

# Chapter 5

## MEASUREMENTS

### BACKGROUND

Using the equipment described in Chapter 3 data has been collected at the laboratory near Thule Air Base during the period from May 15th through October 4th, 1999. Data was acquired continuously with only occasional interruptions and included the parameters shown in Table 5.1. A Hewlett-Packard data logger permitted the acquisition of momentary values collected once per minute throughout the day while the Sci-Tec solar tracker pointed the five pyrhemometers continuously at the solar disk. Each "evening" at midnight Thule Air Base local time (UTC + 4 hours) the tracker rotated back into position for the next day of measurements, an operation which took at most two or three minutes.

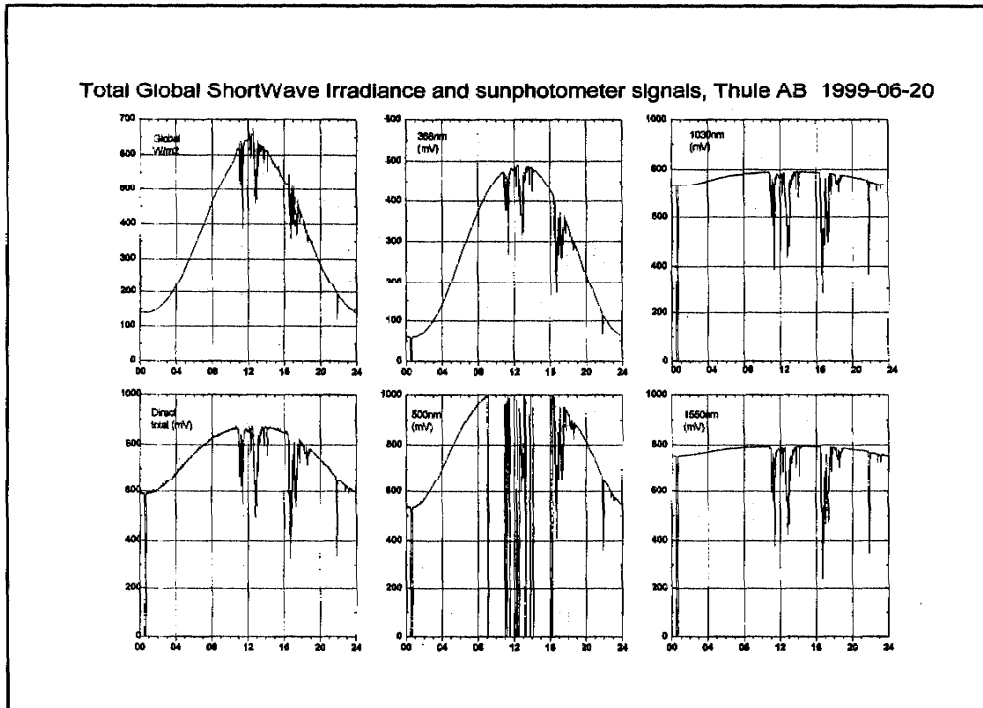
PHYSICAL QUANTITY	INSTRUMENT	OUTPUT RANGE
Temperature	Weather Station	0-1 volt
Relative humidity	Weather Station	0-1 volt
Wind Speed	Weather Station	0-1 volt
Wind Direction	Weather Station	0-1 volt
Global Solar Irradiance	YES pyranometer	0-1 volt
Direct Irradiance 368 nm	Kipp-Zonen pyrhemometer	0-1 volt
Direct Irradiance 500 nm	SolData pyrhemometer	0-1 volt
Direct Irradiance 1030 nm	SolData pyrhemometer	0-1 volt
Direct Irradiance 1550 nm	SolData pyrhemometer	0-1 volt
Direct Irradiance (short wave)	SolData pyrhemometer	0-1 volt
Pyrhemometer temperatures	LM35DZ temperature sensor	0-1 volt

