Current status and first results of the SPP1167 project COPS-GRID

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Motivation
- Precipitation has a strong influence on our economy and general livelihood. The forecast of small-scale severe precipitation events is among the most difficult tasks in meteorology.
- Radiosondes, active and passive remote sensing are the major sources of water vapor observations used operationally.
- Nevertheless, severe gaps exist in the observation network of atmospheric dynamics and the hydrological cycle. This is especially true for the mesoscale.
- More sophisticated observing systems, e.g., polarization Doppler radar, GPS or lidar, will be used operationally in the future. The preparation of the assimilation systems for these systems is an important task.

Hypotheses
- New observing networks, such as radar and GPS stations provide important additional information improving mesoscale precipitation forecasts.
- Sensitive locations exist, where the effect of these observations on the forecast quality is largest.
- Convection permitting simulations are important to improve quantitative precipitation forecasts and process understanding.
- Sophisticated 4-dimensional assimilation systems like Nudging and 4DVAR, used in convection permitting models, are essential for improving QPF on the mesoscale.

Status of the WRF and WRF 4DVAR (IPM)
- The current release is WRF V3.0.1.1 from August 2008 (including 4DVAR F-GAT, public 4DVAR follows in release 3.1 planned for March 2009 with the same set of operators).
- Various new physics options (including 2-moment cloud microphysics and updates of earlier schemes) are included.
- Direct initialization from ECMWF model level data (including cloud water and cloud ice).
- Operators are available for upper air observations, surface measurements, GPS, GPR/MF, GPR/SR, GPS ZTD, satellite observations (winds and radiance) and radar measurements (reflectivity and radial velocity).
- Basic quality checking and data thinning is implemented for standard observations.

Operator development (IPM)
During the next two years, the assimilation system shall be extended to process observations of scanning lidar systems and radial velocities of the WRF radar network.

Scanning lidar:
- Application of radar-derived rain rates into the COSMO-DE analyses.
- Weather prediction models provide all information required to compute the 3D fields of the refractivity (dry + wet), the water vapor and the corresponding delays along any given slant path. A simulation tool developed at the GFZ has been used to compare the observed and the simulated delays (ZTD + STD). The T2D generally agree very well (Fig. 4) but there are some cases where the model diverges from the atmospheric state.

GPS Meteorology (GFZ)
During the COPSS, GFZ provided near real-time GPS-derived tropospheric products to the meteorological community: MVV with a temporal resolution of 15 minutes, STDs with a resolution of 2.5 minutes as well as meteorological observations.

GPS satellite slant delay:
- GPS-derived slant delays have been validated using the COSMO-DE analyses. Weather prediction models provide all information required to compute the 3D fields of the refractivity (dry + wet), the water vapor and the corresponding delays along any given slant path. A simulation tool developed at the GFZ has been used to compare the observed and the simulated delays (ZTD + STD). The T2D generally agree very well (Fig. 4) but there are some cases where the model diverges from the atmospheric state.

Radar radial velocity:
- The extended WRF 4DVAR will be used to perform process studies for selected COPS IOPs (see poster of Thomas Schettalla and talk of Florian Zuz).