

# **ARM Participation in SHEBA: A Mini-CART Site Operated in the Arctic Ocean from October 1997 Until October 1998**

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## **Introduction**

The Surface Heat Budget of the Arctic Ocean (SHEBA) experiment provided a unique opportunity for the Atmospheric Radiation Measurement (ARM) Program to obtain valuable data over the Arctic Ocean by participating in SHEBA through ARM's North Slope of Alaska/Adjacent Arctic Ocean (NSA/AAO) team. A mini-CART (Cloud and Radiation Testbed) site was operated by the ARM NSA/AAO team at SHEBA for a complete annual cycle from October 1997 to October 1998. In addition to the data collected by ARM, invaluable supporting data were collected by other groups funded by the National Science Foundation and the Office of Naval Research. These two agencies provided the logistical support for SHEBA as well as additional support for a dozen or so research teams collecting complementary data on the atmosphere, the sea ice, and the underlying ocean. Taken together the data collected by SHEBA and ARM NSA/AAO form a very unique and valuable data set.

To ensure the collection of high quality data by the NSA/AAO team at SHEBA, technically skilled instrument operators as well as a data quality assurance (QA) personnel were on-site for the duration of the project. The purpose of having a QA person on site was to enable near-real time visualization and inspection of the data streams thereby ensuring that the data collected were of known and reasonable quality. Working together as a team, the instrument operator and the QA person were able to detect instrument problems and take corrective action almost immediately. This teamwork also provided a continuous stream of valuable metadata to accompany the parametric data collected by ARM NSA/AAO at SHEBA.

Instead of having to wait until the end of the six-week turnaround for data to come off the SHEBA ship, the onsite team efforts by the instrument operators and the QA personnel were instrumental in avoiding large gaps in the data streams due to instrument problems that otherwise might not have been detected as quickly, and in enhancing the quality of the data collected. An additional advantage of the QA effort

was in providing near-real time visual access of the ARM data to the scientific community onboard the SHEBA ship through a web-based “quick look” data base.

The ARM SHEBA data sets with accompanying metadata are available from the ARM archive. Here we summarize the availability of ARM SHEBA data streams and document their existence and quality throughout the year of operation. We also provide sample data “quick looks” produced in the NSA/AAO quality assurance (QA) process.

## **SHEBA Data and Data Processing Status**

Below we provide a brief overview of the instruments deployed by ARM at SHEBA, brief comments on the instrument performance, and the status of the processing of the data collected. The starting date gives the time when the NSA site scientist team considered the data to be of known and reasonable quality. Instrument problems were encountered from time to time during the project. Exact dates and descriptions of such problems and how they influence the quality of the data are available in the metadata attached to the parametric data submitted to the archive. Tables 1 and 2 list all the instruments ARM deployed at SHEBA, as well as (i) period of operation, (ii) general operational status, (iii) current processing levels, and (iv) availability at the ARM archive.

### **The SHEBA CART Site**

Since the Canadian Icebreaker Des Groseilliers was frozen into the perennial ice-pack in a multi-year ice floe (Figure 1a), it drifted with the ice within the Beaufort Gyro. The position of the Ice Station throughout the campaign is shown in Figure 1b. Samples of “quick looks” produced on-site by the UAF QA operators is shown in Figures 2 through 5.

### **How To Access ARM SHEBA Data**

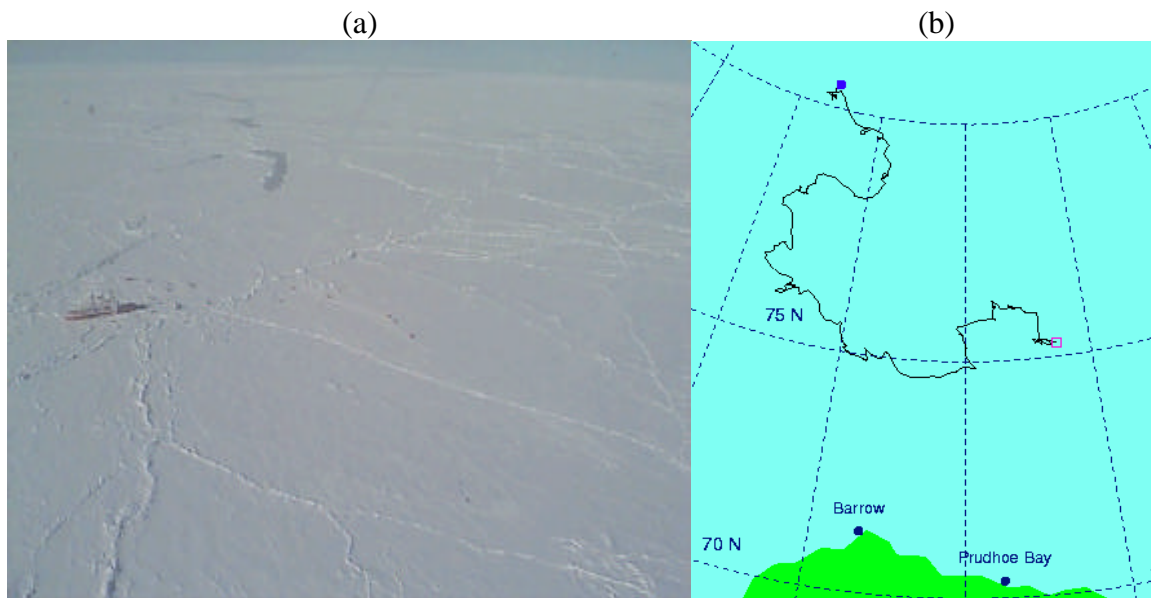
The data collected by ARM at the SHEBA Ice Station can be ordered using a web browser, e-mail or telephone. Data quality reports produced based on the daily inspections done by the QA personnel will accompany the data.

