Indirect Semi-Direct Aerosol Campaign: The Influence of Arctic Aerosol on Clouds

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Key Issues

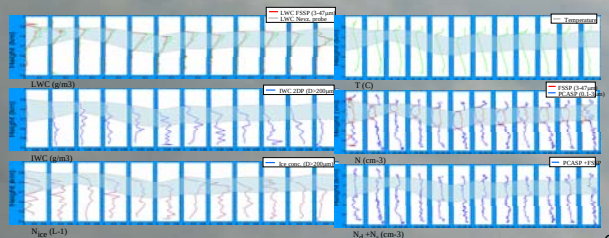
1. How do properties of arctic aerosol in April differ from those measured in October during the Mixed Phase Arctic Cloud Experiment (M-PACE)?
2. To what extent do different properties of arctic aerosol during April produce differences in cloud microphysical and macrophysical properties and the surface energy balance?
3. How well can cloud models and parameterizations used in climate models simulate sensitivity of arctic clouds & surface energy budget to differences in aerosol between April and October?
4. How well can long-term surface-based measurements at the ACRF Barrow site provide retrievals of aerosol, cloud, precipitation and radiative heating in the Arctic?

Overview of ISDAC Data

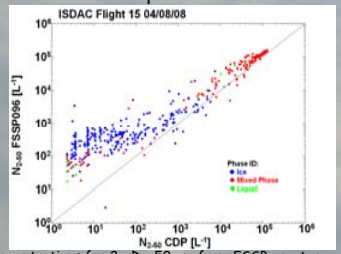
- 27 project sorties representing 103.6 hours of data on 12 different flight days executed by National Research Council (NRC) of Canada Convair 580
- More than 40 instruments on NRC Convair measuring clouds and aerosols with sizes from 10^{-6} mm to 10 mm
- More then two months of continuous surface measurements of size-resolved aerosol hygroscopicity and solar radiance spectra

In-Situ Cloud Measurements

- Redundancy key of cloud measurements, allows assessment of consistency & performance of multiple probes through extinction and closure tests
- Addresses issue of whether shattering of large crystals artificially amplifies small crystal concentrations
- Will generate common data product to estimate IWC, LWC, r_{ei}, r_{ew}, N_{ti}, N_{tw}, $N_i(D)$, $N_w(D)$, β_i, β_w, Z_{ei}, Z_{ew} and habit distributions for remote sensing & model evaluation and for aerosol-cloud-ice nucleation process studies



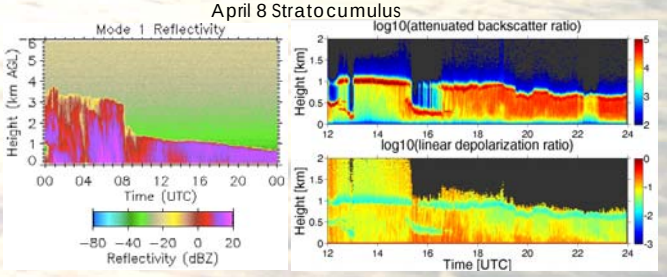
Example of cloud vertical & horizontal structure derived from in-situ data on 26 April 2008, UTC 00:56 – 01:13 (A. Korolev)



Concentrations for 2 < D < 50 μm from FSSP greater those from open path CDP suggesting crystal shattering amplifying concentrations (see Bae/McFarquhar poster)

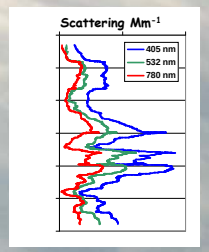
Aerosol-Cloud Process Studies

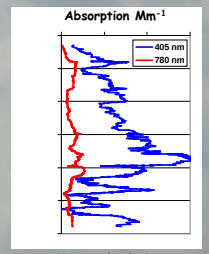
- Golden days for process studies of single-layer strato-cumulus flown on 8 and 26 April when NRC Convair made observations above, below & at multiple levels within cloud



- The MCR (left) and MPL (right) data together with in-situ data will permit closure experiments for aerosol and cloud microphysical and optical properties, and with linkage to modeling studies, understanding effects of ice nucleation

April 19 2008: Pollution in Polar Regions





- Heavily polluted conditions encountered on 19 April (dense haze seen above)
- Aerosol size distributions, hygroscopicity, optical scattering, absorption & cloud condensation and ice nuclei measured
- Combined with measured cloud properties these data will provide good case study of aerosol impacts on arctic clouds

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