1.4. SOUTH POLE OBSERVATORY

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1.4.1. OPERATIONS

The CMDL South Pole Observatory (SPO) is located at the geographic south pole of Antarctica at an elevation of 2838 m above sea level. The Amundsen-Scott South Pole Station is an integral part of the U.S. Antarctic Program run by the National Science Foundation (NSF) and was administered by Antarctic Support Associates (ASA), who provided logistical and operational support.

The vast majority of CMDL's projects at SPO are housed within the Clean Air Facility (CAF) that takes up the majority of the Atmospheric Research Observatory (ARO) building located 400 m grid northeast of the main station. The clean air sector is defined as an area grid northeast of ARO between grid 340º and 110º. Because the wind blows from this direction more than 90% of the time at the South Pole, the CAF is ideally situated to sample air uncontaminated by the rest of the station. Activity within the clean air sector is strictly prohibited.

CMDL's meteorological tower sits on the edge of the clean air sector at grid 340º from ARO. Meteorological sensors, sampling lines and thermal radiation instruments are located there.

CMDL's stratospheric ozonesonde program is conducted from the Balloon Inflation Facility (BIF) located grid south of the main station. This facility is shared with ASA's meteorological department.

The Amundsen-Scott station receives support from regular aircraft flights for only 3 months out of the year from November through January. The station, including CMDL's observatory, is completely isolated from the rest of the world from February through October. During this period, temperatures are too low for aircraft to operate safely. As a result, air samples taken during the austral winter cannot be returned for analysis until the station reopens each November. Data collected in situ are transferred to the home institution regularly via a satellite link to the Internet.

Station power is generally quite reliable but outages do occasionally occur. The CAF is equipped with stable power supplies for some of the more sensitive equipment.

1.4.2. PROGRAMS

Table 1.4 summarizes the programs at SPO for 1998-1999. Operational highlights are as follows:

Carbon Cycle

The Siemens continuous carbon dioxide analyzer ran without significant problems or changes. Sample flasks were filled through the analyzer twice per month and once per week with the Martin and Kitzis Sampler (MAKS) portable pump unit.

Aerosols

The four-wavelength nephelometer ran continuously without any problems. Discreet measurements were made daily with the Pollak CN counter off-line on March 23, 1998, after the condenser temperature became unstable. Repairs to this unit were not possible with the spare parts available. The TSI remained off-line for the remainder of the winter until a new instrument could be flown to the observatory in November.

Solar and Terrestrial Radiation

During the austral summer, all of the solar and terrestrial radiation measuring equipment ran without any significant problems. In January of 1998 the data acquisition software was altered to record 1-min averages instead of 3-min averages, as had been the case before. After sunset each year the short-wave (solar) instruments were taken off-line for the winter.

Ozone and Water Vapor

The Dasibi surface ozone monitor ran continuously without any significant problems. Discrete measurements of total column ozone were taken three times daily during the summer months using a Dobson ozone spectrophotometer. Whenever possible, total ozone values were obtained in the winter with the Dobson using the full moon as a light source.

The balloonborne stratospheric ozonesonde program continued to run well. Profiles of ozone up to approximately 30 km were obtained once per week except during the months of severe stratospheric ozone depletion (August-November) when flights were gradually increased to one every other day.

Halocarbons and Other Atmospheric Trace Species

The two Shimadzu mini-gas chromatographs (GC) continued to run without significant interruption. A new automated four-channel custom-built Chromatograph for Atmospheric Trace Species (CATS) was installed in January 1998 to run concurrently with the Shimadzus. This new GC is intended to replace the older, more limited mini GCs. In addition to the automated sampling, sample flasks were filled twice per month to be analyzed in Boulder.

Meteorology

The meteorology program ran well with no significant problems. Weather observations by station personnel took place daily or during changing conditions.

Cooperative Programs

SIO. The Scripps Institution of Oceanography (SIO) conducts long-term monitoring of CO_2, $^{13}C/^{12}C$ ratio, and N_2O. Twice per month, three evacuated glass flasks were exposed to ambient air. Three glass flasks were pressurized with ambient air on the first and fifteenth of each month for the long-term monitoring of O_2 and N_2. Air samples were taken at depth intervals from within a 15-m hole drilled in the snow firn. The sampling hole was located within the clean air sector approximately 30 m grid east of the Atmospheric Research Observatory. Air samples were returned to SIO and analyzed for atmospheric trace species. Samples were taken once in the summer and once in the winter.

