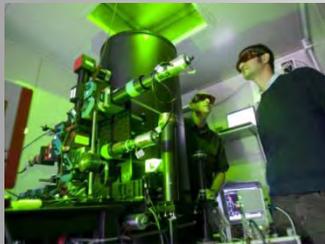# COPS (Convective and Orographically-induced Precipitation Study)

1. **Overview (Volker Wulfmeyer):**
   - **Further insight in COPS data set**
   - **Ongoing projects and their links to ARM, WWRP, and WCRP**
   - **IPM water-vapor differential absorption lidar and temperature rotational Raman lidar**
2. **Dave Turner: Modifications to the water vapor continuum in the microwave suggested by ground-based 150 GHz observations**
3. **Ulrich Löhnert: Overview of microwave radiometry and potential of sensor synergy during the COPS AMF deployment**
4. **Discussion:**
   - **Cloudnet and IPT products**
   - **Model evaluation efforts**
   - **Proposals of future joint projects**

# Data Sets (see cera-www.dkrz.de/WDCC/ui/BrowseExperiments.jsp)

**Radiation:** Energie balance network, AMF, CM-SAF, and Land-SAF retrievals

**Land-surface exchange:** Soil moisture, turbulence, and weather stations

**ABL and CI:** Active-passive VIS-IR-MW remote sensing synergy, soundings, GPS network, MSG Rapid Scan Service (RSS)

**ACM:** In-situ, AERI-MWR-lidar-radar synergy, MSG RSS

**Precip:** In-situ, micro rain radar, DOW, polarization and weather radar

## D-PHASE Model Ensemble:

- 6 LAM ensemble forecast systems
- 12 deterministic models with convection parameterization
- 9 convection permitting deterministic models
- Harmonized and extended data set in GRIB1 following the so-called TIGGE+ table

## Short COPS statistics:

➢ 2,700 soundings

➢ 11,000 h of lidar operation

➢ 10 aircraft with 400 flights hours

➢ 10,000 model runs with 50,000,000 model fields and plots (COPS domain)

➢ 60TB of data

# COPS Publications and Links

- **Website: www.uni-hohenheim.de/cops/**

- **Central data archives:**
  **cera-www.dkrz.de/WDCC/ui/BrowseExperiments.jsp,**
  **with publication data base (12 refereed pubs, 100 at**
  **conferences),**
  **www.archive.arm.gov,**
  **gop.meteo.uni-koeln.de**

- **Recent highlight: Dec. 2008 Special Issue on QPF**
  **of published in** Meteorologische Zeitschrift **see www.metzet.de**

**Coordination**

**& DAP**

D-PHASE/COPS Process Chain
& COPS Coordination
(IPM, WDCC, UniVie, MeteoSwiss)

COPS-GRID
(IPM, GFZ, DWD)

**CI**

Moisture Net (IMK)

SurfAce fLuxes and
Valley convEction
(U Bayreuth, U Mainz, IMK)

Lower and upper
tropospheric forcing
of convection (IMK)

COPS-CI Remote Sensing
(IPM)

Parameterization of cumulus
convection (U Bonn)

**ACM**

COPS-LIDAR-IFT
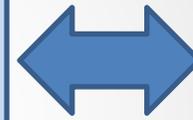(IfT)

**PPL**

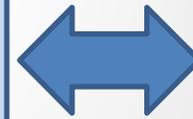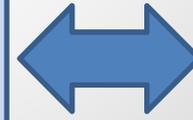Life Cycle of Deep Convection
during COPS (DLR)

