SAFARI 2000 Modeled Tropospheric Air Mass Trajectories, Dry Season 2000

Abstract

The ETA Forecast Trajectory Model was used to produce forecasts of air-parcel trajectories twice a day at three pressure levels over seven sites in Southern Africa for the period August 14, 2000 to September 23, 2000. These sites are Durban, Middleburg, Pietersburg, and Springbok, South Africa; Maun, Botswana; Mongu, Zambia; and Windhoek, Namibia.

The twice daily three-dimensional wind field (at 0000 and 1200 UTC) was used as input to the trajectory model. By integrating the vertical motion of the air parcels over a period of time, the trajectory model was able to forecast the net vertical displacement of air parcels during 12-hour periods.

The resulting trajectory plots represent the three-dimensional transport of air in time and can be used to examine what is happening in the low-to-mid troposphere during flight and ground-based observations. These levels are most significant in terms of the thermodynamic structure of the troposphere, especially the stable layers and accumulation of material between and below them, as well containing the major levels of subsidence over the subcontinent. The trajectory model output and thermodynamic profiles of the troposphere were used to position aircraft for sampling trace gases, aerosols and other species during the SAFARI 2000 field campaign and to predict regions of high aerosol and trace gas concentrations downwind.

The model output data are daily forward and backward trajectory plots at 850 hPa, 700 hPa, and 500 hPa pressure levels for each location. The plots are provided as JPEG images with coordinate, date, and time stamps.

Background Information

Investigators:
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Project: SAFARI 2000

Data Set Title: SAFARI 2000 Modeled Tropospheric Air Mass Trajectories, Dry Season 2000

Site: Southern Africa
  Westernmost Longitude: 17.1 E
  Easternmost Longitude: 31.0 E
  Northernmost Latitude: -15.3 S
  Southernmost Latitude: -30.0 S

Data Set Citation:

Freiman, T. 2005. SAFARI 2000 Modeled Tropospheric Air Mass Trajectories, Dry Season 2000. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Data File Information:

The model output is stored as JPEG images, one file per plot, pressure level, and date, with a header displaying pressure level, coordinates, date, and time stamp on the top of each plot. The file naming convention is **OUTx_nnn_yymmdd12_Loc#_xrrr.jpg**,

where: **OUTx** indicates whether the **out**put is a forward (**x=f**) or backward (**x=b**) trajectory,

nnn is the pressure level (i.e., 850 hPa, 700 hPa, or 500 hPa),

yy are the last two digits of the year of data collection,

mm and **dd** are the month and day of data collection,

Loc# indicates the location of data collection (see table below), and

xrrr is a file identifier code where **x** indicates whether the output is a forward (**x=f**) or backward (**x=b**) trajectory and **rrr** is an alphanumeric.

Data File Organization:

The JPEG images are organized and available for downloading by both date and location.

- Date: All of the images for a given date for available locations have been aggregated and compressed.
- Location: All of the images for a given site (see table below) for available dates have been aggregated and compressed.

Other Companion Files:

- A template of each site illustrates how to read the plots. The templates are JPEG images, one for each site identified by name.
- A composite map of the spatial coverage of all the sites used, is provided in JPEG format (see figure below).
- A synoptic analysis of daily meteorological conditions at midday at the three pressure levels for three latitudinal zones (10 to 20 degrees South; 20 to 30 degrees South; and 30 degrees South and southwards) is provided as a companion .csv file (see table below this document.

