FIFE Aircraft Flux - Raw: Univ. Col. (FIFE)

Summary:

The NCAR King Air participation in FIFE-1987 and FIFE-1989 was part of a coordinated atmospheric boundary layer component which included other aircraft, surface measurements, balloon-borne profiles, and SODAR and lidar remote sensing. The chief objective of the boundary layer component was to describe the structure of the atmospheric boundary layer over the FIFE study area, increase knowledge of the physical processes active in the daytime boundary layer, and explore the relationship of surface properties to the time and spatial variation in the structure of the boundary layer.

The phenomena studied were the daytime convective boundary layer structure and physical processes. This study used airborne measurement of vertical and horizontal wind gusts, humidity, potential temperature, mean horizontal wind speed, and horizontal linear trends of temperature, humidity, radiation. Fluxes of sensible heat, moisture, and momentum were estimated from fast response wind gust, temperature, and humidity measurements; these fluxes were evaluated from data with the arithmetic means removed. In addition several radiation parameters were also measured.. Several radiation parameters were also measured (e.g., global short and longwave, upwelling, and downwelling). Altitude of the aircraft was measured by radar and pressure; radar was more accurate but was only valid below about 930 m. Geographical position was measured by an inertial navigation system. All level legs of a flight mission were flown at a constant pressure altitude, thus the altitude of the aircraft over the surface varied.

In general, the data set is of excellent overall quality with very little loss of data. Vertical winds were sampled at an effective rate of 5 samples per second instead of the customary 10 samples per second; this had negligible effect on the fluxes but could compromise estimates of turbulence dissipation. Fluxes were estimated using raw, detrended and high-pass filtered data. From extensive analysis the FIFE Boundary Layer Group recommends using the detrended data.

Table of Contents:

1. Data Set Overview:

Data Set Identification:

Aircraft Flux - Raw: Univ. of Col. (FIFE)
(Raw Atmospheric Turbulence Data from the NCAR King Air).

Data Set Introduction:

The Raw Atmospheric Turbulence Data from the NCAR King Air data set contains fluxes of sensible heat, moisture, and momentum estimated from fast response wind gust, temperature, and humidity measurements. These data used untreated time histories (i.e., raw data) in the derivation of fluxes using the eddy correlation technique.

Objective/Purpose:

The NCAR King Air participation in FIFE-1987 and FIFE-1989 was part of a coordinated atmospheric boundary layer component which included other aircraft (Univ. Wyoming King Air and National Research Council of Canada (NRC) Twin Otter), surface measurements, balloon-borne profiles, and SODAR and lidar remote sensing. The chief objective of the boundary layer component was to describe the structure of the atmospheric boundary layer over the FIFE study area, increase knowledge of the physical processes active in the daytime boundary layer, and explore the relationship of surface properties to the time and spatial variation in the structure of the boundary layer.

Summary of Parameters:

The phenomena studied were the daytime convective boundary layer structure and physical processes. The study used airborne measurement of vertical and horizontal wind gusts, humidity, potential temperature, mean horizontal wind speed, and horizontal linear trends of temperature, humidity, radiation. Fluxes of sensible heat, moisture, and momentum were estimated from fast response wind gust, temperature, and humidity measurements; these fluxes were evaluated from raw data (i.e., RAW). The following radiation parameters were also measured: Global short and longwave; 2 degree field-of-view, 8-12 micrometer, upwelling (apparent surface temperature at lowest altitude flown) and downwelling longwave; a measure of surface greenness (vegetation). Altitude of the aircraft was measured by radar and pressure; radar was more accurate but was only valid below about 930 m. Geographical position was measured by an inertial navigation system. It is important to mention that all level legs of a flight mission were flown at a constant pressure altitude, thus the altitude of the aircraft over the surface varied.

ALERT

It should be noted that in the final submission to the FIS, three sets of flux and RMS data were submitted. The first used untreated time histories in the derivation of fluxes using the eddy correlation technique (RAW), the second used linearly detrended data (DETREND), the third used time histories that were high-pass filtered (FILTERED) with a third order algorithm with a break point set at 0.012 Hz (5 km wavelength). It is felt that most scientists working with the flux and correlation coefficient data, would prefer to use the linearly detrended data. Data from the NAE (Canada) Twin Otter and University of Wyoming King Air aircraft were archived with the identical formats.

Discussion:

The NCAR King Air participation in FIFE was during IFC-1 (Early part of growing season, 1987) and IFC-5 (the 1989 return to the Konza to capture a dry down situation and apply lessons learned from the 1987 experience).

In IFC-1 the King Air worked alone. As it was the first aircraft to visit the FIFE study area various mission profiles were explored.

Initially, adequacy of the 15 km run length was investigated by extending runs 15 km to the east of the FIFE study area where the surface was more similar to that over the FIFE study area than to the west. Other missions included various attempts at flux profiles using L-patterns where the aircraft flew along the north and east sides of the FIFE study area. The so-called Golden Day mission, 6 June 1987, was designed to investigate the time variation of the fluxes near the surface and inversion layers by flying repeatedly along the north side of the FIFE study area between 490 m pressure altitude (~30 m above the highest point along the track) and about 50 m below the inversion level (which varied with time). For both IFC's the aircraft was based at Salina, Kansas. In 1987 the ferry to the FIFE study area was used to obtain inbound vertical profiles of wind, temperature, humidity, and aerosol from approximately 3000 m to near the surface. However, one mission explored the regional variation of fluxes by flying about 100 km to the northeast of the FIFE study area.

In general data quality for IFC-1 is very good. Vertical winds were sampled at an effective rate of 5 samples per second instead of the customary 10 samples per second; this had negligible effect on the fluxes but could compromise estimates of turbulence dissipation. A full data quality report is given in the *Known Problems with the Data Section*.

In IFC-5 the NCAR King Air worked in consort with the NRC Twin Otter. During this IFC emphasis was on time and space variation of atmospheric budgets, spatial variation of fluxes over the FIFE study area, and regional variation. The NCAR King Air concentrated on time variation of convective boundary layer budgets and their regional variation. The budget missions were "time centered" so that the average time-of-day was constant for all pairs of legs flown at the same level. Regional variation was explored by always flying the ferry flight from Salina to the FIFE study area at 500 m pressure altitude. Time variation was explored by coordinated missions with the Twin Otter having the same objective and flight plan; these occurred on 27 July, and 2,4,6,7 August 1989.

These missions are presently under analysis and will be reported in journal articles within the next two years.

In general data quality for IFC-5 was very good. A full data quality report is given in the *Known Problems with the Data Section*.

Related Data Sets:

- Detrended Atmospheric Turbulence Data from the NCAR King Air.
- Filtered Atmospheric Turbulence Data from the NCAR King Air.
- Detrended Boundary Layer Fluxes from the Twin Otter.
- Filtered Boundary Layer Fluxes from the Twin Otter.
- Raw Boundary Layer Fluxes from the Twin Otter.
- Detrended Boundary Layer Fluxes from the UW King Air.
- Filtered Boundary Layer Fluxes from the UW King Air.
- Raw Boundary Layer Fluxes from the UW King Air.
- Eddy Correlation Surface Flux Observations (USGS).
- Eddy Correlation Surface Flux Observations (UNL).
- Eddy Correlation Surface Flux Observations (GSFC).
- Eddy Correlation Surface Flux Observations (UK).
- Eddy Correlation Surface Flux Observations (Argonne).
- Bowen Ratio Surface Flux Observations (GSFC).
- Bowen Ratio Surface Flux Observations (KSU).
- Bowen Ratio Surface Flux Observations (Fritschen).
- Bowen Ratio Surface Flux Observations (UNL).
- Bowen Ratio Surface Flux Observations (USGS).
- Bowen Ratio Surface Flux Observations (Smith).
- FIFE Radiosonde Data.
- FIFE Standard Pressure Level Radiosonde Data.
- FIFE Radiosonde Wind Profiles.
- FIFE Temperature and Humidity Profiles.
- Quick Look Boundary Layer Height.
- Boundary Layer Heights Using SODAR.
- NOAA Radiosonde Observations.
- UW Boundary Layer Winds and Clouds. (Imagery Data)

FIS Data Base Table Name:

AIRCRAFT_FLUX_DATA_RAW.

2. Investigator(s):

Investigator(s) Name and Title:

Dr. Robert Louis Grossman
Research Associate

Title of Investigation:

Aircraft Investigation of Boundary Layer Structure and Turbulence during FIFE.

Contact Information:

Contact 1:
Robert L. Grossman
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Boulder, CO
(303) 492-8932
grossman@boulder.colorado.eud

Contact 2:
Mr. Vince Glover (FIFE-1987)
National Center for Atmospheric Research
Boulder, CO
(303) 497-1030
glover@ncar.ucar.edu

Contact 3:
Mr. Alan Schanot (FIFE-1989)
National Center for Atmospheric Research
Boulder, CO
(303) 497-1030
schanot@ncar.ucar.edu

Requested Form of Acknowledgment.

The National Center for Atmospheric Research (NCAR) King Air participation in FIFE was endorsed by the Research Aviation Panel convened regularly by NCAR and through a special arrangement with the Atmospheric Sciences Division of the National Science Foundation (Dr. Jay Fein). NCAR King Air missions were under the scientific direction of Dr. Robert L. Grossman who was supported by NASA Grant NAG5-904. Pilots were Gil Summers - Jerry

Tejcek (1987) and Jerry Tejcek - Henry Boynton (1989). NCAR Operations Managers were Vince Glover (1987) and Alan Schanot (1989).

3. Theory of Measurements:

The measuring devices on the NCAR King Air for FIFE are basically in situ devices. The aircraft is effectively an Eulerian measurement platform since each measurement along a level run and the level run itself take a short time compared to the interval over which substantial time variation in the atmosphere occurs. However, a complete mission, made up of several level legs, often covers a time period during which diurnal and mesoscale time variations can occur. Analysis of this data must take this into account. FIFE planning was successful in avoiding situations where deep convection could have caused mesoscale time and space variations. Grossman (1992b) concluded that the horizontal gradient estimates for runs less than 60 km have very low confidence; thus most of those data are suspect for theoretical reasons. Vertical flux sampling errors are discussed in Grossman 1992.

