1.2. BARROW OBSERVATORY

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1.2.1. OPERATIONS

During the summer of 1881 Lt. P.H. Ray (U.S. Navy) was sent to Barrow, Alaska, with a small party to collect data on meteorology, natural history, magnetism, and other phenomena. This program lasted 3 years. A permanent weather observing program was started in 1946 and continues today under the National Weather Service. The United States Geological Survey (USGS) began a permanent magnetic observatory program in 1949 that continues today as one of 14 magnetic observatories in the United States. In January of 1973 the National Oceanic and Atmospheric Administration (NOAA) began a program of observations to detect changes in levels of background constituents that may force climate change. A network of four stations was planned with Barrow as the northernmost site.

The Barrow Observatory, Barrow, Alaska (BRW) celebrated 25 years of operation in January 1998. From a small program started in 1973 the station has grown to the point where almost every major global change study that passes through the Arctic has some connection with BRW because of the number (over 40) and longevity (some over 20 years) of programs and the quality of data produced there. Station personnel are often called upon to help with a wide range of scientific studies from a variety of sources. BRW has enjoyed the longest period of personnel stability to date with the station chief passing 15 years and the electronic engineer passing 5 years of service.

Outreach

In March 1998 the station was visited by a delegation from the U.S. Postal Service, including the Postmaster General, when they were in town to celebrate the first-day issue of Arctic animal series stamps and to announce the approval of funds for the construction of a new post office in Barrow. Also in the group were several members of the U.S. Senate staff from the appropriations committee.

Three television documentaries were filmed at BRW over the past 2 years. A film crew from Japan was in town for 2 days and filmed station activities. A crew from Italy filmed for a day for a popular science program in Italy geared towards 8-12 year olds. The British Broadcasting Corporation (BBC) filmed at the station for 2 days for a documentary dealing with the possible consequences of climate change. An American Broadcasting Corporation (ABC) affiliate was in town to film several 5 minute segments for broadcast in San Diego during the weather segment of the news.

BRW station personnel were called on by the local high school to help judge the science fair. In 1997 a Barrow project was sent to state where it placed near the top, and in 1998 a project won first place at the state level. The local community college, Illisagvik, tapped the expertise of the station technician to help with curriculum development for technical trades.

The station chief continues to be involved with the Barrow Arctic Science Consortium and is a member of the Barrow Environmental Observatory Management Committee, and attended a meeting sponsored by the National Science Foundation held in December 1998 to have as many Arctic research programs as possible discuss the needs and future of support needed. Based on material developed at the workshop, a report was issued [*Arctic Research Consortium of the U.S. (ARCUS)*, 1999].

Station Concerns

A new 1998 Ford pick-up replaced the 1992 Ford pick-up. The old truck was sold in place and saved CMDL the cost of backhaul for the old truck. Two new snow machines were secured as replacements for the two older machines purchased in 1984.

Roadwork continued with all but the last 91 m being completed by the fall of 1999. Plans call for completion by summer of 2000. Road construction costs in Barrow are astronomically high, so an agreement was worked out with Illisagvik, the local community college, to have students in the heavy equipment operators class build the road and a consortium of government agencies provide the materials. Costs were shared by CMDL, the Department of Energy Atmospheric Radiation Measurement (ARM) Program, the USGS, and the National Science Foundation (NSF). The road is approximately 915 m (3000 ft) long and one lane wide. The road had sunk into the tundra to the point where several places were lower than the surrounding tundra, causing blockage by drifting snow every winter. The road was closed to vehicular traffic from about October until about June each year and snow machines were used to get to the station from the Distant Early Warning (DEW) line site. The new road will eliminate a less than ideal travel situation.

Funds were secured for Phase 2 of the master plan for upgrades at BRW. Phase 2 calls for a new garage to be built in place that will house compressed gas cylinders as well as cargo and vehicles. Warm storage is in high demand as building costs are prohibitively high. The ability to park the vehicles in a warm place during the day saves on wear and tear to a very large degree.

The computer network at BRW was greatly enhanced by the connection to a T-1 line provided by the ARM program. The T-1 line was part of a reciprocal agreement with the ARM program that allowed them access to land withdrawn by NOAA and personnel support whenever possible. Equipment needed to record data for weathersondes launched by the ARM program is housed at BRW, and BRW personnel helped write programs to transfer data to the ARM program computer located at the Ukpeagvik Inupiat Corporation (UIC) Naval Arctic Research Laboratory (NARL) facility. Balloons are launched once per day by ARM program personnel, and the data are formatted and transferred once per day by BRW personnel.

1.2.2. PROGRAMS

Table 1.2 lists programs for 1998-1999 at BRW. Operational highlights follow.

