



Sensitivity studies with COSMO-DE focused on convective cases

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Outline

1. Motivation
2. Focus of Comparison
3. Sensitivity studies
 1. Initial Conditions
 2. Boundary Conditions
 3. Long term forecasts
 4. State of the art
4. Conclusions

Motivation

- The main short coming of COSMO-DE might be the **insufficient forecast** of convective events, esp. of summery **air mass convection**
- DWD-forecasters complain a bad performance in summery conditions. They also mention a dependency of the performance on the day time at which the model integration starts:
The older a forecast the better seems to be the performance.

Focus

- convective period (31.05. until 13.06.2007)
 - High pressure conditions with enhanced small scale convection in the afternoon
 - Only few large scale system came across Germany

- Sensitivity studies with different initial states, different boundary values and the newest setting of physical parameters

- Comparison of the diurnal cycle of observed (radar) and modelled precipitation rates within the radar domain

Domain of 16 German radars

Use for comparison:

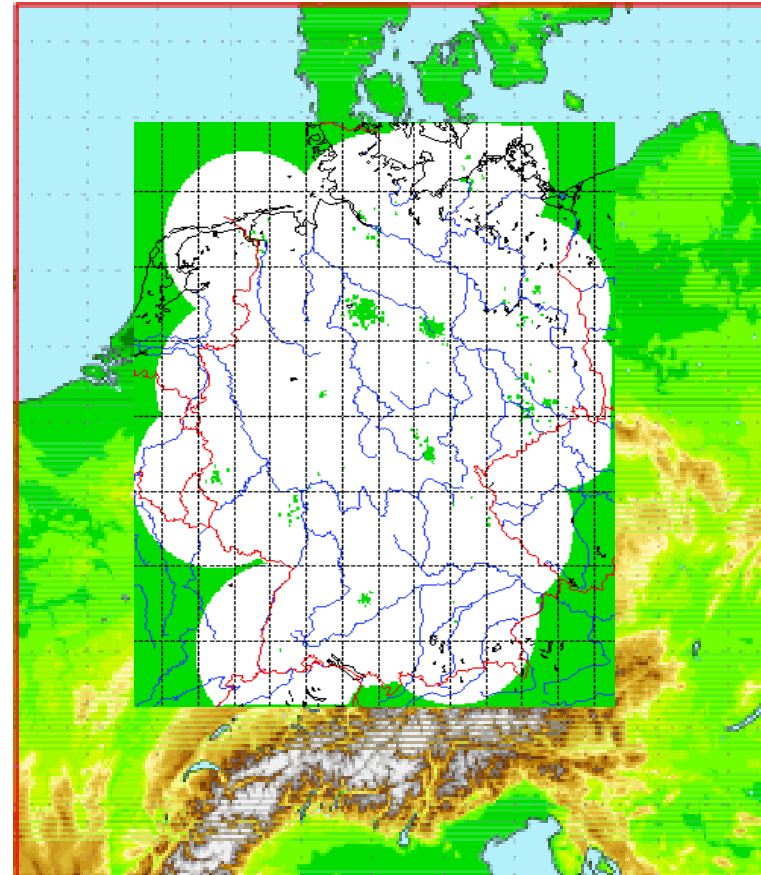
Composite of 2-d precip scan

Resolution: 1km · 1° and 5 min (→ 1h)

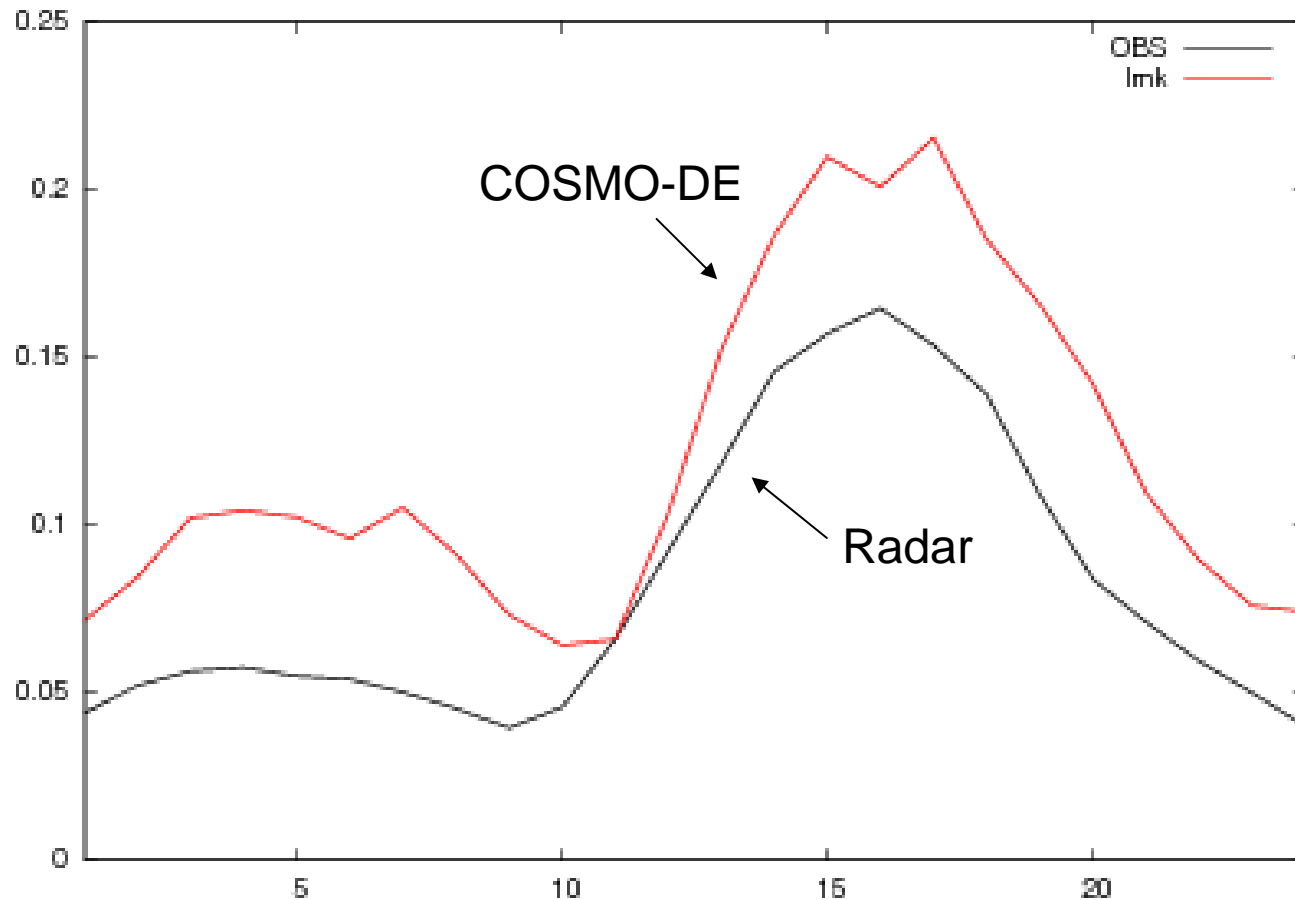
Draw backs for comparison:

Radar measures precipitation in a certain height above ground;

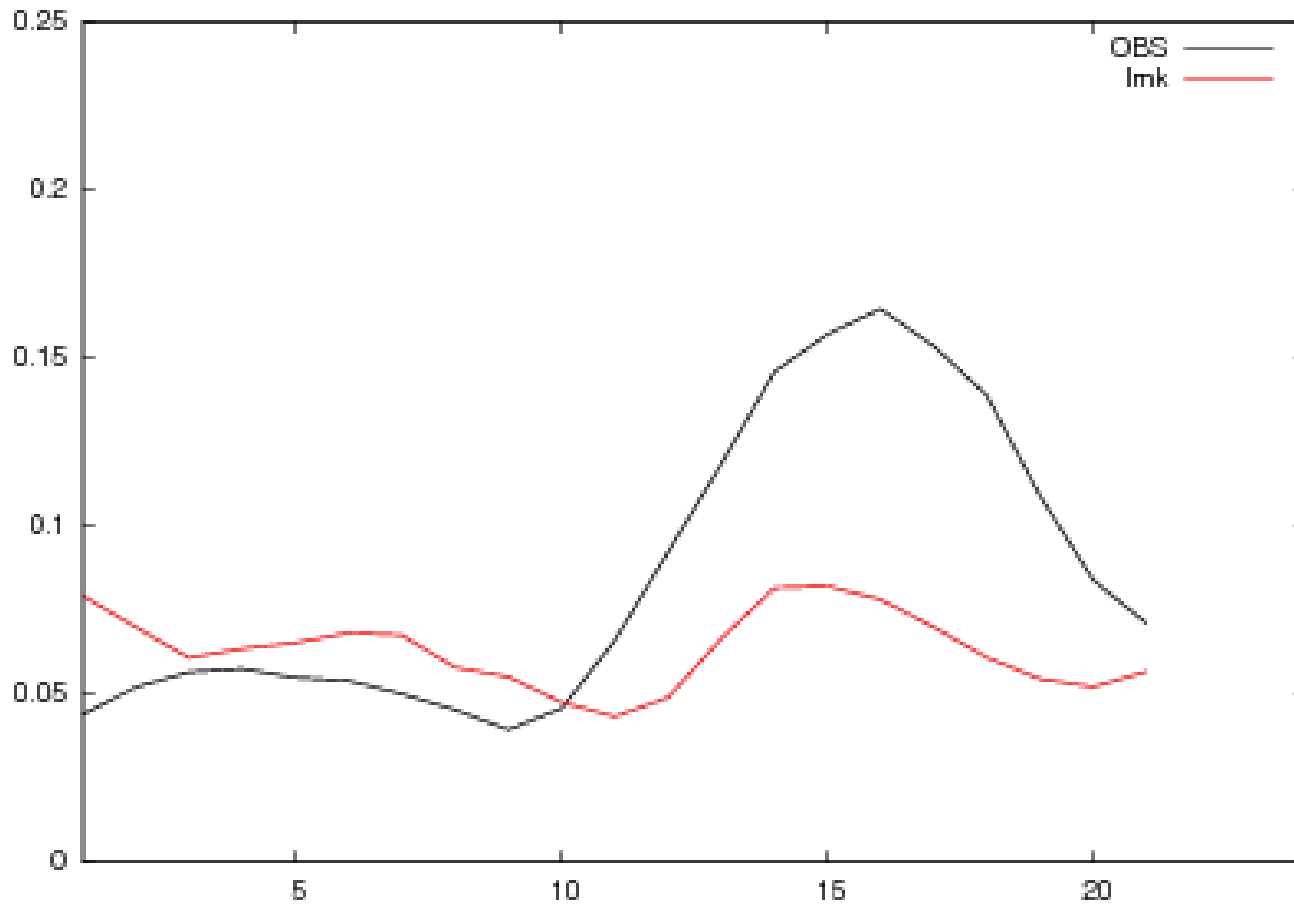
Model forecasts it at the surface (i.e. error due to evaporation beneath clouds)



