

# The Clouds and Precipitation Exploration Laboratory in Germany (CPEX-Lab)

\*Silke Troemel<sup>1</sup>, Susanne Crewell<sup>2</sup>, Ulrich Loehnert<sup>2</sup>, Peter Knott<sup>3</sup>, Clemens Simmer<sup>1</sup>

1. Institute for Geosciences and Meteorology, University of Bonn, 2. Institute for Geophysics and Meteorology, University of Cologne, 3. RWTH Aachen/ FHR Wachtberg

CPEX-Lab (<https://www.fz-juelich.de/cpex-lab>) bundles the scientific competences and technical infrastructures within the geoscientific network of the Aachen-Bonn-Cologne/Juelich research area (Geoverbund ABC/J) in Germany for observing, understanding and predicting the evolution of clouds and precipitation. Observations primarily use ground-based microwave remote sensing, which is the sole technology able to penetrate and provide information from within the cloudy atmosphere under precipitation-bearing conditions. In cooperation with the Center for High-Performance Computations of Terrestrial Systems (HPC-TerrSys) of the Geoverbund ABC/J the observations are coupled with high-resolution modelling of the regional Earth system and data assimilation. As a competence centre of Geoverbund ABC/J CPEX-Lab acts as a central lever to structure research activities in meteorology, remote sensing, applied mathematics, engineering, computer sciences and terrestrial research in the area of clouds and precipitation in order to guide and propel the development of future observation and data assimilation capabilities, and to exploits synergies in cloud and precipitation research, teaching and applications. CPEX-Lab integrates the Jülich Observatory for Cloud Evolution Core Facility (JOYCE-CF), which provides high-resolution and state-of-the-art cloud and precipitation observations using instrument synergy, develops standardized and documented operation procedures for cloud and precipitation observations, enables access to CPEX-Lab instruments for external users, and easy and open access to the database and observations of all instruments.

Central CPEX-Lab goals are (1) the development of new sensing approaches for the cloudy atmosphere with active and passive microwaves in synergy with other observations and modelling, (2) the quantification of the role of clouds and precipitation in the Earth system via coupled observational and modelling approaches, (3) the improvement of short-term severe weather prediction via exploiting synergies between ground- and satellite-based remote sensing and data assimilation, and (4) the optimization of solar radiation and wind exploitation in highly dynamic environments.

We will report about the available instrumentation and ongoing and projects exploiting and extending the CPEX-Lab infrastructure. These include amongst others the development of a low-cost phased-array radar, the installation of a microwave radiometer center for best practise and calibration, a multi-stereo camera approach for monitoring cloud height and overlap statistics, the exploitation of CPEX-Labs' s twin polarimetric X-band radars for 3D wind vector retrievals, the characterization of mammatus via the combination of CPEX-Lab' s cloud and precipitation radars, and the application of radar-based surface precipitation for the flash flood predictions using a distributed hydrological model.

Keywords: cloud and precipitation remote sensing, coupling observations and models, use of renewable energy, Improving short-term forecasts, microwave radiometer center for best practise and calibration