Q It was asked whether the plots reflected morning or afternoon fire counts.
A Most probably afternoon fire counts.

Concerns were raised, on the basis of the fire count presentation, of whether Pietersburg was still too far south a site considering the locations of most of the fires. It was indicated that Pietersburg had been chosen for logistic purposes and that the site did facilitated the investigation of biomass burning in, for example, Mozambique in addition to facilitating the investigation of other issues (e.g. industrial and aeolian dust sources).

SESSION 3: METEOROLOGY
CHAIR: Eugene Poolman, SAWB

3.1 FORECASTING PLANS AND SAMPLE PRODUCTS
Michael de Villiers, SAWB

The SAWB will have a full time forecaster in Pietersburg during the intensive flight campaign. Local and international weather charts will be made available during the campaign. International charts comprising temperature and wind field predictions for 18 to 24 hours in advance will be made available every 6 hours. Domestic sigmets charts are produced every 3 hours and issued 4 hours in advance. All forecasts required for landing purposes will be made available. It was indicated that the UK Met Office should ask Windhoek for weather data. All aviation data and forecast data will be archived and kept available for use later on. More detailed information regarding the aviation and general products available from the SAWB is given in Table 12.

Table 12. General and aviation products available from the SAWB

Aviation Products	**Significant weather charts:** *International* - 6 hourly synoptic times. Issued by WAFC Bracknell. *Domestic / Regional* - 3 hourly synoptic and intermediate synoptic times. Issued by WAFC Bracknell. **Upper winds and temperatures:** *International* - 2 daily based on 0000 and 1200 UTC UKMO model for 24 and 36 hours ahead. Issued by WAFC Bracknell for Flight Levels 100, 180, 240, 300, 350, 390, 450, 530. *Domestic / Regional* - 2 daily. Based on 0000 and 12000 UTC UKMO model up to 36 hours ahead. Issued by SAWB Pretoria for Flight Levels 10, 30, 50, 70, 100, 130, 150, 170, 210, 240, 270, 300, 350, 400, 450.

	Terminal Aerodrome Forecasts (TAFS): *International (FT 24 hour)* - 6 hourly. Bulletins compiled by the SAWB from the GTS. *Domestic / Regional (FC 9 hour)* - 3 hourly. Bulletins compiled by the SAWB from the GTS. **Meteorological Aviation Reports (METARs and SPECIEs):** Bulletins compiled by the SAWB from the GTS. Hourly METARs, half hourly at FAJS, FADN, FAEL, FAPE, FACT. Ad hoc SPECIEs issued. **SIGMETS:** Issued by the SAWB and obtained from the GTS.
General Products	• Eta NWP model in PCGRIDDS format - numerous weather elements, indexes, cross and time sections, etc. • UKMO wide are model (EGRR) - humidity (850, 700, 500 hPa), wet-bulb potential temperature, showalter index, rainfall, sea-level pressure up to 120 hours. • ECMWF model - sea level pressure, 500 hPa GPM's, 850 hPa temperatures up to 168 hours. • Surface 6 hourly synoptic chart. • Radar - composite of SAWB radars with animation. • Local Radar images from a temporary Radar station at Pietersburg. • Satellite images - half hourly Southern Africa and South Africa Infrared and visual images with animation. • Tephigrams - diagrams of Rawisonde atmospheric soundings • RAOB - manipulation of Rawisonde data for the presentation of SkewT's, indices, etc. • Weatherman - GTS communication system.

SAWB Forecast Office Contacts:

Website: http://www.sawb.gov.za
Physical Address: Forum Building, 150 Struben Street, Pretoria
Postal Address: Private Bag X097, Pretoria, Republic of South Africa. 0001.

