CLOUD AND AEROSOL RESEARCH GROUP

SUMMARY OF FLIGHTS AND TYPES OF DATA COLLECTED ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 RESEARCH AIRCRAFT IN THE SAFARI-2000 FIELD STUDY IN SOUTHERN AFRICA FROM 10 AUGUST THROUGH 18 SEPTEMBER 2000

Compiled

by

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(The participation of the University of Washington in SAFARI-2000 was supported by NASA and NSF.)

FRONTISPIECE: Map of study area, showing many of the locations over which measurements were obtained from the University of Washington's Convair-580 research aircraft in SAFARI-2000.

FOREWORD

The SAFARI-2000 field study was carried out in five countries in Southern Africa from 10 August through 18 September 2000. This report is intended to serve as a guide to the extensive measurements that were obtained aboard the University of Washington's Convair-580 research aircraft in SAFARI-2000.

Contained herein are listings of the various types of measurements obtained on the thirty-one research flights of the Convair-580 in SAFARI-2000, and their relationships to simultaneous measurements from satellites (particularly Terra), other aircraft, and SAFARI-2000 ground-based measurements and activities. Summaries of the main accomplishments of each flight, provided by scientists aboard the Convair-580, are also given.

This report does not contain any of the very large number of measurements that were obtained aboard the Convair-580. These will be available in due course through the SAFARI-2000 data archive.

This report is available at the ftp address: ftp://cargsun2.atmos.washington.edu/safari_report/SAFARI-MASTER-02.01.pdf. Corrections and updates to this report will be posted at: http://cargsun2.atmos.washington.edu/sys/research/safari/.

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1. SAFARI-2000 AND ITS OBJECTIVES

The Southern African Regional Science Initiative (SAFARI-2000) is an international science project involving the United States, South Africa, Botswana, Namibia, Zambia, Mozambique, Zimbabwe, and the United Kingdom.

The main objectives of SAFARI-2000 are:

- To provide in situ data (from ground-based measurements and aircraft) that can be used to check the validity of various remote sensing measurements of the atmosphere obtained from the NASA/EOS Terra satellite and the high-flying NASA ER-2 aircraft.
- To obtain measurements needed to evaluate the contributions of emissions from biogenic, biomass burning and industrial sources to the sub-continental haze over Southern Africa.
- To study the evolution of the regional haze during its transport over the sub-continent.
- To study marine stratus clouds off the coast of Namibia using in situ and remote sensing measurements.

The centerpiece of SAFARI-2000 was a large regional field study carried out in Southern Africa in August and September 2000 (see http://www.safari2000.org).

2. MAIN GOALS OF THE UNIVERSITY OF WASHINGTON'S CLOUD AND AEROSOL RESEARCH GROUP IN THE SAFARI-2000 FIELD STUDY

The main goals of the University of Washington's (UW) in the SAFARI-2000 field study were to use its Convair-580 research aircraft to:

- Measure the physical and chemical properties of aerosols and trace gases in ambient air, and from various sources, in Southern Africa.
- Obtain measurements on aerosols, trace gases, clouds, and surface properties for comparisons with simultaneous remote sensing measurements from the NASA ER-2 aircraft and Terra satellite and from SAFARI-2000 ground stations.

- Carry out "closure" studies using in situ and remote sensing measurements made aboard the Convair-580.
- Compare aerosol and trace gas measurments aloft at various locations in Southern Africa.
- Measure the nature and concentrations of aerosols and trace gases, and their emission factors, in smoke from prescribed fires and non-prescribed fires of biomass in Southern Africa.
- Measure the spectral albedo and bidirectional reflection distribution function (BRDF) of various surfaces and clouds in Southern Africa.
- Measure the microstructures of clouds off the Atlantic Coast of Southern Africa.
- Investigate aerosol-cloud interactions.

3. INSTRUMENTS ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 RESEARCH AIRCRAFT IN SAFARI-2000

The instrumentation aboard the UW Convair-580 research aircraft for the SAFARI-2000 field study is listed in Table 3.1. In addition to the large number of instruments for which the UW was responsible, several instruments were provided by guest investigators from universities and U.S. government agencies.

4. CONVAIR-580 FLIGHTS AND FLIGHT TRACKS IN SAFARI-2000

Table 4.1 lists the dates, times, general locations, and some of the main measurements obtained for each of the Convair-580 flights in SAFARI-2000. Figures 4.1-4.31 show the aircraft flight tracks for each of the flights.

TABLE 3.1. INSTRUMENTATION ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 RESEARCH AIRCRAFT IN SAFARI-2000

(a) Navigational and Flight Characteristics

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Latitude and longitude	Global Positioning System (GPS)	Trimble TANS/Vector	Global (~2-5 m)	tans-lat (deg) tans-lon (deg)
True airspeed	Air computer	Shadin	0 to 250 m s^{-1} (<0.2%)	shadin_tas (m s^{-1})
True airspeed	Variable capacitance	Rosemount Model F2VL 781A	0 to 250 m s^{-1} (<0.2%)	tas (m s^{-1})
Heading	From TANS/Vector	Trimble TANS/Vector	0 to 360˚ (± 1˚)	tans-azimth (0 deg is true north)
Pressure	Variable capacitance	Rosemount Model 830 BA	1100 to 150 mb (<0.2%)	pstat
Pressure altitude	Computed from pstat assuming standard atmosphere	—	0-9 km (Error depends on atmospheric conditions.)	palt (ft)
Altitude	Global Positioning System (GPS)	Trimble TANS/Vector	0-9 km (±15-25 ft)	tans-altft (msl, ft)
Altitude above terrain	Radar altimeter	Bendix Model ALA 51A	Up to 0.75 km	ralt (agl, ft)
Pitch	Differential GPS	Trimble TANS/Vector	–90 to 90˚ (±0.15˚)	Tans-pitch (deg, nose down positive)
Roll	Differential GPS	Trimble TANS/Vector	–90 to 90˚ (±0.15˚)	Tans-roll (deg, right wing up positive)

(b) Communications

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Air-to-ground telephone	Via Iridium satellite	Motorola	Worldwide	—
Air-to-ground e-mail	Via satellite	Magellan	Worldwide	—

(c) General Meteorological

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Weather satellite imagery	HF and satellite	ICOM-R8500	Worldwide	Not recorded
Radar reflectivity	3 cm wavelength (pilot's radar)	Bendix/King (now Allied Signal)	250 km	—
Total air temperature*	Platinum wire resistance	Rosemount Model 102CY2CG and 414 L Bridge	-60 to 40˚C (<0.1˚C)	ttot (˚C)
Static air temperature*	Calculated from Rosemount total temperature	Rosemount Model 102CY2CG and 414 L Bridge	-60 to 40˚C	tstat (˚C)
Total air temperature	Reverse-flow	In-house	-60 to 40˚C	ttotr (˚C)
Static air temperature	Reverse-flow thermometer	In-house	-60 to 40˚C (<0.5˚C)	tstatr (˚C)
Dew point temperature	Cooled-mirror dew point	Cambridge System Model TH73-244	-40 to 40˚C (<1˚C)	dp (˚C)

(Cont.)

* Instrument did not provide reliable data for SAFARI-2000.

TABLE 3.1 (continued)

(c) General Meteorological (continued)

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Dew point	IR optical hygrometer	Ophir Corp. Model IR-2000	-40 to 40˚C (~5%)	dp_o = Ophir dew point (degC)
Wind direction	Calculated from TANS/Vector and Shadin	Trimble	0-360˚ (0 deg is magnetic north).	wind_dir
Wind speed	Calculated from TANS/Vector and Shadin	Trimble	—	wind_spd (kts)
Video image	Forward-looking camera and time code	Ocean Systems Splash Cam	—	—

(d) Aerosol

Parameter	Instrument Type	Manufacturer	Range	UW Computer Code
Number concentration of particles (continuous flow)*	Condensation particle counter	TSI Model 3022A	0-10^7 cm^{-3} (d>0.003 μm)	cnc1 (/cc)
Number concentration of particles (continuous flow)†	Condensation particle counter	TSI Model 3025A	0-10^5 cm^{-3} (d>0.003 μm)	cnc2 (/cc)
Size spectrum of particles (from “baghouse” only)	Differential Mobility Particle Sizing Spectrometer (DMPS)	TSI (modified in-house)	0.01 to 0.6 μm (21 channels)	dmpsdn = DMPS concentration spectrum (/cc).
Size spectrum of particles	35 to 120˚ light-scattering	Particle Measuring Systems Model PCASP-100X	0.12 to 3.0 μm (15 channels)	pcasprt = PCASP 100 total concentration (/cc). pcaspdn = PCASP 100 concentration spectrum (/cc).
Total particle concentration§	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3rt (/cc).
Size spectrum of particles§	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3dn = fsp300 concentration spectrum (/cc).
Aerodynamic size spectrum of particles and relative light scattering intensity	"Time-of-flight"	TSI Model 3320 APS	0.5-20 μm (52 channels)	tsirt = TSI 3320 (total concentration (/cc)).
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-100	2 to 47 μm (15 channels)	fsprt = fssp 100 total concentration (/cc). fspdn = fssp 100 particle concentration spectrum (/cc).

(Cont.)

* Not connected until UW Flight Number 1823 on 29 August 2000. Connected thereafter.

† Not connected on UW Flight Number 1810 on 10 August 2000. Connected thereafter.

§ Instrument did not provide reliable data for SAFARI-2000.

TABLE 3.1 (continued)

(d) Aerosol (continued)

Parameter	Instrument Type	Manufacturer	Range	UW Computer Code
Light-scattering coefficient ("continuous" measurements on ambient air, but interrupted on occasions for "baghouse" measurements).*	Integrating 3-wavelength nephelometer with backscatter shutter	MS Electron 3W-02	1.0×10^{-7} m^{-1} to 1.0×10^{-3} m^{-1} for 550 (green) and 700 (red) nm channels. 2.0×10^{-7} m^{-1} to 1.0×10^{-3} m^{-1} for 450 nm channel (blue)	nepblu_c = total scatter blue (/m). nepgrn_c = total scatter green (/m). nepred_c = total scatter red (/m). bkspbl_c = backscatter blue (/m). bkspgr_c = backscatter green (/m). bksprd_c = backscatter red (/m).
Light-scattering coefficient (for "baghouse" samples only) at 530 nm†	Integrating nephelometer	Radiance Research Model M903	1.0×10^{-6} m^{-1} to 2.0×10^{-4} m^{-1} or 1.0×10^{-6} m^{-1} to 1.0×10^{-3} m^{-1}	nephbag (m^{-1})
Light-scattering coefficient (ambient and extinction cell)§	Integrating nephelometer	CE	10^{-7} to 10^{-2} m^{-1} at 537 nm	cetspgr (/m)
Light absorption and graphitic carbon	Particle soot absorption photometer (PSAP)	Radiance Research	Absorption coefficient at 550 nm: 10^{-7} to 10^{-2} m^{-1}. Carbon: 0.1 mg m^{-3} to 10 mg m^{-3} (±5%)	rams550_amb_c (m^{-1})
Humidification factor for aerosol light-scattering (occasionally interrupted for measurements on "baghouse" sample)	Scanning humidogram	In house	b_{sp} (RH) for 30% ≤ RH ≤ 85%	rhhum
Light-extinction coefficient of smoke (in plumes only) at 538 nm	Optical extinction cell OEC (6 m path length)	In-house	5×10^{-5} to 10^{-2} m^{-1}	oecext (m^{-1}) = oec extinction coefficient. oecscat (m^{-1}) = oec scattering coefficient.
Aerosol-shape*	Change in light-scattering with applied electric field–Aerosol Asymmetry Analyzer (A^3)	In-house	Detects 2% deviation from sphericity	rras
Particle size, shape, elemental composition, crystallographic structure, aggregation, etc.‡	Individual particle analysis using electron-beam techniques (e.g., TEM, EDS, EELS, SAED)	P. Buseck (Arizona State Univ.)	Down to a few nanometers	—
Cloud condensation nucleus (CCN) spectrum‡ (for Namibia flights only)	Thermal diffusion chamber	Univ. of Wyoming (operated by R. Bruintjes, NCAR)	CCN concentrations at 0.1, 0.3, 0.6 and 1%	—

(Cont.)

* No pump from 1037-1339 UTC on UW Flight Number 1816 on 18 August, and 0900-0905 on UW Flight Number 1822 on 24 August 2000.

† Instrument did not provide reliable data for SAFARI-2000.

§ Not connected on UW Flight Number 1810 on 10 August 2000, from 1346-1513 UTC on UW Flight Number 1828 on 1 September 2000, and 1214-1236 on UW Flight Number 1833 on 6 September 2000.

‡ Guest instrument.

TABLE 3.1 (continued)

(e) Cloud Physics

Parameter	Instrument Type	Manufacturer	Range (resolution)	UW Computer Code
Liquid water content	Hot wire resistance	Johnson-Williams	0 to 2 or 0 to g m^{-3}	lwjw0 = cloud liquid water content from JW (g/m^3)
Liquid water content*	Hot wire resistance	DMT	0 to 5 g m^{-3}	lwdmt = cloud liquid water content from DMT (g/m^3)
Total particle concentration*	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3rt (/cc).
Size spectrum of particles*	Forward light-scattering	Particle Measuring Systems Model FSSP-300	0.3 to 20 μm (30 channels)	fsp3dn = fsp300 concentration spectrum (/cc).
Size spectrum of particles	Forward light-scattering	Particle Measuring Systems Model FSSP-100	2 to 47 μm (15 channels)	fsprt = fssp 100 total concentration (/cc). fspdn = fssp 100 particle concentration spectrum (/cc).
Liquid water content; effective droplet radius; particle surface area	Optical sensor	Gerber Scientific Ins. PVM-100A	LWC = 0.001-10 g m^{-3}	lwpvm = cloud liquid water from PVM (g/m^3). erpvm = PVM100A effective radius (μm). psapvm = PVM100A raw surface area (cm^2/m^3). sapvm = PVM100A surface area [corrected using fssp100 drop rate] (cm^2/m^3).

(f) Chemistry

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
SO_2 (occasionally interrupted for measurements on "baghouse" sample)	Pulsed fluorescence	Teco 43S (modified in-house)	0.1 to 200 ppb	so2 (ppb) = Teco 43S

(Cont.)

* Instrument did not provide reliable data for SAFARI-2000.

TABLE 3.1 (continued)

(f) Chemistry (continued)

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
O_3 (occasionally interrupted for measurements on "baghouse" sample)	UV absorption	TEI Model 49C	1-1000 ppbv (<0.5 ppbv)	o3 = Pressure corrected TEI49C ozone concentration (ppb).
CO_2 (occasionally interrupted for measurements on "baghouse" sample)	Infrared correlation spectrometer	LI-COR Li-6262	0 to 300 ppmv (0.2 ppmv at 350 ppmv)	co2 (ppm) = Licor 6262
CO (occasionally interrupted for measurements on "baghouse" sample)	IR correlation spectrometer	Teco Model 48	0-50 ppb (~0.1 ppmv)	co (ppb) = Teco 48 (ppb)
NO	Chemiluminescence	Modified Monitor Labs. Model 8840	0-5 ppmv (~1 ppb)	no (ppb)
NO_x (occasionally interrupted for measurements on "baghouse" sample)*	Chemiluminescence	Modified Monitor Labs. Model 8840	0-5 ppmv (~1 ppb)	nox (ppb)
Total particulate mass and species $SO_4^=$, NO_3^-, Cl^-, Na^+, K^+, NH_4^+, Ca^{++}, Mg^{++}	37 Teflon filters, gravimetric analysis and ion exchange chromatography	Gelman Dionix (UW)	0.1 to 50 μg m^{-3} (for 500 liter air sample)	—
Carbonaceous particles (black and organic carbon)†	Quartz filters (Thermal Evolution Techniques)	T. Novakov and T. Kirchstetter (LBNL)	4-160 μg m^{-3} (±1.6 μg m^{-3}) for 1 m^3 sample	—
Hydrocarbons CO, CO_2†	Collected in stainless steel canisters; analysis by GC/FID	D. Blake (U.C. Irvine)	Variable	—
$PM_{2.5}$, $SO_4^=$, NO_3^-, NH_4^+, pH, carbonaceous aerosol†	Particle concentrator, organic sampling system (BC-BOSS sampling system)	D. Eatough (Brigham Young University)	—	—
Reactive and stable gaseous combustion emissions†	Fourier transform IR spectrometer (FTIR)	R. Yokelson (U. of Montana)	ppt-ppb	—

(g) Radiation

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
UV hemispheric radiation, one upward, one downward	Diffuser, filter photo-cell (0.295 to 0.390 μm)	Eppley Lab. Inc. Model TUVR	0 to 70 W m-2 (±3 W m-2)	uvup = uv upward looking (W m-2) uvdo = uv downward looking (W m-2)
VIS-NIR hemispheric radiation (one downward and one upward viewing)	Eppley thermopile (0.3 to 3 μm)	Eppley Lab. Inc. Model PSP	0 to 1400 W m-2 (±10 W m-2)	pyrup = vis-nir upward looking (W m-2) pyrdo = vis-nir downward looking (W m-2)

* Instrument did not provide reliable data for SAFARI-2000.

† Guest instrument.

(g) Radiation (continued)

Parameter	Instrument Type	Manufacturer	Range (and error)	UW Computer Code
Surface radiative temperature	IR radiometer 1.5˚ FOV (8 to 14 μm)	Omega Engineering OS3701	-50˚ to 1000˚C ±0.8% or reading	irtemp (degC) = surface temp. (˚C)
Absorption and scattering of solar radiation by clouds and aerosols; reflectivity of surfaces	Fourteen wavelength all-directions scanning radiometer	NASA-Goddard/ University of Washington	14 discrete wavelengths between 340 and 2300 nm	—
Solar Spectral irradiance or radiance; Spectral transmission and reflectance*	Upward and downward pointed hemispherical signal collectors	NASA Ames Solar Spectral Flux Radiometer (SSFR) (P. Pilewskie)	300-2500 nm (5-10 nm resolution). FOV 1 mrad. 1 Hz spectral sampling rate.	—
Aerosol optical depth, water vapor, and ozone*	14-channel Sun-tracking photometer	NASA Ames (P. Russell)	14 discrete wavelengths, 350-1558 nm	—

*Guest instrument

TABLE 4.1. OVERVIEW OF UNIVERSITY OF WASHINGTON'S CONVAIR-580 RESEARCH FLIGHTS IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
10 Aug.	1810	1127-1522	In quadrant northwest of Pietersburg, South Africa, out to about 90 miles from Pietersburg.	• Physical and chemical measurements above and in boundary layer.
14 Aug.	1811	1026-1132	Pietersburg to Lanseria, South Africa.	• Measurements en route.
14 Aug.	1812	1216-1505	About 80 miles northwest of Johannesburg, South Africa.	• Physical and chemical measurements in boundary layer.
14 Aug.	1813	1551-1649	Lanseria to Pietersburg, South Africa.	• Measurements en route.
15 Aug.	1814	0655-1115	Pietersburg to Skukusa (in Kruger National Park), South Africa. Then to about 30 miles west of Skukusa. Return to Pietersburg.	• Measurements from Pietersburg to Skukusa in free troposphere (at 9,000 ft) en route. • Runs at an altitude of 100 ft beneath Terra satellite overpass (at 0822 UTC) at Skukusa. • Physical and chemical measurements at 3, 000 ft just west of Skukusa. • Measurements of smoke from two grass fires and some cumulus sampling about 30 nautical miles west of Skukusa.

(Cont.)

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

TABLE 4.1 (continued)

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
17 Aug.	1815	0701-1213	Pietersburg, South Africa, to south and central Kruger National Park, South Africa. Return to Pietersburg.	• Measurements en route at 10,000 ft. • Vertical profile from 10,000 ft to 100 ft over Kruger National Park. • Physical and chemical measurements at 4,000 ft. • Measurements in two smoke plumes from grass fire (flaming and smoldering combustion). • Measurements on return flight to Pietersburg.
18 Aug.	1816	0802-1339	Pietersburg, South Africa, to Madikwe Game Reserve (on South Africa/ Botswana border) and return.	• Measurements en route. • Physical and chemical measurements of smoke from prescribed fire in Madikwe Game Reserve.
20 Aug.	1817	0657-0705	Flight cancelled on Pietersburg runway.	N/A
20 Aug.	1818	0713-0819	Pietersburg, South Africa, toward South Africa/Botswana border and return. (Flight terminated prematurely due to radio commu-nication problem with ATC.)	• Physical and chemical measurements in ambient haze en route.

(Cont.)

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

TABLE 4.1 (continued)

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
20 Aug.	1819	1124-1541	Pietersburg, South Africa, to Madikwe Game Reserve (on South Africa/ Botswana border) and return.	• Physical and chemical measurements in smoke from prescribed fire in Madikwe Game Reserve. ER-2 passed over fire at 0840 UTC. Terra satellite overpass at 0841 UTC. • Measurements of ambient smoke and haze near Botswana/ South Africa border.
22 Aug.	1820	0658-1235	Pietersburg, South Africa, to Skukusa (in Kruger National Park, South Africa) and return to Pietersburg via Phalaborwa, South Africa.	• Vertical profile over Skukusa Airport with ER-2 aircraft and Terra satellite overpasses. • BRDF near Skukusa. • BRDF near Mopane trees (??) in northern Kruger National Park.
23 Aug.	1821	1138-1448	In vicinity of Pietersburg, South Africa.	• Intercomparisons of measurements of aerosol and state parameters on Convair-580 with South African Aerocommanders, and with rawinsonde launched from Pietersburg Gateway Airport.
24 Aug.	1822	0638-1130	Pietersburg, South Africa, to Inhaca Island, Mozambique.	• Detailed vertical profile over Inhaca Island with Terra satellite and ER-2 aircraft overpasses.

(Cont.)

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

TABLE 4.1 (continued)

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
29 Aug.	1823	0822-1114	Pietersburg, South Africa, to South Africa/ Zimbabwe border, and return.	• Measurements en route during outbound and return legs. • Physical and chemical measurements in well mixed boundary layer at 9,500 ft and at 5,300 ft near South Africa/Zimbabwe border. Terra and TOMS satellite overpasses at 0834 and 0930 UTC, respectively. • BRDF of uniform shrub near South Africa/Zimbabwe border. • Vertical profile near South Africa/Zimbabwe border. • Some cloud penetrations near South Africa/Zimbabwe border.
29 Aug.	1824	1245-1540	Pietersburg, South Africa, to Skukusa (Kruger National Park, South Africa) and return.	• BRDF centered on Skukusa tower. • Measurements of smoke from small smoldering fire in Kruger National Park. (Also sampled older smoke on flight back to Pietersburg.) • 200 ft agl run over plantations on high veldt.
31 Aug.	1825	0842-1421	Pietersburg, South Africa, to central Mozambique coast. North along Mozambique coastline to west of Beria. Return to Pietersburg.	• Measurements at several levels on transit legs. • Run at 100 ft along Mozambique coastline. • Measurements of smoke at several distances downwind from smoldering fire west of Beria, Mozambique. • Good measurements in haze and smoke on return flight.

(Cont.)

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

TABLE 4.1 (continued)

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
1 Sept.	1826	0532-1108	Pietersburg, South Africa, to Kaoma, Zambia, to Kasane, Botswana.	• Measurements en route to Kaoma. • Detailed measurements on prescribed Miombo burn near Kaoma, Zambia. Terra satellite overpass at 0902 UTC. • Measurements en route from Kaoma to Kasane.
1 Sept.	1827	1229-1241	Did not take off from Kasane, Botswana, due to recall by ATC.	
1 Sept.	1828	1329-1551	Kasane, Botswana, to Pietersburg, South Africa.	• Measurements en route from Kasane to Pietersburg.
2 Sept.	1829	0736-1334	Pietersburg, South Africa, to Maun, Botswana, and return to Pietersburg.	• BRDF centered on Maun tower. • Vertical profile under TOMS satellite at Maun tower.
3 Sept.	1830	0702-1238	Pietersburg, South Africa, to Sua Pan, Botswana, and return.	• BRDF over Sua Pan and grass. • Vertical profile over Sua Pan parabola with Terra satellite overpass at 0852 UTC. • Measurements at several altitudes on transit legs.

(Cont.)

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

TABLE 4.1 (continued)

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
5 Sept.	1831	0838-1413	Pietersburg, South Africa, to Kaoma, Zambia, to Kasane, Botswana, via Senanga, Zambia.	• Measurements from Pietersburg to Kaoma. • Measurements on smoke from prescribed burn of Dambo near Kaoma. • Measurements en route to Kasane with low-level pass over Senanga, Zambia.
6 Sept.	1832	0700-1058	Kasane, Botswana, to about 20 miles north of Mongu, Zambia. Return to Kasane.	• Low-level run from Senanga, Zambia, to Mongu to about 20 nm north of Mongu. • Measurements en route back to Kasane. • BRDF over Mongu tower. • Vertical profile over Mongu airport. ER-2 overflight at 0900 UTC.
6 Sept.	1833	1133-1354	Kasane, Botswana, to Pietersburg, South Africa.	• Measurements in boundary layer from Kasane to Pietersburg.
7 Sept.	1834	0755-1220	Pietersburg to Timbavati Game Reserve (near Kruger National Park, South Africa) to Phalaborwa, South Africa, and return to Pietersburg, South Africa.	• Extensive measurements on large prescribed fire in Timbavati Game Reserve with Terra satellite overpass at 0828 UTC and ER-2 aircraft overflights at 0828, 1145 and 1205 UTC (see AirMISR imagery). • Two intercepts of plume from Phalaborwa copper mine. • Two sets of BRDF on Mopane trees.

(Cont.)

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

TABLE 4.1 (continued)

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
10 Sept.	1835	0558-1025	Pietersburg, South Africa, to Walvis Bay, Namibia.	• Measurements en route.
11 Sept.	1836	0835-1222	Walvis Bay, Namibia, to off central Namibian coast; then to Kuiseb Desert, Namibia. Return to Walvis Bay.	• Underflew Terra satellite overpass (at 0942 UTC) and ER-2 aircraft overpass (at 0942 UTC) in thin, broken stratus cloud off central Namibia coast. • Vertical profile to 12,200 ft off central Namibia coast for sunphotometer and in situ comparisons. • Two sets of five CAR turns for BRDF measurements of "red" sand in Kuisab Desert, south of Walvis Bay.
13 Sept.	1837	0826-1416	Walvis Bay, Namibia, to off Namibian coast. Return to Walvis Bay.	• Measurements below, above and in stratus off Namibian coast under Terra satellite overpass (at 0930 UTC) and ER-2 aircraft overpass (at 0930 UTC). • Vertical profile, with physical and chemical measurements, from cloud top to 16,800 ft.

(Cont.)

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

TABLE 4.1 (continued)

Date (2000)	University of Washington Flight Number	Period of Flight (UTC)*	General Location†	Main Measurements
14 Sept.	1838	0800-1232	Walvis Bay, Namibia, to off west coast of South Africa. Return to Walvis Bay.	• Measurements on post-frontal cumulus congestus, including inflow, outflow, and below cloud base measurements. • Measurements of effluents from two freighter ships. • Vertical profile to 12,200 ft for sunphotometer and in situ measurements. • Measurements through dust storm on descent into Walvis Bay.
16 Sept.	1839	0709-1245	Walvis Bay, Namibia, to Etosha National Park, Namibia. Return to Walvis Bay.	• BRDF of white Etosha pan (at 19.05˚/15.96˚) and of Mopane trees (at 19.18˚ south/15.66˚ east) in Etosha National Park. • Vertical profile from 200 ft to 15,750 ft over ground-based sunphotometer site in Etosha (at 19˚11' south/15˚55' east). • Measurements in and below small cumulus clouds near Walvis Bay.
18 Sept.	1840	????	Walvis Bay, Namibia, to Pietersburg, South Africa.	• No measurements en route.

* Local time = UTC + 2 hours

† For more detail on flight tracks, see Convair-580 flight track plots (Figures 4.1-4.31).

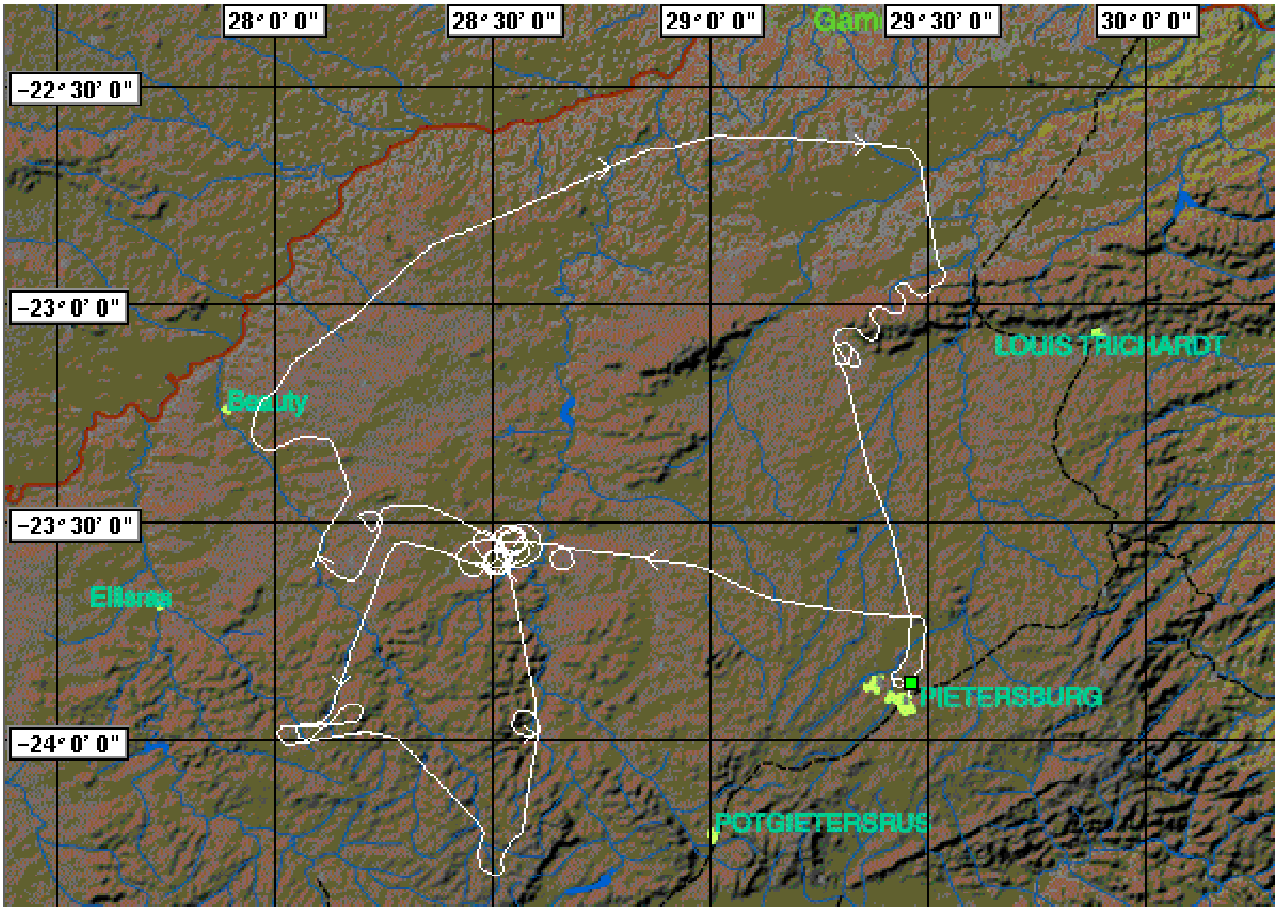

Figure 4.1. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 10, 2000 (UW Flight 1810).

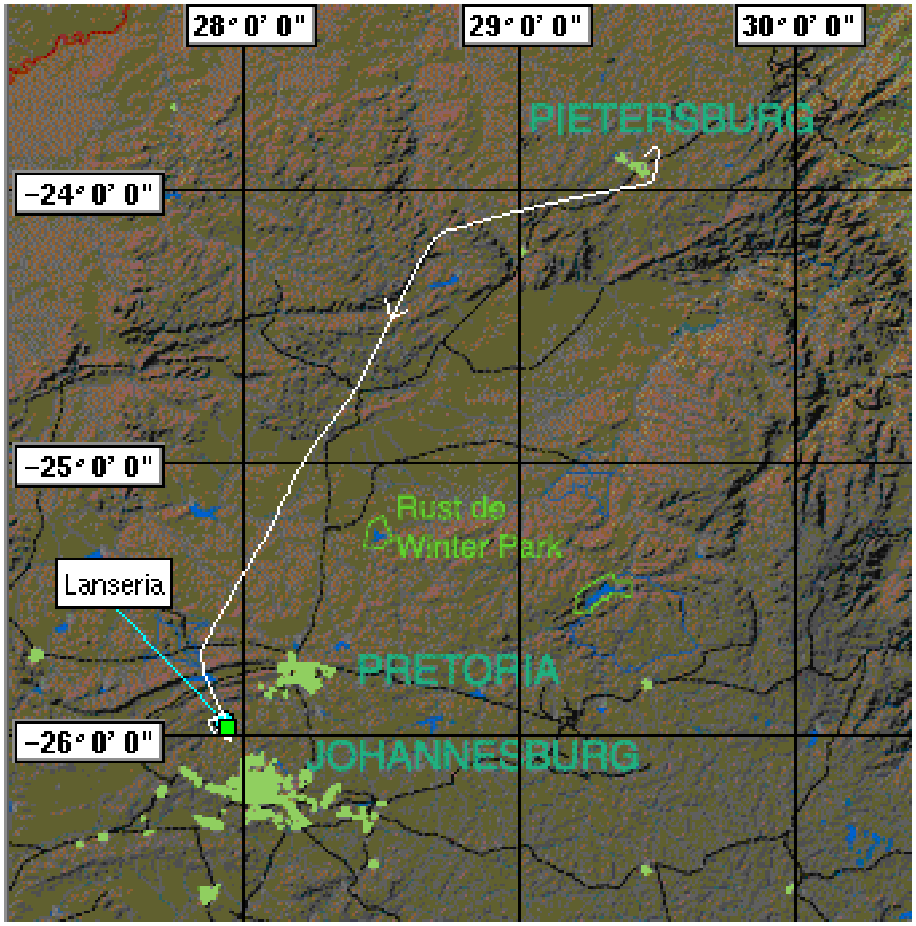

Figure 4.2. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 14, 2000 (UW Flight 1811).

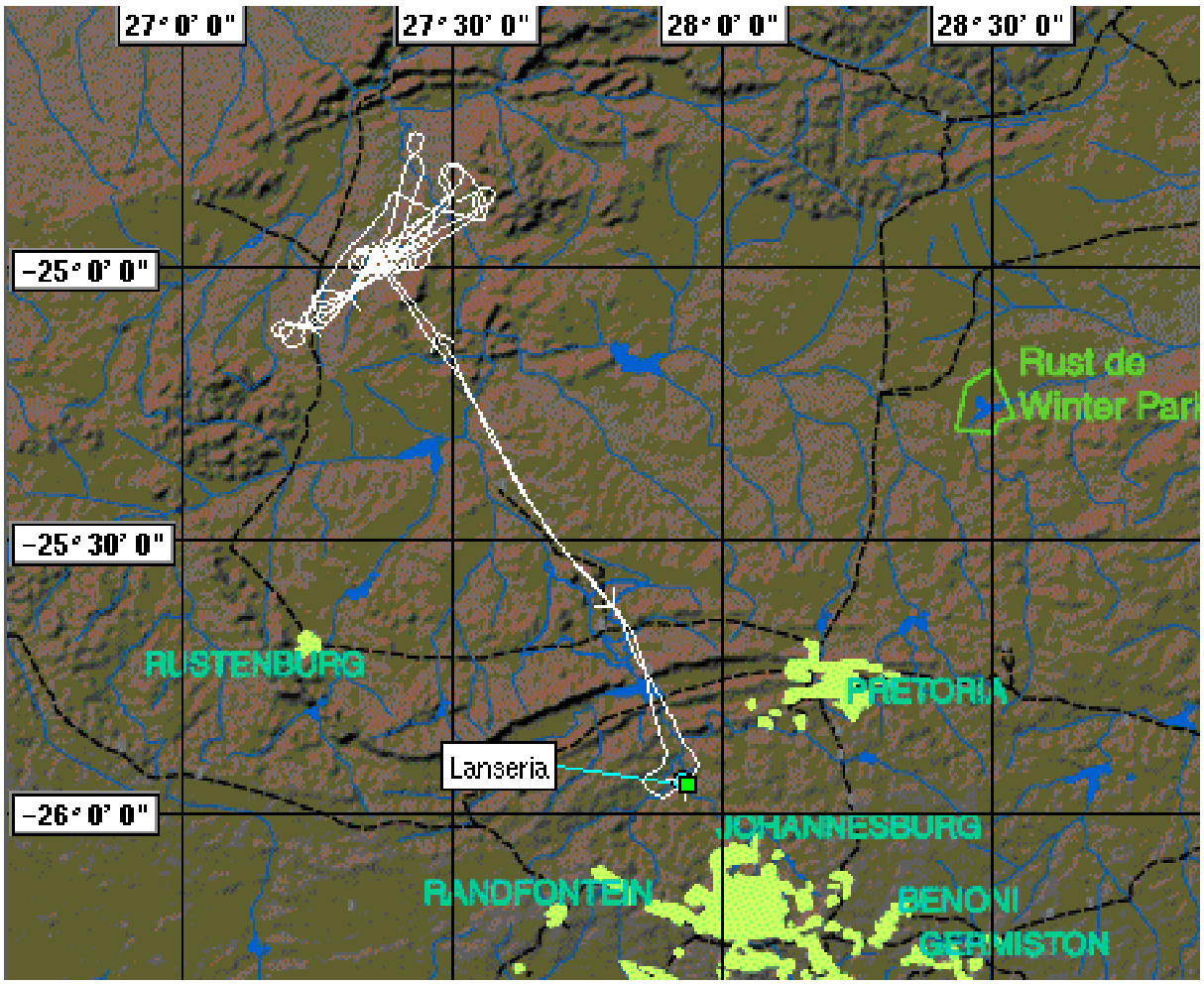

Figure 4.3. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 14, 2000 (UW Flight 1812).

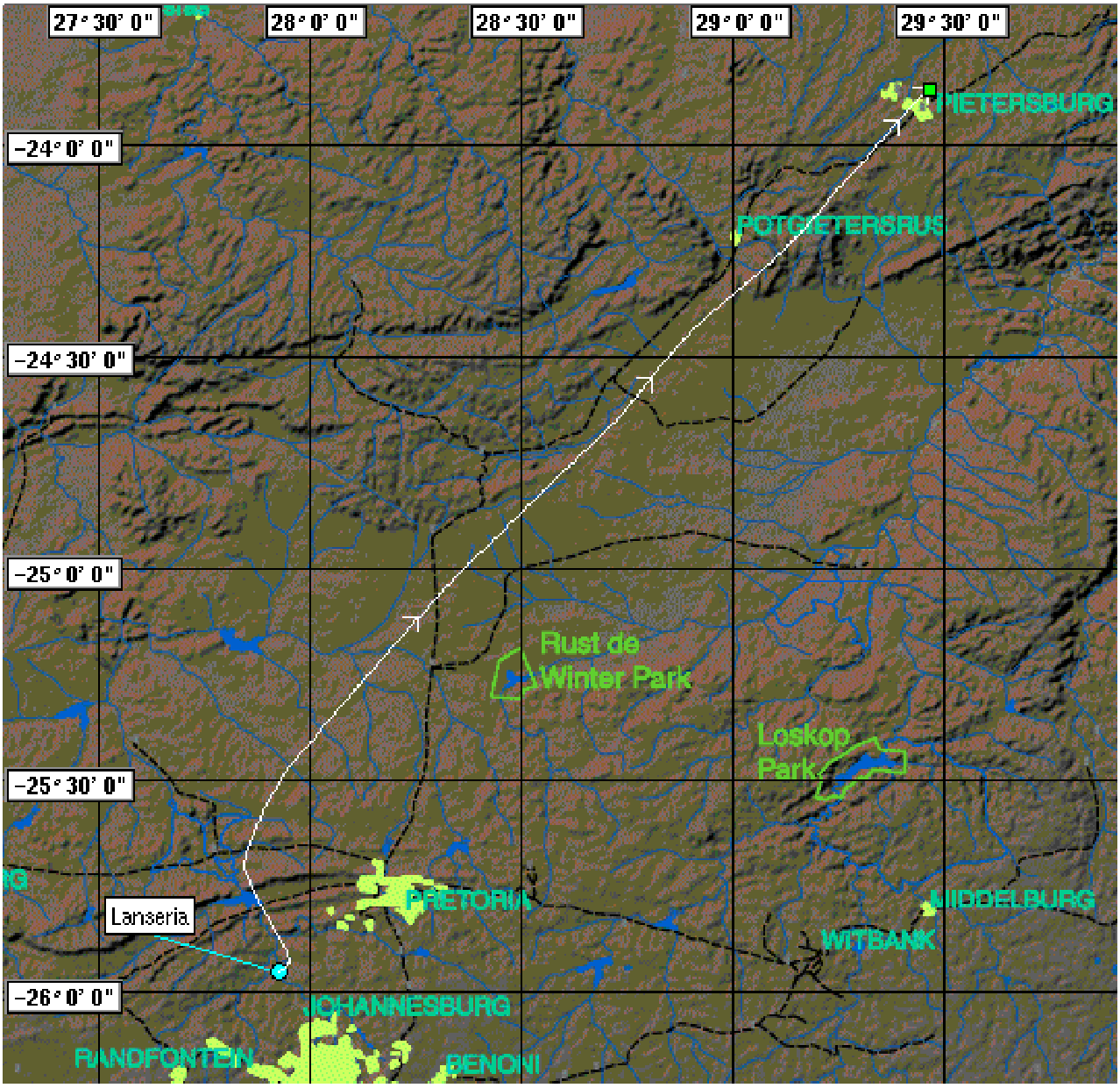

Figure 4.4. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 14, 2000 (UW Flight 1813).

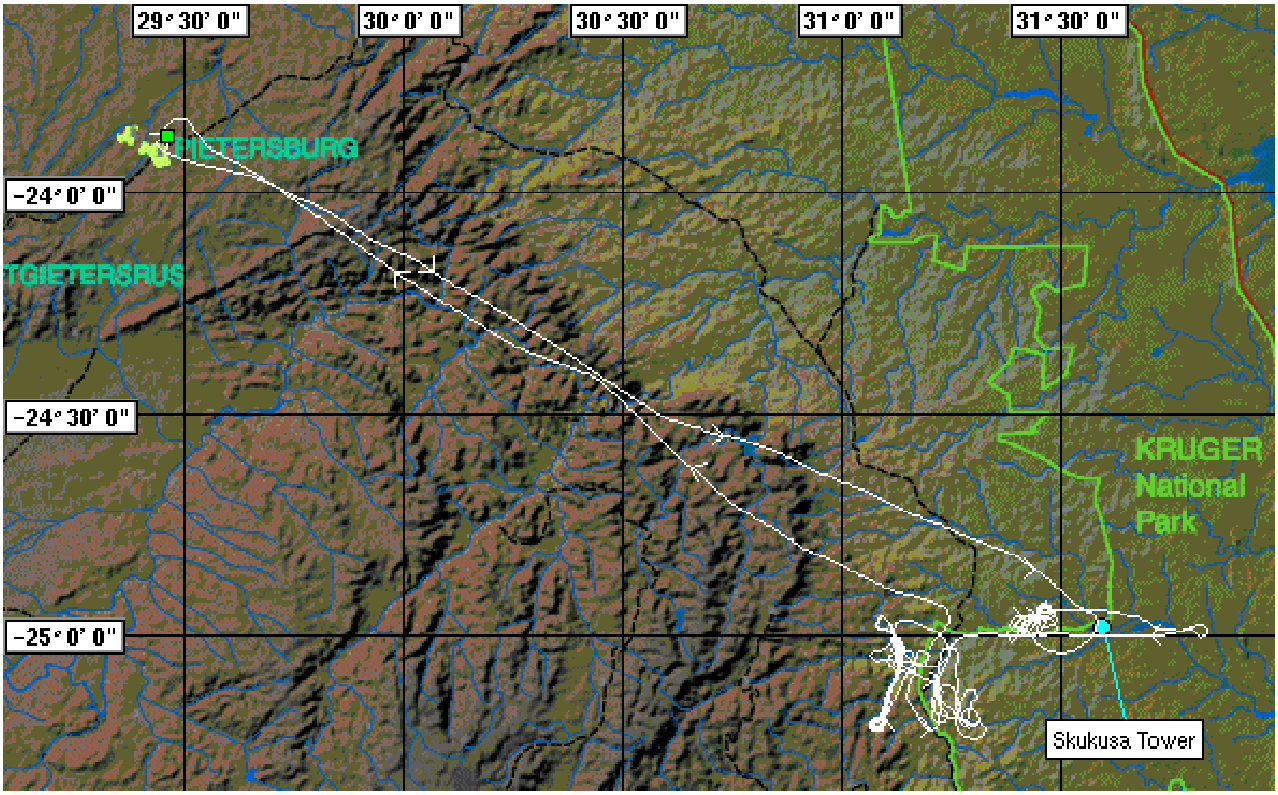

Figure 4.5. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 15, 2000 (UW Flight 1814).

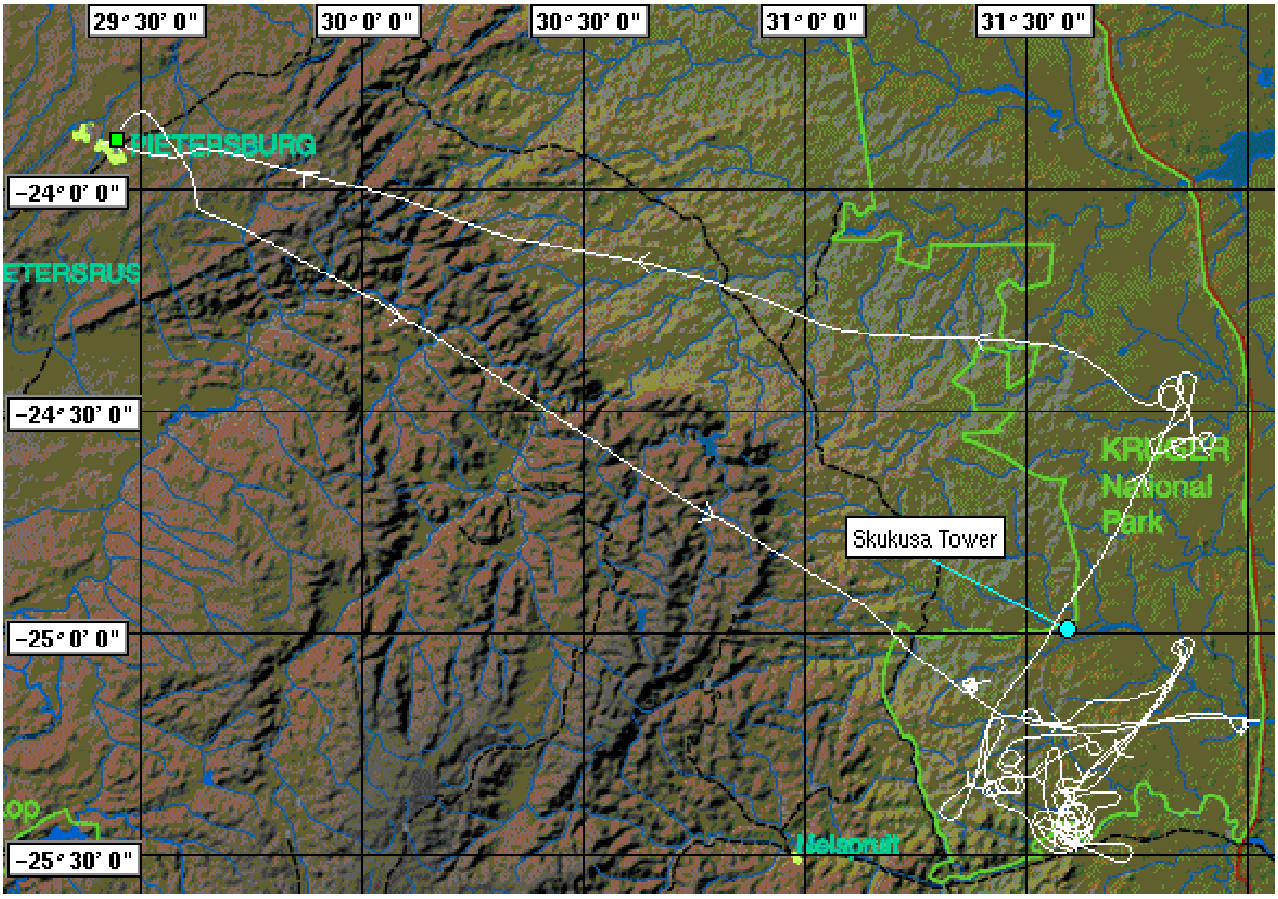

Figure 4.6. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 17, 2000 (UW Flight 1815).

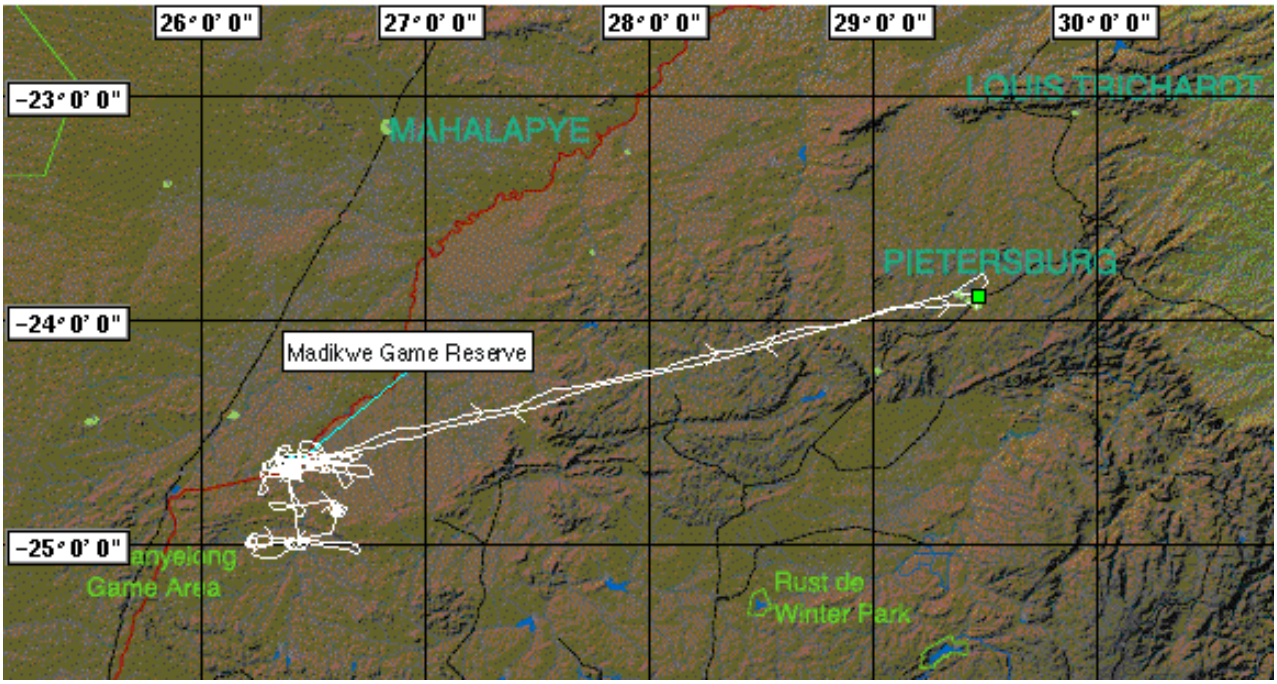

Figure 4.7. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 18, 2000 (UW Flight 1816).

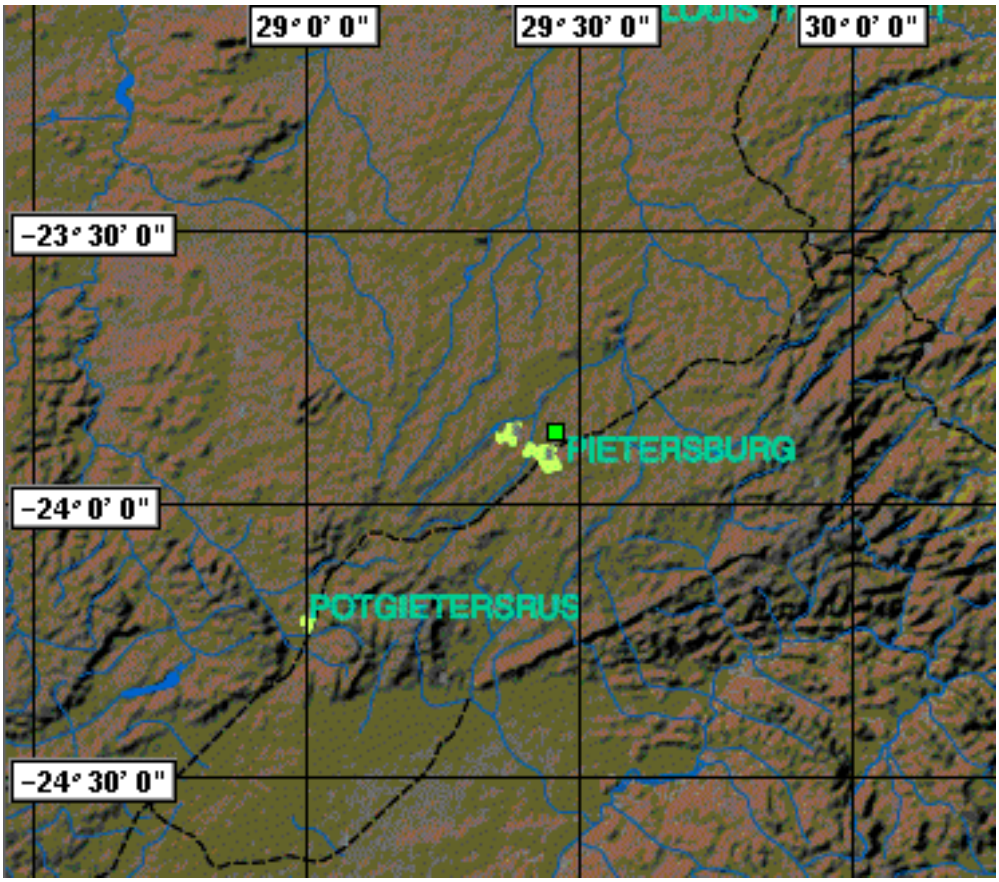

Figure 4.8. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 20, 2000 (UW Flight 1817).

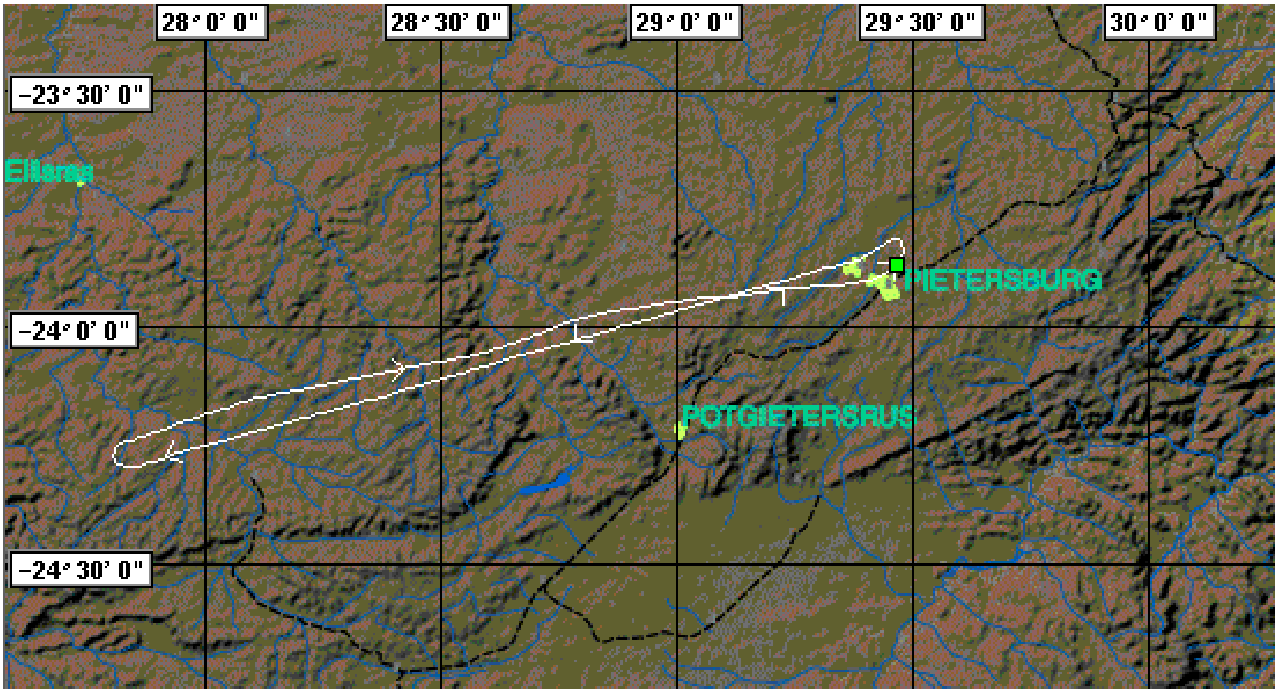

Figure 4.9. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 20, 2000 (UW Flight 1818).

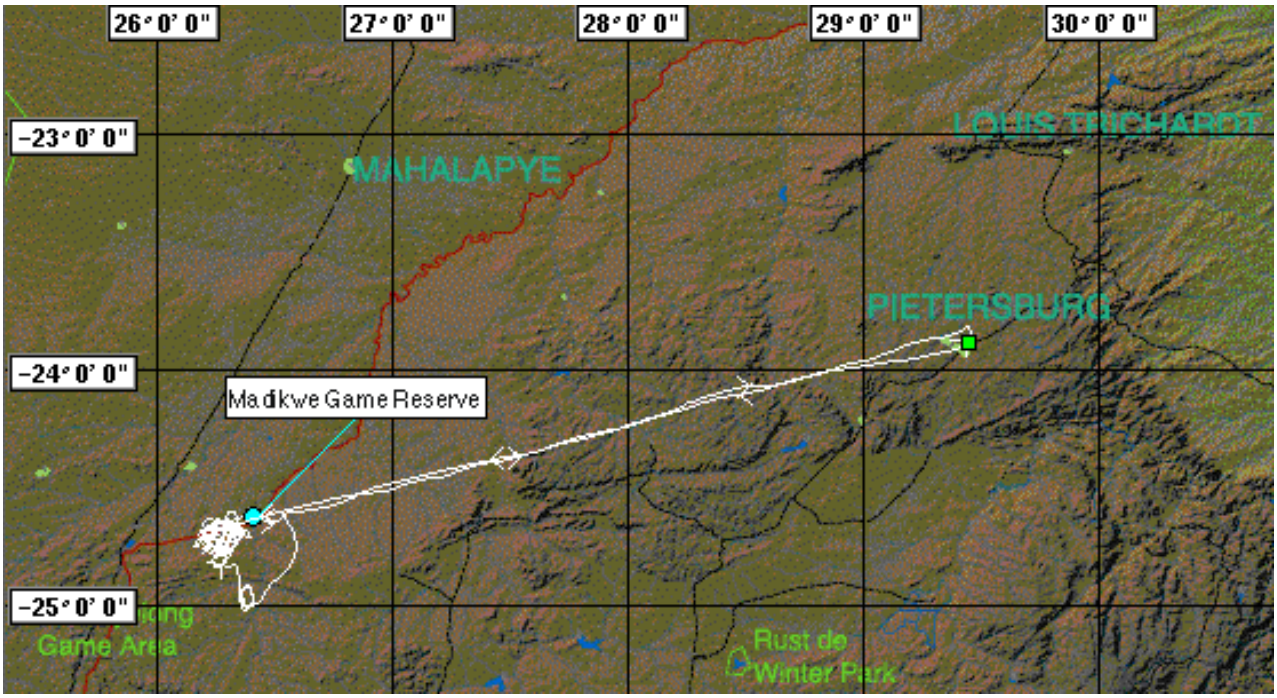

Figure 4.10. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 20, 2000 (UW Flight 1819).

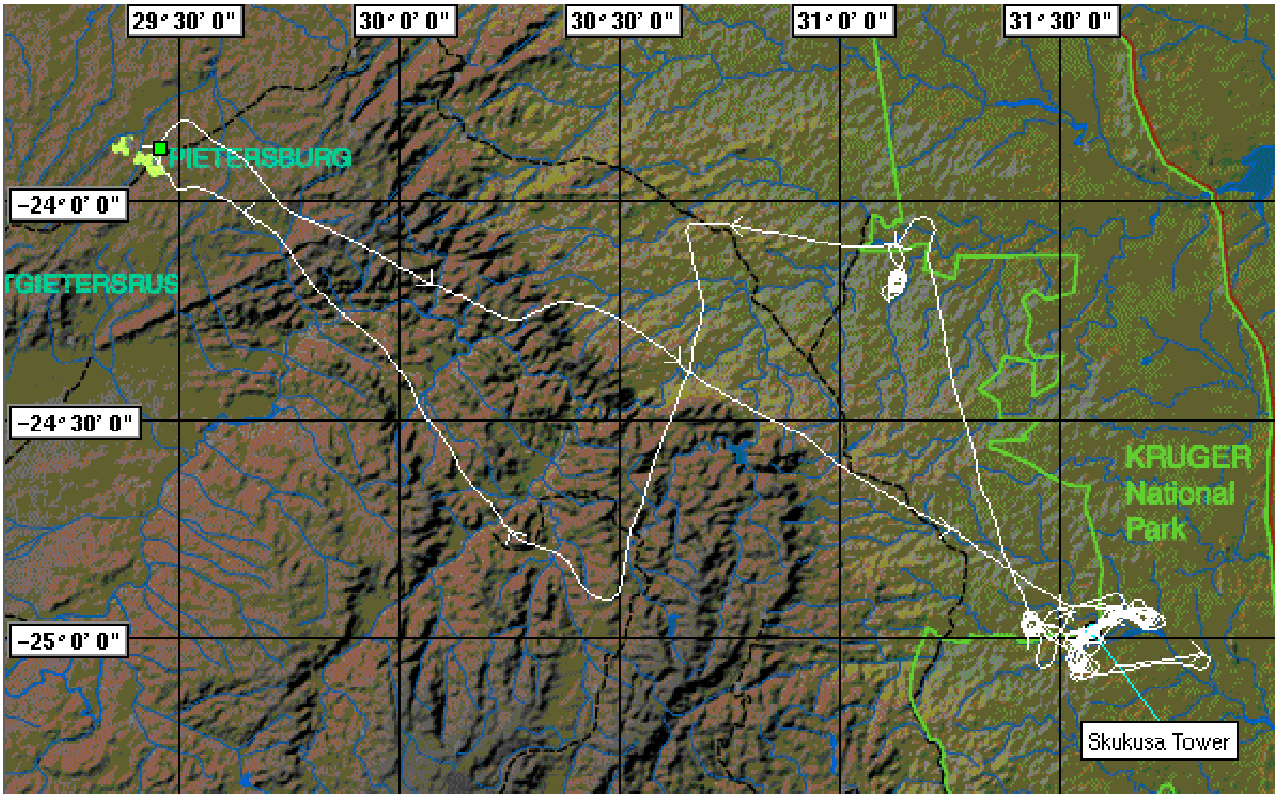

Figure 4.11. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 22, 2000 (UW Flight 1820).

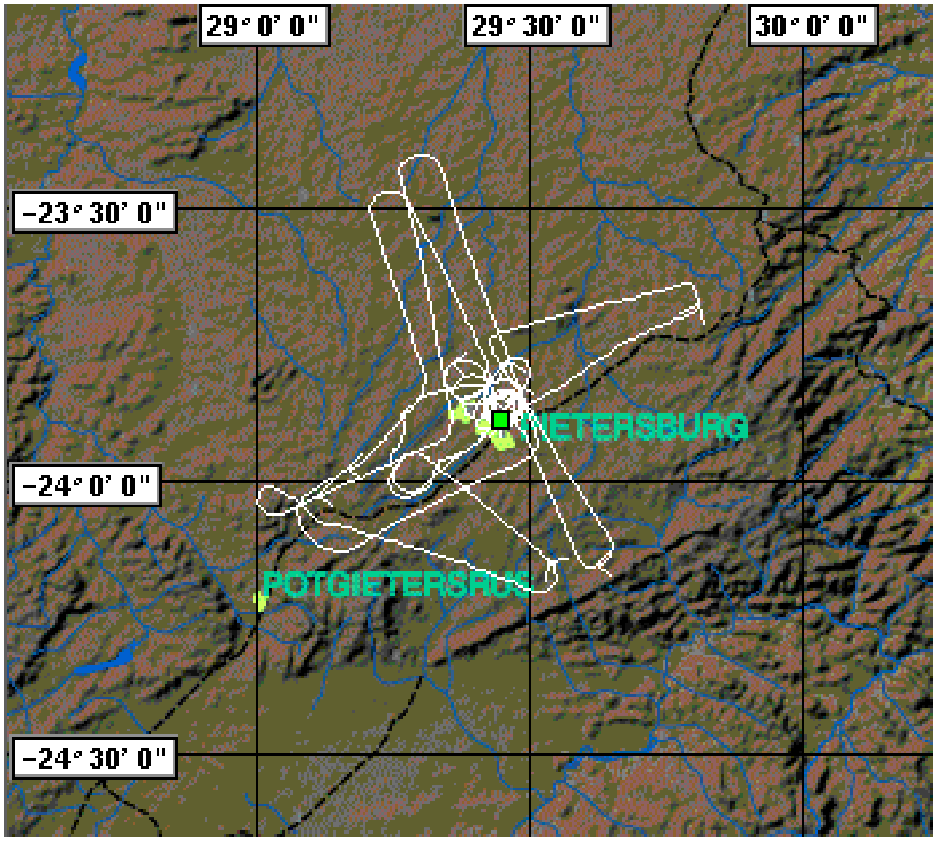

Figure 4.12. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 23, 2000 (UW Flight 1821).