The theory of measurements for each of the nearly 100 instruments on the NCAR King Air is well beyond the scope of this presentation. For guidance contact Mr. Alan Schanot (see the *Contact Information Section*).

4. Equipment:

Sensor/Instrument Description:

National Center for Atmospheric Research
Research Aviation Facility
Aircraft Research Instrumentation
King Air N312D - Project #7-217
FIFE-87, IFC-1
P.I's: Hall (NASA) & Grossman (University of CO)

- I. Airborne Data System.
    - A. Acquisition: King Air ADS (Motorola 68000 based), Kennedy Model 9800 Tape Drives. (2 units).
    - B. Display: Hewlett-Packard Model 2113E Computer (1000 Series), HP Model 9885M Floppy Disk Drive, HP Model 9876A Printer, HP 85 Terminal, and Panasonic Model WV-5362 Twin Video Monitors, (2 units).
- II. Aircraft Position, Velocity, and Attitude.
    - A. Litton LTN-51 INS (Inertial Navigation System) located in the cabin. SN-527.
    - B. LORAN C, Advanced Navigation Inc., ANI-7000.
    - C. DME, KDM-7000.
- III. Static Pressures.
    - A. Rosemount Model 1501 Digital Pressure Transducer - Fuselage Port (PSFD). SN-36.

- B. Rosemount Model 1201F1 Pressure Transducer - Right Wing Tip (PSW). SN-1510.
- IV. Dynamic Pressure.
  - A. Rosemount Model 1221F1VL (starboard wing tip). SN-1380
  - B. Rosemount Model 1221F (radome differential pressure). SN-1382.
- V. Air Temperatures.
  - A. Rosemount Type 102 Non-deiced Sensor-Rosemount Model 510BF Amplifier (radome instrument ring mount). SN-2933.
  - B. NCAR Reverse Flow Minco Sensor-Rosemount Model 510BF Amplifier (starboard wing tip). SN-86.
  - C. Fast Response Temperature Probe, NCAR Built, (Sensor on Radome Extension).
- VI. Dew Point and Humidity.
  - A. EG&G Model 137-C3 Dew Point Hygrometers (2 units in Fuselage Mount (DPT, DPB). SN-1001, 641.
  - B. 2 NCAR Model LA-3 Lyman-alpha Hygrometer - Radome Mount (VLA1 & VLA2). Spacing = .5 cm on research flight 1 and inter-comparison flights. All other flights spacing = .25 cm.
- VII. Flow Angle Sensors, Radome.
  - A. Attack - Rosemount Model 1221FVL Differential Pressure Transducer (ADIFR). SN-1071.
  - B. Slideslip - Rosemount Model 1221FVL Differential Pressure Transducer (BDIFR). SN-1093.
- VIII. Radio Altitude.
  - A. Collins ALT-55 Radio Altimeter (HGM).
- IX. Photography.
  - A. Forward looking from cockpit: PULNIX Model TM-34K black and white camera, time and date superimposed. Images recorded on VCR in VHS format. Audio recording from cabin.
  - B. Downward looking from cabin: GE Model 1CVK 5032A color camera, time and date superimposed. Images recorded on VCR in VHS format. Base of camera toward aircraft tail.
- X. Cloud Physics.
  - A. Particle Measuring System/King Liquid Water Sensor.
  - B. JW/Cloud Technology Liquid Water Sensor.
  - C. Particle Measuring Systems Model ASASP Aerosol Size Distribution, Wing Mounted, Range .12 to 3.12 um and Resolution .025 to .375 um (progressively weighted).
  - D. Particle Measuring Systems Model FSSP Droplet Size Distribution, Wing Mounted, Range 3 to 45 um and Resolution 3 um.
- XI. Radiation Fluxes.
  - A. Visible Radiation. Eppley Model PSP Pyranometer. Radiation Band .285 to 2.8 um. Two Units: Top (SWT) and Bottom (SWB).
  - B. Infrared Radiation. Eppley Model PIR Pyrgeometer. Radiation Band 4 to 45 um. Two Units: Top (IRT) and Bottom (IRB).

    - C. Ultra Violet Radiation. Eppley Model TUVR. Radiation band .295 to .385 um. Two units: Top (UVT) and bottom (UVB).
    - D. Surface Temperature. Barnes PRT-5, Downward Looking.
    - E. Sky Temperature. Barnes PRT-5, Upward Looking.
- XII. Miscellaneous.
    - A. Event Recording from Cabin.

NOTE: Inter-comparison flights using CINDE King Air configuration did not have downward video or downward PRT-5 on board. In addition, radiation variables were not sampled and PMS probes were not turned on.

National Center for Atmospheric Research
Research Aviation Facility
Aircraft Research Instrumentation
King Air N312D - Project #8-220
FIFE - 1989, IFC-5
P.I.: R.L. Grossman, Univ. Colorado

- I. Airborne Data System.
    - A. Acquisition. King Air ADS (Motorola 68000 based), Kennedy Model 9800 Tape Drives, (2 units).
    - B. Display: Hewlett-Packard Model 2113E Computer (1000 series), HP Model 9885M Floppy Disk Drive, HP Model 9876A Printer, HP85 (terminal), and Panasonic Model WV-5362 Twin Video Monitor, (2 units).
- II. Aircraft Position, Velocity and Attitude.
    - A. Litton LTN-51 INS (Inertial Navigation System) located in the cabin. SN-025 & 527.
    - B. LORAN C, Advanced Navigation Inc., ANI-7000.
- III. Static Pressures.
    - A. Rosemount Model 1501 Digital Pressure Transducer - Fuselage Port (PSFD). SN-36.
    - B. Rosemount Model 1201F1 Pressure Transducer - Right Wing Tip (PSW). SN-1510.
- IV. Dynamic Pressures.
    - A. Rosemount Model 1221F1VL - Right Wing Tip (QCW). SN-1380.
    - B. Rosemount Model 1221F1VL - Radome (QCR). SN-1382.
- V. Temperatures.
    - A. Rosemount Type 102 Non-deiced Sensor-Rosemount Model 510BF Amplifier - Radome Mount (TTB). SN-2943/358.
    - B. NCAR Fast Response Temperature Probe-Rosemount Model 510BF Amplifier - Radome Mount (TTKP). SN-572/407.
    - C. NCAR Reverse Flow Temperature Probe-Rosemount Model 510BF Amplifier - Right Wing Tip (TTRF). SN-86/360.
- VI. Dew Point and Humidity.

    - A. EG&G Model 137-C3 Dew Point Hygrometers - 2 units on Fuselage Mounts (DPT, DPB). SN-1027/493 & 807/483.
    - B. NCAR Model LA-3 Lyman-alpha Hygrometers - 2 units on Radome Mounts (VLA, VLA1). Pathlengths set at 0.5 cm. SN-1 & 5.
    - C. NCAR Microwave Refractometer - Forward Overhead Mount.
- VII. Flow Angle Sensors, Radome.
    - A. Attack - Rosemount Model 1221F1VL Differential Pressure Transducer (ADIFR). SN-1071.
    - B. Sideslip - Rosemount Model 1221F1VL Differential Pressure Transducer (BDIFR). SN-1063.
- VIII. Cloud Physics.
    - A. Rosemount Model 871FA Icing Rate Detector - Right Wing Tip (RICE).
    - B. PMS King Probe Liquid Water Sensor - Left Wing Tip (PLWC).
    - C. Particle Measuring Systems Model ASASP - Wing Mount Aerosol Size Distribution, 0.12 to 3.12 um. SN-3249-1182-07.
- IX. Radiation Fluxes.
    - A. Visible Radiation. RAF Modified Eppley Model PSP Pyranometers - 2 units: Upward looking (SWT), Downward looking (SWB). SN-12148 & 12125.
    - B. Infrared Radiation. RAF Modified Eppley Model PIR Pyrgeometers - 2 units: Upward looking (IRT), Downward looking (IRB). SN-11033 & 23607.
    - C. Ultraviolet Radiation. RAF Modified Eppley Model TUV Pyranometers - 2 units: Upward looking (UVT), Downward looking (UVB). SN-24127 & 24128/24132.
    - D. Remote Surface Temperature. Barnes PRT-5, Downward looking (RSTB). SN-423/157.
    - E. Cloud Base Temperature. Barnes PRT-5, Upward looking (RSTT). SN-385/423.
- X. Geometric Altitude.
    - A. Collins Model ALT 55 B Radio Altimeter - Fuselage Mount, 0 to 800 m AGL (HGM). SN-2857.
- XI. Air Chemistry.
    - A. NCAR Modified TECO Model 49 Ozone Analyzer.
    - B. NCAR Chemiluminescent (FAST) Ozone Analyzer.
- XII. Photography.
    - A. GE Model 1CVK5040 Video Camera and Recorder - Color Camera, Downward looking, with Date/Time Recording.
    - B. PULNIX Model CCD Video Camera Module - Cockpit Forward looking with GE Video Recorder, Date/Time Recording, Audio Recording Capability.

User Supplied Equipment:

- A. NASA Vegetation Moisture Stress Indicator.

Collection Environment:

Airborne.

Source/Platform:

National Center for Atmospheric Research Beechcraft Super King Air B200T.

Source/Platform Mission Objectives:

The NCAR King Air is maintained by the Research Aviation Facility (RAF) for airborne measurements in support of atmospheric research.

Key Variables:

The variables measured are included in the equipment list in the *Sensor/Instrument Description Section*.

Principles of Operation:

For guidance on particular instruments contact the Research Aviation Facility, National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307.