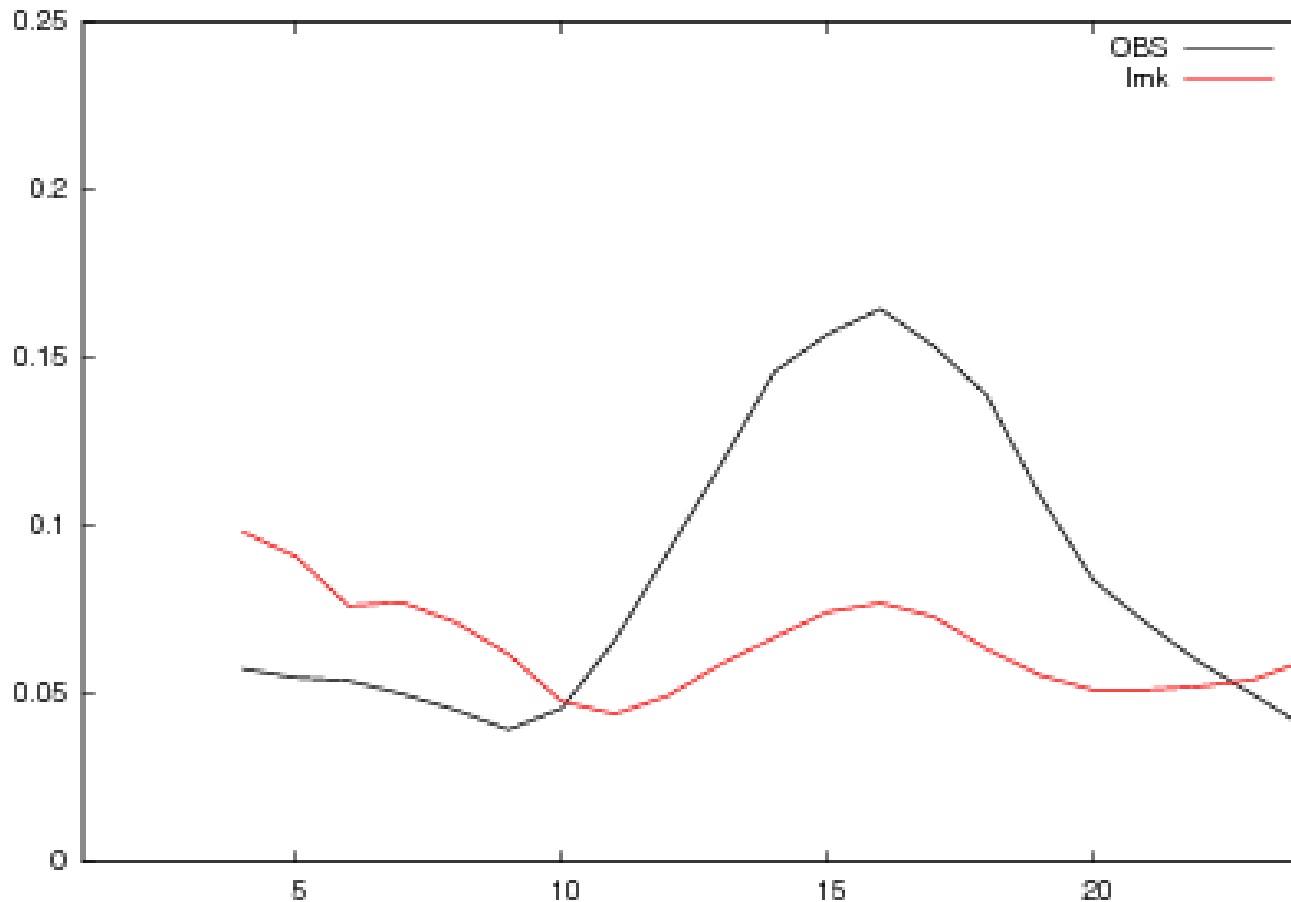
Operational COSMO-DE assimilation



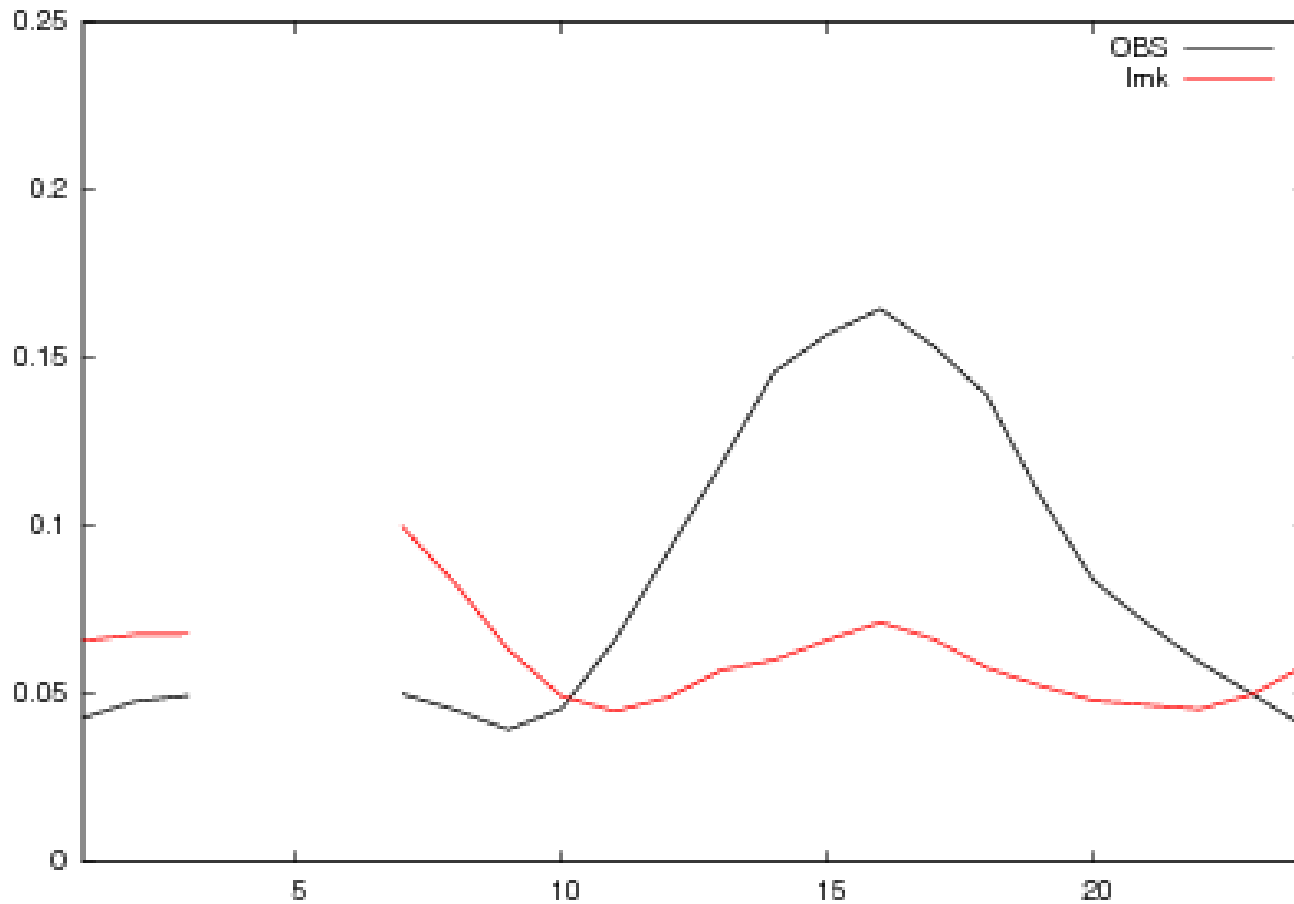
Operational COSMO-DE 00 UTC forecast



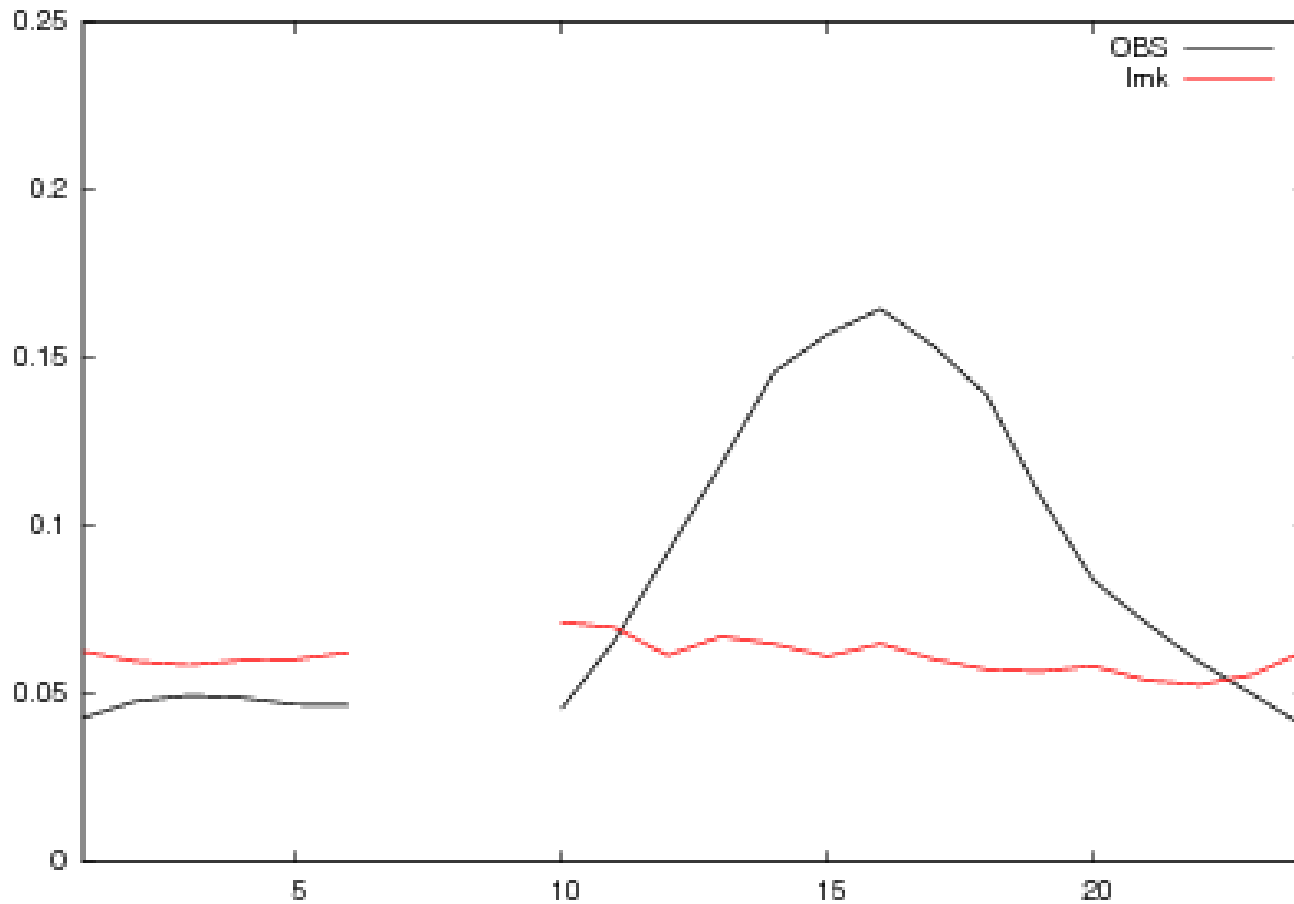
Operational COSMO-DE 03 UTC forecast



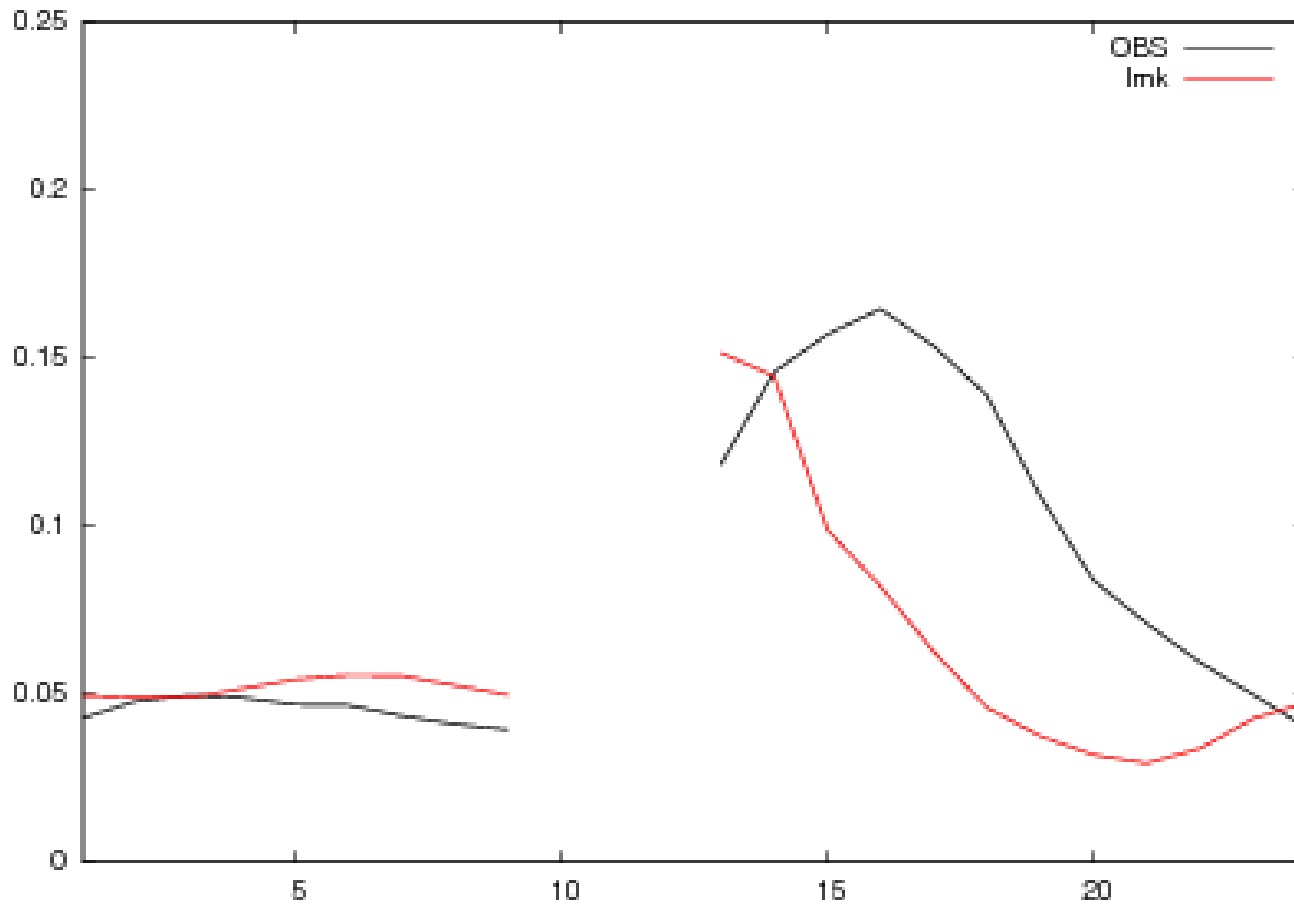
Operational COSMO-DE 06 UTC forecast



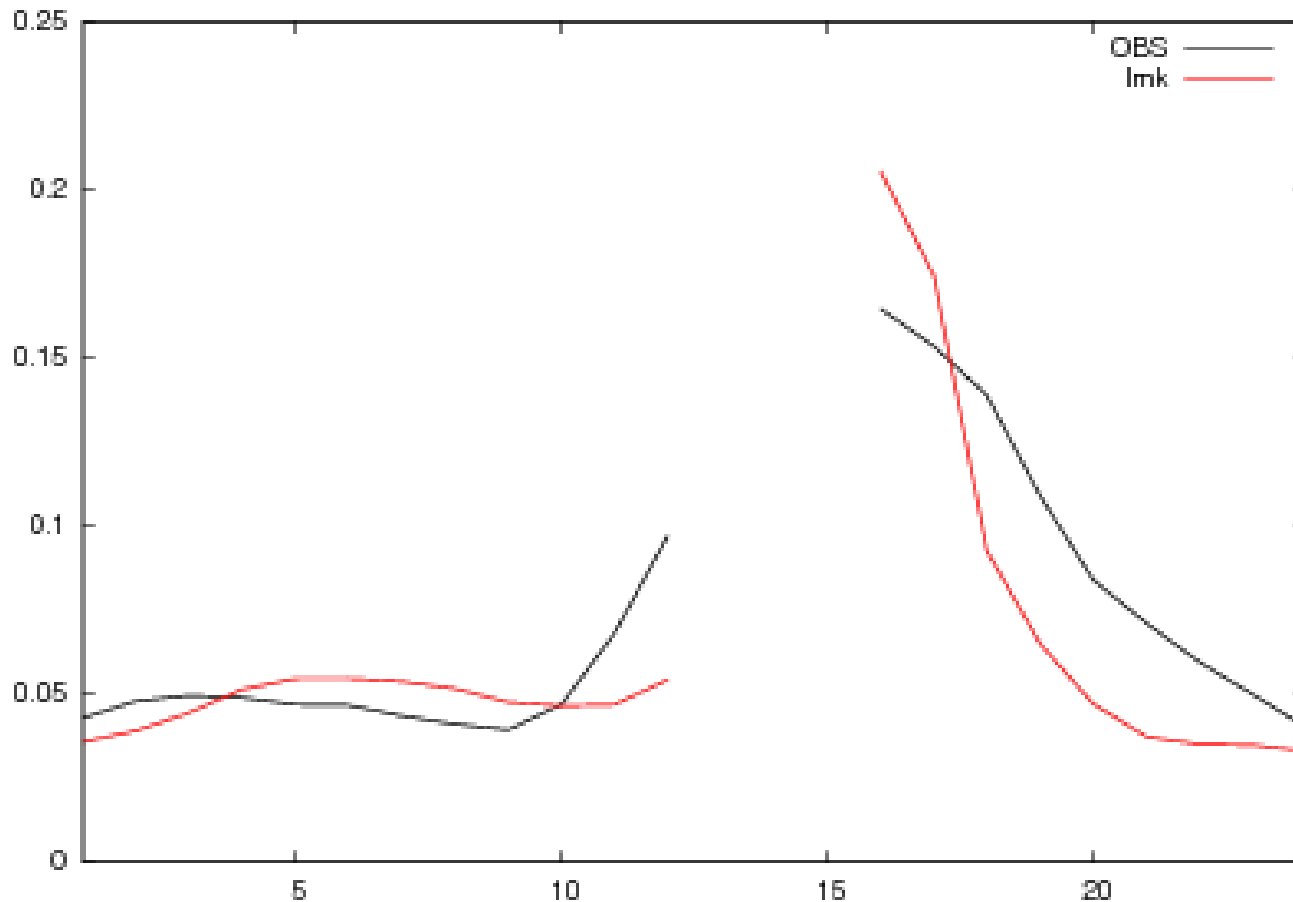