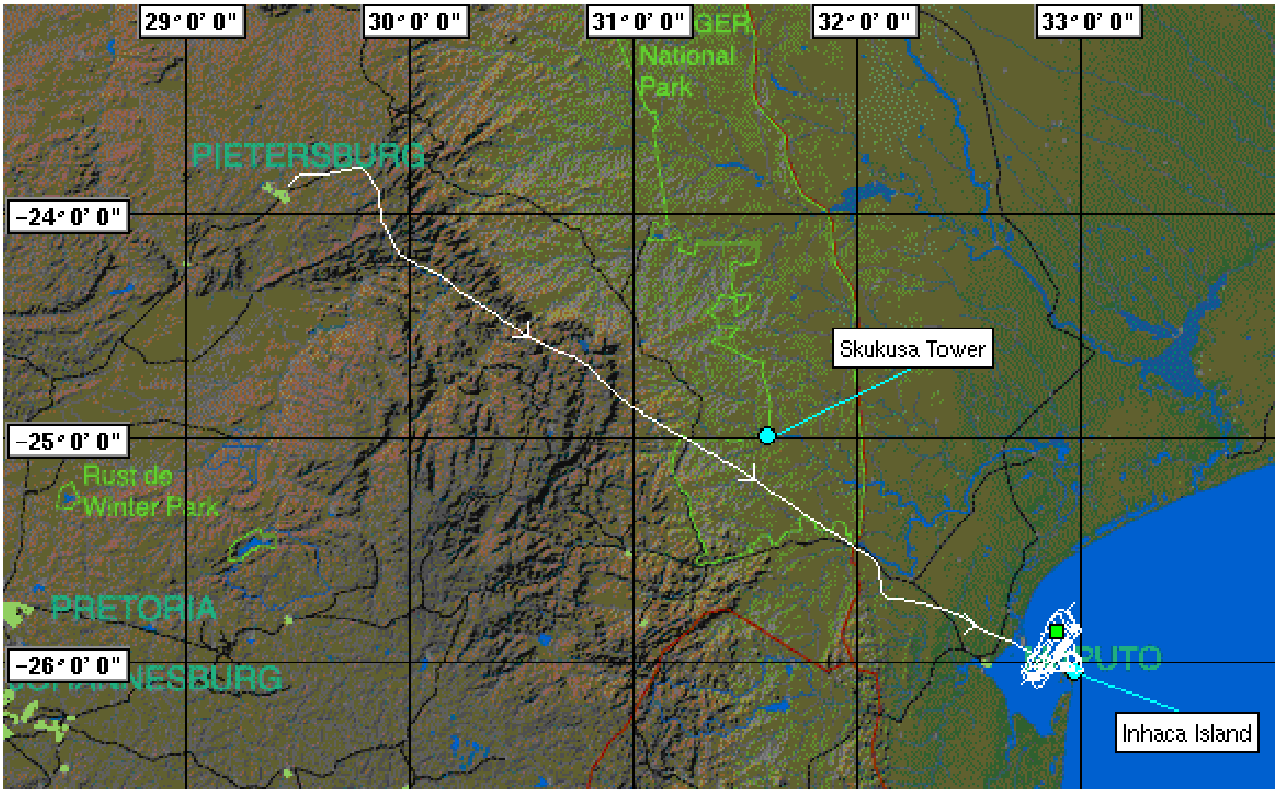

Figure 4.13. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 24, 2000 (UW Flight 1822).

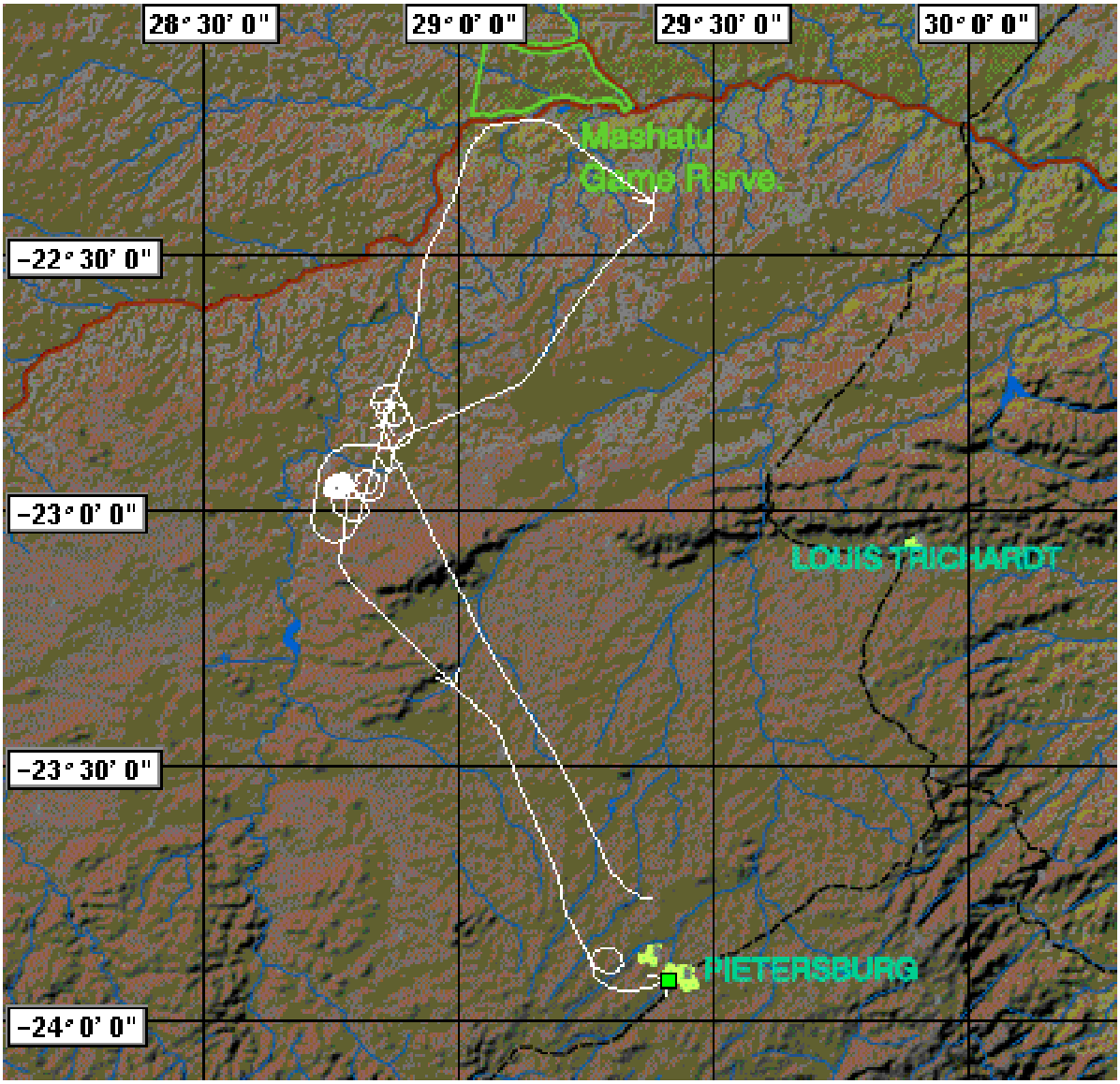

Figure 4.14. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 29, 2000 (UW Flight 1823).

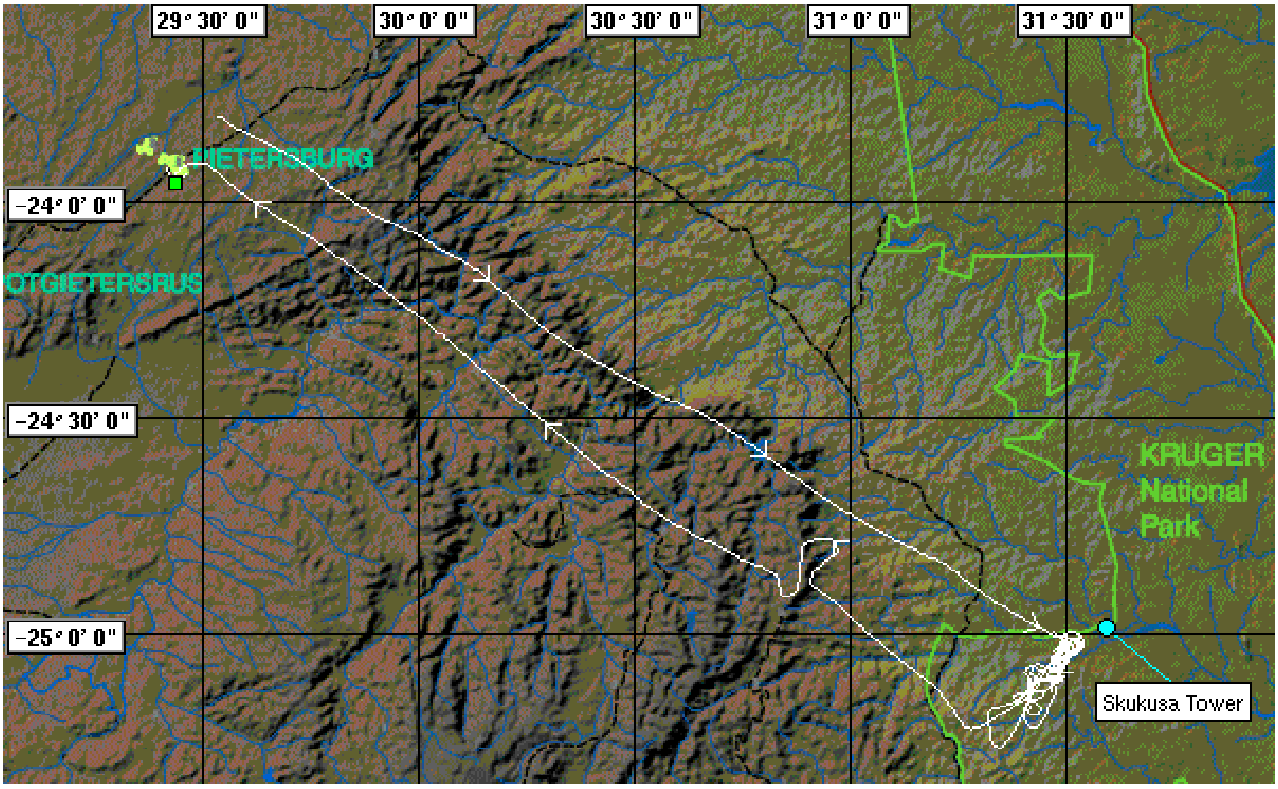

Figure 4.15. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 29, 2000 (UW Flight 1824).

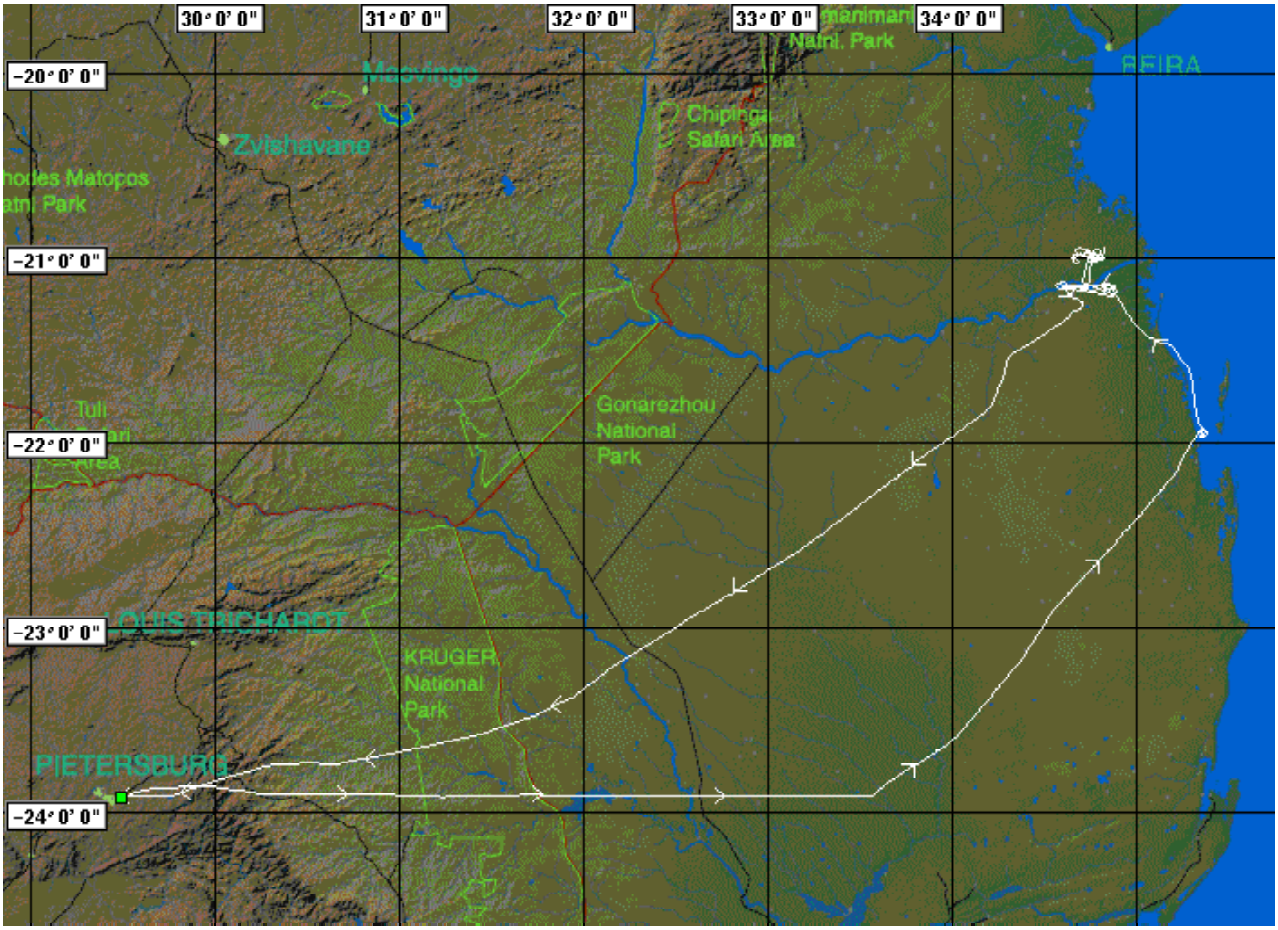

Figure 4.16. Flight track (white line) of the Convair-580 in SAFARI-2000 on August 31, 2000 (UW Flight 1825).

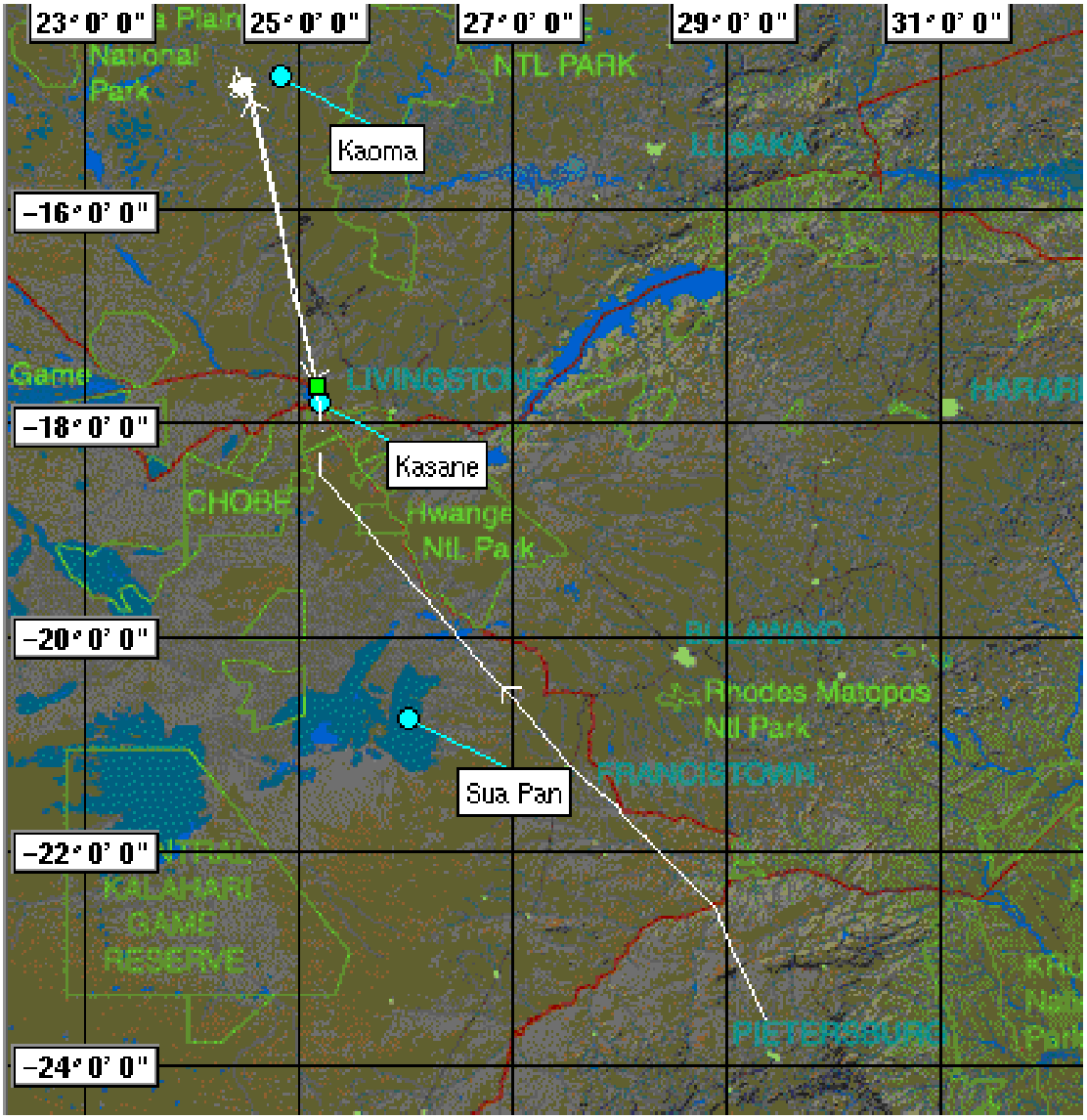

Figure 4.17. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 1, 2000 (UW Flight 1826).

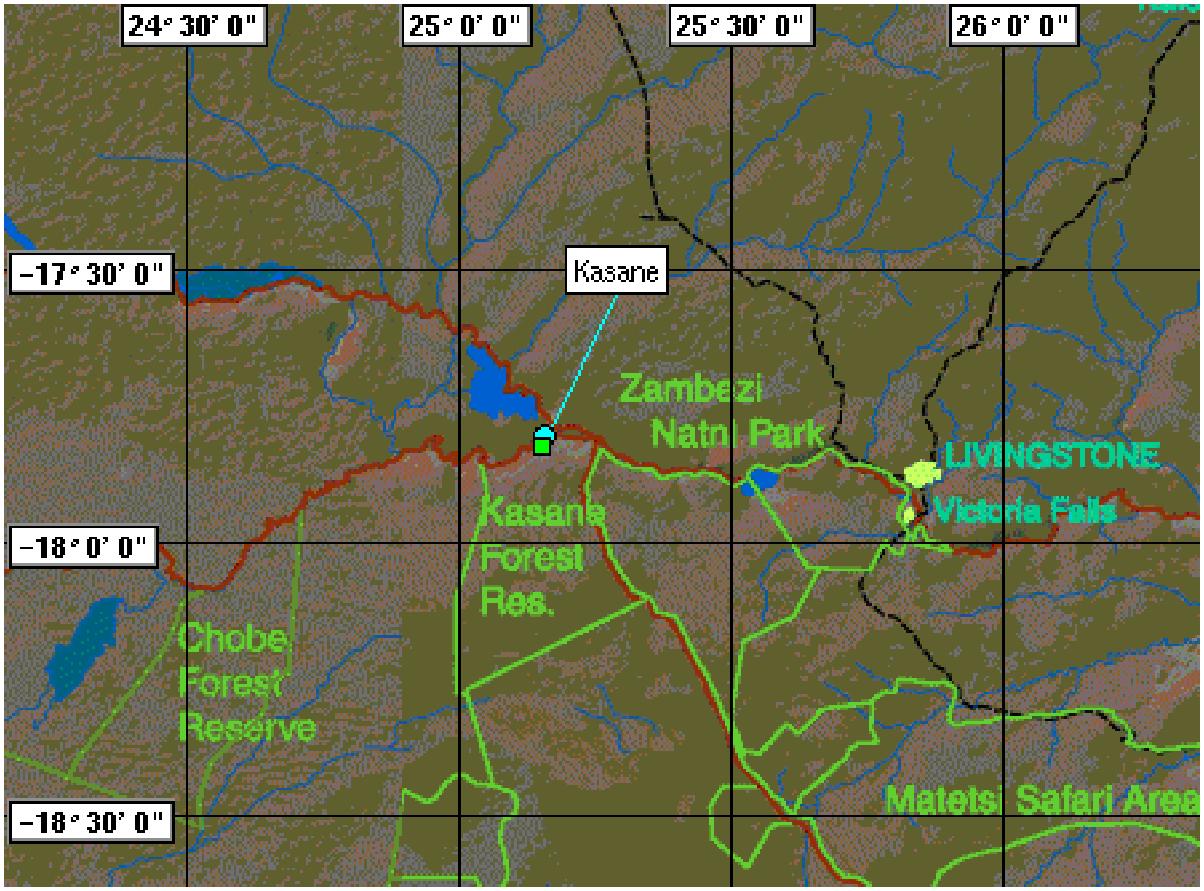

Figure 4.18. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 1, 2000 (Flight UW 1827).

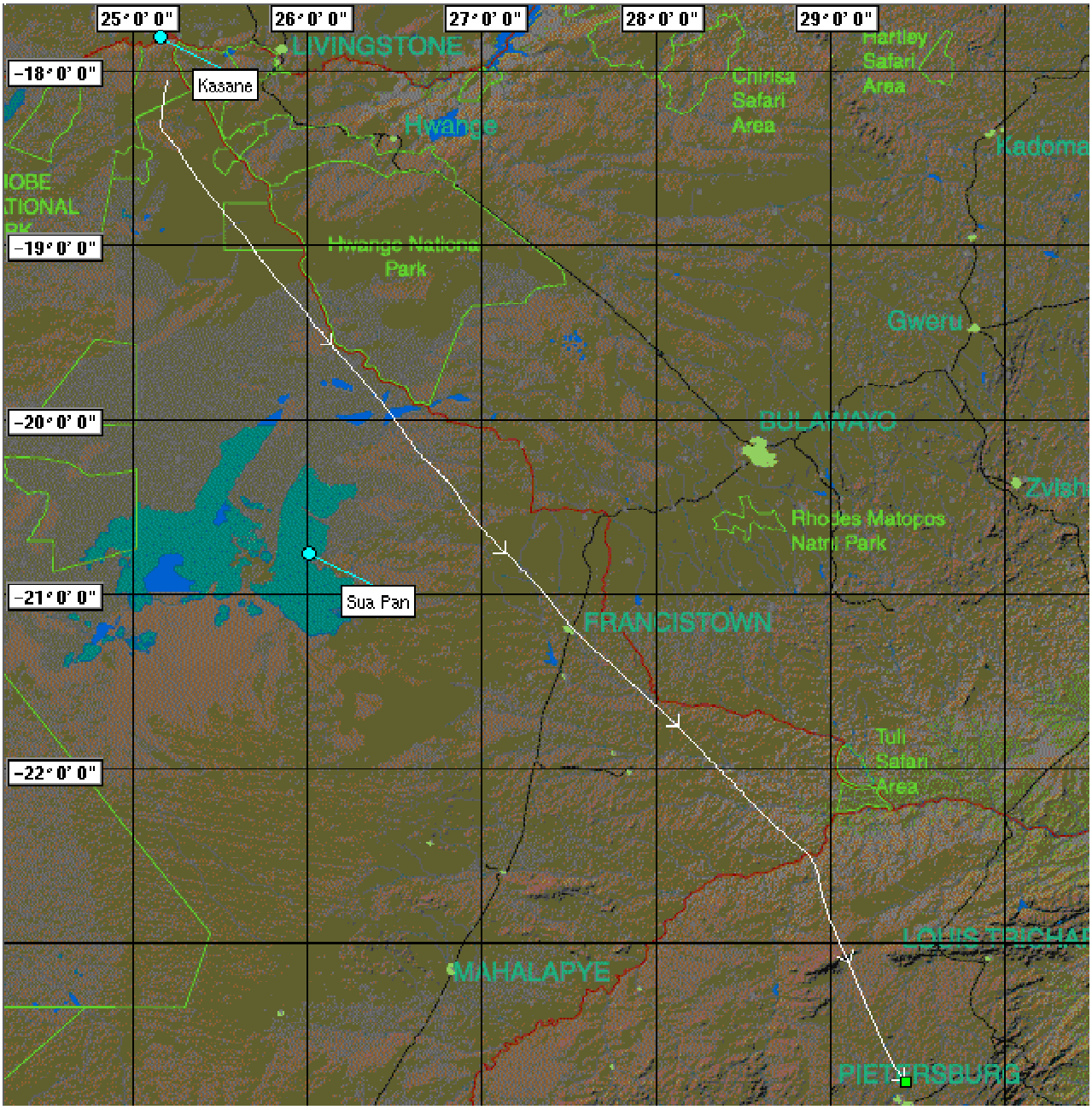

Figure 4.19. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 1, 2000 (UW Flight 1828).

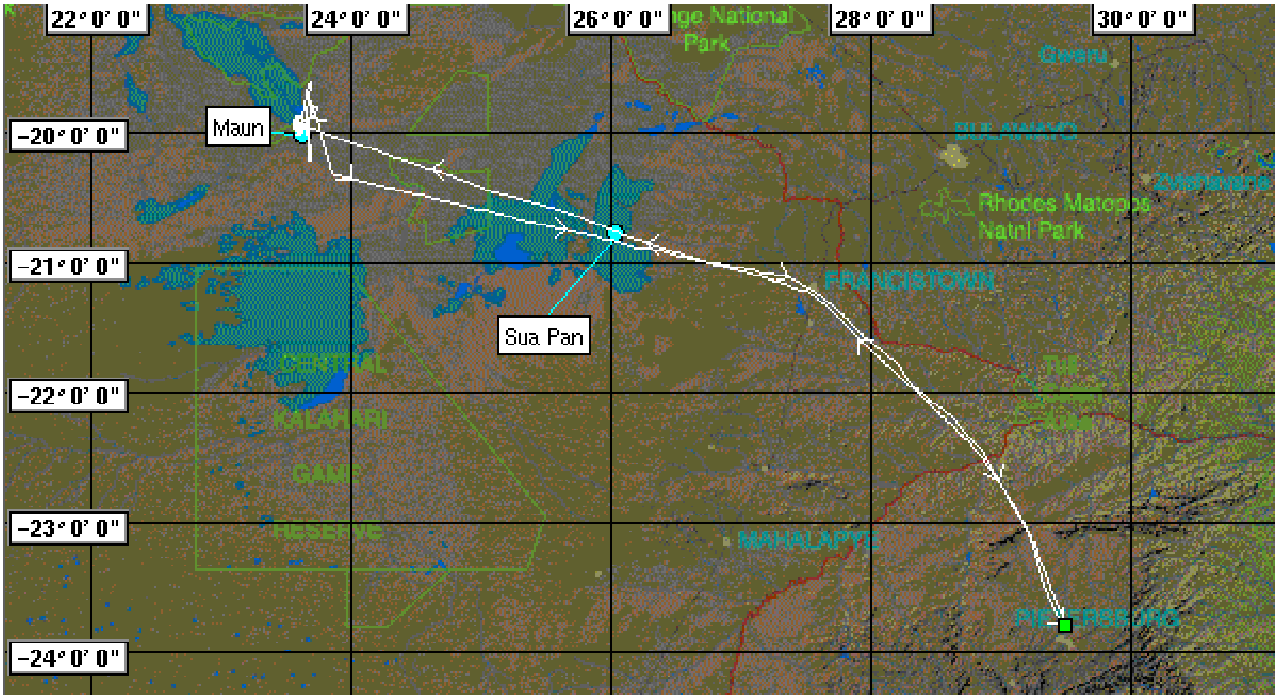

Figure 4.20. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 2, 2000 (UW Flight 1829).

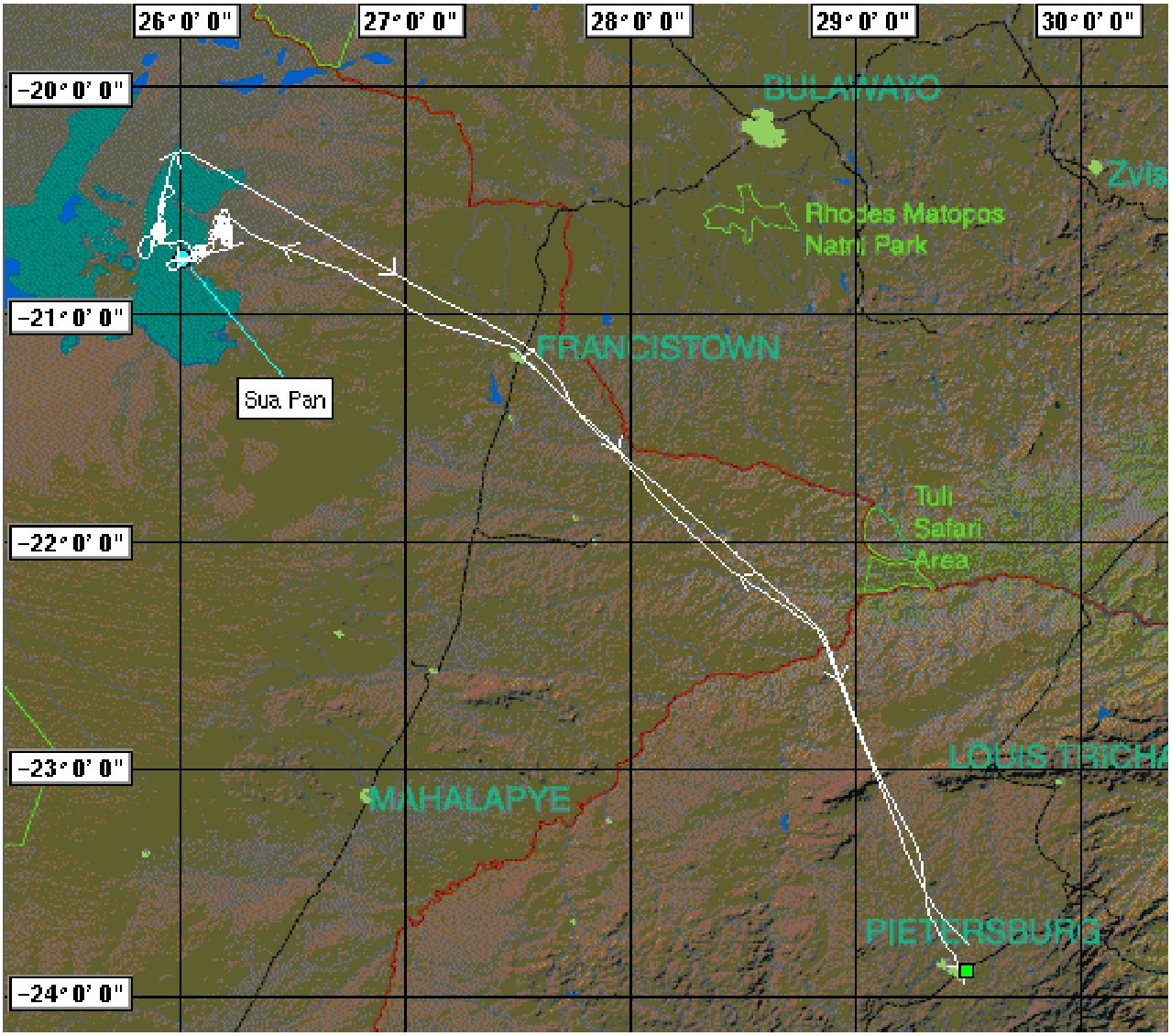

Figure 4.21. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 3, 2000 (UW Flight 1830).

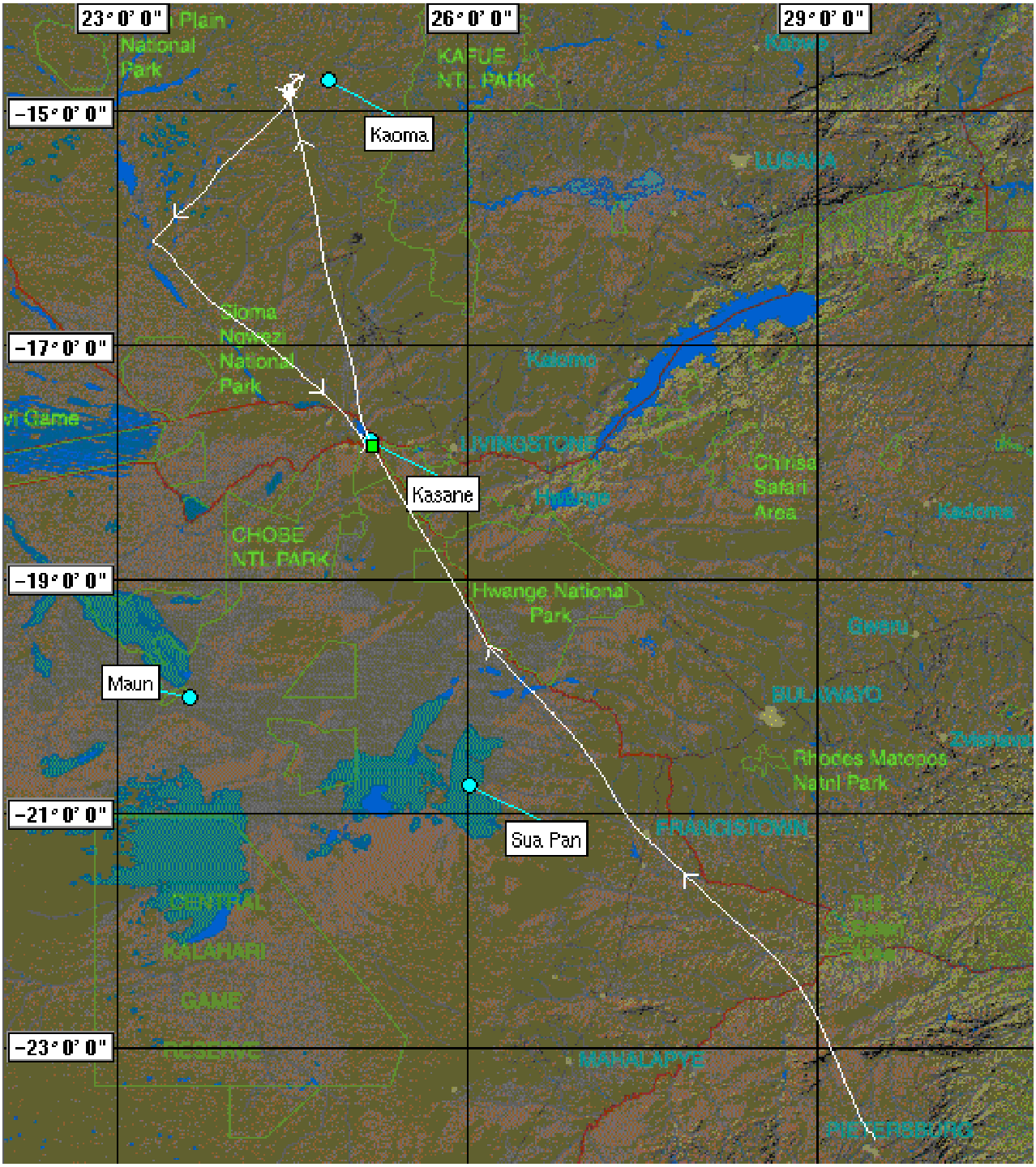

Figure 4.22. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 5, 2000 (UW Flight 1831).

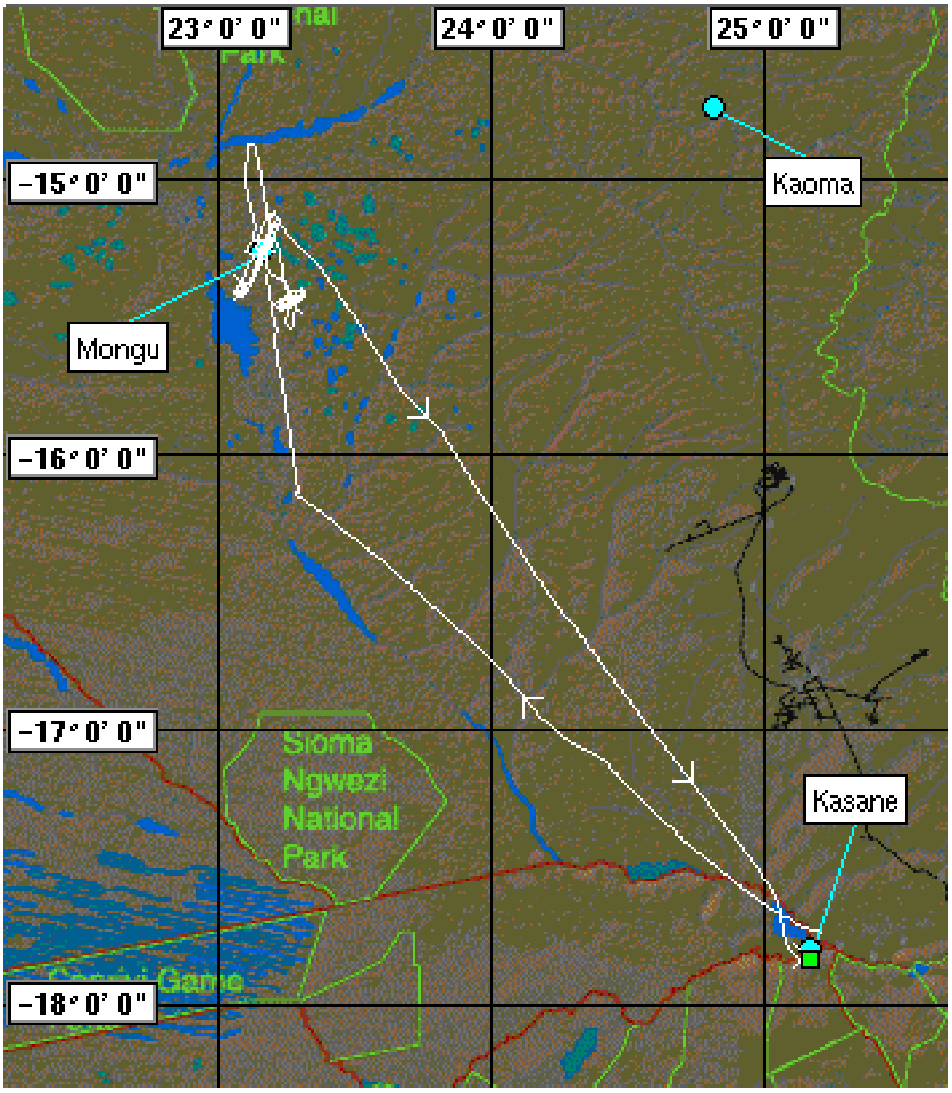

Figure 4.23. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 6, 2000 (UW Flight 1832).

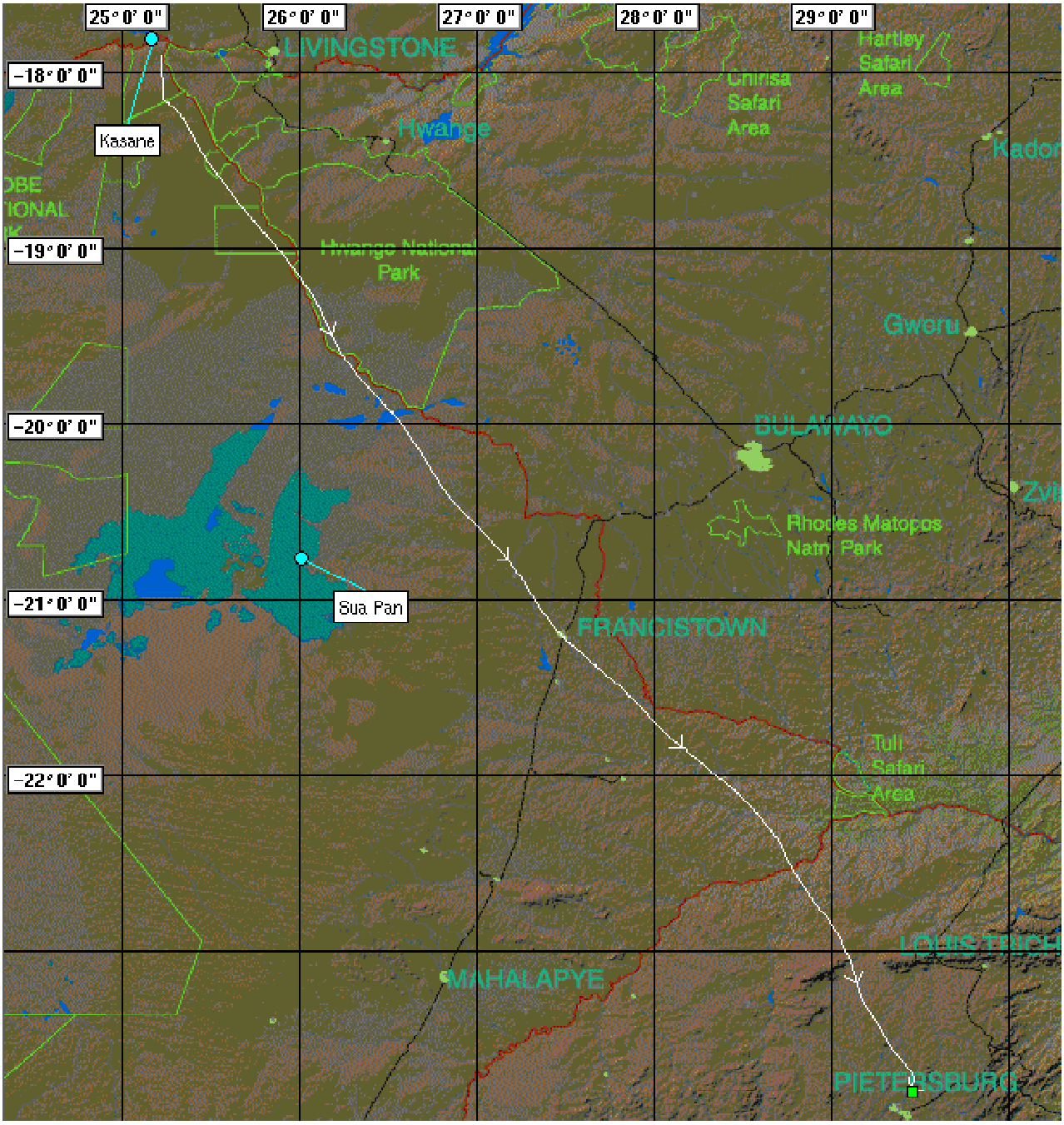

Figure 4.24. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 6, 2000 (UW Flight 1833).

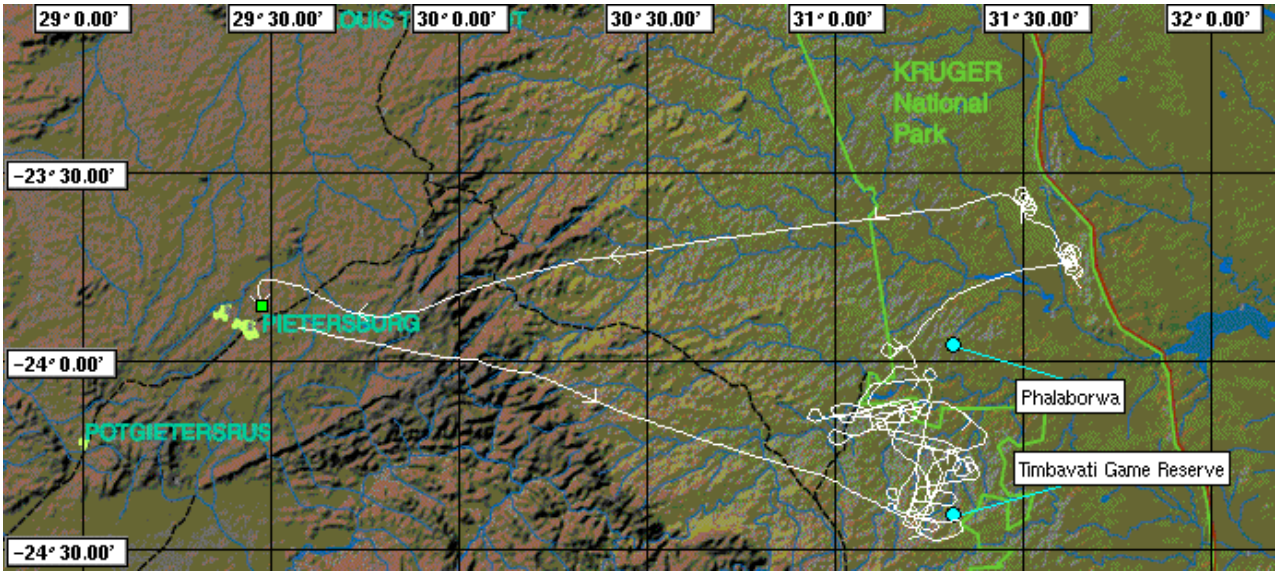

Figure 4.25. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 7, 2000 (UW Flight 1834).

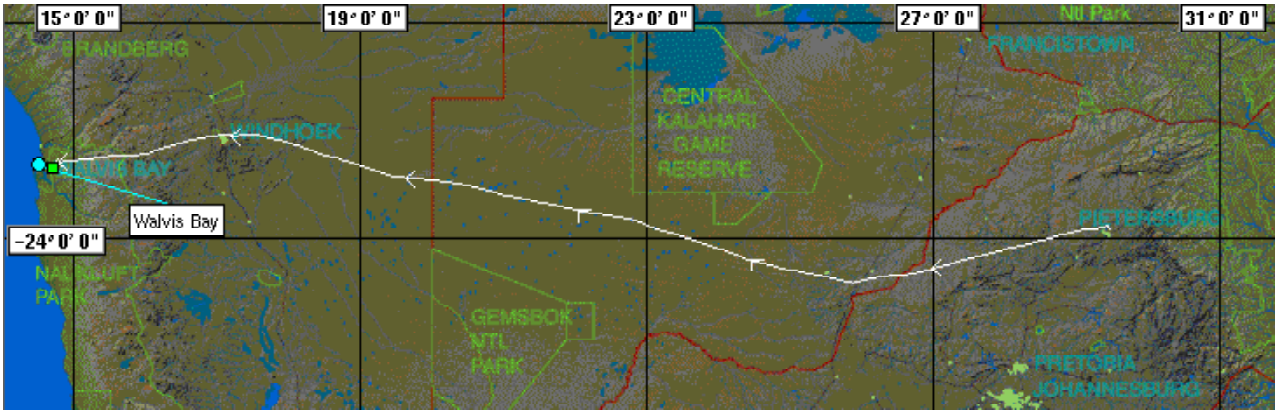

Figure 4.26. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 10, 2000 (UW Flight 1835).

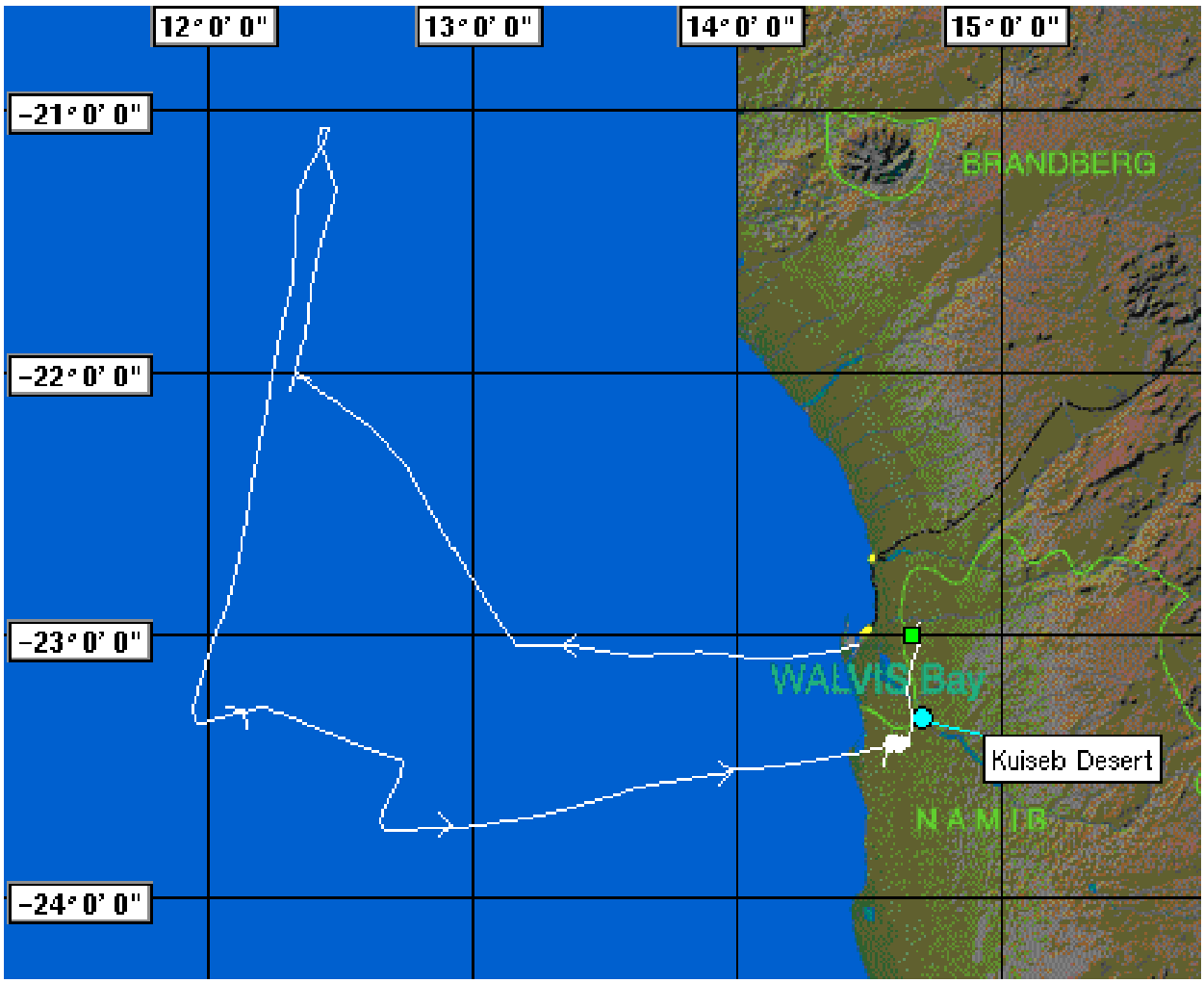

Figure 4.27. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 11, 2000 (UW Flight 1836).

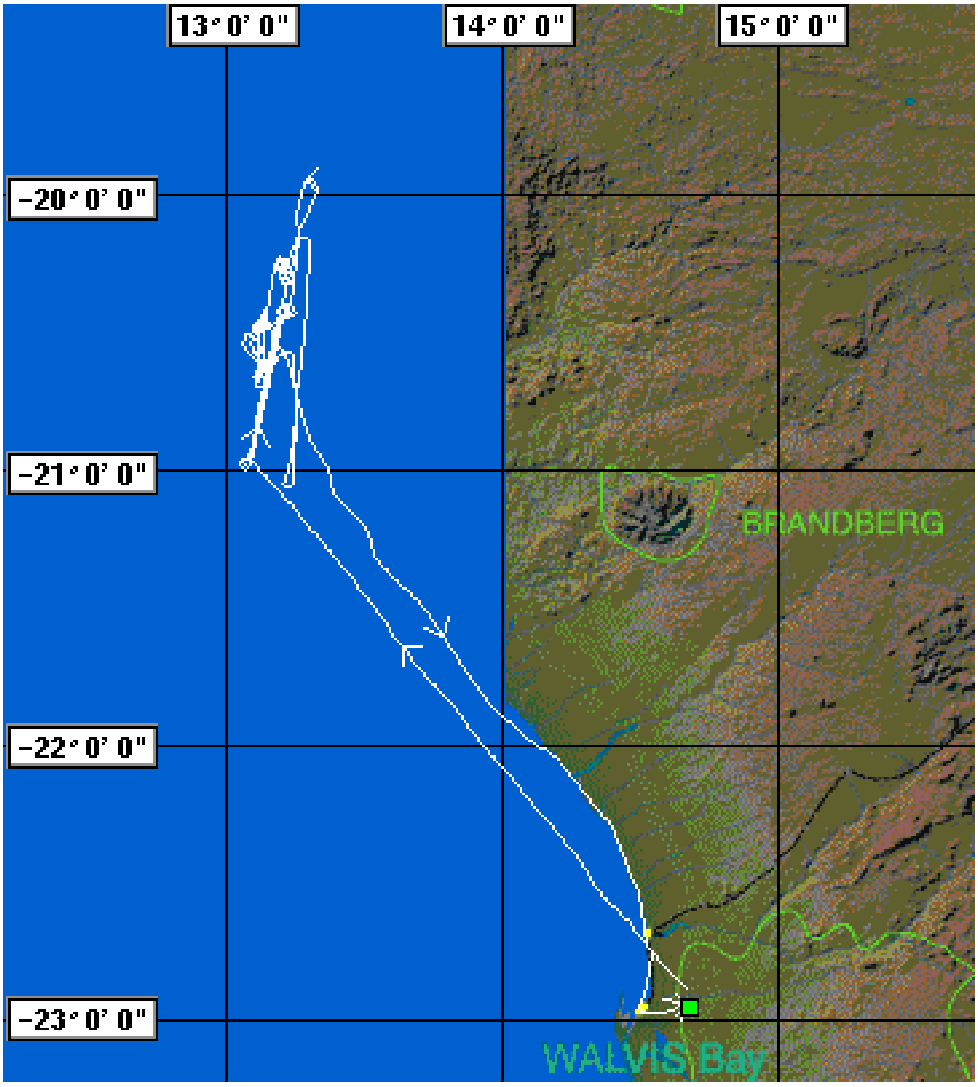

Figure 4.28. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 13, 2000 (UW Flight 1837).

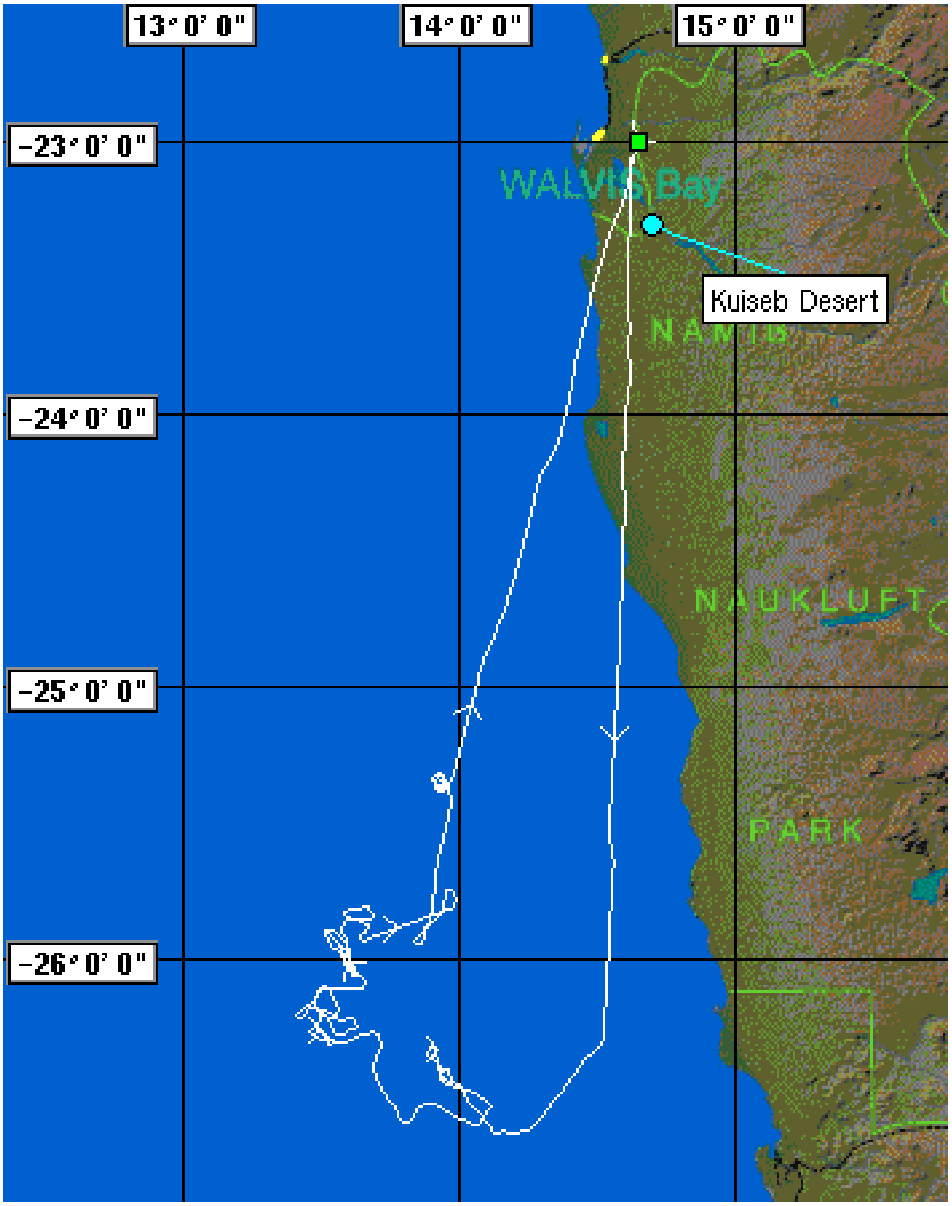

Figure 4.29. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 14, 2000 (UW Flight 1838).

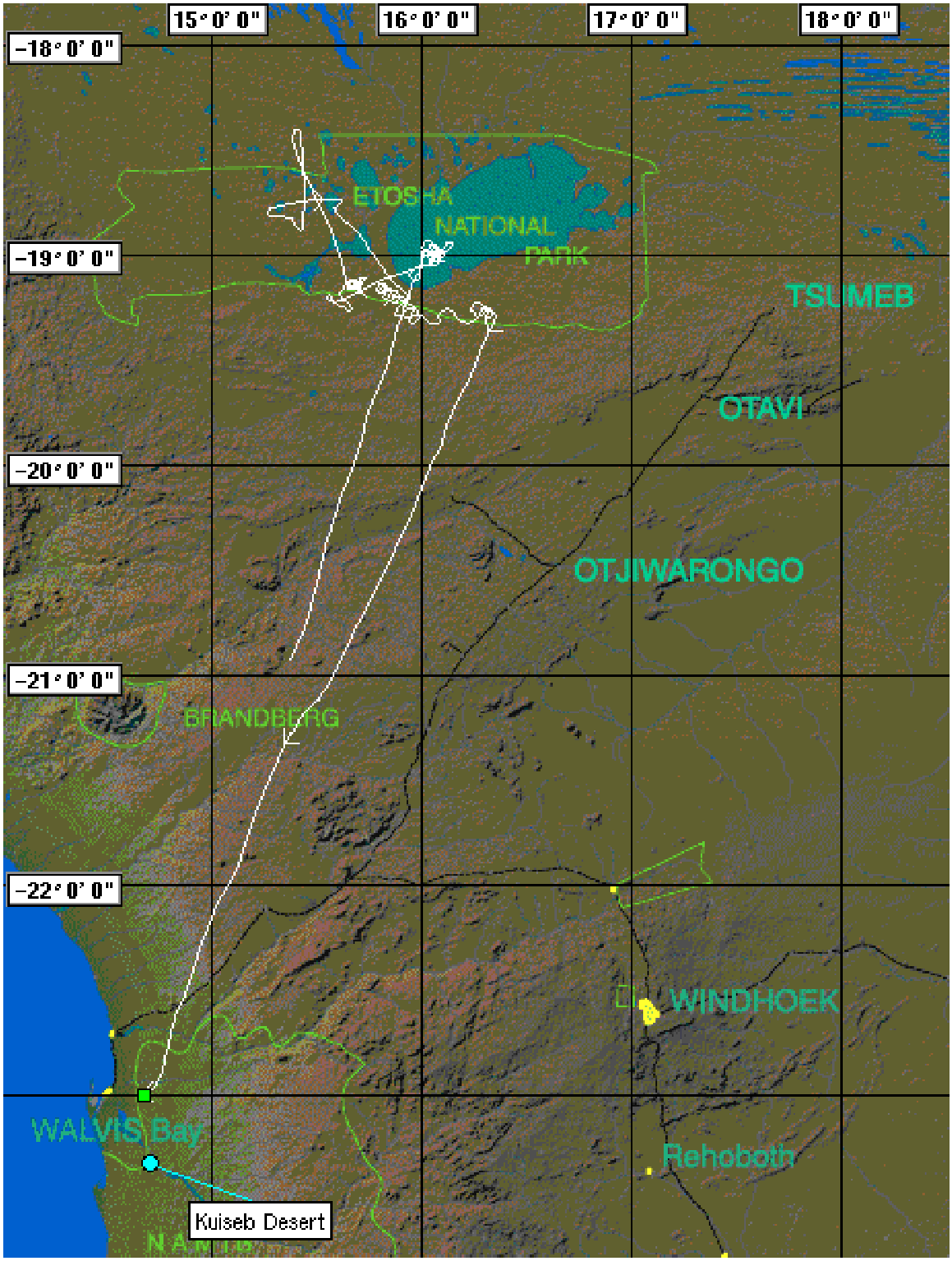

Figure 4.30. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 16, 2000 (UW Flight 1839).

Flight track not available (no measurements made)

Figure 4.31. Flight track (white line) of the Convair-580 in SAFARI-2000 on September 16, 2000 (UW Flight 1840).

5. TYPES OF DATA COLLECTED ABOARD THE CONVAIR-580 RESEARCH AIRCRAFT IN SAFARI-2000

Thirty-one flights, totaling nearly 120 research flight hours, were flown by the University of Washington's Convair-580 research aircraft in SAFARI-2000 during the period 10 August through 18 September 2000. Table 5.1 gives an overview of some of the main accomplishments of these flights.

Table 5.2 shows the relationships between the Convair-580 flights, ER-2 flights, Terra and TOMS satellite overpasses, and the South African Aerocommander flights. It should be noted that the various aircraft may not have always been sampling over exactly the same location at exactly the same time.

Table 5.3 lists the occasions on which measurements of smoke in well-defined plumes from biomass fires were obtained aboard the Convair-580.

To interpret properly the various measurements on aerosols and gases obtained aboard the Convair-580, it is important to understand that two sampling methods were used: "continuous" and "baghouse." The former is when an instrument measures the properties of the ambient airstream continuously as it passes by the aircraft. Baghouse sampling is a method for obtaining a sample of ambient air by collecting it almost instantaneously in a 2.6 m^3 Velostat bag in the aircraft cabin. This air sample is then fed to various instruments. Baghouse sampling was often the only way to get good measurements in narrow plumes. Some instruments on the Convair-580 sampled only continuously (see below), some sampled only from the baghouse, and some sampled continuously at times and at other times from the baghouse.

The chemistry and aerosol instruments that sampled *continuously* without interruption (excluding warm-up periods or instrument malfunctions) were the CE nephelometer, the TSI 3022A condensation nuclei counter (CNC-1), the TSI 3025A condensation nuclei counter (CNC-2), and the TSI 3320 aerodynamic particle sizer. The chemistry and aerosol instruments that *generally* sampled continuously, but which were interrupted on occasions for baghouse

TABLE 5.1. OVERVIEW OF SOME OF THE MAIN ACCOMPLISHMENTS OF THE CONVAIR-580 FLIGHTS IN SAFARI-2000.

- Aerosol and trace gas sampling in the boundary layer and free troposphere in various regions of South Africa, Mozambique, Botswana, Zambia and Namibia.
- Measurements of the physical and chemical characteristics of aerosols and trace gases on seven occasions beneath NASA ER-2 aircraft overflights.
- Measurements on the physical and chemical characteristics of aerosols and trace gases on ten occasions beneath Terra satellite, and on two occasions beneath TOMS satellite.
- Physical and chemical measurements on smoke (including emission factors of particles and gases) from five prescribed fires in Southern Africa.
- Physical and chemical measurements on smoke (including emission factors of particles and gases) from six non-prescribed fires in Southern Africa.
- Measurements of the physical and chemical properties of aerosols, together with airborne sunphotometer and spectral radiometer measurements, in vertical profiles in Southern Africa, Mozambique, Botswana, Zambia and Namibia.
- Measurements of physical and chemical properties of aerosols over SAFARI ground-instrumented sites at Skukusa (South Africa), Inhaca Island (Mozambique), Maun and Sua Pan, Kasane (Botswana) to north of Mongu (Zambia), and Etosha Pan (Namibia).
- Twelve sets of bidirectional reflection distribution function (BRDF) measurements over various surfaces in Southern Africa.
- Cloud condensation nucleus (CCN) spectral measurements over western Namibia and off Namibian coast on four flights.
- Two sets of cloud microphysical measurements in stratus clouds off Namibian coast simultaneously with NASA ER-2 aircraft overpasses.
- Cloud microstructural measurements, and aerosol inflow and outflow, on cumulus clouds off west coast of South Africa.
- Measurements of aerosol and trace gas emissions from two freighter ships off west coast of South Africa.
- Brief measurements in two dust storms over Walvis Bay, Namibia.

