The Year at the North Slope of Alaska and Adjacent Arctic Ocean ARM Cloud and Radiation Testbed Site

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Barrow Continues to Augment Instrumentation

The NSA/AAO (North Slope of Alaska/Adjacent Arctic Ocean) facility near Barrow went into operation in spring 1998 in time for the start of the National Aeronautics and Space Administration's (NASA's) FIRE (First ISCCP [International Satellite Cloud Climatology Program] Regional Experiment). The site went into operation with considerable work at Barrow yet to be finished, but the opportunity afforded by FIRE and Surface HEat Budget of the Arctic Ocean (SHEBA) was not to be missed. In the past year, the remaining work has been or is about to be completed. Ingest routines have now been written for most of the instruments (allowing automated data handling), a 915-MHz wind profiler with Radio Acoustic Sounding System (RASS) has been installed, a 10-m tip tower is about to be installed to carry the Ground Radiometer (GNDRAD) instrumentation that now tends to get buried in the snow, and a downward-looking video camera will soon be in place on the 40-m tower to document snow cover. The current suite of instrumentation is given in Table 1. The locations of the Barrow and Atqasuk sites are shown in Figures 1 and 2. A view of the Barrow site is also given in Figure 3.

Participation in SHEBA and FIRE Arctic Cloud Completed

Atmospheric Radiation Measurement (ARM) NSA/AAO instrumentation were on the SHEBA icebreaker (Des Groseilliers), which was intentionally locked in the Arctic ice pack and drifted with the pack from October 1997 until October 1998. Together with the instrumentation provided by other agencies and organizations, SHEBA served as a mini Cloud and Radiation Testbed (CART) site. But this CART site was augmented with instrumentation supplied by the National Science Foundation (NSF) and Office of Naval Research (ONR) that characterized the ice, the snow on the ice, and the state of the ocean below the ice. The overall purpose was to obtain a better understanding of the behavior of the ice and how to improve algorithms describing its behavior in general circulation models (GCMs). That

Table 1. ARM and related instrumentation.

	Location
Surface Meteorological Sensors	
Wind speed, wind direction, temperature, humidity	NOAA CMDL & NWS[(a)]
Same as above, but at 2 m, 10 m, 20 m, 40 m	ARM
Dew point/frost point hygrometer (1 level fixed)	NOAA CMDL
Same as above, but elevation scannable over tower height	ARM, soon
Optical precipitation gauge	ARM
Standard precipitation gauges	NOAA CMDL & NWS
Wind, Temperature, and Humidity Sounding Systems	
Microwave Radiometer (MWR; column liquid water & water vapor)	ARM
915-MHz wind profiler w/RASS (WS, WD, T profile)	ARM
Radiosondes	NWS & ARM
Cloud Observation Instrumentation	
Millimeter Cloud Radar (MMCR)	ARM
Micropulse Lidar (MPL)	ARM
Ceilometer (VCEIL)	ARM & NWS
Whole Sky Imager (WSI)	ARM
Downwelling Radiation	
Extended Range-Atmospheric Emitted Radiance Interferometer (ER-AERI; FTIR, 4 microns - 26 microns)	ARM
UV spectrometer	NSF NARL
Infrared thermometer	ARM
Cimel sunphotometer (CSPHOT; 8 wavelengths)	NASA ARM
Multifilter Rotating Shadowband Radiometer (MFRSR)	ARM
Normal Incidence Multifilter Radiometer (NIMFR)	ARM
Precision Solar Pyranometer, Unshaded (PSP/DS)	ARM
Precision Solar Pyranometer, Shaded (PSP/DD)	ARM
Normal Incidence Pyranometer (NIP; pyrheliometer)	ARM
Precision Infrared Radiometer, Unshaded (PIR/DI)	ARM
Precision Infrared Radiometer, Shaded (PIR/DDI)	ARM
Ultraviolet B radiometer (UVB)	ARM
Duplicate PSPs and PIRs	NOAA CMDL
Upwelling Radiation	
Infrared thermometer	ARM
Precision Solar Pyranometer (PSP/US; 1.5 m, soon 10 m)	ARM
Precision Infrared Radiometer (PIR/UI; 1.5 m, soon 10 m)	ARM
Multifilter Radiometer	ARM
Downward-pointing video camera (snow cover)	ARM, soon
Duplicate PSPs and PIRs	NOAA CMDL
Aerosol Instrumentation	
Multi-wavelength integrating nephelometer	NOAA CMDL
Condensation nuclei counter (CNC)	NOAA CMDL
Filter samplers	NOAA CMDL
Micropulse Lidar (MPL)	ARM
Gas Instrumentation	
Flask samplers	NOAA CMDL
Gas chromatography for greenhouse & ozone-destroying gases	NOAA CMDL
UV ozone monitor	NOAA CMDL
Column ozone monitor	NOAA CMDL