Operational COSMO-DE 09 UTC forecast



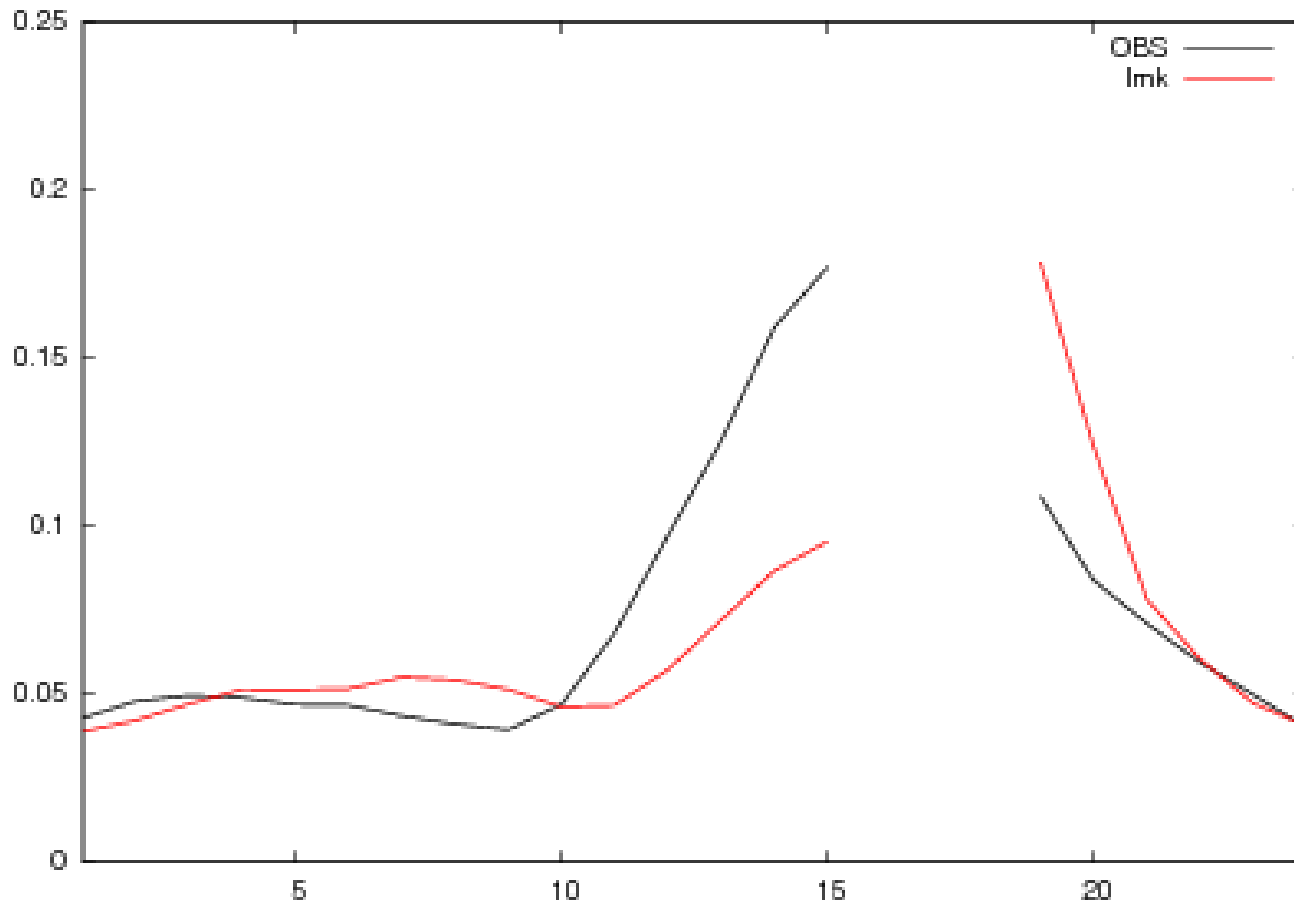
Operational COSMO-DE 12 UTC forecast



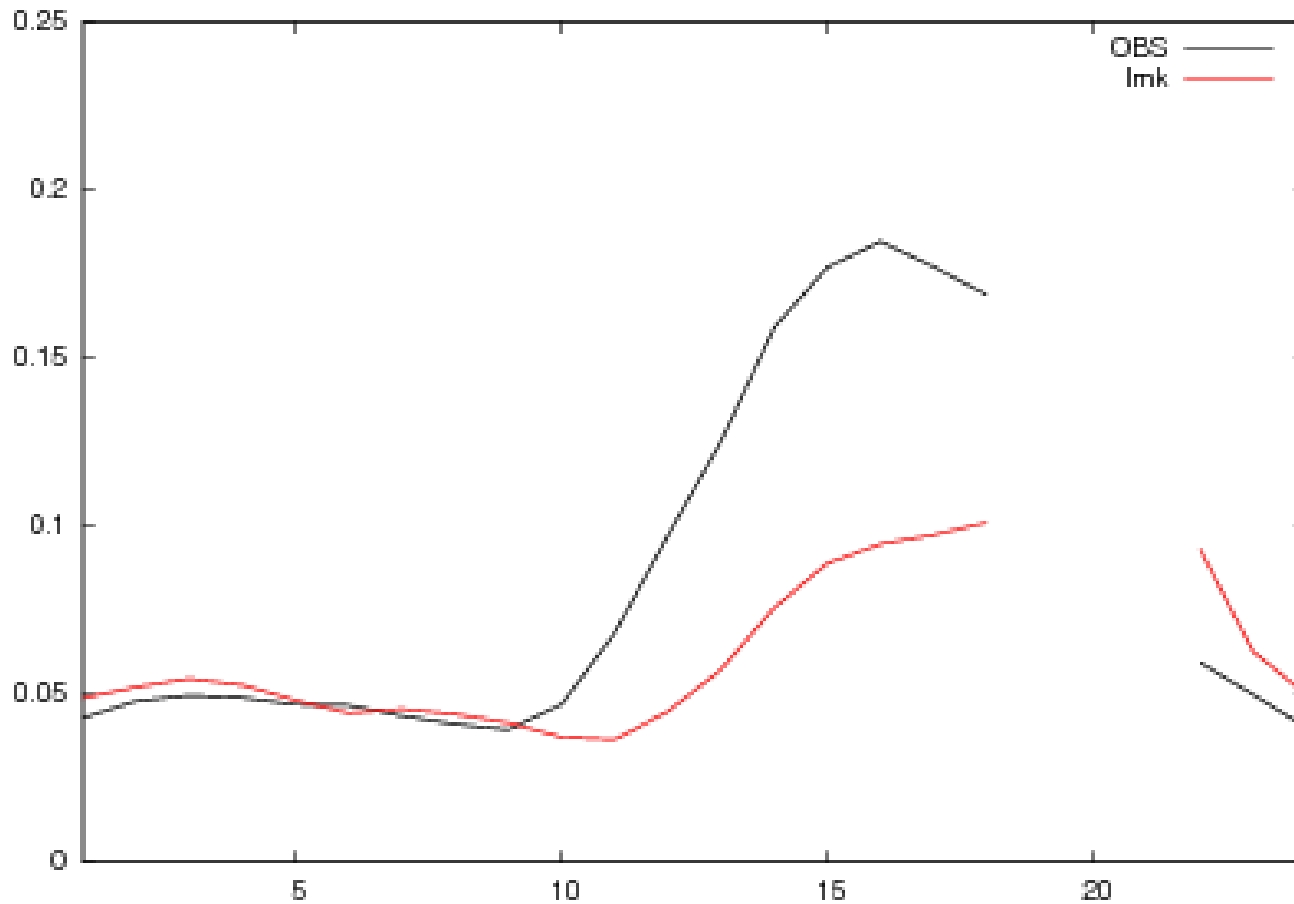
Operational COSMO-DE 15 UTC forecast



Operational COSMO-DE 18 UTC forecast



Operational COSMO-DE 21 UTC forecast



Sensitivity of initial conditions

1. Take COSMO-DE analysis with retuned latent heat nudging