**Table 5.1:** Overview of instruments mounted at the Thule Air Base laboratory.

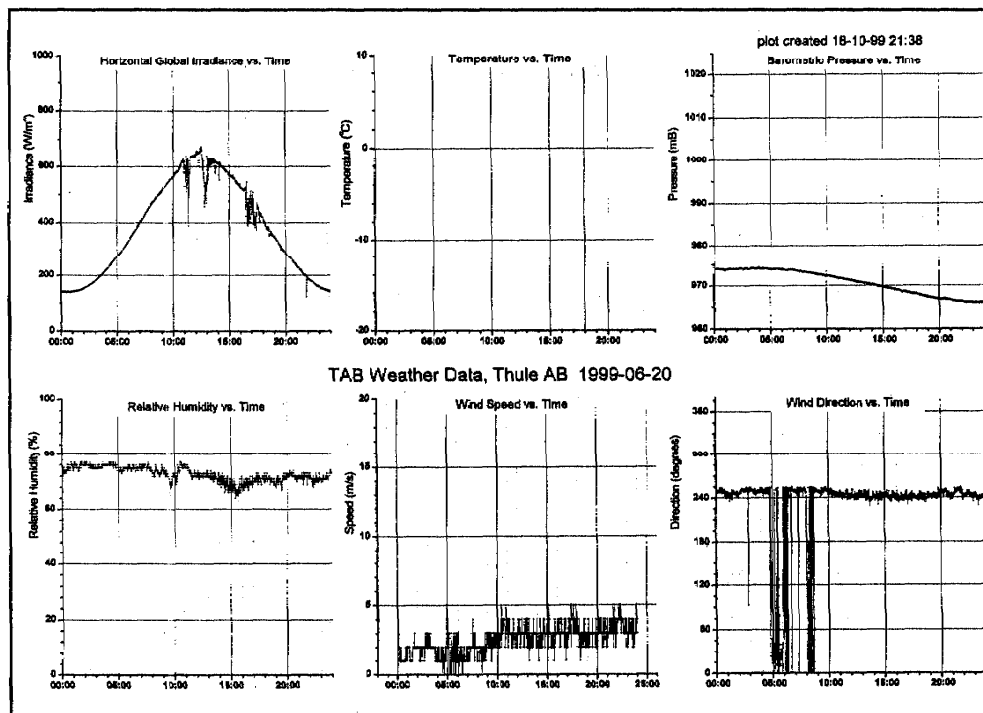
The data acquired were stored on the local server using a Pascal program to carry out preliminary data handling and to structure and store the data in .SRS text files for subsequent use. The entire data set for the day was transmitted via the internet to the Danish Meteorological Institute in Copenhagen and distributed from there to relevant users.

### SAMPLE DATA

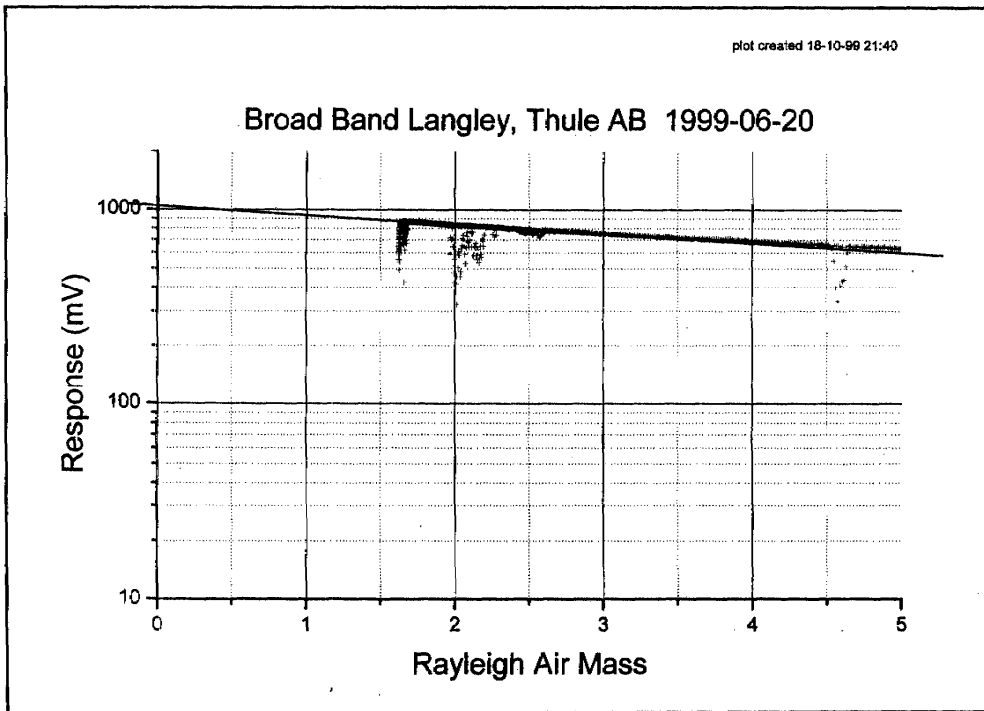
The figures on the following pages illustrate typical results after a day of data collection on a clear mid-summer day at Thule Air Base.