(a) NOAA CMDL (Climate Monitoring and Diagnostics Laboratory) and ARM sensors are collocated on NOAA land NE of Barrow; the National Science Foundation (NSF) sensor at NARL (former Naval Arctic Research Laboratory) is 2 km to the west; the National Weather Service (NWS) sensors and Upper Air Sounding Station are 6 km to the SW near the Barrow airport.

Figure 1. Map of Alaska showing location of existing and proposed ARM NSA/AAO facilities.

requires measurement of radiative energy flows, the task that ARM took on. In spring and summer 1998, SHEBA and NASA FIRE aircraft also made in situ measurements above both the SHEBA icebreaker and the Barrow ARM facility. One of the NASA aircraft, the University of Washington Convair 580, was based in Barrow and hence took much more data over the Barrow ARM facility than would have been the case had it been based elsewhere. All told, four instrumented aircraft took part. The year-long SHEBA drift is shown in Figure 4.

Microwave Water Vapor IOP

This Spring 1999 Intensive Operational Period (IOP) began as a test of the capabilities of the NASA 183-GHz Microwave Radiometer's (MWR's) ability to provide good data on column water vapor under Arctic winter conditions when the standard lower frequency MWR is not sufficiently sensitive to provide high-accuracy data. Once planning began, the IOP grew with the addition of participation by the National Oceanic and Atmospheric Administration (NOAA) Environmental Technical Laboratory (ETL); State University of New York (SUNY), Albany; the University of Denver; and Radiometrics Inc.; with additional microwave, infrared (IR), and solar radiometers (http://neptune.gsfc.nasa.gov/~per/MMWRarctic/index.html). By chance, the NOAA Depolarization and Backscatter Unattended Lidar (DABUL) polarization sensitive elastic scatter lidar was also onsite for an Arctic haze study. The "field of dreams" phenomena is alive and well! The IOP went remarkably well.