2. Take COSMO-DE analysis without latent heat nudging
3. Take interpolated COSMO-EU analysis:
no small scale data assimilation nor latent heat nudging applied
4. Take COSMO-DE analysis without any moisture observations by radiosonds
5. Take COSMO-DE analysis with additional GPS-IWV observation

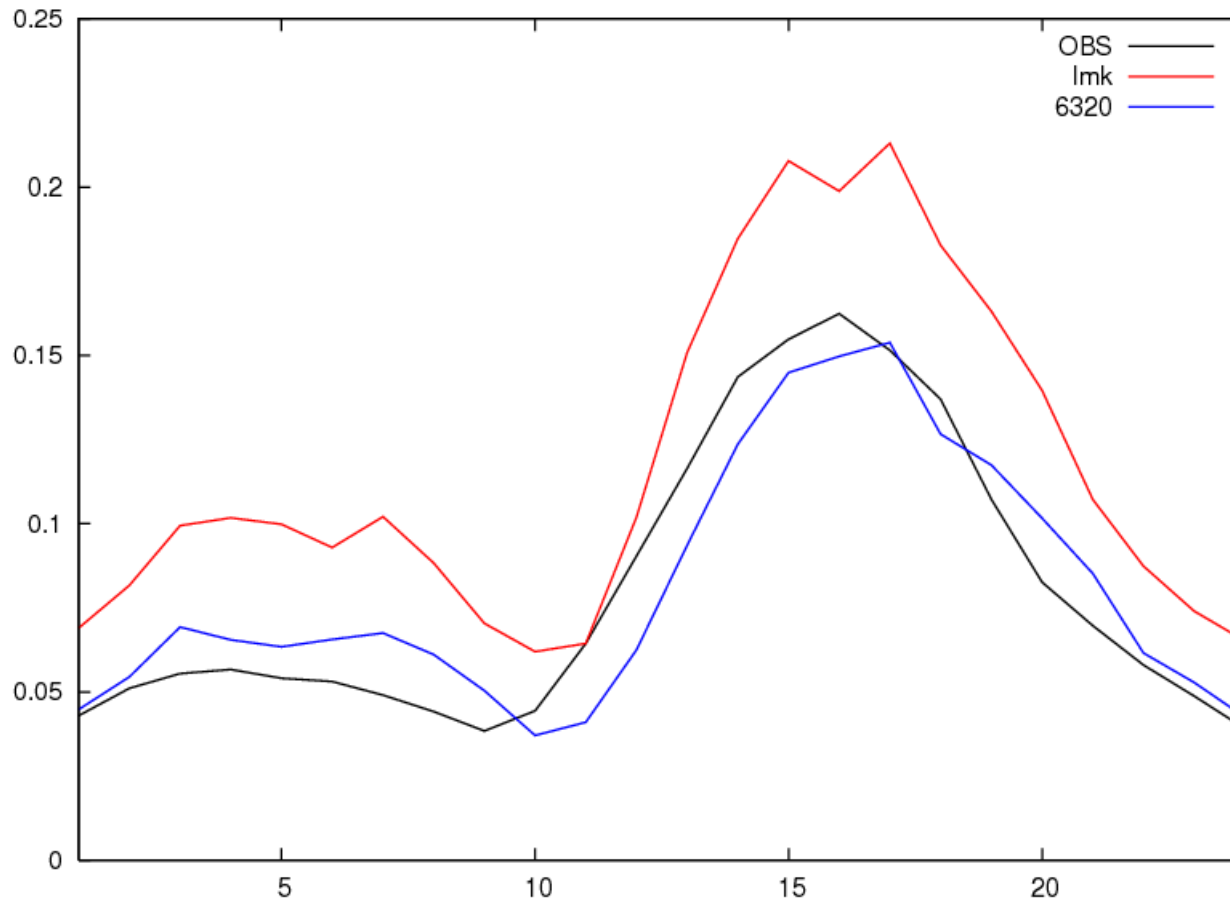
Meaning on the next slides:

