

Name of research institute or organization:

**Institut für Physik der Atmosphäre, Johannes Gutenberg-Universität Mainz**

Title of project:

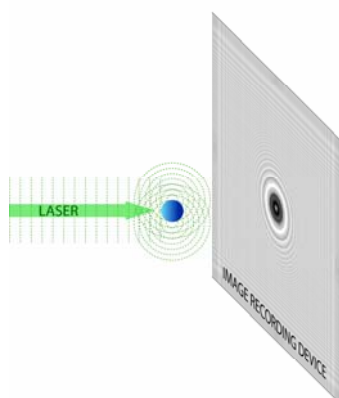
Digital in-situ holography of atmospheric ice particles

Project leader and team:

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during CLACE V also: Dr. Hermann Vössing; Dr. Joachim Curtius

Project description:

Embedded in the “Cloud and Aerosol Characterization Experiment (CLACE) V” in February and March 2006, a newly developed, portable imaging system was field-tested for the first time. Having the aim to achieve simultaneous, sharp images of potentially multiple particles within a certain atmospheric volume *in situ*, its

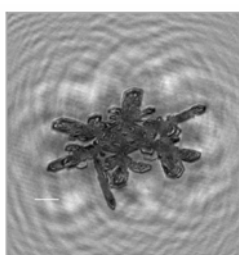
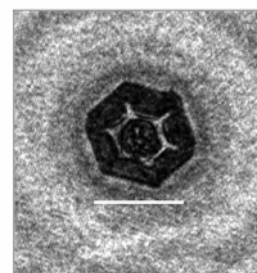


measurement principle is based on the technique of digital holography. In digital holography, the objects under scrutiny are illuminated using coherent light, and the resulting diffraction patterns are imaged using a digital image sensor, such as a CCD or a CMOS-array (see figure). From these raw holograms, a sharp image is reconstructed later on, where each particle can be brought into focus individually.

This camera system additionally has the special feature, that it has a crossed beam path, thereby increasing the volume per “shot”.

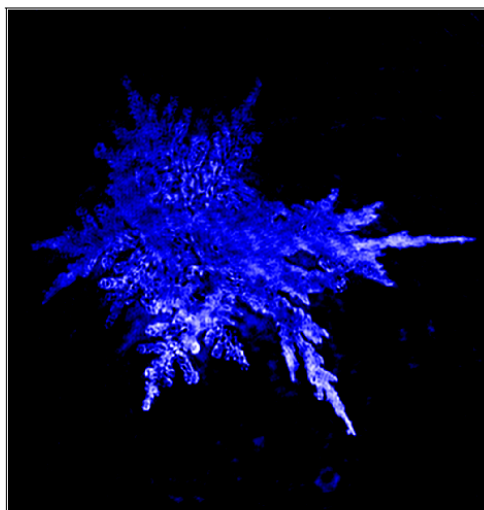
The digital holographic particle camera passed its first field test quite satisfactorily, yielding several thousand holograms of ice particles during several weeks of operation on the Jungfraujoch.

However, under the atmospheric conditions encountered on the Jungfraujoch, certain disadvantages of the initial design became apparent, such as, most notably, a severe undersampling of large particles due to distortions of the airflow.



The experiences made during CLACE V led to several improvements of the instrument. In December 2006, a revised version of the instrument, improved with respect to opto-mechanical construction, ease of mounting and improved softwarewise to allow for real-time viewing of a certain fraction of the raw holograms, successfully underwent a new field verification on the High Altitude Research Station Jungfraujoch.

While the design and optimization process is still ongoing, it can already be said that the tests and measurements on the Jungfraujoeh are indispensable for making the digital holographic particle camera a scientific “real world” application, marking a large step towards the additional development of a reliable airborne measurement system in the future (the residual figures show reconstructions of images of ice crystals from digital holograms obtained during CLACE V (second and third figure) and in Decembre 2006 (fourth figure, false colour representation)).



Key words:

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digital holography, ice crystals, in situ measurement, CLACE

Collaborating partners/networks:

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CLACE V – campaign; collaborative research centre “Die troposphärische Eisphase (SFB641)”

Scientific publications and public outreach 2006:

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**Refereed journal articles**

SMF Raupach et al., Digital crossed-beam holography for *in situ* imaging of atmospheric ice particles, *J. Opt. A: Pure Appl. Opt.* **8** (2006) 796.

**Conference papers**

Raupach, SMF, Curtius J, Vössing HJ, Borrmann S: Digital In-Situ Holography of Atmospheric Ice Particles on the Jungfraujoeh (Poster), Top of Science, Interlaken (2006)

**Radio and television**

“Schneeforschung – Die Magie der weißen Flöckchen”, TV report on the second field deployment on the Jungfraujoeh in: *Deutsche Welle TV – Projekt Zukunft*, shown on Decembre 24, 2006.

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