**D-PHASE**

**ETReC07**

**COPS-Austria**

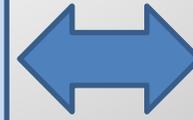**COPS-France**

**COPS-Italy**

**COPS-UK**

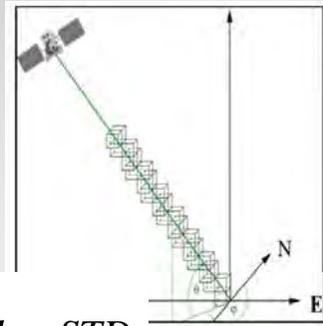**ARM**

**TRACKS**
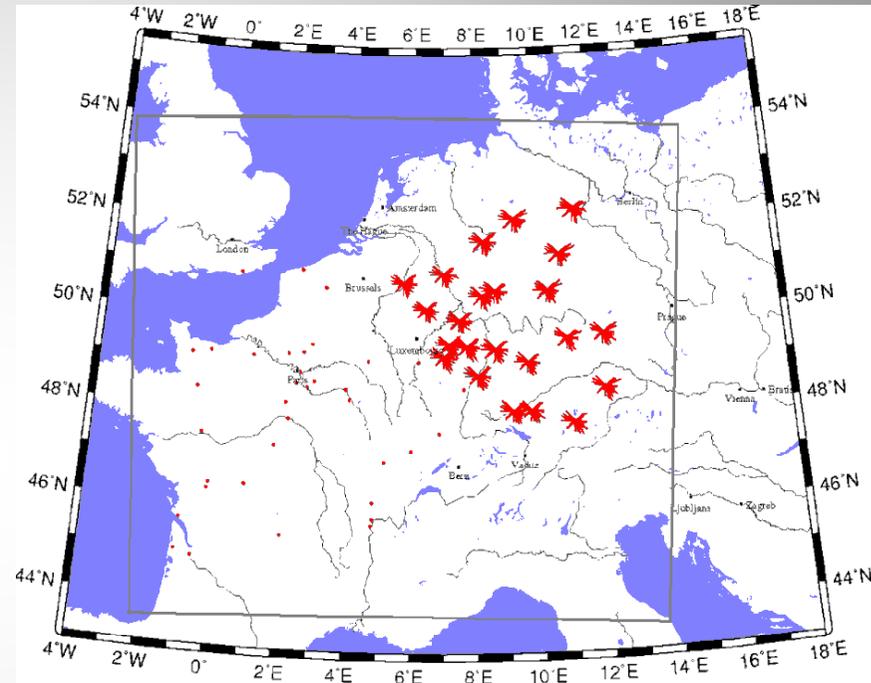
# Data Assimilation: 4DVAR Using GPS Slant Total Delay (STD) of European Network



$$STD = \int_{z_0}^{TOA} \left( c_1 \frac{p}{T} + c_2 \frac{pm}{(c_3 + m)T^2} \right) ds + STD_0$$

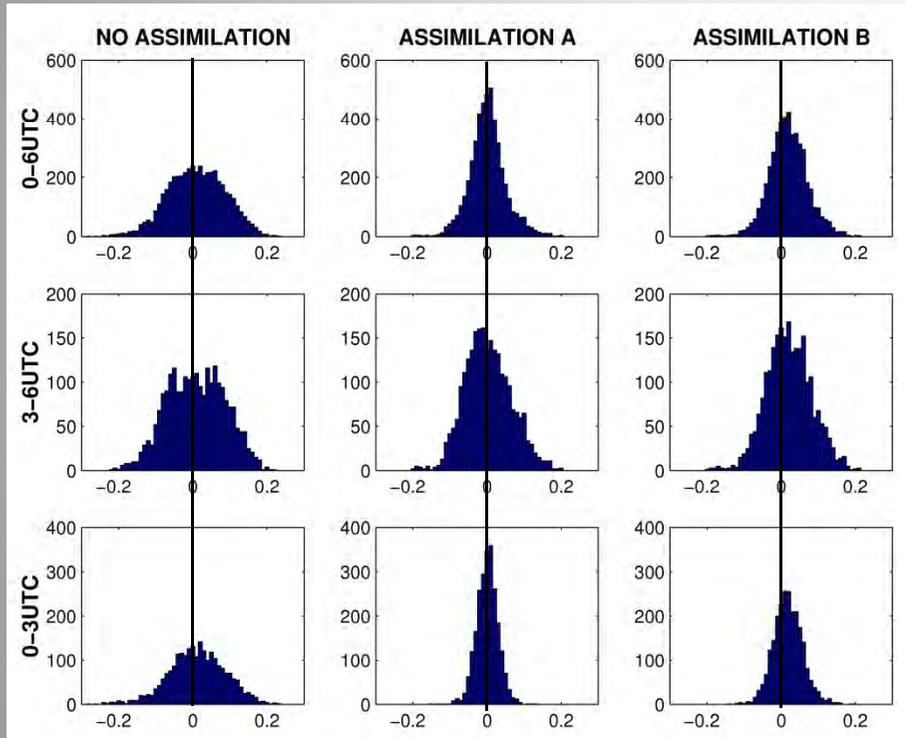**GPS STD contains continuous information concerning the 3D mixing-ratio field over a large domain.**

**IPM developments and applications using MM5:**
- **Wulfmeyer et al. MWR 2006 (airborne lidar),**
- **Grzeschik et al. JTECH 2008 (ground-based Raman lidar)**
- **Zus et al. Meteorol. Z. 2008 (GPS network)**

# Data Assimilation, Verification, and Predictability

**Frequency distribution of difference between observed and modeled STDs**



18 km res.    Grell +     Kuo +
              hor. diff.  hor. diff.

**The power of 4DVAR:**

- **Improvements of forecasts**
- **Advanced model evaluation tool by means of reanalyses, e.g., of regional climate models in weather forecast mode**
- **Provides flow dependent analysis error covariance matrices**
- **Starting point for mesoscale model ensemble perturbations and, thus, mesoscale predictability studies**
- **First reanalysis project has been started by German Meteorological Service (DWD)**

# COPS Breakout AIs
# Scientific Exploitation of the AMF Data Set

- **Retrieval algorithm intercomparison**
- **Comparisons with satellite retrievals**
- **Comparison of satellite retrievals**
- **Cloud and precipitation statistics data sets**
- **Coordination of model verification**
- **Comparison of COPS statistics with other sites**
- **Data assimilation impact studies (MWR)**
- **Corresponding Wiki?**
- **Links to COPS data set on ARM website**
- **Team working on these issues will be set up**