Sensor/Instrument Measurement Geometry:

- Turbulence, Winds: Differential Pressure Gust Probe on Nose Radome Turbulence;
- Temperature: Cluster mounted within 1 m of Differential Pressure Probe Turbulence;
- Moisture: Lyman-alpha hygrometer mounted within 3 m of Differential Pressure Probe Inertial Navigation System for Gust Probe corrections: mounted near center of gravity of aircraft (main wing spar);
- Radiation: Cluster of solar and infrared devices on top and bottom of fuselage, just aft of main wing spar; and
- Cloud Physics: PMS Probes mounted near wing tips.
- Note: Turbulence measurements may be subject to flow deformation around aircraft. This is the subject of ongoing research at NCAR/RAF. To date the research has shown possible contamination of momentum flux but scalar fluxes appear to be unaffected.

Manufacturer of Sensor/Instrument:

See the *Sensor/Instrument Description Section* and the *Principles of Operation Section*.

Calibration:

With one exception (described below), all instruments were calibrated according to NCAR RAF procedures. These usually involve calibration to tertiary NIST standards. For details on NCAR RAF calibration procedures contact either Vince Glover (IFC-1) or Alan Schanot (IFC-5) at NCAR Research Aviation Facility, P.O. Box 3000, Boulder, CO 80307; phone (303)497-1030.

The exception, noted above, is the calibration of the Lyman Alpha humidity device. The data herein used the Friehe-Grossman Method which is described in Friehe et al., 1986. Additional information is contained in Appendix C of Grossman et al., 1992. This method depends upon the accurate calibration and operation of the thermoelectric dewpoint instrument on the aircraft. The method requires that each level leg be independently calibrated. The calibration coefficients are checked for altitude (pressure and/or temperature) dependence. In the case of both IFC-1 and -5 the calibration coefficients were averaged for all legs in the well-mixed layer for a given mission since little altitude dependence was noted for the slope of the calibration curve (which is important to the estimation of the moisture flux). This introduced a 2 to 6% error in the moisture flux which should be added to the errors discussed in Grossman et al. 1992b.

Specifications:

Not available at the revision.

Tolerance:

Not available at the revision.

Frequency of Calibration:

NCAR RAF calibrates their instrumentation twice for a given project. Once before the aircraft leaves for the field experiment and when the aircraft returns. The Lyman-alpha calibration, as described above, was performed for each level leg in a given mission.

Other Calibration Information:

During IFC-1, one comparison mission was flown with the NAE (Canada) Twin Otter on 12 July 87. Several comparison missions were flown with the NAE Twin Otter during IFC-5. The results of these comparison missions showed that in general each aircraft was within a few percent of the other even though instrumentation and calibrations were different for the two. Details of the inter-comparison missions can be found in MacPherson et al., 1992.

5. Data Acquisition Methods:

Airborne in situ measurement of the primary variables which go into the computation of the 34 variables used in the estimation of mean values and higher moment statistics is complex. Each aviation facility (and experimenter, in some cases) has his/her own methodology. To check these methods and instruments an analysis of several wing-to-wing comparisons between the NCAR King Air and NAE Twin Otter made during FIFE appears in MacPherson et al., 1992.

The pattern of the aircraft flight track is an important consideration. These patterns are described in the *Discussion Section*. The first line of each data block has the start time/start point and end time/end point of the level leg to which the data refer; THE TIME SEQUENCE OF THESE LEVEL LEGS SHOULD BE REVIEWED BEFORE SERIOUS ANALYSIS OF THE DATA BEGIN.

6. Observations:

Data Notes:

Not available.

Field Notes:

Visual observations for each of the missions were recorded in two ways. First by notes taken by Dr. Grossman and secondly by videotapes recorded by two side-looking and one downward looking video cameras. A copy of the handwritten notes and videos can be obtained from the FIFE Information System. A flight-by-flight discussion of these observations is beyond the scope of the project and is actually part of the interpretation of the data by an individual investigator. Dr. Grossman, with a few days notice, would be able to discuss his observations with an interested investigator.

7. Data Description:

Spatial Characteristics:

The FIFE study area with areal extent of 15 km by 15 km, is located south of the Tuttle Reservoir and Kansas River, and about 10 km from Manhattan, Kansas, USA. The northwest corner of the area has UTM coordinates of 4,334,000 Northing and 705,000 Easting in UTM zone 14.

Spatial Coverage:

The spatial resolution of the data is related to the sampling interval and the length of the individual level legs or pattern of level legs. The sampling interval determines the shortest length scale resolvable by the instruments and the length of the level leg determines the largest length scale resolvable. The data presented here only refers to the length of the level leg. For reference, the mean parameters presented (such as pressure, temperature, mixing ratio, etc.) were collected at one sample per-second (equivalent to about 80 meters horizontal distance through the atmosphere) and the turbulence parameters (such as vertical wind speed, Lyman alpha moisture, fluxes, etc.) were collected at 50 samples per second and block averaged to an effective sampling interval of 20 samples per second (equivalent to about 4 meters horizontal distance through the atmosphere). All data were digitally over sampled and high pass filtered to reduce aliasing and electrical interference from the many sources of EM radiation on the aircraft.

Spatial Coverage Map:

Not available.

Spatial Resolution:

Most NCAR King Air Missions were over the FIFE study area, therefore refer to length scales of the order 15 by 15 kilometers.

Exceptions were:

- IFC-1 5/26/87 level legs 30 kilometers
- 6/03/87 regional survey, level legs 80 kilometers
- 6/06/87 level legs 30 kilometers
- IFC-5 all ferry missions from Salina to FIFE site, level legs approximately 100 kilometers; analysis of these data are not included in this submission.
- 8/11/89 level legs 30-60 kilometers
- 8/12/89 level legs 15-100 kilometers

Projection:

Not available.

Grid Description:

Not available.

Temporal Characteristics:

The temporal resolution of the NCAR King Air aircraft data in FIFE was episodic with three to five hours of measurement per mission. There were never more than two missions in a day. Thus the aircraft data is not presented as a continuous data stream sampled at given intervals throughout the day. Flight operations were constrained by daylight hours.

Temporal Coverage:

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                        FIFE-87 NCAR KING AIR FLIGHT SUMMARY
1987
Date,Run No.   FIFE Flight Type               Remarks
------------   ----------------   --------------------------------
5/26         CMP-2 (F2)        Flux profiles over north end
of Konza site. Orientation.
5/30         CMP-2 (F1)        Flux profiles over north end
of Konza site. Good mission.
6/1,#1       CMP-1 (F1a)       Flux profiles over north end
of Konza site. Concentrate on
lower subcloud layer.
6/1,#2       CMP-1 (F1a)       Flux profiles over north end
of Konza site. Concentrate on
lower subcloud layer.
6/3          IMP-E             Regional Survey to NE of Konza
site. Two levels in subcloud
layer.
6/4,#1       CMP-1 (F1a)       Flux profiles over north end
of Konza site. Concentrate on
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lower subcloud layer.

6/4,#2	CMP-1 (F1a)	Flux profiles over north end of Konza site. Concentrate on lower subcloud layer. Further work on flux statistics with 6 legs each at lowest and highest levels.
6/6,#1	CMP-1 (F1a)	Time series of fluxes at two levels: near surface and top of mixed layer. Possible entrainment statistics.
6/6,#2	CMP-1 (F1a)	Time series of fluxes at two levels: near surface and top of mixed layer. Possible entrainment statistics.

FIFE MISSION SUMMARY FOR NCAR KING AIR 1989 (IFC-5)

Date/Time (Flight No.)*	**Flight Plan**	**Weather**	**Remarks**
26 JULY 1007:23 to 1235:42 CDT	PLUS Pattern: 4 levels (RF01)	Began with sctd Ci then brkn Scu and sctd CuCg. Hazy	Regional run. Gust probe calibration maneuvers.
27 JULY 1235:15 to 1618:37 CDT (RF02)	T Pattern: 4 levels	Sctd variable brkn Cu; variable cloud base.	Regional run. Gust probe calibration maneuvers. Lidar run. Twin Otter mission in morning.
28 JULY 1026:32 to 1235:42 CDT (RF03)	Stack: 3 levels plus Grid using Twin Otter	Sctd Cu.	Regional run.
02 AUGUST 1210:54 to 1513:37 CDT (RF04)	L Pattern: 2 levels.	Brkn Cu, sctd CuCg sctd As and Ci. Cloud cover diminished with time.	Regional run. Lidar run. Twin Otter mission in morning.
04 AUGUST 1149:13 to 1647:56 CDT (RF05)	Stack plus L pattern: 4 levels	Clear, hazy, no change with time!	FIFE Golden Day. Regional Run. Gust probe calibration maneuvers. Twin Otter grid pattern in morning and late afternoon.
06 AUGUST 1247:13 to 1649:32 CDT (RF06)	Stack plus L pattern: 4 levels	Clear becoming sctd Cu. Winds from NNE-NE. Very hazy.	Intercompare with Twin Otter. Lots of bugs on windshield. Gust probe calibration maneuvers. Twin Otter L pattern in morning and late afternoon.
07 AUGUST 1254:20 to 1254:20 to	T pattern: 4 levels 4 levels	Sctd Cu, sctd Ci. Very clear Ci. Very clear	Regional run. Much fewer bugs this day. Twin Otter

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1543:19 CDT                  visibility.        mission in morning
(RF07)         Winds from N.      and late
Cold front         afternoon.
passage.
08 AUGUST    L pattern:      Clear becoming     Regional run.
0921:17 to   2 levels        brkn Cu. Light     Lidar run. Time
1334:44 CDT                  winds.             variation
(RF08)                            objective.
11 AUGUST    Telescoping,    Brkn Cu, very      Regional run
1124:54 to   3-level stacks  hazy. Later sctd   intercompare with
1705:21 CDT  from Konza to   Cu, brkn Ac, sctd  Twin Otter
nr. Emporia,    Ci.                 outbound from
Ks. Salina.                         Scale dependence
(RF09)                             objective.
12 AUGUST    Regional scale  Sctd Cu, brkn Ac,  Regional run
1051:11 to   T pattern plus  sctd Ci. Cu became intercompare with
1457:18 CDT  Grid (Twin      brkn with time     Twin Otter. Scale
Otter)                              dependence
objective. Lake
(RF10)                             calibration of
infrared surface
temperature.
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Footnote:

* These flight numbers have been deduced by the information system staff using the information provided by A. Schanot that appears in the *Known Problems with the Data Section* of this document. These flight numbers provide the link between the information given here and the information given for IFC-5 in the *Known Problems with the Data Section*.