black lines mean the radar observations

red lines mean the operational COMSO-DE run

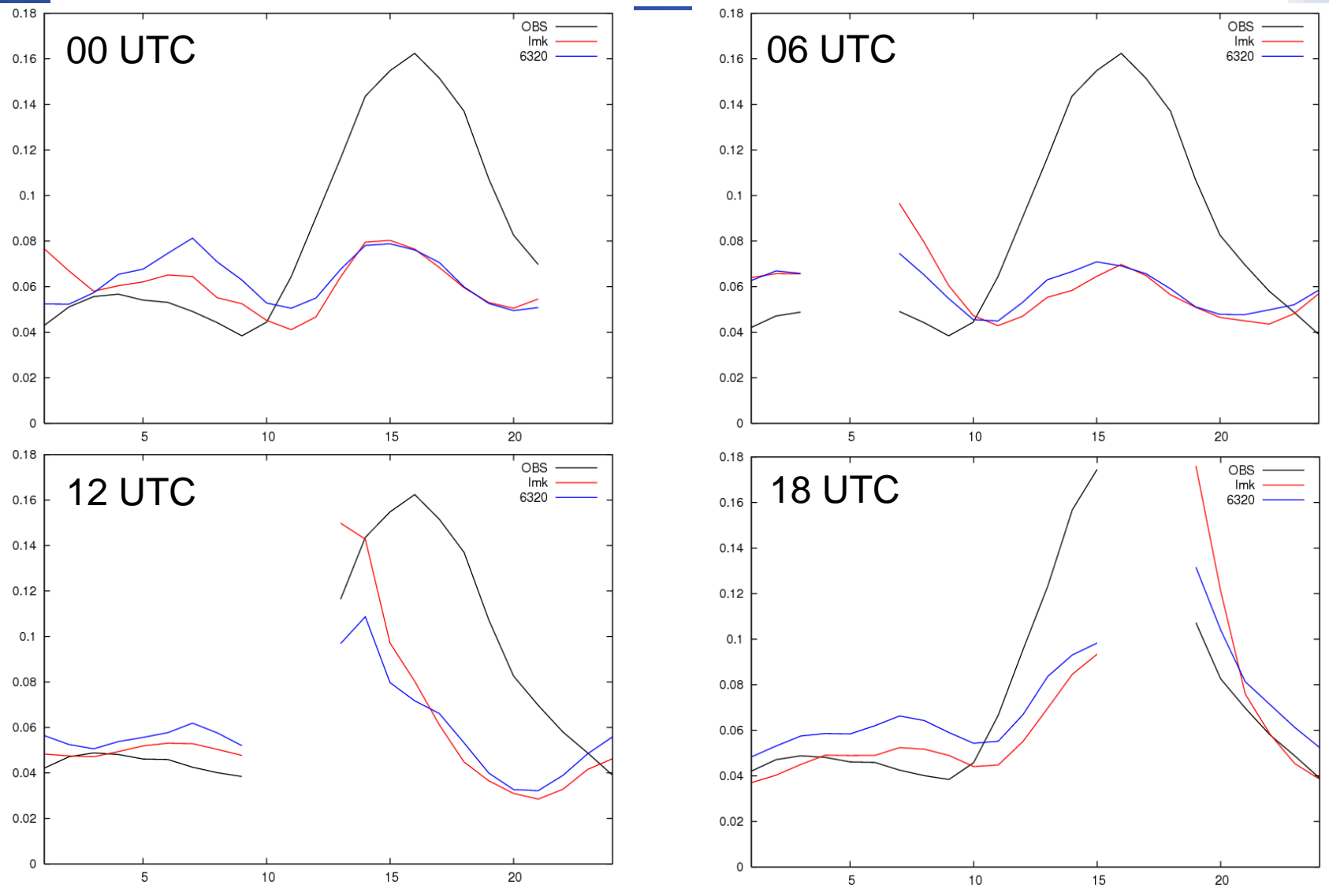
blue lines mean the sensitivity studies

assimilation



Deutscher Wetterdienst

COSMO-DE analysis with retuned latent heat nudging



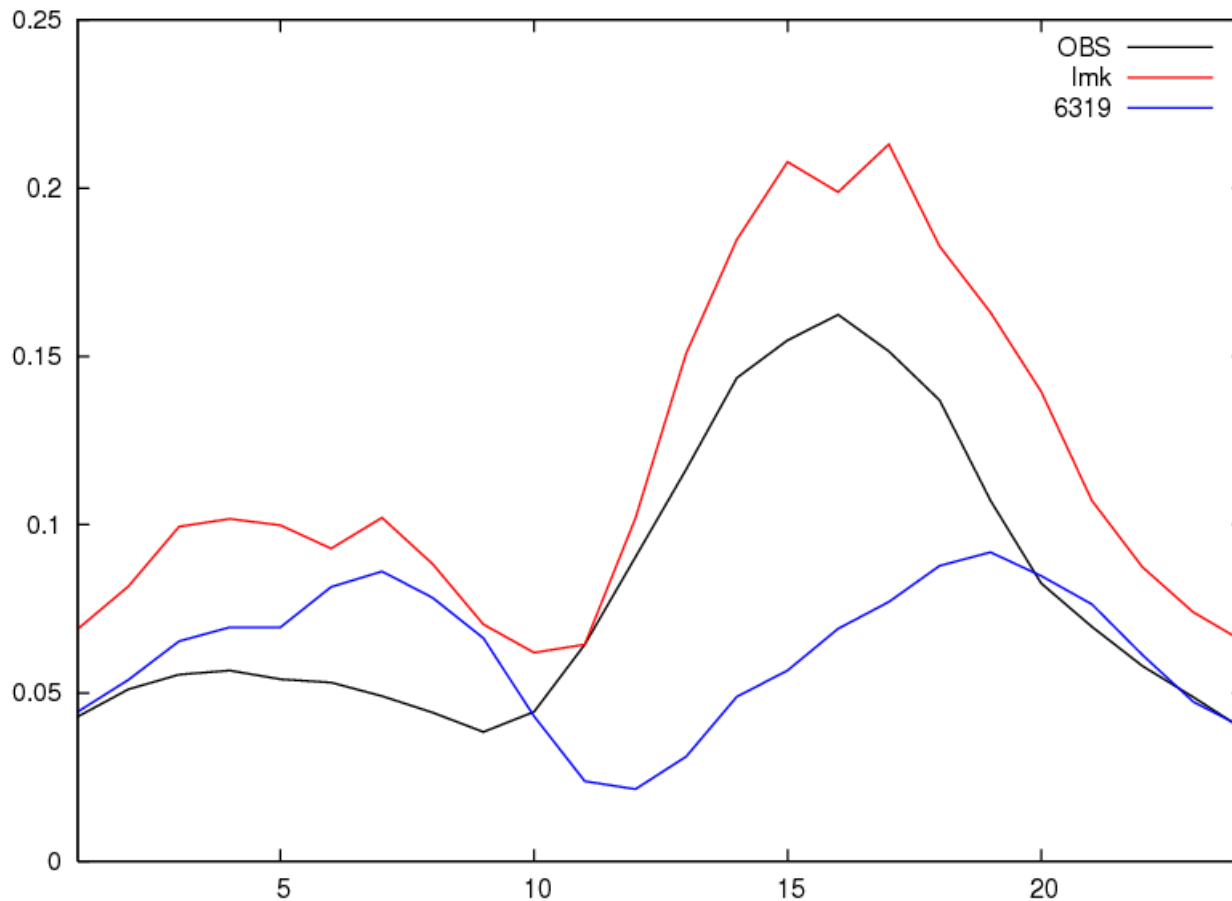
Sensitivity of initial conditions

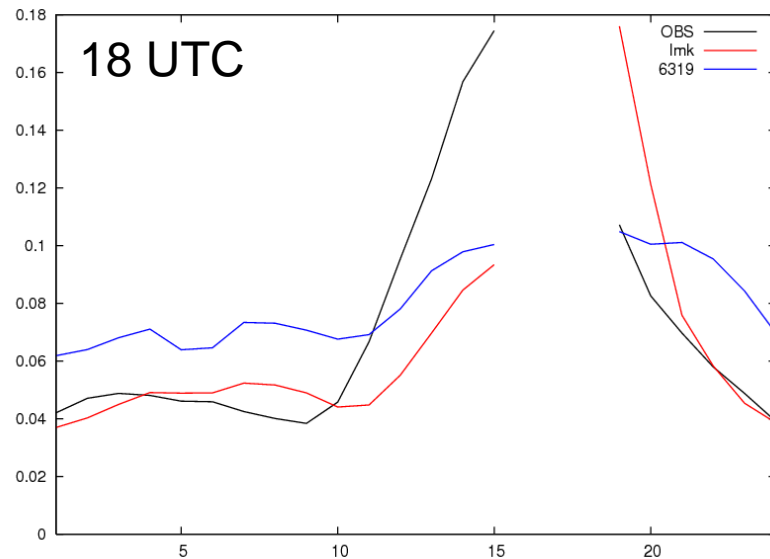
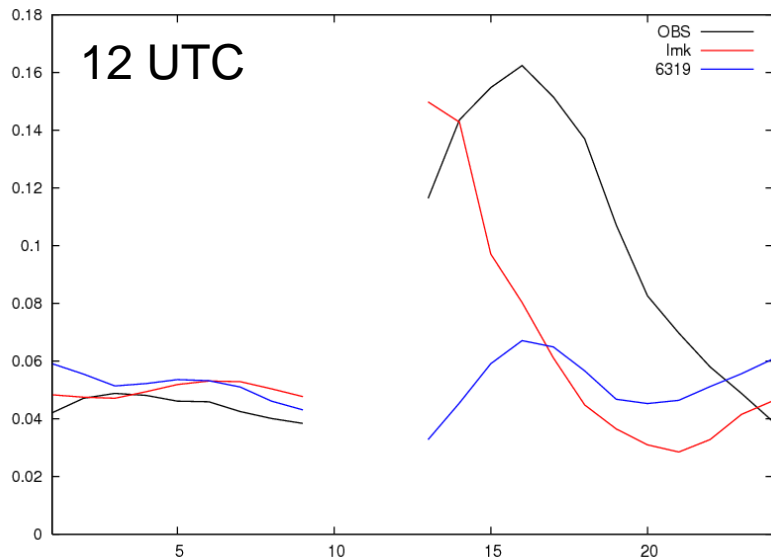
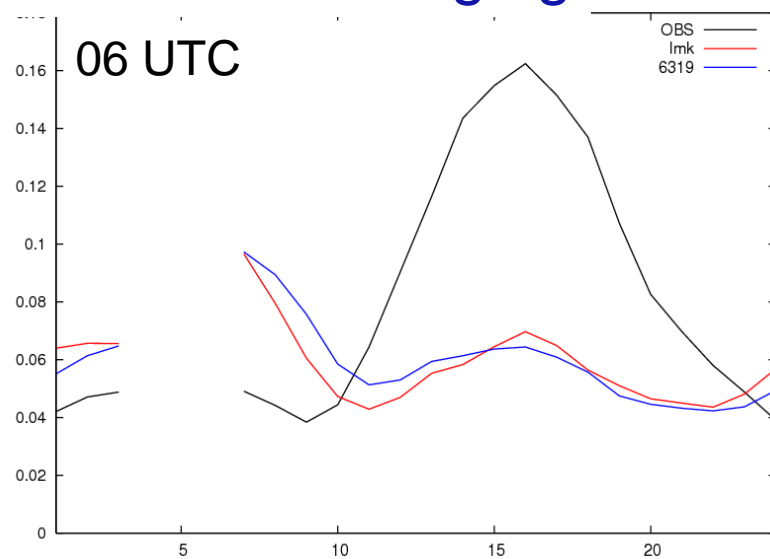
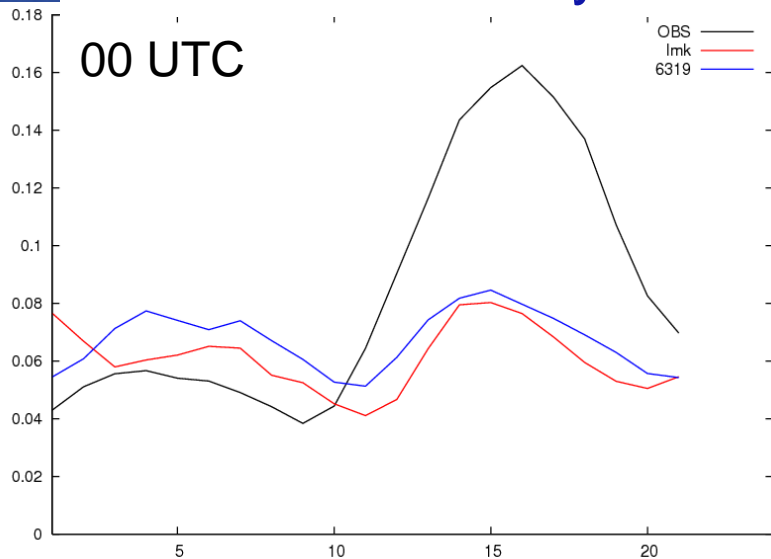
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No assimilation of radar derived precipitation is applied.
No triggering of convective cells observed by radar.



