Long-Term Evaluation of COSMO-DE and COSMO-EU Model Forecasts during GOP 2007 within Priority Program on Quantitative Precipitation Forecast: First Results

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GOP 2007

A General Observation Period (GOP) is currently being performed within the German Priority Program on Quantitative Precipitation Forecasting (PQP). By optimizing the use of existing instrumentation on a large data set of in-situ and remote sensing data especially on the hydrological cycle is being gathered over the full year 2007.

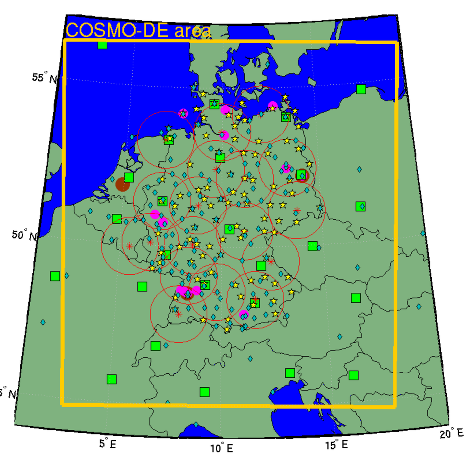

Fig. 1: Map of GOP area indicating micro rain radar stations (pink disks), radiosounding stations (green squares), DWD ceilometer network (yellow), GPS network (blue diamonds), and German and Belgium weather radars (red circles)

NWP Models

- COSMO-DE
  2,8 km mesh size, 50 layers, forecast length +21 h, covering mainly Germany (see Fig. 1) (Baldauf etal. 2006)
- COSMO-EU
  7 km mesh size, 40 layers, forecast length up to +78 h, coveribng whole Europe (Schulz und Schättler, 2005)

Observational data

Integrated Water Vapor (IWV): RS vs GPS observations

A comparions of radiosonde vs GPS IWV observation revealed that 12-UTC IWV observations by radiosonde ascents were significantly dryer those from 00-UTC ascents (Fig. 2). The bias between radiosonde and GPS differs from station to station, but is for all stations greater at 12 UTC than at 00 UTC. The reason for this difference between 00 UTC and 12 UTC is probably a daytime dry bias of about 7 % in radiosonde humidity measurements due to radiative effects (Vömel et al., 2007), whereas GPS IWV observations do not show such a dependeny on time of the day.