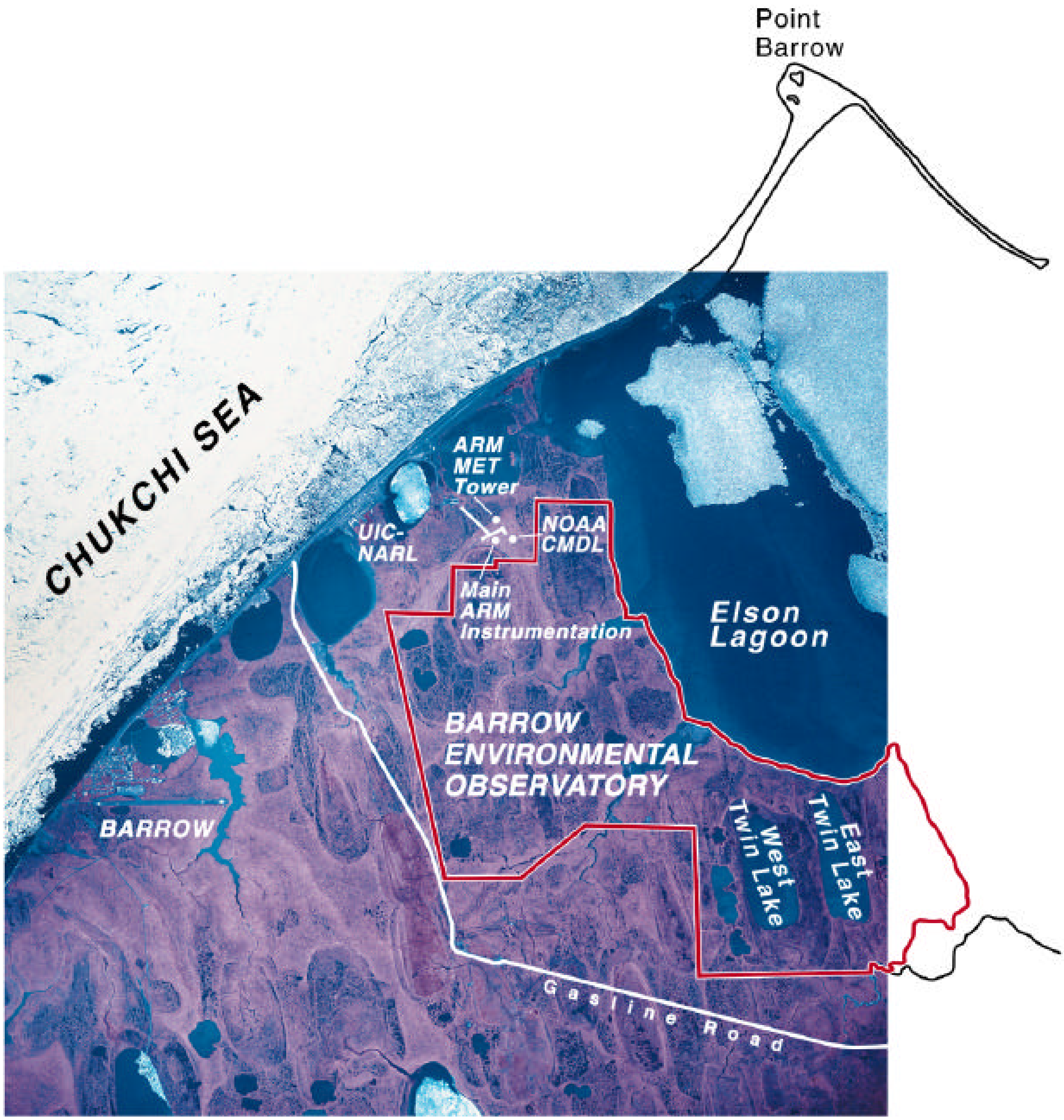
