Name of research institute or organization:

Institute for Atmospheric Physics, University of Mainz, Germany

Title of project:

GipfelHolo instrument taking part in the CLACE 2013/INUIT projects

Project leader and team:

Prof. Dr. Stephan Borrmann (group leader)
Dr. Jacob Fugal (project/lab leader)
Oliver Schlenczek (instrument operator, data analysis)
Christian von Glahn (electrician)
Klaus Dieter Wilhelm (mechanic)

Project description:

Microphysical processes in clouds on scales of a few millimeters are crucial for macrophysical cloud properties such as absorption and scattering of solar and terrestrial radiation, the formation of precipitation, cloud-lifetime, and remote-sensing of clouds such as with radar and lidar measurements. Most important for precipitation in the mid and higher latitudes, are interactions between ice crystals and supercooled liquid water droplets in mixed-phase clouds. To examine the microphysical composition of a cloud, one needs an instrument which is able to measure cloud droplets and cloud ice in a size range from a few microns up to a few millimeters. With GipfelHolo, we are able to examine the three-dimensional distribution of cloud droplets and ice crystals in a sample volume of approx. 36 x 24 x 350 mm at one instant in time. With this technique, we are able to examine the environment of ice crystals and small droplets in clouds on a spatial scale of a few millimeters. Additionally, we can obtain size distributions of different hydrometeor classes as well as the ice / liquid water partitioning or how much ice or water stays in the cloud.

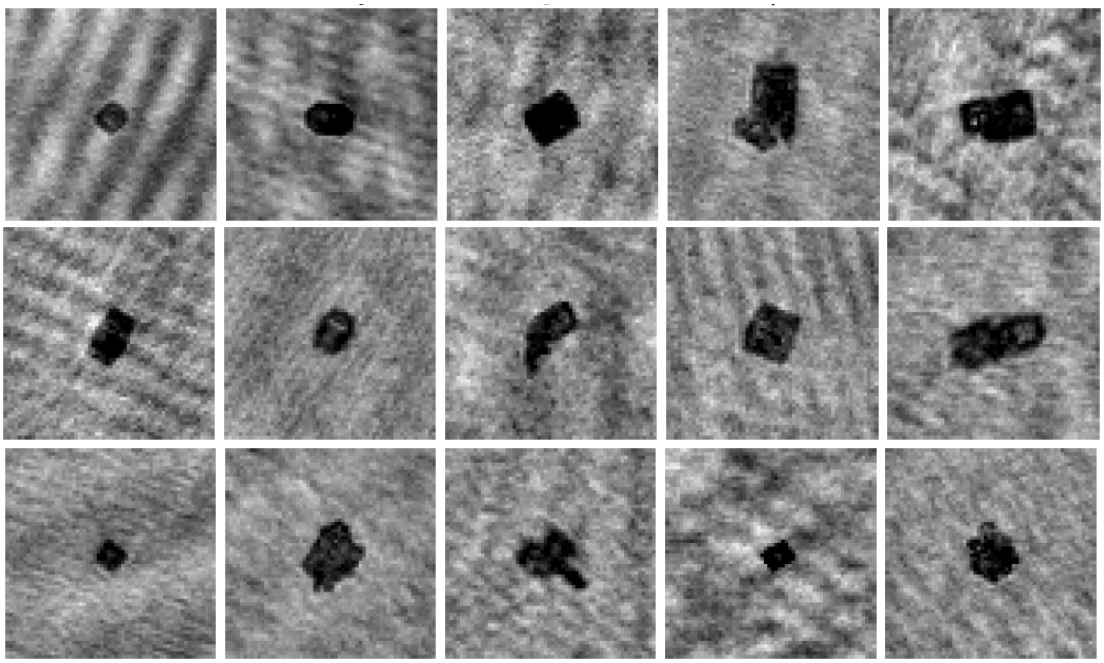

Figure 1. Ice crystals from diamond dust case on Feb 08 2013 (20:51-21:00 UTC) measured with GipfelHolo at Jungfraujoch. Each image has a length scale of 330 µm.