Central Forecast Office
Tel: +27 12(0)82 233 9800
Fax: +27 12 309 3990

Email: svk@sawb.gov.za

Kees Estie
Director: Forecasting, communication and observations
Tel: +27 12 309 3098
Fax: +27 12 309 3990
Email: estie@sawb.gov.za

Michael de Villiers
Deputy Director: Meteorological technical services
Tel: +27 12 309 3054
Fax: +27 12 309 3990
Email: mpdev@sawb.gov.za

Michael Edwards
Deputy Director: General and aviation forecasting
Tel: +27 12 309 3105
Fax: +27 12 309 3990
Email: edwards@sawb.gov.za

Ian Hunter
Deputy Director: Marine forecasting and analysis
Tel: +27 12 309 3104
Fax: +27 12 309 3990
Email: ian@sawb.gov.za

Kevin Rae
Assistant Director: Central forecast office
Tel: +27 12 (0) 82 233 9800
Fax: +27 12 309 3990
Email: kevin@sawb.gov.za

Questions and Answers

Q Can the SAWB provide Lagrangian air parcel information?
A Trajectory modelling is undertaken by Wits University and will be discussed later on.

Q Will the forecaster attend the flight planning meetings to give advice and explain the forecasts?
A Yes

Q Are maps and charts available for Kasane?
A It would be necessary to contact the Botswana Met Office for access to these.

Q The regional head of the Met Offices in the region are having a meeting next week, can the issue of providing information for Safari 2000 participants be raised?
A Yes, we can think about that.

3.2 MODELLING

3.2.1 NCEP REGIONAL ETA PREDICTION SYSTEM
Hilarie Riphagen, SAWB

The NCEP regional Eta prediction system has been operational at the SAWB since 1993, and has been configured for South Africa's needs. This system provides the forward and backward input files required for the forward and backward trajectory modelling required 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.

The NCEP model has underwent upgrades in 1996, 1998, 1999 and will be further upgraded in 2000. The November 1999 upgrade facilitated improvements in the data ingest system, and provided for a new analysis system and forecast model enhancements. Boundary conditions are accounted by the NCEP global spectral model by either gridded, p-level from GTS or spectral coefficient, σ-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.

Model Domain and Resolution:

The modelling domain is within 53° S to 1° N and 30° W to 70° E. In August 1999 the model resolution was 48 km, and facilitated the prediction of 38 eta layer with a time step of 120 seconds. By August 2000 the resolution will have been improved to 32 km, with 45 eta layers and a time step of 72 seconds.

Output Domain and Resolution:
The output domain is between 48°S to 9°S and 13°W to 53°E, with a resolution of half a degree S/N and E/W. Predictions are given for 19 pressure levels ranging from 1000 hPa to 100 hPa at 50 hPa intervals. In August 1999 predictions were only available on a 6-hourly basis. During August 2000, such predictions will be available on a 3-hourly basis.

Model Application during SAFARI 2000:

The model output domain can be centred on any are of interest, in this case Pietersburg. The model provides decode u, v, w and psfc, and forwards and backwards inputs for trajectory modelling which will be of value to the IFC. The NCEP model outputs allow trajectory modelling to be done interactively or in batch mode. Figure 23 shows model grid points and examples of boxes where trajectories could be run. An example of ETA model trajectories is given in Figure 24.

