Interpretative synergy of starphotometry and lidar measurements at two High-Arctic stations during Polar Winter of 2010-11.

Motivation

- Warming temperatures, increased ozone depletion and decreasing sea ice extent are among the recent changes in the Arctic.
- Aerosols have important (direct and indirect) effects on the Arctic climate.
- What are the dynamics of Arctic aerosols and how do they influence and change with changing climate? (an emphasis on the Polar Winter)
Aerosol characterization

- **Aerosols properties:**
  - **Extensive:** amount of aerosol
  - **Intensive:** single-particle attributes

- **Optical measurements:**
  - **Photometry:** Aerosol Optical Depth (AOD)
  - **Lidar:** Backscatter and extinction profiles
Photometry-lidar synergy

- Extinction-to-backscatter ratio ("lidar ratio") values needed in the Klett method of lidar analysis can be deduced from the ratio of AOD to integrated $\beta_a$
- Lidar vertical profiles of backscatter coefficient and depolarization ratio help in understanding retrievals from sunphotometry (for example the division into fine and coarse ODs) and vice versa
- Higher degree of confidence and comprehension
The two Arctic sites

Eureka (Nunavut, 79°59′N, 85°56′W)

- Starphotometer
- AHSRL
- Raman lidars

Ny Alesund (Svalbard, 78°55′N, 11°55′E)

- Starphotometer
- Raman
- MPL lidars

Frequent overpasses by CALIPSO!
Eureka
Sun photometry-lidar synergy

Eureka, April 2008
Starphotometer SPSTAR09

14 AOD bands: 420-1040nm
Starphotometry

Two stars (TSM)

One star (OSM)

- **TSM**: assumption of homogeneous horizontal distribution of absorbing and scattering particulates
- **OSM**: calibration values

$M, M_0$: measured, extraterrestrial magnitude; $m$: air mass; $h$: elevation
Eureka (Feb. 21, 2011)
Ny Alesund (Feb. 8, 2011)
Eureka (Mar. 10, 2011)
Eureka (March 2011)
Potential source (OMI and MODIS)

pyroCB discussions

Aqua, 04:00
Take home points:

- We have tens of days of simultaneously acquired starphotometry AODs and lidar backscatter profiles at Eureka and Ny Alesund during 2010-11
- Excellent starphotometry-lidar correlation for several days, but...
- ...starphotometry data is not perfect
- Some potential aerosol and ice crystal events are under investigation.
Thank you!