assimilation



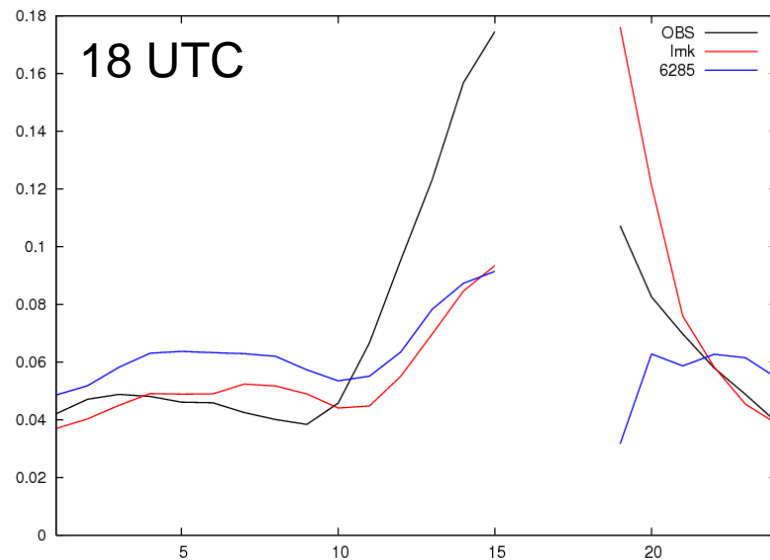
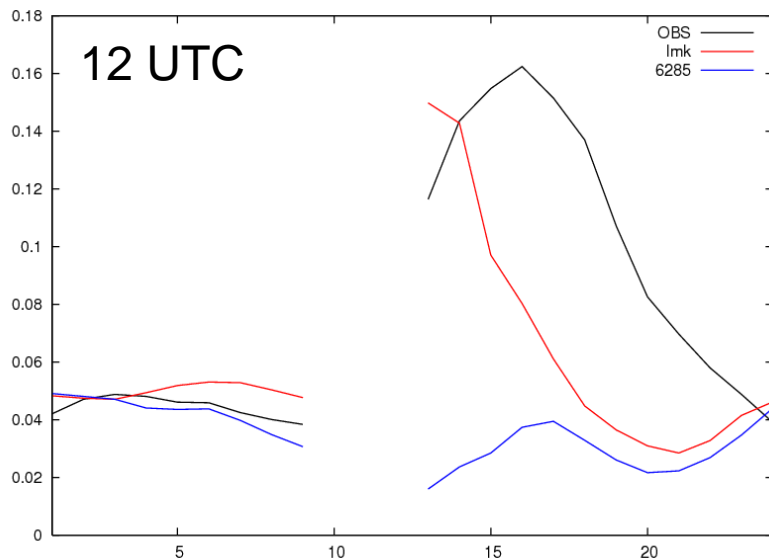
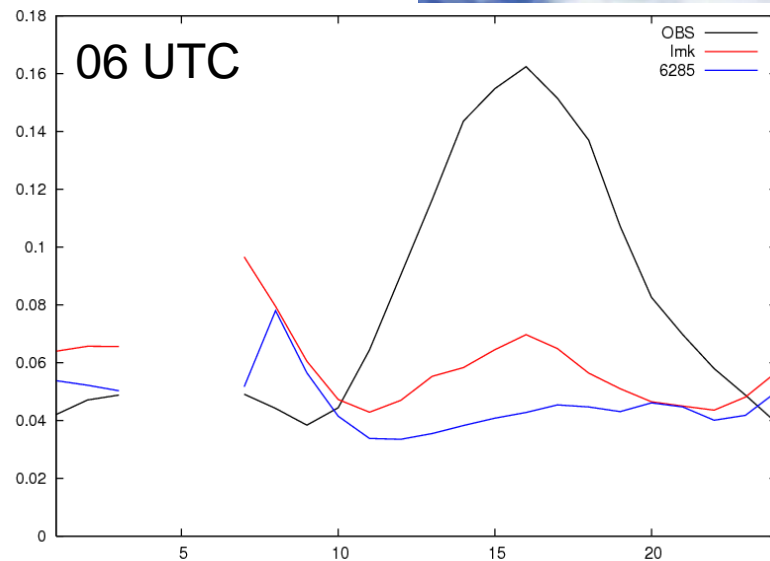
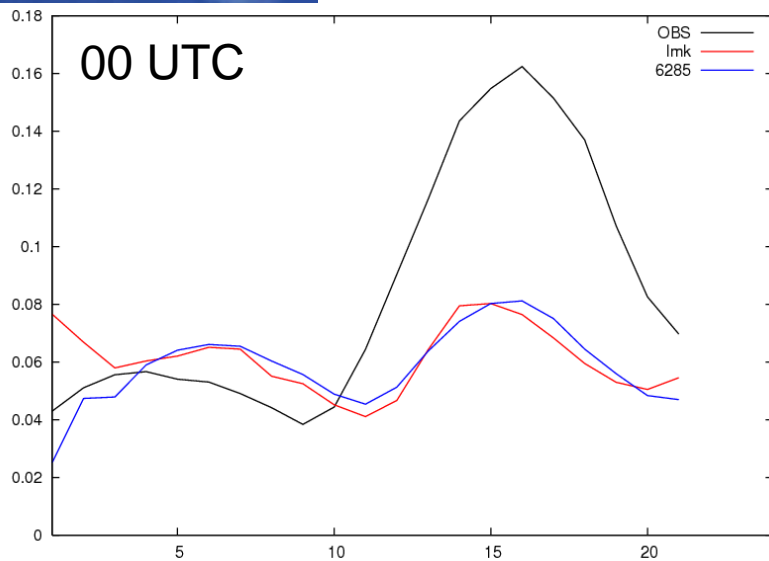


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Deutscher Wetterdienst interpolated COSMO-EU analysis