Details regarding the plots:

The following sites were used to run forward and backward trajectories:

Sites	Country	Coordinates	Plot Number	Location Number
Pietersburg	South Africa	29.5 E, -23.9 S	Plot 1	Loc 1
Mongu	Zambia	23.2 E, -15.3 S	Plot 2	Loc 2
Maun	Botswana	23.4 E, -20.0 S	Plot 3	Loc 3
Windhoek	Namibia	17.1 E, -22.6 S	Plot 4	Loc 4
Springbok	South Africa	17.8 E, -29.7 S	Plot 5	Loc 5
Middleburg	South Africa	29.3 E, -25.8 S	Plot 8	Loc 8
Durban	South Africa	31.0 E, -30.0 S	Plot 9	Loc 9

A composite map of the spatial coverage of all the sites:
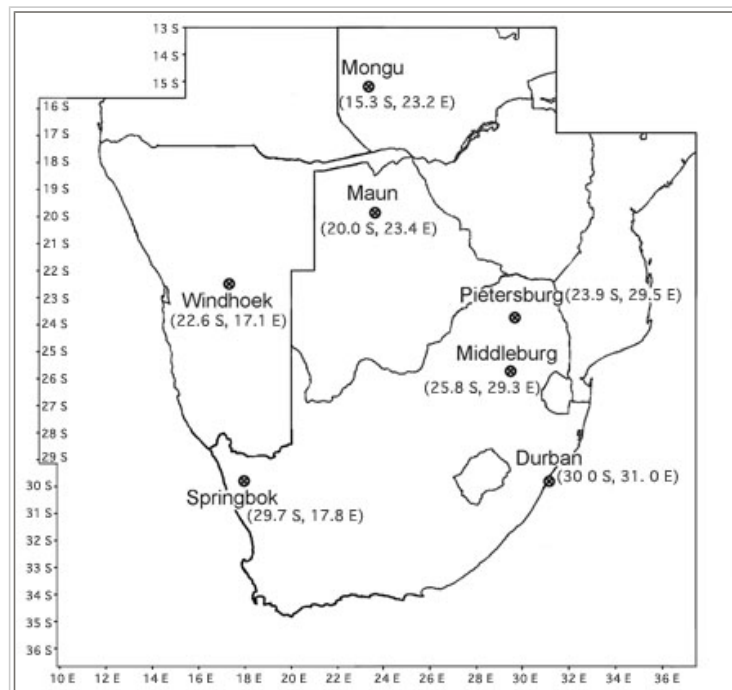
ETA Forecast Trajectory Model:

The National Centers for Environmental Prediction's (NCEP) step-mountain eta coordinate model, generally known as the ETA Model, provided the forward and backward input files required for the forward and backward trajectory modelling for the SAFARI 2000 campaign. The model uses: modified Betts-Miller convection schemes, the Mellor-Yamada turbulence closure model, the Cloud water model, and the Four-layer soil model.

Boundary conditions are accounted by the NCEP global spectral model by either gridded, p-level from GTS or spectral coefficient, o-level from the inhouse GSM. Many data types are ingested by the NCEP preprocessor to assimilate initial conditions. Such data are introduced into the model, on an intermittent basis, through a 3-hourly cycle data assimilation process 12 hours prior to the model starting time.

The model output domain can be centered on any area of interest, in this case, the sites listed above. The model provides decode u, v, w and psfc, and forward and backward inputs for trajectory modelling. The NCEP model outputs allow trajectory modelling to be done interactively or in batch mode.

For this data set, the ETA Forecast Trajectory Model was used to produce forecasts of air-parcel trajectories over seven sites in Southern Africa. The model was also was used by the South African Weather Bureau/Service (SAWS) to produce the basic meteorological data for the SAFARI project [South African Weather Service (SAWS), 2004].

Additional details about the ETA Forecast Trajectory Model used to produce this data set:

1. The ETA Forecast Trajectory Model was run for the period August 14, 2000 to September 23, 2000.
2. Data are available twice daily (0000 and 1200) (UTC).
3. Advection was 3-hourly.
4. The grid resolution is 0.5 degrees.
5. A five point array was used around each site of resolution 2.5 degrees.
6. A 48-hour trajectory was run forward (f) and backward (b) from the initial site.

