SAFARI 2000 Upper Air Meteorological Profiles, South Africa, Dry Season 2000

Abstract

This data set contains upper air meteorological profiles from 594 radiosonde launches made from sites in South Africa the University of Wyoming. These sonde launches were made to augment the regional sounding network in the region during the SAFARI 2000 Dry Season Campaign of 2000.

Vaisala RS80 sondes were launched from nine sites in South Africa between August 1, 2000 and September 30, 2000. The launch sites were Pietersburg (changed to Polokwane after 2000), Pretoria (Irene), Bethlehem, Springbok, De Aar, Durban, Cape Town, Port Elizabeth, and Gough Island. The parameters measured by the radiosonde instrument package RS80 include: pressure, air temperature, relative humidity, wind speed, and wind direction.

Background Information

Investigators:

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Project: SAFARI 2000

Data Set Title: SAFARI 2000 Upper Air Meteorological Profiles, South Africa, Dry Season 2000

Site: South Africa
Westernmost Longitude: -10
Easternmost Longitude: 31
Northernmost Latitude: -24
Southernmost Latitude: -41

Data Set Citation:

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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.

Web Site: http://weather.uwyo.edu/upperair/sounding.html

Data File Information

Each data file contains one radiosonde flight, in ASCII table form. The data files are named using the following format:

rad_station_YYYYMMDD_HHz.txt

For example, the file "**rad_68538_20000825_00z.txt**" is a radiosonde flight ("**rad**") from station "**68538**" (De Aar, see the **Site ID Table** in the next section) on **2000-08-25** (August 25, 2000) at **00z** (hour 0000 Zulu, or GMT).

There is a large header of metadata, then column headers, then the data. A sample data record is provided below:

##HEADER DeAar Observations at 00Z 25 Aug 2000	
DATE	000825
TIME	0000
LATITUDE	-30.65
LONGITUDE	24.00
ELEVATION	1287.00
SHOWALTER	2.66
LIFTED_DX	3.07
LIFTED_TV	2.75
SWEAT	71.42
K_IDX	24.90
CROSS_IX	16.70
VERT	29.70
TOTALS	46.40
CAPE	0.00
CAPE_TV	0.04
CINS	0.00
CINS_TV	-167.04
RICH_NR	0.00
RICH_NR_TV	-999
LCL_PS	-999
LCL_T	-999
TPOT	301.82
THICK	-999
MIXING	5.93
PRECIP	-999
##	**DATA**

#	PRES	HGHT	TEMP	DWPT	RELH	MIXR	DRCT	SKNT	THTA	THTE	THTV
#	hPa	m	C	C	%	g/kg	deg	knot	K	K	K
	881.0	1287	11.4	7.1	75	7.23	90	4	295.0	316.2	296.3
	875.0	1344	14.0	5.0	55	6.29	66	5	298.3	317.1	299.4
	869.0	1402	16.8	4.8	45	6.24	42	6	301.8	320.8	303.0
	851.0	1578	16.2	3.2	42	5.69	329	10	303.0	320.4	304.0
	850.0	1588	16.2	3.2	42	5.70	325	10	303.1	320.6	304.1
	796.0	2134	11.8	0.5	46	5.01	300	12	304.1	319.6	305.1
	767.4	2438	9.3	-1.0	48	4.65	285	14	304.7	319.2	305.6
	700.0	3202	3.2	-4.8	56	3.84	260	12	306.0	318.1	306.7
	636.5	3962	-3.5	-10.7	57	2.68	280	17	306.9	315.5	307.3
	620.0	4172	-5.3	-12.3	58	2.41	273	17	307.1	314.9	307.5
	597.0	4469	-6.5	-26.5	19	0.74	263	16	309.0	311.6	309.1
	589.1	4572	-7.0	-29.3	15	0.58	260	16	309.6	311.7	309.8
	544.5	5182	-9.6	-45.8	3	0.12	245	12	313.5	314.0	313.5

