Name of research institute or organization:

Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology

Title of project:

The Morphology and Optical Properties of Ice Particles in Mixed Phase Clouds (ISI-MICROPHYSICS)

Part of this programme:

CLACE 2014

Project leader and team:

Dr. Martin Schnaiter, project leader
Paul Vochezer

Project description:

Within this project we participated in the CLACE 2014 field campaign which took part in January and February 2014 at Jungfraujoch (JFJ). During CLACE 2014 we performed measurements with the Small Ice Detector (SID-3) and the Particle Phase Discriminator (PPD-2K). The SID-3 was mounted on a mast of the University of Manchester which was deployed on the Sphinx terrace. The mast adjusted itself to the wind direction and an aspiration unit together with a pump ensured a permant flow of cloud particles through the instrument. The PPD-2K was mounted as part of the ice selective inlet (ISI) which was developed and operated in collaboration with the Paul Scherrer Institute (PSI), Switzerland.
The idea behind this arrangement of instruments is the same as for our CLACE 2013 contribution and is described as follows. The SID-3 and the PPD-2K are equivalent in measurement principle and output. The SID-3 sampled all cloud particles, which is in the case of a typical mixed phase cloud on JFJ a mixture of liquid droplets and ice particles, however dominated by liquid droplets. Thus the SID-3 was expected to sample mainly droplets and only a few ice particles. The PPD-2K in contrast was built in the ISI and thus sampled ice particles only. The removal of liquid droplets by the ISI should enable a very detailed sampling of the ice phase with the PPD-2K.

Figure 1 depicts a time series of CLACE 2014 during which the PPD-2K was operated. Overall the PPD-2K recorded 271'626 ice particles and 4'463 droplets. Thus only 1.6% of the transmitted particles of the ISI were droplets - which is a proof of concept. The upper panel of Figure 2 depicts a comparison of the absolute numbers of ice particles sampled by the PPD-2K and the SID-3 averaged over 600s. As the temporal occurance of ice particles coincides in both instruments, this plot supports the finding that the ISI works in principle. Unfortunately the numbers are very close to each other. This indicates that there is no clear benefit of operating the PPD-2K as part of the ISI. The lower panel of Figure 2 displays a detailed analysis of different ice particle shapes. The PPD-2K recorded more pristine particles than the SID-3 which indicates a change in ice particle morphology in the ISI.

In summary, Figure 1 and Figure 2 proof that the ISI concept works in principle. However, Figure 2 displays changes to both the number and morphology of the ice particles caused by the ISI. It is currently not fully understood how much of that change is due to the different location of the ISI and SID-3 and how much is due to the ISI inlet characteristics.