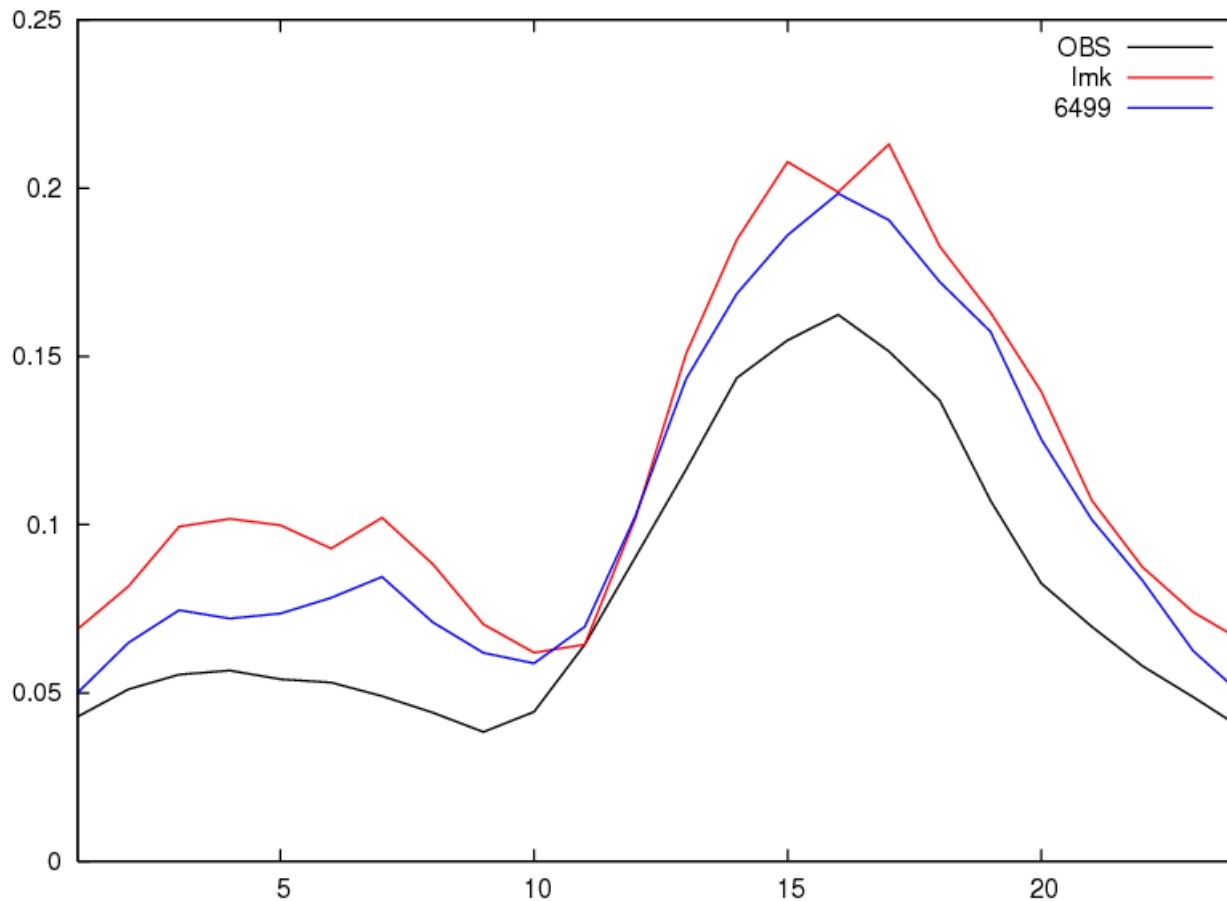


Sensitivity of initial conditions

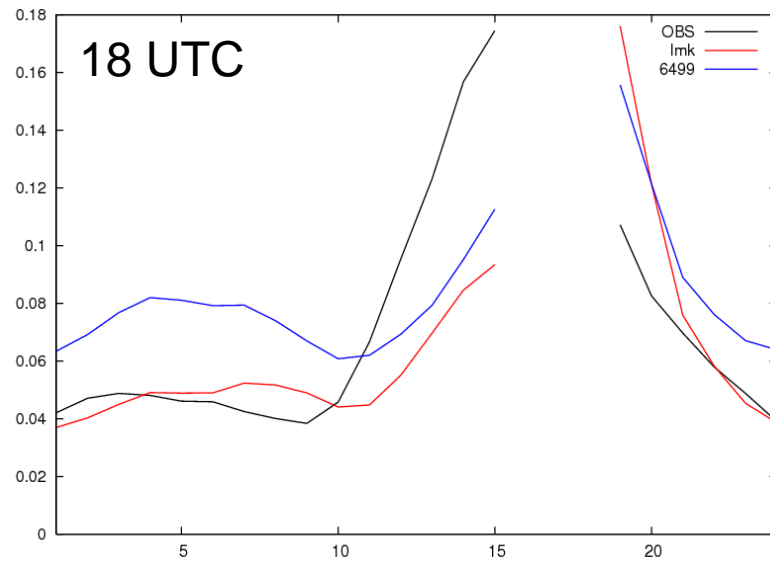
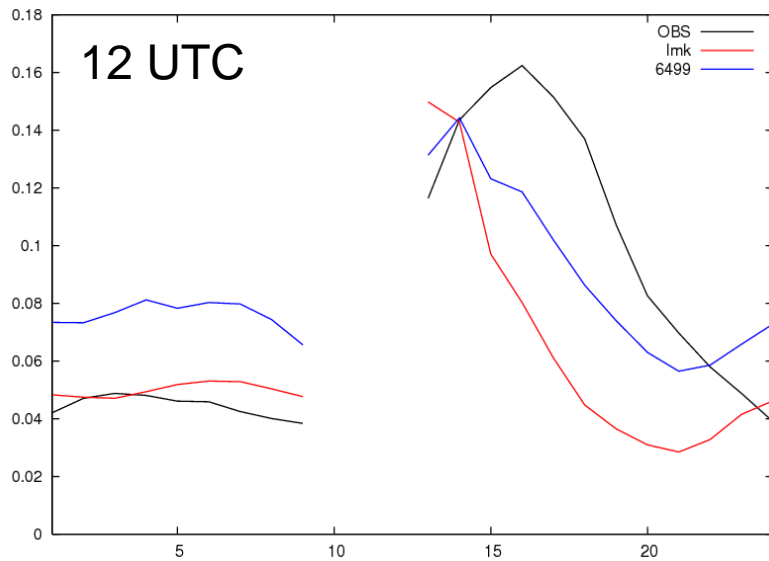
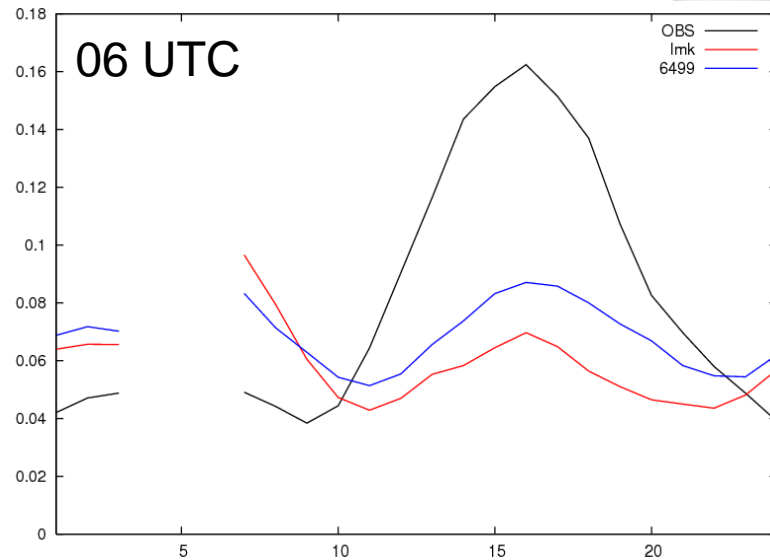
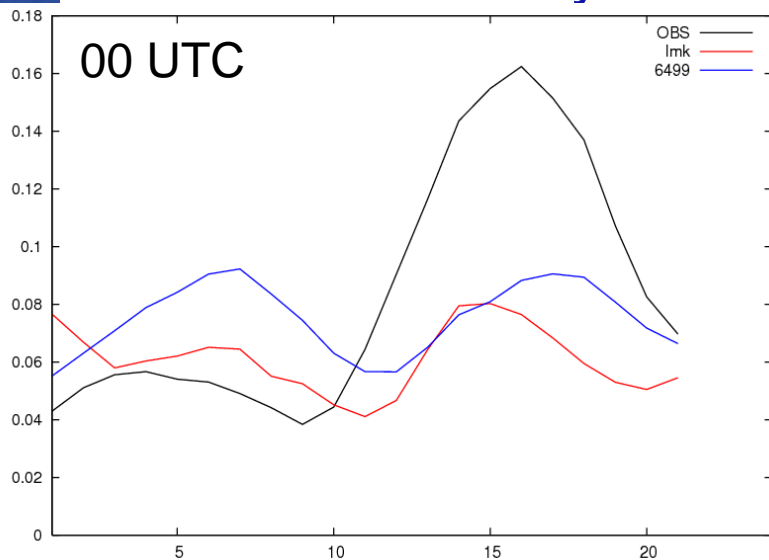
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Non-Assimilating the moisture information of radio sondes makes the model much wetter and leads to an increased production of precipitation in general.

