Karlsruhe Institute of Technology

CNR-INO
ISTITUTO NAZIONALE DI OTTICA
CONSIGLIO NAZIONALE DELLE RICERCHE

Institute of Meteorology and Climate Research
Atmospheric Aerosol Research

In Situ Optical Characterization of Ice Fog and Diamond Dust at DOME-C, Antarctica

Adrian Hamel (*adrian.hamel@kit.edu*)[1], Emma Järvinen[1], Massimo del Guasta[2], Carl Schmitt[3] and Martin Schnaiter[1,4]

[1]Karlsruhe Institute of Technology
[2]National Institute of Optics, CNR-INO
[3]University of Alaska Fairbanks
[4]schnaiTEC GmbH

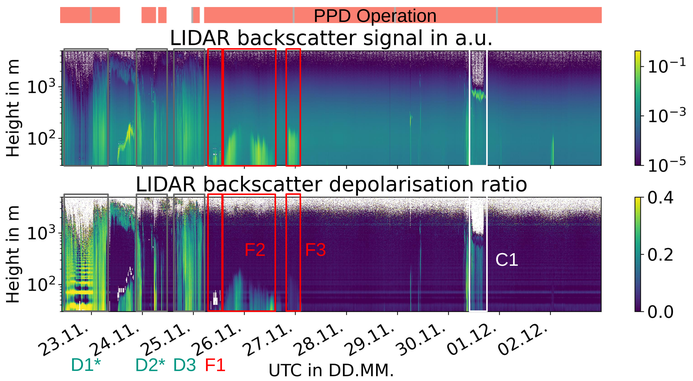
Motivation

In situ measurements of atmospheric ice crystals on the Antarctic plateau are scarce. For particles smaller than 50 µm the ice crystal structure cannot reliably be derived with current optical array probes. Light scattering measurements of ice particles on DOME-C give new insights on microphysics.

Methods

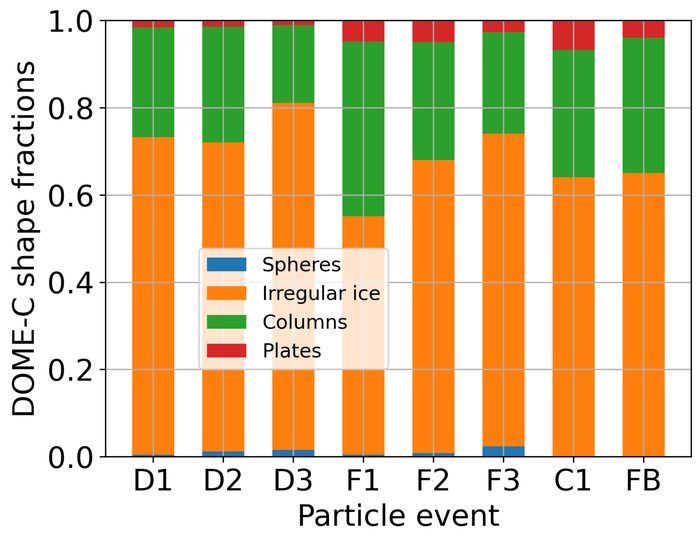
- Data set of about two weeks from Nov & Dec 2023 from **DOME-C, Antarctica**. More data (until Jan 2024) will be available when the instrument is back from deployment.
- In situ measurements of forward scattering intensity with the Particle Phase Descriminator (PPD) of shape, size, concentration, complexity (k_e value) for particle diameters between **11 µm and 150 µm**[1,2].
- Diamond dust streaks (D)/ low level ice fog (F)/ cloud origin (C) particle events are determined with polarisation lidar[3,4].
- Compared to ice fog measurements during ALPACA campaign at Fairbanks, Alaska in municipal area from Jan & Feb 2022 (FB)[5].