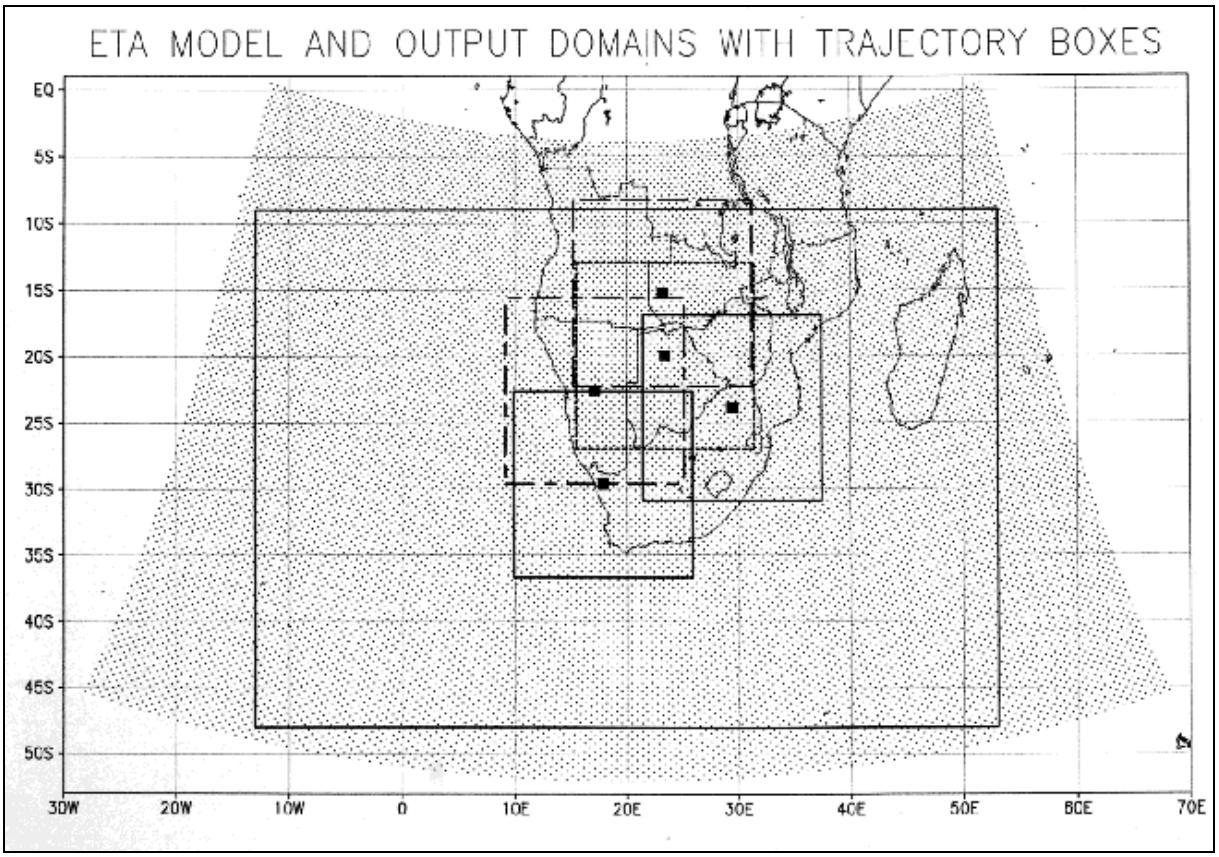

Figure 23. ETA model and output domain with example trajectory boxes.

