Priority Program SPP 1167 of the DFG

Quantitative Precipitation Forecast

Current status and first results of the SPP1167 projects COPS-GRID and D-PHASE Verification

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COPS-GRID:

This project is executed in cooperation with GFZ and DWD. See posters A8 and C5 and talk V. Wulfmeyer.

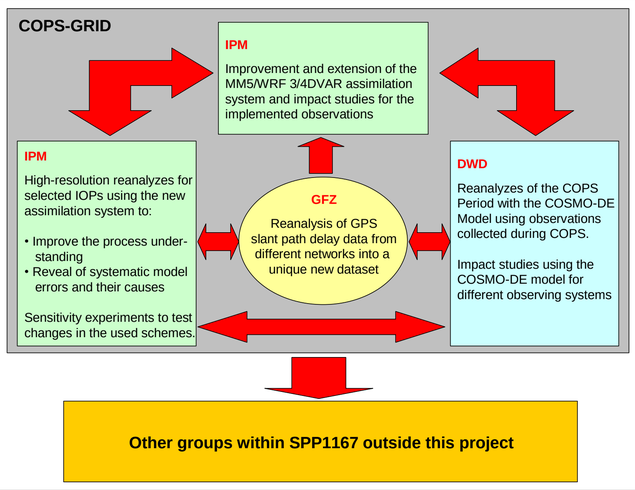


***Figure 1**: Project partners and their major tasks in the project COPS-GRID. GFZ provides improved GPS slant path delay data to IPM and DWD. On the other hand, they use the results of the high-resolution model studies. IPM and DWD closely cooperate for the planned impact studies. Both, GPS as well as model results are provided to other groups with SPP1167.*

Case study experiment: COPS IOP 9c (20 July 2007)

A strong mesoscale convective system (MCS) developed over France and passed the COPS region to the northwest. Re-developing, strong convection on the eastern side of the Black forest merged into a squall line moving from southwest to northeast during the day.

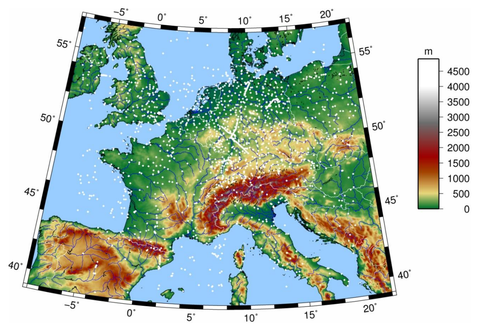


***Figure 2**: Domain configuration for the WRF simulations. It consists of 550x550 grid boxes and 50 vertical levels up to 50 hPa and is operated with 3.6 km horizontal resolution. The white dots mark locations of observations used during the assimilation.*

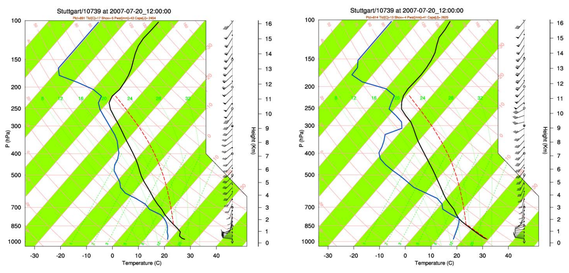


***Figure 3**:Skew-T diagram of temperature, dew point temperature and wind for the WRF grid point Stuttgart at 12Z, 20th July 2007. **Left panel**: CONTROL forecast, **Right panel**: 3DVAR forecast.*

For the assimilation experiment a total number of 1600 observations are assimilated in the time window +/- 1 hour around the analysis time 00Z, 20th July 2007.

Observations types were SYNOP, Metar, SHIP, TEMP, AIREP, GeoAMV, Profiler and GPS ZTD.