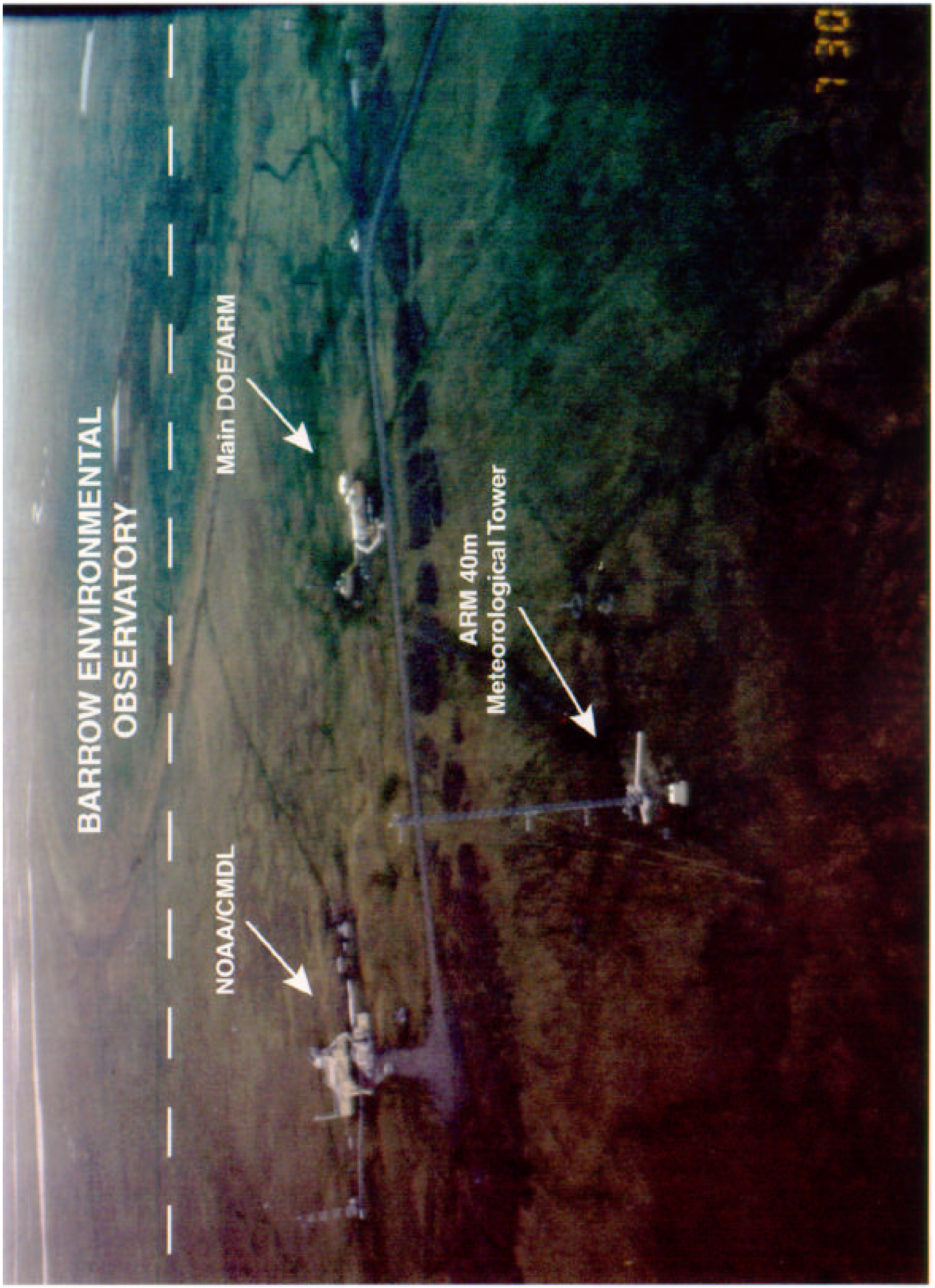