TABLE 5.2. SUMMARY OF UNIVERSITY OF WASHINGTON'S CONVAIR-580 RESEARCH FLIGHTS IN RELATIONSHIP TO OTHER PLATFORMS IN SAFARI-2000*

(a) Convair-580 Flights Beneath the NASA ER-2 Aircraft

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Time of ER-2 Overpass (UTC)	Notes
20 Aug.	1819	1124-1541	0840	Purpose of flight was to monitor prescribed fire in Madikwe Game Reserve (on South Africa/ Botswana border). ER-2 passed over fire soon after ignition. Convair-580 sampled smoke from fire some hours later.
22 Aug.	1820	0658-1235	0828	Detailed measurements obtained from Convair-580 in vertical profile over Skukusa Airport, Kruger National Park, South Africa. Terra satellite overpass at 0828 UTC.
24 Aug.	1822	0638-1130	0816	Detailed measurements obtained from Convair-580 in vertical profile over Inhaca Island, Mozambique. Terra satellite overpass at 0816 UTC. Aerocommander JRA in vicinity.
6 Sept.	1832	0700-1058	~0900	Detailed measurements obtained from Convair-580 in vertical profile over Mogu airport, Zambia. BRDF measurements over Mongu tower.

(Cont.)

* This table highlights some of the potentially important links between measurements obtained on the multivarious platforms in SAFARI-2000. Many other links may exist.

† Local time = UTC + 2 hours

TABLE 5.2 (continued)

(a) Convair-580 Flights Beneath the NASA ER-2 Aircraft (Continued)

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Time of ER-2 Overpass (UTC)	Notes
7 Sept.	1834	0755-1220	0828, 1145 and 1205	Convair-580 obtained extensive measurements of smoke from a large prescribed fire in the Timbavati Game Park (near Kruger National Park, South Africa). ER-2 overflew fire in earlier and later stages of burn.
11 Sept.	1836	0835-1222	0942	Convair-580 obtained measurements in thin, broken stratus clouds off Namibian coast. Terra overpass at 0942 UTC.
13 Sept.	1837	0826-1416	0930	Convair-580 obtained measurements in stratus clouds off Namibian coast. Terra overpass at 0930 UTC.

(b) Convair-580 Flights Beneath the Terra Satellite

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Time of Terra Overpass (UTC)	Notes
15 Aug.	1814	0655-1115	0822	Detailed measurements obtained from Convair-580 near Skukusa Airport, Kruger National Park, South Africa. 80% low cloud cover during Terra satellite overpass.

(Cont.)

† Local time = UTC + 2 hours

TABLE 5.2 (continued)

(b) Convair-580 Flights Beneath the Terra Satellite (Continued)

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Time of Terra Overpass (UTC)	Notes
20 Aug.	1819	1124-1541	0841	Purpose of flight was to monitor prescribed fire in Madikwe Game Reserve (on South Africa/ Botswana border). Terra satellite passed over fire soon after ignition. Convair-580 sampled smoke from fire some hours later. ER-2 overpass at 0840 UTC.
22 Aug.	1820	0658-1235	0828	Detailed measurements from Convair-580 in vertical profile over Skukusa Airport, Kruger National Park, South Africa. ER-2 overpass at 0828 UTC.
24 Aug.	1822	0638-1130	0816	Detailed measurements obtained from Convair-580 in vertical profile over Inhaca Island, Mozambique. ER-2 overpass at 0816 UTC. Aerocommander JRA in vicinity.
29 Aug.	1823	0822-1114	0834	Detailed measurements obtained from Convair-580 in vertical profile near South Africa/ Zimbabwe border. TOMS overpass at 0930 UTC.
1 Sept.	1826	0532-1108	0902	Measurements from Convair-580 of smoke from small prescribed burn of Miambo near Kaoma, Zambia (14.818˚S/24.475˚E) at time of Terra satellite overpass.

(Cont.)

† Local time = UTC + 2 hours

TABLE 5.2 (continued)

(b) Convair-580 Flights Beneath the Terra Satellite (Continued)

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Time of Terra Overpass (UTC)	Notes
3 Sept.	1830	0702-1238	0852	Measurements from Convair-580 at 100 ft agl in run over grass/brush/trees and sand near parabola site at Sua Pan, Botswana, at time of Terra satellite overpass. Followed by airborne BRDF measurements at two sites near and over Sua Pan (20.577˚S/26.080˚E).
7 Sept.	1834	0755-1220	0828	Convair-580 made extensive measurements on smoke from the prescribed fire in the Timbavati Game Reserve (near Kruger National Park, South Africa). Fire lit at 0820 UTC. ER-2 overpasses at 0828, 1145 and 1205 UTC.
11 Sept.	1836	0835-1222	0942	In situ measurements from Convair-580 of microstructure of thin, broken stratus off Namibian coast at time of Terra satellite overpass.
13 Sept.	1837	0826-1416	0930	In situ measurements from Convair-580 of microstructure of stratus off Namibian coast at time of Terra satellite overpass. BRDF measurements over Etosha National Park, Namibia.

(Cont.)

† Local time = UTC + 2 hours

TABLE 5.2 (continued)

(c) Convair-580 Flights Beneath TOMS Satellite

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Time of TOMS Overpass (UTC)	Notes
29 Aug.	1823	0822-1114	0930	Detailed measurements obtained from Convair-580 in vertical profile near South Africa/ Zimbabwe border.
2 Sept.	1829	0736-1334	0948	Detailed vertical profiles and BRDF measurements over Maun tower at time of TOMS overpass.

(d) Convair-580 Flights Close in Time and Space to Flights of the South Africa Aerocommander Aircraft (JRA or JRB)

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Period of Aerocommander Flights (UTC)	Notes
15 Aug.	1814	0655-1115	0725-0922 (JRB) 0743-0917 and 1220-1320 (JRA)	Convair-580, JRA and JRB obtained vertical profiles over Skukusa, South Africa. Terra satellite overpass at 0822 UTC.
18 Aug	1816	0802-1339	0814-1137 (JRA)	Measurements from Convair-580 and JRA in smoke from prescribed fire in Madikwe Game Reserve (on South Africa/Botswana border).

(Cont.)

† Local time = UTC + 2 hours

TABLE 5.2 (continued)

(d) Convair-580 Flights Close in Time and Space to Flights of the South Africa Aerocommander Aircraft (JRA or JRB) (Continued)

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Period of Aerocommander Flights (UTC)	Notes
20 Aug.	1818 and 1819	0713-0818 and 1124-1541	0717-1033 (JRA)	Convair-580 and JRA flew Pietersburg to Madikwe Game Reserve (MGR) on South Africa/Botswana border. Obtained measurements at different times on smoke from prescribed fire in MGR.
23 Aug.	1821	1138-1448	1347-1509 (JRA) 1135-1435 (JRB)	Intercomparison of measurements between three aircraft and radiosonde in Pietersburg area, South Africa.
24 Aug.	1822	0638-1130	0703-1030 (JRA)	Measurements from Convair-580 and JRA over Inhaca Island, Mozambique. Terra and ER-2 overpasses at 0816 UTC.
29 Aug.	1823	0822-1114	0820-1127 (JRA)	In first flight on this day, Convair-580 obtained measurements on South Africa/ Zimbabwe border. JRA flew well to east of Convair-580 in Mozambique (Beira, etc.). JRB flew west of Pietersburg, South Africa. Terra overpass at 0835 UTC; TOMS overpass at 0930 UTC; ER-2 overflight of Mozambique and Skukusa.
29 Aug.	1824	1245-1540	1347-16711 (JRA) 0725-0940 (JRB)	In second Convair-580 flight on this day, measurements were obtained in the Kruger National Park, South Africa.

(Cont.)

† Local time = UTC + 2 hours

TABLE 5.2 (continued)

(d) Convair-580 Flights Close in Time and Space to Flights of the South Africa Aerocommander Aircraft (JRA or JRB) (Continued)

Date (2000)	University of Washington Flight Number	Period of Convair-580 Flight† (UTC)	Period of Aerocommander Flights (UTC)	Notes
31 Aug.	1825	0842-1421	0710-1120 (JRB)	Convair-580 flew over Mozambique coast and studied fires west of Beria, Mozambique. JRB flew over Mozambique.
3 Sept.	1830	0702-1238	0700-1000 (JRB) 1150-1345 (JRB)	Convair-580 and JRB obtained measurements over Sua Pan, Botswana. Terra overpass at 0852 UTC.
5 Sept.	1831	0838-1413	0808-1045 (JRA)	Convair-580 obtained measurements from Pietersburg, South Africa, to Kaoma, Zambia, to Kasane, Botswana. JRA flew well east of Convair-580 from Pietersburg to Lusaka, Zambia, with vertical profiles en route.
6 Sept.	1833	1133-1354	1223-1511 (JRA)	Convair-580 flew from Kasane to Pietersburg, South Africa, with measurements en route. JRA flew from Lusaka, Zambia, to Pietersburg.
7 Sept.	1834	0755-1220	0811-1135 (JRA) 1345-1541 (JRA)	Convair-580 obtained detailed measurements on prescribed fire in Timbavati Game Reserve (near Kruger National Park, South Africa), then north to Phalaborwa, South Africa, and return to Pietersburg, South Africa. On first flight of day, JRA flew from Pietersburg to Vilanculos, Mozambique. On second flight, JRA returned to Pietersburg.

† Local time = UTC + 2 hours

TABLE 5.3. MEASUREMENTS FROM UNIVERSITY OF WASHINGTON'S CONVAIR-580 ON SMOKE FROM BIOMASS FIRES IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Period of Measurements (UTC)*	Type of Fire and Notes
15 Aug.	1814	0947-1015	Sampled smoke from two non-prescribed small grass fires about 30 miles west of Skukusa, South Africa. Terra satellite overpass at 0822 UTC.
17 Aug.	1815	0926-1100	Sampled smoke from a non-prescribed grass fire with flaming and smoldering combustion. Measurements close to fire and about 15 nautical miles downwind (Plume #1).
		1100-1130	Sampled vertical smoke plume from non-prescribed fire (Plume #2). This fire appeared to be larger, hotter, and had more flames than fire sampled from 0926-1100 UTC.
18 Aug.	1816	0907 to ~1250	Sampled smoke from prescribed fire in Madikwe Game Reserve (on South Africa/ Botswana border). Sampled smoke over fire, 12.5 and 28 nautical miles downwind, back along long axis of plume to fire head, at 6,000 ft in vertical plume over fire, and just below base of capping cumulus (thick smoke). Tried to penetrate capping cumulus over fire. Good chemical and aerosol sampling of smoke and ambient air. JRA Aerocommander also obtained measurements in smoke from this fire.
20 Aug.	1819	1241-1445	Sampled smoke from prescribed fire in Madikwe Game Reserve (on South Africa/ Botswana border). Horizontal runs under, through, and over smoke plume. Two "grab-bag" samples of smoke for chemical and physical measurements. Measurements in ambient air.

(Cont.)

* Local time = UTC + 2 hours

Table 5.3 (continued)

Date (2000)	University of Washington Flight Number	Period of Measurements (UTC)*	Type of Fire and Notes
29 Aug.	1824	1415-1445	Four passes through smoke from small non-prescribed, smoldering fire in Kruger National Park, South Africa. Sampled older smoke on transit back.
31 Aug.	1825	1125-1225	Sampled smoke from non-prescribed smoldering fire in Mozambique (west of Beria). Three penetrations of plume over fire, and smoke sampled at about 10 and 15 miles downwind. Grab bag, HC cans and FTIR measurements.
1 Sept.	1826	0838-1007	Prescribed burn of Miombo near Kaoma, Zambia. Woodland understory, dead leaves and grass. Mostly flaming combustion. Extensive ground-based documentation of fuel and burn by D. Ward. Extensive chemical and physical measurements from Convair-580 close to fire, along long axis of fire and at 4 and 7 miles downwind. Terra overpass at 0902 UTC.
5 Sept.	1831	1134 to ~1245	Prescribed burn of Dambo grassland near Kaoma, Zambia. Extensive ground-based documentation of fuel and burn by D. Ward. Mostly flaming combustion. Extensive measurements in smoke at 500 ft over fire. Ambient measurements also.
7 Sept.	1834	0831 to ~1045	Extensive measurements on large prescribed fire in Timbavati Game Reserve (near Kruger National Park, South Africa). Fire ignition at about 0820 UTC. Physical and chemical measurements at various distances downwind of fire and over fire. Terra satellite overpass at 0828 UTC. ER-2 overpasses at 0828, 1145 and 1205 UTC.

* Local time = UTC + 2 hours

sampling, were the NO_x, CO_2, SO_2, CO, O_3, MS Electron nephelometer, Particle Soot Absorption Photometer (PSAP), and humidograms. The chemistry and aerosol instruments that sampled *only from the baghouse* were the Differential Mobility Particle Sizer (DMPS) and the M903 Radiance Research nephelometer (the "baghouse nephelometer").

The locations and times when light-scattering and absorption coefficients, particle size distributions from 0.01 to 0.6 μm (with the DMPS), and aerosol humidification factors (from the scanning humidogram), were measured from the baghouse are listed in Table 5.4. The humidogram is an instrument that slowly increases the relative humidity (RH) of an air sample to measure the resulting increase in light scattering (with the MS Electron 3-wavelength nephelometer). The air sample can come from either the continuous airstream or the baghouse. The RH scan takes about 5 mins. Since humidograms were obtained both by sampling from the continuous airstream and from the baghouse, there are two columns in Table 5.4 that list the UTC start times. The DMPS, for measuring particle sizes, takes about 5 mins to complete a scan and was often run more than once off of a single baghouse sample. Multiple DMPS scans from a single baghouse sample are indicated in Table 5.4 by listing the individual UTC sample times separated by a comma. The trace gas chemistry instruments (e.g., NO_x, CO_2, O_3, etc.) and the PSAP generally sampled from the continuous airstream, but they could also sample from the baghouse. Therefore, the times when the trace gas instruments and the PSAP were *not* sampling continuously are listed in Table 5.4.

Two instruments were operated intermittently (regardless and independently of the baghouse): the long-path Optical Extinction Cell (OEC—which provides measurements of the light extinction coefficient in plumes), and the Aerosol Asymmetry Analyzer (A^3). The time periods when these two instruments were operated are listed in Table 5.5.

Table 5.6 lists the locations and times at which grids were exposed for subsequent analysis of individual particles by electron microscope, etc.

TABLE 5.4. MEASUREMENTS OF LIGHT-SCATTERING AND ABSORPTION COEFFICIENTS, DMPS PARTICLE SIZE DISTRIBUTIONS, AND HUMIDIFICATION FACTORS, FROM "GRAB" BAGHOUSE SAMPLES ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
10 Aug	1810	1332		1407					Haze (10000 ft, 700 hPa) about 90 nautical miles NW of Pietersburg, South Africa.
		1431	1431-1440	1435, 1442					Haze (9600 ft, 710 hPa) about 90 nautical miles NW of Pietersburg, South Africa.
14 Aug	1812					1312			Haze (7000 ft, 780 hPa) about 80 nautical miles NW of Johannesburg, South Africa.
		1326	1326-1410	1328,1334		1337			Haze (7000 ft, 780 hPa) about 80 nautical miles NW of Johannesburg, South Africa.
15 Aug	1814	0852	0853-0930	0853, 0903, 0923		0846	0912		Haze (2700 ft, 920 hPa) near Skukusa, South Africa.
		0950	0950-0957	0953 (failed)					Plume from small grass fire about 30 nautical miles west of Skukusa, South Africa.
17 Aug	1815					0757			Haze (1600 ft, 970 hPa) near Kruger National Park, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		0834	0835-0923	0835, 0844		0828			Haze (4000 ft, 880 hPa) in Kruger National Park, South Africa.
		1003	1003-1014	1003					Plume from smoldering grass fire in dying stage in Kruger National Park, South Africa.
		1025	1025-1037		1025-1037		1025		Plume from smoldering grass fire in dying stage in Kruger National Park, South Africa.
		1047	1047-1054	1050					Plume from smoldering grass fire in dying stage in Kruger National Park, South Africa.
		1109	1111-1116				1111 (failed)		Plume from young and active grass fire in Kruger National Park, South Africa.
		1129	1129-1140	1135 (failed)					Plume from young and active grass fire in Kruger National Park, South Africa.
18 Aug	1816	0915	0915-0940	0920		0925			Plume from vertical smoke column just after the prescribed fire was lit in the Madikwe Game Reserve on South Africa/Botswana border.
		1000	1000-1005	1005					Plume 12.5 miles downwind of above prescribed fire.
		1023	1023-1033	1028					Plume 12.5 miles downwind of above prescribed fire.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		1227	1227-1238						Plume 21 miles downwind of above prescribed fire.
20 Aug	1818	0804		0804		0757			Haze (9500 ft, 715 hPa) between Madikwe Game Reserve and Pietersburg, South Africa.
20 Aug	1819	1203	1214-1219	1204, 1214		1153			Upper haze (11000 ft, 690 hPa) over Madikwe Game Reserve on South Africa/ Botswana border.
		1250	1251-1300		1251-1300				Plume from prescribed fire in Madikwe Game Reserve. Smoldering with some visible flames.
		1329	1330-1343	1330	1330-1343		1329		Plume from prescribed fire in Madikwe Game Reserve. Smoldering with more visible flames.
		1356	1356-1408		1356-1408				Plume from prescribed fire in Madikwe Game Reserve. Smoldering with more visible flames.
		1437	1438-1446	1438					Haze (5000 ft, 850 hPa) over Madikwe Game Reserve.
22 Aug	1820					0721			Haze (10000 ft, 710 hPa) between Pietersburg and Skukusa, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		0730	0731-0753	0738, 0746					Haze (10000 ft, 710 hPa) between Pietersburg and Skukusa, South Africa.
						0845			Haze (7600 ft, 750 hPa) near Skukusa, South Africa.
		0952	0953-1018	0953, 1010		0951			Haze (3100 ft, 920 hPa) over Skukusa, South Africa.
23 Aug	1821	1301	1302-1317	1303, 1311		1227			Free troposphere (15800 ft, 570 hPa) near Pietersburg, South Africa.
24 Aug	1822	0708	0709-0735	0709, 0719		0709			Haze (11500 ft, 670 hPa) en route from Pietersburg to Inhaca Is., Mozambique.
		0844	0844-0852	0844					Haze (600 ft, 1020 hPa) over Inhaca Is.
		0916	0916-0926	0916					Haze (4200 ft, 890 hPa) over Inhaca Is.
		0945	0946-0952	0946		0945			Haze (8000 ft, 770 hPa) over Inhaca Is., Mozambique.
						0956			Haze (8500 ft, 735 hPa) over Inhaca Is., Mozambique.
29 Aug	1823					0858			Haze (9500 ft, 850 hPa) near South Africa/ Zimbabwe border.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		0906	0907-0922	0907, 0914					Haze (9500 ft, 850 hPa) near South Africa/Zimbabwe border (Terra and TOMS overpasses).
						0928			Haze (9500 ft, 850 hPa) near South Africa/Zimbabwe border (Terra and TOMS overpasses).
		0940	0940-0946	0940					Haze (9500 ft, 850 hPa) near South Africa/Zimbabwe border (Terra and TOMS overpasses).
		1003	1004-1016			1005			Haze (5300 ft, 725 hPa) near South Africa/Zimbabwe border (Terra and TOMS overpasses).
		1016	1016-1028						Haze (5300 ft, 725 hPa) near South Africa/Zimbabwe border (Terra and TOMS overpasses).
		1028	1028-1031, 1036-1045	1031					Haze (5300 ft, 725 hPa) near South Africa/ Zimbabwe border.
29 Aug	1824	1319	1320-1327	1320		1317			Haze (11500 ft, 670 hPa) en route from Pietersburg to Skukusa, South Africa.
		1340	1340-1346	1340		1337			Haze (3000 ft, 910 hPa) over Skukusa, South Africa.
		1413	1413-1415						Plume from small, smoldering fire in Kruger National Park, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		1421	1421-1437		1421-1437				Plume from small, smoldering fire in Kruger National Park, South Africa.
31 Aug	1825					0932			Haze (9700 ft, 720 hPa) approaching Mozambique coast.
		0941	0943-1003	0942, 0951					Haze (9700 ft, 720 hPa) approaching Mozambique coast.
		1005	1004-1018	1004, 1011					Haze (9700 ft, 720 hPa) approaching Mozambique coast.
		1031	1032-1040	1032		1033			Haze (5000 ft, 860 hPa) approaching Mozambique coast.
						1108			Haze (3700 ft, 900 hPa) over the Indian Ocean off Mozambique coast.
		1120	1121-1131		1121-1131				Plume from smoldering fire west of Beria, Mozambique.
		1134	1136-1148	1136	1136-1148		1136	1136-1142	Plume from smoldering fire west of Beria, Mozambique.
		1201	1201-1216		1201-1216				Aged smoke west of Beria, Mozambique.
		1221	1222-1241	1222	1222-1241		1222	1222-1228	Aged smoke west of Beria, Mozambique.
		1351	1352-1402	1352	1352-1402		1352	1355-1359	Lofted smoke plume en route back to Pietersburg.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
1 Sep	1826	0614	0615-0713	0615, 0623		0612			Haze (12600 ft, 645 hPa) en route from Pietersburg, South Africa, to Zambia.
		0721	0721-0746	0721, 0727		0718			Haze (10700 ft, 695 hPa) en route from Pietersburg, South Africa, to Zambia.
		0806	0807-0828	0807	807-828	0802			Haze (6200 ft, 810 hPa) en route from Pietersburg, South Africa, to Zambia.
		0902	0903-0916		903-916				Plume near prescribed burn of Miombo at Kaoma, Zambia (Terra overpass).
		0919	0920-0939	0920	920-939		0920	920-927	Plume near prescribed burn of Miombo at Kaoma, Zambia.
		0947	0948-1000		948-1000				Plume about 7 miles downwind of prescribed burn of Miombo at Kaoma, Zambia.
		1003	1004-1013	1004	1004-1013		1004	1004-1013	Plume about 7 miles downwind of prescribed burn of Miombo at Kaoma, Zambia.
2 Sep	1829	0805	0805-0811			0803			Haze (10600 ft, 695 hPa) en route from Pietersburg, South Africa, to Maun, Botswana.
		0828	0829-0849	0828					Haze (10500 ft, 695 hPa) en route from Pietersburg to Maun, Botswana.
		0854	0855-0909	0855, 0901		0852			Haze (10400 ft, 700 hPa) en route from Pietersburg to Maun, Botswana.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		1019	1020-1026	1020		1019			Haze (5200 ft, 840 hPa) over Maun tower, Botswana.
		1030	1030-1036	1030					Haze (5400 ft, 835 hPa) over Maun tower.
		1051	1051-1106	1052	1054-1106				Haze (7500 ft, 760 hPa) over Maun tower.
		1113	1115-1121	1115		1113			Haze (11700 ft, 600 hPa) over Maun tower.
3 Sep	1830	0734	0735-0750	0736, 0742		0733			Haze (10400 ft, 700 hPa) en route from Pietersburg, South Africa, to Sua Pan, Botswana.
		0752	0753-0812	0754, 0805					Haze (11000 ft, 690 hPa) en route from Pietersburg to Sua Pan, Botswana.
		0847	0848-0901	0849, 0855		0846			Haze (3000 ft, 900 hPa) above Sua Pan.
		1021	1021-1039	1026		1021			Haze (8300 ft, 715 hPa) above Sua Pan.
		1101	1101-1115	1102, 1109		1058			Haze (7900 ft, 770 hPa) en route back to Pietersburg, South Africa.
		1129	1130-1136	1130		1126			Haze (7800 ft, 770 hPa) en route back to Pietersburg.
5 Sep	1831	0909	0910-0923	0911, 0917		0910			Haze (10500 ft, 700 hPa) en route from Pietersburg, South Africa, to Kaoma, Zambia.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		1006	1006-1019	1006, 1011		1005			Haze (11800 ft, 650 hPa) en route from Pietersburg to Kaoma, Zambia.
		1041	1042-1054	1042, 1048		1040			Haze (13900 ft, 615 hPa) en route from Pietersburg to Kaoma, Zambia.
		1156	1158-1209		1158-1209				Plume close to prescribed burn of Diombo at Kaoma.
		1210	1210-1218	1211	1210-1218		1212	1212-1218	Plume close to prescribed burn of Diombo a Kaoma.
		1222	1223-1231	1223	1223-1231		1224	1224-1230	Plume close to prescribed burn of Diombo at Kaoma.
		1233	1233-1244		1233-1244				Plume close to prescribed burn of Diombo at Kaoma.
		1248	1248-1303	1249	1248-1303	1245			Haze (5400 ft, 835 hPa) on way to Senanga, Zambia.
6 Sep	1832	0732	0733-0749	0733, 0740		0729			Haze (12700 ft, 645 hPa) near Senaga, Zambia.
		0758	0758-0807	0759		0757			Haze (3800 ft, 885 hPa) near Mongu, Zambia.
		0914	0914-0920	0914		0911			Haze (4000 ft, 880 hPa) near Mongu, Zambia.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		0941	0941-0947	0941		0939			Haze (9500 ft, 725 hPa) near Mongu, Zambia.
		0954	0954-1002	0956		0951			Haze (5300 ft, 840 hPa) near Mongu, Zambia.
						1030			Haze (14000 ft, 610 hPa) near Mongu, Zambia.
6 Sep	1833					1234			Haze (12500 ft, 650 hPa) near Pietersburg, South Africa.
		1334	1335-1347	1336, 1342		1332			Haze (7700 ft, 770 hPa) near Pietersburg, South Africa.
7 Sep	1834	0825	825-835	0826		0826			Haze (11500 ft, 670 hPa) en route from Pietersburg to Timbavati Game Reserve, South Africa.
		0843	844-853		844-853				Plume from Timbavati prescribed fire near source.
		0858	858-911	0858	858-911		0859	859-905	Plume from Timbavati prescribed fire near source.
		0924	924-936		924-936				Plume from Timbavati prescribed fire 5 miles downwind of fire.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		0946	946-1006	0947	946-959		0947	947-953	Plume from Timbavati prescribed fire 5 miles downwind of fire.
		1015	1015-1028		1015-1028				Plume from Timbavati prescribed fire 20 miles downwind of fire.
		1037	1037-1046	1037	1037-1046		1037	1037-1043	Plume from Timbavati prescribed fire 20 miles downwind of fire.
		1049	1050-1058	1050	1050-1058				Plume from Phalaborwa copper mine, South Africa.
		1107	1107-1124	1112	1107-1124				Haze (3500 ft, 890 hPa) over Mopane trees.
10 Sep	1835	0642	642-705	0643, 0651		0644			Haze (12600 ft, 650 hPa) en route from Pietersburg, South Africa, to Walvis Bay, Namibia.
		0732	733-741	0733			0733		Haze (12500 ft, 650 hPa) en route from Pietersburg, South Africa, to Walvis Bay, Namibia.
11 Sep	1836	0910	910-926	0912		0910			Haze (12600 ft, 645 hPa) off Namibian coast.
		1000	1001-1006	1001		0956			Haze (450 ft, 1000 hPa) off Namibian coast (ER-2 overhead).
		1025	1025-1033	1027		1024			Clean slot (4000 ft, 880 hPa) off Namibian coast.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		1042	1043-1049	1043		1041			Haze (10300 ft, 700 hPa) off Namibian coast.
		1056	1056-1107	1057		1059			Haze (12400 ft, 650 hPa) off Namibian coast.
13 Sep	1837	0922	922-928	0922		0921			Haze (975 ft, 960 hPa) below cloud base off Namibian coast.
		0959	959-1009	1000		0959			Clean slot (4500 ft, 870 hPa) above cloud top off Namibian coast.
		1020	1020-1028	1021			1020		Haze (925 ft, 950 hPa) below cloud base off Namibian coast.
		1042	1042-1050	1043			1042		Clean slot (4500 ft, 870 hPa) off Namibian coast.
		1141	1141-1149	1142		1140			Haze (13000 ft, 640 hPa) off Namibian coast.
		1207	1209-1218	1209					Haze (9500 ft, 720 hPa) off Namibian coast.
14 Sep	1838	1002	1002-1014		1002-1014				Plume from first ship studied off west African coast.
		1028							Plume from first ship studied off west African coast.
		1034	1036-1037	1034	1037-1049				Plume from second ship studied off west African coast.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.4 (continued)

Date (2000)	University of Washington Flight Number	Time of Baghouse Sample (UTC)*	Time of Light-Scattering Measurement from Baghouse Sample (Using Radiance Research M903 Nephelometer) (UTC)*	Time of DMPS Measurement from Baghouse (UTC)*	Time of Trace Gas Measure-ments from Baghouse (UTC)*	Time of Humidogram from Continuous Inlet (UTC)*	Time of Humidogram from Baghouse (UTC)*	Time of Light-Scattering Measurement from Baghouse (Using PSAP) (UTC)*	Sample Description
		1049	1049-1109		1049-1109				Plume from second ship studied off west African coast.
		1115	1115-1124	1116	1115-1124				Haze (1000 ft, 950 hPa, control bag) in vicinity of the second studied ship off the west coast of South Africa.

* Local time = UTC + 2 hours

TABLE 5.5. TIMES WHEN THE PARTICLE SOOT ABSORPTION PHOTOMETER (PSAP), OPTICAL EXTINCTION CELL (OEC) AND AEROSOL ASYMMETRY ANALYZER (A^3) WERE OPERATED ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000*

Date (2000)	University of Washington Flight Number	PSAP	OEC	A^3
10 Aug	1810	OK	NC	NI
14 Aug	1811	OK	None	NI
14 Aug	1812	OK	None	NI
14 Aug	1813	OK	None	NI
15 Aug	1814	OK	0950 UTC	NI
17 Aug	1815	OK Filter damage (1025 UTC)	1003 UTC 1105 UTC 1129 UTC	NI
18 Aug	1816	OK 1037-1339 UTC (No pump)	0925 UTC 1225 UTC	NI
20 Aug	1817	No flight	—	—
20 Aug	1818	OK	None	NI
20 Aug	1819	OK	1311 UTC 1328 UTC 1354 UTC	NI
22 Aug	1820	OK	None	NI
23 Aug	1821	OK	None	NI
24 Aug	1822	0900-0905 UTC (Pump down)	None	NI

(Cont.)

* OK = Working and recorded
NC = Not connected to data system
NI = Not installed

Table 5.5 (continued)

Date (2000)	University of Washington Flight Number	PSAP	OEC	A[3]
29 Aug	1823	OK	Down (1018 UTC)	NI
29 Aug	1824	OK	1420 UTC	NI
31 Aug	1825	OK Bag (1219 UTC) Bag (1352 UTC)	1119 UTC 1126 UTC 1134 UTC Down (1328 UTC)	OK
1 Sep	1826	OK Bag (1004 UTC)	0857 UTC 0901 UTC 0904 UTC	OK
1 Sep	1828	OK	Down (1346-1523 UTC)	OK
2 Sep	1829	OK	None	OK
3 Sep	1830	OK	None	OK
5 Sep	1831	OK	1154 UTC 1156 UTC 1202 UTC 1204 UTC 1206 UTC	OK
6 Sep	1832	OK	None	OK
6 Sep	1833	OK	OK Down (1214-1237 UTC)	OK

(Cont.)

* OK = Working and recorded
NC = Not connected to data system
NI = Not installed

Table 5.5 (continued)

Date (2000)	University of Washington Flight Number	PSAP	OEC	A[3]
7 Sep	1834	OK	0843 UTC 0845 UTC 0850 UTC 0856 UTC 0930 UTC 0940 UTC 0945 UTC 1012 UTC (weak)	OK

* OK = Working and recorded
NC = Not connected to data system
NI = Not installed

TABLE 5.6. GRID SAMPLES (FOR SUBSEQUENT TRANSMISSION ELECTRON MICROSCOPY STUDIES) COLLECTED ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Period of Grid Exposure (hr:min:sec, UTC)*	Sampling Conditions
10 Aug.	1810	13:31:53 - 15:00:00	Haze layer, near top of boundary layer, about 90 nautical miles NW of Pietersburg, South Africa.
14 Aug.	1812	13:08:46 - 13:38:46	Haze layer at 7,000 ft about 80 nautical miles NW of Johannesburg, South Africa.
14 Aug.	1812	13:39:30 - 14:24:00	Haze layer at 7,000 ft about 80 nautical miles NW of Johannesburg, South Africa.
15 Aug.	1814	08:47:20 - 09:47:20	Haze at Skukusa Airport, South Africa, possible interception of smoke.
17 Aug.	1815	08:29:30 - 09:25:00	Haze layer at 4,000 ft in Kruger National Park, South Africa.
17 Aug.	1815	10:25:30 - 10:34:25	Smoke from first non-prescribed flaming and smoldering grass fire (sampled from bag house) in Kruger National Park, South Africa.
17 Aug.	1815	11:28:00 - 11:34:15	Smoke from second non-prescribed fire in Kruger National Park, South Africa. Fire larger, hotter and flaming than first fire (sampled from baghouse).
18 Aug.	1816	08:56:00 - 09:14:00	Background haze, upwind of prescribed fire in Madikwe Game Reserve on South Africa/Botswana border.
18 Aug.	1816	10:19:32 - 11:10:35	Discontinuous sampling in and out of smoke from prescribed fire in Madikwe Game Reserve on South Africa/Botswana border.
20 Aug.	1819	11:54:45 - 12:35:00	Upper haze layer at 11,000 ft in Madikwe Game Reserve on South Africa/Botswana border.
20 Aug.	1819	12:45:45 - 13:14:00	Collection during flight in and out of smoke from prescribed fire in Madikwe Game Reserve on South Africa/Botswana border.
20 Aug.	1819	13:25:00 - 13:55:00	Discontinuous sampling in and out of smoke from prescribed fire in Madikwe Game Reserve on South Africa/Botswana border.
22 Aug.	1820	07:15:40 - 07:58:00	Haze en route from Pietersburg to Kruger National Park, South Africa.
22 Aug.	1820	09:36:50 - 10:19:30	Haze at variable altitude over Skukusa Airport, South Africa.
23 Aug.	1821	12:55:50 - 13:55:00	Free troposphere near Pietersburg, South Africa.
24 Aug.	1822	06:58:25 - 07:40:35	Haze en route to Mozambique coast.
24 Aug.	1822	08:16:15 - 08:56:15	Haze in spiral descent over Inhaca Island, Mozambique.
29 Aug.	1823	08:52:00 - 09:47:00	Haze sample in boundary layer near South Africa/Zimbabwe border.
29 Aug.	1823	10:03:45 - 10:43:45	Multiple bags over uniform surface of shrubs and red soil near South Africa/Zimbabwe border.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.6 (continued)

Date (2000)	University of Washington Flight Number	Period of Grid Exposure (hr:min:sec, UTC)*	Sampling Conditions
29 Aug.	1824	14:12:15 - 14:16:15	Flying in and out of smoke plume from small smoldering fire in Kruger National Park, South Africa.
29 Aug.	1824	14:42:12 - 14:45:25	Along length of plume near source from small smoldering fire in Kruger National Park, South Africa.
31 Aug.	1825	09:42:36 - 10:15:00	In boundary layer en route to Mozambique coast.
31 Aug.	1825	11:40:00 - 11:47:30	Sample from bag house of smoke near smoldering fire west of Beria, Mozambique.
31 Aug.	1825	12:26:30 - 12:40:50	Sample of smoke from bag house 10 miles downwind of smoldering fire west of Beria, Mozambique.
01 Sept.	1826	06:29:30 - 07:35:00	In boundary layer en route to Zambia, heading north.
01 Sept.	1826	09:25:00 - 09:33:50	Smoke above prescribed burn of Miombo near Kaoma, Zambia.
01 Sept.	1828	13:58:30 - 15:16:00	At top of boundary layer en route to Pietersburg, South Africa, heading south.
02 Sept.	1829	08:01:10 - 08:42:10	In boundary layer, en route to Maun, Botswana.
02 Sept.	1829	09:53:25 - 10:35:00	Spiral descent over Maun, Botswana.
02 Sept.	1829	11:42:15 - 12:44:15	In boundary layer en route to Pietersburg from Maun, Botswana.
03 Sept.	1830	07:25:15 - 08:00:00	Thick haze ($b_s \simeq 10^{-4}$ m^{-1}) in boundary layer en route from Pietersburg, South Africa, to Sua Pan, Botswana.
03 Sept.	1830	08:37:00 - 08:56:00	Spiral descent over trees and grass in Sua Pan, Botswana.
03 Sept.	1830	10:54:10 - 11:28:30	In boundary layer en route from Sua Pan, Botswana, to Pietersburg, South Africa.
05 Sept.	1831	09:13:00 - 10:13:00	In boundary layer en route northbound from Pietersburg, South Africa, to Zambia.
05 Sept.	1831	11:55:00 - 12:26:40	Discontinuous sampling of smoke from prescribed burn of Diombo near Kaoma, Zambia (grass fire with flames).
05 Sept.	1831	12:33:45 - 12:43:45	Smoke from Diombo grass fire (from bag house) near Kaoma, Zambia.
06 Sept.	1832	07:31:15 - 08:13:15	In boundary layer haze en route from Kasane, Botswana, to Senaga, Zambia.
06 Sept.	1832	09:50:00 - 10:22:00	Sample taken during BRDF measurements over Mongu, Zambia, and in climb to 17,000 ft.
06 Sept.	1833	12:48:00 - 13:18:00	En route from Kasane, Botswana, to Pietersburg, South Africa, at 10,000 ft.
07 Sept.	1834	09:04:00 - 09:08:30	Smoke near Timbavati Game Reserve prescribed fire, South Africa (from bag house).
07 Sept.	1834	09:39:00 - 09:40:00	Smoke 10 miles downwind from Timbavati fire.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.6 (continued)

Date (2000)	University of Washington Flight Number	Period of Grid Exposure (hr:min:sec, UTC)*	Sampling Conditions
07 Sept.	1834	09:52:00 - 10:05:00	Smoke along length of plume, 5 to 23 miles from Timbavati fire.
10 Sept.	1835	06:22:00 - 07:32:00	En route from Pietersburg, South Africa, to Walvis Bay, Namibia, at 12,500 ft.
10 Sept.	1835	07:37:00 - 08:45:00	In boundary layer over Botswana at 12,500 ft.
10 Sept.	1835	08:49:00 - 10:06:00	In boundary layer over Namibia at 12,500 ft.
11 Sept.	1836	10:55:00 - 11:34:00	In boundary layer off Namibian coast, WSW of Walvis Bay.
13 Sept.	1837	09:05:00 - 10:44:00	Above/in/below marine stratus off Namibian coast.
13 Sept.	1837	11:32:00 - 12:12:00	In main haze layer off Namibian coast.
14 Sept.	1838	10:34:00 - 11:09:00	Sampling (from bag house) of effluent from second freighter ship studied.
16 Sept.	1839	10:36:00 - 11:37:00	Vertical profile over Etosha National Park, Namibia.
16 Sept.	1839	11:42:00 - 12:25:00	In clean boundary layer, south of Etosha National Park, Namibia, heading to Walvis Bay.

* Local time = UTC + 2 hours

Table 5.7 provides details on the operation of the sun-tracking sunphotometer aboard the Convair-580.

Table 5.8 lists the locations and times when samples of ambient air were collected in stainless steel canisters for subsequent analysis of hydrocarbons, CO and CO_2.

Table 5.9 provides details on the FTIR measurements of reactive and stable combustion emissions.

Aboard the Convair-580 intermittent air samples were passed through Teflon filters (for subsequent ionic and aerosol mass analysis) and quartz filters (for subsequent carbonaceous analysis). Table 5.10 lists the time periods when these two types of filters were exposed. Also shown in this table is whether the air sample was from the continuous airstream or from the baghouse.

Table 5.11 shows the periods when filters on the PC-BOSS system were exposed to the ambient air. These filters were subsequently analyzed for ionic and carbonaceous aerosol species and pH.

Table 5.12 lists those flights on which dedicated measurements were obtained of the bidirectional reflection distribution function (BRDF) with the cloud absorption radiometer (i.e., the CAR), spectral reflectivity (with the SSFR), and broadband visible/IR and ultraviolet albedos (with the Eppley radiometers), were obtained of various selected surfaces in Southern Africa. It should be noted however that spectral and broadband reflectivities were measured throughout most flights.

Table 5.13 gives more details on the CAR measurements.

Measurements of cloud condensation nuclei at various supersaturations were made aboard the Convair-580 from 10-16 September (i.e., on the flight from Pietersburg, South Africa, to Walvis Bay, Namibia, and on the four flights based out of Walvis Bay). Table 5.14 lists the times when these measurements were obtained.

Table 5.15 lists photographs taken by Peter Hobbs aboard the Convair-580 aircraft (and some from ground).

TABLE 5.7. SUMMARY OF MEASUREMENTS OBTAINED WITH THE AMES AIRBORNE SUNPHOTOMETER (AATS-14) ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
14 Aug	1811	1040-1127	Schmid	R14Aug00.AF	Pietersburg to Lanseria, South Africa, transit flight, no research maneuvers.	AOD <0.01 at cruising altitude. Only partial profile (loss of tracking) during descent into Lanseria where AOD~0.25 (clouds?).	Window cleaning not possible. No Nav Data. Feed first 2 min; 2 min missing around 1113. Heading valid only at end of flight.	
14 Aug	1812	1224-1504	Schmid	R14Aug00.AG	About 80 nm NW of Johannesburg, South Africa.	Vertical profile (not continuous because loss of tracking, also clouds) near Lanseria AOD=0.35 (clouds) to 0.01. AOD =0.17 at 200 ft. Vertical profile (not continuous because loss of tracking, also clouds?) near Lanseria AOD=0.17.	Window cleaning not possible. No Nav Data. Feed around 1415 and 1445.	
14 Aug	1813		Schmid	AATS-14 not operated (no Sun)	Lanseria to Pietersburg, South Africa.			
15 Aug	1814	0708-1105	Russell	R15Aug00.AC	Pietersburg to Skukusa (in Kruger National Park), South Africa. Then to about 30 miles west of Skukusa. Return to Pietersburg, South Africa.	Mostly under clouds. AATS-14 parked several times. Measurements en route in free troposphere AOD <0.02 (at 9,000 ft). 100 ft runs beneath TERRA overpass (at 0823 UTC) at Skukusa. AOD 0.06? (through holes in clouds).	Window cleaning not possible.	Pietersburg Cimel (but cloudy); 2 Skukusa Cimels; Skukusa lidar not operational.

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
17 Aug	1815	0706-1210	UW	R17Aug00.AB	Pietersburg to south and central Kruger National Park, South Africa. Return to Pietersburg.	Continuous vertical profile after take off. AOD = 0.15 to 0.01. Measurements en route at 10,000 ft. AOD = 0.01. Vertical profile from 10,000 ft to 100 ft in Kruger National Park AOD = 0.01 to 0.1. Several gaps due to loss of tracking. Physical and chemical measurements at 4,000 ft. Measurements in two smoke plumes (flaming and smoldering combustion). Probably picked up by AATS-14, but need exact times. Measurements on return to Pietersburg. AOD = 0.02 at 10000 ft. Vertical profile during landing. AOD = 0.23 at Pietersburg. Several opportunities to derive layer AODs for closure studies.	Window cleaned before sunset 16 Aug. From now on regular cleaning.	Pietersburg Cimel; Skukusa lidar operational after 1430 UTC.
18 Aug	1816	0814-1335	UW	R18Aug00.AC	Pietersburg to Madikwe Game Reserve on border of South Africa and Botswana, and return.	Measurements en route. AOD = 0.02 at 10000 ft. Physical and chemical measurements of smoke from prescribed fire in Madikwe Game Reserve. Plumes probably picked up by AATS-14, but need exact times. Outside plumes AOD = 0.2.		

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
20 Aug	1818	0731-0819	UW	R20Aug00.AB	Pietersburg toward South Africa/ Botswana border and return. (Flight terminated prematurely due to radio communication problem with ATC.)	Cruising altitude 2.8 km AOD=0.08 to 0.12 (gradient). Maybe good case to compare with flux-radiometers.	Window cleaned after this flight (not dirty).	
20 Aug	1819	1130-1536	UW	R20Aug00.AD	Pietersburg to Madikwe Game Reserve on border of South Africa and Botswana, and return.	Physical and chemical measurements in smoke from prescribed fire in Madikwe. Measurements of ambient smoke and haze near Botswana/South Africa border. Plumes probably picked up by AATS-14, but need exact times. Outside plumes AOD = 0.3.		
22 Aug	1820	0705-1230	UW	R22Aug00.AD	Pietersburg to Skukusa (in Kruger National Park), South Africa, and return to Pietersburg via Phalaborwa.	Detailed continuous vertical profile (11 horizontal legs between 12500 ft asl and near ground; UTC: 0807-1007) over Skukusa. ER-2 and Terra overpass. AOD near ground = 0.4.	Window cleaned after this flight (some dirt).	Pietersburg Cimel; Skukusa Cimel; Skukusa lidar (no data after 910), ER-2 lidar, Terra.
23 Aug	1821	1221-1438	UW	R23Aug00.AD	In vicinity of Pietersburg, South Africa.	Intercomparisons of aerosol and state parameters with South African Aerocommanders and with rawinsonde launched from Pietersburg Gateway Airport. AOD = 0.015 at 4.5 km, 0.5 at landing in Pietersburg. Vertical profile has a gap (loss of tracking).	Instrument started 43 min after engine on. Instrument parked between 1356 and 1400.	Pietersburg Cimel.

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
24 Aug	1822	0644-1007	UW	R24Aug00.AB	Pietersburg, South Africa, to Inhaca Island Mozambique.	Profile during ascent from Pietersburg AOD = 0.33 to 0.05 (with gaps). Transit to Inhaca Island at 11700 ft asl (7 to 8 UT) passes over Skukusa. AOD = 0.06. Climb to 4 km, fast descent (0810 to 0825) over Inhaca Island: AOD = 0.33. Terra overpass 0816 UTC. Detailed vertical profile (6 levels, 0848 to 1004) over Inhaca Island, Mozambique, with Terra and ER-2 overpasses. Generator failure, no data after 1004 UTC.		Pietersburg Cimel, Skukusa lidar, ER-2, Inhaca Island Cimel, Terra.
29 Aug	1823	0841-1108	UW	R29Aug00.AA	Pietersburg to border between South Africa and Zimbabwe, and return.	Profile 1030-1048 UTC.	Instrument started 21 min after engine on. Parked between 1057-1059. No data last 10 min. Window cleaned after flight (wasn't bad).	Instrument not started at Terra overpass (0834 UTC), CV-580 was not near ground. TOMS (0930 UTC) CV-580 at 2.7 km therefore no comparison possible.
29 Aug	1824	1303-1427	UW	R29Aug00.AB	Pietersburg to Skukusa, Kruger National Park, South Africa, and return.	AATS-14 not turned on during climb to 11,400 feet. Transit to Skukusa, descend to 900 m (AOD = 0.05-0.2) for BRDF circles. Four passes through smoke from small smoldering fire (min altitude 625 m).	Many of nav data feed drop outs. AATS-14 stopped 1 hr 13 min before end of flight because operator was instructed to avoid over-heating.	Skukusa lidar, CV-580 not close enough to ground for comparison with Cimel or Tower instruments.

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
31 Aug	1825	0926-1414	UW	R31Aug00.AC	Pietersburg, South Africa, to central Mozambique coast. North along Mozambique coastline to west of Beria. Return to Pietersburg.	Continuous vertical profile after 1229-1244 (heading back to Pietersburg). Profile into Pietersburg (AOD decrease because of spatial inhomogeneity or clouds?).	AATS-14 started 44 min after engine on. Parked 1056-1059. No nav data feed until 1228 UTC. Need to get nav data from UW.	Pietersburg Cimel.
1 Sep	1826	0553-1104	UW	R01Sep00.AB	Pietersburg, South Africa, to Kaoma, Zambia, to Kasane, Botswana.	Measurements en route to Kaoma. Detailed measurements on prescribed Miombo burn near Kaoma, Zambia. Profile out of Kaoma, Measurements en route from Kaoma to Kasane. Good AOD measurements throughout. Profile during descent into Kasane.	AATS-14 not operated during ascent out of Pietersburg.	Terra 902 UT; Kaoma Cimel.
2 Sep	1829	0740-1326	Schmid	R02Sep00.AB	Pietersburg, South Africa, to Maun, Botswana, and return to Pietersburg.	Good measurements throughout. Variable AOD during constant altitude transit to Maun. Spiral into Maun under TOMS (profile not continuous due to loss of tracking). Total column AOD 0.42. BRDF circles centered on Maun tower. Vertical profile with 5 legs ascending from Maun. Transit to Pietersburg. Profile into Pietersburg.	Tansvector not working until 0746 UTC.	Maun Cimel not operated. TOMS 0948 UTC.

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
3 Sep	1830	0708-1222	Russell	R03Sep00.AB	Pietersburg, South Africa, to Sua Pan, Botswana, and return.	Good meas. throughout. Variable AOD during constant altitude transit to Sua Pan. Climb to 15,100 feet. Spiral into Sua Pan under Terra (profile almost continuous). Total column AOD = 0.93. 9-10 UT BRDF circles, then descend near ground AOD now around 0.7; did vertical profile with 3 horizontal legs. Back to Pietersburg.		Sua Pan Cimel, Terra 0852 UTC.
5 Sep	1831	0848-1409	Schmid	R05Sep00.AA	Pietersburg, South Africa, to Kaoma, Zambia, to Kasane, Botswana, via Senanga, Zambia.	Clouds above aircraft for most of the flight. But Kaoma and Senanga Cimel overpasses should be cloud free. Kaoma AOD = 2 (prescribed fire), Senanga AOD = 1.5.		Kaoma Cimel; Senanga Cimel.
6 Sep	1832	0707-1056	Schmid	R06Sep00.AB	Kasane, Botswana, to about 20 miles north of Mongu, Zambia. Return to Kasane.	Good measurements throughout. Very high AODs. Golden day. Low-level run (500 ft agl) Senanga to Mongu. 100 ft run north of Mongu. BRDF measurements over Mongu Tower. ER-2 overhead. Two vertical profiles over Mongu lidar. Climb to 17,000 ft msl on leaving Mongu airport and still in haze layer!	AATS-14 window cleaned. Was not dirty. Nav data after 0714 UTC.	Senanga Cimel; 2 Mongu Cimels, Mongu lidar was not saving data between 6 and 16 UTC; ER-2.
6 Sep	1833	1140-1351	Schmid	R06Sep00.AC	Kasane, Botswana, to Pietersburg, South Africa.	Transit at altitudes between 7,800 ft and 12,600 ft asl. Always in BL. Clouds above aircraft for some portion of flight.	Parked twice when Sun blocked by clouds for extended time.	Pietersburg Cimel.

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
7 Sep	1834	0809-1217	UW	R07Sep00.all	Pietersburg to Timbavati Game Reserve, near Kruger National Park, South Africa, to Phalaborwa, and return to Pietersburg.	Extensive measurements on large prescribed fire at Timbavati, South Africa, with Terra and ER-2 overflights. Continuous profile 1135-1145 near Kruger heading back to Pietersburg.	No data between 0906 and 0919 UTC.	Terra, ER-2, Skukusa Cimels and lidar.
10 Sep	1835			AATS-14 not operated.	Transit flight Pietersburg, South Africa to Walvis Bay, Namibia.			
11 Sep	1836	0840-1105	Redemann	R11Sep00.AA	Off central Namibia coast.	Purpose of flight: Terra cloud validation.0930-1100 UTC: cloud studies, AATS-14 parked frequently, no tracking through clouds; 1105 UTC: AATS-14 not tracking for rest of flight.	No nav data feed 0939-0951 UTC; window in front of longest two wavelengths probably dirty at end of flight. Window cleaning not possible.	Terra 0942 UTC, ER-2, Walvis Bay Cimel down.

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
13 Sep	1837	0840-1408	Redemann	R13Sep00.AA	Off Namibia coast.	Purpose of flight: Terra and ER-2 underflight for stratus studies; 0840 UTC: after penetration of stratus deck at Walvis Bay AOD: ~0.65; 0853 UTC: AATS-14 parked for cloud in situ studies; 0853–1113 UTC: AATS-14 frequently parked and unparked for attempts of tracking through clouds and at the top of stratus deck (AOD above stratus: ~0.6-0.7); 1113-1135 UTC: spiral ascent above stratus deck-AOD: ~0.67 to 0.1 at 16,800 ft; 1225 UTC: BRDF measurements with AOD ~0.55; 1353 UTC: AATS-14 tracking through cloud.	No Nav Data Feed 0848-0937 UTC. Window cleaning not possible. Post-flight analysis shows contamination problem in longest two channels (see Duane's pictures).	Terra 0930 UTC, ER-2.
14 Sep	1838	0813-1221	Redemann	R14Sep00.AA	Off Namibia and western South Africa coast, south of Walvis Bay	Purpose of flight: ship plume studies; 0814 UTC: AATS-14 unparked—plan is to keep AATS-14 parked for cloud penetrations because of moisture/dirt collection; 0902 UTC: AATS-14 tracking in post-frontal air, during horizontal leg AOD: ~0.12 to 0.05; 0950-1125 UTC: ship plume studies with AATS-14 tracking; 1128 UTC: short spiral ascent at the edge of high alto-cu deck—AOD: ~0.17 to 0.07.	Window cleaned before and after flight. Window contaminated during flight for 380 nm channel?	Walvis Bay Cimel.

(Cont.)

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.7 (continued)

Date (2000)	University of Washington Flight Number	AATS-14 Unpark/ Park (UTC)*	Operator	Raw Data File	Location	General Comments†	Notes	Potential Comparisons with Other Platforms
16 Sep	1839	0726-1244	Redemann	R16Sep00.all	Walvis Bay, Namibia, to Etosha National Park, Namibia, and back to Walvis Bay.	Purpose of flight: BRDF's over Etosha Pan; 0726 UTC: AATS-14 unparked; 0745 UTC: loss of power for all instruments; 0807 UTC: AATS-14 running again; 0821 UTC: horizontal aerosol gradient, AOD: ~0.3 to ~0.22 0841 UTC: spiral descent over Etosha Pan— AOD: ~0.15 to 0.41 0916-1043 UTC: BRDF studies and spiral ascent over Cimel SP site—AOD: ~0.33 to 0.15—considerable AATS-14 tracking problems.	No data between 0746 and 0807 UTC. Window dirty after flight. Confirmed by post-mission measurements on Mauna Loa.	Walvis Bay Cimel; Etosha Pan Cimel.

* Local time = UTC + 2 hours

† All aerosol optical depths (AOD) are stated for a wavelength of 500 nm.

TABLE 5.8. TIMES AT WHICH "CAN GRAB SAMPLES" WERE OBTAINED (FOR SUBSEQUENT HYDROCARBON ANALYSIS) ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Can ID Number	Time of Can Sample* (UTC)	Latitude of Aircraft (Deg. South)	Longitude of Aircraft (Deg. East)	Altitude of Aircraft (Meters)†	General Location	Sampling Conditions
10 Aug.	1810	1185	1430	22.61	29.08	2830	Pietersburg, South Africa	Free troposphere plus small amount of boundary layer air
10 Aug.	1810	3054	1330	23.89	28.59	3209	Pietersburg, South Africa	Boundary layer
10 Aug.	1810	3112	1150	23.57	28.79	2990	Pietersburg, South Africa	Boundary layer
14 Aug.	1812	2369	1251	24.98	27.39	3437	Johannesburg, South Africa	Free troposphere
14 Aug.	1812	1361	1310	24.82	27.44	2075	Johannesburg, South Africa	Boundary layer
15 Aug.	1814	3275	0850	25.19	31.08	859	Kruger National Park, South Africa	Boundary layer
17 Aug.	1815	3062	0831	25.18	31.80	1103	Kruger National Park, South Africa	Boundary layer
17 Aug.	1815	3217	1002	25.46	31.58	729	Kruger National Park, South Africa	Plume above fire 1
17 Aug.	1815	1271	1039	25.23	31.42	1810	Kruger National Park, South Africa	Plume downwind of fire 1
17 Aug.	1815	3256	1110	24.43	31.83	1064	Kruger National Park, South Africa	Plume above fire 2
18 Aug.	1816	2481	0916	24.67	26.41	1006	Madikwe Game Reserve, South Africa	Plume above fire 1 (can pump failed after this sample)
20 Aug.	1819	3220	1156	24.26	27.93	3123	Madikwe Game Reserve, South Africa	Boundary layer
20 Aug.	1819	3218	1253	24.74	26.24	1397	Madikwe Game Reserve, South Africa	Plume above fire 1
20 Aug.	1819	3200	1312	24.71	26.25	1099	Madikwe Game Reserve, South Africa	Plume downwind and under fire 1 plume
20 Aug.	1819	3120	1328	24.66	26.29	1376	Madikwe Game Reserve, South Africa	Plume above fire 2
20 Aug.	1819	2594	1354	24.72	26.25	1152	Madikwe Game Reserve, South Africa	Plume above fire 2

* Local time = UTC + 2 hours

† Pressure altitude

(Cont.)

TABLE 5.8 (Continued)

Date (2000)	University of Washington Flight Number	Can ID Number	Time of Can Sample* (UTC)	Latitude of Aircraft (Deg. South)	Longitude of Aircraft (Deg. East)	Altitude of Aircraft (Meters)†	General Location	Sampling Conditions
20 Aug.	1819	2125	1418	25.00	26.39	1053	Madikwe Game Reserve, South Africa	Boundary layer
22 Aug.	1820	1261	0720	24.17	30.04	2831	Kruger National Park, South Africa	Boundary layer
22 Aug.	1820	3092	0952	24.98	31.58	814	Kruger National Park, South Africa	Boundary layer
23 Aug.	1821	1199	1306	23.62	29.24	4575	Pietersburg, South Africa	Free troposphere
23 Aug.	1821	1058	1309	23.76	29.28	4566	Pietersburg, South Africa	Free troposphere
24 Aug.	1822	1240	0715	24.57	30.57	3307	Inhaca Island, Mozambique	Boundary layer
24 Aug.	1822	1249	0828	26.05	32.76	65	Inhaca Island, Mozambique	Boundary layer
29 Aug.	1823	1340	0850	22.84	28.85	3501	South Africa/Zimbabwe border	Boundary layer
29 Aug.	1823	1356	0900	22.86	28.90	2659	South Africa/Zimbabwe border	Boundary layer
29 Aug.	1823	3219	1000	22.93	28.76	1386	South Africa/Zimbabwe border	Boundary layer
29 Aug.	1824	2206	1410	25.10	31.46	954	Kruger National Park, South Africa	Plume above fire 1
29 Aug.	1824	3222	1417	25.16	31.37	689	Kruger National Park, South Africa	Plume above fire 1
29 Aug.	1824	3050	1437	25.11	31.42	1411	Kruger National Park, South Africa	Plume downwind of fire 1
29 Aug.	1824	3804	1459	24.79	30.88	1706	Kruger National Park, South Africa	Boundary layer (can was not analyzed by UCI)
31 Aug.	1825	1216	1015	23.06	34.41	2763	Mozambique coast	Boundary layer
31 Aug.	1825	3811	1035	22.14	35.18	1384	Mozambique coast	Boundary layer
31 Aug.	1825	3251	1119	21.00	34.74	208	Mozambique coast	Plume above fire 1
31 Aug.	1825	1242	1133	20.96	34.64	230	Mozambique coast	Plume above fire 1
31 Aug.	1825	3083	1159	21.15	34.71	196	Mozambique coast	Plume, 10 miles downwind of fire 1

* Local time = UTC + 2 hours (Cont.)

† Pressure altitude

TABLE 5.8 (Continued)

Date (2000)	University of Washington Flight Number	Can ID Number	Time of HC Can Sample* (UTC)	Latitude of Aircraft (South)	Longitude of Aircraft (East)	Altitude of Aircraft (Meters)	General Location	Sampling Conditions
31 Aug.	1825	3263	1205	21.16	34.59	867	Mozambique coast	Plume, 10 miles downwind of fire 1, up in elevation
31 Aug.	1825	1117	1223	21.19	34.59	313	Mozambique coast	Plume, 15 miles downwind of fire 1
1 Sept.	1826	1250	0626	21.64	27.99	3602	Kaoma, Zambia	Boundary layer
1 Sept.	1826	2104	0806	16.61	24.88	1727	Kaoma, Zambia	Boundary layer
1 Sept.	1826	1083	0902	14.81	24.48	1217	Kaoma, Zambia	Plume above prescribed Miombo burn
1 Sept.	1826	1096	0908	14.86	24.47	1200	Kaoma, Zambia	Plume above prescribed Miombo burn, up in elevation
1 Sept.	1826	3097	0936	14.95	24.36	1738	Kaoma, Zambia	Plume, 8 miles downwind of Miombo burn (not in right plume?)
1 Sept.	1826	2022	0946	14.76	24.35	1747	Kaoma, Zambia	Plume, 8 miles downwind of Miombo burn (can not analyzed by UCI)
1 Sept.	1826	1168	1006	14.85	24.45	1819	Kaoma, Zambia	Plume, 4 miles downwind of Miombo burn
1 Sept.	1828	1049	1416	19.68	26.24	3925	Kaoma, Zambia	Boundary layer
2 Sept.	1829	1232	1019	19.95	23.53	1505	Maun, Botswana	Boundary layer
3 Sept.	1830	1363	0955	20.61	25.89	1536	Sua Pan, Botswana	Boundary layer over Sua Pan
3 Sept.	1830	1304	1125	21.50	27.81	2201	Sua Pan, Botswana	Boundary layer
5 Sept.	1831	3262	0909	22.63	28.90	2972	Kaoma, Zambia	Boundary layer
5 Sept.	1831	1063	1156	14.84	24.43	1265	Kaoma, Zambia	Plume over prescribed Diombo burn
5 Sept.	1831	1391	1208	14.80	24.49	1263	Kaoma, Zambia	Plume over prescribed Diombo burn
6 Sept.	1832	2165	0933	15.35	23.12	4539	Mongu, Zambia	Boundary layer
7 Sept.	1834	2525	0842	24.37	31.22	586	Timbavati Game Reserve, South Africa	Plume over Timbavati fire, took sample a little early
7 Sept.	1834	3114	0857	24.36	31.25	581	Timbavati Game Reserve, South Africa	Plume over Timbavati fire, on time
7 Sept.	1834	2237	0924	24.33	31.25	870	Timbavati Game Reserve, South Africa	Plume 5 miles downwind of Timbavati fire

* Local time = UTC + 2 hours
† Pressure altitude

(Cont.)

TABLE 5.8 (Continued)

Date (2000)	University of Washington Flight Number	Can ID Number	Time of HC Can Sample* (UTC)	Latitude of Aircraft (South)	Longitude of Aircraft (East)	Altitude of Aircraft (Meters)	General Location	Sampling Conditions
7 Sept.	1834	3121	0938	24.18	31.12	1419	Timbavati Game Reserve, South Africa	Plume 10 miles downwind of Timbavati fire
7 Sept.	1834	1094	1013	24.16	31.17	499	Timbavati Game Reserve, South Africa	Plume 18 miles downwind of Timbavati fire
13 Sept.	1837	3224	1006	20.42	13.23	1243	Walvis Bay, Namibia	Boundary layer, above cloud deck
13 Sept.	1837	2337	1020	20.89	13.09	279	Walvis Bay, Namibia	Boundary layer, below cloud deck
13 Sept.	1837	3116	1141	20.08	13.24	3659	Walvis Bay, Namibia	Boundary layer
14 Sept.	1838	1276	1001	26.24	13.48	19	Walvis Bay, Namibia	Plume from ship 1
14 Sept.	1838	3107	1033	25.99	13.61	168	Walvis Bay, Namibia	Plume from ship 2
16 Sept.	1839	3101	1007	18.86	15.55	1413	Etosha Pan, Namibia	Boundary layer, Etosha Pan
16 Sept.	1839	3216	1104	19.19	15.90	4181	Etosha Pan, Namibia	Boundary layer, upper level haze

* Local time = UTC + 2 hours
† Pressure altitude

TABLE 5.9. MEASUREMENTS OF REACTIVE AND STABLE COMBUSTION EMISSIONS USING THE FOURIER TRANSFORM INFRARED SPECTROMETER (FTIR) ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Whenever the Convair-580 was at research speed the FTIR measured CO_2, CO, CH_4, and H_2O pseudocontinously (every 0.8 s). Shown in this table are the times when the continuous sampling was interrupted to take grab samples of smoke, adjacent background air, or of air during a long, level flight leg. Different sampling types allow the measurement of different species as indicated by the following measurement:

VOB or **VOS** ("Valves open" background or smoke) species measured: CO_2, CO, CH_4, H_2O, sometimes N_2O

VCB ("valves closed" background): same species as above, but including O_3 at times

VCS (valves closed smoke): many or all of following measured; H_2O, CO_2, CO, CH_4, NO, NO_2, O_3, ethylene, acetylene, hydrogen cyanide, formaldehyde, acetic and formic acid, methanol, and ammonia.

