Baseline measurements & results from the Greenland Summit Environmental Observatory (GEOSummit)

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Scope of measurements
Selected results: aerosols
Planned GEOSummit upgrades
Meteorological measurements have been continuous since mid-1980’s
- up to 1998: U. Wisconsin
- beginning in 1996: U. Colorado
- beginning in 2003: DMI
## Baseline & core atmospheric measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Frequency</th>
<th>Method</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerosol filter: elements</td>
<td>12-hr</td>
<td>XRF, PIXE, PESA, STIM</td>
<td>UC Davis</td>
</tr>
<tr>
<td>Aerosol filter $^7\text{Be}$, $^{210}\text{Pb}$</td>
<td>weekly</td>
<td>gamma spectroscopy</td>
<td>UNH</td>
</tr>
<tr>
<td>Surface snow major ions</td>
<td>2/week</td>
<td>ion chromatog &amp; fluorimetry</td>
<td>UCM</td>
</tr>
<tr>
<td>Surface snow: elements</td>
<td>weekly</td>
<td>ICP-MS, ICP-OES</td>
<td>DRI</td>
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<td>Snow accumulation</td>
<td>wkly/mthly</td>
<td>stake forest &amp; transect</td>
<td>staff</td>
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<tr>
<td>Weather</td>
<td>6 hr</td>
<td>observations</td>
<td>staff</td>
</tr>
<tr>
<td>Aerosol scattering</td>
<td>continuous</td>
<td>aethalometer</td>
<td>NOAA-GMD</td>
</tr>
<tr>
<td>Surface ozone</td>
<td>continuous</td>
<td>instrumental in situ</td>
<td>NOAA-GMD</td>
</tr>
<tr>
<td>Atmospheric gases</td>
<td>weekly</td>
<td>canister samples</td>
<td>NOAA-GMD</td>
</tr>
<tr>
<td>Meteorology</td>
<td>continuous</td>
<td>automatic weather station</td>
<td>CU</td>
</tr>
<tr>
<td>Reactive gases</td>
<td>continuous</td>
<td>MAX-DOAS</td>
<td>UCLA</td>
</tr>
<tr>
<td>Surface aerosols</td>
<td>continuous</td>
<td>nephelometer</td>
<td>pending</td>
</tr>
<tr>
<td>Back trajectories</td>
<td>periodic</td>
<td>standard</td>
<td>pending</td>
</tr>
<tr>
<td>Radiosondes</td>
<td>2/day</td>
<td>standard</td>
<td>no one</td>
</tr>
<tr>
<td>Ozone vertical profile</td>
<td>seasonally</td>
<td>balloon/ozone sonde</td>
<td>NOAA-GMD</td>
</tr>
</tbody>
</table>
Surface snow trace elements

Elemental analysis using ICP-MS in class 100 clean room
Surface snow trace elements co-vary

Note periods where many elemental concentrations co-vary
Elements have common source areas & transport processes
Example: spring dust peaks

Banta et al., paper in preparation
Spring peaks: residence times & trajectories

Multiple source regions for spring peaks
Asian dust vs. North American dust
Surface snow trace elements – pollution sources

Note periods of elevated V, S & Pb – possible pollution tracers

Associated with less significant increase in:
- Na (sea salt)
- Al (dust)
Surface snow trace elements – marine sources

- Periods of elevated S & Na
- Other elemental concentrations not elevated
- Possible marine sources
Residence time/trajectory of marine source
Atmospheric aerosols

Measures aerosol amount & composition
Operates continuously, w/ 6-hr resolution
No evidence of camp pollution in samples

Dust peaks of Asian origin
Tracking aerosol sources at Summit – sulfate

- Stable, \(~0.5 \, \mu m\), from N.A.
- Very fine, from stratosphere
- Fine, anthropogenic, from Siberia
Atmospheric aerosols

Smaller sizes (0.34 to 0.75 µm) dominate

Multiple April-May soil aerosol peaks in snow
Atmospheric aerosols

Modeling suggests largest aerosol sizes should dominate snow

Some correlation between surface snow & largest aerosol chemical concentrations, e.g. April & May peaks in snow
Snow accumulation
Camp activities not impacting aerosol concentrations in snow?

Possible exception
Future plans

- Maintain as a “clean site” – reduce fossil fuel use
- Upgrade science facilities & capabilities – new Atmospheric Watch Observatory
- Central component of U.S. Artic Observing Network
- Part of NOAA Global Monitoring Network, also GAW
- Continue to extend international collaborations
Last major upgrade was 1997-98 – first ‘winterover’ year-round measurements

GISP2 Bighouse adequate for summer but not winter

also reconfigured power

added Greenhouse with living, lab & office space
Clean air studies 1 km from main camp

No vehicle traffic
Up to 20 scientists measuring different atmospheric species
GEOSummit is ideal location for studying cold, remote troposphere
2004-05 winter damage & repairs

Buildings completely buried
Snow accumulation on roofs
Structural damage
Raising the Bighouse

Raise again in 2007
Replace by 2010