Web address:	<a href="http://www.archive.arm.gov/cgi-bin/archive">http://www.archive.arm.gov/cgi-bin/archive</a>
E-mail:	<a href="mailto:armarchive@ornl.gov">armarchive@ornl.gov</a>
Phone:	+(423) 241-4851

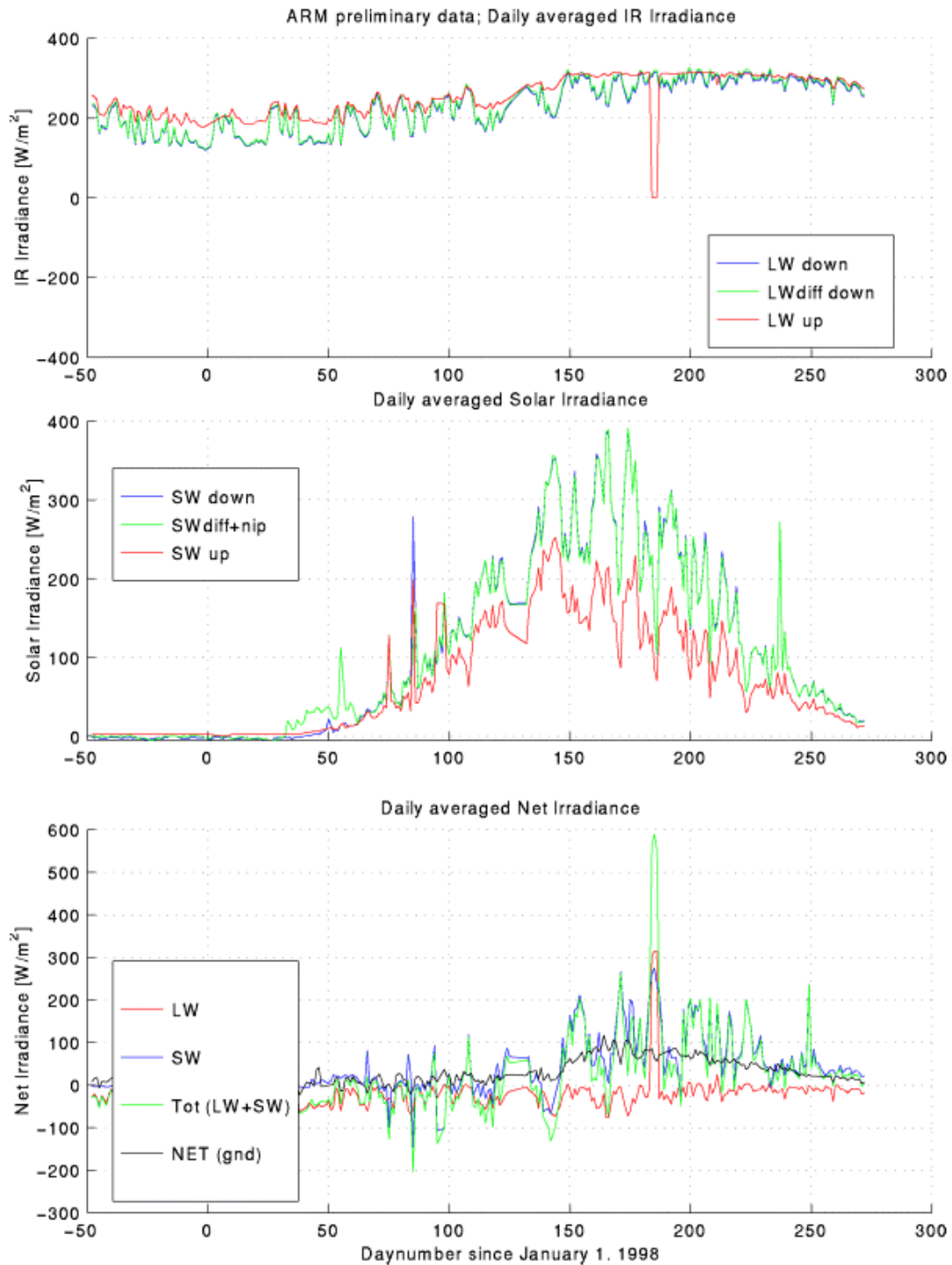
<b>Table 1. List of instrument abbreviations.</b>	
<b>ARM SHEBA CART Instruments</b>	
<b>Instrument</b>	<b>Instrument Name</b>
SKYRAD	Downwelling radiation platform
PIRg	Precision Infrared Radiometer, global
PIRd	Precision Infrared Radiometer, diffuse
PSPg	Precision Solar Pyranometer, global
PSPd	Precision Solar Pyranometer, diffuse
NIP	Normal Incidence Pyranometer
UVB	Ultraviolet Biometer
IRT	Infrared Thermometer
NIMFR	Normal Incidence Multifilter Radiometer
MFRSR	Multifilter Rotating Shadowband Radiometer
GNDRAD	Upwelling radiation platform
PIR	Precision Infrared Radiometer
PSP	Precision Solar Pyranometer
IRT	Infrared Thermometer
NET	Net-Radiometer
MFR	Multifilter Radiometer
Auxiliary	All other ARM instrumentation
VCEIL	Ceilometer (near-infrared LIDAR)
ER-AERI	Extended Range Atmospheric Emitted Radiance Interferometer
MWR	Microwave Radiometer
WSI	Whole Sky Imager
GPS	Global Positioning System