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
14 Aug	1811	10:41:14	b01	VCB	10733	-24.0123	29.2212	Upper haze layer (VC)
14 Aug	1811	10:45:51	b02	VCB	10785	-24.0916	28.8881	Upper haze layer (VC)
14 Aug	1812	12:28:58	b01	VCB	4663	-25.9358	27.9292	Lower haze on Lanseria runway (contam.? and P shifted (VC)*
14 Aug	1812	12:48:31	b02	VOB	12181	-24.9825	27.3850	Free troposphere above mixed haze layer, integrated sample (VO)
14 Aug	1812	13:06:11	b03	VOB	7680	-24.9790	27.3768	Middle of mixed haze layer: (VO)
17 Aug	1815	07:15:27	b01	VCB	9289	-24.0209	29.6214	Upper haze en route to Skukuza (VC)
17 Aug	1815	07:17:13	b02	VCB	9506	-24.0734	29.7036	Upper haze en route to Skukuza (VC)
17 Aug	1815	07:21:18	b03	VCB	9613	-24.1932	29.9268	Dry free troposphere en route to Skukuza (VC)
17 Aug	1815	07:46:29	b04	VCB	8735	-25.0452	31.2325	Dry free troposphere en route to Skukuza (VC)
17 Aug	1815	07:50:47	b05	VCB	6751	-25.1273	31.3617	Upper boundary layer, (VC)
17 Aug	1815	07:56:09	b06	VCB	1995	-25.1322	31.3645	Lower boundary layer (~100 ft above ground level) (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
17 Aug	1815	08:29:05	b07	VCB	4169	-25.2036	31.6997	Background during approach to haze layer Art Rangno spots in the distance (VC)
17 Aug	1815	08:33:12	b08	VCB	4192	-25.1708	31.9110	Sample from Ambient haze Art Rangno identifies at ~4 K-ft (valves closed)
17 Aug	1815	09:35:12	b09	VCB	1601	-25.3619	31.5466	First background of smoldering **fire #1** (VC)
17 Aug	1815	09:44:27	s01	VCS	4118	-25.4635	31.6042	First (poorly timed) plume pen of smoldering **fire #1** (VC), not good plume signal
17 Aug	1815	09:52:19	b10	VCB	3129	-25.4455	31.6031	Second background for smoldering **fire #1** (VC)
17 Aug	1815	09:53:57	s02	VCS	2838	-25.4539	31.5668	Second plume pen of smoldering **fire #1**, better than first attempt, but not great (VC)
17 Aug	1815	09:58:44	b11	VCB	2598	-25.3756	31.6881	Third background for smoldering **fire #1** (VC)
17 Aug	1815	10:02:11	s03	VCS	2902	-25.4541	31.5755	Third plume pen of smoldering **fire #1** plume (VC)
17 Aug	1815	10:08:54	b12	VCB	2934	-25.4705	31.7064	Fourth background of smoldering **fire #1** (VC)
17 Aug	1815	10:31:26	b13	VCB	5942	-25.4298	31.5004	Missed attempt at fourth plume pen of smoldering **fire #1**, closed valves too early, used as background
17 Aug	1815	10:40:02	s05	VCS	6681	-25.2793	31.3941	Sample of "dark brown" haze layer (VC)
17 Aug	1815	10:46:47	s06	VCS	6750	-25.2979	31.3803	Same as previous (Art est. haze 2hrs old) (VC)
17 Aug	1815	11:04:48	s07	VCS	3688	-24.4657	31.8303	First plume pen of flaming **fire #2** (VC)
17 Aug	1815	11:09:10	s08	VCS	3805	-24.4678	31.8393	Second plume pen of flaming **fire #2** (best sample) (VC)
17 Aug	1815	11:13:04	b14	VCB	3819	-24.4961	31.8515	Background of flaming **fire #2** (VC)
17 Aug	1815	11:26:13	s09	VCS	3555	-24.4568	31.8369	Third plume pen of flaming **fire #2** (VC)
18 Aug	1816	09:07:00	b01	VCB	3877	-24.6714	26.4140	Sample for background on approach to Madikwe fire (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
18 Aug	1816	09:15:00	s01	VCS	3557	-24.6951	26.4451	First sample of smoke (VC)
18 Aug	1816	09:18:15	b02	VCB	3728	-24.6907	26.3706	2nd background sample (VC)
18 Aug	1816	09:20:26	s02	VCS	3703	-24.6592	26.4306	2nd sample of smoke (VC)
18 Aug	1816	09:24:23	b03	VCB	3698	-24.6443	26.3533	3rd background sample (VC)
18 Aug	1816	09:32:58	s03	VCS	3815	-24.6524	26.4472	3rd smoke sample,weak signal from missed peak (VC)
18 Aug	1816	09:55:52	s04	VCS	5551	-24.8376	26.3270	Sample downwind of aged plume (VC)
18 Aug	1816	09:59:37	b04	VCB	5317	-24.8064	26.5069	Background sample taken downwind, possible contamination from another distant smoke plume. (VC)
18 Aug	1816	10:05:32	b05	VCB	5410	-24.8362	26.6489	Sample of ambient air (VC)
18 Aug	1816	10:17:55	b06	VCB	5344	-24.9564	26.4805	Attempted sample of diffuse aged plume, (actually a background) (VC)
18 Aug	1816	10:37:54	b07	VCB	5459	-25.0110	26.6113	Sample in ambient air (another background) (VC)
18 Aug	1816	10:51:57	b08	VCB	7915	-25.0159	26.4090	Attempted sample of plume downwind from source, (actually background) (VC)
18 Aug	1816	11:08:49	b09	VCB	6129	-24.7202	26.3876	Sample of ambient air, neph read ~10^{-4} just before sampling (VC)
18 Aug	1816	11:15:36	b10	VCB	6667	-24.5834	26.5185	Background sampled (VC)
18 Aug	1816	11:50:09	b11	VCB	6444	-24.5761	26.4977	Ambient haze sample during UW ambient bag sample (VC)
18 Aug	1816	12:22:46	s08	VCS	6381	-24.6197	26.2995	Plume pen after fire intensified and well below capping cumulus (VC)
18 Aug	1816	12:34:07	s09	VCS	12685	-24.6690	26.3006	Plume pen in recently cloud-processed smoke (VC)
18 Aug	1816	12:39:12	s10	VCS	13666	-24.5968	26.3589	Plume pen in recently cloud-processed smoke (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
18 Aug	1816	12:42:44	b12	VCB	13722	-24.6743	26.4350	Background sample in dry free troposphere (originally called "freetrop.spc") (VC)
20 Aug	1819	11:56:06	hihaze	VOB	11082	-24.2637	27.9280	Sample of upper haze layer en route to Madikwe fire (VO)
20 Aug	1819	12:19:11	hihaze2	VCB	11052	-24.5607	26.6917	Sample of upper haze layer en route to fire (VC)
20 Aug	1819	13:02:17	s01	VCS	4506	-24.7883	26.2644	Sample of smoke near base of plume (valves closed for 7 scans).
20 Aug	1819	13:02:29	s02	VCS	4470	-24.7847	26.2697	Sample of smoke near base of plume (VC).
20 Aug	1819	13:06:26	b02	VCB	4048	-24.6693	26.2156	Background for s01 and s02.spc
20 Aug	1819	13:10:41	s03	VCS	4562	-24.7125	26.1919	Sampled plume base, this time flying through opposite side of plume (VC).
20 Aug	1819	13:27:10	s04	VCS	5302	-24.6751	26.3215	Sample of smoke plume, evidence of less O_3 than in bkg (VC).
20 Aug	1819	13:31:20	b03	VCB	5658	-24.7765	26.2771	Background for s04.spc (VC)
20 Aug	1819	13:52:01	s05	VCS	4398	-24.7374	26.2955	Another plume sample, fire appears to be flaring up (VC).
20 Aug	1819	13:56:38	b04	VCB	4123	-24.6552	26.3393	Background for s05.spc (VC)
20 Aug	1819	14:19:07	82006	VCB	3979	-24.9622	26.3954	Actually rescanning sample acquired as b04 (VC)
20 Aug	1819	14:23:33	ambient2	VCB	4145	-24.9902	26.3972	Actually rescanning sample acquired as b04 (VC)
22 Aug	1820	07:22:11	b01.spc	VCB	10106	-24.2146	30.1298	Upper haze sample en route to Skukuza at 10 K-ft., UW reports absolute ozone conc. equal to 62 ppbv. (VC)
22 Aug	1820	07:26:57	b02.spc	VCB	10084	-24.2324	30.3530	Another upper haze sample at 10K-ft, (check S/N for instrument) (VC)
22 Aug	1820	08:08:14	vp01.spc	VOB	12630	-25.0010	31.5347	First track of vertical profile, GPS ~12.5 K-ft (valves open)
22 Aug	1820	08:24:52	vp02.spc	VOB	11567	-24.9545	31.6691	Second track of vertical profile ~11 K ft, valves open, Terra overpass at 08:27:00 UTC

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
22 Aug	1820	08:29:02	vp03.spc	VOB	10634	-25.0139	31.5445	Third track of vertical profile (~10.5 K-ft) (VO)
22 Aug	1820	08:36:10	vp04.spc	VOB	9557	-24.9447	31.7220	4th track of vertical profile at ca. 9.5 K-ft) (VO)
22 Aug	1820	08:45:39	vp05.spc	VOB	8639	-24.9454	31.6347	5th track of vertical profile (~8.5 K ft) (VO)
22 Aug	1820	08:56:59	vp06.spc	VOB	7590	-24.9493	31.6197	6th track of vertical profile (~7.5 K ft) (VO) Hobbs reports O_3 equal to 50 ppbv.
22 Aug	1820	09:08:39	vp07.spc	VOB	6257	-24.9447	31.6192	7th track of vertical profile (~6 K-ft) (VO)
22 Aug	1820	09:21:31	vp08.spc	VOB	5120	-24.9355	31.6618	8th track of vertical profile, passed through boundary layer ca. 5.5 K-ft.between 7th and 8th VP track (VO).
22 Aug	1820	09:35:01	vp09.spc	VOB	4137	-24.9617	31.6794	9th track of vertical profile, (~4 K-ft) (VO)
22 Aug	1820	09:47:16	vp10.spc	VOB	3120	-24.9400	31.6663	10th and final track of vertical profile over Skakuza airport, (~3 K-ft) (VO)
22 Aug	1820	09:52:20	vp10cv.spc	VCB	3121	-24.9951	31.5653	Closed valves during final track, Can #09322 sampled same time valves closed.
22 Aug	1820	09:59:27	vp11.spc	VOB	3118	-24.9346	31.6086	Sample over airport, on last track of vertical profile (VO)
23 Aug	1821	12:13:06	vp01.spc	VOB	10615	-23.7532	29.6411	**Upper haze** layer (10 K ft), first level leg, integrated sample (VO)
23 Aug	1821	12:19:15	vp02.spc	VOB	9708	-23.6583	29.6755	**Upper haze** layer (10 K ft), second level leg, integrated sample (VO)
23 Aug	1821	13:02:48	vp03.spc	VCB	15871	-23.4634	29.2178	Dry free trop (**above haze** layer at 16 K) grab sample **1** (O_3?), (VC)
23 Aug	1821	13:14:39	vp04.spc	VCB	15837	-23.9811	29.1446	Dry free trop (**above haze** layer at 16 K) grab sample **2**, (VC)
23 Aug	1821	13:19:17-13:22:43	overcu.spc	VOB				Wetter free trop above cumulus (**above haze** at 16 K), int. sample (VO)
23 Aug	1821	13:24:59	vp05.spc	VCB	15859	-23.9784	29.4375	Dry free trop (**above haze** at 16 K) grab sample **3** (VC), photo 11 taken approx. time scans 450-470 were taken.

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
23 Aug	1821	13:38:20	vp06.spc	VCB	15830	-23.4530	29.2575	Dry free trop (**above haze** layer at 16K) grab sample **4**, (VC)
23 Aug	1821	13:46:05	vp07.spc	VCB	15859	-23.8158	29.3350	Dry free trop (**above haze** layer at 16 K) grab sample **5**, (VC)
23 Aug	1821	13:58:54-13:59:10	penecu.spc	VOB				22 sec **integrated sample while penetrating top of high cumulus (16K)** (VO)
23 Aug	1821	14:19:17	vp09.spc	VOB	5220	-23.9406	29.3720	Long level leg at 5K in **lower haze** layer near Pietersburg airport (VO).
24 Aug	1822	07:12:59	b01	VOB	11744	-24.5045	30.4666	50 ave scans of upper haze en route to Inhaca (VO)
24 Aug	1822	08:00:01	b02	VOB	11690	-25.9331	32.7377	200 ave scans for NO signal check (VO).
24 Aug	1822	08:50:30	vp01	VOB	176	-25.9072	32.9169	Verticle profile at 176 ft. (VO)
24 Aug	1822	08:58:07	vp02	VOB	2068	-26.0154	32.8042	Vertical profile track at 2 K ft (GPS) (VO)
24 Aug	1822	09:15:54	vp03	VOB	4145	-25.9286	32.9040	Vertical profile track at 4 K ft (GPS) (VO)
24 Aug	1822	09:24:44	vp04	VOB	6370	-26.0017	32.7680	Vertical profile track at 6 K ft (VO)
24 Aug	1822	09:38:50	vp05	VOB	6824	-26.0485	32.7385	Final vertical profile track (VO) due to power outage on plane
29 Aug	1824	13:10:21	b01.spc	VCB	11625	-24.3122	30.3141	200 ave'd scans collected in upper haze en route to Skukuza (VC)
29 Aug	1824	13:37:45	b02.spc	VOB	3323	-24.9923	31.4967	Sample during BRDF over Skukuza (VO)
29 Aug	1824	13:51:09	b03.spc	VCB	3121	-25.0227	31.5008	Sample during BRDF circle #5, (VC)
29 Aug	1824	14:12:55	s01.spc	VCS	2335	-25.1325	31.4011	Sample of smoke (VC)
29 Aug	1824	14:16:17	b04.spc	VCB	2451	-25.1363	31.3714	Background sample for s01.spc, (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
29 Aug	1824	14:20:47	s02.spc	VCS	2495	-25.1452	31.4008	Another smoke sample, (VC)
29 Aug	1824	14:24:03	b05.spc	VCB	2532	-25.1702	31.4429	Background for s02.spc (VC)
29 Aug	1824	14:34:49	b06.spc	VOB	5171	-25.1991	31.3704	Attempt at sampling aged plume failed, good background, (VO)
29 Aug	1824	15:00:58	b07.spc	VCB	5353	-24.8910	30.8665	Attempt at biogenic emissions (VC).
29 Aug	1824	15:13:56	b08.spc	VCB	10694	-24.4724	30.2438	Sample of haze over highveld (VC).
31 Aug	1825	09:20:50	b01.spc	VCB	11155	-23.9024	31.1023	Measurement of free trop on way to Mozambique (VC)
31 Aug	1825	09:36:56	b02.spc	VCB	9714	-23.8921	32.2178	Sample of haze layer over Mozambique (VC)
31 Aug	1825	09:53:18	b03.spc	VCB	9754	-23.9016	33.3399	Sample in hazier (fire influenced) region over Mozambique (VC)
31 Aug	1825	10:46:31	b04.spc	VCB	484	-21.8414	35.3047	Sample taken ca. 100-ft agl in MBL over central Mozambique coastline (VC)
31 Aug	1825	11:16:40	b05.spc	VCB	1773	-20.9310	34.7513	Background sampled upwind from smoldering fire (VC)
31 Aug	1825	11:20:03	s01.spc	VCS	861	-20.9722	34.6975	Sample of thick smoke at source of smoldering fire (VC)
31 Aug	1825	11:26:07	s02.spc	VCS	712	-20.9728	34.6993	2nd sample of smoke at source of smoldering fire (VC)
31 Aug	1825	11:28:49	b06.spc	VCB	645	-20.9736	34.7993	2nd background collected after flying through plume (VC)
31 Aug	1825	11:34:20	s03.spc	VCS	700	-20.9759	34.7010	3rd sample at source of smoldering combustion plume (VC)
31 Aug	1825	11:37:18	b07.spc	VCB	708	-20.9591	34.7289	3rd background collected upwind of plume.
31 Aug	1825	11:44:14	s04.spc	VCS	576	-21.1473	34.6676	1st sample collected at 10 nautical miles (nm) downwind from plume source (VC)
31 Aug	1825	11:48:08	b08.spc	VCB	735	-21.1509	34.5934	Background collected 10 nm down from source (noticably more polluted than upwind backgrounds) (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
31 Aug	1825	11:52:51	b09.spc	VCB	685	-21.1749	34.7994	2nd background 10 nm from source (VC)
31 Aug	1825	12:00:15	s05.spc	VCS	657	-21.1488	34.6459	2nd sample in middle of plume, 10 nm downwind (VC)
31 Aug	1825	12:05:37	s06.spc	VCS	3088	-21.1627	34.6280	3rd sig 10 nm downwind, sampled at top of plume (VC)
31 Aug	1825	12:20:48	s07.spc	VCS	1137	-21.1434	34.6519	4th sig 10 nm downwind, sampled from middle of plume (VC)
31 Aug	1825	12:23:55	s08.spc	VCS	1088	-21.2051	34.6284	1st sample at 15 nm downwind from source (VC)
31 Aug	1825	13:28:49	s09.spc	VCS	12710	-23.3936	31.8461	Sample en route to Pietersburg of smoke plume penetrating clouds into free troposphere (~12.5 K-ft) (VC)
31 Aug	1825	13:32:18	b10.spc	VCB	12823	-23.4779	31.6622	Background for free trop plume penetration (12.5 K-ft) (VC)
31 Aug	1825	13:59:01	b11.spc	VCB	11827	-23.7808	30.1296	Sample of free trop en route to Pietersburg, (VO).
1 Sep	1826	08:04:00	b01.spc	VCB	6225	-16.7273	24.8988	Measurement of haze layer en route to Kaoma, sunphotometer "pegged", (VC)
1 Sep	1826	08:07:09	b02.spc	VCB	6317	-16.5378	24.8715	Measurement of (darker) haze en route to Kaoma, (VC)*
1 Sep	1826	08:40:48	b03.spc	VCB	5115	-14.8118	24.4640	Sample of ambient air before miombo fire (VC)
1 Sep	1826	08:57:17	s01.spc	VCS	4396	-14.7984	24.4873	First sample of smoke, (missed peak CO), fire ignited at 8:56 (VC)
1 Sep	1826	09:01:46	s02.spc	VCS	4369	-14.8222	24.4780	2nd sample of miombo fire plume, stronger CO signal than s01.spc. Corresponds to UW bag 1 and Terra overpass (VC)
1 Sep	1826	09:09:04	s03.spc	VCS	4096	-14.8144	24.4769	Sample of lower 3rd of smoke plume, "good CO peak", (VC)
1 Sep	1826	09:13:06	b04.spc	VCB	4562	-14.8365	24.4839	Background for s03.spc (VC)
1 Sep	1826	09:19:18	s04.spc	VCS	4363	-14.8295	24.4822	Sample of plume at 500 AGL, dark, flaming combustion occuring, UW bag 2 sampled (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
1 Sep	1826	09:26:36	s05.spc	VCS	6250	-14.8171	24.4613	Sample near top of smoke plume ca. 2000-ft agl, (VC)
1 Sep	1826	09:34:26	b06.spc	VCB	6466	-14.9009	24.3256	Attempt to sample downwind plume, missed plume, but possible good background spc. (VC)
1 Sep	1826	09:38:49	s06.spc	VCS	6482	-14.8224	24.3645	Downwind sample of plume at 2000-ft agl (VC)
1 Sep	1826	09:59:10	vp01.spc	VOB	6906	-14.8456	24.4206	Continuous sampling downwind of plume (VO).
1 Sep	1826	10:07:01	b07.spc	VCB	6763	-14.8022	24.4441	Sample 4 mi downwind, looks like possible background (VC)
1 Sep	1828	14:40:37	b01.spc	VCB	14051	-20.8442	27.2107	Attempt at sampling high plume, but never saw any change in signal from ambient, possibly a good background sample (VC)
1 Sep	1828	14:49:37	b02.spc	VCB	13782	-21.2701	27.5843	Missed attempt at high plume, good background sample (VC)
1 Sep	1828	15:33:21	b03.spc	VCB	12149	-23.3952	29.2061	Same situation as previous scans, plumes difficult to see (VC)
3 Sep	1830	07:52:09	vp01.spc	VOB	10483	-21.8180	28.1084	Sample of ambient for CO and CH_4 in upper haze (VO)
3 Sep	1830	08:30:31	vp02.spc	VOB	15161	-20.5784	26.2311	Sample in upper haze before fast, descending vertical profile, (VO)
3 Sep	1830	08:43:45	vp03.spc	VOB	3602	-20.6074	26.1494	Sample of hazy Sua Pan air, visibility about 1 nm. (VO)
3 Sep	1830	08:44:38	vp04.spc	VOB	3475	-20.6448	26.1558	Another sample of hazy Sua Pan air, visibility seems slightly improved (VO)
3 Sep	1830	08:51:42	vp05.spc	VOB	3152	-20.6889	26.1341	Another Sua Pan ambient air sample, sunlight more intense, during Terra overpass. (VO)
3 Sep	1830	09:00:13	vp06.spc	VOB	5047	-20.7160	26.0659	Same as previous samples (VO)
3 Sep	1830	10:17:33	vp07.spc	VOB	7866	-20.5320	25.8943	A sample of Sua Pan ambient air at ~8,000 ft. (VO)
3 Sep	1830	10:21:15	vp08.spc	VOB	8356	-20.4475	25.9273	Same as previous sample (VO)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
3 Sep	1830	10:35:39	b01.spc	VOB	15247	-20.5874	25.9288	Final sample of upper haze, visibility still seems poor for this altitude. (VO)
5 Sep	1831	08:58:42	b01.spc	VCB	10537	-23.1513	29.1469	Sample of haze layer above low, continuous cloud layer near Pietersburg (VC)
5 Sep	1831	09:19:22	b02.spc	VCB	10514	-22.1619	28.5375	Another sample of haze layer above continuous clouds (VC)
5 Sep	1831	10:42:35	b03.spc	VCB	13941	-18.1546	25.3443	Sample at13 K-ft over Zambezi floodplain, possible high O_3 (VC)
5 Sep	1831	11:07:54	b04.spc	VCB	9566	-16.6965	24.8692	Sample ambient haze at 9 K-ft 1/2-way to Kaoma from Zambezi River (VC)
5 Sep	1831	11:44:35	b05.spc	VCB	5696	-14.7896	24.4497	Bg sample collected at fire site collected before dambo ignited (VC)
5 Sep	1831	11:48:56	b06.spc	VCB	5012	-14.8098	24.4416	Another background sample collected after dropping 500-ft (VC)
5 Sep	1831	11:55:18	s01.spc	VCS	4291	-14.8242	24.4528	Dambo fire ignited at 11:49 UTC, sample while traversing plume, (VC)
5 Sep	1831	11:57:29	s02.spc	VCS	4402	-14.8127	24.4551	Another sample while traversing plume (VC)
5 Sep	1831	12:02:18	s03.spc	VCS	4440	-14.8042	24.4591	Sample of thick brown smoke plume (VC)
5 Sep	1831	12:04:36	s04.spc	VCS	4487	-14.8226	24.4478	Sample of smoke with a whiter color (VC), approx. 30% of area burned.
5 Sep	1831	12:07:29	b07.spc	VCB	4352	-14.8044	24.4685	Background sample for s03 and s04.spc
5 Sep	1831	12:09:57	b08.spc	VCB	4301	-14.8392	24.4363	Another background sample for s03 and s04.spc
5 Sep	1831	12:25:49	b09.spc	VCB	4461	-14.8021	24.4679	Another sample of background air while looking for other fires.
5 Sep	1831	12:32:50	s05.spc	VCS	4433	-14.8085	24.4498	Final sample near dambo source, smoke intensity very low (VC)
5 Sep	1831	12:44:37	b10.spc	VCB	5440	-14.6933	24.5465	Final background of ambient air around dambo fire. (VC)
5 Sep	1831	13:24:31	b11.spc	VCB	5226	-16.0825	23.3161	200 ave scans collected for ambient measurement en route to Kasane. (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
6 Sep	1832	07:30:52	b01.spc	VCB	12758	-17.0969	24.3727	Sample of ambient air in upper haze (VC)
6 Sep	1832	07:35:35	b02.spc	VCB	12759	-16.9192	24.1381	Same as above, note that instrument still needs to warm up (VC).
6 Sep	1832	07:53:33	vp01.spc	VCB	4748	-16.1366	23.2734	Sample 1 of low level haze in transit Senanga-Mongu (15 ave scans/subfile), (VC)
6 Sep	1832	07:57:54	vp02.spc	VCB	3845	-15.9161	23.2486	Sample 2 of low level haze in transit Senanga-Mongu (15 ave scans/subfile), (VC)
6 Sep	1832	08:02:50	vp03.spc	VCB	3824	-15.6846	23.2096	Sample 3 of low level haze in transit Senanga-Mongu (15 ave scans/subfile), (VC)
6 Sep	1832	08:07:11	vp04.spc	VCB	3800	-15.4790	23.1864	Sample 4 of low level haze in transit Senanga-Mongu (15 ave scans/subfile), (VC)
6 Sep	1832	08:11:20	vp05.spc	VCB	4011	-15.2874	23.1552	Sample 5 of low level haze in transit Senanga-Mongu (15 ave scans/subfile), (VC)
6 Sep	1832	08:16:17	vp06.spc	VCB	3456	-15.0761	23.1023	Sample 6 of low level haze in transit Senanga-Mongu (15 ave scans/subfile), (VC)
6 Sep	1832	08:23:00	vp07.spc	VCB	4826	-14.9221	23.1226	Sample 7 of low level haze in transit Senanga-Mongu (15 ave scans/subfile), (VC)
6 Sep	1832	08:33:41	vp08.spc	VCB	5818	-15.4402	23.2665	Background sample collected before starting BRDF turns over Mongu Tower (VC)
6 Sep	1832	08:42:37	b03.spc	VCB	5941	-15.4423	23.2883	Ave scans on BRDF turn #1,(VC)
6 Sep	1832	09:13:27	b04.spc	VCB	4019	-15.2499	23.1655	Haze directly over runway at Mongu airport, (VC)
6 Sep	1832	09:30:18	b05.spc	VCB	15785	-15.2059	23.1846	Sample of haze at 15 K ft over Mongu runway, sampled after continuous VP, NOTE: ER-2, SHIS overpass! (VC)
6 Sep	1832	09:39:55	b06.spc	VCB	9516	-15.3956	23.0432	Haze sample at 9 K ft level run (VC)
6 Sep	1832	09:52:11	b07.spc	VCB	5242	-15.3772	23.1067	Haze sample at 5 K ft level run (VC)
6 Sep	1832	10:09:30	b08.spc	VCB	16408	-15.6291	23.5730	Haze sample at ca. 17 K-ft, still in haze. (VC)
6 Sep	1832	10:14:20	b09.spc	VCB	17585	-15.8686	23.7570	Haze sample of ambient air at 17.4 K-ft, still in haze, (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
6 Sep	1832	10:37:06	b10.spc	VCB	13771	-17.0077	24.5691	Haze sample collected ca. 14 K-ft, Hobbs says O_3 is approx. 100 ppbv (VC)
6 Sep	1832	10:43:40	b11.spc	VCB	9523	-17.3450	24.8286	Final haze sample collected at 9.5 K-ft, OAD reported at ca. 0.9, (VC)
6 Sep	1833	11:57:00	b01.spc	VCB	12617	-18.4669	25.4591	Sample 1 of haze while heading south along Zimbabwe border (12.6 K) (200 avg: VC)
6 Sep	1833	12:17:47	b02.spc	VCB	12660	-19.4788	26.1814	Sample 2 of haze while heading south along Zimbabwe border (12.6 K) (200 avg: VC)
6 Sep	1833	12:30:14	b03.spc	VCB	12677	-20.0804	26.6391	Sample 3 of haze while heading south along Zimbabwe border (12.6 K) (200 avg: VC)
6 Sep	1833	12:48:42	b04.spc	VCB	10044	-20.9796	27.3310	Sample 1 haze at 10 K further south (200 avg (VC)), air more humid than over Kasane
6 Sep	1833	13:15:30	b05.spc	VCB	9973	-22.1592	28.5412	Sample 2 haze at 10 K still further south (200 avg (VC)), AOD measurements increasing
6 Sep	1833	13:34:54	b06.spc	VCB	7827	-23.1867	29.1546	Haze sample at 7.8 K in South Africa (200 avg VC), AOD = 0.8
7 Sep	1834	08:27:14	b01.spc	VCB	11549	-24.2301	30.7148	Sample of upper haze en route to Timbivati fire (VC)
7 Sep	1834	08:31:59	b02.spc	VCB	11076	-24.3409	31.0295	Sample of upper haze before descending to fire (VC)
7 Sep	1834	08:40:08	b03.spc	VCB	***1232***	-24.4133	31.2037	Background prior to PP1 - 500' agl (VC)
7 Sep	1834	08:42:47	s01.spc	VCS	***1972***	-24.3732	31.2570	PP1 - heavy smoke, 500' agl, UW bag 1 collected (VC)
7 Sep	1834	08:46:11	s02.spc	VCS	***2746***	-24.3714	31.2402	PP2 - 1000' agl, 3 miles downwind from fire front (VC)
7 Sep	1834	08:49:28	b04.spc	VCB	***3662***	-24.3937	31.1778	Background 1500' agl, 5 miles downwind prior to PP3 missed PP3-4 (VC)
7 Sep	1834	08:55:10	s03.spc	VCS	2109	-24.2900	31.2691	PP5 - upper 1/3 of plume, 2500' agl, 5 miles downwind (VC)
7 Sep	1834	09:00:40	b05.spc	VCB	2188	-24.4203	31.2478	Background haze at 3000' agl (VC)
7 Sep	1834	09:21:26	s03a.spc	VCS	3297	-24.3575	31.2292	PP6 - repeat PP5 UW bag 3 collected (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
7 Sep	1834	09:25:16	b06.spc	VCB	3007	-24.3162	31.3127	Missed sample of "puff" above plume (PP7), possible background (VC)
7 Sep	1834	09:30:54	b07.spc	VCB	6646	-24.3027	31.3301	Background (VC)
7 Sep	1834	09:32:58	s04.spc	VCS	5298	-24.2352	31.2797	PP8 - puff above plume, **incipient O_3 prod**, 10 nm downwind (VC)
7 Sep	1834	09:34:22	s05.spc	VCS	5074	-24.2147	31.2065	PP8a - largest puff above plume, **incipient O_3 prod**, 10 nm downwind (VC)
7 Sep	1834	09:39:51	s06.spc	VCS	5150	-24.1936	31.2126	PP9 - **incipient O_3 prod**, 10 miles downwind, UW bag 4 collected (VC)
7 Sep	1834	09:45:53	s07.spc	VCS	2161	-24.3559	31.2485	PP10 - 500' agl, sampled near source (VC)
7 Sep	1834	09:48:27	b08.spc	VCB	2225	-24.4092	31.1904	Background upwind of front, 500' agl (VC)
7 Sep	1834	09:50:53	lax1.spc	VOS	2152	-24.3398	31.2238	Transect of plume long axis #1 (VO)
7 Sep	1834	09:53:39	lax2.spc	VOS	1925	-24.2324	31.1504	Transect of plume long axis #2 (VO)
7 Sep	1834	09:56:50	lax3.spc	VOS	1921	-24.1417	31.1215	Transect of plume long axis #3 (VO)****
7 Sep	1834	10:14:42	s09.spc	VCS	2072	-24.1766	31.0878	PP11 (Peter's PP10) - 18 miles downwind, **stronger O_3 prod**, (VC)
7 Sep	1834	10:20:31	s10.spc	VCS	1716	-24.1650	31.0942	PP12 - repeat PP11, UW bag 5 collected, **O_3 strong**, 18 nm downwind (VC).
7 Sep	1834	10:29:08	b09.spc	VCB	6214	-24.1332	31.0596	Missed PP13 - 6000' agl, above middle of plume, 18 miles dwnwnd, possible background (VC)
7 Sep	1834	10:32:03	b10.spc	VCB	4984	-24.1274	30.9325	Background ~4000' agl, 18 miles downwind, out of plume (VC)
7 Sep	1834	10:36:21	s11.spc	VCS	1983	-24.1452	31.0767	PP14 - 18 miles dwnwnd, **strong O_3**, 500' agl (VC)
7 Sep	1834	10:49:04	s12.spc	VCS	2265	-23.9814	31.1442	Copper mine stack - 1-2seconds in plume (VC)
13 Sep	1837	09:04:32	b01.spc	VCB	1131	-21.7882	13.7521	100 avg'd scans, sample under clouds, (VO)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
13 Sep	1837	09:14:23	vp01.spc	VCB	2105	-21.3858	13.4465	Running in clouds while TERRA goes overhead
13 Sep	1837	09:23:27	vp02.spc	VCB	984	-21.0265	13.1429	Running under clouds while TERRA goes overhead
13 Sep	1837	09:29:32	vp03.spc	VCB	2192	-20.7654	13.1166	Running in clouds while TERRA goes overhead
13 Sep	1837	09:35:08	vp04.spc	VCB	2298	-20.5105	13.1730	Running in clouds while TERRA goes overhead
13 Sep	1837	10:04:34	vp05.spc	VCB	4496	-20.4633	13.1848	Continuous scan 1500' above cloud top
13 Sep	1837	10:09:54	vp06.spc	VCB	3448	-20.4768	13.1792	Background air 1500' above cloud top
13 Sep	1837	10:49:09	vp07.spc	VOB	5101	-20.6134	13.0954	Continuous scan of 1st BRDF, above clouds - valves open
13 Sep	1837	11:13:12	vp08.spc	VOB	3032	-20.3874	13.1455	Horizontal continuous scan above clouds - valves open
13 Sep	1837	11:32:49	vp09.spc	VCB	16356	-20.1730	13.2370	Upper haze at15,200' agl (VC)
13 Sep	1837	11:40:40	vp10.spc	VCB	12897	-20.0606	13.2446	Upper haze at 13,000' agl (VC)
13 Sep	1837	11:45:05	vp11.spc	VCB	12911	-20.3171	13.2354	Upper haze at 13,000' agl (VC)
13 Sep	1837	11:48:29	vp12.spc	VCB	12873	-20.3237	13.1969	Upper haze at 13,000' agl (VC)
13 Sep	1837	12:05:45	vp13.spc	VCB	9503	-20.8585	13.2360	Upper haze at 9,000' agl (VC)
13 Sep	1837	12:11:17	vp14.spc	VCB	9478	-21.0096	13.2019	Upper haze at 9,000' agl (VC)
13 Sep	1837	12:16:52	vp15.spc	VCB	8371	-20.7528	13.2371	Upper haze at 8,000' agl (VC)
13 Sep	1837	12:25:54	vp16.spc	VCB	5276	-20.5122	13.0848	Measurement of ambient haze during BRDF 2 (VC)
13 Sep	1837	12:55:30	vp17.spc	VCB	5118	-20.4699	13.1476	Measurement of ambient haze during BRDF 2 (VC)

(Cont.)

Table 5.9 (continued)

Date (2000)	University of Washington Flight Number	Time (hr:min:sec, UTC)	Sample Name	Measurement Code	Altitude (ft - msl)	Latitude (deg, south)	Longitude (deg, east)	Notes
13 Sep	1837	12:58:56	vp18.spc	VCB	3481	-20.6005	13.2158	Measurement of haze just above clouds, (cloud tops dropped off) (VC)
14 Sep	1838	09:10:42	b01.spc	VOB	6211	-26.5207	14.3224	Clean air sample, 0.08 AOD, valves open and closed
14 Sep	1838	09:36:27	b02.spc	VOB	3285	-26.5624	14.0967	Sample of small cloud, VO and VC during spc
14 Sep	1838	09:42:28	b03.spc	VCB	2899	-26.5483	13.8306	"Milling around", possible good background (VC)
14 Sep	1838	09:57:11	s01.spc	VCS	375	-26.2598	13.4918	First PP of plume from *"Royal Sphere"* (VC)
14 Sep	1838	10:00:52	s02.spc	VCS	438	-26.2409	13.4837	PP2 from *"Royal Sphere"* (VC)
14 Sep	1838	10:14:50	s03.spc	VCS	441	-26.1412	13.4485	PP3 (possibly missed) from *"Royal Sphere"* (VC)
14 Sep	1838	10:33:11	s04.spc	VCS	330	-25.9873	13.6006	PP4 from *"MSC Giovanna"* spotted by Hobbs (VC)
14 Sep	1838	10:41:58	s05.spc	VCS	404	-25.9466	13.5945	PP5 from *"Giovanna"* ship (VC)
14 Sep	1838	10:45:50	b04.spc	VCB	444	-25.9178	13.5382	Background sample after sampling ship plume (VC)
14 Sep	1838	10:50:40	b05.spc	VCB	502	-25.8463	13.5651	Another background sample (VC)
14 Sep	1838	10:54:09	b06.spc	VCB	430	-25.7934	13.6704	Background sample, ~0.16 AOD (VC)
14 Sep	1838	11:00:10	b07.spc	VCB	503	-25.8900	13.6567	Final background sample before starting vertical profile (VC)
14 Sep	1838	11:04:02	vp01.spc	VCB	423	-25.8694	13.7723	Sample of horizontal track before beginning rapid spiral ascent (VC)
14 Sep	1838	11:39:05	b08.spc	VCB	11965	-25.3556	13.9531	12 K-ft sample, collect at 11:39:49 UTC, but valves closed 44 sec before scanning
14 Sep	1838	11:39:05	b09.spc	VCB	11965	-25.3556	13.9531	Rescan of previous sample, collected at 11:49:04 UTC, but valves closed 10 min before scanning

TABLE 5.10. SAMPLING OF IONIC AND CARBONACEOUS AEROSOL SPECIES WITH TEFLON AND QUARTZ FILTERS ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Teflon Filter Holder Number and Filter Number (holder-filter)	Quartz Filter Holder Number	Start Time (hhmm, UTC)*	Stop Time (hhmm, UTC)*	Sample Inlet (C = continuous airstream, BH = baghouse sample)	Sample Description
10 Aug	1810	1-1	1	1157	1234	C	Haze in free troposphere (12000 ft, 670 hPa) northwest of Pietersburg, South Africa.
		2-2	2	1335	1405	BH	Haze in free troposphere (10000 ft, 700 hPa) northwest of Pietersburg, South Africa.
14 Aug	1812	3-3	3	1309	1426	C	Haze (7500 ft, 780 hPa) about 80 miles northwest of Johannesburg, South Africa.
15 Aug	1814	5-5	5	0847	0947	C	Haze (3300 ft, 920 hPa) Skukusa, South Africa.
17 Aug	1815	6-6	6	0829	0927	C	Haze (4200 ft, 880 hPa) Kruger National Park, South Africa.
		7-7	7	1000	1014	BH	Smoke plume, near fire in a smoldering combustion stage, Kruger National Park, South Africa.
		3-8	3	1110	1116	BH	Plume, near flaming fire in initial stages, Kruger National Park, South Africa.
18 Aug	1816	2-10	5	0857	0913	C	Approaching Madikwe Game Reserve on South Africa/Botswana border. Haze (6000 ft, 830 hPa).
		6-11	1	0915	0940	BH	Vertical column sample of smoke from a newly-lit prescribed fire in Madikwe Game Reserve on South Africa/ Botswana border.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.10 (Continued)

Date (2000)	University of Washington Flight Number	Teflon Filter Holder Number and Filter Number (holder-filter)	Quartz Filter Holder Number	Start Time (hhmm, UTC)*	Stop Time (hhmm, UTC)*	Sample Inlet (C = continuous airstream, BH = baghouse sample)	Sample Description
		7-12	2	1000 1023	1005 1033	BH	In smoke, 12.5 miles downwind of prescribed fire in Madikwe Game Reserve (multiple bag fills).
		3-14	3	1137	1215	C	Ambient haze (6000 ft, 815 hPa) in Madikwe Game Reserve for comparison with smoke samples.
		4-15	4	1227	1238	BH	In smoke, 21 miles downwind of prescribed fire in Madikwe Game Reserve (multiple bag fills).
20 Aug	1819	1-16	1	1157	1243	C	Ambient haze (11000 ft, 690 hPa) in Madikwe Game Reserve near South Africa/Botswana border.
		2-17	2	1251	1300	BH	Smoke plume near smoldering prescribed fire with some visible flames in Madikwe Game Reserve.
		3-18	3	1356	1403	BH	Smoke plume near a smoldering prescribed fire (with more active visible flames) in Madikwe Game Reserve.
		5-20	5	1411	1443	C	Ambient haze in Madikwe Game Reserve (5000 ft, 850 hPa) for comparison with smoke samples.
22 Aug	1820	1-21	1	0715	0758	C	Haze (10000 ft, 710 hPa) on transit from Pietersburg to Skukusa, South Africa.
		2-22	2	0810	0921	C	Haze layer (12000-5000 ft, 670-850 hPa) over Skukusa airport, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.10 (Continued)

Date (2000)	University of Washington Flight Number	Teflon Filter Holder Number and Filter Number (holder-filter)	Quartz Filter Holder Number	Start Time (hhmm, UTC)*	Stop Time (hhmm, UTC)*	Sample Inlet (C = continuous airstream, BH = baghouse sample)	Sample Description
		3-23	3	0935	1031	C	Haze layer (4500-3000 ft, 860-920 hPa) in vertical profile over Skukusa airport, South Africa.
23 Aug	1821	4-24	4	1258	1355	C	Free troposphere (15800 ft, 570 hPa) near Pietersburg, South Africa.
24 Aug	1822	5-25	5	0657	0811	C	In haze (11600 ft, 670 hPa) en route from Pietersburg, South Africa, to Mozambique coast.
		1-26	1	0813	1004	C	Haze layer (11000-200 ft, 680-1020 hPa) over Inhaca Island, Mozambique.
29 Aug	1823	6-29	2	0848	0951	C	Haze (9000 ft, 850 hPa) near South Africa/Zimbabwe border.
		4-30	3	1004	1044	BH	Haze (5300 ft, 725 hPa) (used 3 baghouse samples while doing CAR circles) near South Africa/Zimbabwe border.
29 Aug	1824	1-31	4	1421	1437	BH	Smoke plume from smoldering fire in Kruder National Park, South Africa.
31 Aug	1825	2-32	5	0944	1038	C	Haze layer (9700-5000 ft, 720-860 hPa) en route from Pietersburg, South Africa, to Mozambique coast.
		3-33	1	1121	1131	BH	Smoke plume near smoldering fire located west of Beria, Mozambique.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.10 (Continued)

Date (2000)	University of Washington Flight Number	Teflon Filter Holder Number and Filter Number (holder-filter)	Quartz Filter Holder Number	Start Time (hhmm, UTC)*	Stop Time (hhmm, UTC)*	Sample Inlet (C = continuous airstream, BH = baghouse sample)	Sample Description
		7-34	2	1201	1215	BH	Smoke plume downwind of smoldering fire located west of Beria, Mozambique.
1 Sep	1826	5-35	3	0559	0749	C	Haze layer (12000-10000 ft, 645-695 hPa) en route from Pietersburg, South Africa, to Kaoma, Zambia.
		1-36	7	0802	0831	C	Haze (6200 ft, 810 hPa) en route from Pietersburg, South Africa, to Kaoma, Zambia.
		3-37	1	0903	0916	BH	Smoke plume close to prescribed fire of Miombo near Kaoma, Zambia.
		2-38	2	0948	1000	BH	Smoke plume further downwind from prescribed fire of Miombo in Kaoma, Zambia.
1 Sep	1828	7-39	4	1403	1532	C	Haze (13700 ft) en route from Kasane, Botswana, to Pietersburg, South Africa.
2 Sep	1829	6-40	5	0758	0916	C	Haze (10600 ft, 695 hPa) en route from Pietersburg, South Africa, to Maun, Botswana.
		4-41	6	0954	1122	C	Haze layer from free troposphere to surface over Maun, Botswana.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.10 (Continued)

Date (2000)	University of Washington Flight Number	Teflon Filter Holder Number and Filter Number (holder-filter)	Quartz Filter Holder Number	Start Time (hhmm, UTC)*	Stop Time (hhmm, UTC)*	Sample Inlet (C = continuous airstream, BH = baghouse sample)	Sample Description
		5-42	7	1145	1302	C	Haze layer (9400-11600 ft, 715-600 hPa) en route from Maun, Botswana, to Pietersburg, South Africa.
3 Sep	1830	1-43	1	0720	0805	C	Haze (10400 ft, 700 hPa) en route from Pietersburg, South Africa, to Sua Pan, Botswana.
		3-44	2	0834	0858	C	Haze layer (11000-3000 ft, 690-900 hPa) descending over Sua Pan, Botswana.
		2-45	3	1055	1140	C	Haze (7800 ft, 770 hPa) on return flight to Pietersburg.
5 Sep	1831	1-47	1	0903	0942	C	Haze (10500 ft, 700 hPa) on transit from Pietersburg, South Africa, to Kaoma, Zambia.
		2-48	2	1159	1209	BH	Smoke plume near prescribed fire of Dambo near Kaoma, Zambia.
6 Sep	1832	3-49	3	0728	0746	C	Haze (12700 ft, 645 hPa) en route from Kasane, Botswana, to Senanga, Zambia.
		4-50	4	0758	0817	C	Haze (3800 ft, 885 hPa), Zambia.
		5-51	5	0934	1000	C	Haze layer (15000-5300 ft, 600-840 hPa) in descent over Mongu airport, Zambia.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.10 (Continued)

Date (2000)	University of Washington Flight Number	Teflon Filter Holder Number and Filter Number (holder-filter)	Quartz Filter Holder Number	Start Time (hhmm, UTC)*	Stop Time (hhmm, UTC)*	Sample Inlet (C = continuous airstream, BH = baghouse sample)	Sample Description
6 Sep	1833	6-52		1154	1227	C	Haze (12600 ft, 650 hPa) en route from Kasane, Botswana, to Pietersburg, South Africa. (Simultaneous sampling of Teflon filters during a transit flight.)
		7-53		1154	1227	C	Haze (12600 ft, 650 hPa) en route from Kasane, Botswana, to Pietersburg, South Africa. (Simultaneous sampling of Teflon filters during a transit flight.)
			6	1229	1302	C	Haze (12600 ft, 650 hPa) en route from Kasane, Botswana, to Pietersburg, South Africa. (Simultaneous sampling of quartz filters during a transit flight.)
			7	1229	1302	C	Haze (12600 ft, 650 hPa) en route from Kasane, Botswana, to Pietersburg, South Africa. (Simultaneous sampling of quartz filters during a transit flight.)
7 Sep	1834	1-56	1	0844	0852	BH	Smoke near large prescribed fire in Timbavati Game Reserve, South Africa.
		2-57	2	0925	0936	BH	Smoke 5 miles downwind of large prescribed fire in Timbavati, South Africa.
		3-58	3	1016	1027	BH	Smoke 20 miles downwind of large prescribed fire in Timbavati, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.10 (Continued)

Date (2000)	University of Washington Flight Number	Teflon Filter Holder Number and Filter Number (holder-filter)	Quartz Filter Holder Number	Start Time (hhmm, UTC)*	Stop Time (hhmm, UTC)*	Sample Inlet (C = continuous airstream, BH = baghouse sample)	Sample Description
10 Sep	1835		4	0620	0806	C	Haze (12600 ft, 650 hPa) en route from Pietersburg, South Africa, to Walvis Bay, Namibia. (Simultaneous sampling of quartz filters during a transit flight.)
			5	0620	0806	C	Haze (12600 ft, 650 hPa) en route from Pietersburg, South Africa, to Walvis Bay, Namibia. (Simultaneous sampling of quartz filters during a transit flight.)
		4-59		0807	0953	C	Haze (12600 ft, 650 hPa) en route from Pietersburg, South Africa, to Walvis Bay, Namibia. (Simultaneous sampling of Teflon filters during a transit flight.)
		5-60		0807	0953	C	Haze (12600 ft, 650 hPa) en route from Pietersburg, South Africa, to Walvis Bay, Namibia. (Simultaneous sampling of Teflon filters during a transit flight.)
13 Sep	1837	2-61	7	1131	1221	C	Haze layer (9000-12000 ft, 725-650 hPa) off Namibian coast.
14 Sep	1838	6-62	2	1003 1046	1030 1109	BH	Effluents from two freighter ships off the west coast of South Africa.
16 Sep	1839	4-63	4	1036	1153	C	Haze layer, free troposphere to surface over Etosha Pan, Namibia.

* Local time = UTC + 2 hours

TABLE 5.11. SAMPLES FOR THE PC-BOSS COLLECTED ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Period of Grid Exposure (hr:min:sec, UTC)*	Code for Filter Set	Sampling Conditions
10 Aug.	1810	13:32:45 - 15:01:00	A	In haze layer near top of boundary layer about 90 nautical miles of Pietersburg, South Africa.
14 Aug.	1812	13:07:43 - 14:24:00	A	In boundary layer haze about 80 nautical miles northwest of Johannesburg, South Africa.
15 Aug.	1814	08:46:22 - 09:47:20	B	Haze at Skukusa Airport, South Africa, possible interception of smoke.
17 Aug.	1815	08:27:50 - 09:26:00	C	In haze layer over Kruger National Park, South Africa.
18 Aug.	1816	11:05:00 - 11:11:30	A	Sample collected along smoke plume from prescribed fire in Madikwe Game Reserve, South Africa, heading toward fire.
20 Aug.	1819	11:54:10 - 12:35:00	C	In haze layer at 11,000 ft over Madikwe Game Reserve on South Africa/Botswana border.
20 Aug.	1819	12:47:00 - 13:56:30	B	In and out of smoke plume from prescribed fire in Madikwe Game Reserve, South Africa.
22 Aug.	1820	08:02:00 - 09:21:15	D	In boundary layer over Skukusa Airport, South Africa.
23 Aug.	1821	12:58:00 - 13:55:00	B	Free troposphere sample near Pietersburg, South Africa.
24 Aug.	1822	06:57:50 - 08:03:30	A	In haze during transit from Pietersburg, South Africa, to Inhaca Island, Mozambique.
24 Aug.	1822	08:17:50 - 10:04:15	B	In haze during spiral descent over Inhaca Island, Mozambique.
29 Aug.	1823	08:50:00 - 09:30:00	D	In haze in boundary layer (early shut down due to electric power problem) near South Africa/Zimbabwe border.
01 Sept.	1826	06:20:00 - 07:46:00	C	In boundary layer en route from Pietersburg, South Africa, to Zambia, heading north at 10,000-12,000 ft.
01 Sept.	1826	09:00:00 - 09:34:30	B	In and out of smoke plume (traveling along plume length) from prescribed burn of Miombo near Kaoma, Zambia.
02 Sept.	1829	07:59:45 - 09:30:30	A	In boundary layer en route from Pietersburg, South Africa, to Maun, Botswana.
02 Sept.	1829	11:41:25 - 13:04:00	C	In boundary layer on return trip from Maun, Botswana, to Pietersburg, South Africa.
05 Sept.	1831	09:10:30 - 10:14:50	C	In boundary layer en route from Pietersburg, South Africa, northbound to Zambia,
05 Sept.	1831	12:06:00 - 12:35:00	D	In and out of smoke from prescribed burn of Dambo near Kaoma, Zambia (grass fire with flames).
06 Sept.	1832	07:54:30 - 08:21:00	B	En route from Senaga to Mongu, Zambia, encountered a few small plumes.
06 Sept.	1833	11:53:20 - 12:40:00	A	In thick haze on return from Kasane, Botswana, to Pietersburg, South Africa.
07 Sept.	1834	08:21:00 - 09:00:00	D	En route from Pietersburg, South Africa, to Kruger National Park, South Africa. Encountered some smoke plumes.

* Local time = UTC + 2 hours

(Cont.)

TABLE 5.11 (Continued)

Date (2000)	University of Washington Flight Number	Period of Grid Exposure (hr:min:sec, UTC)*	Code for Filter Set	Sampling Conditions
11 Sept.	1836	10:54:00 - 11:34:00	B	In boundary layer off Namibian coast west of Walvis Bay, Namibia.
13 Sept.	1837	09:03:00 - 10:11:00	C	Above/in/below marine stratus off Namibian coast.
13 Sept.	1837	10:14:00 - 10:41:00	C	Above/in/below clouds off Namibian coast. Variable flows noted.
13 Sept.	1837	11:31:00 - 12:12:00	D	In upper main haze layer off Namibian coast.
14 Sept.	1838	09:56:00 - 10:51:00	D	Multiple penetrations of two ship plumes off west coast of South Africa.

* Local time = UTC + 2 hours

TABLE 5.12. MEASUREMENTS FROM THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 OF THE BIDIRECTIONAL REFLECTION DISTRIBUTION FUNCTION (BRDF) WITH THE NASA GODDARD CLOUD ABSORPTION RADIOMETER (CAR), SPECTRAL REFLECTIVITY WITH THE NASA AMES SSFR, AND BROADBAND ALBEDO (WITH EPPELEY RADIOMETERS) OF SELECTED SURFACES DURING SAFARI-2000 (SEE TABLE 5.13 FOR MORE DETAILS ON THE CAR MEASUREMENTS.)

Date (2000)	University of Washington Flight Number	Period of Measurements (UTC)*	Location and/or Nature of Surface
22 Aug.	1820	1034-1050	About 5 nautical miles west of Skukusa airport, Kruger National Park, South Africa.
22 Aug.	1820	1116-1140	Trees located southwest of Phalaborwa in Kruger National Park, South Africa.
29 Aug.	1823	0959-1030	Uniform brush and red soil near El Dorado (close to South Africa/Zimbabwe border). Terra satellite overpass at 0834 UTC; TOMS satellite overpass at 0930 UTC.
29 Aug.	1824	1335-1410	Centered on Skukusa tower, Kruger National Park, South Africa.
2 Sept.	1829	1020-1046	Centered on Maun tower, Botswana. TOMS satellite overpass at 0948 UTC.
3 Sept.	1830	0858-1001	(1) Grass/brush/trees near Sua Pan parabola ground site, Botswana. (2) White surface at Sua Pan parabola site, Botswana. Terra satellite overpass at 0852 UTC.
6 Sept.	1832	0857-0908	Centered on Mongu tower, Botswana. ER-2 overpass during measurements.
7 Sept.	1834	1122-1135	Mopane trees in Kruger National Park, South Africa.
11 Sept.	1836	1138-1208	Sand in Kuiseb National Park, Namibia.
13 Sept.	1837	1048-1102	Two sets of BRDF measurements on stratus clouds.
16 Sept.	1839	0904-0917	White pan in Etosha National Park, Namibia.
16 Sept.	1839	0920-1001	Mopane trees Etosha National Park, Namibia.

* Local time = UTC + 2 hours

TABLE 5.13. MEASUREMENTS WITH THE NASA GODDARD CLOUD ABSORPTION RADIOMETER (CAR) ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
15 Aug.	1814	Multi–spectral & multi–angular surface and sky radiometric measurements en route from Pietersburg to Skukusa, South Africa, then to about 30 miles west of Skukusa and on return to Pietersburg.	No record by CAR operator	—
18 Aug.	1816	Multi–spectral & multi–angular surface and sky radiometric measurements en route from Pietersburg to Madikwe Game Reserve on border of South Africa and Botswana, and on return.	No record by CAR operator	—
20 Aug.	1818	Flt. 1818: Multi–spectral & multi–angular surface and sky radiometric measurements between Pietersburg, South Africa and South Africa-Botswana border.	No record by CAR operator	Frequent CAR computer crashes—data not taken continuously.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
20 Aug.	1819	Flt. 1819. Surface and sky radiometric measurements taken between Pietersburg to Madikwe Game Reserve on border of South Africa and Botswana, and on return and in smoke plume of prescribed fire in Madikwe.	Hazy	Time code in the CAR data is 7.32 hours behind UTC time. Data dropout experienced (missed some dark current scans, hereafter referred to as "data dropout"). Imaging mode—starboard. This problem is being addressed.
22 Aug.	1820	Multi–spectral & multi–angular surface and sky radiometric measurements from Pietersburg to Skukusa, South Africa, and on return to Pietersburg via Phalaborwa. BRDF measurements over Mopane trees in the northern Kruger National Park.	Hazy	Filter wheel channels operated; data dropout noted; Imaging mode—starboard (other modes used towards the end of the flight). Terra/ER-2 overpass during this flight.
23 Aug.	1821	Multi–spectral & multi–angular surface and sky radiometric measurements in the vicinity of Pietersburg, South Africa.	Hazy for most part. Clean layer sandwiched between two haze layers towards the horizon.	This was Engineer's test flight; data collected for 45 minutes. Data dropout observed. Imaging in starboard mode.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
24 Aug.	1822	Multi–spectral & multi–angular surface and sky radiometric measurements from Pietersburg, South Africa, to Inhaca Island, Mozambique, and back to Pietersburg.	Hazy for most part. Clean layer sandwiched between two haze layers observed towards the horizon.	Data dropout observed; imaging mode alternated from starboard, downward, and back to starboard. Terra/ER-2 overpass during this flight.
29 Aug.	1823	Flt. 1823: Multi–spectral & multi–angular surface and sky radiometric measurements from Pietersburg, South Africa, to the border of South Africa and Zimbabwe, and back. BRDF measurements near South Africa-Zimbabwe border over a uniform shrub area (22.9˚ S/28.8˚ E).	Hazy and clear; few cloud cells observed.	Data dropout observed; Imaging mode: starboard; Filter wheel channels (wavelength between 1.5 to 2.3 μm) operated; Return leg was of varying altitudes between 200 and 10000 feet.
29 Aug.	1824	Flt. 1824: BRDF over Kruger National Park tower.	Hazy and clear; Smoke plumes observed between Pietersburg and Kruger National Park, South Africa.	Data dropout observed; Imaging mode: starboard; Filter wheel channels operated; Return leg was of varying altitudes.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
31 Aug.	1825	Multi–spectral & multi–angular surface and sky radiometric measurements from Pietersburg, South Africa, to central Mozambique Coast then north along coastline to west of Beira, Mozambique, and return to Pietersburg.	Relatively clean. Smoke plume from fires in Mozambique; broken clouds along Mozambique coastline.	Filter wheel channels operated on/off. Imaging modes used: starboard and downward; data dropout observed. At 1319 UTC flying over very thick smoke in Mozambique close to South Africa border; couldn't see the surface from 3874 m asl.
1 Sept.	1826	Flt. 1826: Multi–spectral & multi–angular surface and sky radiometric measurements en route from Pietersburg, South Africa, to Kaoma, Zambia, and then to Kasane, Botswana.	Hazy along the way (estimated that 90 % of the haze was beneath our flight level—3839 m asl).	Start measurements—0855 UTC. Filter wheel operated on/off and TANS vector data sampled at varying rate between 1–10 hertz to investigate data dropout problem. Scanning mode used: starboard and downward. Measurements ended—1057 UTC.
1 Sept.	1828	Flt. 1828: Multi–spectral & multi–angular surface and sky radiometric measurements en route from Kasane, Botswana, to Pietersburg, South Africa.	Hazy; moderate CAT experienced.	Start measurements—1400 UTC. On the way from Kasane, Botswana, to Pietersburg, South Africa, observed smoke plume penetrating the haze layer. Filter wheel at 2.1 μm. Measurements ended—1526 UTC.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
2 Sept.	1829	Multi–spectral & multi–angular surface and sky radiometric measurements en route from Pietersburg, South Africa to Maun, Botswana, and return to Pietersburg. BRDF measurements centered on Maun Tower, Botswana. Multi–spectral & multi–angular surface and sky radiometric profile measurements (up to ~4485 m asl).	Hazier than previous day. Convective domes (protuberances) of haze observed at ~4480 m asl.	Start measurements—0750 UTC. Imaging at starboard mode. Filter wheel operated at 2.1 μm. Data dropout experienced. High aerosol optical thickness. BRDF measurements made from 1023–1042 UTC. Passed over Sua and Makgadikgadi Pans. TOMS overpass this flight. Measurements ended—1310 UTC.
3 Sept.	1830	Multi–spectral & multi–angular surface and sky radiometric measurements en route from Pietersburg, South Africa, to Sua Pan, Botswana, and on return to Pietersburg. BRDF measurements over grass in the vicinity of Sua Pan and over the pan.	Haze layer and cirrus cloud above Convair-580 flight level ~4626 m asl. Poor visibility especially over the pan but started to clear in later part of BRDF measurements. Winds at ~20 knots.	Start measurements—0707 UTC. Filter wheel position operated at 2.1 μm. Imaging mode- downward during transit. Changed to BRDF mode for BRDF measurements at Sua Pan and then to starboard the rest of the flight. Data dropout noted. At 1136 UTC pass underneath a sole cumulus cloud; this cloud can be seen in the CAR quick look images. Measurements ended—1207 UTC.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
5 Sept.	1831	Multi–spectral & multi–angular surface and sky radiometric measurements en route from Pietersburg, South Africa, to Kaoma, Zambia, and then to Kasane, Botswana, via Senanga, Zambia.	Broken (~90%) stratocumulus clouds from takeoff at Pietersburg (0844 UTC) up to ~0941 UTC. Hazy thereafter. At ~1054 UTC cirrus, which looked like smoke plume, reported above our flight level ~4252 m asl. Smoke plumes at ~1105 UTC before arriving at the burn site. At the burn site wind varying between 5 and 10 knots. At 1349 UTC on the way to Kasane reported clouds above the aircraft.	Started measurements at 0851 UTC. Collected data from filter wheel at 1.6 μm—seemed stable for the first one hour. Scanning modes: starboard up to 1000 UTC and then switched to downward. Variable flight level on transit to Kaoma. Maneuvers over pre-burn areas started at ~1143 UTC and burn started at 1153 UTC. Switched scan mode back to starboard at ~1325 UTC. Stopped measurements at 1354 UTC.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
6 Sept.	1832	Flt. 1832: Multi–spectral & multi–angular surface and sky radiometric measurements en route Kasane, Botswana, to about 20 miles north of Mongu, Zambia and return to Kasane. BRDF over Mongu tower.	Very hazy. At 0830 UTC AOD of ~1.03 at 550 nm and strong winds around the Mongu towers reported.	Start measurements at 0715 UTC. Imaging mode is starboard, changed to downward at 0734 UTC. Cryo cooler started at 0734 UTC. Filter wheel at 2.1 μm. Imaging mode changed to BRDF at 0822 UTC. Filter wheel looked stable during the BRDF ten circles over Mongu towers. Channel 3 (0.472 μm) seemed to saturate at 36000 counts and channel 4 (0.675 μm) at 15000 counts. After BRDF (0909 UTC) restarted the instrument to investigate the data dropout problem by varying the TANS vector data rate to the CAR computer. Passed over a sunphotometer at Senanga when flying at 304.8 m (1000 ft) agl. Measurements ended at 1040 UTC.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
6 Sept.	1833	Flt. 1833: Multi–spectral & multi–angular radiometric measurements en route from Kasane, Botswana, to Pietersburg, South Africa.	Very hazy from Kasane to Pietersburg.	Start measurements at 1248 UTC. Imaging mode – downward. Measurements ended at 1339 UTC.
7 Sept.	1834	Multi–spectral & multi–angular surface and sky radiometric measurements en route Pietersburg, South Africa, to Timbavati Game Reserve near Kruger National Park, South Africa. Onto Phalaborwa toward area covered by Mapani trees for BRDF. Return to Pietersburg. BRDF over Mapani trees at two nearby locations (23.60˚ S/31.51˚ E and 23.54˚ S/31.47˚ E). Made few measurement over Pharabolwa copper mines.	Good visibility around Pietersburg and as we head west towards Kruger National Park for prescribed burn.	Started measurements at 0820 UTC. Imaging at BRDF mode—got stuck initially but changed to starboard at 0916 UTC. Filter wheel operated only from 1002–1053 UTC; not reliable during this flight. BRDF measurements started at 1059 UTC. Data dropout noted. Measurements ended at 1156 UTC.
10 Sept.	1835	Multi–spectral & multi–angular surface and sky radiometric measurements en route from Pietersburg, South Africa, to Walvis Bay, Namibia.	Hazy most of the way from Pietersburg to Walvis Bay; partly cloudy (stratocumulus) on reaching Walvis Bay area.	Start measurements at 0617 UTC. Imaging mode is starboard. Data dropout noted. Measurements stopped at 1016 UTC.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
11 Sept.	1836	Multi–spectral & multi–angular radiometric measurements en route Walvis Bay, Namibia, to off central Namibian coast, then to Kuiseb Desert on return to Walvis Bay. Terra over pass at 0942 UTC and ER-2. Reflectance measurement over the ocean through clouds, over cloud tops, and below cloud base. Two sets of BRDF measurements of "red" sand in Kuiseb Desert, south of Walvis Bay, Namibia.	Broken altocumulus above our flight level of 762 m msl and haze layer below.	Start measurements at 0855 UTC. Filter wheel at 1.6, 2.2, and 2.3 μm. Imaging at starboard mode. For the first time noted that heading read into the CAR data was magnetic not the true heading as required. This must be taken in to account for the previous flights. Stop measurements at 1116 UTC.
13 Sept.	1837	Multi–spectral & multi–angular surface (land, ocean, cloud) and sky radiometric measurements en route Walvis Bay, to off Namibian coast and on return to Walvis Bay. Multi–spectral & multi–angular radiometric measurements in cloud. BRDF measurements, 2000 ft above stratocumulus.	Cloudy lower to medium level atmosphere. Clear skies above cloud over which we made BRDF measurements.	Started measurements at 0842 UTC. Imaging at starboard mode. Filter wheel at 1.5, 1.6, and 2.2 μm. In the diffusion domain at 0940 UTC and at 20.45˚ S/13.18˚ E. ER-2 overpass at 0950 UTC when flying through stratocumulus. First set of BRDF was made between 1049-1103 UTC at 20.61˚ S/13.10˚ E; second set was made between at 1220-1255 UTC at 20.45˚ S/13.12˚ E. Data dropout noted. Stop measurements at 1321 UTC.