Additional Sources of Information

SAFARI 2000 SYNOPTIC ANALYSIS AUGUST - SEPTEMBER 2000 (middday)

KEY: CH=continental high   EW=easterly wave

WW=westerly wave   ST=surface trough

RH=ridging high   UT=upper trough

DATES	30 deg South and southwards			20 to 30 deg South			10 to 20 deg South		
	SURFACE	700 hPa	500 hPa	SURFACE	700 hPa	500 hPa	SURFACE	700 hPa	500 hPa
13-Aug	RH	RH	RH	CH	CH	CH	EW	CH	CH
14-Aug	CH	CH	CH	CH	CH	CH	EW	EW	EW
15-Aug	WW	WW	CH	CH	CH	CH	EW	EW	CH
16-Aug	CH	WW	WW	CH	CH	CH	EW	EW	EW
17-Aug	RH	WW	WW	CH	CH	WW	EW	EW	EW
18-Aug	RH	WW	WW	ST	CH	WW	EW	EW	EW
19-Aug	WW	WW	WW	ST	CH	WW	EW	CH	EW
20-Aug	WW	WW	WW	ST	CH	WW	EW	CH	EW
21-Aug	WW	WW	WW	WW	CH	WW	EW	CH	EW
22-Aug	RH	WW	WW	RH	WW	WW	EL	EW	EW
23-Aug	RH	WW	WW	ST	CH	WW	EL	CH	EW
24-Aug	RH	WW	WW	ST	CH	CH	EL	EW	EW
25-Aug	RH	WW	WW	CH	CH	CH	EL	EW	EW
26-Aug	WW	WW	WW	CH	CH	CH	EW	EW	EW
27-Aug	RH	WW	WW	CH	CH	CH	EL	EW	EW
28-Aug	RH	WW	WW	CH	CH	CH	EW	EW	EW
29-Aug	WW	WW	WW	CH	CH	CH	EW	EW	EW
30-Aug	RH	WW	WW	CH	CH	WW	EW	EW	EW
31-Aug	WW	WW	WW	WW	WW	WW	EW	EW	EW
01-Sep	WW	WW	WW	EL	WW	WW	EL	CH	CH
02-Sep	WW	WW	WW	CH	WW	WW	EL	CH	CH
03-Sep	WW	WW	WW	WW	WW	WW	EL	CH	CH
04-Sep	RH	WW	WW	EL	WW	WW	EL	CH	CH
05-Sep	RH	WW	WW	RH	CH	WW	EL	CH	CH
06-Sep	RH	WW	WW	WW	CH	WW	EL	CH	CH
07-Sep	WW	WW	WW	CH	CH	WW	EL	CH	CH
08-Sep	WW	WW	WW	CH	CH	WW	EW	CH	CH

09-Sep WW	WW	WW	CH	WW	WW	EL	CH	CH
10-Sep WW	WW	WW	WW	WW	WW	EL	CH	CH
11-Sep WW	WW	WW	CH	WW	WW	EW	CH	CH
12-Sep WW	WW	WW	CH	WW	WW	EW	CH	CH
13-Sep WW	WW	WW	WW	CH	WW	EW	CH	CH
14-Sep RH	RH	RH	RH	CH	CH	EL	CH	CH
15-Sep RH	WW	WW	WW	WW	CH	EL	CH	CH
16-Sep WW	WW	WW	WW	CH	WW	EL	CH	CH
17-Sep RH	WW	WW	WW	WW	WW	EL	CH	WW
18-Sep RH	RH	WW	RH	WW	WW	EW	CH	EW
19-Sep RH	RH	WW	WW	CH	WW	EW	CH	CH
20-Sep RH	UT	WW	RH	WW-UT	WW-UT	EW	CH	CH
21-Sep RH	UT	WW	RH	WW-UT	WW	EW	CH	CH
22-Sep CH	WW	WW	CH	CH	CH	EW	CH	CH
23-Sep WW	WW	WW	CH	CH	CH	EL	CH	CH

Note: Any representation of the plots must acknowledge the following individuals and institutions:

Tal Freiman - Climatology Research Group, University of the Witwatersrand, Johannesburg, South Africa
Hilarie Riphagen - South African Weather Service, Pretoria, South Africa

For use of any of the plots for publication purposes, please contact the Climatology Research Group.

References

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