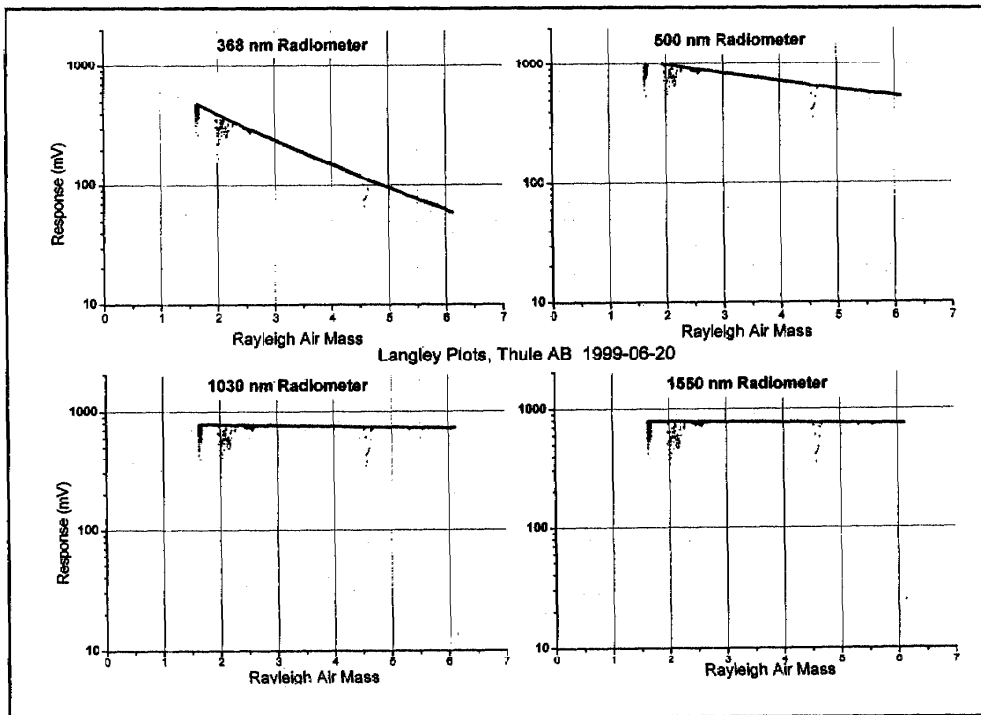
**Figure 5.1:** Global solar irradiance (horizontal) plus output signals from the four direct irradiance pyrheliometers for 20 June 1999 at Thule Air Base.



**Figure 5.2:** Overview of daily weather data collected on 20 June 1999 at Thule Air Base. The temperature sensor was out of operation for several weeks.



**Figure 5.3:** A Langley plot of the direct solar irradiance vs. Rayleigh air mass for 20 June 1999 at Thule Air Base.



**Figure 5.4:** Langley plots for data from the Kipp-Zonen 368 nm pyrliometer and the three SolData filter instruments on 20 June 1999 at Thule Air Base.

## MEASUREMENT PERIOD

The Kipp-Zonen ultraviolet 368 nm pyrheliometer has been in place at Thule Air Base for some time, while the 500 nm, 1030 nm and 1550 nm pyrheliometers were installed there on May 15th, 1999, and operational from the first day. These instruments are supplemented by a broad-band pyrheliometer (300-3000 nm) all with the same 10 mm entrance aperture. The measurements were carried out continuously from mid-May until early October 1999 with only occasional down time for adjustments or repairs. The Sci-Tec solar tracker, the pyrheliometers and the data acquisition system operated with only minor problems.

One such minor problem arose from 16-25 July 1999 due to an incorrect time stamp on the data. The system clock was advanced about an hour just after noon on 16 July and restored to the correct local time in the afternoon of July 25th. The temperature probe from the weather station was defective from June 15th August 23rd. The ambient air temperature at the Thule Air Base laboratory generally lies around the freezing point at this time of year. The wind direction signal was not calibrated, but wind direction data could be recovered if a calibration check is performed. The output signal from the 500 nm pyrheliometer exceeded 1000 mV at midday during several weeks during the summer, and the datalogger was not able to autoscale. Because the air mass changes very little during the midday hours, this error did not lead to significant data loss, as Langley plots could still be performed with no difficulty (see Figure 5.4).

In spite of minor difficulties the essential data required to perform aerosol optical depth calculations was acquired from May 15th through October 4th, and the data used for analysis have been selected from this period.

## SUMMARY

The weather parameters and solar irradiance data measured at Thule Air Base from May 15th-October 4th have been briefly presented. The data files acquired during this experiment are available for further study. The analysis which follows in Chapter 6 directs attention specifically to the determination of aerosol optical depths for selected days during the measurement period.