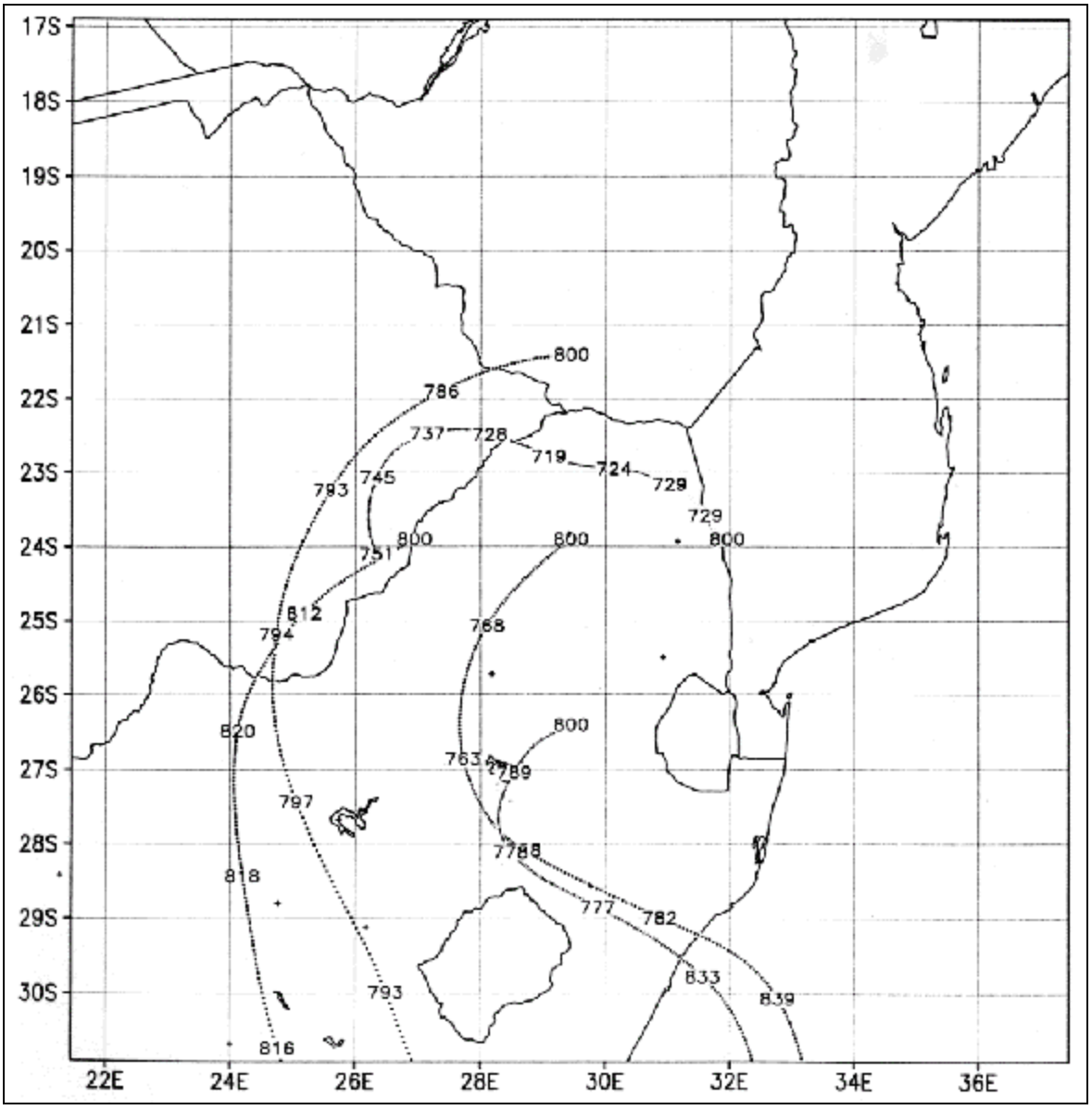

Figure 24. Example of ETA Model trajectories.

3.2.2 FORECAST TRAJECTORY MODEL

Tali Freiman, University of the Witwatersrand

The trajectory model, driven by the forecast meteorological data, as well as the thermodynamic profiles of the troposphere will be used to position the aircraft for sampling trace gases, aerosols and other species during the field campaign and to predict regions of high aerosol and trace gas concentrations downwind.

Absolutely Stable Layers

Several absolutely stable layers are located over the subcontinent, including layers at 700 hPa (~3 km amsl), 500 hPa (~5 km amsl) and 300 hPa (~7 km amsl), and a fourth layer present over coastal areas at 850 hPa. These layers are persistent in time and space and develop a wave-like structure over the subcontinent. On some days a merging of the stable layers is present or a layer is missing (e.g. due to dissipation of lowest layer due to passage of frontal depressions). The absolutely stable layers serve to trap aerosol and limiting their vertical dispersion, whilst promoting horizontal transport.

The synoptic scale circulation determines the location and intensity of the stable layers. These layers are most intense during times when the continental high pressure prevails over the subcontinent. The synoptic conditions which prevailed over the subcontinent during August 1999 are illustrated in Figure 25. During August and September 1999, subtropical high pressures were observed to dominate for 48% and 41% of the time, respectively.