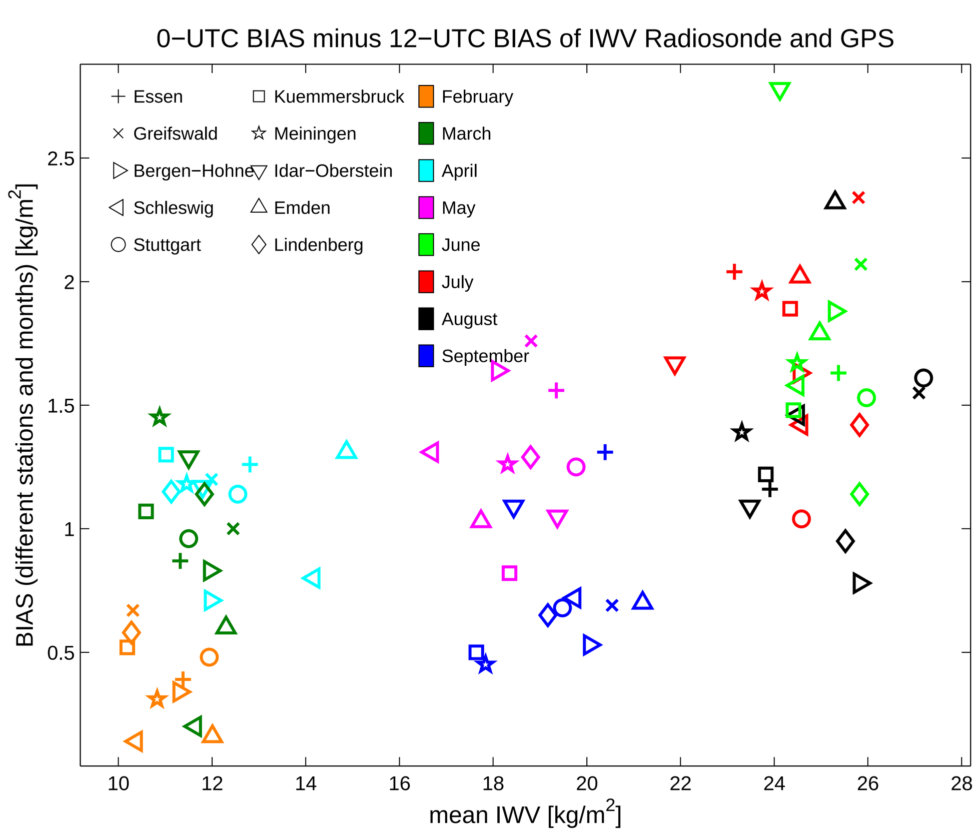

Fig. 2: Mean difference between night-time and day-time IWV Bias (RS-GPS) for different radiosonde stations and months.

Results of Model Evaluation

Integrated water vapor (Model vs. GPS):

- Model IWV bias mainly depends on the start time of the model
- Model runs started at 12, 15, 18 (,21) UTC significantly drier than those started at 00, 03, ... 09 UTC
- COSMO-EU dryer than COSMO-DE

The model runs started at 12, 15, 18 (and, to some extent, 21 UTC) are significantly drier than those started at 00, 03, 06, 09 UTC. The likely reason for this behavior is that in the first group of model runs (started 12 .. 21 UC) the water vapor information from 12-UTC ascends enters while in the second group of model runs the water vapor information from 00-UTC ascends is ingested. A similar difference has been reported by Guerova et al. (2003) for a previous version of the COSMO model for Switzerland. Especially in COSMO-DE the dryer model runs (started 12, 15, 18 UTC) gain moisture with time in their first forecast hours.
RMSE increases with forecast lead time, as to be expected.

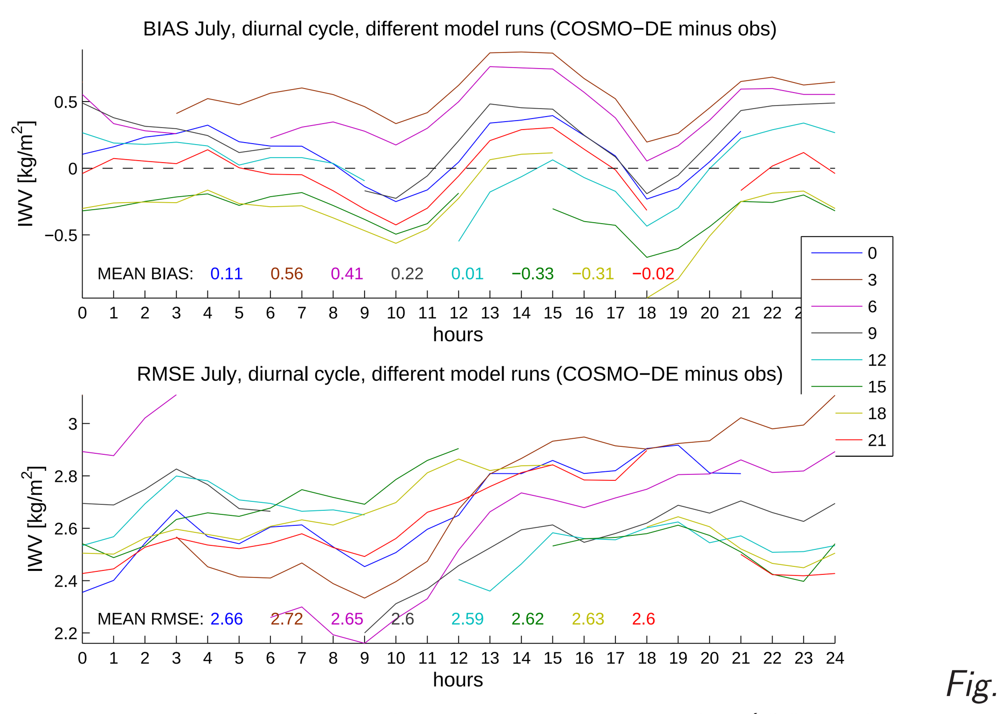

Fig. 3a: Mean diurnal cycle of IWV bias and RMSE (COSMO-DE minus GPS) in July 2007. Colors indicate start times of model runs started.