Radiosonde Sounding Parameters

Header Parameters			
DATE	Date of the radiosonde flight, format YYMMDD		
TIME	Time of the flight, format HHMM in GMT (also called Zulu)		
LATITUDE	Station latitude in degrees		
LONGITUDE	Station longitude in degrees; West longitude is negative		
ELEVATION	Station elevation in meters		
SHOWALTER	Showalter index	SHOWALTER = T500 - Tparcel	
		T500 =	Temperature in Celsius at 500 mb
		Tparcel =	Temperature in Celsius at 500 mb of a parcel lifted from 850 mb
LIFTED_DX	Lifted index	LIFTED_DX = T500 - Tparcel	
		T500 =	Temperature in Celsius of the environment at 500 mb
		Tparcel =	500 mb temperature in Celsius of a lifted parcel with the average pressure, temperature, and dewpoint of the layer 500 m above the surface
LIFTED_TV	LIFTED_DX computed by using virtual temperature*.		
SWEAT	SWEAT index	SWEAT = 12 * TD850 + 20 * TERM2 + 2 * SKT850 + SKT500 + SHEAR	
		TD850 =	Dewpoint in Celsius at 850 mb
		TERM2 =	MAX (TOTALS - 49, 0)

			TOTALS = Total totals index
		SKT850 =	850 mb wind speed in knots
		SKT500 =	500 mb wind speed in knots
		SHEAR =	125 * [SIN (DIR500 - DIR850) + 0.2]
			DIR500 = 500 mb wind direction
			DIR850 = 850 mb wind direction
K_IDX	K index	K_IDX = (T850 - T500) + TD850 - (T700 - TD700)	
		T850 =	Temperature in Celsius at 850 mb
		T500 =	Temperature in Celsius at 500 mb
		TD850 =	Dewpoint in Celsius at 850 mb
		T700 =	Temperature in Celsius at 700 mb
		TD700 =	Dewpoint in Celsius at 700 mb
CROSS_IX	Cross Totals index	CROSS_IX = TD850 - T500	
		TD850 =	Dewpoint in Celsius at 850 mb
		T500 =	Temperature in Celsius at 500 mb
VERT	Vertical Totals index	VERT = T850 - T500	
		T850 =	Temperature in Celsius at 850 mb
		T500 =	Temperature in Celsius at 500 mb
TOTALS	Total Totals index	TOTALS = (T850 - T500) + (TD850 - T500)	
		T850 =	Temperature in Celsius at 850 mb
		TD850 =	Dewpoint in Celsius at 850 mb
		T500 =	Temperature in Celsius at 500 mb
CAPE	Convective Available Potential Energy (J/kg)	CAPE = GRAVTY * SUMP (DELZ * (TP - TE) / TE)	
		SUMP =	sum over sounding layers from LFCT to EQLV for which (TP - TE) is greater than zero
		DELZ =	incremental depth
		TP =	temperature of a parcel from the lowest 500 m of the atmosphere, raised dry adiabatically to the LCL and moist adiabatically thereafter
		TE =	temperature of the environment
CAPE_TV	CAPE computed by using virtual temperature*.	CAPE_TV = GRAVTY * SUMP (DELZ * (TVP - TVE) / TVE)	
		SUMP =	sum over sounding layers from LFCV to EQTV for which (TVP - TVE) is greater than zero
		DELZ =	incremental depth
		TVP =	virtual temperature* of a parcel from the lowest 500 m of the atmosphere, raised dry adiabatically to the LCL and moist adiabatically thereafter
		TVE =	virtual temperature* of the environment
CINS	Convective Inhibition (J/kg)	CINS = GRAVTY * SUMN (DELZ * (TP - TE) / TE)	
		SUMN =	sum over sounding layers from top of the mixed layer to LFCT for which (TP - TE) is less than zero.
		DELZ =	incremental depth
		TP =	temperature of a parcel from the lowest 500 m of

