JOYCE-CF – Jülich Observatory for Cloud Evolution. A core facility for long-term cloud and precipitation observations

Pospichal, B. [1], J. Beer [2], S. Trömel [2], U. Löhnert [1], C. Simmer [2], S. Crewell [1]
[1]Institute of Geophysics and Meteorology, University of Cologne, [2]Meteorological Institute, University of Bonn

1. Motivation

The **Jülich Observatory for Cloud Evolution – Core Facility** (JOYCE-CF) performs **ground-based remote sensing observations** of atmospheric processes with a variety of different instruments with the goal of a detailed description of **cloud and precipitation processes** (Löhnert et al., 2015).

Clouds and precipitation remain amongst the key challenges for weather and climate predictions. The high variability of these crucial atmospheric parameters as well as different phases and shapes of particles make it difficult to model these processes accurately. Multiple scales - from cloud droplets (10^{-6} m) to synoptic scale storm systems (10^{6} m) makes it necessary to simplify many cloud features in **models**. In order to develop **parameterization** for non-resolved processes, it is important to have detailed measurements of these parameters.

Ground-based atmospheric remote sensing provides information on many cloud macro- and microphysical processes by a combination of different active and passive remote sensing methods with high resolution due to the short distance to the clouds. Therefore, ground-based observations are complementary to satellite missions which can provide global coverage, but at much coarser resolution.

2. JOYCE-CF

JOYCE-CF is a cooperation of the **Universities of Cologne** and **Bonn** as well as the **Forschungszentrum Jülich**.

The instrument deployment started in 2008, and the core measurement setup was established by 2011 (Fig. 1). Since 2016, it has been promoted to an DFG-funded core facility which acknowledges the importance of the unique instrumentation for cloud and precipitation processes.

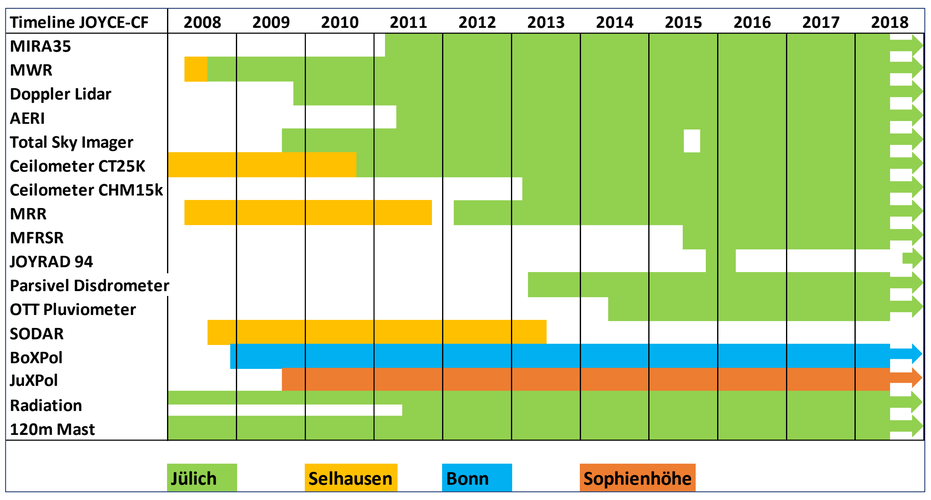

***Fig. 1**: Timeline of JOYCE-CF instrumentation.*

3. Research projects, International cooperation

JOYCE-CF is involved in a variety of national and international research projects. It served as the main observatory for the HOPE campaign within the BMBF-funded project HD(CP)² - High-Definition Clouds and Precipitation for Climate Prediction (Macke et al., 2017).

Since 2011, JOYCE-CF is part of the European cloud observation network Cloudnet (Illingworth et al., 2007). In near future JOYCE-CF is planned to be part of a European research infrastructure on clouds, aerosols and trace gases (ACTRIS). Further projects include TR32 (Patterns in Soil-Vegetation-Atmosphere-Systems), ETCC (Energy Transition and Climate Change) and the Hans-Ertel-Zentrum for Weather Research.

4. Instrumentation, Location

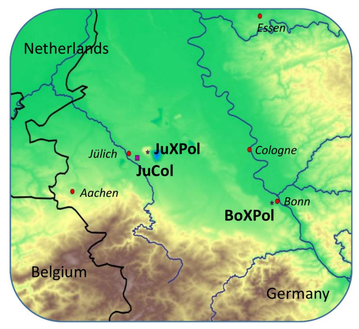

***Fig. 2.** Top: Map of JOYCE-CF area with the main sites. Left: Instruments of JOYCE-CF*

http://joyce.cloud

The instrumentation of JOYCE-CF is distributed at three sites (Fig. 2):

JuXPol and BoXPol are the two scanning polarimetric X-Band radars at the Sophienhöhe and Bonn.

JuCol: Column observations with active and passive instrumentation at the Forschungszentrum Jülich. The list of instruments can be seen in Fig. 1

5. Data products, Access

JOYCE-CF is designed as a research infrastructure to both provide long-term data products for climate studies and to serve as a platform for dedicated measurement campaigns with special focus.

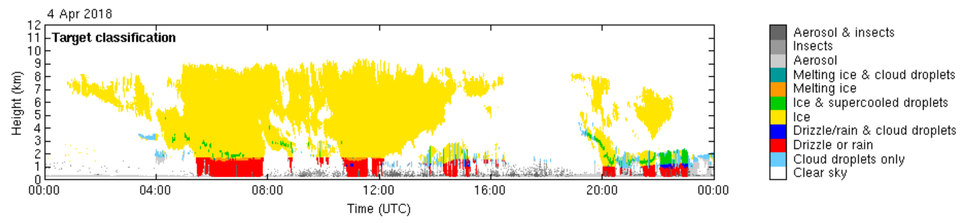

Fig.3: Cloudnet target classification from 4 April 2018 at Jülich (JuCol)

Long-term datasets are available for:

- Cloud classification (Fig. 3), cloud vertical structure, cloud liquid and ice water content
- Precipitation fields, Polarimetric radar variables
- Water vapor (column integrated, profiles)
- Temperature profiles
- Boundary-layer wind profiles (3D)
- Surface radiation balance
- 120 m Tower observations
- Aerosol optical depth

With these observations, JOYCE-CF serves as a testbed for small-scale atmospheric models (e.g. ICON-LEM) in order to asses model performance and to develop new cloud and boundary-layer parametrizations.

Acknowledgements

We acknowledge the Deutsche Forschungsgemeinschaft for funding of the JOYCE-CF core facility. The Forschungszentrum Jülich is thanked for the excellent infrastructure as well as the fruitful long-term cooperation. We would also like the many colleagues who were involved in the measurements and product generation.

References:
Löhnert, U., et al., 2015: JOYCE: Jülich Observatory for Cloud Evolution. *Bull. Amer. Meteor. Soc.,* **96**, 1157–1174.
Macke, A., et al., 2017: The HD(CP)² Observational Prototype Experiment (HOPE) – an overview, Atmos. Chem. Phys., 17, 4887-4914.
Illingworth, A.J., et al., 2007: Cloudnet. *Bull. Amer. Meteor. Soc.,* **88**, 883–898.

Contact: bernhard.pospichal@uni-koeln.de