DOE. The U.S. Department of Energy (DOE) conducts long-term monitoring of the spatial and temporal distribution of specific and anthropogenic radionuclides in the surface air. The DOE pump ran continuously without significant problems; filters were changed once per week. Also, a monthly sample blank was collected once per month.

CSIRO. The Commonwealth Scientific and Industrial Research Organization (CSIRO) monitors the ratio $^{13}C/^{12}C$ in atmospheric CO_2 for use in a two-dimensional global carbon cycle model. One glass flask was pressurized with ambient air every 2 weeks.

SUNY. State University of New York (SUNY). Five air-filled cylinders remained on platforms approximately 800 m downwind of the main station for the quantification of the production rate of radiocarbon by galactic cosmic rays by SUNY. The cylinders were inspected and cleared of snow once per month. Occasionally, the platforms required raising to keep clear of drifting snow.

University of Arizona. Snow samples were taken weekly for the Univiversity of Arizona to study the snow/atmosphere exchange of H_2O_2. Additionally, snow heights were measured from a "sampling grid" inside the clean air sector.

TABLE 1.4. Summary of Measurement Programs at SPO in 1998-1999

Program	Instrument	Sampling Frequency
Gases		
CO_2	URAS-2T and Siemans IR analyzer	Continuous
CO_2, CH_4	2.5-L glass flasks, through analyzer	1 pair $week^{-1}$
	2.5-L glass flasks, MAKS pump unit	1 pair twice mo^{-1}
Surface O_3	Dasibi ozone meter	Continuous
	Electrochemical cell (ECC)	Continuous
Total O_3	Dobson ozone spectrophotometer nos. 80 and 82	3 day^{-1}
Ozone profiles	Balloonborne ECC sonde	1 wk^{-1}, summer, autumn, winter; 3 wk^{-1}, spring
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, 3-L stainless steel flasks	1 pair mo^{-1}
CFC-11, CFC-12, CFC-113, N_2O, CH_3CCl_3, CCl_4	Shimadzu automated GC	2 sample wk^{-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	Pollack CNC	2 day^{-1}
	TSI CNC	Continuous
Optical properties	Four-wavelength nephelometer	Continuous
Solar Radiation		
Global irradiance	Eppley pyranometers with Q and RG8 filters	Continuous, summer
	Eppley pyranometer with Q filter	Continuous, summer
	Net radiometer	Continuous, summer
Direct irradiance	Eppley pyrheliometer with Q, OG1, RG2, and RG8 filters	3 day^{-1}
	Eppley pyrheliometer with Q and RG8 filters	Continuous, summer
Albedo	Eppley pyranometer with Q and RG8 filters, downward facing	Continuous
Diffuse irradiance	Eppley pyranometer with shading disk and Q filter	Continuous
Terrestrial (IR) Radiation		
Upwelling and downwelling	Eppley pyrgeometers	Continuous
Meteorology		
Air temperature	Platinum resistor, 2- and 20 m heights	Continuous
Pressure	Capacitance transducer	Continuous
	Mercurial barometer	1 wk^{-1}
		2 day^{-1}
Wind (speed and direction)	Bendix Aerovane	Continuous
Frost-point temperature	Hygrometer	Continuous
Cooperative Programs		
CO_2, ^{13}C, N_2O (SIO)	5-L evacuated glass flasks	2 mo^{-1} (3 flasks $sample^{-1}$)
O_2, N_2 (SIO)	Air sampling pump and flasks	2 mo^{-1} (3 flasks set^{-1})
Total surface particulate (DOE)	High-volume pump and filters	Continuous (4 filters mo^{-1})
Interhemispheric $^{13}C/^{12}C$ (CSIRO)	Pump unit, 0.5-L and 5-L flasks	2 mo^{-1} (2 flasks set^{-1})
H_2O_2 (Univ. of Arizona)	Snow sample collection	1 wk^{-1}, 2 wk^{-1}- spring
Isotope production (SUNY)	Pressurized cylinders	N/A, checked once mo^{-1}
Trace species in the shallow snow firn (SIO)	Sampling lines, pump, 2-L glass flasks	2 yr^{-1}