			the atmosphere, raised dry adiabatically to the LCL and moist adiabatically thereafter
		TE =	temperature of the environment
CINS_TV	CINS computed by using virtual temperature*.	CINS_TV = GRAVTY * SUMN (DELZ * (TVP - TVE) / TVE)	
		SUMN =	sum over sounding layers from top of the mixed layer to LFCV for which (TVP - TVE) is less than zero.
		DELZ =	incremental depth
		TVP =	Virtual temperature* of a parcel from the lowest 500 m of the atmosphere, raised dry adiabatically to the LCL and moist adiabatically thereafter
		TVE =	Virtual temperature* of the environment
RICH_NR	Bulk Richardson number	RICH_NR = CAPE / (0.5 * U**2)	
		CAPE =	Convective Available Potential Energy
		U =	magnitude of shear (u2 - u1, v2 - v1)
			u1,v1 = average u,v in the lowest 500 m
			u2,v2 = average u,v in the lowest 6000 m
RICH_NR_TV	RICH_NR computed by using CAPE_TV	RICH_NR_TV = CAPE_TV / (0.5 * U**2)	
		CAPE_TV =	CAPE computed by using virtual temperature*.
		U =	magnitude of shear (u2 - u1, v2 - v1)
			u1,v1 = average u,v in the lowest 500 m
			u2,v2 = average u,v in the lowest 6000 m
LCL_PS	Pressure (hPa) at the LCL, lifted condensation level, from an average of the lowest 500 meters.	LCL_PS = PRES * (LCL_T / (TMPC + 273.15)) ** (1 / KAPPA)	
		Poisson's equation	
LCL_T	Temperature (K) at the LCL, lifted condensation level, from an average of the lowest 500 meters.	LCL_T = [1 / (1 / (DWPK - 56) + LN (TMPK / DWPK) / 800)] + 56	
THICK	1000 mb to 500 mb thickness (meter)	THICK = (Z500 - Z1000)	
		Z500 =	Height of the 500 mb surface
		Z1000 =	Height of the 1000 mb surface
PRECIP	Precipitable water (mm) for the entire sounding.		
Data Record Parameters			
PRES	Pressure at the current height, in hPa.		
HGHT	Height of the instrument package, in meters.		
TEMP	Air temperature at the current height, in degrees C.		
DWPT	Dew Point temperature, in degrees C.		
RELH	Relative Humidity, in percent.		
MIXR	Mixing Ratio, in g/kg.		
DRCT	Wind direction, in degrees from true North		
SKNT	Wind speed, in knots.		
THTA	Potential temperature, in degrees K.		
THTE	Equivalent potential temperature, in degrees K.		

THTV	Virtual potential temperature, in degrees K.

* Virtual Temperature: an adjustment applied to the real air temperature to account for a reduction in air density due to the presence of water vapor.

Site Information

The University of Wyoming has radiosonde sites all around the world. This collection contains only the sites in South Africa. These sites are shown on the map and listed in the table below.

U of W Radiosonde Sites in South Africa

Radiosonde Site ID Table

Site ID	Site Name	Latitude	Longitude	Elevation	Number of Radiosonde Launches
68174	Pietersburg (changed to Polokwane after 2000)	-23.83	29.41	1224 m	3
68263	Pretoria (Irene)	-25.91	28.21	1523 m	112
68461	Bethlehem	-28.25	28.33	1678 m	2
68512	Springbok	-29.66	17.90	1007 m	31
68538	De Aar	-30.65	24.00	1287 m	103
68588	Durban	-29.96	30.95	14 m	99
68816	Cape Town	-33.96	18.60	42 m	111
68842	Port Elizabeth	-33.98	25.61	61 m	57
68906	Gough Island	-40.35	-9.88	54 m	76

Data Processing

The data originated from the U.S. Weather Service NOAAport feed. It was decoded and plotted with slightly enhanced version of the GEMPAK software

(http://my.unidata.ucar.edu/content/software/gempak/index.html.

GEMPAK, the GEneral Meteorology PAcKage, is an analysis, display, and product generation package for meteorological data. It is developed by NCEP (the National Centers for Environmental Prediction) for use by the National Centers (Storm Prediction Center (SPC), Tropical Prediction Center (TPC), Aviation Weather Center (AWC), Hydrologic Prediction Center (HPC), Marine Prediction Center (MPC), Environmental Modeling Center (EMC), etc.) in producing operational forecast and analysis products such as those distributed as Redbook Graphics and others displayed on the NWS web pages and utilized internally within the centers.

