HD(CP)² Observational Prototype Experiment

Water Vapour and Temperature Measurements

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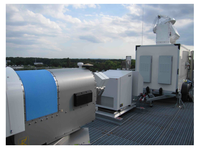
Three supersites within 5 km radius

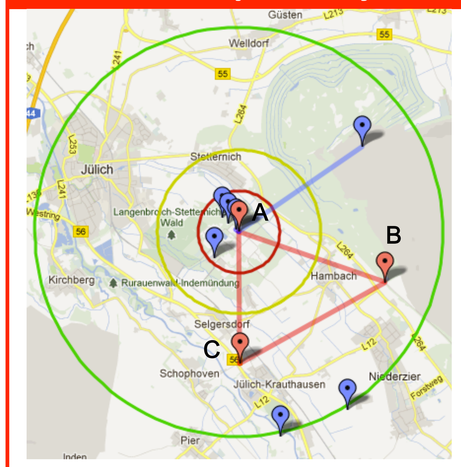
JOYCE: Jülich Observatory for Cloud Evolution (A)
- Scanning cloud radar MIRA
- Scanning MWR HATPRO
- WV Raman lidar MPI & BASIL
- Scanning Doppler lidar
- AERI system
- Ceilometers, MRR, all-sky imager
- Aeronet station, radiation sensors



KITcube & UHOH (B)
- Cloud radar MIRA
- Scanning MWR HATPRO
- Scanning WV DIAL
- Rotational Raman Lidar
- Doppler Lidar, ceilometer
- Mobile X-band radar, rain gauges, MRR
- 2 ceilometers, MRR, 30m tower
- Surface energy balance

LACROS: Leipzig Aerosol and Cloud Remote Observations System (C)
- Multi-wavelength Raman Lidar
- Scanning cloud radar MIRA
- MWR HATPRO
- Scanning Doppler lidar
- All-sky imager, ceilometer

HOPE: April-May 2013, Jülich, Germany



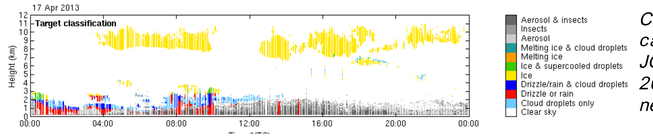
HOPE area 1, 2, 5 km radius (red, yellow, green) around the Research Centre Jülich (red circle)

Objectives
- Evaluate HD(CP)² cloud resolving model (dx=100m) over the full domain of Germany (1000 km)
- Provide information on sub grid variability

Focus
- 3D cloud and water vapor fields
- Clouds (activation) and precipitation (auto conversion) in the BL
- Cloud-overlap and 3D radiative effects
- Aerosol and cirrus cloud properties

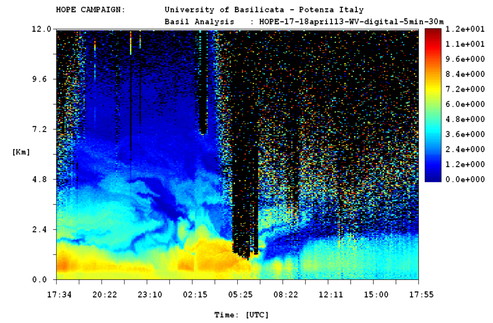
Additional measurements
- 0 and 12 UTC radiosondes
- Array of 100 surface solar irradiance stations
- MWR profiler for continuous BL temperature profiles
- 2 X-band Dual Polarization weather radars
- 3D cloudy reconstruction from all-sky cloud cameras
- EC stations and soil moisture measurements

Measurement integration
- Cloudnet products: cloud classification, cloud cover, cloud microphysics
- 1DVAR retrieval of thermodynamic and cloud property profiles (IPT)
- 3D radar composites merged with satellite data

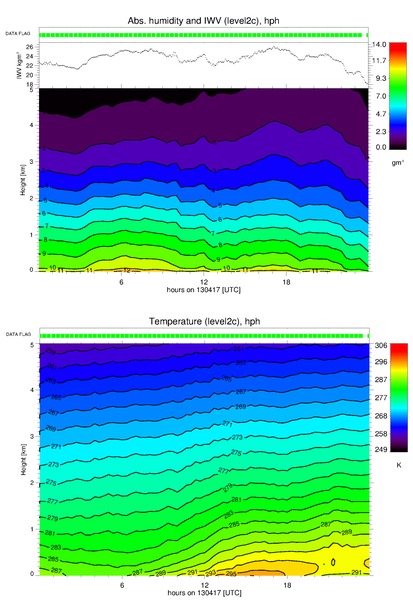


Cloudnet target categorization at JOYCE on 17 April, 2013 (www.cloud-net.org).

Raman Lidar and Microwave Radiometer



Top: BASIL Raman Lidar measurements of water vapor mixing ratio for the 17th and 18th of April. Digital signal with 30 meters vertical resolution and 5 minutes integration time. Calibration performed with radio sounding data. Courtesy of Paolo Di Girolamo, University of Basilicata – Potenza, Italy.



Left: Microwave radiometer data (HATPRO) for the 17th of April: time series of absolute humidity (gm-3; top) and temperature (K; bottom) profiles from ground to 5 km height. Information is based on a statistical retrieval.

HATPRO	LIDAR
✔ calibration with internal references	✗ instability of the laser
✔ continuous data acquisition	✗ no internal calibration
✔ all weather conditions but rain	✗ opaque to clouds
	✗ can have daylight limitations
✗ limited vertical resolution	✔ very high vertical resolution

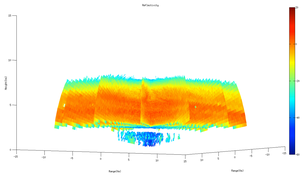
Thesis aim
- Retrieval of highly vertically resolved temperature, absolute humidity and relative humidity profiles by optimally combining MWR and Raman lidar measurements,
- Retrieval application and use for satellite validation (IASI),
- Atmospheric Process Studies of cloud formation (HOPE & Barbados).

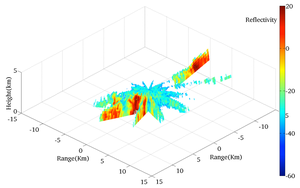
Scanning cloud radar

Coordinated scan patterns of HOPE cloud radars

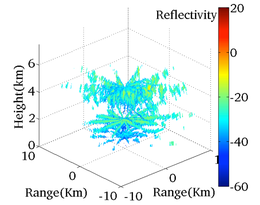
JOYCE scanning cloud radar

- Combine different radars at distinct azimuth angles → enhance effective scan speed
- Temporal coordination necessary





Example of three domus scans@JOYCE



Other scan patterns
- *BL wind parallel:* capture life cycle of single BL cloud with 2 radars
- *Cross wind:* extend standard vertical viewing to two dimensions