Temporal Coverage Map:

Not available.

Temporal Resolution:

On those missions devoted to time variation, intervals ranged between hours and ten's of minutes, depending upon the flight pattern flown.

Data Characteristics:

The SQL definition for this tables is found in the AF_RAW.TDF file located on FIFE CD-ROM Volume 1.

Parameter/Variable Name

Parameter/Variable Description	Range	Units	Source
OBS_DATE The date the observation was made on, in the format (DD-MMM-YY).			
START_TIME The starting time for the observation run in GMT, in the format (HHMM). The seconds for this time is stored in START_SECONDS.		[GMT]	
START_SECONDS The seconds component of the START_TIME (format SS).		[GMT]	
DURATION The duration of the flight in the format (MMSS).			
AIRCRAFT_ID The ID name for the aircraft which made the observation run.			
START_LAT The starting latitude for the observation run.			
START_LON The starting longitude for the observation run.			
START_NORTHING The starting northing position of the aircraft in UTM coordinates.		[meters]	
START_EASTING The starting easting position of the aircraft in UTM coordinates.		[meters]	
END_LAT The ending latitude for the observation run.			

END_LON The ending longitude for the observation run.	
END_NORTHING The ending northing position of the aircraft in UTM coordinates.	[meters]
END_EASTING The ending easting position of the aircraft in UTM coordinates.	[meters]
HEADING The heading of the aircraft.	[degrees from North]
HEIGHT_ABOVE_MEAN_SEA_LVL The altitude of the aircraft above mean sea level, as determined by air pressure.	[meters]
HEIGHT_ABOVE_GRND_LVL The altitude of the aircraft above the ground, as determined by radar.	[meters]
AIR_TEMP_MEAN The mean air temperature.	[degrees Celsius]
POTNTL_TEMP_MEAN The potential mean air temperature.	[degrees Kelvin]
MIX_RATIO_MEAN The mixing ratio taken from a dew-point hygrometer.	[grams] [kg^-1]
NS_WIND_VELOC_MEAN The mean north/south wind component (V), with north being positive.	[meters] [sec^-1]
EW_WIND_VELOC_MEAN The mean east/west wind component (U), with east being positive.	[meters] [sec^-1]

PRESS_MEAN The mean air pressure.	[millibars]
SURF_TEMP_MEAN The mean surface temperature.	[degrees Celsius]
DOWNWELL_RADTN_MEAN The mean downwelling radiation count.	[Watts] [meter^-2]
UPWELL_RADTN_MEAN The mean upwelling radiation count.	[Watts] [meter^-2]
VEG_INDEX_MEAN The mean vegetation (greenness) index.	
AIR_TEMP_RMS The root mean square of the temperature recorded in column AIR_TEMP_MEAN.	[degrees Celsius]
POTNTL_TEMP_RMS The root mean square of the potential temperature recorded in the column POTNTL_TEMP_MEAN.	[degrees Kelvin]
MIX_RATIO_RMS The root mean square of the mixing ratio recorded in the column MIX_RATIO_MEAN, taken from a dew-point hygrometer.	[grams] [kg^-1]
NS_WIND_VELOC_RMS The root mean square of the north/south wind component recorded in column NS_WIND_VELOC_MEAN.	[meters] [sec^-1]
EW_WIND_VELOC_RMS The root mean square of the east/west wind component recorded in column EW_WIND_VELOC_MEAN.	[meters] [sec^-1]

PRESS_RMS The root mean square of the pressure recorded in column PRESS_MEAN.	[millibars]
SURF_TEMP_RMS The root mean square of the surface temperature recorded in column SURF_TEMP_MEAN.	[degrees Celsius]
DOWNWELL_RADTN_RMS The root mean square of the downwelling radiation count recorded in column DOWNWELL_RADTN_MEAN.	[Watts] [meter^-2]
UPWELL_RADTN_RMS The root mean square of the upwelling radiation recorded in column UPWELL_RADTN_MEAN.	[Watts] [meter^-2]
VEG_INDEX_RMS The root mean square of the vegetation (greenness) index recorded in column VEG_INDEX_MEAN.	
AIR_TEMP_LINEAR The linear trend of the temperature recorded in the column AIR_TEMP_MEAN.	[degrees Celsius] [meter^-1]
POTNTL_TEMP_LINEAR The linear trend of the potential temperature recorded in column POTNTL_TEMP_MEAN.	[degrees Kelvin] [meter^-1]
MIX_RATIO_LINEAR The linear trend of the mixing ratio recorded in column MIX_RATIO_MEAN (derived from dew point).	[grams] [kg^-1] [meter^-1]
NS_WIND_VELOC_LINEAR The linear trend of the north/south wind component recorded in column NS_WIND_VELOC_MEAN.	[meters] [sec^-1] [meter^-1]

EW_WIND_VELOC_LINEAR The linear trend of the east/west wind component recorded in column EW_WIND_VELOC_MEAN.	[meters] [sec^-1] [meter^-1]
PRESS_LINEAR The linear trend of the pressure recorded in column PRESS_MEAN.	[millibars] [meter^-1]
SURF_TEMP_LINEAR The linear trend of the surface temperature recorded in column SURF_TEMP_MEAN.	[degrees Celsius] [meter^-1]
DOWNWELL_RADTN_LINEAR The linear trend of the downwelling radiation count recorded in DOWNWELL_RADTN_MEAN.	[Watts] [meter^-2] [meter^-1]
UPWELL_RADTN_LINEAR The linear trend of the upwelling radiation count recorded in column UPWELL_RADTN_MEAN.	[Watts] [meter^-2] [meter^-1]
VEG_INDEX_LINEAR The linear trend of the vegetation (greenness) index recorded in column VEG_INDEX_MEAN.	
MOIST_AIR_DENSITY_X_CP The moist air density times specific heat capacity (CP). Kelvin^-1]	[Watts][sec] [degrees
LATENT_HEAT_OF_VAPOR The latent heat of vaporization at 20 degrees Celsius. [gram^-1]	[Watts] [sec]
MOIST_AIR_DENSITY The moist air density. [meter^-3]	[kg]
VERT_GUST_VELOC_RMS_RAW The root mean square of the vertical wind gust velocity.	[meters] [sec^-1]

NS_GUST_VELOC_RMS_RAW The root mean square of the north/south wind (U) gust velocity.	[meters] [sec^-1]
EW_GUST_VELOC_RMS_RAW The root mean square of the east/west wind (V) gust velocity.	[meters] [sec^-1]
ALONG_WIND_VELOC_RMS_RAW The root mean square of the along-wind component of the wind gust velocity.	[meters] [sec^-1]
ACROSS_WIND_VELOC_RMS_RAW The root mean square of the across-wind component of the wind gust velocity.	[meters] [sec^-1]
POTNTL_TEMP_RMS_RAW The root mean square of the potential temperature.	[degrees Kelvin]
WATER_MIX_RATIO_RMS_RAW The root mean square of the water mixing ratio (lyman alpha).	[grams] [kg ^-1]
CO2_MIX_RATIO_RMS_RAW The root mean square of the carbon dioxide content.	[milligrams] [kg^-1]
VERT_GUST_VELOC_SKEW_RAW The skewness of the vertical gust wind velocity.	
NS_GUST_VELOC_SKEW_RAW The skewness of the north/south wind gust velocity.	
EW_GUST_VELOC_SKEW_RAW The skewness of the east/west wind gust velocity.	
ALONG_WIND_VELOC_SKEW_RAW The skewness of the along-wind component of the wind gust velocity.	

ACROSS_WIND_VELOC_SKEW_RAW The skewness of the across-wind component of the wind gust velocity.	
POTNTL_TEMP_SKEW_RAW The skewness of the potential temperature.	
WATER_MIX_RATIO_SKEW_RAW The skewness of the water mixing ratio.	
CO2_MIX_RATIO_SKEW_RAW The skewness of the carbon dioxide content.	
NS_MOMNTM_FLUX_RAW The north/south momentum flux, calculated from W*V (wind components).	[Newtons] [meter^-2]
EW_MOMNTM_FLUX_RAW The east/west momentum flux, calculated from W*U (wind components).	[Newtons] [meter^-2]
ALONG_MOMNTM_FLUX_RAW The along-wind momentum flux, calculated from W*along-wind gust (wind components).	[Newtons] [meter^-2]
ACROSS_MOMNTM_FLUX_RAW The across-wind momentum flux, calculated from W*across-wind gust (wind components).	[Newtons] [meter^-2]
SENSIBLE_HEAT_FLUX_RAW The sensible heat flux. [meter^-2]	[Watts]
LATENT_HEAT_FLUX_RAW The latent heat flux. [meter^-2]	[Watts]
CO2_FLUX_RAW	

The carbon dioxide flux. [kg] [hectare^-1] [hour^-1]

NS_MOMNTM_CC_RAW
The correlation coefficient for vertical wind velocity and north/south wind gusts.

EW_MOMNTM_CC_RAW
The correlation coefficient for vertical wind velocity and east/west wind gusts.

ALONG_MOMNTM_CC_RAW
The correlation coefficient for vertical wind velocity and along-wind component of the wind gust velocity.

ACROSS_MOMNTM_CC_RAW
The correlation coefficient for vertical wind velocity and across-wind component of the wind gust velocity.

SENSIBLE_HEAT_CC_RAW
The correlation coefficient for the sensible heat flux.