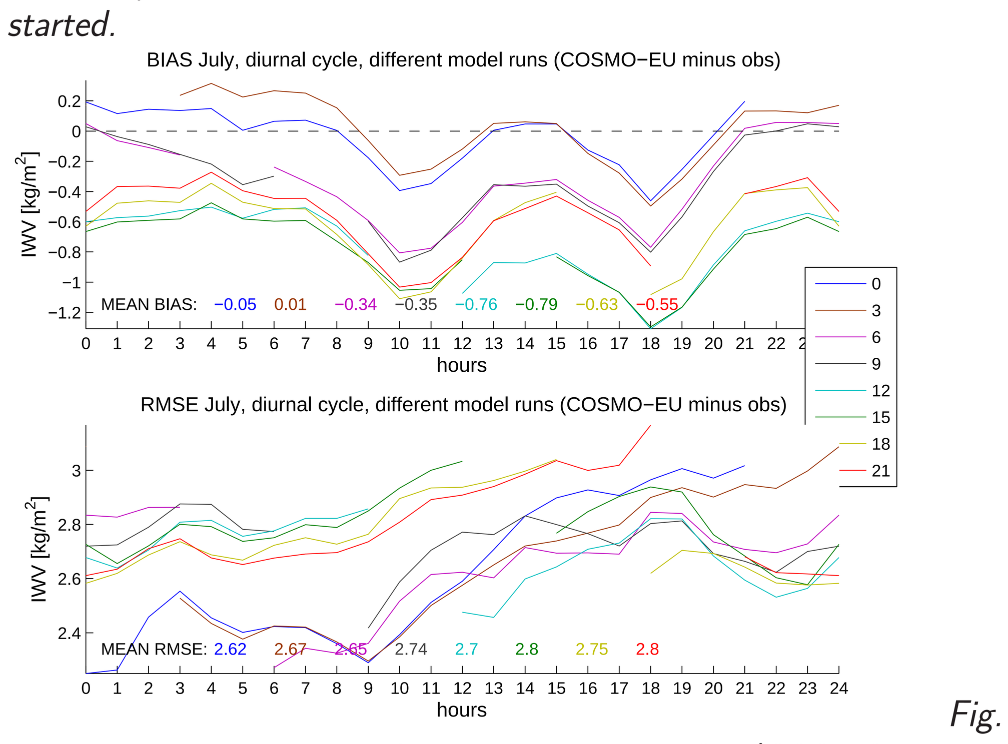

Fig. 3b: Mean diurnal cycle of IWV bias and RMSE (COSMO-EU minus GPS) in July 2007. Colors indicate start times of model runs started.

Cloud base height (Model vs. Ceilometer):

Measurements of cloud base height (ceiling) are currently available from about 100 DWD stations (see Fig. 1). Fig. 4 shows that cloud base in July 2007 was generally slightly too low in COSMO-DE compared to the ceilometer observations. The model runs started at different times of the day don't differ in terms of their mean cloud base height as strongly as they do in terms of IWV. But some tendeny similar to the one seen in the IWV shows up also in the simulated cloud base height: COSMO-DE runs started 00, 03, ..., 09 UTC simulate lower cloud base heights than the model runs started at 00, 03, ... 09 UTC, resulting in deeper(?) clouds.