**Table 2.** This table shows the operational period and a brief statement of the performance of the instrument during this period. The table also lists the current processing level of all the data-streams and which data-streams are currently available at the ARM archive.

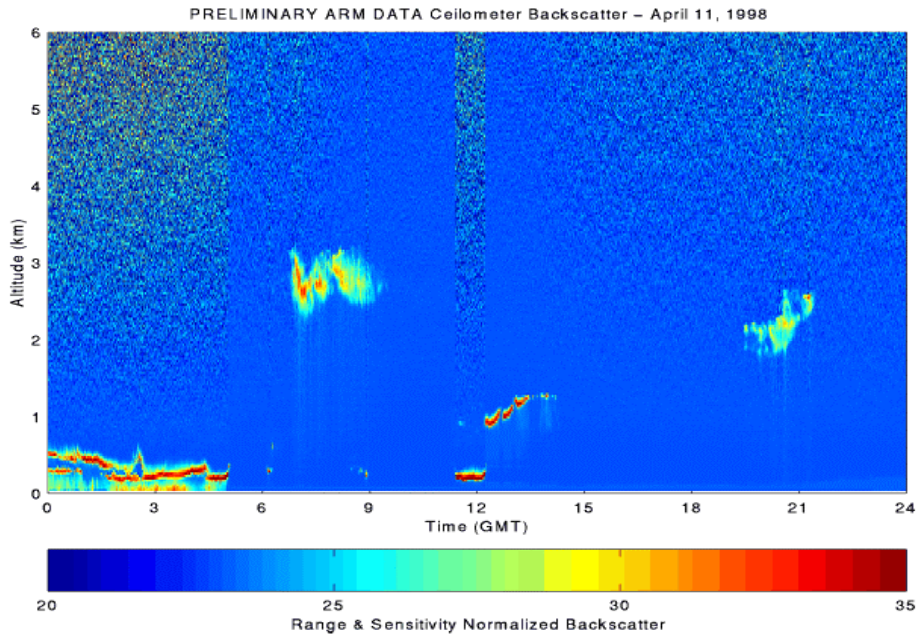
<b>ARM SHEBA Instrument and Data Status</b>					
<b>Instr.</b>	<b>Start Date</b>	<b>End Date</b>	<b>Operational Status</b>	<b>Data Level</b>	<b>At the Archive</b>
<b>SKYRAD</b>					
PIRg	11/09/97	09/30/98	Good	00,a1,b1	YES
PIRd	11/09/97	09/30/98	Good	00,a1,b1	YES
PSPg	10/21/97	09/30/98	Good	00,a1,b1	YES
PSPd	10/21/97	09/30/98	Good	00,a1,b1	YES
NIP	10/21/97	09/30/98	Good	00,a1,b1	YES
UVB	10/21/97	09/30/98	Good, problems with frosting and icing on dome	00,a1,b1	YES
IRT	12/15/97	09/30/98	Good, had to be replaced on 3/28/98	00,a1,b1	YES
NIMFR	03/15/98	09/30/98	Good, but occasional drop out or bad data	00,a0,a1,b1	YES
MFRSR	03/09/98	09/30/98	Good, but occasional drop outs or bad data	00,a0,a1,b1	
<b>GNDRAD</b>					
PIR	11/08/97	09/30/98	Good	00,a1,b1	YES
PSP	10/19/97	09/30/98	Good	00,a1,b1	YES
IRT	11/18/97	09/30/98	Good	00,a1,b1	YES
NET	03/13/98	09/30/98	Fair, had a lot of frosting and internal condensation	00,a1,b1	YES
MFR	10/26/97	09/30/98	Good, but occasional drop out or bad data	00,a0,a1,b1	YES
<b>Auxiliary Instr.</b>					
VCEIL	10/18/97	10/01/98	Good, 12/10/97-01/14/98 missing due to instrument component failure	00,a1,b1	
ER-AERI	11/09/97	6/15/98	Good, 2/5/98-2/18/98 and 5/21/98-6/2/98 missing due to instrument failure	00,a1	YES
MWR	10/20/97	10/01/98	Good, 11/19/97-12/05/97 missing data, frequent problems with frosting and snow on dome.	00,a1,b1	YES
WSI	10/22/97	10/01/98	Good, some internal dome frosting problems.	00,a1,b1	
GPS	10/17/97	10/04/98	Good, frequent short periods of data drop outs.	00,a1	