LATENT_HEAT_CC_RAW
The correlation coefficient for the latent heat flux.

CO2_FLUX_CC_RAW
The correlation coefficient for the CO2 flux.

MIX_RATIO_CC_RAW
The correlation coefficient for the mixing ratio * potential temperature.

COMMENTS
Any comments pertaining to this record.

```
FIFE_DATA_CRTFCN_CODE
The FIFE Certification Code for            *
the data, in the following format:
CPI (Certified by PI), CPI-???
(CPI - questionable data).
```

```
LAST_REVISION_DATE
data, in the format (DD-mmm-YY).
```

Footnote:

* Valid levels

The primary certification codes are: EXM Example or Test data (not for release) PRE Preliminary (unchecked, use at your own risk) CPI Checked by Principal Investigator (reviewed for quality) CGR Checked by a group and reconciled (data comparisons and cross checks)

The certification code modifiers are: PRE-NFP Preliminary - Not for publication, at the request of investigator. CPI-MRG PAMS data that is "merged" from two separate receiving stations to eliminate transmission errors. CPI-??? Investigator thinks data item may be questionable.

Sample Data Record:

OBS_DATE	START_TIME	START_SECONDS	DURATION	AIRCRAFT_ID	START_LAT
12-AUG-89	1642	12	526	NCAR	3904.9
12-AUG-89	1650	37	654	NCAR	3904.9
12-AUG-89	1659	44	645	NCAR	3904.9
12-AUG-89	1710	3	614	NCAR	3904.9

START_LON	START_NORTHING	START_EASTING	END_LAT	END_LON	END_NORTHING
-9633.7			3905.3	-9615.3	
-9614			3904.9	-9637.1	
-9638.3			3905.1	-9615.5	
-9616.1			3904.9	-9636.9	

END_EASTING	HEADING	HEIGHT_ABOVE_MEAN_SEA_LVL	HEIGHT_ABOVE_GRND_LVL
91	1158	100	
266	863	560	
92	520	192	
265	420	89	

AIR_TEMP_MEAN	POTNTL_TEMP_MEAN	MIX_RATIO_MEAN	NS_WIND_VELOC_MEAN
16.13	299.9	8.76	5.25
19.22	300.02	8.77	5.82
22.82	300.15	8.9	4.83
24.07	300.38	8.88	5.73

EW_WIND_VELOC_MEAN	PRESS_MEAN	SURF_TEMP_MEAN	DOWNWELL_RADTN_MEAN
-.38	881.5	33	800
-.17	913.7	34	769
-.32	952.3	35.1	735
-.15	963.8	36	886

UPWELL_RADTN_MEAN	VEG_INDEX_MEAN	AIR_TEMP_RMS	POTNTL_TEMP_RMS
146	99.999	.11	.1
99.999	.15	.15	.27

99.999	.18	.18	.18
99.999	.29	.29	.24

MIX_RATIO_RMS	NS_WIND_VELOC_RMS	EW_WIND_VELOC_RMS	PRESS_RMS
.37	.91	.91	.4
.85	.92	.4	2.7
1.07	1.19	.3	3.8
1.12	1.39	.2	3.9

SURF_TEMP_RMS	DOWNWELL_RADTN_RMS	UPWELL_RADTN_RMS	VEG_INDEX_RMS
2.8	121	14	99.999
111	15	99.999	0
136	24	99.999	0
93	16	99.999	0

AIR_TEMP_LINEAR	POTNTL_TEMP_LINEAR	MIX_RATIO_LINEAR
-1.680E-07	-.00000011	-.00000894
.000000445	-.00000362	.00000153
-4.410E-07	.00000416	.000000446
.000000913	-.0000067	-.00000148

NS_WIND_VELOC_LINEAR	EW_WIND_VELOC_LINEAR	PRESS_LINEAR
-.00000191	-1.570E-07	.00000284
.000000694	.00000105	.0000868
.00000129	-.00000386	-.0000801
-.00000135	-.00000404	.0000717

SURF_TEMP_LINEAR	DOWNWELL_RADTN_LINEAR	UPWELL_RADTN_LINEAR
.000051	.00203	.000575
.00312	.0003	99.999
-.0000986	.000499	99.999
.00501	.000245	99.999

VEG_INDEX_LINEAR	MOIST_AIR_DENSITY_X_CP	LATENT_HEAT_OF_VAPOR
99.999	1061.2	2575.3
1.23	2633.2	1.083
1.08	2701	1.115
.99	2719	1.124

MOIST_AIR_DENSITY	VERT_GUST_VELOC_RMS_RAW	NS_GUST_VELOC_RMS_RAW
1.056	1.1	.91
-.11	.85	.92
-.26	1.07	1.19
-.33	1.12	1.39

EW_GUST_VELOC_RMS_RAW	ALONG_WIND_VELOC_RMS_RAW	ACROSS_WIND_VELOC_RMS_RAW
.91	.91	.91
.85	.92	.15
1.07	1.19	.17
1.12	1.39	.29

POTNTL_TEMP_RMS_RAW	WATER_MIX_RATIO_RMS_RAW	CO2_MIX_RATIO_RMS_RAW
.12	.39	99.999
.29	99.999	1.23
.19	99.999	1.07
.26	99.999	.99

VERT_GUST_VELOC_SKEW_RAW	NS_GUST_VELOC_SKEW_RAW	EW_GUST_VELOC_SKEW_RAW
1.177	-.027	.368
-.279	.392	-.274
-.265	.007	-.298
-.404	.026	-.418

ALONG_WIND_VELOC_SKEW_RAW	ACROSS_WIND_VELOC_SKEW_RAW
-.084	-.372
-.397	.674
-.01	1.146
-.033	1.264

POTNTL_TEMP_SKEW_RAW	WATER_MIX_RATIO_SKEW_RAW	CO2_MIX_RATIO_SKEW_RAW
.32	-.903	99.999

```
-1.459                   99.999                   .625
-.887                   99.999                   .398
-.197                   99.999                   .292
     NS_MOMNTM_FLUX_RAW   EW_MOMNTM_FLUX_RAW   ALONG_MOMNTM_FLUX_RAW
------------------   ------------------   ---------------------
-.13                .21                 -.14
-.03               -.11                  .03
.15               -.27                 -.13
-.1               -.33                   .1
     ACROSS_MOMNTM_FLUX_RAW   SENSIBLE_HEAT_FLUX_RAW   LATENT_HEAT_FLUX_RAW
----------------------   ----------------------   --------------------
-.2                      7                     444
17                      431                      99.999
95                      250                      99.999
146                      294                      99.999
     CO2_FLUX_RAW   NS_MOMNTM_CC_RAW   EW_MOMNTM_CC_RAW   ALONG_MOMNTM_CC_RAW
------------   ----------------   ----------------   -------------------
99.999           -.12                .2                -.14
-.09            -.02            -.09                 .02
-.21             .11            -.21                -.09
-.27            -.06            -.26                 .07
     ACROSS_MOMNTM_CC_RAW   SENSIBLE_HEAT_CC_RAW   LATENT_HEAT_CC_RAW
--------------------   --------------------   ------------------
-.19                      .05                  .4
.08                      .45               99.999
.46                      .45               99.999
.45                      .41               99.999
     CO2_FLUX_CC_RAW   MIX_RATIO_CC_RAW   COMMENTS
---------------   ----------------   --------------------
99.999            -.46
-.35              -.1
.29              -.27
.19              -.35
     FIFE_DATA_CRTFCN_CODE   LAST_REVISION_DATE
---------------------   ------------------
CPI                     03-SEP-92
CPI                     03-SEP-92
CPI                     03-SEP-92
CPI                     03-SEP-92
```

8. Data Organization:

Data Granularity:

The NCAR King Air aircraft data in FIFE was collected via three to five hours of measurement per mission, with a maximum of two missions in a day. The aircraft data is not presented as a continuous data stream sampled at given intervals throughout the day. The sampling interval for data collection determines the shortest length scale resolvable by the instruments and the length of the level leg determines the largest length scale resolvable. For reference, the mean parameters presented (e.g., pressure, temperature were collected at one sample per-second (i.e., approximately 80 meters horizontal distance) and the turbulence parameters (e.g., vertical wind speed) were collected at 50 samples per second and block averaged to an effective sampling interval of 20 samples per second (equivalent to about 4 meters horizontal distance).

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The CD-ROM file format consists of numerical and character fields of varying length separated by commas. The character fields are enclosed with a single apostrophe. There are no spaces between the fields. Each file begins with five header records. Header records contain the following information: Record 1 Name of this file, its table name, number of records in this file, path and name of the document that describes the data in this file, and name of principal investigator for these data. Record 2 Path and filename of the previous data set, and path and filename of the next data set. (Path and filenames for files that contain another set of data taken at the same site on the same day.) Record 3 Path and filename of the previous site, and path and filename of the next site. (Path and filenames for files of the same data set taken on the same day for the previous and next sites (sequentially numbered by SITEGRID_ID)). Record 4 Path and filename of the previous date, and path and filename of the next date. (Path and filenames for files of the same data set taken at the same site for the previous and next date.) Record 5 Column names for the data within the file, delimited by commas. Record 6 Data records begin.

Each field represents one of the attributes listed in the chart in the *Data Characteristics Section* and described in detail in the TDF file. These fields are in the same order as in the chart.

9. Data Manipulations:

Formulae:

See NCAR/RAF Bulletin No. 9 (by Miller and Friesen) for details of the formulas used to obtain the derived data from the aircraft measurements; this reference is available from the Research Aviation Facility, NCAR, P.O. Box 3000, Boulder, CO 80307. Grossman 1992 discusses the eddy correlation flux calculation method. Mean, standard deviation, skewness estimates were calculated from standard statistical formulae.

Derivation Techniques and Algorithms:

The derivation techniques and algorithms were discussed previously. The main ones were the Lyman-alpha calibration technique and eddy correlation flux technique.