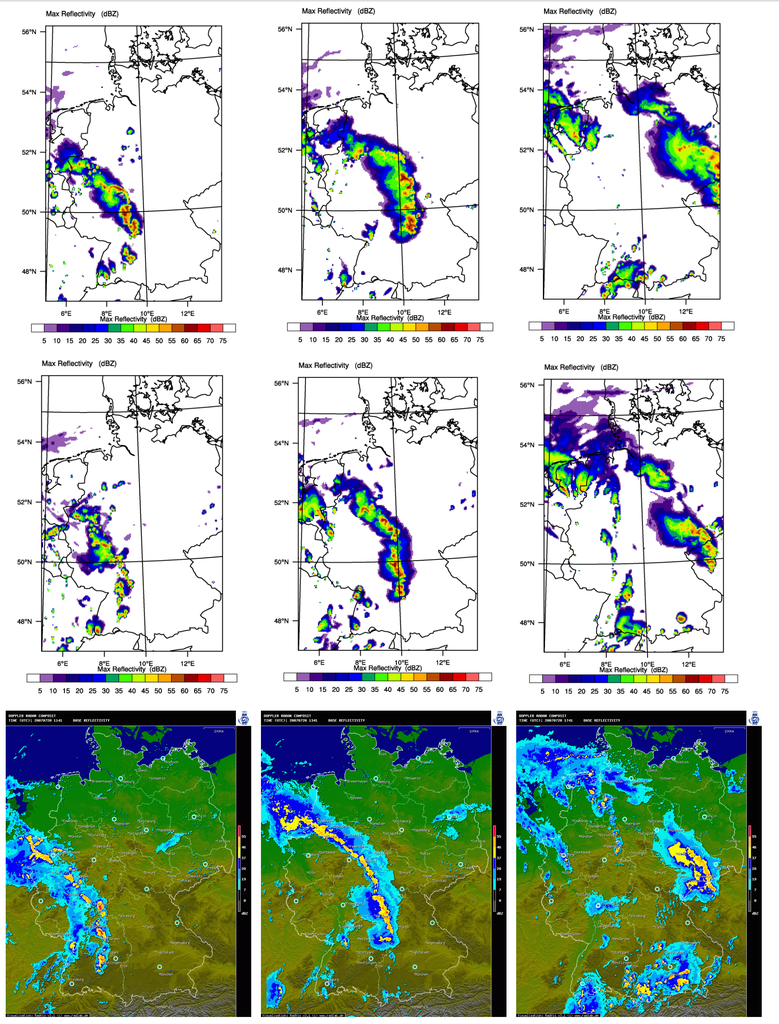
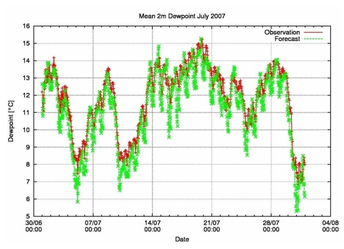


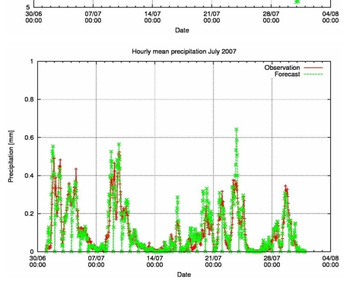
***Figure 4**: Radar reflectivity derived from WRF model output for 3 time steps during the development of the squall line .**Top row**: CONTROL. **Middle row**: 3DVAR. **Bottom row**: DWD composite (GUST).*

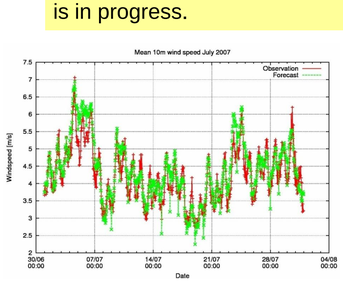
Forecast Statistics July 2007

An important task is to investigate the performance of the forecasts of different synoptic situations occurring in the region shown in Figure 2. Therefore, we evaluated all 30 hour forecasts of July 2007, started at 00Z each day.

In these simulations, no re-assimilation of observations was done. A similar series of forecasts with assimilation is in progress.

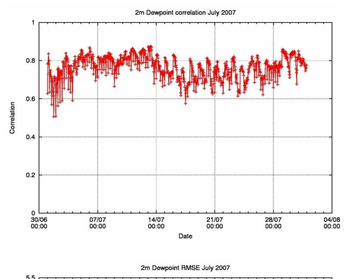






The analyses are performed with the Model Evaluation Tools (MET) verification package from the NCAR Development and Testbed Center in Boulder, Colorado.