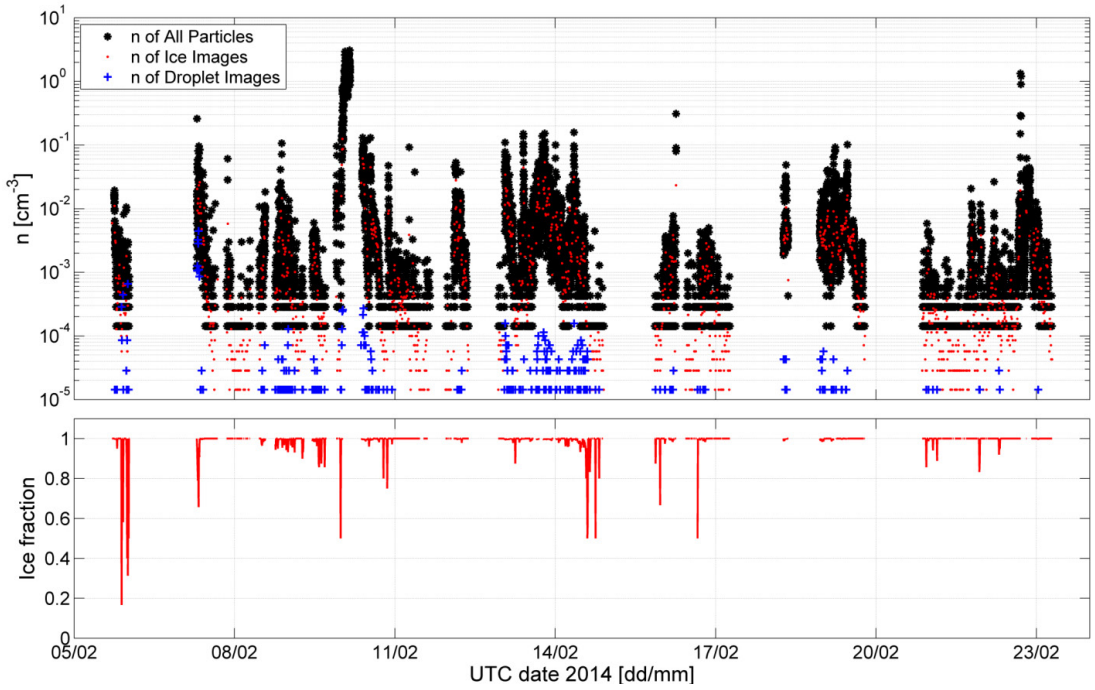

Figure 1. Time series of the PPD-2K measurements as part of the ISI during CLACE 2014. Upper panel: Number concentrations of all particles counted by the PPD-2K and number concentrations of assigned ice and droplet scattering patterns. Lower panel: Ice fraction calculated from the scattering patterns.

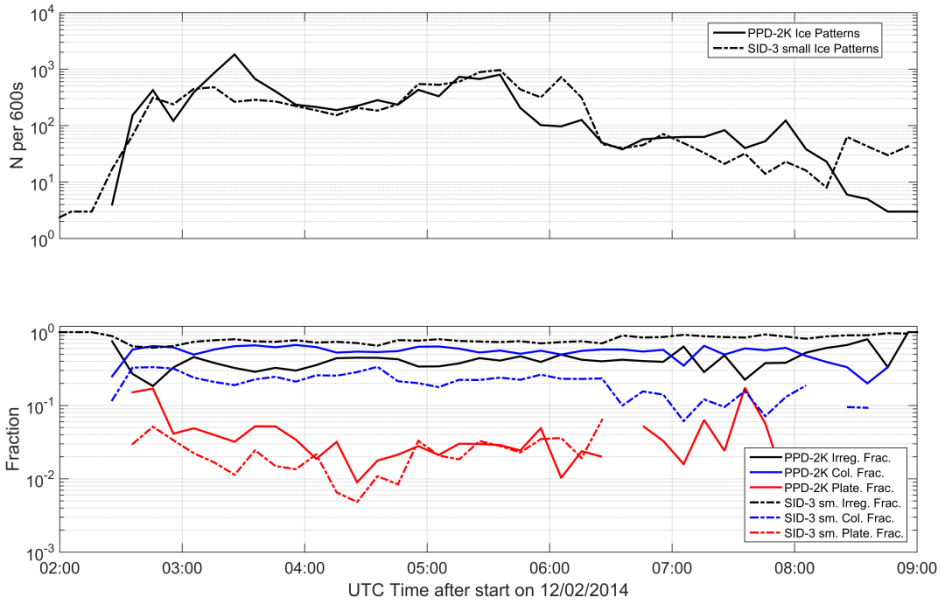

Figure 2. Comparison of the PPD-2K and SID-3 measurements from the 12/02/2014. Upper panel: Absolute number of recorded scattering patterns classified as ice and averaged over 600s for the PPD-2K as part of the ISI and the SID-3 sampling all cloud particles respectively. Lower panel: Detailed analysis of specific ice particle shape fractions.

Key words:
Cloud microphysics, small ice particles, ice particle habits

Collaborating partners/networks:
Paul Scherrer Institute
University of Manchester

Scientific publications and public outreach 2014:

Refereed journal articles and their internet access

Kupiszewski, P., E. Weingartner, P. Vochezer, A. Bigi, B. Rosati, M. Gysel, M. Schnaiter, and U. Baltensperger, The Ice Selective Inlet: a novel technique for exclusive extraction of pristine ice crystals in mixed-phase clouds, Atmos. Meas. Tech. Discuss., **7**, 12481-12515, doi: 10.5194/amtd-7-12481-2014, 2014.
http://www.atmos-meas-tech-discuss.net/7/12481/2014/amtd-7-12481-2014.html

Conference papers

Vochezer, P., P. Kupiszewski, Z. Ulanowski, A. Abdelmonem, and M. Schnaiter, Characterization of small cloud ice particles in mixed phase clouds, 14th Conference on Cloud Physics, July 7-11, Boston, USA, 2014.

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