(Cont.)

TABLE 5.13 (continued)

Date (2000)	University of Washington Flight Number	Types of Measurements	Ambient Conditions	Notes
14 Sept.	1838	Multi–spectral & multi–angular surface (sand, ocean, cloud) and sky radiometric measurements en route Walvis Bay, Namibia, to off coast of South Africa and on return to Walvis Bay. Measurements over ship effluents right above ships (150 m msl) while off the Namibian/South African coast.	Broken clouds over land and ocean.	Start measurements at 0807 UTC. Imaging mode was starboard. No data dropout during the first two hours. Filter wheel on/off; not reliable this flight. Measurements stopped at 1218 UTC.
16 Sept.	1839	Multi–spectral & multi–angular and sky radiometric measurements en route Walvis Bay, to Etosha National Park, Namibia, and on return to Walvis Bay. BRDF over Etosha Pan (18.96˚ S/15.99˚ E) and over Mapani trees in the vicinity of the pan (19.14˚ S/15.67˚ E). Made horizontal runs over BRDF sites to make measurements for comparison with SSFR.	Clear skies above but hazy in the boundary layer.	Start measurements at 0725 UTC took measurements for 20 minutes and then lost Aircraft power. Restarted again at 0805 UTC. Data dropout noted. Filter Wheel channels show very low response. Stopped measurements at 1218 UTC.

TABLE 5.14. CLOUD CONDENSATION NUCLEUS (CCN) DATA COLLECTED ABOARD THE UNIVERSITY OF WASHINGTON'S CONVAIR-580 IN SAFARI-2000

Date (2000)	Time (UTC)*	Measurements Obtained†
10 Sep	0726	CCN spectra
	0812	CCN very consistent with CN
	0849	CCN spectra
	0855	Altocumulus cloud
	0858	CCN spectra
	0907	CCN spectra
	0917	Very clear
	0919	CCN spectra continued
	0906	Re-wetting CCN
	0934	Constant SS 0.3%
	1024	CCN measurements on the flight back to Walvis Bay
11 Sep	0913	CCN spectra
	0926	Stop CCN spectra
	0929	CCN spectra
	0957	CCN spectra
	1035	CCN spectra at 20,000 ft
	1046	CCN spectra at 10,500 ft
	1052	CCN spectra at 12,000 ft
	1122	Some measurments over the red sand dunes
	1123	Down to 7,000 ft
	1127	CCN spectra
	1141	CCN spectra
	1152	CCN spectra
13 Sep	0902	CCN spectra
	0921	Descending to just below cloud base
		CCN spectra
	0941	CCN spectra
	0955	Climbing to cloud top
	0957	CCN spectra
	1020	CCN spectra below cloud base
	1049	CCN spectra at 4,500 ft
	1109	CCN spectra
	1142	CCN spectra at 12,000 ft
	1207	CCN spectra at 9,000 ft
	1219	CCN spectra at 8,000 ft
	1227	CCN spectra
	1311	CCN spectra below cloud base

(Cont.)

* Local time = UTC + 2 hours

† "CCN spectra" refer to CCN concentrations at supersaturations (SS) of 0.1, 0.3, 0.6 and 1%.

TABLE 5.14 (Continued)

Date (2000)	Time (UTC)*	Measurements Obtained†
14 Sep	0813	CCN working
	0846	CCN spectra
	0936	CCN spectra
	1032	Re-wetting CCN
	1033	CCN operating again
	1052	CCN spectra
	1105	CCN spectra
	1114	Constant SS 0.3%
	1130	Vertical profile of CCN (spectra)
	1141	Re-wetting CCN
	1223	CCN spectra
16 Sep	0722	CCN working
	0811	Constant SS 0.3%
	0901	CCN spectra
	0907	CCN spectra
	0920	CCN spectra
	0928	CCN spectra
	1000	CCN spectra
	1025	Constant SS 0.3%
	1106	At 14,000 ft in vertical descent
	1112	CCN spectra started
	1130	CCN spectra at 6,000 ft
	1215	Re-wetting CCN
	1215	Constant SS 0.3%

* Local time = UTC + 2 hours

† "CCN spectra" refer to CCN concentrations at supersaturations (SS) of 0.1, 0.3, 0.6 and 1%.

TABLE 5.15. PHOTOGRAPHS TAKEN BY PETER V. HOBBS IN SAFARI-2000.
(Photographs can be viewed on CARG Homepage http://cargsun2.atmos.washington.edu)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
14 Aug.	1812	MVC-001X.JPG	14:09:08	Top of haze layer about 80 miles northwest of Johannesburg, South Africa.
16 Aug.	—	MVC-002X.JPG to MVC-005X.JPG	—	Work on Convair-580 at Gateway Airport, Pietersburg, South Africa.
17 Aug.	—	MVC-006X.JPG	—	ER-2 aircraft on ground. Photo taken from cockpit of Convair-580.
17 Aug.	1815	MVC-007X.JPG	10:12:36	First fire (flaming and smoldering in Kruger National Park, South Africa) studied on this flight.
17 Aug.	1815	MVC-001X.JPG	11:57:54	Cloud atop haze in Madikwe Game Reserve on South Africa/Botswana border.
18 Aug.	1816	MVC-002X.JPG	09:29:14	Fire studied in Madikwe Game Reserve on South Africa/Botswana border.
18 Aug.	1816	MVC-003X.JPG	11:56:42	Smoke and capping cumulus over fire studied in Madikwe Game Reserve on South Africa/Botswana border.
19 Aug.	—	MVC-004X.JPG	—	CARG living quarters at Eskulaap Park, Pietersburg, South Africa.
20 Aug.	1819	MVC-005X.JPG	13:37:46	Photo obscured by propeller.
20 Aug.	1819	MVC-006X.JPG	14:01:20	Madikwe Game Reserve (poor photo).

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
20 Aug.	1819	MVC-007X.JPG	14:02:00	Madikwe Game Reserve (poor photo).
20 Aug.	1819	MVC-008X.JPG	14:07:04	Prescribed fire studied in Madikwe Game Reserve, South Africa.
20 Aug.	1819	MVC-001X.JPG	15:19:40	Haze from 10,000 ft heading back from Madikwe Game Reserve on South Africa/ Botswana border to Pietersburg, South Africa.
22 Aug.	1820	MVC-002X.JPG	10:32:22	Terrain for BRDF measurements about 5 nautical miles west of Skukusa airport, South Africa.
22 Aug.	1820	MVC-003X.JPG	10:33:30	Terrain for BRDF measurements about 5 nautical miles west of Skukusa airport, South Africa.
22 Aug.	1820	MVC-004X.JPG	11:16:10	Mopane trees (??) on which BRDF measurements were obtained.
22 Aug.	1820	MVC-005X.JPG	11:36:54	Mopane trees (??) on which BRDF measurements were obtained.
24 Aug.	1822	MVC-001X.JPG	07:53:12	Clean slot near Mozambique coast.
24 Aug.	1822	MVC-002X.JPG	09:56:14	Much better photo of clean slot near Mozambique coast.
29 Aug.	1823	MVC-003X.JPG	09:50:40	Poor photo (obscured by propeller).

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
29 Aug.	1823	MVC-004X.JPG	09:56:46	Area of uniform shrub for BRDF measurements on brush and red soil near Eldorado near South Africa/ Zimbabwe border.
29 Aug.	1823	MVC-005X.JPG	10:15:32	Close-up of area of uniform shrub for BRDF measurements on brush and red soil near Eldorado on South Africa/Zimbabwe border.
29 Aug.	1824	MVC-006X.JPG	13:34:34	Area for BRDF measurements centered on Skukusa tower, Kruger National Park, South Africa.
29 Aug.	1824	MVC-007X.JPG	13:51:08	Dry riverbed in Kruger National Park, South Africa.
31 Aug.	1825	MVC-001X.JPG	11:36:24	Fires west of Beria, Mozambique, on which measurements were obtained.
31 Aug.	1825	MVC-002X.JPG	11:36:36	Fires west of Beria, Mozambique, producing smoke on which measurements were obtained.
31 Aug.	1825	MVC-003X.JPG	11:36:50	Fires west of Beria, Mozambique, producing smoke on which measurements were obtained.
31 Aug.	1825	MVC-004X.JPG	13:53:10	On top of thick haze en route back from Mozambique to Pietersburg, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
1 Sept.	1826	MVC-001X.JPG	08:50:02	Miombo vegetation near Kaoma, Zambia.
1 Sept.	1826	MVC-002X.JPG	08:58:48	Prescribed burn of Miombo near Kaoma, Zambia, on which measurements were obtained from Convair-580.
2 Sept.	1829	MVC-003X.JPG	09:42:44	Near Maun, Botswana. In free troposphere, with haze below. (TOMS overpass at 0948 UTC.)
2 Sept.	1829	MVC-004X.JPG	09:54:56	Surface near Maun tower, Botswana. (Good photo.)
2 Sept.	1829	MVC-005X.JPG	09:55:46	Surface near Maun tower (not as good as previous photo).
2 Sept.	1829	MVC-006X.JPG	10:20:36	Surface for BRDF measurements centered on Maun tower, Botswana.
2 Sept.	1829	MVC-007X.JPG	11:23:42	Nice photo showing haze below taken at altitude during climb over Maun tower, Botswana. (Good photo.)
2 Sept.	1829	MVC-008X.JPG	11:46:00	Pans in the Makgadikgadi National Park, Botswana.
4 Sept.	—	MVC-001X.JPG	07:42:04	Nice photo of ER-2 on ground at Gateway Airport, Pietersburg, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
5 Sept.	1831	MVC-002X.JPG	11:57:04	Beginning of prescribed burn of Dambo near Kaoma, Zambia, on which measurements were obtained from Convair-580. (Poor photo.)
5 Sept.	1831	MVC-003X.JPG	11:57:08	Shows fire line and smoke from prescribed Dambo burn near Kaoma, Zambia.
5 Sept.	1831	MVC-004X.JPG	11:57:14	Good photo showing fire line for prescribed burn of Dambo near Kaoma, Zambia.
5 Sept.	1831	MVC-005X.JPG	12:25:24	Smoke from prescribed Dambo fire and general haze near Kaoma, Zambia.
6 Sept.	1832	MVC-006X.JPG	08:41:44	Haze near location of BRDF measurements over Mongu tower, Zambia.
6 Sept.	1832	MVC-007X.JPG	08:45:02	Surface on which BRDF measurements were obtained centered on Mongu tower, Zambia.
6 Sept.	1832	MVC-008X.JPG	08:47:36	Surface on which BRDF measurements were obtained centered on Mongu tower, Zambia.
6 Sept.	1832	MVC-009X.JPG	08:49:14	Surface on which BRDF measurements were obtained centered on Mongu tower, Zambia.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
7 Sept.	1834	MVC-001X.JPG	08:36:32	Nice photo of prescribed fire in the Timbavati Game Reserve (near Kruger National Park, South Africa) on which measurements were obtained from the Convair-580.
7 Sept.	1834	MVC-002X.JPG	08:46:26	Smoke associated with the prescribed fire in the Timbavati Game Reserve, South Africa.
7 Sept.	1834	MVC-003X.JPG	08:59:32	Smoke plume from the Timbavati prescribed fire, South Africa.
7 Sept.	1834	MVC-004X.JPG	09:02:42	Smoke plume from the Timbavati prescribed fire, South Africa.
7 Sept.	1834	MVC-005X.JPG	09:40:48	Smoke from the Timbavati prescribed fire, South Africa.
7 Sept.	1834	MVC-006X.JPG	10:46:36	Open-pit copper mine at Phalaborwa, South Africa.
7 Sept.	1834	MVC-007X.JPG	10:47:20	Better photo of open-pit copper mine at Phalaborwa, South Africa.
7 Sept.	1834	MVC-008X.JPG	10:47:58	Open-pit copper mine at Phalaborwa, South Africa.
7 Sept.	1834	MVC-009X.JPG	11:04:32	Mopane trees on which BRDF measurements were obtained (poor photo), South Africa.
7 Sept.	1834	MVC-010X.JPG	11:06:38	Better photo (but haze) of Mopane trees on which BRDF measurements were obtained, South Africa.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
7 Sept.	1834	MVC-011X.JPG	11:20:28	Mopane trees on which second series of BRDF measurements were obtained, South Africa.
7 Sept.	1834	MVC-012X.JPG	11:22:04	Mopane trees on which BRDF measurements were obtained.
7 Sept.	1834	MVC-013X.JPG	11:52:38	Looking down on haze en route back from Kruger National Park to Pietersburg, South Africa.
7 Sept.	1834	MVC-014X.JPG	11:52:46	Looking down on haze en route back from Kruger National Park to Pietersburg, South Africa. (Better photo.) (No clean slot.)
10 Sept.	1835	MVC-001X.JPG	10:14:58	Haze layer off Namibian coast.
11 Sept.	1836	MVC-002X.JPG	09:49:16	Nice photo of “clean slot” off northern Namibian coast. (Terra and ER-2 overpasses at 0942 UTC.)
11 Sept.	1836	MVC-003X.JPG	11:29:38	Nice photo of “clean slot” off southern Namibian coast. (Namib Desert and coastline.)
11 Sept.	1836	MVC-004X.JPG	11:33:20	Contrast in visibility (compared to previous photo of “clean slot”) with few thousand feet descent into Namib Desert, Namibia.
11 Sept.	1836	MVC-005X.JPG	11:39:10	Area of Namib Desert on which BRDF measurements were obtained, Namibia.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
11 Sept.	1836	MVC-006X.JPG	11:39:22	Area of Namib Desert on which BRDF measurements were obtained, Namibia.
13 Sept.	1837	MVC-007X.JPG	09:55:02	View of cloud top between "points A and B" (Terra and ER-2 overpasses at ~0930 UTC) off Namibian coast.
13 Sept.	1837	MVC-008X.JPG	09:55:36	View of cloud top between "points A and B" (Terra and ER-2 overpasses at ~0930 UTC) off Namibian coast.
13 Sept.	1837	MVC-009X.JPG	10:51:08	Stratus cloud tops on which first set of BRDF measurements were made off Namibian coast.
13 Sept.	1837	MVC-010X.JPG	12:24:20	Stratus cloud tops on which second set of BRDF measurements were made off Namibian coast.
13 Sept.	1837	MVC-011X.JPG	12:48:28	Stratus cloud tops on which second set of BRDF measurements were made off Namibian coast.
13 Sept.	1837	MVC-012X.JPG	13:32:46	"Clean slot" over Namibia.
14 Sept.	1838	MVC-001X.JPG	08:35:46	Edge of stratiform cloud and cumulus beyond off southern Namibian coast.
14 Sept.	1838	MVC-002X.JPG	08:41:48	Edge of stratiform cloud and cumulus beyond off southern Namibian coast.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
14 Sept.	1838	MVC-003X.JPG	09:30:24	Small cumulus on which inflow, outflow and structural measurements were obtained off SW African coast.
14 Sept.	1838	MVC-004X.JPG	09:52:28	Nice photo of first freighter on which plume measurements were obtained off west coast of South Africa.
14 Sept.	1838	MVC-005X.JPG	10:26:16	Poor photo of second freighter on which plume measurements were obtained off west coast of South Africa.
14 Sept.	1838	MVC-006X.JPG	12:01:10	Namib Desert and coastline.
14 Sept.	—	MVC-007X.JPG	12:48:20	Good photo of sandstorm on ground near Walvis Bay Airport, Namibia. Same sandstorm on which measurements were obtained on landing approach from UW flight 1838.
16 Sept.	1839	MVC-008X.JPG	08:44:20	Poor photo of Etosha (white) Pan, Namibia.
16 Sept.	1839	MVC-009X.JPG	08:48:18	Poor photo of Etosha (white) Pan, Namibia.
16 Sept.	1839	MVC-010X.JPG	09:05:42	White Etosha Pan on which BRDF measurements were obtained, Namibia.
16 Sept.	1839	MVC-011X.JPG	09:27:36	Poor photo.
16 Sept.	1839	MVC-012X.JPG	09:40:44	Mopane trees in Etosha Park, Namibia, on which BRDF measurements were obtained.

(Cont.)

* Local time = UTC + 2 hours

TABLE 5.15 (Continued)

Date (2000)	University of Washington Flight Number	Photograph Code Number	Time of Photograph (hr:min:sec, UTC)*	Subject of Photograph
16 Sept.	1839	MVC-013X.JPG	09:43:26	Mopane trees in Etosha Park, Namibia, on which BRDF measurements were obtained.
16 Sept.	1839	MVC-014X.JPG	09:54:04	Nice photo of Mopane trees in Etosha Park, Namibia, on which BRDF measurements were obtained.
16 Sept.	1839	MVC-015X.JPG	09:58:08	Very nice shot of Mopane trees in Etosha Park, Namibia.
16 Sept.	1839	MVC-001X.JPG	10:36:32	Portion of Etosha Pan: red area surrounded by white.
16 Sept.	1839	MVC-002X.JPG	10:37:44	Second photo of red and white areas in Etosha Pan.
16 Sept.	1939	MVC-003X.JPG	10:56:14	Clean slot over Namibia taken at about 8,800 ft msl.

* Local time = UTC + 2 hours

6. SUMMARIES OF GOALS AND ACCOMPLISHMENTS OF THE CONVAIR-580 FLIGHTS IN SAFARI-2000

Two types of summaries for the Convair-580 flights in SAFARI-2000 are provided in this section.

The first set of summaries (given in Section 6.1 below) are those written by the Convair-580 Flight Scientist. These contain brief statements on the main goals of each flight, the general location of the flight, weather conditions, the main accomplishments of each flight, the main instrument malfunctions, and (in most cases) a timeline of activities during the flight.

Complete typed transcriptions are available for all of the in-flight voice recordings made on the Convair-580 in SAFARI-2000. These "blow-by-blow" accounts provide detailed information on what transpired on each flight. However, because of their large bulk, these transcriptions are not reproduced here in their entirety.* Instead, we give in Section 6.2 typed transcriptions of the verbal *summaries* that crew members recorded aboard the aircraft toward the end of each of the flights. Although subsequent data analyses might reveal important aspects of a flight, and of the data collected, that were unknown to crew members at the time of the flight, these summaries have the advantage of spontaneity.

6.1. Flight Scientist's Summaries

(a) University of Washington Flight 1810 (August 10, 2000)

Period of Flight (UTC): 1127-1522

Goals of Flight: Test of instruments, systems and procedures.

* Requests for copies of the complete transcriptions for specific flights should be sent to:
Professor Peter V. Hobbs
University of Washington
Department of Atmospheric Sciences
Box 351640
Seattle, Washington 98195-1640

Location: West through north quadrant out to about 90 nm from Pietersburg.

Weather Conditions:

Well mixed boundary layer. Top of boundary layer near 10,500 ft. Scattered cumulus; bases near top of boundary layer, maximum cloud tops near 15,000 ft.

Accomplishments:

1) Physical and chemical measurements (including filter and can sampling, etc.) in free troposphere.

2) Same as #1 above but near and above top of boundary layer.

Main Instrument Malfunctions:

Tansvector not calibrated.

Ophir, No_x, CN.

No audio tape from about 1319-1522 UTC.

Flight Scientist: Peter V. Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
~1135-1152	Climb to 11, 000 ft to free troposphere.
1152-1218	Sampling in free troposphere. Ionic and carbon filters on continuous sampler plus 1 HC can sample. Test of cloud physics probes in small cumulus.
1330 - 1500	9, 500 ft in haze near top of boundary layer (light scattering about 2×10^{-5} m^{-1}). Carbon and ionic filters on bag-house, Eatough filters and Buseck screen on continuous sampling. HC cans, DMPS.

(b) University of Washington Flight 1811 (August 14, 2000)

Goals of Flight:

No fuel available at Pietersburg. Therefore, transit to Lanseria (near Johannesburg) for fuel. Fueled twice at Lanseria, once for research flight 1812, and again for research flight 1813 and to return to Pietersburg with close to full tank (for possible flight on 15 Aug.).

Period of Flight (UTC): 1026-1132

Location: Transit from Pietersburg to Lanseria, South Africa, near top of boundary layer.

Weather Conditions: Scattered cumulus fractus.

Accomplishments: Measurements en route.

Main Instrument Malfunctions: See Squawk list

Flight Scientist: Peter Hobbs

Approx. UTC time (UTC = local time minus 2 hours)	Activity
SEE ABOVE	

(c) University of Washington Flight 1812 (August 14, 2000)

Goals of Flight: Profile northwest of Johannesburg, South Africa.

Period of Flight (Engines on to engines off: UTC): 1216-1505

Location: From Lanseria to about 80 miles northwest of Johannesburg, which was location for vertical profile measurements. Return to Lanseria, South Africa.

Weather Conditions: Widely scattered cumulus fractus clouds.

Accomplishments:

1) Vertical profile of boundary layer (well mixed) and into free troposphere.
2) Measurements in lower free troposphere.
3) Full set of chemistry and physical measurements at 7,000 ft.
4) Sunphotometer measurements at 200 ft.
5) Climbed to 9,700 ft.

Main Instrument Malfunctions: CAR not "talking" to Goddard computer.

Flight Scientist: Peter Hobbs

Approx. UTC time (UTC =local time minus 2 hours)	Activity
1229	Take off from Lanseria (north of Johannesburg), South Africa.
1229-1241	Climb to 10,500 ft for transit to research site (80 nm northwest of Johannesburg). Boundary layer well mixed.
1244 -1255	Climb to free troposphere (11,500 ft). Some measurements in free troposphere.
1255-1304	Descended to 7,000 ft.
1304-1426	Intensive chemical and physical measurements at 7,000 ft (all filters, 1 can, DMPS, humidigraph, BOSS, Buseck grids). Estimate of single scattering albedo 0.85; should be representative of boundary layer.
1426-1431	Descend to 500 ft agl at 500 ft/min. Run at 500 ft for sunphotometer measurements (optical depth=0.15).
1434-1443	Climb to 9,000 ft at 1000 ft/min.
1443-1456	Return to Lanseria. Intercepted (by accident) smoke plume from flaming grass fire (seen in CN and SP measurements).
1456-1503	Descent to Lanseria.
1503	Land at Lanseria, South Africa.
1505	Engines off.

(d) University of Washington Flight 1813 (August 14, 2000)

Goals of Flight:

Transit from Lanseria (refueled for possible flight on 15 Aug.) to Pietersburg, South Africa.

Period of Flight (Engines on to engines off: UTC): 1551-1649

Location: Lanseria to Pietersburg, South Africa.

Weather Conditions: Scattered clouds.

Accomplishments: Measurements en route.

Main Instrument Malfunctions: See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
1551	Engines on
1556	Take off from Lanseria, South Africa.
1556-1602	Climb to 11,000 ft
	Transit from Lanseria to Pietersburg at 11,000 ft
1634-1641	Descent to Pietersburg
1641	Land at Pietersburg, South Africa.
1649	Engines off

(e) University of Washington Flight 1814 (August 15, 2000)

Goals of Flight:

1) Underfly Terra overpass (at 0822 UTC) at Skukusa, Kruger National Park, South Africa.

2) Profile of boundary layer near Skukusa.

Period of Flight (Engines on to engines off: UTC): 0655-1115

Location: Near Skukusa, Kruger National Park, South Africa.

Weather Conditions:

Broken small cumulus and stratocumulus clouds. Good visibility (about 50 nm).

Accomplishments:

Goals #1 and #2 accomplished. Als about 30 miles west of Skukusa.

Main Instrument Malfunctions:

DMT; J-W too high; some problems with CAR.
See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0705	Take off from Pietersburg, South Africa.
0705-0711	Climb to 9,000 ft.
0711-0748	Transit to Skukusa in free troposphere at 9,000 ft.
0748-0820	Descend to 100 ft asl 2 nm west of Skukusa.
0820-0838	Runs at 100 ft east-west close to Skukusa airport (Terra overpass at 0822 UTC; about 80% low cloud cover).
0838-0842	Head west 30 nm from Skukusa to find clearer skies for sunphotometer measurements. Climb to 3,000 ft
0847-0947	Full suite of chemical and physical measurements at 3,000 ft. Measurements should be representative of well mixed boundary layer. Visibility quite good because of easterly winds and marine air.
0947-1015	Sampled smoke from two small grass fires.
1015-1036	Some cloud penetrations.
1036-1039	Climb to 9,000 ft
1039-1102	Transit to Pietersburg at 9,000 ft.
1102-1109	Descent to Pietersburg.
1109	Land at Pietersburg, South Africa.

(f) University of Washington Flight 1815 (August 17, 2000)

Goals of Flight: Measurements in Kruger National Flight (KNP), South Africa.

Period of Flight (Engines on to engines off: UTC): 0701-1213

Location: South-central KNP

Weather Conditions:

Cloudless, haze.

Accomplishments:

1) Vertical profile from 10,000 ft to 100 ft at research location (KNP).
2) "Full" chemistry and physics sampling at 4,000 ft.
3) Sampled two smoke plumes.

Main Instrument Malfunctions: CAR. See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = time minus 2 hours)	Activity
0710	Take off from Pietersburg, South Africa.
0710-0725	Climb to 10,000 ft.
0725-0748	Transit to KNP.
0748-0756	Descent from 9,700 to 100 ft.
0756-0827	Climb to 4,000 ft.
0827-0926	"Full" chemistry and physics at 4,000 ft.
0926-1100	Sampled plume from flaming and smoldering combustion of grass burning close to fire and 15 nm downwind (plume #1).
1100-1130	Sampled vertical smoke plume from larger flaming hot fire (plume #2).
1130-1208	Return to Pietersburg at 10,000 ft.
1208	Land at Pietersburg, South Africa.

(g) University of Washington Flight 1816 (August 18, 2000)

Goals of Flight:

Sample smoke from prescribed fire near Madikwe Game Reserve (on South Africa/Botswana border).

Period of Flight (Engines on to engines off: UTC): 1802-139 UTC

Location of fire: 24 deg 39 min 26.3 sec south/26 deg 23 min 18.6 sec east.

Weather Conditions: Clear

Accomplishments:

1) Partial profile of ambient air in target area prior to fire.
2) Sampled vertical smoke column just after ignition. Thin smoke.
3) Sampled across plume about 12.5 and 28 nm downwind. Thin smoke.
4) Sampled along long axis of plume heading back toward fire.
5) Sampled ambient air at 6,300 ft.
6) Sampled much thicker smoke in vertical column over fire.

7) Sampled thick smoke just below capping cumulus cloud.
8) Measurements just above base of capping cumulus

Main Instrument Malfunctions:

HC can pump, aerosol pump. Scanning humidograph malfunctioned about halfway during flight due to overheating.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0811	Take off from Pietersburg, South Africa.
0811-0850	Climb to 9,500 ft.
0850-0907	Descend to 6,000 ft 15 mins out from target area.
0907- ????	Into target area at 6,000 ft plus descent over fire site with continuous chemical sampling in ambient air for filters etc. before fire was started.
???? - 1137	Chemical and physical sampling of vertical column over fire and older smoke downwind at about 12.5 and 28 nm downwind. Flew along axis of smoke plume back to fire in fairly thin smoke; fire much more active now than in earlier sampling over fire.
1137-1215	Ambient bag sampling for chemistry at 6,300 ft.
1224	Across thick smoke in vertical plume above fire at 6,000 ft. Bag sample for filters.
1240-????	Penetration of thick smoke column just below base of capping cumulus, followed by similar penetration just above base of cloud.
	Return to Pietersburg near top of boundary layer.
1333	Land at Pietersburg, South Africa.

(h) University of Washington Flight 1817 (August 20, 2000)

Goals of Flight: Sample prescribed fire in Madikwe Game Reserve (on South Africa/Botswana border).

Period of Flight (Engines on to engines off: UTC): 0657-0705

Location: Flight aborted before take off due to flap problem.

Weather Conditions: N/A

Accomplishments: None

Main Instrument Malfunctions: N/A

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
SEE ABOVE	

(i) University of Washington Flight 1818 (August 20, 2000)

Goals of Flight:

Sample prescribed fire in Madikwe Game Reserve (on South African/Botswana border) with ER-2 overpass (at 0815 UTC) and Terra overpass (at 0841 UTC).

Period of Flight (Engines on to engines off: UTC):

0713-0819 (Flight terminated before reaching target area because of radio communication problem; subsequently found to be ATC radio problem!)

Location:

Transit from Pietersburg, South Africa, to about two-thirds of way to Madikwe Game Reserve, on South Africa/Botswana border, and back to Pietersburg in ambient haze.

Weather Conditions: Broken stratocumulus on take off, clearing en route to west.

Accomplishments:

Did not achieve goal but obtained aerosol and chemical measurements (no bag samples for chemistry) in ambient haze en route, including good humidiograph and a DMP sample.

Main Instrument Malfunctions: No "O" ring for HC can sample.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0718	Take off from Pietersburg, South Africa.
0718-0745	Transit at 9,700 ft (about 1,500 ft below main haze top).
0745-0813	Return to Pietersburg (due to radio communication problems with ATC). In good haze layer. Humidiograph measurements at 0755-0801 UTC and DMPS at 0804 UTC.
0813	Land at Pietersburg, South Africa.

(j) University of Washington Flight 1819 (August 20, 2000)

Goals of Flight:

1) Sample smoke from prescribed fire in Madikwe Game Reserve (on South Africa/Botswana border: 26 deg 40 min 32.5 sec south/26 deg 14 min 08.2 sec east). Fire lit at 0815 UTC.

Period of Flight (Engines on to engines off: UTC): 1124-1541 UTC

Location:

See above, plus transit flights from and return to Pietersburg, South Africa.

Weather Conditions:
Scattered cumulus on take off; clear on landing. Many fires and smoky in target area.

Accomplishments:

1) Full chemistry and physics on smoke from prescribed fire. Prescribed fire flared up during period on site. Many other fires in vicinity.

2) Good ambient sampling on site and in transit flights.

3) Passes beneath, in and above smoke plume (for radiometer measurements).

Main Instrument Malfunctions:

CAR filter wheel plus not full rotation capabilities. See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
1130	Take off from Pietersburg, South Africa.
1130-1150	Climb to 12,500 ft.
1150-1152	Descend to 11,100 ft.
1154-1241	Full chemistry and physics measurements in upper haze layer.
1241	Spiral down over target area (Madikwe Game Reserve).
1307-1320	Horizontal runs under, in and over smoke plume (for radiation and sunphotometer measurements).
1320-1356	Two bag samples in smoke for chemistry and physics measurements.
1411-1442	Full chemistry and physics sampling of ambient air at about 4,000 ft for comparisons with smoke.
1442-1445	Climb to 6,000 ft.
1445-1502	Gas calibrations at 6,000 ft.
1502-1505	Climb to 9,000 ft.
1505-1527	Transit to Pietersburg at 9,500-10,000 ft.
1527-1535	Descend to Pietersburg.
1535	Land at Pietersburg, South Africa.

(k) University of Washington Flight 1820 (August 22, 2000)

Goals of Flight:

1) Full profile over Skukusa Airport, Kruger National Park, South Africa, encompassing time of Terra overpass (0828 UTC) and ER-2 overpass.

2) BRDF over Skukusa instrumented tower.

3) BRDF over Mopane trees.

4) Sample emissions from Phalaborwa copper mine, South Africa.

5) Sample emissions from plantations on high veldt.

Period of Flight (Engines on to engines off: UTC): 0658-1235 UTC

Location: See above, plus map of flight path (Fig. 4.11).

Weather Conditions:
Very hazy in boundary layer. Very polluted over Kruger National Park.

Accomplishments:

1) Goal #1 accomplished. Comprehensive physical and chemical measurements, and sunphotometer and SSFR measurements at eleven levels over Skukusa airport.

2) Goal # 2 done BUT over towers to west of airport.

3) Done (but did we identify Mopane trees correctly?).

4) No measurements on emissions from Phalaborwa copper mine (insufficient time).

5) No measurements on plantations (could not find at location given).

Main Instrument Malfunctions:
PVM and JW noise in clear air. See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC time (local time = UTC time plus 2 hours)	Activity
0706	Take off from Pietersburg, South Africa.
0706-0717	Climb to 9,500 ft.
0717-0805	Transit to Skukusa at 9,500 ft.
0805-0808	Climb from 9,500 ft to 12,500 ft.
0816-1008	"Full" chemistry and physical measurements in vertical profile over Skukusa airport. Eleven horizontal runs centered on airstrip. Good sunphotometer and SSFR measurements. Terra and ER-2 overpass at 0828 UC. (Micropulse lidar at airport may have gone down during CV-580 profile due to power outage on ground).

1034-1050	Five 20 deg banked circles for CAR measurements over two red and white stripped towers about 5 nm west of Skukusa airport (NOT location of Skukusa instrumented tower, which we could not find).
1050-1100	Transit north to near Phalaborwa (23 deg 59 min S/31 deg 07 min E). No time for measurements on plant.
1116-1140	Eight CAR turns over Mopane trees (maybe!) just SW of Phalaborwa.
1140-??	Searched in vain for plantations on high veldt. Not at location given to us by SAFARI control. Therefore, no dedicated measurements over plantations.
1230	Land at Pietersburg, South Africa.

(l) University of Washington Flight 1821 (August 23, 2000)

Goals of Flight:

1) Intercomparison of state, aerosol, and gas parameters with data from the Pietersburg GPS model rawinsonde and with the two South African Aerocommanders in a simultaneous vertical profile from the surface to 16,000 ft.

Period of Flight (Engines on to engines off: UTC): 1138 to 1448

Location: Pietersburg, South Africa.

Weather Conditions:

Hazy. Isolated cumulus fractus, humilis and mediocris clouds. No winds at the surface, southerly winds aloft.

Accomplishments:

Intercomparison of CV-580 and two Aerocommander measurements, and of CV-580 state parameter with GPS brand rawinsonde.

Main Instrument Malfunctions: See Squawk list.

Flight Scientist: A. Rangno

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
1144 -1208	300 ft /minute climb to 700 mb.
1208-1217	Level flight at 700 mb with Aerocommanders.
1217 -1238	Descend to 9,000 ft then flew level flight for comparison in more homogenous aerosol layer than at 700 mb.
1238-1257	Begin slow climb to locate top of haze layer and sample clean free troposphere.
1257-1357	Sample clean free troposphere.
1357-1400	Level flight to cumulus top to sample cumulus mediocris top.
1400-1419	Descend at 500 ft /min to 850 mb after exiting cumulus tops.
1419-1432	Low level runs for aerosol samples.
1432-1436	Depart for Pietersburg and land.

(m) University of Washington Flight 1822 (August 24, 2000)

Goals of Flight:

1) Vertical profile (with "full" chemistry and physics measurements) over Inhaca Island, Mozambique, at time of Terra (0816 UTC) and ER-2 overpasses.

Period of Flight (Engines on to engines off: UTC): 0638-1130

Location:
SAFARI instrumented tower at Inhaca Is. (26 deg 01 min south /32 deg 55 min east).
Vertical profile offset by about 9 nm to north of tower to avoid cloud over island.

Weather Conditions: Scattered small cumulus over land.

Accomplishments:

1) Main goal achieved, but two higher levels (10,000 and 12,000 ft) of vertical profile not flown because of loss of one generator on CV-580, and therefore no power for instruments and computers.

Instrument Malfunctions:

Lost power to research instruments and computers at 1004 UTC.
See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0647	Take off from Pietersburg, South Africa.
0647-	Climb to 11,000 ft.
- 0800	Transit to Inhaca Is., Mozambique at 11,7000 ft.
0800-0808	Climb to 13, 000 ft off Mozambique Coast near Inhaca Is.
0810-	Descend in spiral over Inhaca airport from 13, 000 to 300 ft.
0816	Terra overpass. ER-2 overpass.
0847-1004	Level passes at 200, 2000, 4000, 6000, 8000, and 8,500 ft a few miles north of Inhaca Is. (see aircraft position plot). Horizontal and climb legs were about 5 mins long.
1004	Loss of power to research instruments and computers etc. due to failure of right engine voltage regulator.
1004-1130	Return to Pietersburg, South Africa. No measurements or recordings en route back.

(n) University of Washington Flight 1823 (August 29, 2000)

Goals of Flight:

1) Fly beneath Terra overpass (0834 UTC) and ER-2.
2) Fly beneath TOMS overpass (0930 UTC).
3) Physical and chemical characteristics of boundary layer.
4) CAR BRDF.

Period of Flight (Engines on to engines off: UTC): 0822-1114

Location: Near South Africa/Zimbabwe border

Weather Conditions: Clear

Accomplishments:

1) Done.
2) Done.
3) Done at 9,500 ft and 5,300 ft msl.
4) Done, 12 turns over uniform surface of shrubs and red soil.

Main Instrument Malfunctions:

See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0830	Take off from Pietersburg, South Africa.
0834	Terra overpass.
0803-0836	Climb to 10,000 ft.
0836-0850	Transit to research area (climb to 12,900 ft).
0850-0855	Descend to 9,500 ft.
0855-0950	Full chemistry and physical measurements.
0930	TOMS overpass
0950-0959	Descend at 500 ft/min to 5,300 ft msl (2,000 ft agl).
0959-1030	Twelve CAR turns at 2,000 ft agl over uniform brush and red soil near Eldorado.
1030-1045	Climb at 500 ft/min to 12, 500 ft (good SP drop off).
1050-1058	Cloud penetration.
1059-1107	Descend to Pietersburg.
1107	Land at Pietersburg, South Africa.

(o) University of Washington Flight 1824 (August 29, 2000)

Goals of Flight:

1) BRDF over Skukusa tower, Kruger National Park, South Africa.
2) Sample smoke from fire in Kruger National Park.

Period of Flight (Engines on to engines off: UTC): 1245-1540

Location:

Skukusa tower (25 deg 01 min 19 sec south/31 deg 30 min east), South Africa.

Weather Conditions:

Stratocumulus and cumulus at take off and in flight; clear over Skukusa.

Accomplishments:

1) Done: ten CAR circles for BRDF measurements centered on Skukusa instrumented tower (no clouds).

2) Sampled smoke several times from small smoldering fire in Kruger National Park. Also sampled older smoke on transit home.

3) HC can sample at about 200 ft agl above plantations to west of escarpment.

Main Instrument Malfunctions:

PC-BOSS not run due to power limitations. See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
1252	Take off from Pietersburg, South Africa.
1252-1300	Climb to 11,400 ft.
1300-1335	Transit to Skukusa and descend.
1335-1410	Ten circles over Skukusa tower for BRDF measurements (see PVH photos).
1415-1445	Four passes through smoke from small smoldering fire.
1445-1500	Climb, start return trip.
1500	Run at 200-300 ft above plantations. 1 HC can.
1500-1530	Climb, head back to Pietersburg.
1530	Land at Pietersburg, South Africa.

(p) University of Washington Flight 1825 (August 31, 2000)

Goals of Flight:

1) Measurements at various levels en route to Mozambique coast.
2) Sample inflow on Mozambique coast.
3) Sample fires in NE Mozambique.

Period of Flight (Engines on to engines off: UTC): 0842-1421

Location: NE Mozambique

Weather Conditions:

Clear at take off; increased stratocumulus and cumulus approaching Mozambique coast.

Accomplishments:

1) Done at 12,600, 9,000, 7,400, and 4,900 ft steps on way to Mozambique coast.

2) No time to do profiles on coast but ran at 100 ft above coastline in marine air.

3) Sampled one smoldering fire west of Beria over fire, 10 miles downwind and one run at 15 miles downwind (physical and chemical measurements over fire at 10 miles).

Main Instrument Malfunctions:

1) See Squawk list.

2) Switched in new voltage regulator from Seattle - OK.

3) No Eatough rack due to voltage regulator concerns.

4) Aerosol sphericity measurements toward end of flight suspect.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0855	Take off from Pietersburg, South Africa.
0855-0900	Climb to 12,600 ft.
0927-0929	Drop to 9,700 ft.

0929-1018	Chemical and physical measurements at 9,700 ft (increased pollution as we approached Mozambique coast).
1018-1021	Descend to 7,400 ft.
1021-1025	Run at 7,400 ft.
1025-1029	Descend to 4,900 ft
1029-?	Run at 4,900 ft.
~ 10 minutes	Run along shoreline at 100 ft.
1055-1100	Climb above scattered cloud top.
1100-1121	Head north then NW searching for fires.
1125-1225	Sampled smoldering fire. 1) 3 penetrations over fire. Grab bag on 1st and 3rd penetration. 2) 10 miles from fire: 2 bags in thickest smoke (low down) 1 penetration (for HC can and FTIR) near top of smoke. 3) 15 miles downwind: 1 penetration for physical measurements (no bag) and 1 HC can in thickest smoke.
1225	Start back.
1225-1328	Return to Pietersburg at 12,800 ft. Penetrated strong smoke at 12,800 ft from fire below.
1337-1349	Another lofted plume (bag sample). Head back to Pietersburg.
1421	Land (good sunphotometer measurements on descent) at Pietersburg, South Africa.

Additional Comments:
1) Aerosol single-scattering albedo = 0.76!
2) Lower humidity factor in smoke

(q) University of Washington Flight 1826 (September 1, 2000)

Goals of Flight:

1) Sample prescribed burn of Miambo near Kaoma, Zambia (14.818˚ south/24.47 east).

2) Terra overpass at 0902 UTC.

Period of Flight (Engines on to engines off: UTC): 0532-1108

Location: Kaoma, Zambia, and Kasane, Botswana.

Weather Conditions:

Clear at take off; increasing smoke heading into Zambia.

Accomplishments:

Goals 1) and 2) done.

3) Also, chemical and physical measurements over fire and at 7 and 4 nm downwind, and run along length of plume from head of fire.

4) Measurements en route from Pietersburg, South Africa, to Kaoma, Botswana, and from Kaoma to Kasane, Zambia.

Main Instrument Malfunctions:

See Squawk list.
(Two new voltage regulators on—both OK).

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0540	Take off from Pietersburg, South Africa.
0540-0550	Climb to 12,700 ft.
0550-0838	Transit at 12,700 ft to top of boundary layer, then to 8,500 ft after crossing South Africa/Zambia border, then at 6,200 ft. Nice sunphotometer profile into Kaoma.
0838	Arrive at fire (pilot's wind 070˚/11 kts).
0846	Fire ignition.
0857	1st pass through smoke column close to fire.
0901	2nd pass through smoke column (1st grab bag).
0902	Terra overpass.
0902-0919	3rd pass through smoke plume. 4th pass through smoke plume. 6th pass through smoke plume.

0919	7th pass through smoke plume (2nd grab bag).
0926-0933	Run along length of plume from head of fire.
0947-1007	Crossed width of plume at 7 nautical miles downwind; very thin smoke (1 grab bag). Another penetration across width of plume (without bag sample) at 7 nautical miles downwind. Penetration across plume (no bag) at 4 nautical miles downwind of fire (no bag). Second crossing of plume at 4 nautical miles downwind (no bag). Third crossing of plume at 4 nautical miles downwind (grab bag). Fourth crossing of plume at 4 nautical miles downwind (1 HC can sample).
1007	Finished working on plume.
1007-1108	Return to Kasane, Botswana, to refuel.

(r) University of Washington Flight 1827 (September 1, 2000)

Goals of Flight:

Recalled by Botswana ATC on runway before take off (to pay "passenger" fee!).

Period of Flight (Engines on to engines off: UTC): 1229-1241

Location: Kasane, Botswana.

Weather Conditions: Clear

Accomplishments: None

Main Instrument Malfunctions: N/A

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
SEE ABOVE	

(s) University of Washington Flight 1828 (September 1, 2000)

Goals of Flight:

Transit Flight from Kasane, Botswana, to Pietersburg, South Africa.

Period of Flight (Engines on to engines off: UTC): 1329-1551

Location: Kasane, Botswana, to Pietersburg, South Africa.

Weather Conditions:

See verbal summary of flight.

Accomplishments:

Measurements near top of boundary layer en route from Kasane to Pietersburg. Occasional smoke plumes at 13, 600 ft. Three layers on descent into Pietersburg.

Main Instrument Malfunctions:

Sunphotometer switched off due to low sun angle.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
SEE ABOVE	

(t) University of Washington Flight 1829 (September 2, 2000)

Goals of Flight:

1) Profile over instrumented Maun tower, Botswana (19˚ 55' S/23˚36' E) for closure study. TOMS overpass at 0948 UTC.

2) BRDF over instrumented Maun tower, Botswana.

Period of Flight (Engines on to engines off: UTC): 0736-1334

Location: Pietersburg, South Africa, to Maun, Botswana, return to Pietersburg.

Weather Conditions:

Cloudless, hazy.

Accomplishments:

1) Good profile in very uniformly mixed haze from 100 agl to 14,800 msl. Full physical and chemical measurements (single scattering albedo ≅ 0.75!!).

2) Eight CAR turns over Maun tower at 2,000 ft.

3) Continuous filter + PC-BOSS + HC cans at 10,500 ft/msl on transit from Pietersburg to Maun.

4) Continuous filter + PC-BOSS + HC cans at 11,500 ft/msl on transit from Pietersburg to Maun.

Main Instrument Malfunctions:

See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0743	Take off from Pietersburg, South Africa.
0743-0938	Transit to Maun at 10,500 ft.
0938-0952	Climb to 14,700 ft 15 minutes out from Maun, Botswana.
0948	TOMS overpass.
0952-1010	Spiral descent at 19˚ 55' south/23˚ 36' east (latitude/longitude of Maun tower) from 14,700 msl to 100 agl.
1010-1012	Constant altitude run at 100 ft over Maun tower.
1013-1017	Climb to 2,000 ft agl.
1020-1046	Eight CAR turns at 2,000 ft agl over Maun tower.

1046-1051	Climb to 7,680 ft msl.
1051-1056	Constant altitude run at 7,680 ft.
1056-1103	Climb to 9,600 ft msl
1103-1110	Constant altitude run at 9,600 ft.
1110-1113	Climb to 11,800 ft.
1113-1120	Constant altitude run at 11,800 ft.
1120-1124	Climb to 14,800 ft (in free troposphere).
1124-1129	Constant altitude run at 14,800 ft.
1129-1139	Start return trip. Descend to 9,500 ft.
1139-1148	Transit at 9,500 ft.
1148-1150	Climb to 11,570 ft.
1150-1326	Transit at 11,400 ft.
1326	Land at Pietersburg, South Africa.

(u) University of Washington Flight 1830 (September 3, 2000)

Goals of Flight:

1) BRDF's over grass and white pan in Sua Pan (parabola and grassland sites), Botswana, at 20˚ 34.63' south/26˚ 04.82' east for BRDF.

2) Spiral profile and low-level run over Sua Pan. Terra overpass at 0852 UTC.

3) Power plant plume at Matimba, 23˚ 43.6' south/27˚ 41.31' east.

Period of Flight (Engines on to engines off: UTC): 0702-1238

Location: Sua Pan, Botswana.

Weather Conditions: Thick haze, and smoke

Accomplishments:

1) Done, although extremely thick smoke and strong winds (>15 kts) caused some delays in executing the BRDF circles due to excessive drift and difficulty visually locating good sites. 1st BRDF over grass/trees partially satisfactory—but considerable inhomogeneity. Second BRDF far better with good homogeneity at surface.

2) Vertical profiles went well with some "enhancements" to the vertical profile climb in the form of 5 minute legs at 100 ft agl over Sua Pan, 8,000 ft, and 15,000 ft.

Radiometer and sunphotometer measurements impacted by scattered cirrus clouds that were occasionally overhead of the aircraft.

3) Could not sample power plant due to lack of time.

4) Excellent data in long ferry legs to and from site at 10,700 and 8,000 ft, respectively, in thick homogeneous (old?) smoke. No real plumes detected. No fires sighted, although poor visibility made it unlikely that any but very close would have been seen.

Main Instrument Malfunctions:

See Squawk list.

Flight Scientist: A. Rangno

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0710	Take off from Pietersburg, South Africa.
0710-0718	Climb to 10,600 ft.
0718-0818	Transit at 10,400 ft. Chemical and physical measurements at 10,600 ft (gradually increasing pollution approaching Sua Pan).
0818-0829	Climb to near free troposphere at 15,100 ft.
0829-0833	Run at 15,100 ft for sunphotometer.
0833-0843	Descend in spiral to 100 ft agl
0843-0856	Run at 100 ft agl over grass/brush/trees to sand of Sua Pan; about equal time over grass/brush/trees and Sua Pan. Terra overpass at 0852 UTC.
0856-0858	Climb to 2,000 ft agl.
0858-1001	BRDF circles at 2,000 ft agl at 2 sites, grass/brush/trees near Sua Pan and over Pan itself.
1001-1005	Descend to 100 ft agl for straight run over Sua Pan marking the start of the vertical profile.
1005-1013	Straight run over Sua Pan at 100 ft agl.
1013-1018	Spiral climb over Sua Pan. Climb to 8,400 ft for mid-point of aerosol layer sampling.
1018-1028	Straight run at 8,400 ft.
1028-1037	Spiral climb to 15,000 ft and free troposphere over Sua Pan.

1037-1046	Level run at 15,100 ft over Sua Pan and beyond for sunphotometer and aerosol measurements.
1046-1054	Descend into thick smoke at 8,400 ft for chemical measurements at a different level than those en route to Sua Pan.
1054-1217	Ferry leg to Pietersburg. Chemical and aerosol measurements in extremely thick relatively homogeneous haze and smoke.
1217-1223	Descend to land.
1223	Land at Pietersburg, South Africa.

(v) University of Washington Flight 1831 (September 5, 2000)

Goals of Flight:

1) Measurements on transit from Pietersburg, South Africa, to Kaoma, Zambia.

2) Measurements on prescribed burn of grass (Diomba) near Kaoma, Zambia, at 14˚ 48' 34" south/24˚ 27' 03" east.

3) Measurements on transit from Kaoma, Botswana, to Kasane, Zambia.

Period of Flight (Engines on to engines off: UTC): 0838-1413

Location:

Kaoma, Zambia; Senanga, Zambia; Kasane, Botswana.

Weather Conditions: Overcast

Accomplishments:

Goals 1) through 3) achieved.

Also, passed over Senanga, Zambia, en route and descended over Senanga, Zambia.

Additional Comments:

Crew stayed overnight in Kasane.

Main Instrument Malfunctions:

FSSP-300 remounted but still no measurements.
PVM noisy toward latter part of flight.
Audio tape back tracking on occasions.

See also Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0844	Take off from Pietersburg, South Africa.
0844-0850	Climb to 10,500 ft.
0850-0941	Transit at 10,500 ft ($b_s = 1x10^{-4}$ per m) (optical depth about 0.8 at 10,500 ft!).
0941-0944	Climb to 11,850 ft.
0944-1012	Transit at 11,850 ft
1011-1016	Climb to 12,900 ft.
1016-1036	Transit at 12,900 ft.
1036-1037	Climb to 13,953 ft.
1037-1054	Transit at 13,953 ft.
1054-1101	Descend to 9,500 ft.
1101-1134	Transit at 9,500 ft.
1134-1139	Descent at 500 ft/min to 2,000 ft agl over prescribed Diomba fire site (top of convective boundary layer at 8,600 ft).
1150	Fire ignition (wind near surface ENE/5,000-10,000 ft).
~115?	1st pass of smoke over fire at 500 ft agl. 2nd pass of smoke over fire at 500 ft agl. 3rd pass of smoke over fire at 500 ft agl (1st bag sample) (see PVH's photos of fire). 4th pass at 500 ft for physical measurements. 5th pass at 500 ft for physical measurements. 6th pass of 500 ft for physical measurements. 7th pass of 500 ft for 2nd bag sample. 8th pass of 500 ft for physical measurements. 9th pass of 500 ft for physical measurements.

	10th pass of 500 ft for physical measurements. 11th pass at 500 ft for 3rd bag sample.
?? (See transcript of verbal flight recording.)	Pass at 500 ft through the plume at a short distance downwind for physical measurements. Weak smoke signals (no bag). Ambient air sampling in vicinity of fire.
1245-1252	Head to Senanga, Zambia.
1257-1413	Descent from 11,000 ft to 1,580 ft on approach to Senanga (OD at 1,580 ft = 1.5).
1413	Land at Kasane, Botswana.

(w) University of Washington Flight 1832 (September 6, 2000)

Goals of Flight:

1) Low-level pass on south-to-north line from Senanga, Zambia (16˚ 0.69' south/23˚ 17.86 east).

2) BRDF over instrumented Mongu tower, Zambia (15˚ 26' south/23˚ 15' east).

3) Vertical profile over Mongu Airport (lidar) in Zambia at 15˚ 15.26' south/23˚ 19.03' east (check 09.03' ?) with ER-2 overpass.

Period of Flight (Engines on to engines off: UTC): 0700-1058

Location: Kasane, Botswana; Senanga, Zambia; and Mongu, Zambia.

Weather Conditions: Haze and altocumulus.

Accomplishments:

Goals 1) through 3) all done very well. (Extended south-to-north low-level pass to some distance north of Mongu.)

Main Instrument Malfunctions:

See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0711	Take off from Kasane, Botswana.
0711-0721	Climb to 12,600 ft.
0722-0746	Transit to just south of Senanga at 12,600 ft.
0746-0756	Descend to 500 ft agl over Senanga.
0756-0813	Run north at 500 ft agl through Mongu Airport.
0813-0817	Descend to 100 ft agl just north of Mongu and run north.
0817-0821	Climb to 1,000 ft, run north.
0821-0824	Turned back to southerly heading about 20 miles (?) north of Mongu (climb to 2,000 ft.
0824-0835	Head south at 2,000 ft to Mongu Tower (tower identified near road crossing).
~0847-0856	First five BRDF turns drifting over tower (strong wind).
0856-0908	Second five BRDF turns (repeat of 1st 5 turns in terms of location). ER-2 overhead - confirmed.
0912-0917	To Mongu Airport then 5 min level run at 500 ft agl over airport.
0917-0933	Climb from 500 ft to ~15,000 ft msl.
0933-0938(?)	5 min. level run over Mongu Airport at ~15,000 ft. Spiral down over airport to 9,000 ft level. Level run at 9,000 ft over airport for 5 minutes.
0952-0957	Descend to 5,000 ft level run at 5,000 ft over airport.
0957-1015	Start return to Kasane, but climb to 17,000 ft msl on leaving Mongu airport.
1015	Descend to lower altitude and return to Kasane, Botswana.

(x) University of Washington Flight 1833 (September 6, 2000)

Goals of Flight:

Return from Kasane, Botswana, to Pietersburg, South Africa, with measurements en route.

Period of Flight (Engines on to engines off: UTC): 1133-1354

Location: Kasane, Botswana, to Pietersburg, South Africa.

Weather Conditions: Thick haze

Accomplishments:

Goal of flight achieved.

Additional Comments:

See PVH's comments on tape about profile out of Kasane and en route.

Main Instrument Malfunctions:

FSSP-300.

PMS improved with zeroing.

See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
1143	Take off from Kasane, Botswana.
1143-1152	Climb to 12,600 ft.
1152-1239	Transit at 12,600 ft (upper 1/3 of boundary layer) in profile out of Kasane).
1240-1245	Descend to 10,000 ft.
1246-1317	Transit at 10,000 ft.

~1240-1256	Heater on PCASP switched from off to on to off. Check size of spectrum to see if any RH effect on aerosol in going from aerosol RH (low) to even drier. (See PVH's comments on tape (~1230 UTC) about effect of RH on light scattering for changes in RH at low RH).
1317-1322	Descend to 9,400 ft.
1322-1330	Transit at 9,400 ft.
1330-1333	Descend to 7,800 ft (top of convective boundary layer at 8,400 ft) increase in CN and light scattering
1333-1340	Transit at 7,800 ft.
~1340-1349	Descent to Pietersburg.
1349	Land at Pietersburg, South Africa.

(y) University of Washington Flight 1834 (September 7, 2000)

Goals of Flight:

1) Sample large (1,000 ha) prescribed fire west of Kruger National Park, South Africa, at 24˚ 23' south/31˚ 15' 18" east (the Timbavati Game Park fire).

2) BRDFs on Mopane trees at 23˚ 44' south/31˚ 36' east, South Africa.

3) Sample Phalaborwa Copper Mine (23˚ 44' south/31˚ 36' east) South Africa.

Period of Flight (Engines on to engines off: UTC): 0755-1220

Locations:

Kruger National Park, Phalaborwa, and Mopane, South Africa.

Weather Conditions:

South Atlantic high bringing cleaner air to Pietersburg (conditionally unstable and dry).

Accomplishments:

1) Done—largest fire sampled in SAFARI-2000. Very good measurements with relatively clean background.
2) Done—two sets of five circles for BRDF measurements of Mopane trees in two locations.
3) Done briefly (two penetrations) on way to Mopane site.

Additional Comments:

Late take off (about an hour) due to failure of fuel pump on Gateway fuel truck.

Main Instrument Malfunctions:

1) FSSP-30
2) Cambridge dew point too high—dirt?
3) PVM noisy until zeroed.

See also Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0806	Take off from Pietersburg, South Africa.
0806-0831	Climb to 11,600 ft.
0816-0831	Transit at 11,600 ft.
~0820	Fire ignition.
0831-0836	Descend to fire
0836	Start study of fire plume.
0843	1st pass across plume near fire head (1st bag). 2nd pass across plume 3 nautical miles downwind. 3rd pass across plume 5 nautical miles downwind. 4th pass across plume near fire head (2nd bag). 5th pass in upper 1/3 of plume about 5 nautical miles downwind. 6th pass across plume center at 5 nautical miles (3rd bag) 7th pass in upper filaments of smoke, separated from main plume at 3,000 ft agl and 10 nautical miles downwind. 8th pass in upper filaments of smoke, separated from main plume at 3,000 ft agl and 10 nautical miles downwind. 9th pass at 5 nautical miles through main plume (4th bag—2nd at 5 nautical miles).

	Run from fire head along length of plume out to about 23 nautical miles downwind (physical measurements only). 10th pass across plume at 500 ft (physical measurements) at 18 nautical miles downwind. 11th pass across plume at 500 ft (5th bag at 18 nautical miles downwind). 12th pass below main smoke plume at 18 nautical miles downwind. 13th pass above main smoke plume at 18 nautical miles downwind. 14th pass at 18 nautical miles downwind at 500 ft (main smoke) 6th bag—2nd at 18 nautical miles downwind, follow smoke downwind along plume length as we headed north to Mopane site. Two penetrations of plume from Phalaborwa copper plant at 2 distances downwind.
1105-1120	1st group of five circles for BRDF measurements of Mopane trees.
1113	Pilot's wind 200 mag/17 kts.
1122-1135	2nd group of five circles for BRDF measurements of Mopane trees.
1135	Leave CAR site, head back to Pietersburg.
1214	Land at Pietersburg, South Africa.

(z) University of Washington Flight 1835 (September 10, 2000)

Goals of Flight:

Transit of CV-580 base of operation from Pietersburg, South Africa, to Walvis Bay, Namibia, with measurements en route.

Period of Flight (Engines on to engines off: UTC): 0558-1025

Location:

Pietersburg, South Africa, to Walvis Bay, Namibia.

Weather Conditions:

Cloudless sky on take off, scattered altocumulus on landing.

Accomplishments:

Goal accomplished.

Main Instrument Malfunctions:

See Squawk list

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
SEE ABOVE	

(aa) University of Washington Flight 1836 (September 11, 2000)

Goals of Flight:

Obtain measurements in marine stratus off Namibian coast beneath Terra overpass at 0942 UTC and ER-2 overpass.

Period of Flight (Engines on to engines off: UTC): 0835-1222

Location: Off central Namibia coast.

Weather Conditions: Thin broken stratus.

Accomplishments:

1) Flew beneath Terra track but only encountered very thin broken stratus. Some measurements in below and above thin broken stratus.

2) Vertical profile to 12,200 ft in clear air for sunphotometer and in situ comparisons.

3) Two sets of five BRDF measurements of sand in Kuiseb Desert just south of Walvis Bay, Namibia (at 23 deg 23 min 44 sec south/14deg 38 min 38 sec east).

Main Instrument Malfunctions:

1) "New" PVM probe has large noise spikes in cloud.

2) Sunphotometer not working after vertical profile to 12,800 ft.

3) See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0843	Take off from Walvis Bay, Namibia.
0843-0901	Climb to 12,800 ft.
0901-0928	Transit at 12,800 ft to get under Terra track.
0928	Descend to thin broken stratus cloud. 10 deg temp inversion above cloud top.
0940-0948	Search for thicker and more extensive stratus.
0955-1000	180 deg turn and head south to location where ER-2 reported more extensive stratus. Some measurements above, in and below thin broken status. Ran out of stratus completely heading south.
1000-1030	Continued hunting (in vain) for suitable stratus.
1030-1100	Climb to 12,200 ft for sunphotometer and in situ profile.
1100-1137	Head back to shore, descending in steps.
1138-1208	Two sets of five CAR turns for BRDF measurements of sand in Kuiseb Desert (23 deg 23 min 44 sec south/14 deg 38 min 38 sec east). (Two photos of sand by PVH.)
1208	Return to Walvis Bay.
1222	Land at Walvis Bay, Namibia.

(bb) University of Washington Flight 1837 (September 13, 2000)

Goals of Flight:

1) Underfly TERRA and ER-2 off Namibian Coast. Terra overpass at ~0930 UTC (1130 local) at 20˚ 56' south/13˚ 04.8' east (point A) to 20˚ 26.7' south/13˚ 11.2' east (point B).

2) BRDF over Etosha National Park, Namibia.

Period of Flight (Engines on to engines off: UTC): 0826-1416

Location:

Off Namibian coast under Terra and ER-2.

Weather Conditions:

Stratus at take off and in flight.

Accomplishments:

Goal #1 done fully.

Goal #2 not done (no time).

3) Vertical profile with chemical measurements from above cloud top to 16,800 ft.

4) Two sets of BRDF measurements on two different cloud tops.

Main Instrument Malfunctions:

See Squawk List. (Seem to be getting good agreement between FSSP, JW and PVM, and maybe DMT, LWC; but noise on PVM and occasionally on JW.)

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0836	Take off from Walvis Bay, Namibia.
0836-0843	Climb.
0845-0853	Run at 1,500 ft above cloud top.
0855-0900	Run in stratus off coast while heading for point A.
0900-0904	Run below cloud base.

0906-0911	Run 1,500 ft above cloud top.
0914-0919	Run in cloud.
0920-0928	Run below cloud base between points A and B.
0930	Terra overpass; ER-2 above.
0930-0940	Run in stratus between points A and B.
0940-0948	Run below cloud base between points A and B (CCN spectra).
0950-0955	In cloud between points A and B.
0957-1009	1,500 ft above cloud top between points A and B (2 photos).
1011-1017	In cloud heading to A.
1018-1027	Below cloud base heading to A, then to B.
1028-1038	In cloud A to B; above cloud B to A.
1048-1102	5 CAR turns for BRDF of cloud tops (pilot's wind 250 mag/5 kts). Descend to just above cloud top.
1111-1115	Run just above cloud top to NE.
1115-1134	Spiral upward at 1,000 ft per minute to 16,800 ft.
1135-1140	Descend to 13,000 ft.
1140-1200	Level at 13,000 ft for complete set of filter etc. samples. (Clear slot just above cloud top, followed by uniformly polluted layer above.)
1201-1212	Descend to 9,488 ft.
1212-1214	Descend to 8,400 ft.
1214-1220	Run at 8,400 ft.
1220-1225	Descend to 5,600 ft (clear slot).
1225-1255	10 turns for BRDF of stratus cloud tops.
1255-1258	Descend to cloud top in same location.
1258-1300	Run above cloud top.
1300-1310	In cloud, heading back to Walvis Bay.
1310-1314	Below cloud base heading back to Walvis Bay.
1314-1328	In cloud.
1328-??	Above cloud top.
??	Hand over to pilots for cabin pressure checks. Should have some measurements on dust during landing approach.
1413	Land at Walvis Bay, Namibia.

(cc) University of Washington Flight 1838 (September 14, 2000)

Goals of Flight:

Measurements off Namibian and South African Coasts.

Period of Flight (Engines on to engines off: UTC): 0800-1232

Location:

Off coasts of Namibia and western South Africa.

Weather Conditions:

Passed through cold front on trek south.

Accomplishments:

1) Measurements of outflow, inflow and cloud structure in small cumulus congestus in postfrontal air.

2) Measurements of effluents from two freighter ships.

3) Vertical profile for sunphotometer and in situ measurements from surface to 12,000 ft in fairly clean postfrontal air just behind altocumulus overhang.

Main Instrument Malfunctions:

Humidiogram not working (filter destroyed on previous flight).

See also Squawk List.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0808	Take off from Walvis Bay, Namibia.
0808-0821	Climb to 10,000 ft.
0821-0907	Transit south at 10,200 ft through frontal overhang (moderate turbulence) and into postfrontal region. Measurements of outflow, inflow and cloud structures of small cumulus congestus.

0955-1024	Measurements of effluents from first freighter ship. Two grab bags for chemistry etc.
1024-1115	Study of emissions from 2nd freighter ship. Two grab bags for chemistry etc.
1115-1130	Head back to northeast.
1130-1139	Vertical profile to 12,000 ft for sunphotometer and in situ measurements in postfrontal air just clear of altocumulus overhang.
1139-	Head back to Walvis Bay. Physical measurements in sandstorm on descent into Walvis Bay.
1232	Land at Walvis Bay, Namibia.

(dd) University of Washington Flight 1839 (September 16, 2000)

Goals of Flight:

BRDF over Etosha National Park, Namibia.

Period of Flight (Engines on to engines off: UTC): 0709-1245

Location:

Etosha National Park, Namibia.

Weather Conditions:

Cloudless over Etosha National Park.

Accomplishments:

1) BRDF over white Etosha Pan at 18 deg 58 min 22 sec south/16 deg 00 min 5 sec east.