***Figure 5**: Comparison of observed (red) and simulated (green) mean dew point temperature (upper left), mean precipitation (lower left), and mean 10m wind speed (bottom).*



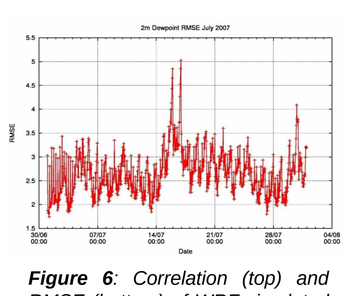


***Figure 6**: Correlation (top) and RMSE (bottom) of WRF simulated mean dew point temperature for July 20007.*

First results of WRF experiments

- The statistical evaluation of the WRF CONTROL forecasts shows that the model generally agrees well with the observations for the different variables with differences occurring in details.
- The simulated 10m wind velocity appears systematically to strong during nighttime leading to a too strong mixing and therefore to lower humidities.
- Both forecasts show the general features of the developing squall line for IOP 9c.
- Initialization with 3DVAR leads to an improved representation of the development of the squall line.
  - The front is narrowed with a sharper reflectivity gradient especially on the rear side of the developing system.
  - The timing of the line (slower with assimilation) and the location of the single cells is more realistic as in the CONTROL simulation when compared to the DWD radar composite.

Outlook

On the agenda are the investigation of more COPS IOPs and extended statistics with more variables and scores. The monthly statistics will also be done for a series of forecasts initialized by 3DVAR. Another important task is to relate the model performance to the synoptic situation.

D-PHASE Verification

This project is done in cooperation with UniVie, MeteoSwiss, KIT and WDCC. See poster C7 and talks V. Wulfmeyer and M. Dorninger.

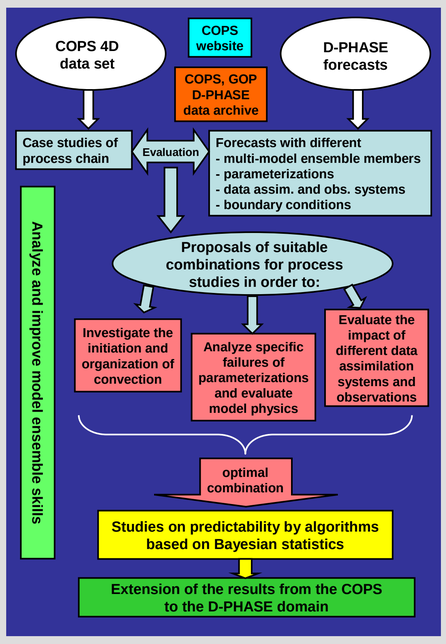


***Figure 7:** COPS/D-PHASE research vision and coordination. All colors indicate a respective work package (WP). Dark blue background: IPM COPS Coordination. Cyan: IMK COPS website. Orange: WDCC data archive. Light blue: IPM model evaluation with support by MeteoSwiss, and UniVie. Light red: IPM process studies with support by MeteoSwiss, and UniVie. Light green: Verification with MeteoSwiss and UniVie. Yellow: IPM, Dark green: IPM and UniVie.*