Data Processing Sequence:

Data Processing by NCAR/RAF: The aircraft data analog signals were initially low pass filtered with a cutoff frequency of 20 Hz, the data were then digitally sampled at 50 samples per second, digital filters were used to low pass again at 20 Hz, The data then were block averaged to a 10 sample per second sampling rate and 1 sample per second sampling rate. Some slow response data obtained at 1 sample per second were interpolated to 20 samples per second: pressure was the main parameter for this project.

Data Processing by R.L. Grossman: Data were despiked by removing all data which were 5 standard deviations from the mean. This represented less than 1% of the data. Moisture mixing ratio was used to avoid corrections due to the dependence of density on temperature. For the filtered data a high-pass recursive filter was used. The filter used here is a third-order high-pass digital filter, derived from the maximally-flat approximation (Budak 1974) and converted to time domain using the pole-zero technique of Jacquot 1981. The cutoff frequency of the filter is fixed at .017 Hz (85 m/s average airspeed divided by a wavelength of 5000 m). Fluxes were computed using standard eddy correlation technique based upon Reynolds Averaging Rules.

Processing Steps:

Discussed in previous sections.

Processing Changes:

None.

Calculations:

Special Corrections/Adjustments:

None.

Calculated Variables:

Not available.

Graphs and Plots:

None.

10. Errors:

Sources of Error:

Only the highlights are given here since it is beyond the scope of the project to discuss potential errors for all of the measurements on the aircraft.

- **SURF_TEMP_MEAN: surface emissivity is assumed to be 1.0 (a black-body), this may not be true.
- Moisture in the atmosphere between the aircraft and the surface introduced an error.
- Only the 30 m runs gave reliable surface temperatures.
- **Often moisture variability in the atmosphere introduced errors In the along track variation of surface temperature.**
- **HEIGHT_ABOVE_MEAN_SEA_LVL: this is a computed quantity based upon a standard atmosphere temperature profile to nominal aircraft altitude and a standard sea level pressure of 1013.5 kPa. The actual sea level pressure and temperature profile could have been different, introducing error into this derived quantity. This quantity is based upon the Lyman-alpha Hygrometer data. These data were calibrated in a special way.

Errors are discussed previously.

Quality Assessment:

This is discussed in the *Notes Section*.

Data Validation by Source:

NCAR/RAF experts carefully went over the data before it was released to the Principal Investigator. Their reports are given in the *Known Problems with the Data Section*. The Principal Investigator also looked very carefully at the data for the missions flown on 1 June, 4 June, and 6 June 1987 before publishing results. Level legs for all missions were subjected to criteria based on aircraft altitude changes, position over the FIFE study area, and roll altitude of the aircraft. However, missions other than 1, 4, and 6 June 1987 may contain subtle errors because the principal investigator did not subject these data to the same scrutiny as those used in published results.

Confidence Level/Accuracy Judgment:

Based upon four peer reviewed articles based upon the 1987 data only, the principal investigator feels that the data are of high quality. Limitations have been discussed in the publications as well as in this documentation. The judgment is based also on the analysis of wing-to-wing inter-comparison of measurements as well as computational techniques reported in MacPherson 1992.

Measurement Error for Parameters:

A complete list can be found in NCAR/RAF Bulletin No.14, a selection from that list is presented below:

Parameter/Variable	Accuracy	Resolution
Mag. heading	0.05 deg	.00275 deg
Static press.	1 kPa	.06 kPa
Geom. Alt.	1.5m, 0-152m	
7% , 152-930m 0.1 m		
Lat/lon	< 1 nm per hr	.0014 deg
Ground veloc.	< 1 knot/hr drift	.04 m/s
Vert. veloc.	0.1 m/s	.012 m/s
Pitch/roll	.05 deg	.00275 deg
Platform hdg.	.05 deg	.00275 deg
Airspeed	.07 kPa	.006 kPa
Total press.	1.0 kPa	.034 kPa
Air temp.	0.5 C	.006 C
Dewpoint temp.	0.5 C, > 0 C	.006 C,
1.0 C, < 0 C Note: these have to be converted to mixing ratio using temperature and pressure errors.		
Vapor density	n/a	.0006 g/m**3
wind components	1.0 m/s	.012 m/s
Global Infra-red Radiation	not given	.40 W/m^2

```
Global Solar Radiation      not given        .12 W/m^2
```

Additional Quality Assessments:

FIS staff applied a general Quality Assessment (QA) procedure to the data to identify inconsistencies and problems for potential users. As a general procedure, the FIS QA consisted of examining the maximum, minimum, average, and standard deviation for each numerical field in the data table. An attempt was made to find an explanation for unexpected high or low values, values outside of the normal physical range for a variable, or standard deviations that appeared inconsistent with the mean. In some cases, histograms were examined to determine whether outliers were consistent with the shape of the data distribution.

The discrepancies, which were identified, are reported as problems in the *Known Problems with the Data Section*.

Data Verification by Data Center:

The data verification performed by the ORNL DAAC deals with the quality of the data format, media, and readability. The ORNL DAAC does not make an assessment of the quality of the data itself except during the course of performing other QA procedures as described below.

The FIFE data were transferred to the ORNL DAAC via CD-ROM. These CD-ROMs are distributed by the ORNL DAAC unmodified as a set or in individual volumes, as requested. In addition, the DAAC has incorporated each of the 98 FIFE tabular datasets from the CD-ROMs into its online data holdings. Incorporation of these data involved the following steps:

- copying the entire FIFE Volume 1, maintaining the directory structure on the CD-ROM.
- using data files, documentation, and SQL code provided on the CD-ROM to create a database in Statistical Analysis System (SAS).
- creating transfer files to transfer the SAS metadata database to Sybase tables.

Each distinct type of data (i.e. "data set" on the CD-ROM), is accompanied by a documentation file (i.e., .doc file) and a data format/structure definition file (i.e., .tdf file). The data format files on the CD-ROM are Oracle SQL commands (e.g., "create table") that can be used to set up a relational database table structure. This file provides column/variable names, character/numeric type, length, and format, and labels/comments. These SQL commands were converted to SAS code and were used to create SAS data sets and subsequently to input data files directly from the CD-ROM into a SAS dataset. During this process, file names and directory paths were captured and metadata was extracted to the extent possible electronically. No files were found to be corrupted or unreadable during the conversion process.

Additional Quality Assurance procedures were performed as follows:

- Statistical operations were performed to calculate minimum and maximum values for all numeric fields and to create a listing of all values of the character fields. During this process, it was determined that various conventions were used to represent missing values. (Note: no modifications were made to any data by the DAAC). In most cases, missing value identification conventions were discussed in the accompanying .doc file. Based on a visual check of the minimum and maximum values, no glaring errors or holes were identified that might indicate errors introduced during CD-ROM mastering by the FIFE project or data ingest by the DAAC.

- Some minor inconsistencies and typographical errors were identified in some of the character fields and column labels, however, no modifications were made to the data by the DAAC.
- Some conversions of ASCII data were necessary to move the data from a DOS platform to a UNIX platform. Standard operating system conversion utilities were used (e.g., dos2unix).
- Much of the metadata required for archival is imbedded in the narrative documentation accompanying the data sets and extracted manually by DAAC staff who have read the .doc files provided on the CD-ROM and have hand entered this information into the metadata database maintained by the DAAC. QA procedures have been performed on these metadata to identify and eliminate typographical errors and inconsistencies in naming conventions, to ensure that all required metadata is present, and to ensure the accuracy of file names and paths for retrieval.
- Data requested for distribution to users are checked to verify that files copied from disk to other media remain uncorrupted.

As errors are discovered in the online tabular data by investigators, users, or DAAC staff, corrections are made in cooperation with the principal investigators. These corrections are then distributed to users. CD-ROM data are corrected when re-mastering occurs for replenishment of CD-ROM stock.

11. Notes:

Limitations of the Data:

Not available.

Known Problems with the Data:

IFC-1 Data Quality Report from V. Glover

The National Center for Atmospheric Research Aviation Facility has given permission to copy their data quality report for the NCAR King Air participation in FIFE IFC-1. This report was authored by Mr. Vince Glover of NCAR and appears in its entirety. Additional comments by the principal investigators (Grossman, Mahrt, and Hall) are enclosed by parentheses within the text.

"This summary has been written to outline areas of concern in the data set and is not intended to point out every bit of questionable data. It is hoped that this information will facilitate the use of the data as the research concentrates on specific times and flights. In general, the data set is of excellent overall quality with very little loss of data."

"The following report is organized into two sections. The first lists general limitations and systematic biases in the RAF measurements. The second section lists isolated problems on a flight-by-flight basis."