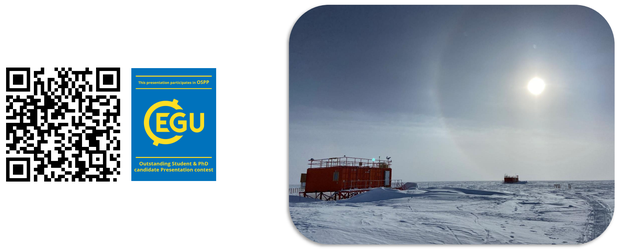
Particle event characterisation with polarisation LIDAR



Possible aerosol pollution effects from Concorida station due to wind direction in D1* and D2*.

Small ice crystals at DOME-C, Antarctica, have predominantly (>55%) irregular scattering patterns for ice fog and diamond dust events.

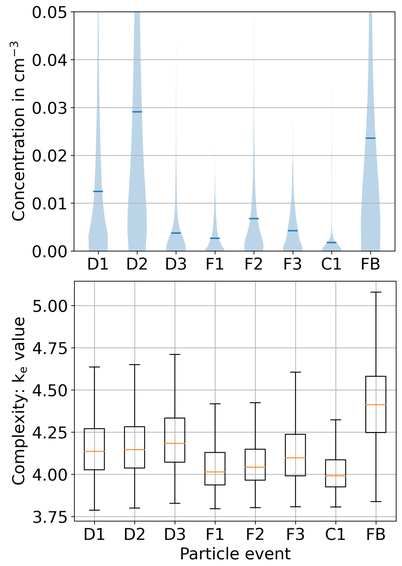




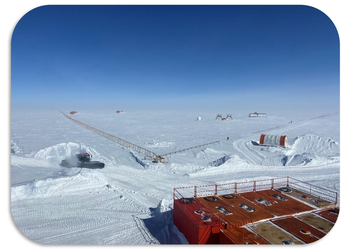
Measurement site at DOME-C

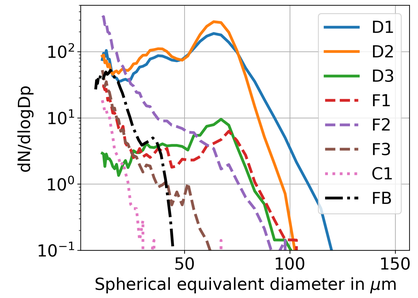
Results

- **Measurements of ice fog in Fairbanks, Alaska show more complex ice crystals than on the Antarctic plateau.**
- **Monomodel particle size distribution of ice fog (<10 µm) significantly differs from bimodel diamond dust (>30 µm).**
- **Mean ice fog particle concentration (F1,F2,F3) at DOME-C (0.0056 cm^{-3}) is 76 % lower than at Fairbanks during ALPACA campaign (0.0236 cm^{-3}).**

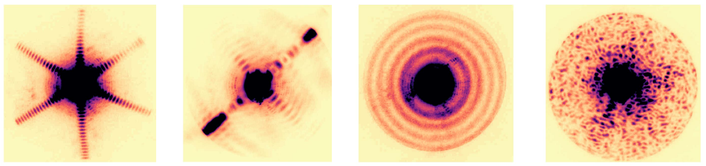


Ice Fog at DOME-C
26.11.2023





Forward scattering patterns



References:
[1] Schnaiter, M., et al., 2016. *Cloud chamber experiments on the origin of ice crystal complexity in cirrus clouds*, Atmos. Chem. Phys., 16, 5091–5110, doi:10.5194/acp-16-5091-2016
[2] Vochezer, P., et al., 2016: *In situ characterization of mixed phase clouds using the Small Ice Detector and the Particle Phase Discriminator*, Atmos. Meas. Tech., 9, 159–177, doi:10.5194/amt-9-159-2016
[3] http://lidarmax.altervista.org/lidar/Antarctic%20LIDAR.php
[4] Palchetti, L., et al., 2015: *Far-Infrared Radiative Properties of Water Vapor and Clouds in Antarctica*, Bull. Amer. Meteor. Soc., 96, 1505–1518, doi:10.1175/BAMS-D-13-00286.1
[5] Schnaiter, M., et al., 2024: *PPD-2K Ice Fog Particle Size and Shape Distributions from ALPACA*, Karlsruhe Institute of Technology, doi:10.35097/1935