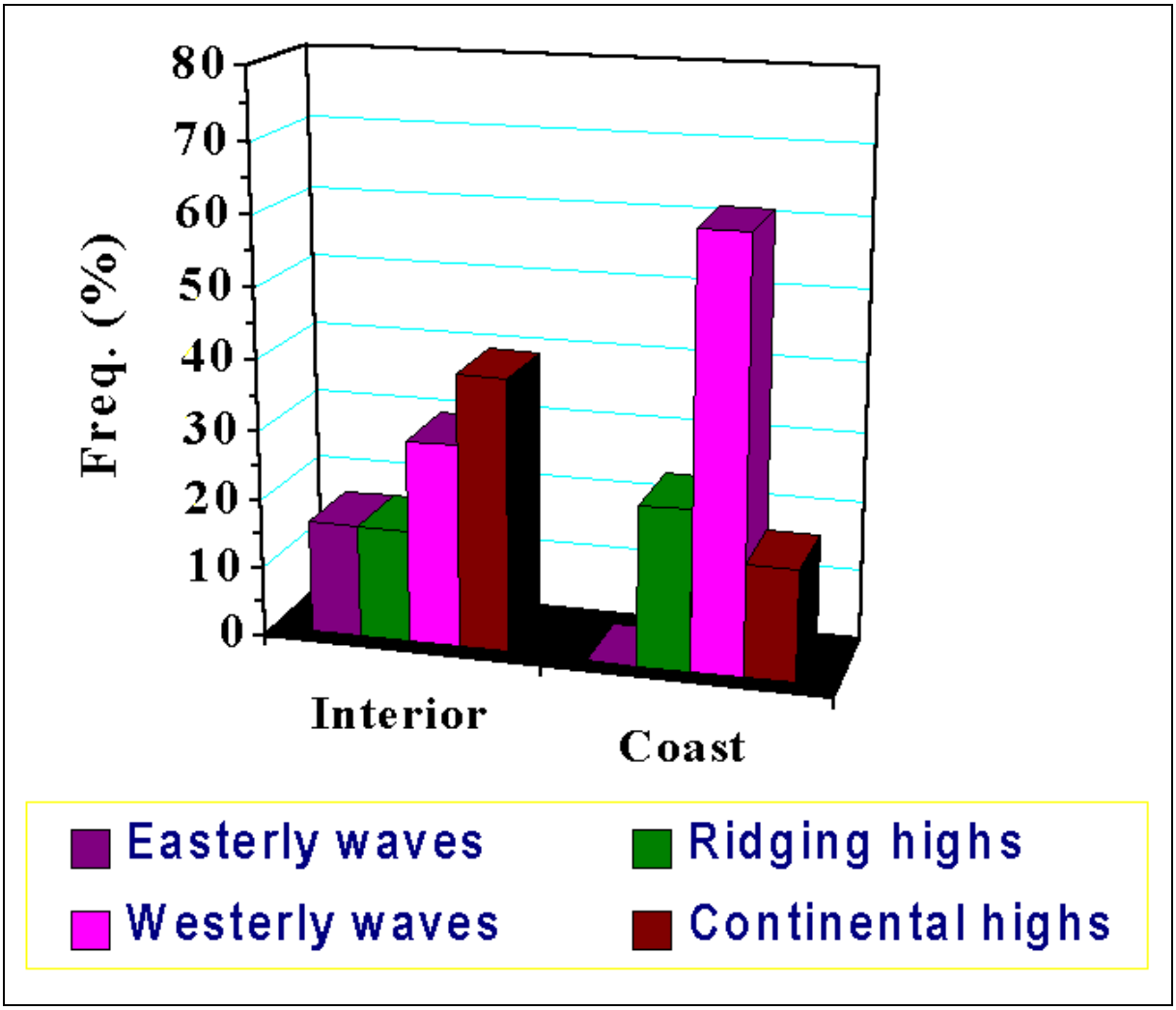

Figure 25. Synoptic conditions over Southern Africa during August 1999.

Major Transport Modes

Major transport modes evident over the subcontinent are illustrated in Figure 26, viz.:
(1) Direct easterly or westerly transport
(2) Anticyclonic recirculation

During winter, a high percentage of the Indian Ocean transport exits at 600 to 500 hPa (occurs more that 50% of the time). Recirculation dominates in the lower troposphere.

