Instrument System Characteristics for TWP (Manus and Nauru) 12 Aug. 1998

	Measurement	**Manufacturer**	**Sampling Rate (Interval)**	**Accuracy**	**Height/Range**
1. *In-Situ*					
Thermometer	Temperature	Vaisala	1 min. avgs. (1 sec.)[1]	+/- 0.41 °C	2 m
R/H Sensor	Relative Humidity	Vaisala	1 min. avgs. (1 sec.)	+/- 2% RH	2 m
Anemometer	Wind Speed	R.M. Young	1 min. avgs. (0.5 sec.)	+/- 1% for 2.5 to 30 m/s	10 m
Wind Vane	Wind Direction	R.M. Young	1 min. avgs. (1 sec.)	+/- 5 deg.	10 m
Barometer	Air Pressure	Vaisala	1 min. avgs. (60 sec.)	+/- 0.035 hPa	1 m
Optical Rain Gauge	Rain Rate	Scientific Technology	1 min. avgs. (1 sec.)	+/- 0.254 mm	1 m
2. Balloon-Borne BBSS (We currently launch 1 sonde per day					
Thermometer	Temperature Profiles	Vaisala	1 per 2 sec. (about 6 m)	+/- 0.2 °C	0 to < 100 hPa (about 20 km)
R/H Sensor	Relative Humidity Profiles	Vaisala	1 per 2 sec.	+/- 3% RH	0 to < 100 hPa
Barometer	Air Pressure Profiles	Vaisala	1 per 2 sec.	+/- 0.5 hPa	0 to < 100 hPa
Wind Speed	Speed Profiles	Vaisala	1 per 10 sec.	+/- 0.5 m/s	0 to < 100 hPa
Wind Direction	Direction	Vaisala	1 per 10 sec.	+/- 5 deg.	0 to < 100 hPa
3. Radiometric (Uplooking)					
PSP (Global)	Solar Irradiance	Eppley	1 min. avgs. (1 sec.)	+/- 3% irradiance	Vertical Integral
PSP (Diffuse)	Solar Irradiance	Eppley	1 min. avgs. (1 sec.)	+/- 3% irradiance	Vertical Integral
PIR (Global)	Terrestrial Irradiance	Eppley	1 min. avgs. (1 sec.)	+/- 5% irradiance	Vertical Integral

	Measurement	Manufacturer	Sampling Rate (Interval)	Accuracy	Height/Range
PIR (Shaded)	Terrestrial Irradiance	Eppley	1 min. avgs. (1 sec.)	+/- 5% irradiance	Vertical Integral
UVB	Erythemial UV Solar Irradiance	Solar Light	1 min. avgs. (1 sec.)	+/- 5% daily ave.	Vertical Integral
IRT	Equivalent Blackbody Brightness Temp.	Heimann	1 min. avgs. (1 sec.)	+/- 0.225 K at 20 °C	Vertical Integral
MFRSR	Aerosol Optical Depth at 6 visible and near IR wavelengths	Yankee	1 per 20 sec.[3]	+/- 0.01 optical depth	Vertical Integral
4. Radiometric (Downlooking)					
PSP	Solar Irradiance	Eppley	1 min. avgs. (1 sec.)	+/- 3% irradiance	Vertical Integral
PIR	Terrestrial Irradiance	Eppley	1 min. avgs. (1 sec.)	+/- 3% irradiance	Vertical Integral
IRT	Equivalent Blackbody Brightness Temp.	Heimann	1 min. avgs. (1 sec.)	+/- 0.225 K at 20 °C	Vertical Integral
5. Net Radiation					
Net Radiometer	Net Radiative Flux	Radiation & Energy Balance Sys. Inc.	1 min. avgs. (1 sec.)	+/- 10% irradiance flux	1 m
6. Remote Sensing					
MWR	Column water vapor and liquid water	Radiometrics	1 per 20 secs.	+/- 0.13 K (about 2 mm H_2O vap. & 0.03 mm liquid H_2O	Vertical Integral
MPL	Cloud Height	Science & Engineering Service Inc.	1 per min. (0.0004 sec.)	2% about 150 m (resolution 300 m)[4]	20 km (1^{st} bin 120 m)
Ceilometer	Cloud Height	Vaisala	1 per 15 secs.	15 m (resolution)	7.25 km

	Measurement	Manufacturer	Sampling Rate (Interval)	Accuracy	Height/Range
AERI (Nauru Only)	Temperature and Water Vapor Profiles	U. of Wisconsin	1 per 7 min. (206 sec.)[5]	Better than 1.6 °C in temperature and 2.5 °C in dewpoint (from comparison w/ rawinsondes)	Vertical Integral
MMCR (Nauru Only)	Cloud Reflectivity and Vertical Velocities	NOAA	About 1 per 9 secs.[6]	0.5 dB measurement about 90 m resolution (Doppler 0.1 m/s)	15 km
WSI	Cloud Type and Cloud Fraction	Marine Physical Laboratory	1 per 10 min.[7]	Cloud type dependent cloud fraction (uncertainty not known)	Whole Sky

7. Data Collection

Data are gathered from the instruments hourly, so unless the instruments are manually polled, true real time collection is not possible. For many of the instruments that do their own data logging (eg. MPL, MWR, vceil) there are real time data displays at the instrument. Data are typically written to tapes at one-week intervals and are sent back to the U.S. at roughly one-month intervals.

8. Annotations

[1] We don't have access to these high-resolution data. However, for the SKYRAD, GNDRAD, and SMET data loggers, the one-minute max, min, and standard deviation are saved to give an indication of the variability within the minute.

[2] In addition to averaging data for 60 second intervals, the PIRs (for both SKYRAD and GNDRAD) and the UVB also save 20 second averages of the raw thermistor and thermopile data. This is because non-linear processing is applied to these raw data to obtain the fluxes and we wanted to allow for reprocessing.

[3] Every 20 seconds, the MFRSR makes a measurement in seven spectral channels with a rotating shadow band in a series of four positions. From these four sets of measurements, the hemispheric, diffuse, and direct fluxes are determined.

[4] The low-resolution MPL (installed at Manus) has a vertical resolution of 300 meters while the high-resolution model to be installed at Nauru (and eventually at Manus) has a vertical resolution of 30 m.

[5] 206 seconds are required for an AERI scan across its spectral domain. A scan is performed about every 7 minutes.

[6] The millimeter radar obtains a set of profiles about every 10 seconds. Within this ten seconds, a lot goes on – I'm fuzz on a lot of those details. I do know, however, that in this ten seconds, the radar cycles through a series of four modes that have different range and sensitivity properties. These modes are geared toward detecting different types of clouds.
[7] A set of WSI images will be obtained every 10 minutes.