2) BRDF over Mopane trees.

3) Vertical profile from 200 ft to 12,500 ft over ground-based sunphotometer in Etosha National Park (19 deg 11 min south/15 deg 55 min east).

4) Measurements en route back to Walvis Bay.

5) Measurements in dust storm on descent into Walvis Bay, Namibia.

Main Instrument Malfunctions:

No power from 0745-0750 UTC.

See Squawk list.

Flight Scientist: Peter Hobbs

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
0717	Take off from Walvis Bay, Namibia.
0717-0733	Climb to 11,200 ft.
0733-0830	Transit north at 11,200 ft.
0830-0836	Climb to 13,600 ft.
0836-0839	Climb to 14,700 ft.
0839-0854	Descend to 400 ft (Pilot's wind estimate: 320 mag/40 knots at 14,000 ft).
0904-0917	Five circles for BRDF of white pan in Etosha National Park at 18 deg 58 min 22 sec south/16 deg 00 min 5 sec east.
0917-0920	Transit at 200 ft to 2nd BRDF site
0920-1001	Continue transit to 2nd BRDF site at 200, 700, 1200, and 1700 ft agl. Five circles for BRDF of Mopane trees.
1001-1018	Transit to 18.50 deg south/15.40 deg east at 200, 700, 1200, and 2,000 ft to look for burn-scar site; did not find site.
1018-???	Transit to 18.90 deg south/15.40 deg east to look for "open shrub" site; did not find site.
1040-1052	Transit to Etosha sunphotometer site at 19 deg 11 min south/15 deg 55 min east.
1052-??	Vertical profile near Etosha sunphotometer ground site from 200 ft to 15,700 ft and then down to 6,000 ft. Continuous sampling for ionic and carbonaceous filters and TEM. HC can samples in upper and lower aerosol layers.
???-1241	Transit back to Walvis Bay. Some penetrations of small cumulus clouds near Walvis Bay.
	Measurements in dust storm on descent into Walvis Bay.
1241	Land at Walvis Bay, Namibia.

(ee) University of Washington Flight 1840 (September 18, 2000)

Goals of Flight: Transit of Convair-580 from Walvis Bay, Namibia, to Pietersburg, South Africa. (No research crew aboard and no measurements made.)

Period of Flight (Engines on to engines off: UTC): ???

Location:

Walvis Bay, Namibia, to Pietersburg, South Africa.

Weather Conditions: Not recorded.

Accomplishments: Goal achieved.

Main Instrument Malfunctions: N/A

Flight Scientist: None

Approx. UTC Time (UTC = local time minus 2 hours)	Activity
SEE ABOVE	

6.2. Transcriptions of In-Flight Verbal Summaries[*]

(a) University of Washington Flight 1810 (August 10, 2000)

No summary.

(b) University of Washington Flight 1811 (August 14, 2000)

11:21 AM

[*] AR = Art Rangno, BM = Brian Magi, BS = Beat Schmid, BS = Bob Swap, BY = Bob Yokelson, CG = Charles Gatebe, CI = Calvin Ingram, DE = Delbert Eatough, DS = Don Spurgeon, GG = Grant Gray, HA = Harold Annegarn, IB = Isaac Bertschi, JL = Jason Li, JR = Jerry Rhode (Pilot), JR2 = Jens Redemann, KR = Kristy Ross, LS = Larry Sutherland (Pilot), MK = Michael King, PH = Peter Hobbs, PR = Phil Russell, RB = Roelof Bruintjes, RS = Ricky Sinha, RW = Ray Weiss, TC = Ted Christian, TK = Tom Kirchstetter, TS = Tim Suttles, TW = Tom Wilson, ZS = Zan Sutherland (Pilot)

PH: This was basically a transit flight to the northern Johannesburg area (Lanseria airport) to get gas. We've been playing around with the instruments and seeing what's working and what's not.

(c) University of Washington Flight 1812 (August 14, 2000)

2:27 PM

PH: Let's summarize on the tape what we've been doing for the past hour or more. Who's ready to go?

RS: This is Ricky. I can summarize the chemistry measurements. I took 1 can sample at 7,000 ft.

RS: We have one can sample for that 1 hr leg. The CO, CO_2, SO_2, and ozone have also been recorded. There appears to be no detectable CO or SO_2. The ozone and CO_2 have been steady. I did a calibration of the CO_2 to make sure that the value we've recording is reasonable. That's it.

PH: Anyone else on the line?

RW: I am.

PH: Ray, tell us what you did.

RW: All the instruments worked well in the homogeneous plume.

RW: The nephelometers all agreed including the bag-house nephelometer, which is running on continuous samples and also on the bag. We had two humidograms and they both worked well. We've got about a factor to increase in scattering from about 20% to 80% RH. That's about it. Everything seemed to work fine. Single-scattering albedos looked like they were around 0.8 to 0.85.

PH: Is the PSAP is working okay?

RW: Yes. It does at this level.

PH: A single scattering of 0.85 you think?

RW: That's what it looks like.

PH: In the green?

RW: In the green.

PH: Is Tom Kirchstetter there?

AR: He's off his headset. I could say a few words if you like.

PH: Okay Art. Go ahead.

AR: The synoptic situation is one where we have a strong anticyclone extreme southern South Africa eastward flow, moving around Johannesburg and then increasing in strength northward. Also a very strong subsidence above the boundary layer. The boundary layer itself is located around 1,500 ft over Johannesburg as we took off on this flight. At Johannesburg we found an upper layer situated on top of the one that's the boundary layer, which we sampled out of there as we left. Then we exited that layer and then found a kind of a rural area in which we sampled homogeneously mixed aerosols with the exception of the very tail end of the flight. We're definitely here at 4:30 and this is something Bob Swap talked about the rapid decoupling that begins to occur between 4 and 5 o'clock. It's beginning to become evident if you look out the window you can see something looking like stratiform haze down there at the bottom here. Off the left wing here I can see some of the stratification is below the tops of these little hills. So it's only 100 to 200 ft high at the most. Where we're starting to see some of the stuff get trapped at the bottom. I guess that's about it. We had some cumulus fractus. I'll add that one little thing.

PH: Is Tom ready to go yet? Anyone else on their headset? What about Bob Yokelson, does he want to say something? What about Beat Schmid? Summarize for the tape what you've done today.

BS: Yes. While the sunphotometer was working continuously it lost track only very briefly probably less than 10-20 s and that was required for the sun. So it always took data, no problem, with the exception as I said before. I don't know how the window looks because we didn't have a chance to get on the roof and it's impossible to tell from the data alone. I started taking data immediately during taxiing and all the way through. So we can continue on as long as we have power.

BS: I forgot to say that we lost the lat/long for awhile. I don't know if that was just the communication or what. Tom?

TW: It was just a momentary outage. It wasn't more than like a minute or two.

BS: Do you have it on the file?

TW: No, it was out for like a minute.

BS: So everything was out?

TW: Yes.

BS: So that means also backup for that time?

TW: Exactly.

BS: So then we will not have any reasonable data for that time that seems to be brief.

AR: Since we're flying a straight track you can interpolate pretty accurately.

END OF TAPE SIDE ONE

2:35 PM

PH: Is Tom Kirchstetter there now?

TK: I'm here.

PH: Would you summarize for the tape what you've done?

TK: Sure. Today on flight 1812 I collected two sets of TEM grids on Peter Buseck's system; one beginning at 13:08:46 and ending at 13:38:46, and the second beginning at 13:39:30 and ending at 14:24:00. I collected one set of filter samples on the PC-BOSS for Delbert Eatough. That began at 13:07:43 and ended at 14:24. All systems worked fine with no obvious problems.

PH: Good. Brian, are you there?

BM: Yes. Can you hear me?

PH: Yes I can.

BM: 13:09 to 14:26 collected two filter samples from ambient haze. The filter samples were quartz-quartz. The filter holder #3 and Teflon-quartz filter holder #3 with Teflon filter #3 in the filter holder. The flow rates for these samples began at about 22 liters/min and then went to 65 liters/min at 13:20 for an unknown reason. It seemed to coincide with a bag-house sample fill, but then I reduced the flow to 45 liters/min at about 14:15 to check volume accuracy on the flow meters. There was one bag purge at 12:56 and one bag sample collected at 13:26. The bag sample was used for the DMPS at 13:28 and 13:34. The bag sample was also routed to the bag-house nephelometer and the bag-house nephelometer, just penciling down values, ranged between 3.6×10^{-5} and 5.6×10^{-5} with the higher values tending to be at the beginning of the bag-house sample. So the one problem I found was that the volume of the flow through the flow meters seemed to disagree. There seems to be about a 10% difference in the volume readout.

PH: Good. What about Bob Yokelson? Would someone put him on the headset?

AR: Yes he is.

PH: Are you there Bob?

AR: Yes, I think that's it. He's looking around. He's starting to talk.

BY: I'm here. Did you have a message for me?

PH: I want you to summarize for the tape what you've done and anything you want to put on the tape recorder, speak up.

BY: We've got spectra in real-time and also signal averaged over various intervals at the two altitudes that we did the major part of the flying today and showed that the system was working well.

BM: Peter, let me add one thing to the filters. Quartz-quartz filter #3 collected 4,085 liters and Teflon-quartz filter holder #3 collected 3,731 liters.

PH: Did we get the volumes on the ionic filters? If not, if someone has got them let's put them on the tape?

BM: Ionic filter was 3,731. When I say Teflon-quartz I mean ionic.

PH: Jason, are you there?

JL: Yes, I'm here.

PH: Do you want to say anything for the tape.

JL: Two things, first of all I operated the SSFR for Peter Pilewskie. Everything worked okay. No error messages. For CAR basically my computer cannot synchronize with the instrument itself. So when we go back I will have our engineer look at it.

PH: Was it rotating? Do we still have some problems at our end?

JL: It rotated okay, I think. I can't operate the instrument from my own computer.

PH: Okay. I think that's about it.

2:53 PM

PH: My summary for this flight. We had to go to Lanseria near Johannesburg to refuel. After refueling at Lanseria we took off to the north. Art, about how far north of Johannesburg did we go for this profile?

AR: About 40 nautical miles.

PH: There we spent the rest of the flight doing vertical profiles: the intensive chemistry scenario, except we found the boundary layer to be so uniform that it was only necessary to get detailed measurements at one level. That allowed us to spend considerable time, about 1.5 hr at 7,000 ft, in the boundary layer. There we got a full set of measurements, filters, two humidographs, can sample, DMPS, etc. Prior to that we had got some measurements in the free troposphere. But because of the clean background we didn't do any filters there, but we got a HC can sample and some gas measurements. Following the measurements at 7,000 ft, we descended at 500 ft/min down to 200 ft in order to get a good total optical depth reading from the sunphotometer. Then we climbed at 1,000 ft/min up to 9,700 ft. That didn't get us to the top of the boundary layer, but it was nearly at the top. Unfortunately air traffic control wouldn't let us go any higher. We are now heading back to Lanseria to refuel and from there back to Pietersburg. This was a pretty good flight. The main problem was the CAR is not talking to the computer, although the CAR is rotating. That didn't affect this particular flight because it was concentrated on chemistry. But, had the CAR been up, we would have ended the spiral descent with some CAR measurements. Rough estimates gave the single-scattering albedo to be 0.85 in the green. That's quite low. The optical depth measured at 200 ft was 0.15.

2:59 PM

PH: The SO_2 has really picked up as we're approaching the Johannesburg area. In addition, we've intercepted a few smoke plumes.

(d) University of Washington Flight 1813 (August 14, 2000)

4:41 PM REMAINDER OF TAPE BLANK

Transit flight from Lanseria to Pietersburg, South Africa. Instruments operated en route. No summary.

(e) University of Washington Flight 1814 (August 15, 2000)

10:38 AM

PH: We are now heading back to Pietersburg. So let's start our summary. I'll give an overview, then I'll have individuals summarize the flight from their point of view.

The main purpose of this mission was to underfly the Terra and the ER-2. The Terra overpass of Skukusa was at 0822 UTC. Then it was to do a vertical profile over the Skukusa site. We accomplished both of those goals. I'll just add though that it wasn't an ideal scenario for comparing with the remote sensing measurements because we had a lot of scattered cloud. The boundary layer was fairly low, topping out at about 6,000 to 7,000 ft. It was relatively clean in the boundary layer. We were running at 100 ft above ground level through Skukusa from 0820 to 0834 UTC, which bracketed the overpass, which was at 0822. We then climbed to 500 ft/min to 3,000 ft and we remained there for an hour or so. In fact, exactly an hour (0847 to 0947 UTC) were we did chemical measurements. Following that we penetrated the first smoke plume, from a small grass fire, at 0951, then a second smoke plume from a small grass fire at 1007 UTC. In the second smoke plume we did a humidograph. We didn't see any increase in the light-scattering coefficient on that humidograph, but there maybe some question as whether it was correct or not. Ray will comment on that. Maybe we did two humidographs. Finally, from 1015 to 1036 UTC, we did cloud penetrations and at 1036 we handed the plane back to the pilots to head back to Pietersburg. That's my summary. Since Phil Russell is next to me, he can give his summary now.

PR: I would say that for the sunphotometer the main feature was lots of clouds today. We did park the instrument when we descended through the cloud layer and parked it again when we ascended through it at the end. I guess the one positive thing is that the instrument showed a good ability to maintain tracking while under a broken cloud field. It recorded cloud optical depths up to 6 or 7 before it would lose tracking. Early on when we were down at 100 ft, tracking was lost fairly often and a lot of searching of scanning was done. I was actually concerned we might be overworking the motors, but it did not actually park them and it did always seem to eventually find the sun. When we were at 3,000 ft msl, we still had lots of broken cloud above us, but there we very rarely seemed to lose track. The data record will consist of a lot of aerosol optical depth spectra in-between cloud optical depths. I think the change from one to the other will be easily recognizable. Even when we were down near the surface the aerosol optical depth uncontaminated by cloud were never very large. About 0.1 or 0.15 was the maximum values we saw. We are tracking now and we're heading home tracking above the boundary layer. That's it for me.

PH: Anyone else ready to go?

TK: Sure, I can go.

PH: Who is this? Speak up please.

TK: This is Kirchstetter.

PH: Speak up Tom.

TK: Do you hear me know?

PH: I'm going deaf in my old age, and think about the poor typist who has to decipher all this up.

TK: How am I now? I've got right against my face.

PH: That's better.

TK: My summary is that I collected 1 set of filter samples using the BC-BOSS while we were flying around at 3,000 ft. The times for the collection in UTC are 08:46:22 to 09:47:20 and I collected 1 set of TEM grids. The same thing at the 3,000 ft altitude and the times in UTC are 08:47:20 to 09:47:20. Both systems seemed to work just fine.

PH: Is that it?

TK: That's it.

PH: How do you feel?

TK: I feel much better. I came up front earlier because I was getting a little bit too shaky back here, but I feel fine now.

PH: The next person.

JL: This is Jason Li. I can give a summary for the CAR instrument. The main purpose of this flight is to test out the instrument and the fear of the signal levels for the camera objects we're seeing here like clouds or surface. The instrument for the most part worked fine. Although the filter wheel channels wasn't working at the beginning. Subsequently I turned it off to cool her and then I turned it back on. It seemed like the filter wheel worked magically for some reason. We have to look at it carefully when we go back. The rotational mechanism worked in one direction, not the other. So now I am stuck in the downward viewing mode. That's one of the things we probably should look at. The main highlight of this flight is the downward imaging mode over the Skukusa tower. I had a lot of good measurements. Finally Peter Pilewskie's instrument is working beautifully. I had no problem with it. That's all. Actually, Peter, I do have a question. When was the actual Terra overpass?

PH: It was 1022 local. In UTC it was 0822. At 0822 UTC we were right over Skukusa. Well, actually a little bit displaced from it but essentially over it. So you got something, Jason, and we'll just have to keep plugging away at the problems.

JL: Yes, it's getting better all the time.

PH: By the way up here in the free trop (9,500 ft), we're seeing plumes of particles coming up on the neph, but interestingly not on the CNC-2. So they must be fairly large particles in the accumulation mode.

AR: Peter, we're very, very close to cloud top here. It's possible they maybe detraining particles from the evaporating cloud tops.

PH: Perhaps that's why they're big.

AR: That's what came to mind when you said "large."

PH: Next person, please.

AR: I guess I can say some other words here. The weather situation is much like yesterday, very, very strong anticyclone situated in southern South Africa and producing easterly flow across northern South Africa. Today the rawinsondes weren't available to me. Pretoria was easterly at 5 to 10 knots up to about 9,000 ft and then from 9,000 to 18,000 ft at 500 mbars out of the east and east-southeast at 20 knots. So we had a pretty good easterly flow and with that we had a good push of maritime air from the Indian Ocean across the escarpment and flooding over the high veldt there into Pietersburg and Pretoria area. As we took off, we took off in a situation of increasing low cloud as the morning convection and boundary layer began to deepen up and some convective plumes and that began to fill in. Then as we continued eastward, we began to overfly solid stratocumulus, which continued solid until the escarpment and some probably 10 to 20 miles west of there where it appeared that the elevation of the stratocumulus and cumulus cells topping out around 7,500 ft to 8,500 ft. Then the base of the clouds being at 4,500 ft and that base at 3,500 what appeared to be the top of the mixed layer with the clouds kind of resting on top of that being heated plumes extending above the overall haze layer that which there was. Visibility in that area was extremely good, more than 50 nautical miles on the horizontal when we were down low in the park region by Skukusa.

PH: Excuse me Art. We just hit a plume on the CN 20 s ago. Hadn't seen any of those at this level before. Okay, carry on.

AR: Where was I?

PH: Don't start again!

AR: Roger. Coming up the side of the escarpment here off the right wing you can see some of it and I'm guessing that some of that has gotten into these cumulus and then ejected out maybe at this level or at least momentarily into the inversion. In the low-level park the air is quite clean. Isolated fires here and there, but they were generally in our line tracks with the satellite overpass completely clear of any plume, downwind of any plume areas that I saw. On that track to the east we had overcast conditions to the west. We had more broken to scattered cumulus. At the end of our tracks we began our midlevel sampling out in a clearer region in a foothill region of the escarpment. At that location we had some isolated cumulus in the area and generally continuing good visibility. The final comment I'll make is that on the way back the cloud base had risen from 3,500 ft to 6,200 ft. That's probably

fairly normal upward change in cloud base considering the amount of heating that goes on during the day, so low in the morning and high in the afternoon and so forth. The top of the boundary layer near Pietersburg was right around 7,700 ft when we broke clear. That's the lowest we've seen in that area during our trip. Out here pretty much the same except that over the escarpment. Maybe a little bit upwind of it it did hump up a few hundred feet, but generally the top of the boundary layer is fairly consistent at 7,700 ft around Pietersburg, maybe at 8,000 ft in the park area. That's it.

PH: Thanks Art. Next person.

RS: This is Ricky. We took 1 can sample today at about 8:50 UTC, can 3275, in the boundary layer.

PH: Speak up Ricky.

RS: We took the can 3275 at 0850 UTC in the boundary layer. Also took CO, CO_2, SO_2, and ozone measurements. All the instruments were working. The SO_2 noise diminished once we reached the lower altitude and I took a quick CO_2 calibration at 1014 UTC for 2 min just to verify the measurements. That's it.

PH: Brian.

BM: I took a Teflon-quartz and a quartz-quartz filter sample from ambient haze off the continuous inlet. The numbers on the filters were Teflon-quartz filter holder #5 with Teflon filter #5 and quartz-quartz filter holder #5. The time of the samples for both was 0847 to 0947 and both sampled about 3,600. Actually Teflon-quartz sampled 3,601 liters and quartz-quartz sampled about 3,604 liters of air. The bag was purged twice before actually collecting a sample, once at 0717 and once at 0733 in the free troposphere. The bag sample was collected at 0852. The DMPS was run off of ambient haze in the bag sample at 0853, 0903 and 0923. DMPS was run off the attempted plume capture at 0953, but that was a bad measurement I think. At 1008 the bag nephelometer was run off of ambient haze. It had values of about 1.8 to 2.33×10^{-5} m^{-1}. The bag nephelometer off the attempted plume sample was about a value of 4.8×10^{-4} m^{-1}. So there was something in the bag, but it fell off very quickly possibly because we only partially sampled the plume. I'm almost sure about that because we didn't completely purge the bag. I'm not sure why the smoke was the first thing sampled though. Problems: making sure the bag is purged and the flow meters seemed to react to the bag-house when the bag-house in the empty position. I'll explore that problem today and tomorrow.

PH: Good. Ray.

RW: This is Ray. Scattering levels were typically below cloud level about 2×10^{-5} m^{-1}, and we had excellent agreement between the MS, CE and the bag-house nephs, which is good. We ran 3 humidograms. We ran an ambient one at 0846 UTC and it got an increase of

humidification factor of about 2. We ran one off the bag at 0912 UTC and got about the same result. Then we ran one off the fire plume at 1009 UTC and we had a problem with the bag there, so it may have humidified or something happened. Also the extinction cell I got a chance to run twice off two plume passes. On the first one the time constants were way different between the cell and the nephelometer, which is to be expected. I retested them and on the second pass they were pretty good. So it looks like it's probably going to work in these fire plumes. That's about it. Everything worked, everything else.

PH: Good. Those first two humidograms you said ambient and bag, but they were both ambient air, but one was taken through the continuous and one through the bag. Is that correct?

RW: That is correct. We also have single-scattering albedos typical of what we had yesterday.

PH: Similar, which was 0.85.

RW: About 0.8 to 0.85 in that range.

PH: That's pretty low. The third humidogram on the plume itself, the smoke plume you think was a bust. Something went wrong, right?

RW: Well, something went wrong. Once the humidity got to that 70%, the scattering just disappeared off both the bag-house nephelometer and the MS nephelometer, which is after the humidifiers so I don't know what happened. The bag went empty or something.

PH: Have I missed anyone? Any of the engineers want to make any comments about things. Are Don or Grant on the headset?

DS: Things have looked pretty good to me throughout the entire flight. We do need to let the pilots know that the CAR nose is in the downward position because they may have to land it that way.

PH: Okay. Does Grant have anything to add?

GG: I was just very happy to see that the TANSvector had come back online and we seem to be performing quite well.

PH: Yes, the TANSvector looks good and that's great. So this was a pretty good flight even though it wasn't in ideal conditions for comparing with the remote sensing measurements, because of the cloud. I'm very pleased how many things are working. I think we can do good science if we keep all these things up. Things I noticed that still have problems are the old ones. The DMT seems to be dead. The JW is overreading maybe by a factor of 5 or 10. It's very spiky. Did anyone else notice anything else not working? I hope that we will not have a flight tomorrow. That's my intention, but we could be overruled at the meeting this afternoon. But I don't want to fly tomorrow. I think we need a day to catch up on the paperwork on these last 2 flights (actually 4 flights, but 2 scientific flights) and to

work on the instruments that are down. We probably will fly on Thursday at a time to be determined at the Wednesday afternoon meeting. So that's it.

DS: That's good. We need at least one day to get your radiometers hooked up. When we've got those done, I think we've got almost the entire package working.

PH: Right. After lunch when we get off the plane today, I'm going to come back and take a look at this device that's being built to get on top of the plane to clean the radiometer domes, and see if there are any potential problems with it. Bob said to me he wipes his hands of it, but that doesn't mean we can't use it. I want to see it myself.

(f) University of Washington Flight 1815 (August 17, 2000)

PH: This was a flight, which occupied most of the morning and the first hour of the afternoon, over the Kruger National Park. We came in at altitude from the free trop and descended to our research location, which was south of Skukusa in the south-central part of Kruger National Park (KNP). We descended to close to the surface, 100 ft, for a full sunphotometer profile in clear sky. We then climbed back up to 4,000 ft for an hour of full chemical and physical measurements. The last part of the flight was concerned with sampling two fires. The first fire was smoldering and dying out as we sampled it, but we sampled it up close to and then further downwind we sampled the aged smoke. The second fire, fire #2 I called it, was a much younger and more vigorous and we got two bag samples on that. So it should be fairly good on that last fire. We got into much thicker smoke. We're now heading back to Pietersburg.

11:32 AM

PH: Anyone else ready for a summary? Art, go ahead.

AR: We took off from Pietersburg this morning about 9 AM under a generally stratified condition of haze aloft and exited into the free trope about 9,000 ft ± 500 ft or so. We traveled down toward the escarpment. In the last 20 to 30 miles toward the escarpment, there was a general increase in the visibility below the plane, so there was some kind of haze boundary on the westside of the escarpment. Then also as we went over the escarpment the free trop the boundary layer dropped down noticeably, not a ledge like the escarpment, but it did drop down to around 6,000 ft out here in our research areas. When we were flying our low-level passes over Kruger to begin the day, it was noticed that we penetrated the boundary layer about 4,200 ft in the region nearest the escarpment. We seemed to overfly the top of the convection at that same level going eastbound, which was typical of the gradually lowering terrain toward the coast of Mozambique. Then we climbed on up to (garbled), I'm sorry that was a 100 ft pass I'm thinking about there, I did notice a gradient of the haze from that western end toward the eastern end. Clear at the eastern end, which was (background noise—garbled) went back to our haze layer at about 4,200 msl. That's actually what makes the boundary layer that we had topped it at the east

end and were penetrating the boundary layer up at the west end of our pass and more or less west end, that might have been northwest I guess. From there on the (convective) boundary layer was rising by 1,000 ft an hour as best I can estimate from our two levels of penetrations, so that might be a number we could perhaps hang onto.

PH: Excuse me Art. We just went through the top of the mixed layer at about 8,000 ft.

AR: Thanks Peter. I said 6,000 ft because we were up at the top of that smoke earlier around 6,000 ft. I was estimating that was pretty well it. I guess there's a little more here. Thanks. There was high pressure right over us, over the northern province and with that high we had variable winds up to about 10,000 ft and then becoming light easterly in the province area. I think that's about all I'm going to say I don't want to run too late.

PH: Next person.

BS: The sunphotometer worked just by itself, worked well. It never really lost track. It never started searching. In fact the antenna wire is causing some major headaches. It goes off the sun a little bit whenever that wire hits the sun seeker and so there's no optical depth measurements at that point. If it happened that we have a bad heading, then we don't get any data for as long as we keep that heading. So that's the sort of problem in the spirals and I need to figure out what we can do about that. Maybe we need to descend slower so the gap in altitude is smaller because for each turn we're going to miss some time and so if we descend slower then maybe we could get a more continuous profile. The spectrum at altitude when we're above the boundary layer is still kind of sensing I don't fully understand with the measurements of optical depths being highest and actually lower in the UV and lower in the near-IR. In the plumes at least the last two ones, we do get some optical depths. Measurements through the plume, which we can't compare the optical depths at the same altitude when there's no plumes, so that you can get an idea about plume spectrum and size distribution. That's it.

PH: In the future we can devote some time to sampling a plume just from the sunphotometer point of view. Today we emphasized the chemistry and physical in situ measurements. We could do some passes below the plume, progressively up through the plume on a good orientation, so you can get a good set of sunphotometer measurements.

BS: Right. I never anticipated that little wire to be such a big headache.

PH: We discovered that in TARFOX several years ago, it was the same problem. Next person.

RS: I can do the chemistry summary. I took 4 HC cans today. The first one was in the haze layer. The second one was above fire #1. The third one was downwind of fire #1. The fourth was above fire #2. The four gases, CO, CO_2, SO_2 and ozone, all worked fine today. They responded to the plumes fast enough, so that I don't think we need to use the bag in connection with the gas instruments. We can just always use the continuous line. The NO_x is still not set up. That's pretty much it.

PH: What was the ozone reading in the plumes?

RS: It went up to about 60 ppb, ambient was around 40.

PH: That's not very high. Anyone else ready?

TK: This is Kirchstetter. I can go.

PH: Go Tom.

TK: I collected 3 sets of TEM grids. The first one was from the direct inlet, the second through a full bag of smoke. The times of collection are 082930 to 092500 UTC. That was the direct sample. The two bag samples are 10:25:30 to 11:34:25. The second bag sample is 112800 to 113415. Incidentally, we got a really good plume sample from that last bag. The nephelometer readings were 2.3×10^{-3} m^{-1}, which was the highest I've seen so far.

PH: The object of today's exercise was to get a bit of practice at that; I think I know how to do it now. We need to do a test run through the plume to see its profile, and then actually get the sample on the next run through.

TK: Let me just finish off by saying when I collected just one set of filters from Delbert Eatough's PC-BOSS system and that was in the general haze layer that we were at before we started doing any plume sampling. That sample times were at 082750 to 092600, and again these two systems were working quite well. That's all for now.

PH: So that was in the sampling at 4,000 ft, where we were for 1 hr.

TK: That's correct. That's where I collected the PC-BOSS sample.

PH: Next one up. How about Isaac for a summary?

RW: This is Ray. I could go.

PH: Go ahead.

RW: All the aerosol instrumentation worked pretty well. Ran 2 or 3 humidograms, which were successful. The most successful one seems to be the continuous ones in the background air. I think in the future I'm going to have to dedicate a bag to the humidigram rather than filter sampling at the same time. I was able to get OAC measurements, so I probably can get single-scattering albedo in at least fire #2 and maybe fire #1.

PH: In the future, remind me if I forget to devote a bag to the humidiograph. We want to get a few good measurements in both old smoke and fresh smoke. Once we've done it a couple

of times and get the same result, we don't have to keep repeating it. Is Brian or Isaac there? Will someone get them on the headset?

11:40 AM

IB: Peter, this is Isaac.

PH: Go ahead.

IB: I have 7 plume penetrations, three from the first. We did 2 fires on the first plume. We did 3 plume penetrations. On the second fire we did three plume penetrations as well. On the second fire it looks like we saw signals of methanol and ammonia. Just took preliminary analysis of the spectra that we took in addition to CO, CO_2, and methane. The first fire I didn't see very high level of ammonia. Possibly I saw traces of methanol though. One thing I did notice was I was able to tell that when you guys were sampling with the bag and it looked like you guys were sampling a little too early. Of course you guys are getting a higher flow rate in your bag house than we are through the FTIR cell, but our CO signals were a lot higher once we were well into the plume instead of just into the edge.

PH: So you're saying you got higher CO signals on the boundary of the plume.

IB: Actually, a couple of seconds after entering the plume going by your count.

PH: Good. I think we've got Brian now and the engineers if they want to say anything or Tom Wilson.

TW: I guess it seemed like the flight went pretty well today. No data lockouts yet. Hopefully we will make it to landing. It looks like Grant did a great job taking my seat up there, so congratulations to Grant.

DS: As far as the installation that Grant and I got done, the broadband pyranometers are working extremely well. I'm having a little trouble with the UVs, but they're not quite as important and we'll take a look at them and probably get them working.

PH: We should note that the radiometers haven't been cleaned.

DS: I actually cleaned them myself.

PH: Top and bottom?

DS: Yes.

PH: Good. Make sure they get cleaned along with the other things on top.

DS: Will do.

BS: How do you clean them?

DS: When I took the cap off of the other stuff back here, I got up there and cleaned it.

11:48 AM

PH: Getting occasional every 4 min or so noise spike on the CN-2 and occasionally we're seeing a plume come up from the ground and we're in one now actually. Well, maybe not, but anyway about a minute ago a plume came up on the CN at this altitude of 10,500 ft. The neph has now been switched to a longer time constant. It's now very low values, so we're seeing some oscillations.

BM: I can do a summary, Peter, if you need me to.

PH: Go ahead Brian.

BM: We got 3 filter sets today and 1 blank. Teflon-quartz filter holder #6, Teflon #6 and quartz-quartz filter holder #6 sampled from 0829 to 0927 UTC in ambient haze at…

TAPE REVERSED TO SIDE 2

BM: …4,000 for that elevation. They sampled for 3,957 liters. The second filter set was a plume sample. The first plume sample was Teflon-quartz filter holder #7…(END OF TAPE)

(g) University of Washington Flight 1816 (August 18, 2000)

PH: Just an interim brief summary. What we've been doing for the last 2 hr or so is sample this one prescribed fire. It wasn't a very big fire and so we had trouble getting good response, particularly on the nephelometer, but we took 2 bags on the vertical column just after the fire was lit. We took 2 bags on the aged smoke about 12.5 miles downwind and the next one at 21 miles downwind. Then finally we obtained a third bag sample as we ran along the length of the plume from about 20 miles out back to the fire head. Actually, it was the fifth bag sample, 2 on the vertical column, 2 on the aged smoke, and then 1 bag running along the length of the plume.

12:48 PM

PH: Today's flight was devoted entirely to the prescribed fire out on the border, actually west of Pietersburg by about 200 miles or so, between South Africa and Botswana. The fire was lit soon after we arrived. Prior to that we had done one short period ambient. It was supposed to be a continuous sample I think for the filters, but it wasn't too good because it wasn't very long. The fire was lit a bit prematurely, so we started to sample it from about 0910

UTC. At the beginning of the plume, the smoke was pretty thin, but we took the vertical column. Got 2 bag samples on the vertical column, not very good samples, thin smoke. We then moved to about 12.5 nautical miles downwind of the fire and tried to get into that same plume, by which time we were 28 miles downwind. We got 1 bag at 12.5 miles, another one at 21 miles downwind on what we'll call aged smoke. We then ran along the length of the plume back to the fire. I think we tried for a bag sample, no HC cans (the can pump had failed). The bag sample we got didn't have a high enough light scattering measurements so we didn't put that through the filters. So that one was basically for the real-time measurements of the aerosol. We were having some trouble at this point with the aerosol flows as well, so some of those instruments were not on as high a response as they would be normally because of the slow airflow through them. But I think we got some reasonable measurements based on what I was seeing. We then spent the next 45 min or so sampling ambient air for a continuous bag sample at 6,300 ft. That was between about 1137 and 1215 UTC. About 1224 we sampled through the vertical plume of the fire by which time it was quite a bit more vigorous putting up lots of smoke. Some 3 hr after we had arrived on site, the fire was much more vigorous. We went through the vertical plume at about 1224 at about 6,000 ft and got a good bag sample, which we then put through the filters. At about 1240 or there about, maybe a bit earlier, we did a penetration of the plume below cloud base. There was a capping cumulus by this time. No bags, just for real-time aerosol measurements. Subsequently, at about 1240, we went through the capping cumulus just above cloud base. We're now heading back in the free troposphere back to Pietersburg. Anyone else want to do their summary just jump in here.

RS: This is Ricky. The can pump failed midway through the flight, but we did get one sample on the first pass through the first fire. We also tried connecting the bag house to the chemistry instruments today and that worked pretty well. Every time we filled a bag we sampled that air through the chemistry instruments also. I had some problems with the CO instrument. I had a range problem. It was maxing out, so I need to adjust the range when we reach the ground. I think that's pretty much it. I just got to make sure I get that can pump fixed. Bob told me that we should get the NO_x pump setup for the next flight, so I'll check with him again.

PH: That will be important for Sunday's flight. I should make a note here that this really was a dress rehearsal for what will be a bigger prescribed fire in this same location on Sunday. So we need to lick our wounds and repair what's down and get up for Sunday.

12:57 PM

PH: I've been off the headset, but who's done their summary so far?

RS: Just you and me so far.

PH: Art, why don't you do yours?

AR: Well, you covered things pretty well, Peter, but I will say a few words about the weather situation. It's very similar to yesterday. We have a high-pressure center over the northern province with light variable winds. Above the surface high there is something a little different. We had a weak cyclonic circulation at 700 millibars and on up. The flow was a little bit different than we'd seen. It was out a little bit more, out of the east at 10 knots, a few knots as we saw in our plume tracking. The boundary layer tended to slope upward as we left Pietersburg to go to our prescribed fire, something up to around 10,000 ft I think it was on exit from Pietersburg up to about 11,000 to 11,500 ft. Then a little "bright plume" in the boundary layer in the middle of the research area and began our descent. It was a little different boundary layer than we'd seen before. It didn't have a little sharp top to it. It sort of frizzed away as you went upward rather than having a sharp lid. When we got also into the boundary layer down low into the prescribed burn, it was a noticeable overall gradient of the haze to the north and in the horizontal visibility with a deepening of blue sky above the aircraft, aerosol thinning above. It finally diminished just as we were turning around of the prescribed burn, so there was quite a gradient in the east to west direction in the aerosol loading it seemed.

PH: Just one moment Art. Larry or Jerry? They're not there. I was going to go up another 1,000 ft and see if we could get away from this bumpiness. Go ahead Art.

AR: I was just noticing something else was a little different in this flight. It was the boundary layer. It was not very active in the low levels around our fire and I'm not really sure why that was. It wasn't as bumpy as I would have expected it to be. It never really did get bumpy. I don't know if it's because of all the smoke we had in that area in suppressing the insulation a bit as you saw around the fire. It was very hazy most of the day, the sun dim, so that was one of the other things that I noticed. In so far as flying through our plume, there were plumes from several fires a little to the south of our prescribed fire, about 12 to 20 miles. There was certainly some interaction of those plumes, so someone might separate them just because they were slightly differently aged. I guess that's about it. I think I probably covered most of the things. Is there anything I might have left out, Peter?

PH: Sounds good to me, Art, at this point anyway. Next up.

BM: I could do a filter summary.

PH: Go ahead Brian.

BM: 0857 to 0913 UTC I did an ambient haze. Filter set Teflon-quartz holder #2, quartz-quartz holder #5, Teflon filter #10. Sampled at 1,138 liters of air. Background scatter was 2×10^{-5} m^{-1}. From 0915 to 0940, Teflon-quartz filter holder #6, quartz-quartz filter holder #1, Teflon filter #11. Sampled 300 liters from a plume. Bag-house nephelometer is reading 1×10^{-3} m^{-1} in the beginning of the sampling. It was kind of a split on the next filter set. I'm not too sure about this one. The times were 1000 to 1005 and 1023 to 1033 UTC because I stopped the flow for a little while. This is Teflon-quartz filter #7, quartz-quartz holder #2, Teflon filter #12. I sampled at about 500 liters of what I think was plume air, but I really

don't know. I kind of lost track of it that time. 1137 to 1215 Teflon-quartz filter holder #3, Teflon filter #14, quartz-quartz filter holder #3. Sampled 2,065 liters in ambient haze with a background scatter of about 2×10^{-5} m^{-1} on the MS nephelometer. The final filter set we did was Teflon-quartz filter holder #4, quartz-quartz filter holder #4, Teflon filter #15. We sampled from about 1227 to 1238 from the bag house with a plume sample the very final plume sample we did. Sampled about 480 liters across each filter set and bag-house nephelometer was 9 to 10×10^{-4} m^{-1} scattering, so we had something for a little while. I think that's all we did today.

PH: Good job Brian. Top priority for you is to find a longer headset so you can keep on it while you're doing your thing back there, because a lot of the time I couldn't communicate with you.

BM: Yes.

PH: Tom, do you want to go?

TK: Yes, sure. This is Tom Kirchstetter. I'm reporting on the exposure of TEM grids in the PC-BOSS. Today I exposed 2 sets of TEM grids. Both of these were continuous samples not from the bag. The first was at 0856 to 0914 UTC and that was on the approach when we were flying at 6,000 ft msl. The second set I exposed I actually started, stopped, and then restarted again. The first time I started was when we were going into the plume perpendicular for the second time, so that was like 20 miles downwind of the source. I started at 101932 UTC and stopped at 102310 because we didn't last in the plume very long. I think it was just like 30 s and so I keep that same sample in place and waited until we started to go along the center line of the plume from about 20 miles out up to the fire. So I started to sample at 110340 and then finished it at 111035. In much the same way I exposed 1 set of PC-BOSS filter samples to the plume air when we were traveling along the center line. That was from 1105 to 111130. It reported scattering coefficients ranging from 10^{-5} to 10^{-4} m^{-1}. So for such as short sampling time, I'm not sure we'll have enough mass, but I'll have a much better idea when I unload the filters and if I see a deposit them we certainly have enough. That's about it.

PH: Thank you. Do we still have tape in there? Jerry or Larry?

JR: Go ahead Peter.

PH: Let's go up 1,000 ft and see if we can get away from this bumpiness. It's a bit of an uncomfortable ride.

JR: Okay.

PH: Ray.

RW: This is Ray. The aerosol rack worked fine until about 1035 UTC then I noticed the aux (auxiliary) pump had failed and that supplies the PSAP, humidograph, CNC-3 and the MS nephelometer. We still have some flow through the nephelometer because of ram air but not very much. Probably about 2 to 3 liters a minute compared to 80. Prior to that though we did get a good humidogram after the first plume pass. Pretty high hygroscopic about a factor of 3 increase at 80% RH, which is more than we got on other days.

PH: Was that in the ambient?

RW: It was right after the first plume pass when we went sort of down, ambient air. We ended up turning the instruments off that weren't being used anymore. I did get a little bit of OEC data on some of the plume passes. It looks like on some of the hot ones the single-scattering albedo may have been down to around 0.75 or so, but that's pretty preliminary.

PH: That's in the plume?

RW: That was in the plume.

1:08 PM

PH: Bob Yokelson. Bob give a summary.

BY: Hi Peter. I had to reach my mike from where I was standing. With respect to today's flight track, probably the first three plume penetrations and the last three we had very good signal-to-noise for a lot of gaseous species. It should be the major gaseous species and we're hoping that maybe post-analysis we'll show some ozone in some of the downwind samples. We'll probably know later this afternoon or tomorrow.

PH: Grant or Don or Tom Wilson want to say anything on the headset about this flight?

1:10 PM

DS: Well, we got the CAR going on this flight. It looks like it's done fairly well. The problems that we've had is that we've had a couple minor lockups. We're investigating what's causing that. That's just on the display side. The aerosol pump needs to be looked at to see if it ingested something.

GG: The can pump needs to be looked at as well.

DS: Yes. I suspect maybe the brush has changed by the way it's acting.

PH: For the next flight on Sunday, the top priority are the aerosol pump and the can pump. CAR measurements are not top priority for Sunday. Is it rotating okay now or are you having to keep count of it.

DS: No, I still have to go on in and do the work I need. I need an entire day to do that without any other distractions.

GG: R2D2 performed pretty well all through the flight it appears. The up and down wideband radiometer looked good. The IR thermometer looked good. The upper UV didn't look too good. It gets noisy after penetrations for some odd reason. The lower UV looked pretty good. We don't have a proper calibration value for the displays right now.

1:11 PM

PH: Tom Wilson, do you have anything to add to the tape?

TW: The only thing, I have some ideas why the CAR display locked up right near the end there on this flight. Actually when the display locks up the data is still being recorded.

PH: Thanks. I think that's the end of summaries, but if you have more to add just put it on the tape. We're going along here at 11,500 ft on my altitude reading and still in the boundary layer judging by the bumpiness.

AR: The upward-pointed pyranometer was cleaned before the flight.

(h) University of Washington Flight 1817 (August 20, 2000)

No summary, flight aborted on runway.

(i) University of Washington Flight 1818 (August 20, 2000)

8:10 AM

PH: A brief summary of this flight. We had to turn around when we were about two thirds of the way to the fire site because we lost radio communications. We only have one radio that was working on takeoff and that gave up. We didn't completely lose radio communications. We were having some communication with Air Traffic Control, but the frequencies are messed up a bit, so the pilots decided to turn around. We did get some measurements, which may be of use, in the upper level haze layer, DMPS, humidogram, and our continuous measurements, of course, so that may be of value. We missed the main prescribed fire here, the ER-2 overpass and Terra overpass of that fire. We should have good profile measurements in and out of Pietersburg not quite up to the top of the haze layer, which is about 1,500 ft above us, and good measurements at 9,000 ft and about 6,000 ft. Coming into land. Does anyone else want to add something to the summary? (Subsequently it was discovered that the radio communication problem on this flight was due to an ATC problem!)

8:12 AM

BM: The bag house did not seem to have any leaks in about 10 min of just testing.

PH: No leaks, well that's good. The bag is doing much better than we've done in the past.

(j) University of Washington Flight 1819 (August 20, 2000)

PH: I'm going to summarize this flight so far. This is UW flight 1819. Actually the third numbered flight of today. We finally got here on site. The original fire that we were supposed to sample this morning was still alight and it was smoldering. It was clearly way past it peak, but we worked it anyway.

2:21 PM

PH: However, prior to doing that on the way out we descended in the upper ambient haze layer at 11,100 ft and we did chemical and physical sampling in that layer. We got 1 chemical can, 1 HC can (that is hydrocarbon can), and some BOSS measurements, TEM grids, humidograph, a full set of filters, and DMPS.

AR: Peter, I noticed our fire has produced a small cumulus now, so that's the hottest it's been.

PH: That was from about 1154 to 1241 UTC that we were doing that. At about 1241 we spiraled down over the fire site and got a bag sample passing through the smoke. I think at that point, it was mainly smoldering; although, some flames were still present on the ground. I didn't make a note of exactly what we did on that bag sample, but it will be recorded on the tape. Then we did some runs for the sunphotometer. We ran beneath the smoke as best we could and then in the smoke and then above the smoke going across its long axis. That was from 1307 to 1320 UTC. We then got 2 bag samples in the smoke by which time it flamed up a bit. I think we got two nice bag samples for full chemistry and aerosol sampling of the plume. At 1320 to 1356 we were doing that work. Then at 1411 we started to get our sampling at 4,100 ft in good ambient air representative of the air outside of the plume that we sampled. A neph reading of 4×10^{-5} m^{-1}. That started at 1411 UTC and is still continuing; it will finish in the next 10 to 20 min. Then we'll start to head back to Pietersburg. We've saved 20 min of flight time on the way back to do a CAR sampling where Jason chooses.

Art, would you do a summary?

AR: Roger, Peter. I wasn't able to bring up the surface map today from the South African Weather Service, but we had an easterly flow today, a marine push. This morning when we took off actually we had tops at 6,500 ft. By the time we took off for our second flight the tops of the stratocumulus boundary layer had risen to about 7,500 ft and above that we had a clear slot or at least a visual unimpaired zone of about 1,000 to 2,000 ft on top of the stratocumulus. I understand (I didn't see it myself), the humidity is very low there and that

probably contributed to the perception of being clean when in fact maybe it wasn't. Above that we had the lofted stratified haze layer bounded by about 9,000 and at about 12,000 we didn't quite top out on it at 11,500 ft with still some to go, but we probably topped about 95% I estimated at one point. Then as we traveled eastward as the boundary layer began to deepen up over some of the mountain ranges we began to get some cumulus clouds forming and they were well mixed to convective boundary layer extending up to 11,500 ft or so. Then we came down into the air of the fire the convective boundary layer sloped down again in this lower terrain and probably capped around 10,000 to 9,000 ft. I believe that's the place where we started picking up the turbulence on the way down from 11,500 ft. That also corresponded to the top of the prescribed burn was right around 10,000 to 10,500 ft maybe at the taller little pufflets that had a little extra elevation. The winds today out in this area, at least when we arrived, the smoke was laid down quite a bit. I was estimating that it was a pretty good 5 to 10 knots out of the east, but as the day went on it seemed like that completely disappeared. Even the least smoldering areas had no wind at all. I shouldn't say "no" wind; it was probably below 5 knots. We also had some altocumulus. It was the first altocumulus clouds we had. Unfortunately, when we were running our photometer experiments some of those encroached over the experimental area from the west. Right now we're covering the western semi-circle or at least that's where they're confined to in a scattered to mainly broken coverage by the time you go out about 50 miles or so. So to sum up in the research area, convective boundary layer to about 10,000 ft. Above that and connected to it, without seemingly having a dry slot or a clean slot, was the same haze layer that we transited in. Then above that and in the level of the altocumulus layer, I guess not surprisingly, is a third haze layer up around, I'm estimating, 15,000 ft msl. So it was quite a different picture than what we saw over Pietersburg in which we saw the two layers, the stratocumulus and small cumulus with the convective boundary layer overlaying by a single lofted haze layer topping out around probably 11,000 to 12,000 ft. I guess that's it.

PH: Ray.

RW: Not too much to report. We ran 3 humidograms, one on a bag of the downwind sample from a plume. We had pretty much the same humidification factor in and out of that. Single-scattering albedos again were from 0.8 to 0.85. It looks like I may have gotten something from the OEC, I can probably get some information out of them. It will have to be post processed. Other than that everything worked fine. CNC-3 seems to be reading a little bit low. It may be low on butanol.

PH: Is that the first OEC measurement you've gotten?

RW: No, I've gotten them just every time we've gone through plumes. It's just they're kind of noisy because as soon as we hit the plume it bumps and bounces the extinction cell all over the place. So I'll have to do a little signal processing on it.

RS: Peter, on our way back if we could climb to another height before we leave, I could do one more calibration.

PH: What heights have you had so far?

RS: We had 11,000 ft and about 3,000 ft. I'd like maybe 6,000 ft.

PH: We'll go back at 6,000 ft before we descend for the CAR measurements. You need about 10 min?

RS: Yes. Just let me know a few minutes ahead of time.

AR: Peter, just a note. We had other fires in the area producing cumulus clouds in addition to our original fire.

PH: Anyone else for a summary.

TK: I could give a summary. This is Kirchstetter.

PH: Go ahead Tom.

TK: Today we collected 3 sets of TEM grids. The first set came as we approached at 11,000 ft just in the general haze layer. Start and stop times in UTC are 115445 and 123500. The second set of TEM grids I collected was when were flying both in and out of plumes with the scattering coefficients in green wavelength up to 10^{-3}. Start and stop times there were 124545 to 131400 UTC. I should note that we also had variable altitude during those periods. The last set that I collected came in two parts. These were the last two big plumes that we flew through along the center line, so I started and stopped around each of those. Those times are 132500 to 132930 UTC. Then I started again as we were preparing for another approach at 134800 to 135500 UTC. At each of those plumes the scattering coefficient was up again to 10^{-3}, so I think we probably got some really good samples for Buseck on this flight.

PH: Yes. I think today's sampling was the most comprehensive we've done on smoke. Even though it wasn't very thick smoke I think it's pretty typical of the type of mixture of smoldering and flaming smoke that's dominating the air in this region.

TK: I collected sets of filters on the PC-BOSS. At first there was also on the approach at 11,000 ft and those times were 115410 to 123500 UTC. The second was a really long sample. I just let it run as we were going in and out of the plumes, so this sample that's characterized mainly probably by the smoke since the scattering coefficients in the smoke are two orders of magnitude over the background. The start and stop time for this sample was 124700 to 135630 UTC was the end time, so that was over an hour long. Both of these systems were working just fine once they get started they hold their flows and offer very little problems. That's my summary for today.

PH: Bob, I don't think you ever did a summary. Do you want to do one?

BM: He's coming.

BY: Did somebody want to talk to me?

PH: Yes. Do you want to do your summary now.

BY: We have signal for acetic acid, ammonia, methanol, ethylene, and probably a few other species from a brief look at the data.

PH: That's just in the smoke samples? Can you see that at all in the ambient sampling?

BY: Usually those things are below our detection limits in the ambient air and then they go significantly above that in smoke.

PH: Did you see anything different today in the smoke than you've seen on the previous smoke sampling days?

BY: I haven't been able to analyze it yet because we can't do it that fast, but sometimes if there's a lot of smoldering the ratios to CO are considerably higher than they are for flaming for these types of smoldering compounds.

PH: Okay. Brian, are you ready for a summary?

BM: Yes.

GG: Why don't you standby for just a moment and let me swap audio tapes?

BM: No problem.

END OF TAPE 1, SIDE 2

GG: We're back recording. Your last comments didn't get on the tape, Peter.

PH: They weren't important. Go ahead Brian.

BM: A filter summary for UW flight 1819. Teflon-quartz filter holder #1 and quartz-quartz filter holder #1 and Teflon #16 sampled from 1157 to 1253 in ambient haze at about 11,000 ft. They sampled 2,008 liters of air. The backscatter was about 3.5 to 4×10^{-5} m^{-1} on the MS neph. The second filter was Teflon-quartz holder #2, quartz-quartz holder #2 and Teflon #17 sampled from 1251 to 1300 UTC, 460 liters. This was on a bag-house sample through the first plume that I collected in the bag. Not necessarily that we went through. Backscatter from the bag-house sample was 1.7×10^{-4} m^{-1} and that was from the bag-house nephelometer. The next one was also a bag-house sample. It was Teflon-quartz CQ filter holder #3, filter #3, Teflon #18, 1356 to 1403 UTC, 298 liters sampled. These filters

were sampled when the second bag from the second plume that I sampled in the bag house. Backscatter from the bag-house nephelometer was 1.3×10^{-3} m^{-1} while sampling. The next filter set I used as a blank. I just set them in the cabin for part of the flight. This is Teflon-quartz #4, quartz-quartz #4, Teflon #19. The next one was Teflon-quartz filter holder #5, quartz-quartz filter holder #5, Teflon #20, 1411 to 1443 UTC. This is a continuous air sample of ambient haze at about 5,000 ft that characterized the air around the plumes. 2,022 liters were sampled. Backscatter from the MS neph was about 3.88×10^{-5} m^{-1}. Bag-house summary just for the record, this is the order I collected. Two purges, and collected an ambient haze sample for the DMPS and bag-house nephelometer. Actually did two DMPS runs off that ambient haze bag-house sample. I purged the bag once. Then I collected a plume sample, which I called plume 1 in my notes. Off this bag-house sample I ran the filters, chemistry and bag-house nephelometer. I purged. Collected another plume sample called plume #2. This was the first bag we collected from that and ran the DMPS, humidogram, chemistry and bag-house nephelometer from that. From presumably the same plume, I collected a second bag and ran the filters, quartz-quartz, Teflon-quartz, bag-house nephelometer, and chemistry. Then I did two purges and one ambient haze sample at 5,000 ft for the DMPS and bag-house nephelometer. I think that's all I have.

PH: Thanks Brian. You've been busy back there. Anyone else? Have I missed anyone?

RS: Yes, this is Ricky.

PH: Go Ricky.

RS: Today we took can samples in ambient haze before and after plume samples. We also got pretty good plume samples in the cans. I also calibrated the SO_2, CO_2, CO at 11,000, 6,000, 3,000 ft. All the instruments looked good today. We got samples out of the bag and continuous, so it looked pretty good. I've just got to get the NO_x going hopefully.

PH: Yes, it's a pity to be losing that NO_x. I'll have a word with Bob and you may have to just run around and get it done yourself.

RS: Yes. Just push him a little bit.

PH: Will do. I'm good at that. Ricky, have you finished your calibration?

BM: One more thing for the filters. The variables on the data system called flow 1, flow 2, and flow 3 are all accurately displaying the flow rates for the first time actually on this campaign, so before this those number were pretty much meaningless. We'll have to go with my notes.

PH: Before this flight they were wrong, now why are they suddenly right?

BM: It's kind of confusing. I think you had them one way for KWAJEX and they got swapped around on the data system and then didn't get swapped for SAFARI, so a little bit of confusion I guess there.

PH: Can you clarify for the tape then what flow 1, 2, and 3 now represent, what they refer to?

BM: I can try to clarify. Flow 1, flow 2 and flow 3 are the flow rates for the lowest three flow meters on the chemistry rack. Those flow meters are called flow meter 4, flow meter 5 and flow meter 6, so I can't imagine that's very clear right there but I know what's going on and I'll try to get it as clear as possible in the next couple of days.

PH: That's not clear to me, so on the next flight try to state for the tape exactly what all these flow numbers refer to.

BM: I will do that.

(k) University of Washington Flight 1820 (August 22, 2000)

PH: The first part of this mission we went out to Skukusa in the Kruger National Park. We came in at altitude, climbed up to about 12,000 ft msl and did what I think will be a very nice step-ladder vertical profile for 12,000 ft down to a few hundred feet above the surface over the airport. Got good sunphotometer measurements, paid attention to the shadowing problem, hopefully good aerosol in situ measurements, a couple of humidigraphs of the two main layers (upper one and lower one), and some chemistry measurements. So that should be good for a closure retrieval study comparing the in situ with the sunphotometer measurements and the lidar measurements on the ground, plus the sunphotometer measurements on the ground, so a lot of things there for closure studies.

PH: Then we did CAR circles over what we believed to be the SAFARI observations towers near Skukusa, but there's some uncertainty as to whether those were the towers. They were two red- and white-striped towers. Actually it didn't look very interesting the terrain below and was not representative of Kruger. We did five CAR circles for BRDF measurements, and then we headed up to where we are now over these Mopane trees just to the southwest of Phalaborwa copper mine. We're now doing CAR circles at 1,500 ft above ground over those trees. (It was subsequently found that the area where the CAR circles referred to above were done was not over the SAFARI tower.)

How about the chemists and any one else summarizing the flight so far with respect to the transit to Skukusa and the vertical profile over Skukusa.

RS: We took a HC can sample in the upper boundary layer and the lower boundary layer. For the upper boundary layer the can was taken before the vertical profile and the lower boundary layer was during the vertical profile.

PH: Right. So the upper one I think was taken on the transit flight before we actually got over Skukusa, wasn't it?

RS: That's right.

PH: And the lower one was definitely over Skukusa, but probably the upper one on the transit flight was representative of what was over Skukusa as far as I could see. Any one else?

IB: Peter, this is Isaac. We did continuous FTIR spectra of CO, methane, and CO_2 in the vertical profile for comparison in the Terra overpass.

PH: So that's for comparison with the MODIS, the CO and the methane. Good. And you're getting good measurements above background?

IB: Correct.

RS: Peter, also I saw an elevated SO_2 on the ferry flight over here when we were higher up.

PH: Yes, and ozone, right? Some more from the chemists back there, vertical profile and transit flight in.

TK: Hello this is Kirchstetter.

PH: Go ahead Tom.

TK: Today I took 2 TEM sets. The first was in transit to Kruger at 9,500 ft. Start and stop times are 071540, 075800 UTC. The second set I took in the lower convective boundary layer that was when we got down to about 4,000 ft and below. Start and stop times there were 093650 and 101930 UTC. I took 2 samples with the PC-BOSS. The first was in transit, but I wasn't sampling so that serves as a good blank and I loaded the filters as normal and I keep them on the system for 15 min without any flow through and then took them off.

PH: That was a deliberate control?

TK: Yes that was a deliberate control. Is that clear?

PH: Yes.

TK: The second set I took was when we were profiling over Skukusa and this PC-BOSS set was in the upper layer, so from about 12,500 ft down to 6,300 ft. I stopped as soon as we felt that first bump in the lower convective boundary layer. Start and stop times were 080200 to 092115 UTC. That's all for Kirchstetter.

PH: Just for the sake of the typist, who agonizes over transcribing these tapes, you used a few abbreviations like BOSS and TEM and so on. Would you just describe those in words?

TK: Certainly. TEM stands for transmission electron microscopy and is the system for TEM sampling that Peter Buseck has aboard. These are the grids that we collect in the Cascade impactors. The PC-BOSS system is Delbert Eatough's filter sampler with the 5 filter packs.

PH: Ray or Brian?

RW: This is Ray. We ran 3 humidigraphs, one on the transit flight out, one in the upper layer of the profile, and one in the lower layer. The two upper-layer ones were very hygroscopic. The lower layer one was noticeably less hygroscopic. The lower layer was more absorbing as well than was the upper layer, so that was sort of interesting.

PH: Yes. Did you do a DMPS?

RW: Brian did, but there seems to be some sort of problem with the detector. It wasn't reading very many counts. He may have gotten some later on. I don't know.

PH: Is Brian there?

BM: Yes. Give me 1 s to write everything down.

PH: Art, do you want to give a summary up until this time.

AR: We're in day 2 1/2 of a marine push that we had come across the high veldt. As the air became more stagnant, we've seen the aerosol loading buildup to probably the most visually impaired day, at least from the bubble viewpoint that we've seen. It seems to have also held back the deepening of the boundary layer because today when we took off, of course that was in the early morning, and the boundary layer was only about 1,500 to 2,000 ft above the surface. When we got out to the Kruger, it was limited to about 5,000 ft msl or only about 4,000 ft above the terrain. That is probably the shallowest we've seen for near mid-day observations, and along with that the multilayered (again this is visual observations), thick haze seeming to hold back the insulation at least in the early part of the day. So we didn't see the growth of the boundary layer that we had seen in past days even given approximately similar meteorological conditions.

PH: Art, the vertical profile took us 1.75 hr. Do you think the height of the boundary layer was changing during that time?

AR: On a clear day you're seeing growth of a boundary layer at about this time of day. There's about a 1,000 ft an hour and I doubt it was even 200 or 300 ft an hour during that descent.

PH: Good. Carry on. Any more to say?

AR: Just a bit more. We didn't quite top out of the haze layer, but we were probably above 98% to 97% at 12,500 on the TANS-alt GPS altimeter, altitude that is. There was a higher thin layer above that at probably at that level of the higher altocumulus layer that we saw yesterday and some residual of that. That was well above us, probably 15,000 to 17,000 ft, so many, many layers. I counted 3 layers on the way down where there were visual slots in the layering all the way down, so lots of complicated stratified layers on the way down until we hit the boundary layer.

PH: Good. Have we had everyone? Do the engineers have anything to add by way of instrument performance?

GG: The data system seemed to perform very well. We still have some problems I think with the UV up. It's quite noisy. UV down was responding to river crossings and several incidents like that. Otherwise it looked quite good. We had turbulence online for the first time. I'm not quite sure what it means, but it is putting out some sort of a signal.

PH: Remember we've changed a terminology a bit on the radiometers. When we say UV down, we mean coming down from the sun. When we say UV up, we mean coming up from the earth. So what's coming up from the earth will be detected by our downward pointing radiometer.

GG: It's the upward-pointing radiometer that's giving us trouble, so that would be called UV down in your parlance.

PH: Right. That's a physical parlance that makes more sense than what we've used in the past.

BM: Peter, I can do a summary.

PH: Go ahead.

Back to Main Text

DS: I should mention that the CAR rotation has worked almost flawlessly today.

PH: CAR rotation, which Don worked on yesterday and cleaned up and improved some of the switches, seems to be back online, but we're still missing the filter wheel, which I guess drops out two wavelengths.

11:42 PM

BM: Should I go ahead with the filter summary?

PH: Yes.

BM: The summary for filters and bag house. Teflon-quartz filter holder #1, quartz-quartz filter holder #1 with Teflon filter #21 there was a sample taken at 10,000 ft from 0715 to 0758 UTC. Approximate volume 1,998 liters across each filter set. The next filter set was Teflon-quartz filter holder #2, quartz-quartz filter holder #2, Teflon filter #22 was taken while we were moving down in altitude from about 12,000 ft to 5,000 ft. The times were 0810 to 0921 UTC with a volume of approximate 3,360 liters across each filter set. The next filter set was Teflon-quartz filter holder #3, quartz-quartz filter holder #3 with Teflon filter #23. It was taken in the lower boundary layer from approximately 4,500 to 3,000 ft msl.

PH: Finish off now.

BM: To continue, Teflon-quartz filter holder #3, quartz-quartz filter holder #3 with Teflon filter #23 at 4,500 to 3,000 ft msl sampling was from 0935 to 1031 UTC. Volume was about 3,337 liters across each filter set. Some notes for the record: the quartz-quartz filter holder sets' flow will always be on flow meter #2 and the Teflon-quartz filter holder sets will always be on flow meter #3, which are now marked and labeled for the rest of the SAFARI campaign. Also as a note, flow #1, flow #2 and flow #3 are recording on the QNX data system and they correspond to flow meter 1, flow meter 2, flow meter 3, respectively. So we can get accurate flow rates and we can back out the volumes across each filter if we know the start and stop times, which we do. The bag-house summary, one purge, then 1 sample at 10,000 ft. We attempted to run the DMPS and the bag-house nephelometer outlet sample. The bag-house neph was reading about 9×10^{-5} m^{-1} during that sampling period and the DMPS was having some problems with the CN counter that goes with the DMPS. For some reason it wasn't getting very many counts. I did 3 DMPS runs off of that sample and they all kind of produced sporadic CN counts, so I'm not sure what's happening there. After that sample I did a purge, took another sample at 3,100 ft when we were in the boundary layer. I did 2 DMPS measurements there and also the CN counts were kind of iffy. I'm not sure what it means. The bag-house nephelometer was reading 6.75×10^{-5} m^{-1}. On the CN counter with the DMPS, we checked the butanol level and we're not sure what else to check. But that's the summary for the bag house and filters.

PH: Thanks.

12:10 PM

PH: The main mission was accomplished, which was the detailed vertical profile. I don't think I mentioned in my summary on that that we were near the top of our profile at the time of the Terra overpass, which was at 0828 UTC. There should have been an ER-2 overpass about that same time as well. We were probably up at about 10,000 ft or so at that time.

12:12 PM

PH: Just to complete the summary, we've spent the last 30 min looking around on top of the escarpment for these plantations that Bob Swap wanted us to get emissions from. We

failed to find anything that looks like plantations anywhere near the lat/long that he gave us, so we've given up on that and we're now heading back to Pietersburg.

12:13 PM

PH: In looking for those plantations we went down to about 6,000 ft or. We've now climbed back up to closer to 9,000 ft. The sunphotometer shows that nicely without any interference from shadows. So that little vertical profile above the high veldt maybe useful.

(l) University of Washington Flight 1821 (August 23, 2000)

GG: This is Grant. The recorder did its little trick of kicking out of the record mode sometime during the flight and we didn't get a lot of the audio recorded on the flight.

RS: This is Ricky. We have the CO, CO_2, SO_2 and ozone working. The CO is pretty much at its detection limit, so it's not going to give much information on this flight. The NO_x I tried to get working, but I'm going to need some time on the ground because we just got the pump up and I'm going to need to get some time to get it calibrated. So basically we have SO_2, CO_2 and ozone measurements that we can compare with the Aerocommanders.

BY: This is Bob. We have CO_2, methane, CO, water, N_2O and hopefully some ozone that may be useful for any intercomparison.