Figure 2. Annotated aerial photo of the Barrow area showing location of the ARM NSA/AAO Barrow facilities.

Aerosonde Single-Column Model IOP and Deployment to Atqasuk

A single-column model (SCM) experiment primarily based on the Aerosonde automated aircraft was planned for the first time anywhere in April 1999 (http://www.aerosonde.com). The Aerosonde deployment to Barrow at this time of the year served in part as a cold test for the Aerosonde subscale



. Recent aerial photo of the ARM NSA/AAO and the NOAA Climate Monitoring and Diagnostics

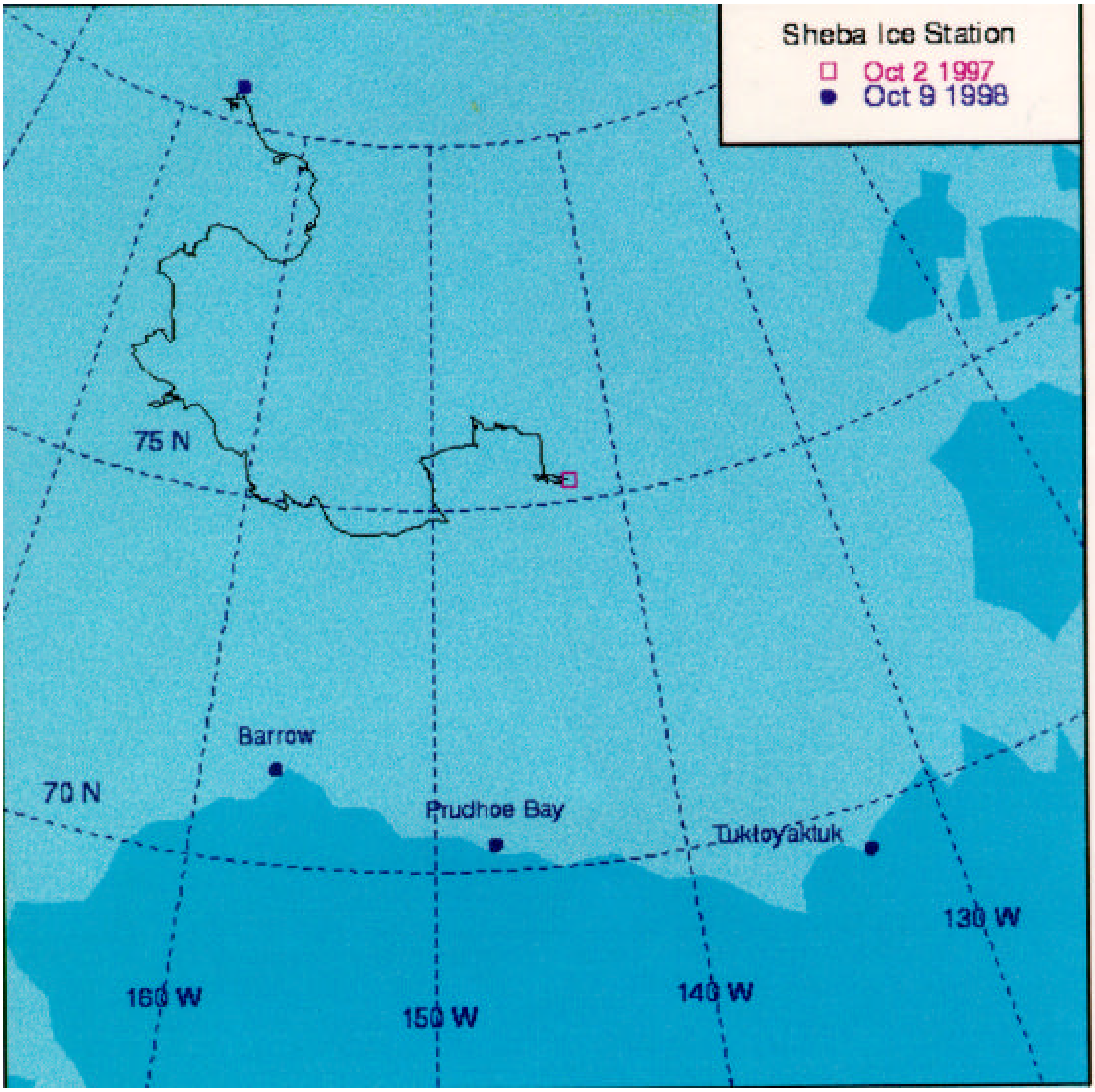


Figure 4. The year-long SHEBA drift.

aircraft. The test revealed that more work needs to be done on the Aerosonde for it to work reliably under Arctic conditions. Plans were also made for initial operation of the NSA/AAO facility at Atqasuk in early summer. Atqasuk is an inland site. At this writing, those plans have been implemented. Together with the data from SHEBA and Barrow, Atqasuk will provide the means to understand how radiative phenomena vary across the coastal transition—from the Arctic ice pack to the inland environment.