Aerosols

The upgraded aerosol equipment was described in the CMDL Summary Report No. 24, 1996-1997 [*Hofmann et al.*, 1998]. It worked well during the entire 2-yr period with the exception of the Thermal Systems Inc, (TSI) CN counter. It was discovered that the TSI data was being affected by the cooling fans in the aerosol rack. The instrument was being cooled to the point that the alcohol was not evaporating and data counts were too low. Station personnel built an acrylic enclosure to minimize cooling by the rack fans. Data collected at BRW continue to show a springtime high in CN concentrations along with the buildup of the Arctic haze.

Solar Radiation

Barrow snowmelt date continues to be one of the most talked about programs at the station. An annual graph is provided by the CMDL Solar Radiation group in Boulder and is the most sought after graph on site. The graph shows the melt trends from the NWS office in the town of Barrow, the melt date as measured by BRW radiation instruments, and the date of the first egg from a study of Guillemot birds on a nearby island. The Guillemot will not lay eggs on Cooper Island, the nesting grounds for the birds, until the snow cover is minimal. All three graphs show a trend towards an earlier melt date.

An Epply pyranometer was installed at about the 15-m level on the tower in 1998. It measures upwelling radiation and will be helpful for albedo measurements. A shade was installed to block the tower and station from the field of view of the instrument, minimizing any error due to obstructions from the direction of the station.

Carbon Cycle

Carbon dioxide. CO_2 mixing ratios as high as 375 ppm were seen during 1998-1999. Values as low as 355 ppm were also noted. The high values were among the highest average values ever.

The Siemens Ultramat 5-E continues to serve as the main CO_2 station instrument and worked well the entire period without any major problem. Calibrations were performed at regular intervals.

Methane. The HP6890 gas chromatograph continued to run well with minimal intervention. Data show a clearly defined frequency with high values occurring in the winter months and low values in the summer.

Carbon monoxide. A Trace Analytical gas chromatograph has been the station instrument since 1991 and continued to run with minimal routine maintenance that included changing a scrubber for Hg and replacing the UV lamp in the detector section.

Flask samples. Flask samples were collected as available and as scheduled. There were no major problems with the flask program. Isotopic composition measurements of CO_2 continues, and data from this program can be found in other sections of this summary report.

Meteorology

A maximum wind speed of 21 m s^{-1} was recorded during 1998-1999. The high temperature was 20ºC and the low was –41ºC. Equipment ran well, with only routine calibration and maintenance required. All sensor probes were calibrated and adjusted as scheduled or needed.

Ozone

Total column. The Dobson ran well the entire period with only one problem. A clutch in the Q1 lever wore out causing the lever to fall to the lowest position. The clutch was rebuilt by station personnel and seemed to work well. Dobson no. 91 continues to be the station instrument. Values as high as 440 Dobson Units (DU) and as low as 290 DU were recorded. Data collection is not possible during the winter months when the sun is below the horizon, but regular calibrations are performed to ensure proper operation of the instrument.

Surface ozone. The Dasibi ran well with only routine calibrations. Surface ozone is one of the longest running programs at BRW and continues to be of value for trend analyses. With the addition of a new cooperative program to measure Hg vapor, surface ozone has taken on a new value. There appears to be a strong correlation between surface ozone values and Hg values measured at BRW in the spring.

HATS

A new system for in situ measurements was installed during 1998 known as the Chromatograph for Atmospheric Trace Species (CATS). There were a few startup problems to be worked out, most notably the chiller for the cryo-cooled samples was replaced once, and leaks in the tubing were fixed. The compliment of gases now measured in situ for the HATS group numbers 11, nearly doubling the number of species over the old system. One of the new gases measured is sulfur hexafloride, SF_6. SF_6 is used mostly as a replacement for polychlorinated biphenyls (PCB) in transformers and has a lifetime in the atmosphere of 3200 years. It is one of the most potent greenhouse gases known.

Cooperative Projects

BRW cooperative programs are listed in Table 1.2. Only projects with major changes are discussed in this section.

A new project was started with the NOAA Atmospheric Turbulence and Diffusion Division (ATDD). The project measures precipitable Hg and complements the system in place at Alert, Canada. Springtime values seem to have a strong correlation with surface ozone and sunrise. Funding for this project is through the Environmental Protection Agency (EPA).

Filters that are analyzed for heavy metals were collected for Hokkaido University every 2 weeks. A second set of packed tubes is collected monthly and is analyzed for volatile organic compounds.

The ARM program is in the final stages of setup, and data are now being collected. The ARM program will complement the CMDL program by measuring global change parameters that CMDL cannot. Between the two programs, BRW will most likely be one of the most comprehensive climate change research sites in the world.