2:23 PM

AR: I'll say a couple of words. Today's flight was dedicated to an intercomparison of our measurements with the Pietersburg rawinsonde (a GPS mode used by the South African Weather Service) and the two Aerocommanders from South Africa. Checking aerosols and our state parameters in a profile that extended to 15,000 ft. We found the top of the boundary layer somewhere around 10,500, where the turbulence stopped and that was about the base of some small cumulus clouds with the top of the haze layer (garbled) way to about 15, approaching to 15,500 before we really got into the extremely pristine clean air and that's where we spent an hour collecting probably nothing. After that we descended, hit a cumulus cloud with one of the Aerocommanders. I don't know which one, on our tail and he was probably only offset a few hundred yards, so it was quite a spectacular comparison there even though cumulus are notorious for highly variable liquid water content. Cloud tops about –5˚, –6˚, not quite cold enough to ice, but enough to set the (garbled). Cloud bases on the way down were higher than we saw during our climb by about a 1,000 ft and representing a typical pattern in tropical or near tropical during the day time when cloud bases rise. That level, about 11,500 ft, was also when we started picking up some turbulence in the general mixed aerosol and this continued all the way down to the ground. No sign of layering from 11,500 ft all the way down to the ground here in the aerosol content aloft. I should mention there was some trace of (garbled) aerosol even if ever.

Sorry, I missed that. I was blabbing back here for the tape, so go ahead.

AR: Tom, were you going to say something.

TK: Yes, I was just going to give my short summary. I collected 1 set of PC-BOSS filters in the free troposphere from 1258 to 1355 UTC, so just 3 min shy of an hour;, and a set of TEM grids from 125550 to 135500 UTC. Last time on the record I don't think I said what PC-BOSS meant. I think it means Particle Concentrator-Brigham Young Organic Aerosol Sampling System. Well, I wouldn't put more than 20 rand on that.

2:28 PM

TK: Maybe it's worth mentioning that while we were in the free troposphere scattering coefficients were I'd say typically 10^{-7}, 10^{-8} m^{-1} even at times, but then we did see some peaks approaching 10^{-5} m^{-1}.

AR: Right, I do remember that and that was in the vicinity of those cumulus clouds. Did you have any comment, Bob? Did you want to say anything?

BY: I gave a short list of gases a few minutes ago on the tape that I think we can use.

2:29 PM

BM: I'll just give a quick filter summary if it's okay. Teflon-quartz filter holder #4, quartz-quartz filter holder #4, and Teflon filter #24 started at 1258 UTC and finished at 1355 in the free troposphere sampling. Volume samples were about 1,947 liters, flow rates were about 30 liters/min during that time. I also collected a bag sample at 1301 in the free troposphere. Took 2 DMPS measurements off of that, one at 8-s sampling time, one at 4-s sampling time. I also ran the bag-house nephelometer off that. That's it.

(m) University of Washington Flight 1822 (August 24, 2000)

No summary on tape.

(n) University of Washington Flight 1823 (August 29, 2000)

No summary on tape.

[See UW flight 1824 for Tom Kirchstetter's summary of filter measurements, etc. on UW flight 1923.]

(o) University of Washington Flight 1824 (August 29, 2000)

PH: I'm going to start my summary. On UW flight 1824, 29 August, second flight of the day, we first of all did 10 BRDF circles right over the Skukusa tower. It should be good, no clouds, got some photographs, everything worked fine. Then we moved to a small, smoldering fire in the Kruger National Park and sampled. Went through the plume four times. The first two were over the fire itself and the second two were running along the length of the plume (not very long). First of all running toward the head of the fire and then, I think, the second one was running over the head of the fire and then downwind. That was the last sample of that particular fire. Then we climbed and started to head back west, which is what we're now doing. We sampled some old smoke as we were approaching the escarpment, which shows up on the CN and the neph. Actually, it looks as if we've got maybe two samples there. Anyway it will show up on the readings. Now we're heading for the tree plantation site to do a hydrocarbon can.

PH: To complete my summary: about 15:00 UTC we got a can sample running about 300 ft above the tops of some extensive plantations on the high veldt just to the west of the escarpment. I'm ready for anyone else to put their summary on the tape.

CG: My summary now. I just wanted to add to what Peter said about the CAR measurements at Kruger National Park in Skukusa around the tower. We did 10 circles and out of those 10 circles we did the first 4 circles at 2.3 micron. Then I did 2 circles at 1.5 and then I did 2 circles at 1.6, 2 circles at 2.1. Now the idea here is I wanted to see the various responses of the filter channels over this area. I think once I do the analysis I will be able to tell whether there was a very good response. Other than that I think the flight was good. Like I said, for that plantation, in the future I would probably like to make reflectance measurements. Thank you.

AR: (END OF SIDE 1, TAPE 1)…less and less all the way up and (garbled) down in the low veldt as we saw in the drift there. Well-mixed boundary layer up to 11,500 ft. Cloud bases were at 11,500 ft. I saw no signs of stratification in our haze layers today. I guess that's about it.

PH: Okay.

RW: This is Ray. I can second that that. It was pretty uniform. I ran two humidigrams. The A^3 showed no response. The humidigram were very similar this morning. Around the fires it was perhaps a little bit darker, but not very much, more absorbing.

TK: Peter, this is Kirchstetter. I guess we all gave our summaries last flight except for me. Is that right?

PH: You didn't give one on the last flight?

TK: No, I didn't.

PH: Give your summary for the last flight, which was UW flight 1823 on 29 August. Note when you finish that and then start your summary for today's flight 1824.

TK: Will do. My summary for UW flight 1823 on 29 August is I collected a 40-min sample at the PC-BOSS starting at 0850 and ending at 0930 and that was while we were flying at 9,000 ft. I was shut down at 0930 because of our temporary power supply condition. Also on that flight, the first flight for today, I collected 2 TEM grid sets. The first was also at 9,000 ft. That was at 0852 to 0947. The second sample came from multiple bags, actually 3 bag fills and we were sampling off of each of them. That's when we were flying at 2,000 ft for the CAR circles above the Kruger shrubs. That sample came at 100345 to 104345 UTC, so 40 min.

PH: Excuse me. We're just going through a little smoke plume here. It's quite substantial. Still rising. Carry on, Tom.

TK: That ends my summary for flight 1823. My summary for UW flight 1824 follows. The PC-BOSS wasn't run at all, so that we could run the other instruments continuously. I attempted to take 2 TEM grids while we were just kind of skirting through the smoke plume. The first I started at 141215 and ended at 141615 UTC, but we were in and out of smoke during that time. It was smoldering fire and Peter reported during that time that we certainly sampled our own plume (that is from our engines), so I'll make note of that for Peter Buseck. The second sample I started and stopped twice. I started at 144212 and stopped at 144345 UTC and that's because we attempted to fly through the plume, but because it was so dispersed I guess we miscalculated and didn't really go through that plume. But then as we approached it I started again and so I sampled from 1444 to 1445 UTC for just a minute.

PH: A big fire down below us, flames. Tom, just hold on a moment. See all of those flames down off at 3 o'clock? That's the biggest fire we've seen today and I picked up the smoke from it I think at 10,000 ft. It's flaming combustion beneath us we just went through some smoke with a big CN response. Okay. Carry on.

TK: So just to kind of wrap it up, I tried to take two TEM grid samples. Both were very short as we went in and out of some small plumes very quickly. That ends my summary for flight 1824.

BY: The FTIR summary is we got two good samples of smoldering combustion on the Kruger National Park fire and we did take data during the BRDF circles and I'm not sure what that might show yet, but we'll take a look at it.

RS: The chemistry summary. We did continuous sampling through all the gas instruments during the BRDF and then switched to bag house. I got 3 HC cans during that plume sample, the first two above the fire and the third one a little downwind. That was pretty

much it. Let me note the times. The first can was 2260 at 1410 UTC, can 3222 at 1417 UTC, and can 3050 at 1437 UTC.

BM: We sampled one filter set, Teflon-quartz filter holder #1, quartz-quartz filter holder #4, Teflon filter #31 from 1421 to 1427 UTC, 457 liters from the bag-house plume sample.

PH: We seem to be going through a smoke plume again here if you want to switch on.

BM: The bag-house nephelometer is reading anything from between 3.7 to about 4.6×10^{-4} m^{-1}. One note on that was the Teflon-quartz filter holder #1.

PH: Just one moment. Art, can you see where this smoke is coming from?

AR: That's a negative Peter.

PH: Very murky here. Sorry Brian, go on.

BM: The note that I was going to make is that the Teflon-quartz filter holder #1 was backward for about 1 min. I didn't notice. It was a mental error. I just turned it around and I'm not sure if the sample will be any good, but anyway there's a note for the record. For the bag house I purged the bag once before sampling at 11,000 ft at which point I did a DMPS and the bag-house nephelometer off of that bag-house sample, which was coincident with a humidigram from ambient air. I purged the bag again before sampling at 3,000 ft with the DMPS again, which is also coincident with a humidigram. I purged the bag and did one plume bag sample, emptied it, did a second bag sample. Did the Teflon-quartz, quartz-quartz, chemistry rack, bag-house nephelometer off of that plume bag sample. Emptied the bag, tried another plume bag and missed that one and emptied it and then just purged and now we're going home. That's all I have I think.

(p) University of Washington Flight 1825 (August 31, 2000)

12:57 PM

BM: I can do a summary real quick of filters.

PH: Go ahead. Do your summary.

BM: For UW flight 1825, Teflon-quartz filter holder #2, quartz-quartz filter holder #5, Teflon filter #32 started at 0944, stopped at 1038 UTC, volume sampled was 2,736 liters in ambient haze from altitudes of about 9,700 to 5,000 ft. The scattering changed from maybe about 4 to 8×10^{-5} m^{-1}. The next filter set was Teflon-quartz filter holder #3, quartz-quartz filter holder #1, Teflon filter #33, sampled from 1121 to 1131 UTC, 411 liters. This is the first bag from the young plume smoke or the smoke at least near the fires. Bag-house nephelometer readings during that measurement were about 4.33×10^{-4} m^{-1}. The next

filter set was Teflon-quartz filter holder #7, Teflon #34, quartz-quartz filter holder #2 from 1201 to 1215 UTC sampling time, 527 liters. This was the first bag off of the aged smoke plume. The aged smoke plume had a scattering coefficient of abut 4.6×10^{-4} m^{-1} in the bag-house nephelometer.

The bag-house summary. I purged the bag once, sampled at 9,700 ft in the lower scattering coefficient regime, which was the beginning of the flight. Did two DMPS runs off of that, a bag-house nephelometer off that, purged the bag. Also coincident with that was a humidigram of ambient air of the continuous flow. Purged the bag, sampled at 9,700 ft in a higher scattering regime, 2 DMPS, 1 bag-house nephelometer, also a coincident humidigram. Purged the bag sample at 5,000 ft. Did one DMPS, bag-house nephelometer and a coincident humidigram. Purged the bag, sampled young smoke (bag 1). In the first we have chemistry, chem rack, bag-house nephelometer, Teflon-quartz filter holders and quartz-quartz filter holders. Sampled the young smoke again without purging, so this is the second bag. We did a humidigram, DMPS, bag-house nephelometer, chem rack, PSAP, and after the DMPS was finished the Buseck filters. Purged the bag. Went to sampling the old smoke in the first bag, chemistry rack, bag-house nephelometer, Teflon-quartz filter holder and quartz-quartz filter holder off of that bag. Did not purge. Then sampled the old smoke in the second bag. Did a humidigram, DMPS, bag-house nephelometer, chem rack. After the DMPS was finished the Buseck system and also PSAP. Then I purged and then I purged. Now we're heading home. The PSAP the only thing different about this was the PSAP was now plumbed to have the option to measure off of the bag house. We'll have the option in the future as well. So this was the first flight that the PSAP was measuring bag house, plume, sample, smoke. That's all I have.

PH: Good summary Brian. You did quite a bit there. Let me give my overview now.

PH: The main goals of this flight were to get some sampling en route to the Mozambique coast at various levels, which we achieved on the way to the coast. We ran four horizontal legs at 12,600 ft, 9,000 ft, 7,400 ft, and 4,900 ft, so that they're stepped-down ladder as we approach the coast. We got some chemical sampling and of course all the physical sampling at various levels. I wanted to do a vertical profile on the coast to see what was coming on shore, but we didn't have time for that. So all we did was a run at 100 ft just above the coastline just to take a look at the lowest-level maritime air. Then we climbed and headed north and then northwest looking for fires in the more northerly portion of Mozambique. We found the number of fires increased as we moved north and then northwest and we found a good smoldering fire. No flames were detected. I'm just going to look on the map to see roughly where we were. I think it was west of Beira and I think it was on the edge of the park that is on the Zimbabwe border with Mozambique, so it's just inside Mozambique I believe. Anyway we noted a lat/long on the tape. There we found a reasonable smoldering fire. We did measurements over the fire, got two bag samples. Actually we did three penetrations, in the first and third of those penetrations over the fire we got grab-bags for chemical sampling. On the second penetration we just did the physical measurements. Then we moved 10 miles downwind from the fire. We got two bags in the thickest smoke fairly low down, 10 miles downwind. While we were waiting

for the first bag to be sampled, we did a penetration near the top part of the smoke and got 1 hydrocarbon can and FTIR measurements to see if we could find any difference between that and the thicker smoke lower down in post-analysis. By this time we had to start heading back, but just before we headed back we penetrated the plume once more at 15 miles downwind. Didn't have time for bag sampling, but we got 1 hydrocarbon can and some physical measurements. At 1225 UTC we started to head back to Pietersburg and we're now on our way back at 12,800 ft.

RS: Peter, this is Ricky. I'm just going to summarize. As far as HC cans go we took 1 can in the haze layer, 2 in plume, and 3 downwind. Let me just state the times, can 1216 at 1015 UTC, can 3811 at 1035, can 1242 at 1111, can 3251 at 1119, and can 3263 at 1205 UTC.

PH: We'll need to refer to the tape as to what we were doing at those various times. It's all on the tape. The NO_x was up most of the time on this flight. Do you have anything to comment on the NO_x or any of the other trace gases?

RS: All the gases were up. They were being sampled continuously until we reached the fire area and then switched to bag house and then switched back to continuous when we left. They all seemed to be working okay. Also, there was can 1170 at 1223 UTC.

PH: How many cans in total today?

RS: Let me just check. I took 6 HC cans today.

PH: How many cans do we have left.

RS: We have about 50.

PH: That should be plenty. Who's next up, Ray?

RW: We ran 5 humidiograms, 3 on the ambient air at the different levels, and then 2 bag humidiograms (one in-close in smoke and one 10 miles downwind). On those 2 bag samples we also connected the PSAP to get absorption for the first time. It agreed very well with the surrounding air. Everything else seemed to work just fine. It would be interesting to compare with the OEC for the in-close measuring.

PH: Any impressions or comments on the humidification factors or anything you noticed today of interest?

RW: Yes. The smoke is darker than any of the other smoke we've seen at least the ambient air. The single-scattering albedo seemed to hover around 0.76 through most of the flight and humidification factor was much lower around 1.7 or so.

PH: Good.

RS: Peter, this is Ricky again. I have one more thing to add. I did a lot of calibrating today, so I got zeros at different altitudes for all the instruments. So we should be pretty much done with calibrations in flight.

PH: I think you need to do that just once more, maybe when we're on the Namibia coast.

RS: Probably when we get to Namibia, yes.

PH: Next one up.

IB: Peter, this is Isaac summarizing the airborne FTIR measurements. We did chemical sampling. We sampled the free troposphere air over Skukusa and the haze that was more heavily influenced by fires in Mozambique. Also, we got measurements of the marine air off the Mozambique coastline, which might be interesting to compare to the haze layers. We also did the smoke sampling. We did 3 plume penetrations of fresh smoke from smoldering biomass burning. We also flew 10 miles downwind and got 4 plume penetrations. The smoke samples 10 miles downwind, one at an upper level (where there might be some interesting photochemistry) and we also did one plume penetration at 15 miles downwind and that was it for the day for the FTIR.

PH: Thanks Isaac. Tom Kirchstetter.

TK: Peter, when you were in the back we began the summary. I gave a summary and so did Art.

PH: Did anyone else summarize at that time?

TK: Don and Grant mentioned some stuff about the power also.

DS: You and Art may want to give yours again. I noticed the record mode had blinked out and I'm not sure if it got recorded. I've already redone the one Grant and I did because I wasn't sure if we got recorded either.

PH: You say you want to redo these?

DS: No. Everybody is fine except Art and Tom Kirchstetter and the one that Grant and I did I think.

PH: So Art needs to go again and Tom K.

DS: Yes.

PH: Go Tom.

DS: He may be on there already.

PH: It's better to duplicate it. Repeat Tom.

TK: I'll say it again. I collected 3 TEM grid sets today. The first at 9,000 ft en route to the coast. That was from 094236 to 101500 UTC. The second TEM grids I collected were of the fire that we sampled, the first was from the second bag grabbed very close to the fire and I sampled from 1140 to 114730 UTC. Then the third and final set came off the second bag when we were 10 miles downwind of the fire source and I sampled from 122630 to 124050 UTC. The Buseck system is working just fine and the PC-BOSS wasn't run today because of a temporary condition with the power supply and that's my summary for UW flight 1825.

PH: Thanks. Art, repeat.

AR: Roger. We're coming into another hot spot for fires here. There's a couple of real shooting tops and we may see some smoke overshooting and heading in this direction just a trace of it. But anyway, another spot with lots of fires down here that are building up to high levels.

PH: That's roughly at about 23˚ S and 32˚30' E. Make a note of that Art.

AR: I just did. I just wrote it down because it looks like an active spot.

PH: Good. In Mozambique.

AR: Roger. I can't tell the country. Weather-wise I thought it was pretty interesting because we had a mid-latitude trough dip down into the latitudes of Pietersburg and vicinity and that brought reversal of the winds aloft from their normal easterly to westerly today. At 10,000 ft it was projected by the models to be 270 at 20 knots by far the strongest westerly flow. If you noticed in Pietersburg and as we climbed out of Pietersburg, the tremendous visibility we had right up to the hazy days we've seen just a few days ago. Evidently this air coming across from the interior of the continent where evidently there is less pollution sources. Then as we approached the escarpment and went down the escarpment, this westerly air was overriding tremendous amount of haze and smoke that was topping out at the level of the escarpment. Then the whole haze layer itself at our flight level thickened as we apparently got into some of this smoke plumes. It had gotten up into the 9,000 to 11,000 ft layer probably from the previous day I would guess because there certainly wasn't anything getting up that high during the day today. So I think that stuff at 9,000 to 11,000 ft even east of the escarpment was still old smoke and that continued to thicken eastward with some momentary exceptions. Then I thought the layering was interesting in that as we worked our way down we didn't really hit the convective boundary layer until we got to the tops and then around the bases of those low-level marine cumulus, which was only about 3,000 ft above the boundary layer. Of course that happening near the coastline where the boundary layer would probably have been very shallow because it was marine flow coming from the east-northeast hadn't been heated much, so it was still fairly shallow. Also as we got below, you may have noticed again quite good visibility and what to me was very much

like a pristine Washington flight, with the exception of the little murk that we sometimes see when the wind has been blowing out over the Washington coast and we get some salt or sulfur particles to reduce the visibility a bit. So it was quite interesting. We had easterly flow down in that marine layer and then westerly flow in the top of really what had been probably long-range transport from the interior of the continent. It was something we hadn't seen. Normally we've seen easterly flow at 10,000 ft and there about coming onshore but from a long, long distance, you know pollution from probably either a fire or perhaps from some other continent. So I'm trying to think of anything else. I think that's about it. The free trop was I think Peter already said he had 12,500 ft and we're in it again here.

PH: Good. Thanks Art. Did anyone notice any instruments not working today.

RW: The A3 started acting strange half way through.

PH: Did we get any measurements with it. When did it start?

RW: Yes, we did it. It showed no nonsphericity, but it's getting this huge signal when the plates go off. So I don't know. I'll have to look at it.

PH: Was that after we sampled the smoke or before?

RW: It started about that time, so we got some smoke measurements with it I believe.

AR: I just want to mention, Peter, that you cannot see the ground this stuff is so thick in here. This is still in the area of some hot spots. I still can't see from the angle I'm looking. That's the first time that's happened today particularly off the left wing.

PH: Any other instruments that weren't working? Charles, do you have anything to say?

CG: Yes. I can give a short summary. This is Charles Gatebe at the CAR station on August 31, flight 1825. Now today the objective as Peter Hobbs mentioned was to do the physics and the chemistry measurements. But along the way toward the southern coastline of Mozambique, I decided to do the sky/surface radiometric measurements and I started measurements on the BRDF mode which I thought was the starboard mode. At around 0915 UTC, the CAR computer went out of sync with the CAR instrument. Now this was kind of strange because there was nothing that we did to the computer or the instrument I would guess. It just went out of sync. I restarted the instrument and everything went on well. It took around 5 min to have the door shut and then open it again, but after that and even now as I speak the CAR instrument is still operating. Now when we went to the coast of Mozambique, I turned the CAR instrument to the downward imaging mode. This was important because I realized we were quite close to the surface or in some cases we were just about 40-50 meters above mean sea level. That was quite good, so I decided to turn my instrument downwards so that we could get surface reflectance measurements.

PH: Carry on Charles.

CG: Charles Gatebe continuing the summary of the CAR instrument. Now around 1052 UTC, that's when I changed the imaging mode to downward, and around 1111 UTC I realized the cyro-pump was heating up and therefore the signal that we were getting from the channel #9 was quite jumpy and therefore I decided to turn it off. After around 30 min I decided to turn it on again just to see how things would behave and apparently after some 10 min or so it didn't improve and I decided to shut off the cryogenic pump. Now this of course means that I don't have any good data from that time around 1130 UTC of the filter wheel channel which I was using today, which was 3.1 micron. I think that's all I can say about the CAR instrument for today. I do believe that the measurements we have taken along these transit flights from Pietersburg to Mozambique coast and back again might be useful in trying to get the surface reflectance characteristics.

PH: Good. I'm glad you got something even though we weren't concentrating on the CAR today.

CG: Thank you Peter.

PH: Another piece of the summary here. About 4 min ago we went through a smoke column up at 12,800 ft from a fire almost directly beneath. That's about the highest we've sampled a good smoke plume so far in these flights. We didn't get any bag samples or do any filter chemistry, but we got some physical measurements. It was on the transit flight back, so we couldn't dwell there. We're going into another smoky plume here.

(q) University of Washington Flight 1826 (September 1, 2000)

10:24 AM

PH: This flight had one main purpose, which was to sample the prescribed burn of Miombo shrub and grass near Kaoma, which Darold Ward organized. However, on the way out we did some chemical sampling. All of our physical sampling was at 12,700 ft, which was probably near the top of the boundary layer. We didn't go into the free trop. Obtained some good physical and chemical measurements on that fairly long transit flight from Pietersburg to central Zambia. Then we dropped to 10,600 ft and then to 8,500 ft, then 6,200 ft as we approached the fire; got some good sunphotometer measurements. We arrived at the fire site at 0838 UTC. Terra overpass was at 0902 UTC. The fire was ignited at 0846 UTC. We made our initial pass through the column over the fire at 0857. Then from about 0900 to about 0920 UTC we did six more penetrations of the smoke column close to the fire. On the second penetration we got our first bag sample, and on the last penetration we got our second bag sample. Then from about 0926 to 0933 UTC we ran along the length of the plume from its head downwind near the upper part of the smoke plume. It should have given some good physical measurements. Then, at 7 nautical miles downwind starting at about 0947 UTC, we crossed the plume across its width and got a bag sample; the smoke was fairly thin there. That was followed by another penetration

(without a bag sample) at that same distance downwind. We then moved back toward the fire and did another cross plume penetration at 4 miles downwind. A couple of penetrations were without a bag sample. In the third penetration at 4 miles downwind, we obtained a bag. Then the fourth penetration we got another HC can sample. That finished at about 1007 UTC and we left the site at about that time. We're now heading back home. The plume from the fire was fairly weak. The fire didn't really get going very well. It was a bit of a disappointment from that point of view, but I think we got as much out of the smoke plume as we could. Other summaries?

AR: I can give a little weather briefing. There is not much to be said. Light easterly winds in the fire area. We were measuring, via pilot, about 10 to 11 knots at 500 ft above the surface, probably a little less at the surface. That was probably one of the reasons it played into a weak fire, I think, was probably the low windspeed down there and just allowed things to burn in place rather than spread downwind rapidly. Another thing I noticed was, as we always notice really, that when we have the early morning take off there are highly stratified haze layers beginning right at the surface. Then with higher visibility slots all the way up to a more well-mixed region up around 10,000 to 12,000 ft I think it was. At that time we flew probably within a 1,000 ft of the free trop for a long, long period. Then during that time and during the time we were actually descending to 10,000 ft there was some oscillations, undulations, long wave-type in the height of the top of the haze layer. I think when we were down around 10,000 ft it looked like the top had descended to perhaps 11,000 ft just 1,000 ft above that level. We got kind of a lid from time to time look and in other places it was kind of fuzzy looking with a gradually decreasing concentration-type of top. The other thing that I noticed, that I thought was interesting, as we crossed into Zambia how their visibility almost immediately began to fall off as we came into a very, very much more smoky environment. I was estimating the horizontal visibility was probably equal to or less than any we've seen at flight levels of about 6,000 ft msl to 4,000 ft msl. So also representative today all the way down to the surface that was another interesting aspect of having 10% to 15% humidity at lower sampling locations. Finally, the subdued convective boundary layer as we approached the fire site and, in fact, we really had hardly any bumps. But then during the period of sampling, the turbulence was picking up steadily to where we found light to moderate turbulence of the type we experienced in that 2,000 ft agl leg and right up to the present level. That was the other thing the transformation of the convective boundary layer while we were there sampling the fire. I guess that's about it.

PH: I just made a note that as the smoke thickened as we got into Zambia, I think it was not from new fires but small old smoldering fires. probably left over from the previous day. So it's probably pretty old smoldering smoke that we were experiencing there.

AR: Yes. Absolutely.

RS: This is Ricky. As far as chemistry goes we continuously sampled with all of the gas instruments until we reached the fire area. Then we took a controlled bag in the background haze and sampled with the chemistry instruments. From then on it was all bag-house sampling until we left the area and then it switched back to continuous. In the fire area we took the can in the haze background, two cans above the fire, three downwind and one can in the higher haze before we reached the area.

GG: This is Grant. The new regulator (actually the replacement regulator, it's not new) performed very well. The voltage held from 28.4 to 28.6. We were running anywhere from 160 up to 230 amps at various times during the flight. It worked quite well. The more expensive audio tape seems to work quite well too. We didn't have any dropouts. The old video tapes we had two dropouts on the first tape. I swapped tapes and we had another dropout, so it may be something in the VCR. Otherwise the instrumentation ran quite well. I believe that's all I have to report.

BY: This is Bob Yokelson. We were all disappointed at the small size of the fire and I recall that Darold's last e-mail to me did say not to give up on him if this fire didn't put up a tremendous column. It wasn't what he expected, but he does expect bigger plume from the next two. I guess this fire is typical of what happens around here. It's pretty important to sample it and perhaps Darold can expand more on how it fits into the pattern of burning he sees around here at some other time. We did get some good samples right over the fire at the beginning and a couple of downwind samples maybe not what we hope for eventually, but they were downwind samples that we managed to grab. That's all I have.

10:35 AM

PH: More summaries.

CG: This is Charles Gatebe. I'll give my summary now. This is UW flight 1826. Today is September 1. The CAR measurements were done throughout the entire flight. I used the downward imaging mode in the earlier part of the flight and then I changed to the starboard imaging mode for the rest of the flight. The filter wheel position was at 2.1 microns throughout the entire flight. For the most part the cryogenic cooler was turned on. The GPS/NAV was sampled at 10 Hz initially and that seemed to introduce some noise. Don, Grant and I figured that we set it to 3 Hz, which seems to have worked some miracles. So we hope that when we analyze this data to be noise free. That's all I have to say for today's flight.

10:38 AM

PH: Any more summaries?

RW: Yes, this is Ray. I can do one. The ferry on the way in was rather interesting. The aerosol seemed less hygroscopic and more absorbing as we approached the fires in Zambia. We got some good OEC passes close in to the fire. Got one with the bag, so it got both PSAP

and OEC measurements on that one pass. At least preliminarily they look like they match pretty well. The smoke is a lot darker than you might expect at least in a preliminary sense, in the 0.6 to 0.7 single-scattering albedo. We got a couple more bag samples at 4 miles down with absorption measurements and humidigrams. That's about it.

3:09 PM (Recorded summary for UW flight 1826 while on UW flight 1828.)

BM: Peter, could I do a summary for the last flight UW 1826. I never actually did that.

PH: Okay. Go ahead.

BM: This is for UW flight 1826 a summary of the filters and the bag-house sampling. For the filters we used Teflon-quartz filter holder #5, quartz-quartz filter holder #3, Teflon #35 sampled from 5:59 to 7:49 UTC, 5,750 liters. This was upper layer haze with altitudes of about 12,000 to 10,000 ft. Nephelometer was about 2 to maybe 5×10^{-5} m^{-1}. The second filter set was Teflon-quartz filter holder #1, quartz-quartz filter holder #7, Teflon filter #36. Sampled from 8:02 to 8:31 UTC, 1,862 liters. This was a background haze sample at 6,200 ft for the plume study. Scattering on the MS nephelometer was 8×10^{-5}. The next filter set was Teflon-quartz filter holder #3, quartz-quartz filter holder #1, Teflon filter #36, sampled from 9:03 to 9:16 UTC, 477 liters. This was a young smoke sample and it was from the first bag from the young smoke. The bag-house nephelometer was about 4×10^{-4}. The next filter set was Teflon-quartz filter holder #2, quartz-quartz filter holder #2, Teflon filter #38, sampled from 9:48 to 10:00 UTC, 469 liters across each filter set. This was older smoke and it was the first bag from the older smoke. Bag-house nephelometer was about 1.2×10^{-4}. For the bag house, I purged the bag, then we sampled at 12,600 ft. I ran the DMPS twice off that sample and the bag-house nephelometer was running at that time too. There was also a coincident humidigram. I purged the bag, sampled at 10,700 ft, did two more DMPSs and a bag-house nephelometer and Ray also ran a coincident humidigram. I purged the bag sampled at 6,200 ft for the background haze of the plume study. Did a DMPS bag-house nephelometer and coincident humidigram. I purged the bag and then I have what I call bag 1 from plume 1, which is the young smoke, so bag 1 from the young smoke. We took that bag. We sampled with the Teflon-quartz, quartz-quartz, bag-house nephelometer and chemistry rack. The second bag from the young smoke plume I have the bag-house nephelometer, chemistry rack, humidigram, PSAP, DMPS and Buseck systems running off of that bag-house sample. I purged, what I say is a partial purge, it was probably enough to get whatever was left of the young smoke out. Then we took a sample of the older smoke (this was the first bag from the older smoke) and the Teflon-quartz filter set, quartz-quartz filter set, bag-house nephelometer and chemistry rack were all running off of that first bag. The second bag again was older smoke and we ran the humidigram, PSAP, DMPS and bag-house nephelometer off of that bag-house sample. I think that was it. I purged the bag after that and I felt too sick to do anything else. So that's the summary for flight 1826.

PH: Fine.

PH: This is Tom Kirtchstetter's summary for UW flight 1826.

TK: On flight 1826 I collected two sets of TEM grids. The first en route to Zambia I collected from 6:29:30 to 7:35:00. The second set was sampled out of the bag that Brian collected in the vertical column from young smoke and I sampled from 9:25 to 9:30:50 off the bag. I collected two sets of PC-BOSS filters also on flight 1826. The first was at 12,000 ft for part of the time and then also at 10,000 ft when we came down a little bit, but that was also en route to Zambia. I collected from 6:20 to 7:46. The second set of PC-BOSS filters I collected on flight 1826 I ran from 9:00 UTC to 9:34:30 UTC. That was when we were traveling in and out of the smoke plume. Most of it was through the vertical column about six times we went in and out. When we ran down 8 miles I then shut it off. That concludes my summary for flight 1826.

3:25 PM

BY: This is Bob Yokelson. I have just one brief note about flight 1826. When we had our most concentrated CO sample, it was only about double the ambient CO and that's primarily because the ambient CO is the highest I've seen it on this mission so far. So it will interesting for us to figure out how we want to treat the background and excess concentrations because of that.

PH: Can you get a concentration from your measurements of CO?

BY: No, but I guess there is almost a ppm of CO just background.

PH: So you've just got a relative measurement the size of the peak, but it's not quantified?

BY: From looking at CO peaks at all different kinds of concentration ranges I'm guessing that the background was about perhaps almost a ppm and Ricky might have some information on that too. The analysis program that we do to get a quantitative number from that it turns out that somebody forgot to put some files on the computer that were supposed to be there, so we can't actually analyze the data for a few more days. But that will be rectified soon.

(r) University of Washington Flight 1827 (September 1, 2000)

PH: Flight 1827 on the 1st of September never got off the ground from Kasane. We were caught on the runway to pay a passenger fee. They wouldn't accept the fact that we were research workers. They didn't recognize SAFARI, and to get off the ground we had to pay $25 per person on board.

Flight aborted.

(s) University of Washington Flight 1828 (September 1, 2000)

PH: We'll do a brief summary of UW flight 1828, which is from Kasane to Pietersburg. We've been flying at constant altitude of about 13,700 ft for most of the flight, which put us just below the top of the haze layer. Occasionally seeing smoke from fires beneath pumping through. We didn't switch on instruments during the takeoff. I don't know why. Therefore, we didn't get a good profile out, which is a pity. Anyone else for summaries?

AR: We took off in well-mixed haze and then as you pointed out we were near the free trop and the boundary layer.

PH: Can't hear you, Art?

AR: The boundary layer oscillated up and down on this journey so that we've been within probably 100 ft of the free trop and probably within about 500 ft of the free trop and right now we're in an elevated area of the boundary layer. One other observation, we did go by a hot fire and the top of that probably went 16,000 ft to 18,000 ft. It was clearly the hottest one I've seen since going on the project here and it still did not have a capping cumulus, so this air mass is extremely dry down below us.

PH: I might also note that we have been doing continuous chemistry and filters on the route, but no sunphotometer measurements.

3:16 PM

PH: Can Ricky or Ray or anyone else give a summary of this flight.

TK: I can give a summary. This is my summary for UW flight 1828. I collected one set of TEM grids while traveling at 13,000 ft from 135830 to 151600 UTC. That's all I did for this flight, no PC-BOSS. But I need to give a summary for flight 1826. I too did not give that. (TO FLIGHT 1826 SUMMARY)

PH: What about Ray or Ricky for this flight 1828.

BY: While Ray's getting his headset on, I'll just mention we did get one spectrum of the air at the top of the haze layer that we've been flying through. So we'll have some methane, CO_2, water and that kind of stuff for this air mass that we've been traveling through on this flight.

PH: That was Bob Yokelson.

BY: Right. That's my summary for UW flight 1828.

RW: This is Ray. Had a complete failure of the OEC on takeoff and I've been working on it the whole time and sort of traced it down the inner connection between it and the nephelometer. Right now I've got it back working again, so cross our fingers.

PH: So it broke down when we took off from UW flight 1828?

RW: That's correct.

PH: Ricky, have you summarized for this flight yet?

RS: No I haven't.

PH: Go ahead.

RS: So we had all the gas instruments up except for CO. We're flying at a high altitude, so there the CO doesn't take samples at that altitude. We also took a can in the high boundary layer.

PH: I think the can was in the protruding smoke layer I believe. Charles, do you have anything for this flight.

CG: Yes, a short one.

PH: Go ahead.

CG: Flight summary for UW flight 1828 for the CAR instrument. Now we started with some few problems, we'll know more later. It (the monitor) was out of sync with the computer, but after some 20 min or so we were able to fix the problem with Don. Now we've been taking measurements from the time the computer came back on and we have been sampling at a filter wheel position at 2.1 microns. Since then the measurement seems to be behaving pretty well. Thank you.

PH: Anyone else want to add anything to the tape.

BM: I'm still sampling with the continuous filters, but I could summarize what I've done I guess.

PH: Go ahead.

BM: I started Teflon-quartz filter holder #7, quartz-quartz filter holder #4 at 1403 UTC. This is a pretty steady upper-layer haze measurement, 13,700 ft altitude, during most of the sampling is what it looks like. The only thing I'm doing different on this flight is I'm using flow meter #1 for the Teflon-quartz filters both rather than flow meter #3, which I have used on almost all the previous flights. I'm just testing to see how flow meter #1 kind of works. Once I tested the bag house for leaks, I filled the bag at 1358 UTC at about 13,700 ft. The pressure in the bag didn't change for about an hour. I emptied the bag at 1456

UTC, so I'm pretty satisfied that there are no leaks in the bag as of yet. I will do it when the continuous filter is finished.

PH: This bag we're using is a new bag. Is it a new unwashed bag or washed bag.

BM: It's a new bag and it's unwashed. I think the only bag that has been washed is the old bag, which we haven't used at all on this campaign.

PH: Good.

GG: Just for the record, the bus is steady at 28.5 and we're drawing 170.

(t) University of Washington Flight 1829 (September 2, 2000)

11:54 AM

PH: I'm going to start the summary of this UW flight 1829 on the 2nd of September. The main purpose of the flight was to do a profile over the Maun tower in Botswana, primarily for closure studies with the sunphotometer and to do a BRDF over that tower with the TOMS overflight at 0948 UTC, which was just about the same time we arrived on site at 14,000 ft. No ER-2 overpass today. We achieved the two main goals of the mission, in addition to measurements in the haze layer on the transit out to Maun and now on the way back at a slightly different altitude. We came into the Maun site at 14,000 ft having transited from Pietersburg most of the way at 10,500 ft, but about 15 min out from the tower we climbed to 14,000 ft, got into the free trop. We then did a spiral descent over the lat/long given for the Maun tower. We didn't actually do a positive identification of the tower, but the spiral was over the lat/long of the tower location as given in Michael King's table. We got down to 200 ft. We did our first horizontal run at 100 ft above ground level. Each horizontal run was 5 min. We then climbed up to 2,000 ft above ground, which was 5,500 ft msl; my heights from now on will be msl. We did our second horizontal run for 5 min at 5,500 ft. We then climbed to 7,600 ft, climbing at 1,000 ft per min, and then we did another 5 min run at 7,600 ft. Then climbed to 9,600 ft constant run for 5 min at 9,600 ft. Then climbed to 11,800 ft and did horizontal runs 5 min at that altitude 11,800 ft. This was a very homogeneous layer that we were working. There was no sign that the aerosol properties differed from the base to the top of the haze layer. The single-scattering albedo estimate for the haze layer was about 0.75, which will be refined in analysis. We did our horizontal run at 11,800 ft, then climbed into the free trop, got up to 14,800 ft and did our last horizontal run at that altitude. Then we started to head for home. Descended to 9,700 ft, transited about that altitude for 10 min or so. To get out of the bumpy air we've climbed up to 11,070 ft, and we're now having a fairly smooth ride as we head back toward Pietersburg. I'm ready for anyone else who wants to put a summary of what they've done on the tape.

RS: This is Ricky. Today we sampled continuously into all the gas instruments (END TAPE 2, SIDE 2; BEGIN TAPE 3, SIDE 1)…Are you ready?

DS: Go ahead now.

RS: I'll just start over. Today the gas instruments were all off. They were only sampling from a continuous line throughout except we did do some bag-house controls over the Maun tower at three different altitudes. We also took an HC can sample while doing the vertical profile over the tower. They looked pretty good.

RW: This is Ray. Ran two humidigrams on the way out and two over the site, one at 2,000 agl and 8,000 agl. They have about the same properties, pretty low humidification factors and low single-scattering albedos. All the equipment worked including the A^3, so I guess everything was just good.

AR: I can say something about the weather. The weather was cloud free leaving Pietersburg there was only the slightest indications of stratification even through we did leave in the morning. That's a little unusual normally we see much more visual evidence of stratification, however, it did turn out in the instruments as I think Peter noted early in the flight and then on the transit trip to our research site in Maun we noticed probably the top of the haze layer going through it's usual sort of 10s of kilometers long undulations in thickness and thinness as the diopter is pointing out the optical thickness will change from time to time above the plane even through we were flying at a constant level. That would be indicative of that sort of thing and also possibly lofted smoke plumes, so there maybe two things going on. Then when we arrived on the site we had kind of a muted boundary layer. I couldn't really pick out the top where the convection really started. It seemed like it was weak and then got a little bit stronger toward the bottom and then just steadily increased as we went through our maneuvers over the site and by the time we ended we were certainly seeing turbulence all the way to 14,000 ft and we certainly didn't see the type of and the intensity of turbulence there at 13,500-14,000 GPS msl that we saw coming into this spot. So it was another situation where we were increasing mixing the aerosol as we were going down. It was already mixed, but it was probably mixed even better by the time we left. That's about it. We're flying back in the turbulent boundary layer. We're seeing the same sort of oscillations in the optical thickness above us.

BS: As the operator of the sunphotometer I managed to start it up on the runway before takeoff.

PH: Just speak up a little louder for the tape.

DS: All you need to do is put it a little bit closer to your mouth and you'll be fine.

BS: Sunphotometer startup on the runway in Pietersburg. No transit today except for the first 8 min. We should be able to interpolate something because we were heading out in a straight line. Then taking measurements all the way including altitude 10,000 ft to that Maun tower. Did some radiation of the physical optical depths as just pointed out by the

weatherman, Art. There was no wire problem at all through the whole time and then we started down the spiral to Maun where we had the wire or another problem, which I'm not sure of, so we lost tracking a couple of times in the spiral down. Then the low run was okay. Well, coming up and doing BRDF and stuff. BRDFs the CAR circles are bad for the instrument. The instrument doesn't work nicely. We need to fix that. It loses track all the time in these banked turns. That is something we clearly need to fix. It's not the airplane's or anybody's fault. It's our fault. Then going back we happen to be on a bad heading a little bit, so that the wire bounces around and wipes out some of the data, but not all of them. So that's not a problem. There is nothing we can do about the wire and there's nothing we can fix on our end about that. We should get some profile while landing in Pietersburg. That's it.

CG: Charles Gatebe, I'd like to give a summary for the CAR. Now just very briefly I'll add to what Peter has said about the BRDF measurements and generally the CAR. Now the summary of UW flight 1829, CAR measurements, 2nd September, transit from Pietersburg to Maun tower and back, measurements done, various measurements. Surface/sky radiance measurements done, scanning at starboard, constant altitude-at 10,000 ft noted, which should be good for these types of measurements. Now, we did the BRDF close to the Maun tower and I will say we didn't see the tower, but we believe we are very close enough. Now the filter wheel was set at 2.1 and performed quite well at that stage. It started oscillating from minus voltages to positive voltages, so I don't know. We'll just have to look at the data and see how good it will be. Now the site, which was chosen for the BRDF was fairly uniform and the sun's position was pretty high. Local time there was around 4:20 (p.m.). For the first three circles (the aircraft pitch) was highly variable from around 14˚ to 24˚, but from the 4th circle to the 8th circle it was fairly good. It was running around 18 to 22, which was not too bad anyway. So now generally we didn't have any problem with the instrument other than the oscillation of the filter wheel channel now which I think we'll continue monitoring. Thank you.

AR: We should be coming into some smoke, Peter, if you haven't seen it already in the next minute or so.

PH: Thanks Charles.

CG: For the sunphotometer I forgot to mention that of course the profile we did over Maun with the stacked levels and turns where we didn't change orientation worked perfect before the sunphotometer. Thank you for that.

TK: Peter, I could chat for a moment about the stuff we did in the back.

PH: Go ahead.

TK: Today I collected three TEM grid sets and two PC-BOSS filter sets. The first TEM grid came en route to our location in Botswana. I collected from 080110 to 084210 UTC and that's when we were at the constant altitude of 10,000 ft msl. For the second TEM grid set, I collected was when we began our spiral down, so from 14,000 ft to 200 ft above ground

and we continued that through our circles at 2,000 ft. So the sample times for that second set of TEM grids is 095325 to 103500 UTC. I'm collecting as we speak a third set of TEM grids. I began sampling at 114215 UTC and I'll probably let it go for quite awhile as we return home.

AR: Peter, there's the smoke off the right wing now.

PH: No sign of it here.

AR: It looks like we're kind of skirting the edge of it more than going into it because there's a gradient in that that looks not much to the left and a little more to the right.

TK: It's quite rocky back here. I can hardly hold my notes.

AR: What happened to that smooth flight?

TK: I'll say quickly what I did to the PC-BOSS. I collected a filter set on the way to our location in Botswana from 075945 to 093030 UTC. I've already looked at the deposit with my eyes and there's quite a bit. So we're doing really good at getting background haze samples right now. I'm also collecting another one as we return, so that one began at 114125 UTC and I'll probably let that go also for the present time. I'll speak into the tape when I turn both of these systems off. That's my summary.

1:02 PM

PH: Anyone else who hasn't done their summary get on the line now.

BM: I was waiting until I finished the sampling. For UW flight 1829 the filter summary, Teflon-quartz filter holder #6, quartz-quartz filter holder #5, Teflon #40, sampled from 0758 to 0916 UTC, 5,247 liters sampled of ambient haze at 10,600 ft. The MS for ambient nephelometer was reading about 5×10^{-5} m^{-1} during that sample period. The Teflon-quartz was on the variable flow #1 and quartz-quartz was flow #2.

The next filter set was Teflon-quartz filter holder #4, quartz-quartz filter holder #6, Teflon-quartz was on flow #3, quartz-quartz was on flow #2. That's Teflon #41, sampled from 0954 to 1122 UTC, 4,680 liters sampled. This is a vertical profile of haze from 13,000 ft to 3,000 ft, basically from the free troposphere to the surface and back again. Nephelometer changed a little bit, but it was about 7×10^{-5} m^{-1} more or less.

The third filter set was on flow #1, Teflon-quartz filter holder #5 and on flow #2 quartz-quartz filter holder #7, Teflon #42, sampled from 1145 to 1302 UTC, 5,000 liters sampled in ambient upper-level haze. We changed altitude here and there. Scattering I think was about 6×10^{-5} m^{-1}. That's all for the filters.

For the bag house we sampled at 10,600 ft. I sampled once at 10,600 ft and ran the bag-house nephelometer off that sample. The DMPS wasn't warmed up at that point, so I didn't run that. But there was a humidigram coincident with that sample. After the DMPS warmed up I sampled again at 10,600 ft, ran the bag-house nephelometer and DMPS. Sampled at 10,400 ft with a coincident humidigram, bag-house nephelometer and two DMPSs. Then I purged the bag. Well, I purged the bag between each of the samples always, so I'm not going to say that. I sampled then at 5,200 ft with a coincident humidigram, then a bag-house nephelometer and DMPS. That sample may have contained air from the previous sample, so I kind of tossed it out and purged the bag with the air around it, with the ambient air, and resampled at 5,200 ft. Ran a DMPS and bag-house nephelometer. Then sampled at 7,500 ft, ran a DMPS, bag-house nephelometer and the chemistry rack. The chemistry was just to see how the chemistry instruments responded to the bag-house flows. The next sample was at 11,700 ft with a coincident humidigram, DMPS and bag-house nephelometer. That's all for the bag house and filters on UW flight 1829.

AR: Well, it looks like we're in another transition where the boundary layer is lowering again ahead and also large, large capping cumulus about 1230 UTC now Peter. This one is really spectacular. You can take a gander at it in-between the props and the fuselage.

(u) University of Washington Flight 1830 (September 3, 2000)

CG: My summary of UW flight 1830 CAR measurements. Date: 3 September. I started measurements at around 0730 UTC reading GPS nav data at 1 Hz just to check on the CAR. CAR cryo-pump was turned off, scanning downward from horizon to horizon. Target site was Sua Pan for BRDF during Terra overflight. At 0757 UTC the CAR instrument was powered off to step up the sampling rate of GPS nav data. The instrument was started again at 0803 UTC. At T = 0815 UTC cryo-pump was turned on, the filter wheel channel set at 2.1 micron ready for BRDF over the Sua Pan. At T = 0857 UTC changed it (CAR) to BRDF mode. BRDF started around 0906 UTC. Measurements taken over vegetative surface, mixture of grass and trees. I think southeast of Sua Pan and chose the best available site, which was difficult to find. Then we took BRDF over Sua Pan. Completed measurements at T = 1002 UTC. Measurements over the Sua Pan looked good, but analysis will tell. Last part of the flight, instrument taking measurements in the starboard, filter wheel channels still look unstable. That's the end of my short summary. Thank you.

AR: If anybody else would like to jump in, I suppose we might as well get this done with.

IB: This is Isaac giving a quick summary. A pretty quite day on the FTIR. Did continuous measurements of CO, methane and CO_2 during two vertical profiles, one during the Terra overpass over the Sua Pan at I believe it was 0835 UTC and then another one approximately an hour later. That's the summary for the FTIR.

11:47 AM

AR: I guess I can jump in and say a few words about the overall flight. Climbed out of Pietersburg to 10,000 ft. That was our transect altitude 10,000 ft, pilot's altitude. On the climb out we had little turbulence all the way up and there were noticeable stratifications of the haze higher visibility slots on that climb up. We pulled at 10,000 ft in very uniform haze and very thick haze, probably the thickest of this project. About 15 min out we began a slow climb at 500 ft/min to 14,000 ft then revised slightly to 14,500 ft. That would translate to 15.1 GPS altitude. At that height we did not clear all of the haze, but we cleared probably 95% to 98% of it. It was also during that climb that some cirrus clouds became visible and did have a noticeable impact at times during the flight. However, they were widely scattered and we often found some close slots that allowed some decent radiometer measurements.

The next part of the flight was to descend in a spiral over what was termed grass to the east of the airport. It turned out it was actually more trees and scrubs than grass, probably grass dominating. We proceeded to do 100-ft legs first across the terrain, the plants that I just described in that going on over the Pan just about the time the Terra overpass occurred at 1052 LT or 0852 UTC. We had a 5-min leg over the brush and subsequently did our BRDFs back over the original, as close as we could near the original descent location on the descent down from 15.1. However, that proved to be troublesome because of both extremely poor visibility, certainly the poorest we've seen at those levels of 200 to 2,000 ft above ground level that we've seen. It was very difficult to pick out a homogeneous area for the BRDF circles. Another problem was the winds were stronger than anticipated and it took a couple of calculations to get the winds right and so we had two tries over the brush before we actually completed one.

Then we went over to the Sua Pan to do a similar routine of BRDF circles. Again in the Pan the irregular shape of the Pan, stronger winds than expected, very poor visibility caused us a couple of false starts before we got it right. Then at the end of that we did a 100 ft pass down the length of the Pan. We tried to keep the shadow off the sunphotometer and stay over the Pan for a good 5 min, which worked out pretty well. The only problem might have been that there was a visibility gradient out there, some kind of a plume no doubt that we were entering at one end of our transect and some of our BRDF circles as a matter of fact. That might show up on some of the aerosol measurements. After we finished our 5-min run at 100 ft over the Pan we climbed up to approximately the midpoint of the haze layer, which was about 8.5 GPS altitude, thousands of feet, and did a 5-min leg over the Pan at that level. Then we continued our climb at about 1,000 ft/min up to the top of the haze layer, which was again when we went up to 15.1 K GPS. At that point the haze had thinned at that same level, much better visibility at 15.1 compared to 2 hr previous or so.

Once we did the 5-min run down the Pan at that level, also somewhat impacted by the remaining scattered cirrus clouds that we had above us, we descended to a different level than we had ferried out on. We're actually now about 7.8 K GPS and that's pretty much been the level that we have stayed at since leaving the Sua Pan. During that leg we saw

something that happened yesterday. We had a lot of turbulence and up to, and there must be some terrain associated with this, until the turbulence and simultaneously at the same time the cumulus fractus went away. Then we entered smooth air, which is what we've been flying in now for probably 20 min or more even through we've maintained the same level. So obviously the convective boundary layer really is needed here again for some reason as it was yesterday on the way home about half way back we lost the turbulence, the flight smoothed out and this time with a much lower elevation as well. So it's a bit of a mystery and I'm going to close there.

PR: This is Phil. I just wanted to say that today was the big day for MISR both on the Terra overpass. Hopefully this was the first day that AirMISR was working on the ER-2, so I'm feeling pretty good that we got a vertical profile before the Terra overpass over the brush and then a vertical profile after the Terra overpass over the Sua Pan. We were at minimum altitude at the time of the Terra overpass. We did as Art mention get an intermediate flat leg over Sua Pan for the radiative flux measurements. I thought the pilots did a great job of getting us over where we wanted to be and at the right altitudes and the right orientations. The sunphotometer tracked quite well. It didn't seem to have the seeking urge that Beat and Art mentioned in yesterday's flight. So I think we got a very nice data set.

AR: I hope it's worth the extra hour and 20 min I'll have to explain to Peter.

PR: Thank you Art. I'll certainly back you all the way.

AR: It's silly to be out there and leave because of some superimposed time limit when you've got to finish the whole thing off.

PR: Yes, I think the MISR guys and the AirMISR guys will really appreciate it. I think this was their big shot.

11:55 AM

AR: Brian, do you want to pass a few words over or what?

TK: Art, I can give my quick summary.

AR: Okay Tom. Go for it.

TK: This is Kirchstetter's summary for UW flight 1830. I took three TEM grid sets today. The first was en route to Sua Pan. I began that just after we left Pietersburg and just finished that sample just south of Francestown. The third sample I took was leaving Sua Pan and I ended that also just south of Francestown. So between the first and the third sets I seem to have encompassed the entire transit back and forth. The middle set, the second set that I took, was when we did our spiral down over the Sua Pan. I didn't do any PC-BOSS today at the request of the engineers and that's my quick summary.

RS: This is Ricky. Today the gas instruments were all up and sampling via the continuous line throughout the whole flight. We also took an HC can above Sua Pan and on the ferry ride home. I noticed today that the ozone values were rather high the whole day around 100 ppv.

11:59 AM

AR: It looks like the horizontal visibility has improved over the last few minutes or 10 min and we're coming over some mountains, so we'll see the turbulence pick up a little bit.

12:01 PM

BM: I can go ahead and do a filter summary and bag-house summary. Teflon-quartz filter holder #1, quartz-quartz filter holder #1, Teflon filter #43, sampled from 0720 to 0805 UTC, 3,193 liters sampled of ambient haze at 10,400 ft. Ambient scattering was about 8.5 $\times 10^{-5}$ m^{-1}. The second filter set was Teflon-quartz filter holder #3, quartz- Teflon filter #44, and quartz filter holder #2. From 0834 to 0858 UTC, 1,667 liters sampled. This is a vertical profile of the ambient haze over the Sua Pan area from 11,000 ft to 3,600 ft msl. The scattering ranged from about 1 to about 2.6 at its maximum $\times 10^{-4}$ m^{-1}. The third filter set was Teflon-quartz filter holder #2, Teflon filter #45, and quartz-quartz filter holder #3. Sampled from 1055 to 1140 UTC, 3,440 liters of ambient haze at approximately 7,800 ft. The ambient scattering was about 1.3×10^{-4} m^{-1} on average. It changed a little bit while we were flying that level. All the Teflon-quartz pairs were sampled on flow meter #1. The quartz-quartz pairs were sampled on flow meter #2.

The bag-house summary. I won't be mentioning purges of the bag, but I did purge the bag before each sample. Sampled at 10,400 ft two DMPS runs, the bag-house nephelometer and coincident humidigram. Sampled at 10,400 ft again in a slightly higher scattering regime two DMPSs, a bag-house nephelometer and coincident humidigram. Sampled at 3,600 ft very close to the surface of I think it was the Sua Pan two DMPSs, a bag-house nephelometer and a coincident humidigram. Sampled at 8,300 ft one DMPS, a bag-house nephelometer and humidigram. Sampled at 7,900 ft two DMPSs, a bag-house nephelometer and another humidigram. Took a second sample at 7,800 ft or about 7,900 ft, the same basic altitude, and did a DMPS bag-house nephelometer and also a coincident humidigram. The only reason I took two samples at that level was the humidigram from the first sample may have been interrupted when we passed between a layer of cumulus fractus, I think, and the haze layer.

For the aerosol I don't know exactly what Ray usually says, I guess CN and neph I was watching those pretty much when we were going through the haze layers and they pretty distinctly showed when we passed from one layer to the neph. It looked like about three layers that we were kind of going in and out of, but we'll have to really look at the data and kind of take a closer look at that.

AR: That was a good point, Brian. I forgot to mention that even over the Pan the haze seemed to be stratified quite a bit because of the muted boundary layer out there.

12:05 PM

PR: We seem to be going through quite a gradient of optical depth here, maybe even under some plumes.

(v) University of Washington Flight 1831 (September 5, 2000)

PH: I'm going to start my summary. The main purpose of today's flight was to sample the prescribed burn of Diombo grassland in Zambia that Darold Ward has prepared and has quantified fairly carefully. It was located at 14 degrees 48 min 34 s/24 degrees 27 min 03 s. Prior to that we transited from Pietersburg to near Kaoma in Zambia. Very hazy day. The optical depths were fairly high. Light scattering was high. Very uniform air mass in the horizontal. On the way here we sampled at a few different altitudes, 10,500 ft, 11,000, 12,900, 13,900, back down to 9,500, but it didn't look as if the physical properties of the air changed very much either in the vertical or the horizontal. As we came on site to the site of the fire, we started to descend to the fire site at 500 ft/min. When we were about 10 min out, we hit the top of the convective boundary layer at 8,600 ft. Arrived at the fire site at about 1140 UTC. The fire was ignited at 1150 UTC. Winds were estimated to be from the east-northeast at 5 to 10 knots. I won't go through all the passes we did through the fire, but we probably did 13 to 15 or so total passes and all pretty close to the fire. We got 3 bag samples. The fire itself had a lot of flames. It didn't produce all that much smoke, but what was there we sampled. We got 3 bags for chemistry and all the various measurements we do on the bag, several humidigrams. We then went just a few miles downwind and crossed the plume a couple of times, but it was very weak. It could barely be seen in the neph and the CN measurements. It was too weak to do any chemical sampling on. We ended up by doing a bag sample on the ambient air, which was very smoky anyway. Now we're heading back. We're going to go back via Senanga, which is the southerly point on the sunphotometer line in Zambia.

PH: Anyone for summaries?

AR: I could give a little weather overview here. I did have a chance to check in with Stewart Metcalf and did some satellite stuff. Today's weather was impacted by two things, a high pressure in the southern part of South Africa, which extended out over the west Indian Ocean, producing an upslope easterly flow from the Indian Ocean which we saw today as overcast strato/stratocumulus clouds in Pietersburg. Above that we had westerly flow, pretty vigorous, 20 knots at 10,000 ft and 30 knots at a little bit higher than that. Along with that that bunch of the upper level flow reaching down into the tropics northwest of us and touching out some of that high level moisture associated with the ITCZ. This subtropical jet having a little rivulet of cirrus and a few altocumulus clouds that we essentially flew down toward the ITCZ as we came out to our research site. So it was

pretty interesting because we unfortunately had to stay under those cirrus clouds, that river of cirrus clouds, coming out of the tropics as we went to our research site and that impacted our photometer measurements. After that we tried to climb, as Peter mentioned, up to the higher levels of the haze layer, there was no indication of any topping lid even at 14,000 something or other and indicating that probably this was the highest top of haze that we've seen. Because normally when there's no beginning of a lid on the haze layer it's been about 4,000 ft or even more before you get to the free trop. So I'm pretty sure that this is the deepest layer of haze and certainly, as our aerosol people know, the densest as well. So it's quite a phenomenal day in that regard. Other than that on the research side we had light east to northeast winds as the pilots mentioned and a subdued boundary layer. I would call hardly light turbulence noted at low levels even out over the site and so probably the effect of both the broken cirrus coverage that we had and the very heavy smoke that prevented the insulation from really sending those convective plumes up. I think that's about it.

PH: Any more summaries, Ray?

RW: Not too much to report really. Everything seemed to work fine. I got some OEC measurements in the plume. Humidigrams, both ambient and of the plume samples, were a little difficult at times to get the RH up high enough because the nephelometer dipped so high. But I think everything worked okay.

PH: What sort of humidification factors did you see today en route and in the smoke?

RW: They were about 1.4 en route and the smoke looked like it was lower than that. I'll have to do a little extrapolating. The single-scattering albedos are pretty low too in the smoke. They may be in the 60s.

PH: Point 6.

RW: Correct.

PH: Anyone else? What about Bob?

BY: I'm talking a quick look at the data. I'll give a summary after that.

TK: I can go.

PH: Go ahead.

TK: I took three TEM grid sets today. The first was in transit from 0913 to 1013 UTC. The second two were of smoke. The second one that I took was a continuous sample as we penetrated the plume over and over again, so it was during these 13 or so passes. The last one I took was off the bag, our last bag of that plume. Took two PC-BOSS sets. The first was in transit. I'll be right back.

PH: Is he running the NO_x?

RS: Yes, it's on a continuous line right now.

PH: Good, just keep it on.

TK: So…

(END SIDE 1, TAPE 3)

TK: …it was in transit from 091030 to 101450 UTC. The second one that I took as we were traveling in and out of the plume from the grass fire, even though it was a pretty short sampling duration just from 1210 to 1235 UTC, was just 25 min. Passing through that plume was plenty enough time to put an easily seeable deposit on the filters. That's my summary.

PH: Very good.

RS: This is Ricky. As far as the summary goes, all the gas instruments were running today. We sampled from the continuous line until we got to Kaoma and switched to bag house and then at the very end of the fires we did a control bag and then switched back to continuous line. I did some NO calibrations at the beginning of the flight and I'm doing some now. We also took HC cans, two over the fire and the plume and one in the ferry flight over.

PH: We have 15 cans left. Is that right?

RS: Yes. We have seven left on board. I don't think we should use all seven tomorrow.

PH: No we won't need many (if any) cans tomorrow, maybe one. Just leave them on board.

BM: I can do a filter summary.

PH: Please do.

BM: The Teflon-quartz filter holder #1, Teflon #47, quartz-quartz filter holder #1 on flow 1 and flow 2, respectively, sampled from 0903 to 0942 UTC, 2,785 liters of ambient haze at 10,500 ft. The MS nephelometer was reading about 1.4×10^{-4} m^{-1} at the haze level. The second filter set was Teflon-quartz filter holder #2, quartz-quartz filter holder #2, Teflon #48 sampled on flow 3 and flow 2, respectively. This is the bag-house sample of the plume, which is kind of pretty young smoke I think. Sampled from 1159 to 1209 UTC, 460 liters across each filter there and the bag-house nephelometer was reading about 3×10^{-4} m^{-1}.

The bag-house summary: I sampled at 10,500 ft, did 2 DMPSs, a bag-house nephelometer and coincident humidigram. I sampled at 11,800 ft two DMPSs, a bag-house nephelometer and a coincident humidigram as well. Sampled at 13,900 ft two DMPSs, a bag-house nephelometer and a coincident humidigram. Then we went to the plume and I just labeled it bag 1, 2, 3, and 4. So bag 1 of this plume, Teflon-quartz, quartz-quartz, bag-house neph and chem rack all sampled off of the first bag. The second bag there was no purging between any of these bags other than what was emptied through the sampling systems. With bag 2 we sampled with DMPS, bag-house nephelometer, chem rack, humidigram and PSAP. Bag 3 we sampled with the DMPS, bag-house nephelometer, chem rack, humidigram and PSAP again. The fourth bag, from the same plume pretty much the same location but slightly aged now because of the time it takes to sample, we sampled with the Buseck filter system, chem rack, and bag-house nephelometer. Then we also sampled once the ambient haze around the plume at I think it was a level of 5,400 ft and we ran that sample to the bag-house neph, chem rack and DMPS. It was just to give an idea of what the levels of flow were compared to the ambient with the chem rack. That's all I did with the bag.

PH: Good. Was everyone all right at the back there today? Was anyone sick?

CG: Peter, I would like to give a short summary of the CAR measurements.

PH: Go ahead.

AR: Charles, can I just say one thing here for Beat's sake? Beat we lost the ice crystals and the halo at about 131530 UTC or so, and it has appeared clear since then.

BS: Yes, I can confirm that. So 0.78 optical depths up here.

AR: All right Charles.

CG: Thank you.

CG: Flight summary for the CAR measurements on flight 1831, September 5. I started measurements at around 0851 UTC starting at starboard. At that time we were flying through the stratocumulus. Filter wheel was set to 1.6 micron with cryo-pump on from the beginning. GPS/Nav was received at 1 Hz and later raised to 3 Hz at around 0908 UTC. Scanning mode was changed to downward at 1000 UTC until the end of this flight. Temperature of the base plate was oscillating between 9 to about 13 degrees C. That was around 0901 UTC. I noted it increased to around 19 degrees C at 1133 UTC climbing to 30 degrees C at around 1220 UTC. At the same time the filter wheel channel showed a dramatic increase over 15,000 counts. Optics 1 and 2 (temperature) and also the telescope showed also an increase. I've also been checking the change of the file size with the time just to make sure we've got the data. We suspect that we're having a data dropout and I wanted to warn about this problem. Otherwise, I'm ready for BRDF mission tomorrow at Mongu.

PH: Thanks Charles. Don't forget to put the CAR in the proper parking position before we start our descent to Kasane.

CG: Thanks for reminding me. Don will help me.

PH: To complete the summary, we did go to Senanga. We did a vertical profile down from 11,000 odd feet msl down to 1,580 ft above ground level right over Senanga airport. Now we're doing a climb out and heading back. It looks as if we've got a good sunphotometer profile there. We lucked out with no significant cloud above us.

PH: Has everyone summarized no.

GG: No. Engineering station: everything that started working as we took off kept working. The FSSP-300 was not up; don't know why, because it was aligned yesterday.

PH: I can't hear you very well, Grant.

GG: It distorts if I get it right next to my lips. At any rate, the FSSP-300 still doesn't seem to be giving us anything. The PCASP is fine. The FSSP-100 is fine. We still have some PVM-100 problems. Otherwise things operated normally.