The indices are slightly non-standard, as the lowest 500 meters have been averaged. The mandatory levels are reported at standard pressure levels: 1000 mb, 925 mb, 850 mb, etc. There are also significant temperatures that are reported at pressure levels with no wind or heights. Finally, there are significant winds data that are reported at height levels with no temperature, humidity, or pressure. The GEMPAK program merges these data together and interpolates the non-reported values.

Instrument Descriptions

The Vaisala RS80 Radiosonde

The RS80 Radiosonde is small and lightweight. Each radiosonde is packed in a hermetically sealed metal foil bag. The rugged sensors and electronics are unaffected by normal levels of shock, vibration, dirt or humidity. International quality control monitoring (i.e. data published by the European Centre for Medium-Range Weather Forecasts, ECMWF) show consistently high quality of geopotential height observations at stations using the RS80 Radiosonde.

The RS80 Radiosonde has been in routine use on synoptic upper-air stations since 1981 as well as on many research and defence related programs. Nearly three million observations have been made by means of these instruments. In international radiosonde comparisons arranged by the WMO, the RS80 Radiosonde demonstrated superior performance with respect to repeatability, accuracy and overall quality. The accuracy of RS80 is fully established and documented. Thorough comparative testing ensures that sounding records are reliable also for climatological uses.

- The capacitive BAROCAP ® pressure sensor has a welded solid state design that consists of capacitive plates housed within a capsule, protected from humidity and dust. There are no mechanical adjustments. The sensor construction is friction-free for continuously variable measurement without discrete steps.
- The THERMOCAP ® temperature sensor is a small capacitive bead encapsulated in glass. A water repellent treatment and metallization of the surfaces ensure minimum radiation sensitivity and excellent performance in rain.
- The HUMICAP ® is a capacitive thin film humidity sensor with good long-term stability and reliable response even at low temperatures and after exposure to condensation.
- A solid state electronic switch connects each of the sensors in turn to the transducer electronics. All parameters are measured at approximately 1.5 second intervals.

- The water-activated battery is carefully optimized for light weight and good performance during high-altitude observations.

Pressure BAROCAP ® Capacitive aneroid
Measuring range: 1060 hPa to 3hPa (mb)
Resolution: 0.1 hPa
Accuracy:
Reproducibility[1] : 0.5 hPa
Repeatability of calibration[2] : 0.5 hPa

Temperature THERMOCAP ® Capacitive bead
Measuring range: +60 °C to - 90 °C
Resolution: 0.1 °C
Accuracy:
Reproducibility[1] : 0.2 °C up to 50 hPa, 0.3 °C for 50-15 hPa, 0.4°C above 15 hPa level
Repeatability of calibration[2] : 0.2 °C
Lag: < 2.5 s (6 m/s flow at 1000 hPa)

Humidity HUMICAP ® Thin film capacitor
Measuring range: 0 to 100 % RH
Resolution: 1 % RH
Lag: 1 s (6 m/s flow at 1000 hPa, +20 °C)
Accuracy:
Reproducibility[1] : <3 %RH
Repeatability of calibration[2] : 2 %RH

1 - Data based on WMO International Radiosonde Comparison Phases I, II and III (WMO/TD no 195 and 451)
2 - Standard deviation of differences between two successive calibrations

DIMENSIONS AND WEIGHT
Dimensions excl. antenna: 55 mm by 147 mm by 90 mm
Weight, battery activated: approximately 220 g
Standard airfreight packing: 100 Radiosondes complete
Dimensions: 760 mm by 570 mm by 420 mm
Gross weight: 36 kg/37 kg RS80-15L, -15F
Long-term sonde protection: Each sonde packed in a hermetic metal foil bag
NOTE: The specifications for RS80 Radiosonde models with GPS windfinding and for AUTOSONDE differ from these.

The radiosonde is launched using a balloon.

Standard Vaisala radiosonde instrument package RS80, which hangs under a balloon.

Manufacturer of Sensor or Instrument

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Additional Sources of Information

References

University of Wyoming, College of Engineering, Department of Atmospheric Science. Worldwide Radiosonde Soundings of the Atmosphere. Data available on-line at [http://weather.uwyo.edu/upperair/sounding.html].

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