A hi-vol filter collector for the University of Alaska, Fairbanks (UAF) was stopped when the pump died. The project is on hold until funding can be secured for a new pump.

All other cooperative research programs continued as before with no major problems and no major changes.

TABLE 1.2. Summary of Measurement Programs at BRW in 1998-1999

Program	Instrument	Sampling Frequency
Gases		
CO_2	Siemens Ultramat 5E analyzer	Continuous
	3-L glass flasks	1 pair wk^{-1}
	0.5-L glass flasks, through analyzer	1 pair wk^{-1}
CO_2, CH_4, CO, and $^{13}C/^{12}C$ and $^{18}O/^{16}O$ of CO_2	0.5-L glass flasks, P^3 pump unit	1 pair wk^{-1}
CH_4	Carle automated GC	1 sample $(12\ min)^{-1}$
Surface O_3	Dasibi ozone meter	Continuous
Total O_3	Dobson spectrophotometer no. 91	3 day^{-1}
N_2O, CFC-11, CFC-12, CFC-113, CH_3CCl_3, CCl_4	850-mL, 2.5-L, and 3-L stainless steel flasks	1 sample mo^{-1}
N_2O, CFC-11, CFC-12, CFC-113, CH_3CCl_3, CCl_4, SF_6, HCFC-22, HCFC-141b, HCFC-142b, CH_3Br, CH_3Cl, CH_2Cl_2, $CHCl_3$, C_2HCl_3, C_2Cl_4, H-1301, H-1211, H-2402, HFC-134a	850-mL, 2.5-L, and 3-L stainless steel flasks	1 sample mo^{-1}
CFC-11, CFC-12, CFC-113, N_2O CCl_4, CH_3CCl_3	HP5890 automated GC	1 sample h^{-1}
N_2O	Shimadzu automated GC	1 sample h^{-1}
CO	Trace Analytical GC	1 sample $(6\ min)^{-1}$
CFC-11, CFC-12, CFC-113, N_2O, CH_3CCl_3, CCl_4, CH_3Br, CH_3Cl, H-1211, SF_6, HCFC-22	Automated CATS GC	1 sample h^{-1}
Aerosols		
Condensation nuclei	Pollak CNC	1 day^{-1}
	TSI CNC	Continuous
Optical properties	Four-wavelength nephelometer	Continuous
Black carbon	Aethalometer	Continuous
Solar Radiation		
Global irradiance	Eppley pyranometers with Q and RG8 filters	Continuous
Direct irradiance	Tracking NIP	Continuous
	Eppley pyrheliometer with Q, OG1, RG2, and RG8 filters	Discrete
Albedo	Eppley pyranometer	Continuous
Terrestrial (IR) Radiation		
Upwelling and downwelling	Eppley pyrgeometers	Continuous
Meteorology		
Air temperature	Thermistor, 2 levels	Continuous
	Max.-min. thermometers	1 day^{-1}
Dewpoint temperature	Dewpoint hygrometer	Continuous
Pressure	Capacitance transducer	Continuous
	Mercurial barometer	Discrete
Wind (speed and direction)	R.M. Young Aerovane	Continuous
Precipitation	Rain gauge, tipping bucket	Continuous
Cooperative Programs		
Total surface particulates (DOE)	High-volume sampler (1 filter wk^{-1})	Continuous
Precipitation gauge (USDA)	Nipher shield, Alter shield, 2 buckets	1 mo^{-1}
Magnetic fields (USGS)	3-Component fluxgate magnetometer and total field proton magnetometer	Continuous
	Declination/inclination magnetometer sample	6 sets mo^{-1}
Hg (ATDD)	Tekran 2537A Hg vapor analyzer	Continuous
CO_2, ^{13}C, N_2O (SIO)	5-L evacuated glass flasks	1 set wk^{-1} (3 flasks set^{-1})
CH_4 (Univ. of Calif., Irvine)	Stainless steel flasks	1 pair wk^{-1}
O_2 in air (Princeton Univ.)	3-L glass flasks	1 set $(3\ mo)^{-1}$
CO_2 flux (San Diego State Univ.)	CO_2 and H_2O infrared gas analyzer and sonic anemometer	Continuous, check site 1 wk^{-1}
Magnetic fields (NAVSWC)	^{3}He sensors	1 $(2\ wk)^{-1}$
Magnetic micropulsations (Univ. of Tokyo)	Magnetometer and cassette recorder	1 $(3\ wk)^{-1}$
UV monitor (NSF)	UV spectrometer	1 scan per 0.5 hour
Study thaw depth in permafrost (SUNY)	Temperature probe	Continuous
Total VOC and heavy metals (Hokkaido Univ.)	Filter samples	1 $(2\ wk)^{-1}$