PH: So the FSSP-300 is mounted, but is not providing any measurements.

GG: That's correct. Don aligned it, did an optical alignment on it; the depth spot had fallen off. Larry found it on the floor and we glued it back right in the center of where it had come off before, realigned the thing, but we're still not getting any data from it apparently.

PH: Fortunately we got that new instrument from TSI that covers a somewhat similar size range and seems to be working quite nicely.

BS: For the sunphotometer summary for most of the flight, there were broken clouds or cirrus above us. We got some measurements every now and then. We got this nice partial profile over Senanga. During the fire work there wasn't much for the sunphotometer of course. There were also clouds above. What we will have even despite clouds is column water vapor. That's all. Tomorrow will be a sunphotometer day.

PH: Sunphotometer and a CAR day.

BS: Sure.

BY: This is Bob Yokelson. I'm ready to give an FTIR summary if it's a good time.

PH: Okay Bob.

BY: In transit we got three or four samples of the haze at different layers. It was unusual haze as we note. Sort of a haze layer above a cloud layer. At the fire we got several good samples. I just looked at one of them now. I saw acidic acid, formic acid, ethylene, CO, CO_2, methane, formaldehyde, methanol, so a lot of good chemistry. An interesting thing we know that there is zero ozone right in the fresh smoke, so the smoke appears to have –85 ppb of ozone, which is because that is actually the background air had about 85 ppb of ozone in the area. So there is a lot of photochemistry going on in the haze, not necessarily in the plume. We also got an ambient air sample just as the plane passed over Senanga, so we will have some air chemistry to go with the partial profile if it comes in handy. That's all for today.

PH: Did you see any chemicals that surprised you?

BY: Quite a few in the African fires. We've seen a lot more formic acid than we've ever seen in the States or in Alaska or the temperate part of the U.S.

PH: Interesting.

(w) University of Washington Flight 1832 (September 6, 2000)

PH: I'm going to start my summary. I think we've done very well on this flight. We've achieved all of the three main objectives that we set out to do. After taking off from Kasane we headed north. When we got over Senanga we dropped down and did a low-level run from 500 ft agl from Senanga through Mongu airport and up maybe about 50 miles north of Mongu. All at 500 ft and that's over the sunphotometer north/south line; although we didn't get to Zambezi. We then headed back to the Mongu tower. We did two groups of 5 CAR turns over the same area; we did one group of 5 turns, and then went back to the same location and did another 5 turns over the same area centered on the Mongu tower. Then we went over Mongu airport and started off with a low-level pass over the airport at 5 min run at 500 ft agl. Then we spiraled up to 15,000 ft on the pilot's reading of altitude. We found from that spiral that the aerosol was very uniform below us, in terms of aerosol light scattering, so we didn't need to sample a great many levels to characterize it. We started our continuous chemical sampling on the descent from 15,000 ft. We spiraled down to 9,000, did a horizontal run at 9,000 ft (these are pilot altitudes) for 5 min. Then descended to 5,000 ft. Did another horizontal run there at 5,000 ft, which we just completed and we're now climbing out heading back home; we'll see as we head back if we can get a little bit higher than the 15,000 ft that we got over the airport itself.

AR: In a weather summary I can say that we're continuing in that easterly flow. At Kasane the wind was 5 to 10 knots out of the east and we had thin to open cirrus overhead and as we took off we also ran into an isolated altocumulus cloud in the area. In about 15 min from departing from Kasane the skies cleared nicely and I haven't seen a cloud since. As Peter noted, well-mixed haze all the way up to 15,000 GPS altitude and estimating it will take 17,000 GPS altitude to clear it at least to 99.9%. The easterly flow here in the area of

Mongu was actually stronger than at Kasane running roughly probably 10 to 15 knots on the surface. From the pilot reports, running about 15 to 20 knots out of 075 true and 085 true. So an easterly wind and yet lots of well-mixed smoke up to at least 15,000 ft that we verified.

PH: Any more summaries?

RW: I could do one.

PH: Okay.

RW: Did 5 humidigrams, all ambient. One in transit at about 8,000 ft, two at 500 ft over the Mongu airport, one at 9,000 ft and one at 5,000 ft. The range of humidification factors was about 1.3 to 1.4, so not very hygroscopic. Sort of the average scattering albedo was pretty uniform. It was about 0.71.

10:08 AM

PH: What was the range of the humidification factors?

RW: About 1.3 to 1.4.

10:20 AM

CG: Peter, I'd like to give a summary for this flight.

PH: Please, go ahead.

CG: This summary is for UW flight 1832 for CAR measurements. I started measurements at around 0715 UTC scanning in the starboard. Channel 3 seemed to saturate around 6,000 counts and channel 4 at around 15,000 counts. It was not very clear to me whether the other channels were saturated. This happened when we're looking at the solar disk. Implications for this is that we seem to be losing a large dynamic range. At Mongu tower (approximate latitude 15 degrees, 42 min south/longitude 23 degrees 28 min) we did two groups of BRDF and this was the main objective for this mission. Now the first five times were for 1.6 microns and second one was for 2.1 microns. Now we finished these BRDF at around 0909 UTC. Immediately after our BRDF measurements, I turned off the instrument; that was around 0912 UTC. Now this was just to try to investigate the data dropout problem that I seem to be experiencing. Now we reset again at around 0913 UTC scanning at starboard, turned off the cooler at around 0954 UTC after I realized that the mean of the dark current was almost equal to the mean of the science data. Now channel 380 (nm) seemed to experience the same problem, that is, dark-current is higher than the (mean) science data. The other channels looked fine. When I restarted the instrument for the second time I noticed housekeeping data flowing now something not noted before.

Now this I suspect could be the cause of the data dropout, but I'll continue to investigate. Otherwise, the instrument seems to be doing pretty well. Thank you.

PH: Thanks Charles. A nice summary. Anyone else?

BS: Summary for the sunphotometer: The domes were cleaned before takeoff, thanks Don. The clock was set accurately to within 1 s of GPS. No ___ data for the first few minutes, but again not a problem because close to the airport. In transit to Senanga, very nice mode, no clouds for most of it. First we did like 500 ft. Later on we went up 100 ft, everything very uniform. Optical depths at 100 ft 1.35 and then later on we climbed to 1,000 ft. Mongu tower 2,000 ft. Then a bad heading when we were heading toward the BRDF. Then doing BRDFs the instrument loses tracking a couple of times. I found out why. It's basically the fast changes in roll that it doesn't handle well. We'll fix that problem, but that's not a problem for now. Then the run over Mongu at 700 ft, then a climb the first time max altitude over 15,000 ft, but the optical depths is 0.2. Then to down to one level at 9,000 ft, another level at 5,000 ft and then climbing to a maximum altitude of 17,500 ft the remaining optical depths at 0.1, but we almost saw the top of the layer virtually though. There might be some stuff above that first layer. Now we're heading home at 14,000 ft. There was never a cloud after maybe 0730 UTC or so.

PH: Thank you.

RS: Summary for chemistry, all the gas instruments were up today just sampling from the continuous line. I did some calibrations and zeroing for part of the flight of all the instruments. They looked pretty good. Took an HC can above Mongu in the upper part of the haze layer.

PH: Any comments on the gas measurements today or anything else you noted?

RS: No, it was similar to yesterday. We had high ozone throughout the column. That was pretty much the only thing I noticed.

TK: I can do a summary in the back.

PH: Go ahead Tom.

TK: I collected one PC-BOSS set. This has when we were en route traveling northbound from Senanga to Mongu when we were running around. We fluctuated about 500 ft above ground and that was from 0754 to 0820 UTC. I have another filter set that's loaded, but I'm going to wait to run that I think when we do our transit back to Pietersburg from Kasane. As far as TEM grids, I collected two sets and I plan to take a third back to Pietersburg from Kasane. The first one I collected today started at 12,000 ft and ended at 500 ft above ground. The sample times were 0731 to 0813 UTC. The second set I collected was when we were at 5,000 ft msl above the Mongu airport and I let that run during an ascent all the way up to 17,000 ft and then I stopped it when we…(END OF TAPE 1, SIDE 2)

(x) University of Washington Flight 1833 (September 6, 2000)

1:43 PM

CG: I'd like to give a short summary, Peter, for this flight.

PH: Yes. We've forgotten our summaries. Let me just jump in quickly. First of all this was basically a transit flight from Kasane to Pietersburg. We took measurements en route. Pretty uniform all the way. Any comments of interest can be found on the main tape. Go ahead.

CG: This is a flight summary for UW flight 1833 for CAR measurements. This was a transit flight from Kasane to Pietersburg. CAR measurements started at 1248 UTC scanning initially in the upward mode for a few minutes and then changing to downward thereafter for the rest of the flight. Now during this flight I checked systematically the effect of changing the rate at which GPS nav data is read to our system as we are investigating the data dropout. I started at a rate of 1 Hz, now raised it to 1.666 and went to 3, 5, and finally 10. Additionally I checked the number of scans per minute and for all the rates the scans remained constant at 50 (revolutions)/min and not 100 as expected. Therefore, the data dropout rate is not caused by the rate at which we are reading the GPS nav data. I also investigated the variation of the science data with respect to the dark-currents for all channels save the filter wheel which was turned off. Now initially for channels 7 and 8, mean science was barely above dark-current but later after 20 minutes of measurements mean science went up above (mean dark-current). For all other channels mean science data was above mean for the dark current, so the data look good. I never turned the cryo-pump at all for this flight. Thank you.

PH: Jump in quickly with your summaries. Keep them brief. Let's have the filter guys first.

RW: They're off their headsets.

TK: I could go. It would be very brief.

PH: Go.

TK: This flight I collected one PC-BOSS filter set and one TEM grid set. I don't have the times in front of me. I just put that book away, so I guess that's the end of my summary.

RW: This is Ray.

PH: Go ahead.

RW: I got several humidigraph measurements on the way back and had a little trouble with the OEC in the first part of the trip, but it's working again.

PH: Ricky, Brian. Will someone get Brian and Ricky on the headset and get them to do their summary.

BS: Sunphotometer, everything is on the tape I believe.

GG: Engineering functions were all nominal.

1:47 PM

BS: This is certainly much cleaner here.

PH: What's happened to Brian and Ricky?

RW: Brian's not ready for a summary and he can't plug in, so I guess he'll have to do it later on the next flight.

PH: Ricky?

RW: Ricky doesn't have his headset on.

PH: Tell him to put his headset on, would you?

RW: Yes, just a second.

RS: This is Ricky.

PH: Summary.

RS: We just sampled continuously through all the gas instruments throughout the flight. I'm now calibrating the instruments. That's pretty much it.

PH: How many HC cans left?

RS: 16.

PH: CN has continued to increase on the descent into Pietersburg and also the light scattering.

BY: A quick FTIR summary. We have a sample at each level altitude during the transit flight.

PH: Good.

BS: I hear we have an optical depth of only like 0.8 and this might even include some cirrus, so nothing compared to the conditions in Kasane.

(y) University of Washington Flight 1834 (September 7, 2000)

PH: While we head toward the next destination, I'm going to summarize what we've done on this smoke plume. We took off from Pietersburg and headed straight to the site of the prescribed fire, which was west of Kruger National Park in a private game reserve (Timbavati); the latitude was 24 degrees 23'43"/31 degrees 15'18". It was the biggest smoke plume we've sampled so far in SAFARI. We arrived on site and descended to the location of the fire. It had already started, I assume about 15 min before we arrived. We descended to the site at between 0831 and 0836 UTC and we started our penetrations of the plume at 0836 UTC. We did a first pass over the plume. It was a nice big smoke plume. Also, fairly clean ambient, which we lucked out on today, so it should be a good contrast. We did our first bag sample and one HC can sample on the first pass. We then did a second pass for physical measurements at 3 miles downwind, and a third pass at 5 miles downwind also for physical measurements while they were using up the first bag sample. We did a fourth pass over the smoke back over the fire site where we grabbed our second bag sample. The fifth pass was 5 miles downwind in the upper third of the plume for anything related to photochemistry. The sixth pass was 5 miles downwind through the middle of the smoke and we got our third bag at that distance, which was the first of 5 miles downwind for our chemical measurements. The seventh penetration was in the upper segment of the plume. Little segments of smoke that had detached from the main plume and had been carried up to 3,000 ft, so that was our seventh penetration. It will be interesting to see what the FTIR shows on those. Actually we did two penetrations of those segments of smoke at about 10 miles downwind. The eighth penetration was back to 5 miles downwind at 500 ft asl through the heaviest smoke where we got our fourth bag sample, which was the second bag at 5 miles downwind. We then ran along the length of the plume heading downwind from the fire head for physical measurements. We went out to about 23 miles downwind. We then went back to 18 miles from the fire and did a penetration at 500 ft through the thickest smoke for physical measurements. Then we repeated that penetration at the same altitude through the thickest smoke for our fifth bag, which was the first bag at 18 miles downwind. We then did a couple of runs to look at radiation effects of the smoke. One was below most of the smoke.

JR: We're 14 miles from the circle, Peter, what altitude do you want to be at?

PH: Let's come in at 2,000 ft agl.

JR: 2,000 ft, okay.

PH: So these next two penetrations are 18 miles downwind. One was below most of the smoke and one was above most of the smoke for radiation effects. Then we did our final penetration back at 500 ft at 18 miles downwind. That was our sixth bag sample and the second one at 18 miles downwind. We then started to head toward the Mopane site. Fortunately that was in the downwind direction, so we kept in smoke running along the length of the smoke as long as we could. As we headed out to the north, that also took us in

the direction of the Phalaborwa copper mine, so we did a couple of penetrations of the smoke plume there. I've got some photographs of that mine, but we couldn't spend much time at that site. We're now heading for the Mopane trees. Any one else want to jump in at this point they can on their summaries.

AR: Probably the weather won't change too much. Maybe I can give a weather report. Today's surface map had a high-pressure region in southern South Africa and along with that we had a weak cold front, most likely at the tail end of one go through. As we saw an end to the easterly flow regime in the Pietersburg area and replaced by westerly flow, today at Pretoria it was southwesterly at 10 knots increasing to 20 knots at 700 mb and on up. It was quite strong. Along with that air mass change we saw a tremendous change in the lessening of the haze in the Pietersburg area. On the satellite imagery the main smoke plumes that we have been flying in for the last couple of days had shifted more over Zimbabwe in the northern portion of the northern province and across some open peak. As we took off and we reached the escarpment, the westerly flow over the land appeared. The land trapped polluted air here in the low veldt and along with that we had southerly winds underneath those westerlies here in the low veldt. That caused our smoke plume to go off to the north generally speaking and then curved back toward the east as the smoke rose into those higher layers that were expected to be westerly anyway on the models. The boundary layer seemed to be a bit suppressed today considering the clear skies and high temperatures expected. I believe we passed through about 5,000 ft msl from the GPS system. Also the haze in the Pietersburg area highly stratified of about 3 layers in the visible in the Pietersburg region and then also as we emerged into the escarpment. We had no clouds. I can't think of anything else. I think that's about it.

PH: Thanks Art.

GG: Standby one while I change tapes.

(END TAPE 2, SIDE 2)

PH: I just want to add a couple of things to my summary. We confirmed the ER-2 was overhead about the time when the fire must have been in its dying stages, but probably still a very well defined broad plume at that time. The ER-2 also passed over earlier, just after the fire was lit, so that's good. Also we had a Terra overpass, though it was well west of us. The MODIS probably imaged this area and that was at 0828 UTC. Any one else now can jump in with summary for the tape of their impressions of the flight.

RW: This is Ray. I'll go. We did ambient humidigrams on the cruise in at altitude and then bag humidigrams plus absorption close into the fire at 500 ft, 5 miles downwind and 18 miles downwind. Got good OEC measurements on all those plume passes except the ones that were 18 miles downwind, but we did get bag PSAP samples down there so we'll have that single-scattering albedo. Pretty good fire. So I guess that's about it.

PH: It was a good fire. Best one so far.

RS: Peter, this is Ricky. I can give a can summary. Can 2525 taken at 0842 UTC over the fire on the first pass. Can 3114 taken at 0857 UTC over the fire, second pass. Can 2237 taken at 0924 UTC, 5 miles downwind of the fire. Can 3121 taken at 0938 UTC, 10 miles downwind of the fire. Can 1094 taken at 1013 UTC, 18 miles downwind of the fire. We sampled all the gas instruments through the continuous flow until we got to the fires and then switched to bag. We also got bag samples at the Phalaborwa mine. We did two controls on the bag as to chem rack. Now we're back to continuous sampling.

PH: Very good.

BM: Can I do a filter summary now?

PH: Go ahead.

BM: This might take a bit. Teflon-quartz filter holder #1, quartz-quartz filter holder #1, Teflon filter #56, sampled from 0844 to 0852 UTC, 400 liters of smoke near the source of the flames. Bag-house nephelometer is equal to 1.85×10^{-3} m^{-1} during that sampling period. The second filter sample is Teflon-quartz filter holder #2, quartz-quartz filter holder #2, Teflon filter #57, sampled from 0925 to 0935 UTC, 520 liters of smoke that is about 5 miles downwind of the source. The bag-house nephelometer was reading about 5.30×10^{-4} m^{-1} during that sample period. The third filter set was Teflon-quartz filter holder #3, quartz-quartz filter holder #3, Teflon filter #58, sampled from 1016 to 1027 UTC, 555 liters of smoke. This was smoke that was 18 miles downwind of the source. The bag-house nephelometer was about 3.4×10^{-4} m^{-1} during that sample period. For the bag house, we sampled at 11,500 ft, ambient haze, DMPS bag-house nephelometer both ran off that sample with a coincident humidigram. The next bag sample was of smoke near the source and this was the first sample of smoke near the source. Off this sample we ran the Teflon-quartz, quartz-quartz filters bare, bag-house nephelometer and chem rack. Off of the second sample from the smoke near the source, we ran the bag-house nephelometer, chem rack, DMPS, humidigram and PSAP and then when the DMPS was finished we ran the smoke to the Buseck system. I purged the bag with ambient air, then sample from a new source, which was 5 miles downwind of the fire and this was the first bag from that part of the fire another smoke. We used the Teflon-quartz, quartz-quartz, bag-house nephelometer and chemistry rack all sampled from there. The second sample from smoke 5 miles downwind of the source was sent to the bag-house nephelometer, chem rack, DMPS, humidigram, PASP, and when the DMPS is finished the Buseck system. We purged the bag and at the same time did a control with the chem rack, which I think Ricky mentioned. Then we went to back to plume, which was 18 miles downwind of the source and sampled. The first sample went to the Teflon-quartz, quartz-quartz filters bare, bag-house nephelometer, and chem rack. The second sample from the 18-mile downwind of source plume went to the bag-house nephelometer, chem rack, DMPS and the humidigram and PSAP. There was no purge. We were still sampling at the end, but then we came across the Phalaborwa copper mines. So we grabbed a bag sample and we sent that to the chem

rack, DMPS, and bag-house nephelometer. The chem rack did see an increase in SO_2 then, so we'll have to take a look at that post analysis to see if we got a clean sample or not. Purged the bag before we started doing the first set of CAR BRDF circles. Then sampled at 3,500 ft and ran it to the chemistry rack, DMPS and bag-house nephelometer primarily to do a control for the chemistry rack to see how it reacted to the flows coming from the bag house. That's all we did with bags and filters on flight 1834.

PH: Thanks Brian. Very interesting features happened here as we climbed out. The CN increased quite dramatically and the light scattering fell off as the humidity fell off as we climbed up. I haven't seen quite that sort of feature before, so we might want to look at that. That started 6 min ago and the main increase in CN was 4 min ago and then 2 min ago that increase in CN was back to about normal, but it has continued to fall off the last two min as we climb out. The neph is falling off as we climb out as well. Also a good sunphotometer profile as we climb out from the region where we did the CAR circles.

AR: I was going to make some observations of stratified haze layer. We had a high visibility layer there around 7,000 ft and very stratified above the convective boundary layer, which I think was topping out at between 5,000 to 6,000 ft msl.

PH: What's interesting is that the neph has fallen off since we started to climb out and it's still falling off as we climb to 11,600 ft currently, but initially the CN increased dramatically.

AR: It might have been some of the lofted smoke in the area from the many fires.

PH: You'd think you'd see that also in the neph, but it's just small particles.

AR: I see.

PH: Do you see that feature Ray on your traces?

RW: Which features?

PH: For the last 8 min as we climbed up, the CN increasing and the neph decreasing.

RW: Yes. The neph has now completely fallen off the planet.

PH: It's out?

RW: No, it's working. It's basically zero.

PH: It's basically zero at 12,400 ft. It's just that initial feature as we climbed up with the neph falling and CN increasing for about the first 2 min of the climb out.

AR: A free troposphere sample possible here.

PH: Any more summaries? What about Tom and Kristy, they haven't summarized yet.

AR: Do you have smoke plumes if you see anything topping flight level?

PH: I just mentioned them, yes. Does Kristy want to do a summary?

KR: I'll go first.

PH: Get that mike right up against the lips.

KR: We took one PC-BOSS and three TEM grid sets today. The PC-BOSS was taken from 0821 to 0900 UTC. It was started in transit to the fire at 11,500 ft and then it continued for several penetrations through the young smoke. The first TEM grid was taken from 0904 to 0908 UTC and it was taken from a bag sample of smoke near the source. The second TEM grid was taken from 0939 to 0940 UTC and it was taken directly from the plume about 10 miles downwind of the source. Then the third group was taken from 0952 to 1005 UTC and that was when we were sampling along the length of the plume.

PH: Is that it?

KR: That's it.

PH: Thanks, nice summary. Did you get sick back there?

KR: I didn't feel too good for a while, but I'm okay. Thanks.

PH: That was a pretty rough flight. I don't think we'll have anything quite like that in Namibia. We did lots of turns low down where it was warm. It will be much more comfortable in Namibia.

KR: I'm glad to hear that. Thanks.

PH: Next one up.

CG: Summary for CAR instrument. This is a flight summary for UW flight 1834, September 7, CAR measurements. I started the measurement at around 0811 UTC, but started recording the data at 0820 UTC to wait for GPS nav data: heading, roll, and pitch which were missing. In today's flight during smoke measurements, I was busy checking the performance of all the channels. I noted that the signal of the first three channels, 340, 380, and 472 nm, was barely above the dark current.

CG: Occasionally, the 340 showed a good response. Now I suspect that the scanning mirror is dirty and needs some cleaning. Now BRDF started at 1106 UTC at 23.74 south/31.60 east and…(END OF TAPE 3, SIDE 1)…5 circles were done. No filter wheel channel was operated during this BRDF. The second set of BRDF measurements were started at

1123 UTC. Not far from the first one, around 23.60 degrees south/31.51 degrees east and completed at 1135 UTC. Now instrument is working other than those issues I have mentioned.

PH: On the way out from our CAR measurements CN increase, neph decreased dramatically as did the RH.

GG: The tapes back on line. We've continued to be plagued with this spontaneous reversal problem. Otherwise engineering didn't see any grievous anomalies except that the TANS and the Shadin were a little bit slow coming up this morning.

PH: Any one else for a summary?

TC: This is Ted on the FTIR. Do you hear me well enough?

PH: Just speak up a little bit more. It has to be transcribed.

TC: I was able to obtain penetration samples for all but one of the plume penetrations, which is good. I also included several backgrounds at various elevations for ambient samples. The copper mine plume was very brief and the exchange time of a cell on this instrument I may not get much of anything out of that. It takes several seconds to fill the cell, so if there is anything there it will be in very small concentration. I did a continuous sample of the CAR circling procedure. Of course, before we look at the data there is no way of knowing what we have, but the samples that I took in the plume appeared to be at the maximum smoke concentrations.

PH: Thanks Ted. Harold would you like to say anything by way of summary for the tape.

HA: I think we had ideal conditions for the fire with the clean air that had intruded at the lower levels of the low veldt that is an excellent contrast between the background air and the fire. On the way back the mixing up to the boundary layer at 6,000 ft appears pretty complete and the general haze over the entire high veldt and low veldt with the concentrated layer between 5,000 and 7,000 ft at above surface. Over.

PH: Thank you.

(z) University of Washington Flight 1835 (September 10, 2000)

PH: Flight 1835, 10th of September. On board are Hobbs, Rangno, Spurgeon, Wilson, Sinha, Magi, Ross, Bruintjes, Gatebe, the three pilots and Calvin. The main purpose of this flight is to take us from Pietersburg to Walvis Bay, but we'll take whatever measurements we can en route.

[See UW flight 1836 on September 11 for summary of CAR measurements on this flight. No other flight summaries available.]

(aa) University of Washington Flight 1836 (September 11, 2000)

PH: I'm going to start a summary here. This is our first flight out of Walvis Bay, Namibia. The purpose of this flight was to underfly the Terra and the ER-2 and to hopefully get into stratus cloud off the Namibian coast. We headed to the general locations that were given by Steve Platnick based on the forecast of stratus. We weren't seeing much in that general area so we headed up toward the northwest where the stratus cloud was supposed to be thicker and indeed there was more stratus there, but it was still very broken and very thin. Then we a had a report from the ER-2 that there was more extensive stratus to the south back closer to the original point that was given by Steve Platnick. So we headed back down there. On the way we did some runs above, below and in very thin stratus cloud. The cloud was so thin, that the LWC was barely measured with the liquid water meters. We then got to the point indicated by the ER-2, but it was essentially devoid of stratus. At that point I converted the flight more into a vertical profile for sunphotometer and in situ measurements. We climbed to 12,200 ft and again we got a fairly good profile on the way up in an almost constant type of aerosol layer from quite low down up to 12,200 ft. There was a very good clean slot, I forget at what altitude, about 2,000 ft I think, that shows up nicely on the measurements. We are now descending and heading back toward the land. We'll try to do a BRDF over some red soil areas that have been picked out by Michael King. Then we'll go back to Walvis Bay where we have to try to pacify the local authorities there for coming in on Sunday when they weren't present. We were told that we could go into town by what appeared to be officials there, but now the immigration people are saying we shouldn't have done that. So we're going to try to take care of that problem before they go home today. Anyone what to make a summary on the tape can jump in here.

JR2: CCN spectra from today they are all very flat spectra indicating larger particles and also the spectra in the clean slot showed the real maritime below 50 100 particles per cc. The spectra in the haze layers are about half the concentrations of what we measured in Pietersburg, but a very flat slope. The slope was much flatter than in Pietersburg maybe indicating the aged aerosol.

11:15 AM

PH: Any more summaries.

AR: I don't have much weather background today, but it was a kind of disappointing day for stratus. We had a little scruff of stratus along the coastline, which looks like there is still a little bit left as we approach the land again. There were no winds at takeoff from Walvis Bay. Then as we got offshore about 50 nautical miles, we began to pick up lots and lots of white caps indicating a strong wind zone out there, which is usually considered conducive for stratus formation. Instead we found little scuffs of stratus topping out at about 1,100 to 1,000 ft and bases virtually the same height probably 900 ft to give you about a 100 ft

depth at the maximum amount. Down below that perhaps along with the strong winds and turbid conditions in which some particles were being picked up by the FSSP, which could have been haze droplets. Sometimes it actually got down to where visibility might be considered fog. Less than 4 statute miles or so is the transition point from haze to official fog and, so we may have actually hit a little fog out there. The haze was very stratified as we usually have found in a maritime region. With the exception of at least _____, when we took off the haze appeared to be very homogeneously mixed as we normally find out over the continent. So I don't know if this is a visual, big flummoxed visually, or whether it is a real perception, but we're also seeing it right now if you look out the right wing it looks very slotted and stratified. Then off the left wing it looks fairly well mixed. As far as the subsidence goes it was really shown by that tremendous inversion on top of the stratus. The temperature dropped no less than 10˚C in about 200 ft as we entered the cloud tops. So I hope for a better day tomorrow.

PH: I should mention there was a low centered off the Namibian coast, so we had a clockwise rotation roughly speaking with winds off shore south of Walvis and on shore north of Walvis.

11:18 AM

GG: From engineering most everything worked quite well except that we had another spontaneous reversal in the audio tape recorder and the 2-D probe seemed to be operating. That requires a proper true air speed clock to get the images to the proper dimension. We'll have to deal with that.

11:54 AM

PH: I'd like to get summaries from Brian, Ricky and Kristy because we'll be landing very shortly.

RS: This is Ricky. All the gas instruments have been running throughout on continuous. I've mostly done NO, O the last half-hour. The only gases that are measuring anything besides very low values are ozone and CO and currently CO is pretty low too. So it's basically ozone was up high when we were flying through haze.

PH: Ozone's 45 here, which is interesting, about half what it was over the ocean.

RS: Exactly. There seems to be some photochemistry going on off the coast to create say 80 or 90 ft of the ozone. Is it true most of the aerosol here is just dust, right?

PH: Probably. Yes. Kristy or Brian?

PH: Are Brian and Kristy on the headset?

KR: Yes. I'm on again.

PH: Give us a summary.

KR: Samples were collected simultaneously with TEM grid and the PC-BOSS. The PC-BOSS was started at 1054 UTC. The TEM grid was started at 1055 UTC. They were both completed at 1154 UTC. The samples were conducted over the Atlantic Ocean to the southwest of Walvis Bay between 12,300 ft and 7,300 ft.

PH: Good. Jens, would you give us a summary of what you've done today?

JR2: All right. The sunphotometer was tracking and operating well for the first 2 1/2 hrs of the flight. We took some data just above that cloud deck that we looked at earlier in the clean region that you indicated and we had aerosol optical depth overhead of about 0.7 at 500 nanometers. During that 45-min ascent those successively dropped down to about 0.07, so quiet drastically. Based on the spikes that I saw up on ascent or descent I would assume that the layer was fairly uniform from what I can tell at this point. Unfortunately at about 1100 UTC, the sunphotometer got obscured by the wire and had no way of finding the sun after that. It was not tracking again after that. We haven't quite figured out yet what the problem is, although we tried to restart the instrument once. The problem then is that you need to have a leveled flight leg so that the sunphotometer can actually find the sun again after on its scans. We haven't done that yet since we are doing these BRDF spirals here. So we got data until 1100 UTC.

BM: I can do filters and a bag-house summary.

PH: We just completed three circles. Go ahead Brian.

BM: On the filters nothing. Ran a bag-house sample at 12,600 ft, DMPS bag. Actually…samples on the bag house. I did the DMPS, bag-house nephelometer and coincident humidigram, meaning the humidigram was run off of continuous air at the same time as the bag-house was being sent to the DMPS and bag-house neph. So I sampled the 12,600 ft, sampled at 450 ft, sampled at 4,000 ft, sampled at 10,300 ft and sampled at 12,400 ft, in that order. The sample at 450 ft had a pretty high humidification factor probably because we were right below the cloud deck. The sample at 4,000 ft was interesting because o& the clean slot we were in, but I can't imagine that we could get much out of it because the nephelometer were for the most part pretty noisy during that sample period. That's all I have for bag house and filters.

CG: Peter, I'd like to do my summary now.

PH: Go ahead Chares.

CG: Now I realize we never did summaries yesterday, so if you give me permission I would quickly like to run through what I did yesterday and then I'll come to today's flight.

PH: Okay. So you're starting with flight 1935 on 10 September. Go ahead.

CG: Thank you. Now this is a flight summary of the CAR measurement taken on UW flight 1835, transit from Pietersburg, South Africa, to Walvis Bay, Namibia, on September 10. In yesterday's flight (this flight) I started CAR measurements at 0617 UTC, approximately 15 min after takeoff. Scanning in the starboard through the entire flight and I had the cryo pump off. This implies that I made no measurements at the channels 1.5 through to 2.2 micron. This was what helped me assess the noise levels when the cryo-pump is turned off. During this flight the heading varied from 270 to around 306, now of course this is an implication that we were scanning in the principal plane and this will influence how we interpret this data. I made the following observations yesterday. Now, channel 3, I noted saturates at round 36,000 count, which is around 12 volts, when looking at a bright cloud and the solar disk. It was not very clear to me whether this effect is observed on the other channels. Generally, that flight was good and also the number of scans per minute seem to drop from the expected 100 to around 50 as we flew from Pietersburg to Walvis Bay. This indicates that the data dropout I've been talking about was still continuing. The mean science data seems lower than the mean of dark-current, when I was scanning through the clear skies. This I will continue to investigate. This is all I can say about yesterday's flight and I just wanted to put it on tape for the record. Now I want to jump to today's summary.

This is the summary for UW flight 1836, CAR measurements, on September 11, 2000. We started CAR measurements at around 0853 UTC and now heading west from Walvis Bay. Now scanning initially in the BRDF mode because we were unable to change it to the starboard because of the headwind. Later on we changed it to starboard at around 0938 UTC. Now ready for Terra overflight. Now the filter wheel position, we initially started at 2.3 microns and that is the default when you start this (LabVIEW) program. Later on we changed to 1.6 and then finally, very close to the time of the Terra overflight, we changed it to 2.2. Now this seemed to be good and we continued monitoring that. Now all channels looked fine, but final analysis will confirm our observation. Now Michael pointed out the possibility of using the measurements in radiative transfer modeling. Now the BRDF measurements were done over sand dunes at the following coordinates, 23 degrees 14' south/14.61 degrees east. We started around 1140 UTC. The first set of circles were set at 2.2 microns and the second set were set at 1.6 microns and they started around 1154 UTC. Now so far we have observed a very good response in all the channels, and we will probably continue to check the data to see whether we are getting garbage or good data. Thank you, Peter.

PH: Michael, do you want to say anything?

(bb) University of Washington Flight 1837 (September 13, 2000)

PH: I'm going to start the summary. The main purpose of this flight was to underfly the Terra and ER-2 off the Namibia coast and get measurements in clouds, below cloud base and above cloud top. We accomplished that between our prescribed Points A and B. Point A

being 20 degrees 56 min south/13 degrees 04.8 min east. Point B being 20 degrees 26.7 min south/13 degrees 11.2 min east.

PH: We worked a couple of hours between Points A and B back and forth, sometimes in cloud, sometimes above cloud top, sometimes below cloud base. It's all documented on the tape. We also did one set of 5 CAR turns for BRDF measurements of cloud tops between 1048 and 1102 UTC. Following that we climbed from just above cloud top up to 15,000 ft for sunphotometer and in situ measurements. Apart from a clean slot that was just above cloud top, it was a fairly uniform layer above that. We came back down and got chemistry measurements in the upper main aerosol layer (filter measurements and so on). We also did a step-wise descent back down to just above cloud top for sunphotometer measurements. Then we did 10 CAR turns for BRDF measurements above the stratus clouds, somewhat thicker by this time than the earlier CAR turns. As we head for home we are currently doing runs in cloud and below cloud base and above cloud top. We achieved all of our objectives, except that we didn't go out to the Etosha Pan because we wouldn't have had enough time on station to do BRDFs there. We'll do that some other day. Anyone else can jump in with summaries now.

AR: Weather-wise we had a situation where we had a strong anticyclone off the South African and Namibian coast producing a strong southerly flows along the coast and strong onshore push, which began yesterday and continued into today. Above that, the usual strong subsidence inversion was about another 10 degrees C between cloud top, the warmest point in the inversion layer immediately above cloud top. Then above that layer as you climb in elevation, the winds turned to the northwest and were quite strong for this latitude, something in the order of 20 to 30 knots out of the northwest at heights of 700 mb and above, 10,000 ft to say 20,000 ft reflecting an upper level trough that's very, very slowly approaching this area. Along with that we sampled stratus on the way out of Walvis Bay. I'm guessing a little bit here, bases were about 1,100 ft, tops about 2,000 ft and then we porpoised up and down a couple of times on our way to our research area under the ER-2. During that time the cloud tops were gradually rising. I think at one other point we had 2,300 ft. Then by the time we got to our research area we were running around 2,800 ft to 3,000 ft. Then when we finished up a little further offshore the tops of the marine boundary layer were up to about 3,300 ft. We were beginning to have little overshooting areas as well where they were as flat as a pancake when we arrived. Then apparently as synoptic conditions were changing, we started to see almost clustering into little cumulus complexes with little overshooting tops of may be very modest overshooting tops maybe 50 to maybe 200 ft above the general thin layer. That, of course, was reflected in our liquid water measurements as we were transecting this stratocumulus with the embedded cumuliform enhanced regions. Near the top the stratiform region having a base somewhere around 2,000 ft to 1,800 ft, a top 2,300 ft to 2,500 ft. Then higher in the cumulus areas with the lower bases being as low as around 800 ft to 900 ft above sea level, and the tops running probably in the 3,000 ft or a little bit more range. So that gave plenty of depth for liquid water content to ease up toward half a gram to a gram in those cumuliform peaks. There wasn't much wind offshore. Perhaps we thought we would see a far amount of wind from the model predictions, but perhaps those stronger winds are further offshore yet.

There were no white caps down there, usually something you look for when you have a lot of stratus around and some convection going on. I guess that's about it.

PH: The winds at about 2,000 ft above cloud top were light and westerly. I suppose it's possible that could account for the clean slot we saw if there was a lot of wind shear with height. I don't know if there was or not. A couple of other things I want to add to my summary. The time of the Terra overpass today was at 0930 UTC and we were on station at that time. The ER-2 was tracking backward and forward for an hour or more and we were on station beneath them for the whole period the ER-2 was on site. The British Met Office's Hercules was up today. I don't know what they were doing, but they were up in our general area I believe. At least our pilots made contact with them at some point. Also a note on liquid water measurements. I noted throughout the tape that today, particularly as the flight progressed, the FSSP and the JW agreed very nicely and now Grant's changed the coding. I don't quite know what he's done, but he's changed the coding on the PVM. Now I'm seeing all three of those instruments agreeing very nicely except for the tremendous noisy spikes we're getting on the PVM, which come in every 10 s or so. Basically I think we've now got very sound liquid water measurements.

JR: I guess I'll go next with the sunphotometer measurements for UW flight 1837. The sunphotometer was unparked at 0829 UTC just about 5 min before takeoff. I tried to take measurements through the stratus deck under which we were flying on our way out to location. That did not work well, so I parked the sunphotometer for most of the duration of the earliest 2 hr of this flight.

PH: Can I just interrupt a moment. Jerry, let's climb just above cloud top now?

JR: Okay.

PH: Go ahead Ted.

JR: Whenever we did peak our head through the clouds during the first 2 hr, which happened a total of three times, the aerosol optical depth at 500 nm above the stratus deck, what we were trying to study was of the order of 0.63 and as much as 0.7, but it looked very uniform.

AR: Cloud top 2,500 ft.

JR: That's correct. At 1039 UTC I unparked the sunphotometer permanently. It was tracking excellently. Optical depths at that point were about 0.6 at 500 nm at an altitude of about 1.3 (that's pressure altitude).

AR: Do you want to unpark it again? We're going to be out of cloud for a while.

PH: Just make a note here. As soon as we came out of cloud top, the noise on the PVM disappeared completely. So it's noisy when we're in cloud.

JR: Going on with the sunphotometer summary. At 1115 UTC we started our upward spiral from just above cloud top, which was equivalent to an optical depth of 0.69, and we ascended all the way to 16,000 ft at which the aerosol optical depth at 500 nm had dropped off to 0.10 to 0.11. Instantaneously it calculated extinction just backup the envelope kind of calculation at the flight level that we descended to afterward was 0.11 with the sunphotometer as opposed to 0.07 with the nephs. We descended to there in a few steps that might not allow calling this a descending spiral, but the optical depth at any given altitude looked comparable to those that we had up on ascent. During the BRDF that Charles ran above cloud top later on the aerosol optical depth was very constant at 0.53 at 500 nm. During the final descent to just above cloud top, I found no increase in aerosol optical depth during those about 1,500 ft to cloud top. In summary this was a very good day for the sunphotometer because it was tracking very well as long as we were clearly out of the clouds and the aerosol layers out there looked very uniform, which gives me a lot of hope to study them at some point. I think that Charles got the best measurements, so I think beer should be on him tonight.

CG: I'll go next now.

PH: Go ahead.

CG: Now my summary will be in addition to what Peter Hobbs said about the CAR BRDF measurements. Today for UW flight 1837 CAR measurements done September 13. I started my measurements at around 0842 UTC and I was scanning in the starboard mode and I turned my filter wheel position to around 1.6 and later on at 2.2. I kept on alternating between 1.6 and 2.2 and in some stages I also had time to check the other filter wheel positions 1.5, 1.7, 2.1, and 2.3 as well. Now during Terra and ER-2 overflight the instrument was in good shape and remaining that way up to as I speak to you now. Measurements done today included two sets of BRDF. The first set was at 1049 UTC and the second set was around 1230 UTC. They were done at almost the same location at 20.61 degrees south/19.10 degrees east. It was almost around 2,000 ft for both of them above cloud top. The cloud was fairly uniform other than a few sections that were broken. Other measurements that were done include BRDF measurements over cloud tops, below clouds and also in the cloud. I recognize that when we were flying in the cloud some sections of the data could be good for the diffusion domain measurements and I probably should look into that for analyzing the data. Now this is all I can say for this flight. Thank you.

PH: Next summary.

AR: I just thought I'd jump in and say, Peter, off the right wing is one of the meteorological peculiarities that we saw on the way up here and it has amazingly persisted this clear slot off the right wing out over the water. So we have these coastal clouds banked up under the plane and off the left wing toward the land and then for some inexplicable reason this tremendous clearing out there that narrowed and narrowed until it disappeared about 10 min ago. It just disappeared out there, but you can see it widening in the distance off about

1 o'clock. It just gets bigger and bigger and bigger. It must be rather striking on the satellite imagery and it's persisted the whole day.

PH: Right. I'll get a photograph.

RB: May be just one thing to note also is that the ER-2 was right on top of us at 0949 UTC due to a radio message. Also the CCN counts below cloud base were representative of the cloud droplet concentrations measured in the clouds. There doesn't seem to be any relations to the CCN measurements above cloud top. The CCN in the higher layers, very dirty air, very efficient CCN, concentrations up to over 1,000/cc. The cloud droplet spectra in the clouds indicate a fairly wide droplet spectra. Particle droplets up to about 30 microns, which would indicate sort of an intermediate maritime concentrations between 102 and.…cm^{-3}.

PH: 1334 UTC I took a photograph of the clean slot described a few minutes ago. Is that the end of the summary for the CCN? Next one.

PH: I'm going to have to get up and bang people on the head to give their summaries.

KR: For the filters, two sets of TEM grids and PC-BOSS samples were collected. The first PC-BOSS sample was started at 0903 and stopped at 1044 UTC. A TEM grid was run parallel to that and started at 0905 and stopped at 1044 UTC. These samples were collected while we were porpoising above and below the marine stratus deck. A second set of samples was also collected simultaneously this time in the upper haze layer at 13,000 ft and 9,000 ft levels. The PC-BOSS was started at 1131 UTC, the TEM grid was started at 1132 UTC and they were both completed by 1212 UTC.

PH: Thanks Kristy.

RS: As far as chemistry summary, I took 3 HC cans today, one below the stratus deck and one above one of the upper haze layers.

PH: Hold on. We've got interference here. Are you on the right line, Zan? Try again Ricky.

RS: Chemistry summary. We took 3 cans, one below the stratus, one above and one in the upper haze. We also had the gas instruments for the sampling from the continuous line throughout. Also did some NO and NO calibrations, standard in the zero.

1:39 PM

PH: Is Brian there?

BM: Yes. I can do a filter summary. Started Teflon-quartz filter holder #2 and quartz-quartz filter holder #7 on flow 3 and flow 2, respectively. At 1130 UTC this is a haze sample of

the upper layer or what we found to be the upper haze layer. Then I stopped the filters at 1220 UTC, sampling 2,500.

BM: Sampled about 2,500 ft, 57 liters of the ambient haze layer. That's all for the filters. The bag house sampled twice above and twice below the stratus deck (slightly above, slightly below) and each of those times we ran the DMPS with an 8-s sample time. Ran a bag-house nephelometer and we also ran a coincident humidigram or it would be a humidigram off of the bag house itself. The very last humidigram I don't know exactly what happened. We ran out of water and I guess the membrane is burned out, so I guess we'll look at that on the ground. It seems like the humidigrams are finished for the SAFARI campaign. That's about all about the bag house and filters.

PH: Thanks. How about Ted back there?

TC: The FTIR began with a continuous scanning. Once we spent a lot of time in the clouds my signal became quite swamped with water, which is expected so I closed my valves and quite scanning for a while. I then resumed with a continuous scan once we got above the clouds. That continuous scan lasted for quite a few hours and it's interspersed with closed-cell samples for each layer that we went through from 16,000 ft clear down to almost sea level. Thank you.

PH: Don or Grant?

GG: The engineering things were mainly nothing except we still have the problem with the PVM. We're still getting noise on that channel and occasional noise on the JW, although when they're not noisy, they agree very well now. The tape deck amazing didn't do any spontaneous reversals and everything else seemed to be in pretty good shape. We're getting data through the 2-Ds. They're being clocked properly and hopefully at least the 2-DP was okay this flight.

PH: Since that noise on the PVM only comes when we're in cloud, it may be static building up.

(cc) University of Washington Flight 1838 (September 14, 2000)

PH: I'm going to start the summary. We headed south today to be offshore of South Africa some miles south of the boundary with Namibia. It was really an exploratory flight and we were hoping that we might see aerosol coming off of South Africa, but that, I think, was not to be. As we flew south, we were heading toward a cold front that was coming up from the south. We passed out from under the altocumulus that was ahead of that front, hit some moderate turbulence in the evaporating downdrafts, then came out into fairly clean post-frontal air with some small, scattered cumulus. We did a few measurements around 0900 to 0945 UTC in the inflow and the outflow of those cumulus and then below cloud base for CCN measurements to see the transport of gases and any particle generation by the clouds. Then as we continued to head south, we took up a couple of ship studies, container ships.

The first ship we sampled from about 0955 to about 1025 UTC. We got one bag sample in the effluent right over that ship. Then a second bag sample running along the length of the plume of the ship. The interest there was in getting emission factors of various species from ship particularly NO_x. Then from about 1025 to 1115 UTC we sampled a second container ship and the names of these two ships are on the tape. The second ship was putting out somewhat more effluent than the first. Again we obtained two bags for filter analysis and also chemistry gas analysis. In the first ship we also obtained HC can sample and in the second ship we obtained one HC can sample as well as CCN spectra measurements. Following calibration of the gas instruments in the ambient air in the vicinity of the ship, we headed back toward the northeast and just before we hit the altocumulus overhang we did a vertical profile up to 12,000 ft for sunphotometer and in situ aerosol measurements. We finished that at about 1140 UTC and we're now heading back to Walvis Bay.

RB: May be I can fill in with the CCN summary here. The CCN was working just after the power came on. Very similar measurements to late yesterday's, about 100 to 200/cc. As we were heading toward the southwest, we again encountered the clean slot of air where we again had lower CCN counts. Then basically the CCN ____ as we passed the frontal system became extremely low, very clean air. The cleanest air we've seen around for quite some time, while doing actually the whole SAFARI experiment, CCN generally the whole spectrum below 100/cc. Then when we did the passing through the ships' plumes after 1020 UTC, very high CCN in those plumes at 0.3% supersaturation about 1,500 to 2,000/cc. Very consistent in both ships' plumes and the background basically was very low again. On the way back during the profile, there were no remarkable differences in CCN or altitude, so very much the same throughout the depth of the atmosphere.

PH: I'll just add for the tape here that CNC-1 became disconnected from its inlet sometime during the flight. Its values went an order of magnitude above the CNC-2 because CNC-1 was sampling cabin air. It was reconnected at some point in the flight. All that should be noted on the flight tape.

RB: The CN counter was reconnected around 1020 to 1030 UTC.

PH: Any more summaries?

AR: I'd like to do some weather here. It was a more interesting weather day obviously. We had a cold push go through Swakopmund and Walvis Bay sometime either later yesterday afternoon or during the night. Along with that we saw the stratus clear out and we had just little cumulus fractus clouds. Rather than being bunched in clusters or layers by the coast they were just kind of spread really thin. As we traveled southward there was a classic deepening of that cold air from those very, very small cumulus fractus clouds to stratocumulus clusters with mounding cumulus congestus and eventually reaching below the freezing level, which we saw on the south side of the frontal system. Clouds forming ice at about -5 to -10. I'd estimate cloud tops were warming to probably -7 or -10. In the transect to our post-frontal cumulus sampling, we passed underneath the middle level cloud

band. It had a fair amount of virga here and there. We're coming up on that again and with that light to briefly moderate turbulence occurred due to the evaporational cooling of that precipitation of the very dry air. While we were below cloud base, I should mention, out in our cumulus sampling area, winds at the surface were 30 knots ± 5 by two independent estimates. Along with that there were occasional counts in the FSSP-100 indicating rather large particles were also out there below cloud base under those conditions, which are pretty typical of maritime situations with strong winds. That's about it. Also one more thing, we had a real isothermal layer for about a kilometer on top of the cumulus fractus around Walvis Bay. The temperatures were about 10 degrees C lower at those levels around Walvis Bay and that would be say 850 to 700 that we've seen on previous flights.

JR: If that was it, Art, I can go next with sunphotometer.

AR: Well, I was just going to say that the winds in the marine boundary layer were southwesterly and southerly and aloft were northwesterly.

JR: I will summarize the sunphotometer measurements for UW flight 1838 out of Walvis Bay. Incidentally all times are UTC. All optical depths that I'll be reporting are at 500 nm.

AR: I just want to step in there for just a second Jens. During the next 5 min we'll be recrossing that area where we experienced the light to briefly moderate turbulence, so you might want to buckle up.

JR: All right. Continuing the sunphotometer summary. The sunphotometer was started at 0808 UTC. The first measurements through the altocumulus deck were taken at about 0820 UTC showing briefly aerosol optical depth of 0.6 above the lower level deck, but it was too noisy to really trust those measurements. The sunphotometer was parked after that when we crossed some of that virga. At 0902 UTC the sunphotometer was tracking in the post-frontal clean air. The air that we found out there was very pristine, probably the lowest optical depth that we've seen so far. At 0906 UTC we saw aerosol optical depth of about 0.05 and these were at fairly low-level transects. At 112834 UTC we started an aerosol profile in the wake of the front. But in the highest aerosol-loading region that we could find, still aerosol optical depths were only as much as 0.2. During the profile, aerosol optical depth dropped to about 0.11 at the very top of the profile. So not too heavy loading all together. At 1148 UTC the sunphotometer was parked because of altocumulus overhead was back again. All together the sunphotometer tracked very well whenever the sun was visible. That's it.

CG: I can quickly say something about the CAR measurements. This is a flight summary for UW flight 1838, September 14, for the CAR measurements out of Walvis Bay. My measurements started around 0813 UTC and I started scanning in the starboard, which you may know is very good for measuring atmospheric transmission and at the same time reflection from the surface. Since most of the time we were scanning over the ocean, I noticed that we had low signals from all the channels with a few spikes originating from the white caps. Transmission seemed quite low since most of the time we were scanning

more in the backscatter direction. Now obviously this changed when we were looking at the clouds and while scanning in the principal plane. In the first few hours there seemed to be no data dropout, but this started becoming obvious in the third hour. Seems to me that the problem of the data dropout is temperature related, since in the first two hours, my temperature readings were quite low. We probably will be investigating this in the future. Filter wheel channels were unreliable and behaved erratically only responding when looking at the solar disc. I'll therefore conclude that the data from these channels are unreliable for this flight. Although this mission's objectives were not generally geared toward the CAR measurements, we have data that can be very useful. Thank you.

KR: As far as the filters are concerned, one PC-BOSS set and one TEM grid set were collected today. The PC-BOSS sample was collected from 0956 to 1051 UTC and it was run continuously while we were conducting multiple penetrations of both ship plumes. The TEM grid sample was collected from 1034 to 1109 UTC. It was run from two bag-house samples collected in the plume of the second ship. That's it.

BM: I'm going to do a filter summary. I did one filter pair. Teflon-quartz filter holder #6, quartz-quartz filter holder #4 and Teflon filter #62. Sampled from 1003 to 1030 UTC and from 1046 to 1109 UTC, 2,230 liters sampled from the bag house of ship's plume. Scattering was about 3×10^{-5} m^{-1}. Teflon-quartz was on flow 3 and quartz-quartz was on flow 2. For the bag house, I sampled the first ship's plume once the first time. Then I ran that through the Teflon-quartz, quartz-quartz, bag-house neph and chem rack. Sampled the first ship for a second time and ran it through the bag-house neph, chem and Teflon-quartz and quartz-quartz. Sampled the second ship's plume. Ran that through the DMPS, chem rack, and Buseck pump system. Sampled the second ship again and ran it through the Buseck, Teflon-quartz, quartz-quartz and chem rack. Then we did a control bag in ambient air. We ran that through the DMPS, chem rack and the bag-house neph. I guess the CNC-2 was a little bit strange at one point because it became disconnected from the aerosol intake. RH from the humidigraph was extremely low and I'm not sure if it is operational, but just so it's on the record it didn't look very good today. The other thing I noticed was the MS neph and the CE neph were not quite as close in agreement as they have been in previous flights. I'm not sure why, may be it's a real thing, maybe it's an instrument thing. I'm not sure.

PH: 1203 UTC I took a photograph of the Namib Desert and coastline.

RS: As far as chemistry summary goes, we took two cans today, one for each ship's plume that we sampled. We were sampling continuously for the gas instruments until we got to the ships and then we switched to the bag house and sampled from the bag. At the very end of that sampling we did a control bag and then switched back to continuous sampling. During flight we had some problem with the aerosol, CNC-2 I guess, and had to take a footing off of the chem rack manifold, so we're going to have to work on fixing that when we get down.

TC: This is Ted for the FTIR. I began sampling at about 0930 UTC, which was after the first set of cloud penetrations. I ran continuously for the remainder of the flight and obtained two grab samples for each ship's plume penetration, which will probably be of interest. I also got continuous sampling along the length of each of those plumes as well as continuous sampling done in the vertical profile. Thank you.

12:08 PM

PH: Lost connection. What happened to Ted, did he finish?

AR: Roger.

GG: No, he finished the sentence.

PH: Has everyone summarized now?

GG: Just a little brief from engineering. We had one audio-tape reversal, so we're not done with that problem. There seems to be a great deal of noise suddenly on three of our radiometers. The wide band on the top seems to be all right. The wide band on the bottom and both UVs seem to be giving us quite a bit of noise. We played around with the DMT a little bit and Tom found one error. It didn't solve the whole DMT problem, but where there's one error there may be another. So we'll look hard at the problem calculating the DMT liquid water content. Otherwise things performed fairly normally. We still have some noise on the PVM and a little bit of noise on the JW. Just for the record, the bus voltage on the 28 volt bus is now running 30.6, which it ran yesterday, and we've been idling at about 175 to 200 amps.

AR: Peter, I forgot to mention that the Pilewskie dome is impacted by some condensate in there. I first noticed it when we were done near the ocean surface, but I wasn't absolutely positive because it looked like it might have been a reflection. But up here I can see that there's definitely something inside it.

PH: Usually we get that condensate at higher altitudes. We haven't seen it before at low altitudes have we?

AR: No, I couldn't tell what it was. I didn't think it was condensate. I was wondering if it was on the outside due to say picking up some salt or something. That didn't seem very likely either, but there was something on there. Now I can see it's got streaks in it. I'm not sure why it has streaks unless it was rubbed and then somehow we're looking at some kind of condensation from the inside has been streaked.

PH: Grant, what were you saying about our pyranometers? Was this the Eppley? Would you say that again? You were coming in a bit soft.

GG: We're seeing an inordinate amount of noise on them. We've had some problems chronically with the UV radiometer on the top and the downward-looking UV, which we haven't been able to get the unit off the top of the aircraft. But we seem to have problems with the bottom or upward-looking wide band and the other UV on the bottom as well today for some other reason. They have been giving some noisy response under low-light conditions, but this is a little bit ridiculous. We might have to take a look at them.

PH: The UV down has been noisy right from the beginning of these SAFARI flights. I don't know why. As far as the visible broadband Eppley is concerned, the one on top didn't get cleaned today and probably hasn't been cleaned since we've been in Namibia, so it needs a good clean if we can get to it.

AR: It was real clean on the last flight, Peter. It was just sparkling. Don did a good job on it.

PH: Just this flight then.

GG: Both of the lower radiometers were cleaned this morning.

CG: …things look generally geared toward CAR measurements. Now we have data that could be very useful and I think that's my summary. Thank you.

PH: Very good. We'll have to wait to see what SAFARI Ops. Center has in store for us tomorrow.

12:26 PM

PH: Add to the summary on the tape the profile on landing at Walvis Bay was through fairly heavy dust as we come into Walvis Bay. We had a profile yesterday also.

(dd) University of Washington Flight 1839 (September 16, 2000)

PH: I'm going to start my summary. We had three main goals on this flight. One was to do BRDFs on various surfaces over the Etosha Pan. The second was then to go off the Namibia coast and look at any stratus that might be out there. The third was to pick up some oxygen at Windhoek. We didn't do the last two. We didn't have time. In any case the ER-2 didn't fly today and the Terra overpass, I think, was marginal and we don't know if any stratus was out there anyway, so I don't think we lost much. We will have to pick up oxygen some other time. However, we did do our BRDFs over the Etosha Pan. At least we did BRDFs on the white pan and on the Mopane trees. Those should be good measurements. The additional thing we did today was a pretty good vertical profile. We were going up and down at various levels throughout the flight, but the main profile was over the sunphotometer at the Etosha site. We started at 200 ft and went up to 15,750 ft, then we descended down to 6,000 ft all in that general area and did continuous chemistry there. We couldn't run the Eatough rack because of power problems. We got one HC can

sample in the upper aerosol layer and another HC can sample earlier on in the lower layer. We've been doing continuous ionic and carbonaceous filters. We've also been doing the Peter Buseck's TEM grids. Now we're heading back to Walvis Bay.

AR: Meteorologically it was a really interesting day today. As we took off from Walvis Bay, there was a small surface low-pressure center just to the south of Walvis Bay. An attempt to develop a closed circulation above that circulation at about 700 mb. Along with that this deep cold column of air. The freezing level dropped down to an amazingly low level of 6,000 ft over Walvis Bay, which translates to a snow level of about 5,000 ft over Walvis Bay which is a little astonishing. Along with that the trough gave us a lot of trouble in terms of headwinds because of the trough being slightly offshore. We had strong northwesterly flow on the east side of the trough amounting to 30 to 40 knots at 10,000 to 11,000 ft msl, which retarded our progress out here. Then as we got into the experimental area, we began to pick up a couple of altocumulus clouds off in the distance. That representing a residual of the mid-level moisture that was being inducted from near the equatorial region by the subtropical jet and then kind of whooshing off to South Africa just to the east of the Etosha experimental zone. So that turned out to be a very favorable development. Visually the enhanced moisture in that stream, which I'm sure will turn up in the _____ water vapor image, was enhanced haze toward the Etosha area and especially to the north of the Etosha area a rather visible thickening of the upper level haze off to the north. Over the Etosha and to the west of probably the polar westerlies running/moving around this trough along the coast and bringing a probably quite different trajectory for much of the area and much drier air in particular. So that made it a very interesting day, although it was very fortunate that we didn't have any clouds in the Etosha area today. The boundary layer today generally running about 2,000 ft above the surface at about 7,000 ft msl.

RB: May be I can go on with the CCN. Are you finished, Art?

AR: Yes. I think that was about it.

RB: Roger. With the CCN we took off from Walvis Bay in basically very low, very clean air below 100/cc. There were two layers of clouds. In-between the two layers the CCN went up to about 200 and then dropped off immediately on top of the higher cloud layer. Until we got up further to the north to Etosha we got into the haze layer, which was typical of the smoke and smoke haze we've been working on in the Pietersburg area. CCN went up to over 1,000 in that layer and the higher layer. Then we went back over Etosha over the lower layer. Generally CCN were lower at the same supersaturation, a couple of hundred. We then did a CCN spectra near the surface with the BRDFs, when they were doing and when we were doing straight-and-level flights. Those were fairly low from about 100 at 0.1% to about 400 to 500 at 1%, a fairly steep curve. This was near the surface over the Mopane and also over the pan, which should not show a tremendous amount of difference, some minor differences there. Then we did a vertical profile. Again very high CCNs in the upper level also correlated well with the CN counts. However, the lower level, lower haze layer had higher CN counts, but the CCN were lower. Definitely two different air

masses at the higher level and the lower level. The lower level CCNs sloped much steeper, but starting up again at 200 and going to 600 at 1%, 200 at 0.1%. The CCN spectra in the upper levels a very flat slope at 0.1%, 850 to 900, to 1,100 to 1,200 at 1%. That's the summary today for the CCN and the aerosol.

AR: I did forget to mention one thing. The emission model today showed a very strong push of cold air convection across to the end of areas of Namibia into the Etosha region, so there was a very strong push from the Atlantic into this region down in the low levels. That was 850 mb and a tremendous of cold-air convection was predicted to occur today at about 2 PM local time an ongoing situation for the last 12 to 24 hr.

JR2: Roelof, are you done with the CCN counters and I will connect with the sunphotometer?

RB: Go right ahead Jens.

JR2: All right. The sunphotometer summary for UW flight 1839 out of Walvis Bay. The sunphotometer was unparked at 0726 UTC. Incidentally all times are UTC. All altitudes are pressure altitudes I'll be reporting. Our initial power loss at 0745 UTC the sunphotometer was powered back up at 0807 UTC and showed aerosol optical depth of 0.15 in the green. We ascended to do a downward spiral profile over the Etosha pan that was actually the better of the two prime profiles for today. At the top of the profile, aerosol optical depths were still as high as 0.14. Upon descent, aerosol optical depths increased to about 0.41, again this is at the green. That profile looked fairly good in terms of tracking of the sunphotometer. During the two BRDFs over the Etosha pan, the sunphotometer was tracking reasonably well and showed homogeneous aerosol optical depth of 0.33 to 0.35. During the second profile over the Etosha Cimel site, the sunphotometer had a harder time tracking optical depth at the surface. They were not quite as large as at the end of the first profile at 0.33. The top of the profile aerosol optical depth had dropped to 0.15 pretty much the same value that we started out from in the first profile. The sunphotometer tracking problems make me believe that our spirals are too tight and that the sunphotometer just can't keep up with the tracking, so we might want to think about a slower ascent and descent rate in our vertical profiles if that will be possible. All together a good day for the sunphotometer. Thank you.

CG: I would like to now give a summary for the CAR instrument.

PH: Okay.

CG: I will initially just summarize what we have done today for the CAR and may be at the end Michael King may want to give a comment, but he has already given a comment. So the comments he gave and what I'll give probably will make one report. This is a summary for flight 1839, CAR measurements, September 15. Michael and I started the measurements at around 0725 UTC scanning in the starboard while heading for the Etosha pan for the BRDFs. Power failure at around 0745 UTC affected us. Therefore, we didn't have measurements up until 0805 UTC when we started the next set of measurements. Now

today's flight was geared toward the CAR measurements. We did BRDF over Etosha pan at around 18.96 degrees south/15.6 degrees east and this was between around 0903 to 0920 UTC and we did 5 circles. Immediately after the BRDF we did horizontal legs. Now this was to compare our data with the SSFR. The second BRDF were done over Mopane trees around 19.14 degrees south/15.64 degrees east. This was between 0942 to 0958 UTC. Again 5 circles were done and we also had horizontal legs. This again is for comparison with SSFR. No other BRDFs were done during this flight. We had intended to do BRDF over a burn scar, but we couldn't manage to get it and therefore we aborted this. Now it is also important to note that we didn't take any measurements from the filter wheel channels. It seems like we've lost the sensitivity and it seemed that the filter wheel channels only responded when scanning or when looking at the solar disc. This is all I can say about the CAR measurements today. Michael may want to add a point or two.

11:48 AM

RS: For chemistry summary, I took two HC cans today over Etosha Pan, one in the lower haze layer and one in the upper. After the power failure we sampled continuously off all the gas instruments except for NO_x, which was turned on at the end of the flight to get a vertical profile. So we did get one vertical profile with all the gases and we got a couple of vertical profiles with all the gases except NO_x. At 1126 UTC I started a NO_x calibration.

11:49 AM

KR: As far as the filters are concerned, the PC-BOSS was not run today because of the power problem, but two TEM grid sets were collected. The first one was started at 1056 and completed at 1137 UTC and it sampled the entire vertical column over the Etosha National Park. The second TEM grid set was started at 1142 UTC at 10,500 ft en route back to Walvis Bay and is currently still running. Thanks.

GG: The power bump at 0745 UTC was caused by the left generator going offline. This just indicates that we should complete the isolation of one of the inverters as we've started to do so we won't have this problem. We'll at least keep the computers up. It took us about 10 min to bring the computer system back up after the power bump. Otherwise things operated pretty normally all day.

BM: I have a quick filter summary. Teflon-quartz filter holder #4 and quartz-quartz filter holder #4 with Teflon filter #63 sampled from 1036 to 1153 UTC, 4,190 liters of air sampled. It was a continuous sample of the vertical profile over the Etosha pan region. The Teflon-quartz was on flow 3 and the quartz-quartz was on flow 2. For the bag house I just took the bag once in the beginning of the flight, the first part of the flight, to check for leaks. There were no apparent changes in the pressure levels in the bag for about an hour and we stayed at the same altitude. It's a pretty good test and I feel pretty good that the bag is sound. That's all.

11:58 AM

PH: Does Ted Christian have a summary?

TC: I'm sorry. This is Ted. I don't have a lot to report. It was pretty uneventful for the FTIR. I did take scan some good samples before, during and after the BRDFs including the circling procedure and horizontal legs before and after. That's about all I did today. Thanks.

(ee) University of Washington Flight 1840 (September 18, 2000)

Transit flight from Walvis Bay, Namibia, to Pietersburg, South Africa. No measurements made and no audio tape recorded.

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