Section One:

1. The EG&G Model 137 Hygrometers as flown for this project are capable of measuring dew points corresponding to 10% relative humidity at the sensor operating temperature. In environments drier than 10% rh, the output trace lacks any structure, but is still operating to its capacity. This should not present any data limitation since this cutoff normally corresponds to absolute humidities of less than 0.5 grams per cubic meter. Sometimes the indicated relative humidity exceeds 100%. This is a consequence of the accuracy limitation of the dew point hygrometers.
2. The first research flight of the project used a Lyman alpha spacing of 0.5 cm. The moisture data from this flight lacked sensitivity. Consequently, the spacing was changed to 0.25 cm for the second flight and remained at the value for all of the other research flights (except the inter-comparison flights where the spacing again was 0.5 cm). The Lyman-Alpha data for this project has been processed to provide moisture values in engineering units. (Grossman n.b.-this Lyman-Alpha calibration method, developed by Mr. Alan Schanot, is available from NCAR/RAF. Another method was developed by Dr. Carl Friehe and Dr. Robert L. Grossman 1986. The Schanot method has been used for the fast response, or turbulence, moisture statistics or fluxes on the following data file; this method has not been fully tested by inter-comparison with other methods or other fast response moisture devices.)
3. In a high rate turbulence (HRT) project such as this the inertial navigation system variables PHDG (aircraft heading), pitch, roll, and VZI (vertical velocity of the aircraft) are sampled at 50 times per second. A post-project review of the set up actually used during the project revealed these four variables were sampled 5 times per second. The effect of this difference was tested (by NCAR and Drs. Grossman, Mahrt, and Lenschow feel that these tests were inconclusive. At the present time it appears that fluxes are probably underestimated by less than 10%; this degradation is still being looked into.).
4. Maneuvers were performed on several flights during the project as well as on the test flights. These maneuvers are designed to evaluate the air motion sensing system. In general, the results from the maneuvers (indicated that the outputs from the air motion instruments) were excellent.
5. (this note refers to plotted output)
6. Broad band radiation was measured using both upward and downward pointing radiometers. Neither of these measurements has been corrected for changes in the aircraft flight attitude. All substantial fluctuations should be compared to the roll and/or pitch parameters to see if these changes result from aircraft motions.
7. The value *palt* is the pressure altitude in meters based on an NACA standard atmosphere. A value of 1013.2 mb is used for the "altimeter setting" for this calculation. This may not be appropriate for this project and result in inaccurate (pressure) altitude values.
8. (this note refers to inputs to derived variables and is of interest only to the principal investigators and those requesting raw data)

9. (this note refers to time gaps which were taken into account when calculating the output of the data file below)
10. The primary static pressure (PSFDC) sensor was a Rosemount Model 1501 digital transducer connected to the fuselage static port. This transducer is very stable and does not show substantial changes with changes in temperature. However, the Rosemount Model 1201F static pressure transducer used on the right wing (PSWC) was subject to errors when it was exposed to rapid changes in ambient temperature. Errors in PSWC are not important to the current project since PSWC is a backup to PSFDC which remained reliable throughout the project. On several flights a distinct 1.5 to 2.0 mb jump is seen in the static pressure difference plots and in the pitot-static pressure difference plots. This jump occurs during rapid, "flaps down" descents performed at the end of several soundings flown during the project. In those rapid descents, the lowered flaps distort the flow around the fuselage static ports. The dynamic pressure sensors were located in the radome gust probe and on the right wing. During turns these sets of sensors will differ systematically due to their locations. This is not an error but a result of the spatial separation of the sensors and the banked attitude of the aircraft in turns.
11. (this note refers to the infrared pyrgeometers which are not used in output on the data file below)
12. (this note refers to the output of the radio altimeters which has been accounted for in the output of the data file below)
13. (this note refers to labeling of the microfilm output of the cloud physics particle counters which are not used in the output on the data file below)
14. Aircraft position for this project is available from three sources namely, INS, Loran-C, and DME. The INS has drift errors which can be reduced by referencing it to the Loran-C and DME. Both Loran-C and DME had occasional dropouts but they usually did not occur at the same time and there should be continuous position data for updating the INS. (this was not done for this quick-look data file.)
15. (this note refers to liquid water content data which are not used in the output of the data file below.)

Data Quality Report
King Air N312D-Project # 0-220
1989 IFC-5
by
Allen Schanot

This summary has been written to outline basic instrumentation problems affecting the data set and is not intended to point out every bit of questionable data. It is hoped that this information will facilitate use of these data as the research concentrates on specific flights and times.

The following report is organized into two sections. The first section lists reoccurring problems, general limitations, and systematic biases in the RAF measurements. The second section lists isolated problems occurring on a flight-by-flight basis. Some User supplied equipment was included in the instrument package. No attempt has been made to evaluate the performance of any of that equipment.

Section I: General Discussion

1. The wind data for this project were derived from measurements taken with the radome wind gust package. As is the case with all wind gust systems, the ambient wind calculations can be adversely affected by either sharp changes in the aircraft's flight attitude of excessive drift in the onboard inertial navigation system (INS). Turns, or more importantly, climbing turns are particularly disruptive to this type of measurement technique. Wind data reported for these conditions should be used with caution.

   Special sets of in-flight calibration maneuvers were conducted on flights TF01, RF02 and RF06 to aid in the performance analysis of the wind gust measurements. All of the information, including the summary of INS performance, indicated that the wind measurement system was performing within standard RAF specifications. The time intervals for each set of maneuvers have been documented in both the flight-by-flight data quality review and on the individual Research Flight Forms prepared for each flight.

2. RAF flies redundant sensors to assure data quality. The performance of these sensors is monitored through the use of difference plots which are included in the data set. Performance characteristics differ from sensor to sensor with certain units being more susceptible to various thermal and dynamic effects than others. Excellent comparisons were typically obtained between the two dynamic pressures (QCWC, QCRC), and the two dew pointers (DPT, DPB). Exceptions are noted in the flight-by-flight summary. The comparison of the three temperature sensors (ATB, ATKP, ATRF) was generally good but pointed out a systematic offset of -0.6 C in ATB with respect to both the other parameters. No physical reason could be found to account for this difference so no adjustment has been made in the GENPRO data set. The differences observed in the static pressures (PSFDC, PSWC) were fairly typical for this type of project with the Model 1201 pressure transducer (PSWC) exhibiting its temperature sensitivity. The reference pressure used in all of the derived parameters (PSFDC) was obtained with a Model 1501 unit which is unaffected by these problems.
3. Humidity measurements were made using two collocated thermoelectric dew point sensors, two symmetrically mounted Lyman-alpha fast response hygrometers, and a fast response microwave refractometer. As discussed above, DPT and DPB tracked well throughout the program. Due to some intermittent spiking in DPT on certain flights, DPB was selected as the reference dew pointer for use in baselining the high rate humidity sensors.

   Lyman-alpha hygrometers are susceptible to in-flight drift in the instrument's bias voltage. Due to this problem, RAF uses a special data processing technique to remove the bias drift by referencing the long term humidity values to one of the more stable thermoelectric dew point sensors. This technique can result in occasional large spikes in the derived Lyman-alpha data (RHOLA, RHOLA1) which often effect the auto-scaling features in the microfilm plotting routines and wash out the plots. Short (2--3 sec) intervals around these spikes should be considered as bad data, but the remaining data points, as recorded on magnetic tape, will be valid. The performance of the data processing technique can be monitored through an examination of the difference plots (DRFHBL, DFRHB1) included in the GENPRO data set. Information on this technique, and literature references on high rate humidity measurements are available in RAF Bulletin # 22. Peak to peak response characteristics for each Lyman-alpha system were determined using the NCAR gas calibration device which is patterned after the "Stull" Lyman-alpha calibration system discussed in the literature. Although both systems generally performed well, sensor SN-1 (VLA, RHOLA) exhibited less drift and should be used as the primary high rate data source.

The microwave refractometer is a high rate humidity sensor currently under development at RAF and was included in this program on an experimental basis. System response is stable with pre and post project calibrations being conducted in the RAF calibration lab. In its current state of development, however, certain flight specific adjustments are necessary to convert the direct measurement of refractivity to an absolute humidity. These adjustments are applied systematically and resulted in only minimal impact on the humidity measurements. The instrument performed well throughout the experiment so the data have been included in the GENPRO data output. Performance during specific intervals can be monitored through an examination of the difference plot (DFRHBR) included in the data set.

4. LORANC navigation data were recorded during the program to assist in the monitoring of the INS performance. Due to a persistent malfunction of the LORANC/ADS interface hardware, the data were generally missing or of poor quality and therefore not included in the final GENPRO output.
5. A set of upward and downward facing radiometers was used to measure shortwave, ultraviolet and infrared irradiance. It should be noted that all units are hard mounted and that none of the data have been corrected for changes in the aircraft's flight attitude. Care should be used in identifying the aircraft attitude to determine a relative sun angle. Specific problem intervals are identified in Section II.
6. A set of remote sensing devices were used to monitor cloud cover and surface conditions along the path of flight. The typical drift normally associated with the PRT-5 remote temperature sensing units (RSTB, RSTT) was minimal due to the nature of the flight profiles. Instrument performance can be monitored by examining the drift in the respective cavity reference temperatures (TCAVB, TCAVT) included in the GENPRO output data set.

   The dual wavelength vegetation sensor is a new device and its performance characteristics are not well known. It appeared to perform well with signal fluctuations (VM660, VM730) mirroring some of the other radiometric measurements.

   As with all radiometric sensors, these units are hard mounted and none of the data have been corrected for changes in the aircraft's flight attitude.

7. A radio altimeter was included in the instrument package to monitor the aircraft's AFL height during the program. The Sperry Rand altimeter (HGM) is only functional from 0-780 m AGL. At altitudes greater than 780 m the instrument is pegged full scale.
8. The PMS-ASASP aerosol probe exhibited chronic sample flow problems over the course of the experiment. Several attempts were made to correct the problem, but these attempts were only marginally successful due to the poor availability of specific parts from the manufacturer. The problem manifests itself in the form of a noisy output and atypically high aerosol concentrations (CONCA, DBARA). Specific problem intervals are identified in Section II.

Section II: Flight-by-Flight Summary

Flight: RF01

- Balanced top and bottom dew pointers (DPT, DPTC; DPB, DPBC) at 1017 CDT.
- Atypical high aerosol concentrations (CONCA) due to recurring flow pump problems on PMS-ASASP particle probe. Data questionable for entire flight.
- Atypical ozone concentrations (TEO3, TEO3C) observed during takeoff likely caused by local surface source. Data questionable from 1012-1014 CDT.
- Microwave refractometer signal (RFI, RHORF) becomes unlocked. Data bad from 1205-1232 CDT.
- Data end in flight at 12:35:42 CDT due to failure of secondary tape drive system.
- One time offset adjustment made to longitude data of this flight due to suspected input error made during Inertial navigation system alignment.

Flight: RF02

- Atypical high aerosol concentrations (CONCA) due to recurring flow pump problems on PMS-ASASP particle probe. Data questionable for entire flight.
- Microwave refractometer signal (RFI, RHORF) becomes unlocked. Data bad from 1253-1355 CDT.
- Down looking ultraviolet radiometer malfunction. Data bad for the entire flight.
- Data gap due to faulty secondary tape drive system. Data lost from 14:55:34-14:59:27 CDT.

