

Name of research institute or organization:

Institut für Atmosphäre u. Umwelt, Universität Frankfurt/M, Deutschland

Title of project:

Measurement of ice nucleating particles by the Frankfurt Deposition Freezing Experiment FRIDGE

Part of this programme:

BACCHUS, INUIT, CLACE

Project leader and team:

Dr. Heinz Bingemer, project leader
Annika Kube, student

Project description:

The number concentration of atmospheric ice nucleating particles (INP) at Jungfraujoch was measured during the CLACE 2014 campaign of January and February 2014 by the off line-method FRIDGE. Atmospheric aerosol particles were collected at the station by electrostatic precipitation of the particles present in samples of around 120 liters of air onto silicon substrates. The number of INP present on the substrates was analyzed in the lab at Frankfurt in the static vapour diffusion chamber FRIDGE by growing ice crystals on the INP. Crystals were photographed by a CCD camera and counted automatically. It is assumed that one crystal represents one INP. The method addresses the INP that are active in the deposition mode and partly in the condensation mode, depending on water vapour saturation. A recently discovered systematic error in the image processing has been eliminated prior to the campaign.

A major goal of our project was thus methodological: the verification of our refined method under atmospherically relevant conditions. This was achieved by the synchronous sampling with the PINC instrument of ETH Zurich. Experimental parameters of both instruments overlap at 241 K and close to water saturation. INP number concentrations measured by FRIDGE at Jungfraujoch under these conditions ranged between 1-12 L⁻¹, with the majority being below 5 L⁻¹ (Fig. 1), and some higher concentration towards the end of the campaign. When analyzing the same sample at a higher temperature and at water subsaturation, the INP concentration decreased. In many samples no crystals were detected at such conditions in the images by FRIDGE. For a discussion of the observed atmospheric INP concentration also see the activity report of ETHZ. In our limited data set both methods agree within their error limits. The data are significantly correlated (Fig. 2). This first successful test of our refined system indicates that the previous substantial errors have been overcome in the new image processing procedure that we apply now.

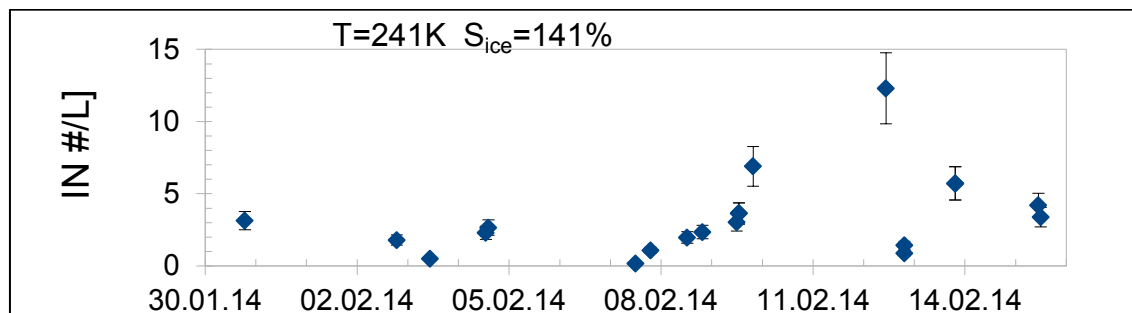


Figure 1. Concentration of deposition and condensation freezing INP analyzed at 241 K and $S_{ice}=141\%$ by FRIDGE at the Jungfraujoch research station during winter 2013/14.

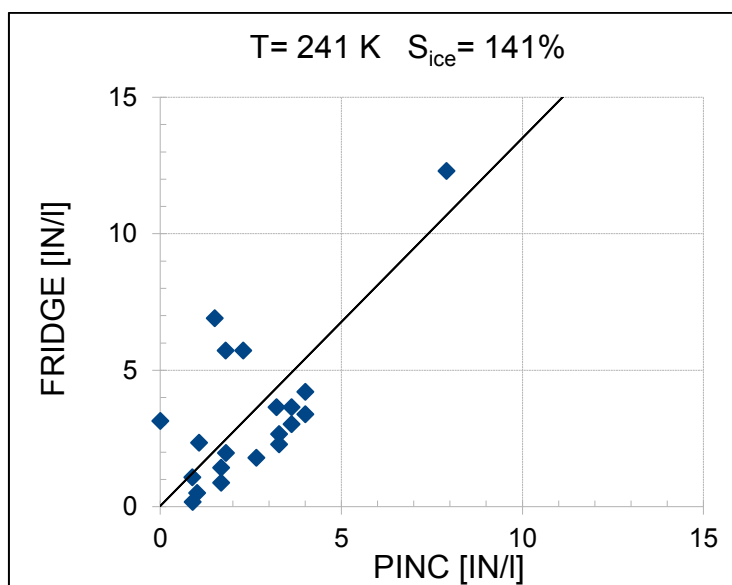


Figure 2. Scatter plot of ambient INP number concentration at Jungfraujoch as measured in Jan./Feb. 2014 synchronously by FRIDGE and PINC at overlapping experimental conditions.

Key words:

Cloud physics, ice nuclei, aerosol

Internet data bases:

<http://www.ice-nuclei.de/the-inuit-project/>

<http://www.bacchus-env.eu/>

Collaborating partners/networks:

Y.Boose, Dr. Z. Kanji, both at: Atmospheric Physics, ETH Zurich

Dr. E. Weingartner, Paul Scherrer Institute

Scientific publications and public outreach 2014:

Theses

Kube, A., Messungen von Eisnuklei am Jungfraujoch mit FRIDGE, Diplomarbeit, Universität Frankfurt/M., in preparation, 2015.

Address:

Institut für Atmosphäre und Umwelt

Universität Frankfurt

Altenhöferalle 1

D-60438 Frankfurt am Main

Deutschland

Contacts:

Dr. Heinz Bingemer

Tel.: +49 69 7984 0257

Fax: +49 69 7984 0262

e-mail: bingemer@iau.uni-frankfurt.de

URL: <http://www.geo.uni-frankfurt.de/iau/index.html>