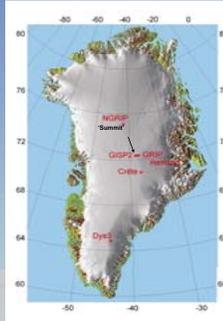


The role of long-term atmospheric measurements in Arctic research: The Greenland Summit Environmental Observatory

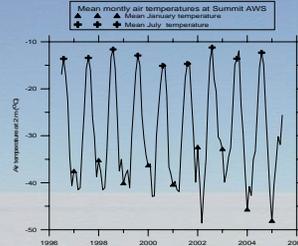
Roger Bales, University of California, Merced; Konrad Steffen, University of Colorado at Boulder; Atsumu Ohmura, Swiss Federal Institute of Technology, Zurich; David Hoffmann, NOAA Climate Monitoring and Diagnostics Laboratory, Boulder

Site overview

Continuous, ground-based measurements of the Arctic atmosphere provide the baseline data and information needed to identify long-term variations in atmospheric properties, understand seasonal-to-interannual variability and provide a foundation for intensive measurement campaigns. These long-term measurements also are an integral component of global monitoring networks such as the Global Atmospheric Watch program. The International Greenland Summit Environmental Observatory (GEOSummit), established in 2003 as a site for continuous measurements to serve these needs, is building the sort of long-term data set needed to meet these objectives.

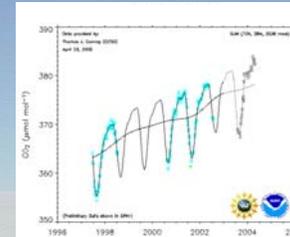


GEOSummit provides the only remote, high-elevation node in an Arctic observing network, and builds on intermittent measurements that have been carried out at the site since the late 1980's. Located at an elevation of 3203 m, at the top of the ice sheet (72° 35' N, 38° 28' W), it is remote from anthropogenic and oceanic influences.

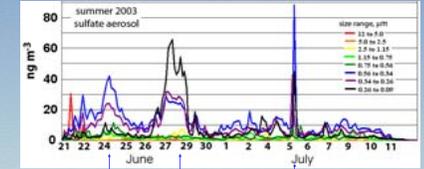


Mean monthly temperatures at Summit AWS

Recent measurements & datasets



GEOSummit CO₂ record



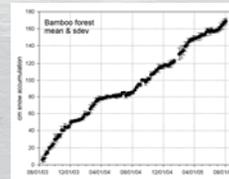
stable, ~0.5 μm, from N.A.
 very fine, from stratosphere
 fine, anthropogenic, from Siberia

Sulfate aerosol form cascade impactor. Sources identified from back trajectories

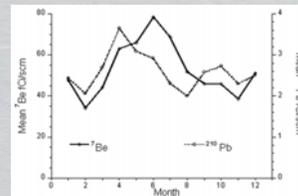
Measurements

Continuous, year-round measurements are serving as a foundation for multi-investigator campaigns aimed at understanding boundary-layer photochemistry, a base for investigations of stratospheric ozone depletion, a record of seasonal variability for interpretation of ice cores, an indicator of pollutant transport in the Arctic and a component in measurements of Arctic change. Long-term data sets such as are being developed are also expected to have important, currently unforeseen, uses in the future.

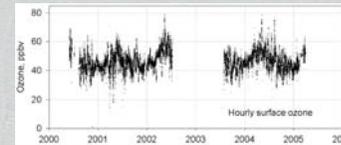
Task	Data product	Responsibility
Maks flasks	discrete greenhouse gas samples	NOAA/CMDL - Conway
Ozone sampler	continuous ozone concentration	NOAA/CMDL - Oltmans
Aethelometer	continuous black carbon	NOAA/CMDL - Andrews/Clarke
Radionuclides	discrete radionuclide samples	UNH - Dibb
Drum impactor	continuous aerosol sampling	UC Davis - Cahill
Surface snow	major ion chemistry, discrete time series	UCM - Bales/Burkhardt
ICP-MS	metals, discrete time series	DRI - McConnell
One meter pit	1 cm. Resolution major ion chemistry	UCM - Bales/Burkhardt
String pit	monthly accumulation markers	UCM - Bales/Burkhardt
Accumulation: BF	height change at snow stakes	UCM - Bales/Burkhardt
Accumulation: ATM	height change at snow stakes	UCM - Bales/Burkhardt
Meteorology	temperature, wind, snow height, humidity, pressure (1.5 & 2.5 m.)	CU - Steffen



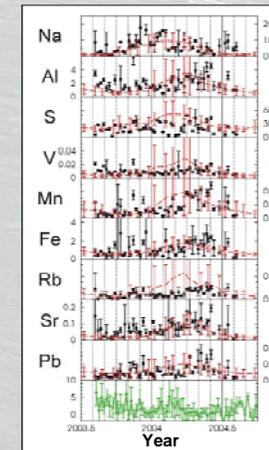
Cumulative accumulation for two-year period beginning August 2003



Seasonal variations in the radionuclide activities at Summit. Averages were calculated first by month (based on 48 hour samples) in each year. This plot shows the average of the monthly averages over the five years of sampling.



Surface ozone record from GEOSummit



Comparison of metals in surface snow & ice cores

Support & directions

GEOSummit facilities and many baseline measurements are currently supported by the U.S. National Science Foundation, with the U.S. National Oceanic and Atmospheric Administration's Climate Monitoring and Diagnostics Laboratory carrying out measurements as part of its global observatories program. The Danish Meteorological Survey has a meteorological station on site and the Swiss National Science Foundation supports atmospheric radiation and turbulence measurements. Planning is currently underway for upgrading and expansion of research and measurement facilities. Continued support of GEOSummit by these organizations and augmentation of measurements will continue to depend on international support for and use of the facility and data.

Measurement history at GEOSummit



Meteorological measurements have been continuous since mid-1980's
 - up to 1988: U. Wisconsin
 - beginning in 1996: U. Colorado
 - DMI