Flight: RF03

- Balanced top and bottom dew pointers (DPT, DPTC; DPB, DPBC) at 1030 CDT.
- Atypical high aerosol concentrations (CONCA) due to recurring flow pump problems on PMS-ASASP particle probe. Data questionable for entire flight.
- Down looking ultraviolet radiometer malfunction. Data bad for the entire flight.
- Spurious recording error in INS position between 1200-1230 CDT.
- Other parameters (winds, etc.) are unaffected.
- Data gap due to faulty secondary tape drive system. Data lost from 12:35:58-12:40:03 CDT.

Flight: RF04

- Balanced top and bottom dew pointers (DPT, DPTC; DPB, DPBC) at 1216 CDT.
- Atypical ozone concentrations (TEO3, TEO3C) observed during takeoff likely caused by local surface source or warm up errors. Data questionable from 1210-1215 CDT.
- Excessive drift in secondary Lyman-alpha hygrometer (VLA1, RHOLA1) from 1210-1300 CDT.
- Data gap due to recording error. Data lost from 12:29:10-12:29:23 CDT.
- Atypically high aerosol concentrations (CONCA) due to recurring flow pump problems on PMS-ASASP particle probe. Data questionable from 1355-1513 CDT.
- Malfunction in top dew pointer (DPT, DPTC) from 1410-1421 CDT.
- Down looking ultraviolet radiometer malfunction. Data bad from 1405-1513 CDT.

Flight: RF05

- Balanced top and bottom dew pointers (DPT, DPTC; DPB, DPBC) at 1152 CDT.
- Atypical high aerosol concentrations (CONCA) due to recurring flow pump problems on PMS-ASASP particle probe. Data questionable for entire flight.
- Down looking ultraviolet radiometer malfunction (UVB). Data questionable for the entire flight.
- Malfunction in top dew pointer (DPT, DPTC) from 1200-1235 CDT.

Flight: RF06

- Data start in flight due to initial ADS system problems.

Flight: RF07

- Balanced top and bottom dew pointers (DPT, DPTC; DPB, DPBC) at 1304 CDT.
- Down looking ultraviolet radiometer malfunction (UVB). Data questionable for the entire flight.

Flight: RF08

- Balanced top and bottom dew pointers (DPT, DPTC; DPB, DPBC) at 0930 CDT.
- Microwave refractometer signal (RFI, RHORF) becomes unlocked. Data bad from 1204-1240 and 1303-1316 CDT.

Flight: RF09

- Balanced top and bottom dew pointers (DPT, DPTC; DPB, DPBC) at 1129 CDT.
- Microwave refractometer signal (RFI, RHORF) becomes unlocked at intermittent intervals through out flight.
- Atypical high aerosol concentrations (CONCA) due to recurring flow pump problems on PMS-ASASP particle probe. Data questionable for entire flight.

- Failure of down looking IR radiometer (IRB, IRBC). Data bad from 1342-1705 CDT.

Flight: RF10

- Atypical high aerosol concentrations (CONCA) due to recurring flow pump problems on PMS-ASASP particle probe. Data questionable for entire flight.
- Atypical response from down looking UV radiometer. Data questionable from 1100-1457 CDT.

FIS staff general QA found the following anomalies in Dr. Grossman's aircraft flux data:

- On August 8, 1989 at 175846(GMT) there was a POTNTL_TEMP_SKEW reading of -3.698.
- In July and August of 1989 there were 21 SENSIBLE_HEAT_FLUX_RAW values that were over 400 [W][m^-2].
- On June 1, 1987 at 1617(GMT) there was a LATENT_HEAT_FLUX_RAW reading of -428 [W][m^-2]
- There are a total of 39 LATENT_HEAT_FLUX_RAW readings that are over 400 [W][m^-2].

Usage Guidance:

The main problems were with the Lyman-alpha Hygrometer Calibration, choosing the level leg timings for fluxes, method of flux calculation, and surface temperature estimation. All of these have been discussed or referenced in the sections above. Here is a capsule discussion.

- Lyman-Alpha Hygrometer: based upon slower response Cambridge Hygrometer. Complex, somewhat subjective, method. No obvious trends with height or time of day noted in the slope of the calibration (important for flux calculations) but height dependence on intercept was noted; so Lyman-Alpha should not be used as an absolute instrument. Up to 6% random error introduced to flux calculation because of the scatter in each mission slope estimates.
- Level Leg Timings: at times the elapsed time of the level legs was barely enough to insure that the flux was "stable".
- Method of Flux Calculation: fluxes were estimated using raw, detrended and high-pass filtered data. This data set contains the raw data. From extensive analysis the FIFE Boundary Layer Group recommends using the detrended data.
- Surface Temperature Estimate: ground emissivity and moisture between ground and aircraft introduced bias and variable errors.

Any Other Relevant Information about the Study:

Not available at this revision.

12. Application of the Data Set:

The Raw Atmospheric Turbulence Data from the NCAR King Air Data Set can be used to help describe the structure of the atmospheric boundary layer over the FIFE study area, increase knowledge of the physical processes active in the daytime boundary layer, and explore the relationship of surface properties to the time and spatial variation in the structure of the boundary layer.

13. Future Modifications and Plans:

The FIFE field campaigns were held in 1987 and 1989 and there are no plans for new data collection. Field work continues near the FIFE site at the Long-Term Ecological Research (LTER) Network Konza research site (i.e., LTER continues to monitor the site). The FIFE investigators are continuing to analyze and model the data from the field campaigns to produce new data products.

14. Software:

Software to access the data set is available on the all volumes of the FIFE CD-ROM set. For a detailed description of the available software see the *Software Description Document*.

15. Data Access:

Contact Information:

ORNL DAAC User Services
Oak Ridge National Laboratory

Telephone: (865) 241-3952
FAX: (865) 574-4665 Email: ornldaac@ornl.gov

Data Center Identification:

ORNL Distributed Active Archive Center
Oak Ridge National Laboratory
USA

Telephone: (865) 241-3952
FAX: (865) 574-4665 Email: ornldaac@ornl.gov

Procedures for Obtaining Data:

Users may place requests by telephone, electronic mail, or FAX. Data is also available via the World Wide Web at http://daac.ornl.gov.

Data Center Status/Plans:

FIFE data are available from the ORNL DAAC. Please contact the ORNL DAAC User Services Office for the most current information about these data.

16. Output Products and Availability:

Tape Products.

NCAR/RAF processed tapes containing the original data from which the derived data (statistics, fluxes, etc.) were estimated can be obtained from the FIS or from NCAR/RAF (cost reimbursable). These data are in the public domain. NCAR may also be able to provide these data in digital file format.

Film Products.

Microfilms of the output from the original data tapes discussed in the *Tape Products Section* are available from the ORNL DAAC.

Video camera (side-looking, downward looking) tapes from the aircraft are available from the ORNL DAAC.

Other Products.

Raw Atmospheric Turbulence Data from the NCAR King Air are available on FIFE CD-ROM Volume 1. The CD-ROM filename is as follows:

\DATA\AIR_FLUX\AF_RAW\NCAR\Yyyyy\ydddMULT.NRR

Where *yyyy* are the four digits of the century and year (e.g., Y1987). Note: capital letters indicate fixed values that appear on the CD-ROM exactly as shown here, lower case indicates characters (values) that change for each path and file.

The format used for the filenames is: *ydddMULT.sfx*, where *y* is the last digit of the year (e.g., 7 = 1987, and 9 = 1989), *ddd* is the day of the year (e.g., 061 = sixty-first day in the year). The filename extension (.*sfx*), identifies the data set content for the file (see the *Data Characteristics Section*) and is equal to .WYR for the raw data.

17. References:

Satellite/Instrument/Data Processing Documentation.

Miller and Friesen NCAR/RAF Bulletin No. 9.

Anonymous NCAR/RAF Bulletin No. 14.

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Kelly, R. 1992. Atmospheric boundary layer studies in FIFE: Challenges and advances. J. Geophys. Res. 97(D17):18,373-18,376.

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Sellers, P.J., F.G. Hall, G.Asrar, D.E. Strebel, and R.E. Murphy. An overview of the First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE). J. Geophys. Res. 97(D17):18,345-18,371.

Archive/DBMS Usage Documentation.

Contact the EOS Distributed Active Archive Center (DAAC) at Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee (see the *Data Center Identification Section*). Documentation about using the archive and/or online access to the data at the ORNL DAAC is not available at this revision.

18. Glossary of Terms:

A general glossary for the DAAC is located at Glossary.

19. List of Acronyms:

BL Boundary Layer CDST Central Daylight-Saving Time CD-ROM Compact Disk, Read-Only Memory DAAC Distributive Active Archive Center EOS Earth Observing System EOSDIS EOS

Data and Information System FIS FIFE Information System FIFE First ISLSCP Field Experiment GMT Greenwich Mean Time HRT High Rate Turbulence IFC Intensive Field Campaign INS Inertial Navigation System ISLSCP International Satellite Land Surface Climatology Project NCAR National Center for Atmospheric Research ORNL Oak Ridge National Laboratory PBL Planetary Boundary Layer RAF Research Aviation Facility SQL Structured Query Language TDF Table Definition File URL Uniform Resource Locator UTM Universal Transverse Mercator

A general list of acronyms for the DAAC is available at Acronyms.

20. Document Information:

April 29, 1994 (citation revised on October 14, 2002).

This document has been reviewed by the FIFE Information Scientist to eliminate technical and editorial inaccuracies. Previous versions of this document have been reviewed by the Principal Investigator, the person who transmitted the data to FIS, a FIS staff member, or a FIFE scientist generally familiar with the data. It is believed that the document accurately describes the data as collected and as archived on the FIFE CD-ROM series.

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March 6, 1996.

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