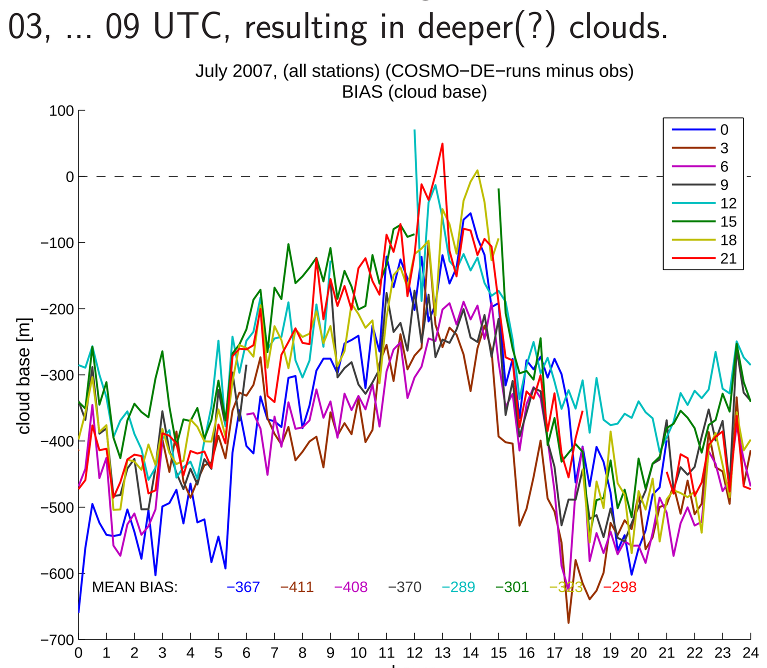

Fig. 4: Diurnal bias of COSMO-DE cloud base vs. ceilometer cloud base (only data where a cloud was present both in model and observation) for July 2007.

Outlook

Next steps:

- Cloud top height, cloud optical thickness, cloud cover from satellite observations (MSG))
- Satellite vs ceilometer
- Dependency of forecast skill on weather situation?

Acknowledgements

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Precipitation(models vs. RANIE analyses)

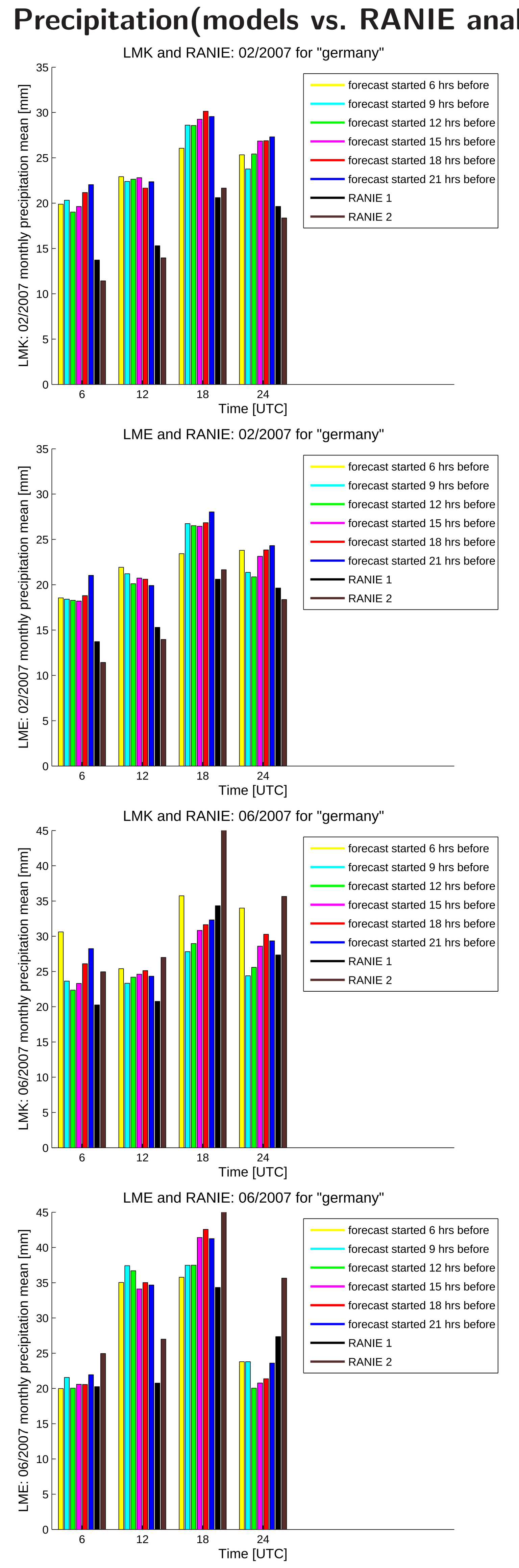

Fig. 5: Mean monthly precipitation over Germany. RANIE precipitation analyses and COSMO-DE and COSMO-EU model forecasts.

Results

- In summer (with Latent Heat Nudging) COSMO-DE simulates systematically more precipiations in early forecast hours than lateron. COSMO-EU (without Latent Heat Nudging) does not show this tendency.
- In winter both modells overestimate precipitation significantly.
- Note that RANIE2 (radar and gauge combined) analyses show in summer significantly more precipitation than RANIE1 analyses whereas in winter in mean they don't differ much.

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