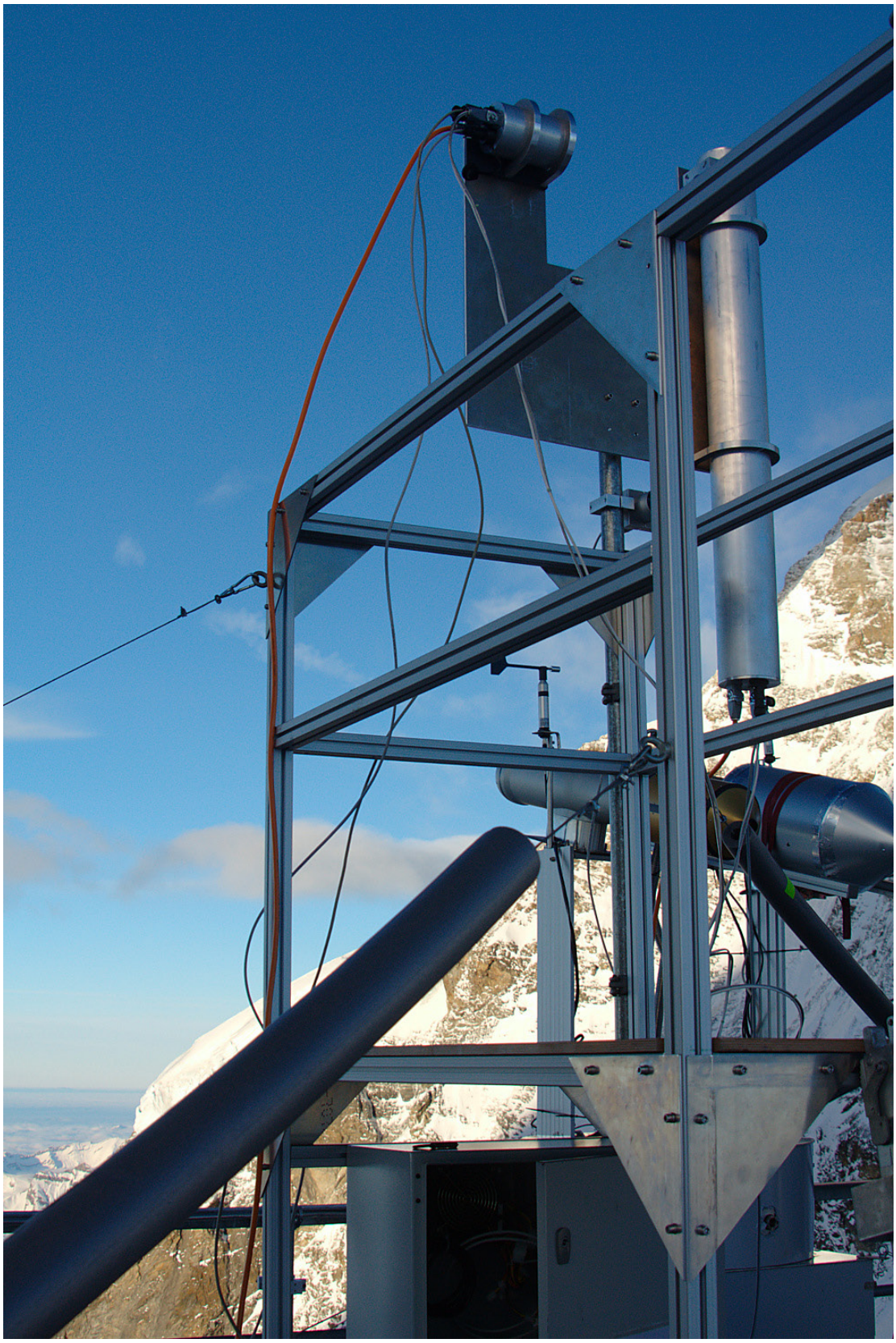

Figure 2. Photo of the instrument on the measurement platform.

The GipfelHolo instrument took measurements of hydrometeors at Jungfraujoch from Jan 23 until Feb 26, 2013 in passing mixed-phase clouds. GipfelHolo was part of a whole suite of cloud-particle instruments including others from the University of Manchester School of Earth, Atmospheric and Environmental Sciences, Karlsruhe Institute for Technology, and ETH Zürich. During the INUIT/CLACE 2013 campaign, GipfelHolo recorded approx. 12 TB of holograms which have been partially analyzed. The weather patterns were quite different during the campaign and therefore we took measurements in various conditions. Included in the data set are holograms of cloud and precipitation hydrometeors from nimbostratus, cellular cumulonimbus, cumulonimbus in a line, and from some non-precipitating water / ice and mixed phase clouds. We had at least two cases of diamond dust (small ice particles nucleating in clear air) and at least one case with almost no cloud ice (despite temperatures being a lot lower than 0°C). One future task is a comparison of the results from our instrument (GipfelHolo) and other cloud probes in the aforementioned instrument suite for various cloud cases. The main focus of our work in this field campaign is the ice / liquid water partitioning in mixed phase clouds as a function of temperature and cloud type. Some images of small ice particles or "diamond dust" are shown in Fig. 1. The instrument is shown in Fig. 2.

Key words:

Cloud microphysics, cloud droplets, cloud ice particles, holographic measurements, mixed-phase clouds

Collaborating partners/networks:

INUIT (Ice Nucleation Unit) Project
University of Manchester, School of Earth, Atmospheric and Environmental Sciences
Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research
ETH Zürich, Institute for Atmospheric and Climate Science

Scientific publications and public outreach 2013:

Conference papers

Schlenczek, O., In-situ-Messungen von Hydrometeoren mit Hilfe eines holografischen Instruments, 8th Extremwetterkongress, Hamburg, Germany, September 23-27, 2013.
Extended abstract (in German) available at: http://extremwetterkongress.de/abstracts/oliver-schlenczek/

Address:

Institut für Physik der Atmosphäre
Universität Mainz
Becherweg 21
D-55131 Mainz

Contacts:

Jacob Fugal and Oliver Schlenczek
Tel.: +49 6131 39 25116 (Jacob)
Tel.: +49 6131 39 24132 (Oliver)
Fax: +49 6131 39 23532
e-mail: fugal@uni-mainz.de and schlencz@uni-mainz.de