Evaluation Strategy

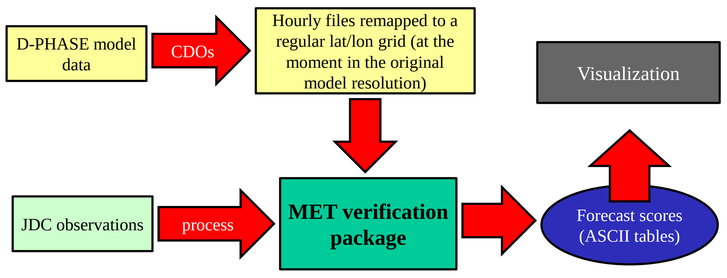
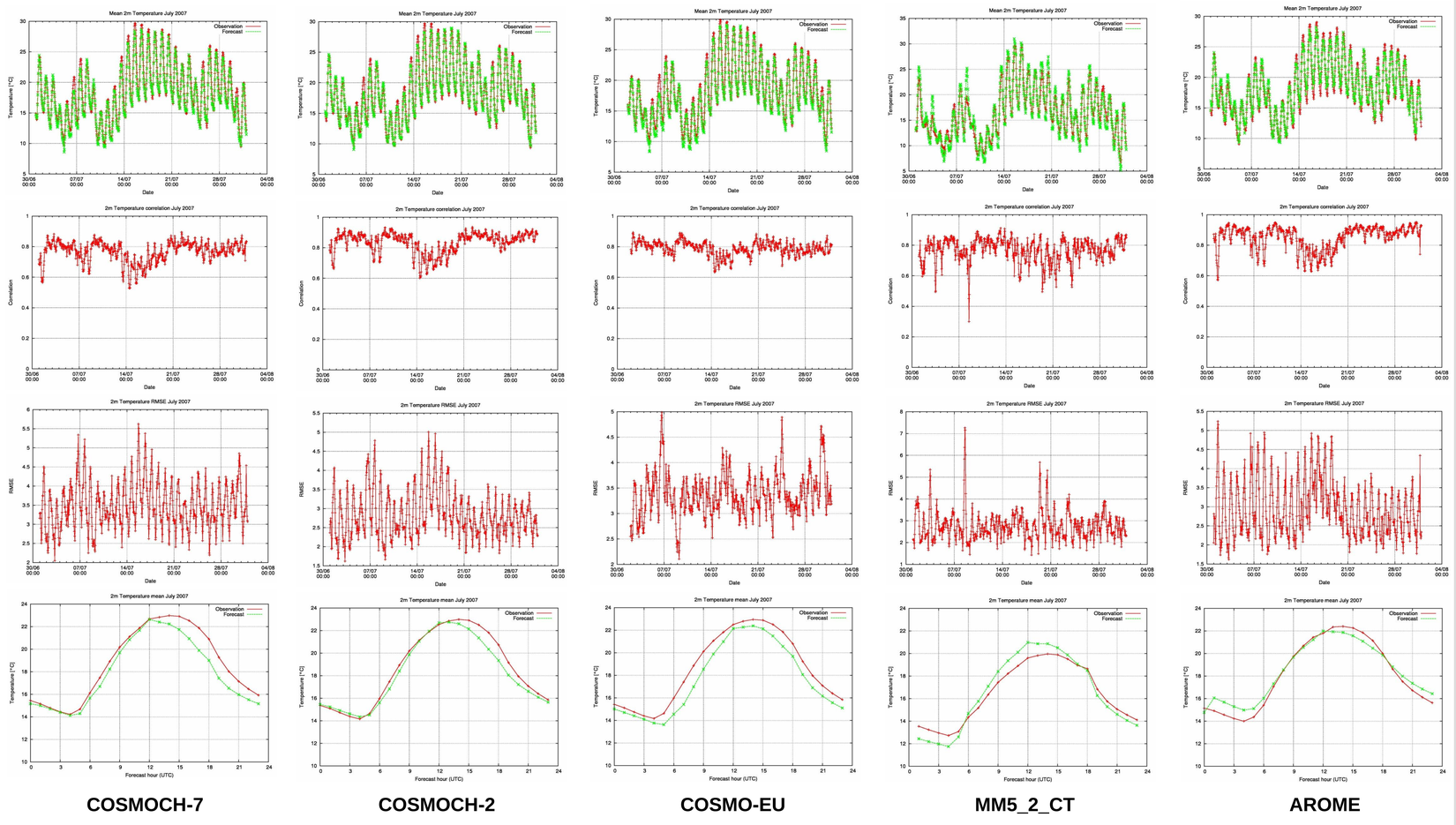


***Figure 8:** Sketch illustrating the evaluation strategy. The D-PHASE model data and the observations are pre-processed for the MET verification package and the resulting ASCII tables are post-processed and visualized with different Linux tools.*

First Verification Results



COSMOCH-7 | **COSMOCH-2** | **COSMO-EU** | **MM5_2_CT** | **AROME**

First Results

- As expected, the models agree well with the observed averaged 2m temperature.
- The COSMO models and AROME tend to underestimate the amplitude of the 2 m temperature, MM5 tends to overestimate the amplitude.
- Large differences between the models occur in the RMSE
- The scores depend on the synoptic situation
- In situations with high near surface temperatures, lower correlation coefficients and larger RMSE occur.

Outlook

The statistical evaluation will be extended to include more models, more evaluated variables, more scores and will cover the whole COPS period.

An accurate relation of the results to the occurring synoptic situation will be performed to reveal similar systematic errors in the different models.