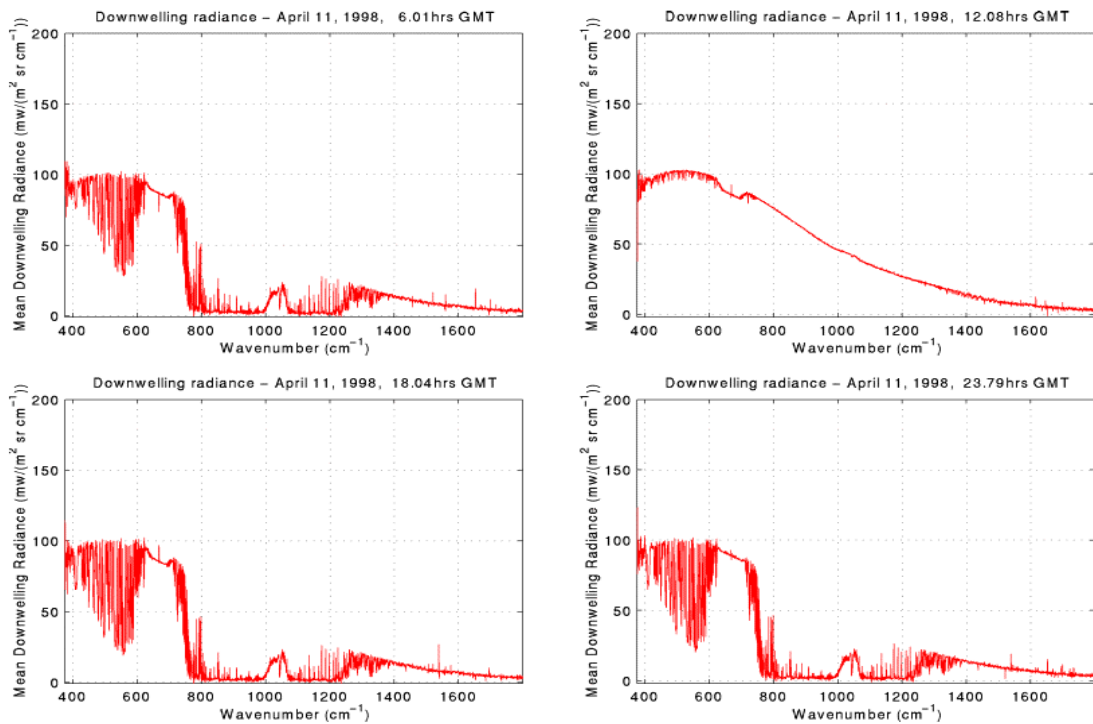
**Figure 1.** (a) Aerial photo of the SHEBA Ice Station at April 11, 1998. (b) Drift track of the SHEBA Ice Station from October 2, 1997, until October 10, 1998.