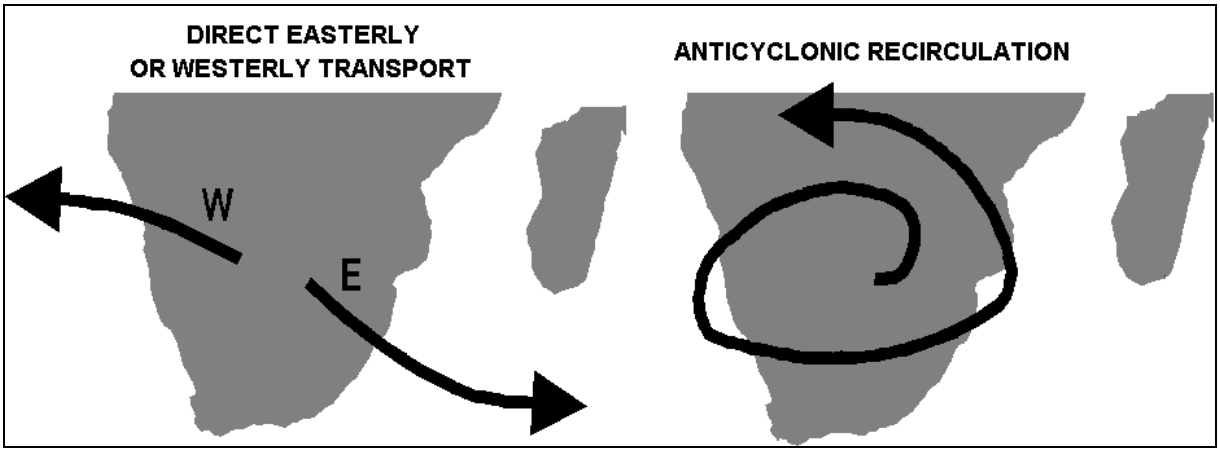

Figure 26. Major transport modes over the subcontinent.

Lagrangian Kinematic Trajectory Model

The Lagrangian Kinematic Trajectory Model, run by the Climatology Research Group of Wits University, uses ECMWF data at input. Such data have a resolution of 2.5° and are available for 8 pressure levels. The model caters for an advection time of up to 10 days forwards and backwards from the point of origin. Multiple trajectories may be run from an initial location for numerous levels and for multiple days.

The Lagrangian Kinematic Trajectory Model will be coupled with the SAWB's NCEP Regional Eta Prediction System for the purpose of the IFC. A description of the Eta data to be used is given as follows:

- Resolution - 48 km, 38 eta layers, time step 120 s (August 1999), 32 km, 45 eta layers, time step of 72 s (August 2000).
- Eta data output at 19 pressure levels at 50 hPa intervals, with horizontal resolution of 0.5 ° N-S and E-W.
- Advection time of 48 hours - available 6-hourly (August 1999) and 3-hourly by August 2000.

3.3 RAWINSONDE PLAN

Deon Terblanche, SAWB

A plan is in place for South Africa to provide the data necessary for the winter season IFC. The SAWB's upper air programme as from 1 April 2000 is outlined in Table 13. Additional ascents during the Safari 2000 period are planned for Durban, De Aar, Lusaka (Zambia) and Beira (Mozambique) (See Table 14). Mozambique currently has 3 upper air stations but not have GPS. Zambia has 4 upper air stations.

Statistics on observational data received during the period 1 January 1999 to 31 December 1999 were presented to indicate the poor data availability in the region (Table 15). Poor communication and equipment maintenance was seen to be responsible for the poor results in terms of the number of rawisonde ascents.

Table 13. SAWB's upper air programme as from 1 April 2000

Station	Number	Lat & Long	00:00 Obs	12:00 Obs
Irene	68263	29.5S 28.2E	GPS	PTU/Pilot
Bloemfontein	68442	29.1S 26.3E		Pilot
Durban	68588	29.9S 30.9E	PTU(W) GPS(S)	Pilot
Cape Town	68816	33.9S 18.6E	GPS	PTU/Pilot
Port Elizabeth	68842	33.9S 25.6E	PTU	Pilot
Upington	68424	28.4S 21.3E		PTU(S)/Pilot
Pietersburg	68174	23.7S 28.9E	PTU(S)	Pilot
Springbok	68512	29.5S 17.8E	PTU(W)	Pilot
Bethlehem	68461	28.2S 28.3E	GPS(W)	Pilot
De Aar	68538	30.7S 24.0E		PTU/Pilot
Gough Island	68906	40.3S 09.9E	GPS	GPS
Marion Island	68994	46.9S 37.8E	GPS	GPS

Notes:
GPS: Radiosondes recording PTU and winds
PTU: Radiosondes recording PTU only - no winds
(W): Winter - 1 April to 30 September
(S): Summer - 1 October to 31 March
Minimum height is 200 hPa and only one second attempt may be made.
12:00 PTU soundings: winds to be determined by optical theodolite.