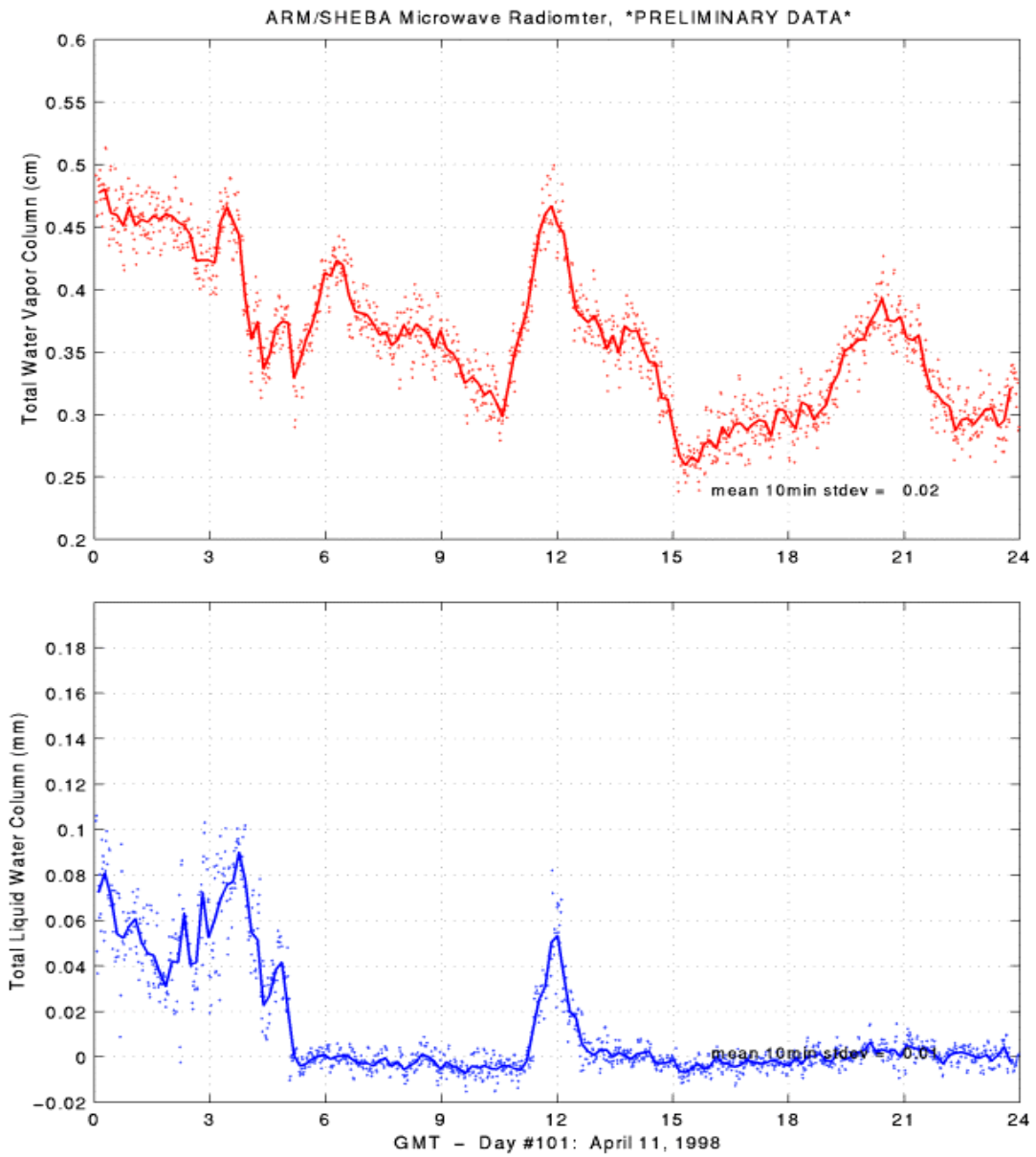
**Figure 2.** Daily averaged radiative balance versus 1998 Julian day based on longwave (LW) and shortwave (SW) broadband radiometer measurements. The dip in the upper panel and peak in the lower panel around day 180 are artifacts due to instrument problems.



**Figure 3.** Backscatter ratio versus altitude measured with the Vaisala Ceilometer, April 11, 1998.



**Figure 4.** Extended Range Atmospheric Emitted Radiance Interferometer measurements on April 11, 1998. Note the arctic window from 400 to 600 wavenumbers, which cannot normally be seen at lower latitudes.



**Figure 5.** Water vapor and total liquid water content on April 11, 1998, derived from measurements made with a Radian Microwave Radiometer.