Table 14. Additional ascents allocated to various stations during Safari 2000

Location / Country	No. of Instruments	Remarks
Lusaka (Zambia)	140	Instruments to be provided sufficient for 2 ascents daily
Beira (Mozambique)	140	Instruments to be provided sufficient for 2 ascents daily. A proposal was submitted to USAID to fund the resurrection of the upper air infrastructure here.
De Aar (South Africa)	70	Supplement instrumentation to be sufficient for 2 ascents daily.
Durban (South Africa)	70	Supplement instrumentation to be sufficient for 2 ascents daily.
TOTAL	420	Type of instrument: Vaisala RS80 15 G TX Frequency: 399 - 407 MHZ RX Frequency: 403 MHZ (SA)

Table 15. Statistics on observational data received for the period 1 Jan to 31 Dec 1999, given in terms of the number of ascents per station

Station Name	Synoptic Number	No. Ascents 00:00 GMT	No. Ascents 12:00 GMT
Tananarive	67083	2	2
Fort Dauphin	67197	1	1
Lusaka	67666	1	1
Harare	67774	58	67
Bulawayo	67964	41	51
Maun	68032	36	49
Letlhakane	68040	11	17
Gabarone	68240	111	113
Windhoek	68110	192	200
Irene (Pretoria)	68263	318	322
Cape Town	68816	323	309
Durban	68588		304
Port Elizabeth	68842	249	
Upington	68424		259
Springbok	68512	253	
Bethlehem	68461	No statistics	No statistics
De Aar	68538	No statistics	No statistics
Gough	68906	253	259
Marion	68994	266	269

Discussion

Botswana Met Office Personnel indicated that more data are available from Botswana stations that is indicated in Table 15. Penny Lesolle indicated that there are 4 rawisonde stations and that all are working perfectly. It appears that the small number of data received by the SAWB for certain stations may be due to communication errors rather than an actual absence of data. It was suggested that the issue of improving communications between various Met Offices in the region be taken up by the personnel of Met Offices present at the meeting.

Meeting participants discussed the best location to allocate instruments for 140 additional ascents at a station during the Safari 2000 campaign. Recommended sites included: Lilongwe, Luanda and Maun. Luanda (Angola) was not seen as presenting a feasible option.

3.4 TYPICAL WEATHER SCENARIOS FOR SAFARI 2000

Michael de Villiers and Roelof Burger, SAWB

Typical weather scenarios were presented through the use of Meteostat imagery being shown in a temporal loop. Imagery for the period August 1999 was selected for the demonstration. (These images will not be included in these proceedings but are obtainable from the SAWB.) It was indicated that the synoptic patterns which characterised this period may not necessarily be typical of the August month in general.

Anticyclonic conditions dominated though much of August 1999. Average airflow during August 1999 reflected the presence of the continental high pressure with its core over the northwestern part of the region at the surface. At 700 hPa the core of the anticyclone was situated over the central part of the region, whilst at 500 hPa the core was located over Namibia and Angola. On occasions when cold fronts passed over the subcontinent, strong NW airflow was observed to occur ahead of the cold front, with slightly weaker SW airflow prevailing to the rear of the front.

SESSION 4: MISSION PLANNING
CHAIR: BOB SWAP, UVA

4.1 GENERIC AIRCRAFT FLIGHT PLANS TO MEET SAFARI 2000 NEEDS

Bob Swap, UVA

Given the main aims of investigating (i) biomass burning, (ii) industrial pollution, and (iii) cloud-aerosol interactions, the following potential flight path types were indicated:

- Gyre multi a/c wall-volume flights
- Gyre single a/c probe
- Fire flights
- Satellite underflights
- Aircraft (ER-2) underflights
- Coastal stratus flights

Attention was drawn to the map indicating the location of ground-based activities (see Figure 21). It was emphasized that the location of these activities be taken into account in the flight planning exercises. What was needed for the IFC was a map comprising specific latitudes and longitudes of sampling locations and information regarding the instruments to be operational at these locations during the IFC. . The AERONET sampling points were recommended as potential anchor points for flight paths (Figure 27). Flight paths should attempt to cover as many of the sectors as is possible. Such paths must be planned with the relevant synoptics in mind