assimilation



COSMO-DE analysis without radiosondes' moisture



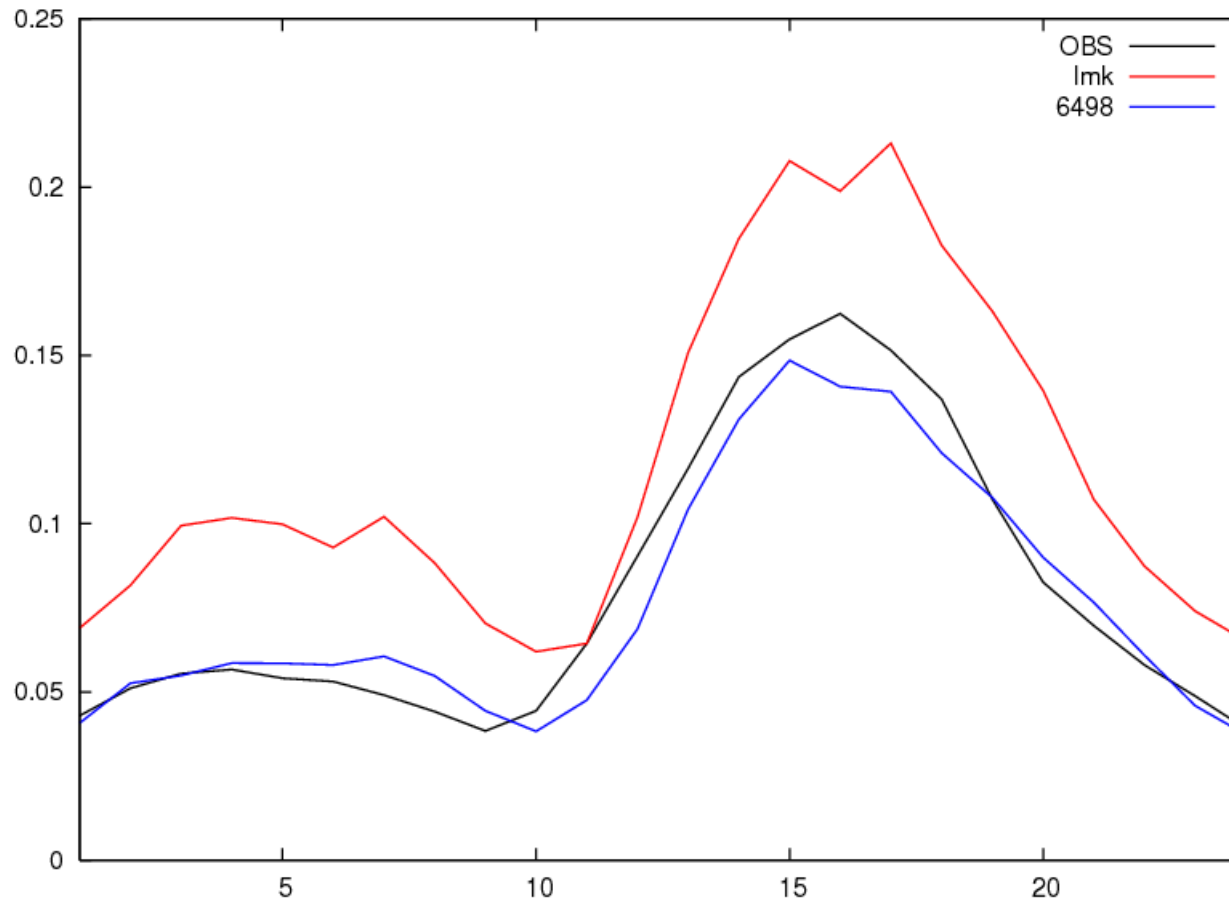
Sensitivity of initial conditions

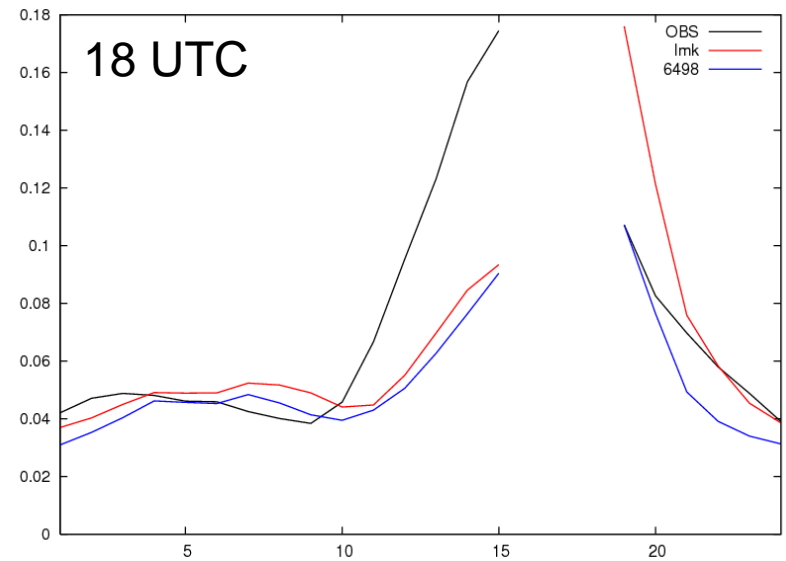
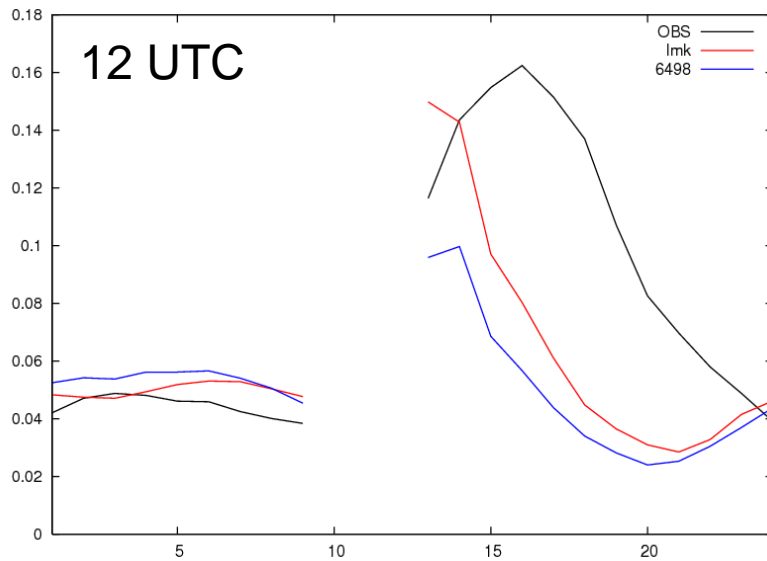
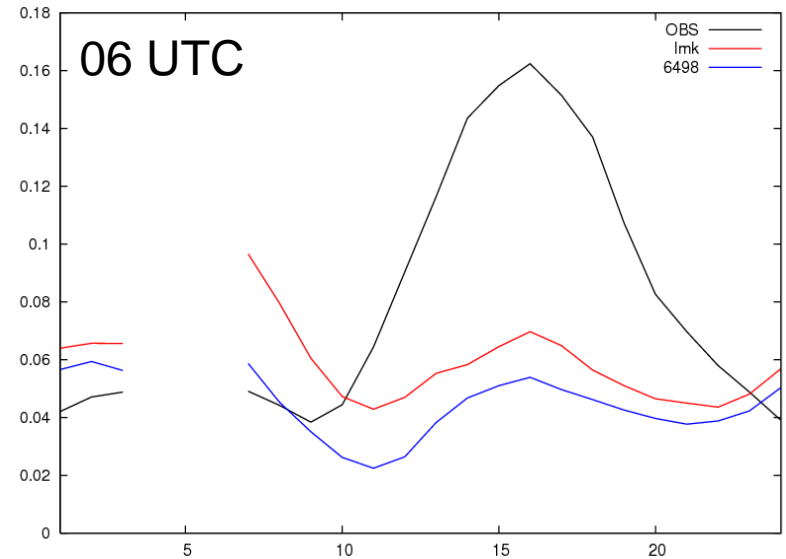
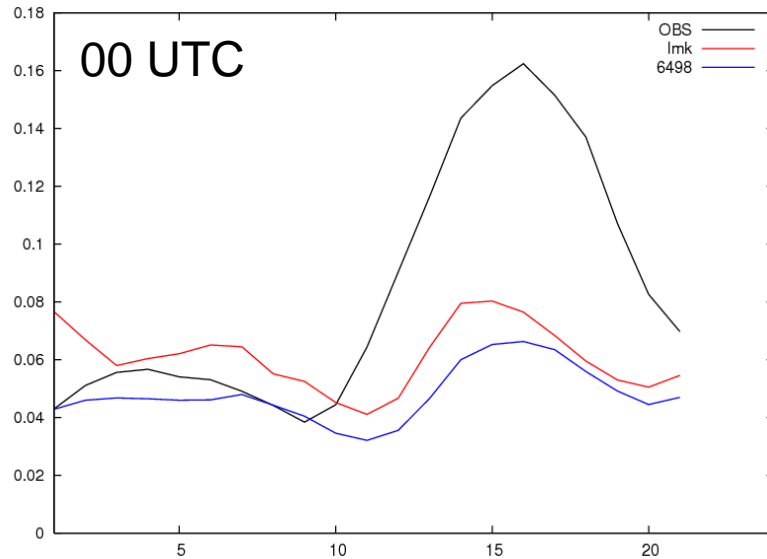
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Assimilating the moisture information of GPS makes the model much drier, and leads to a decreased production of precipitation in general.



assimilation



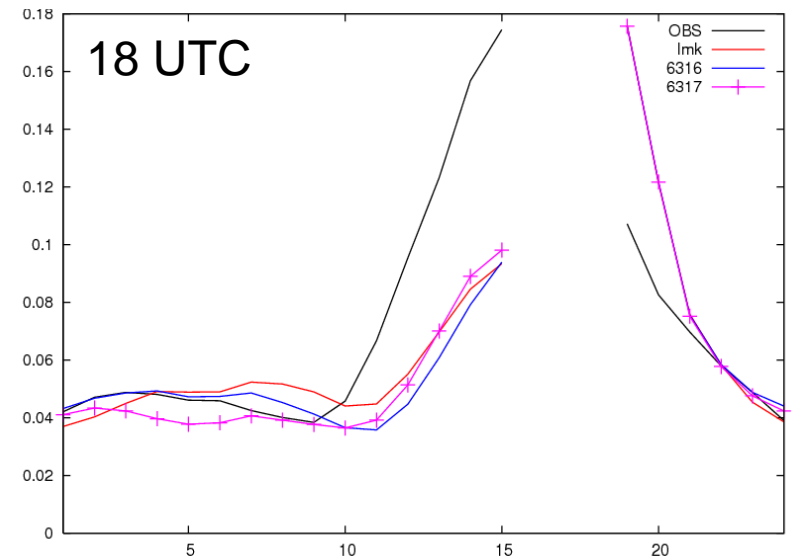
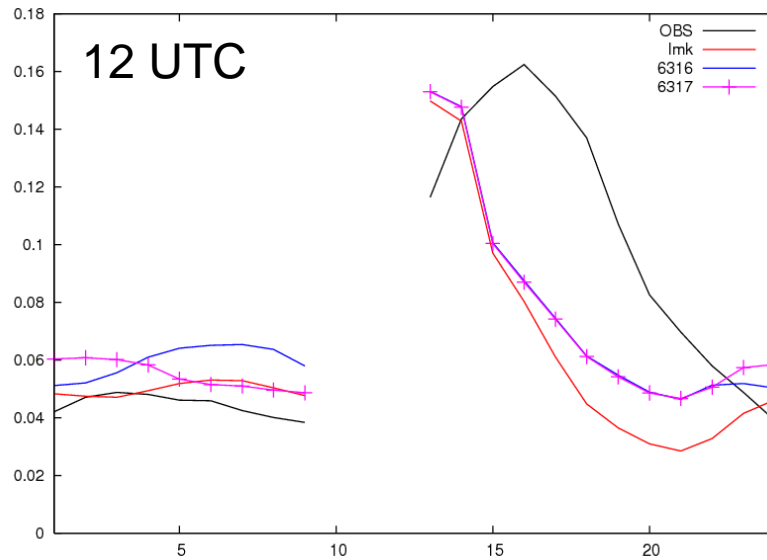
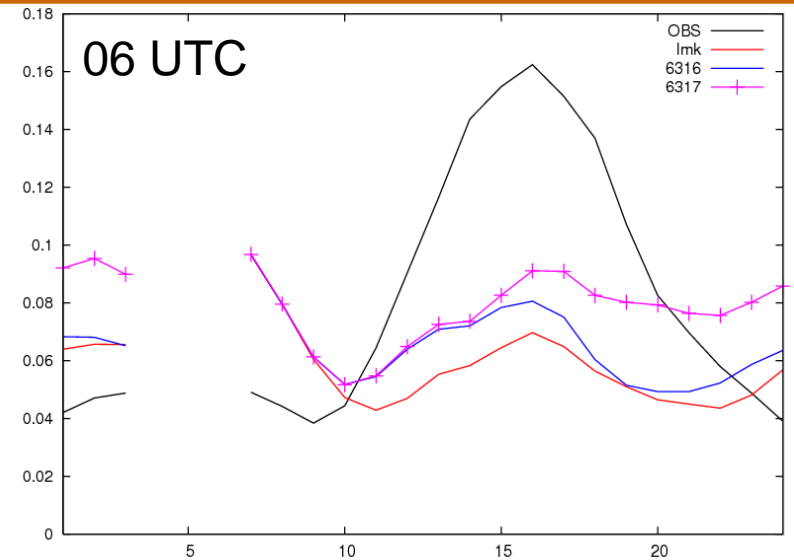
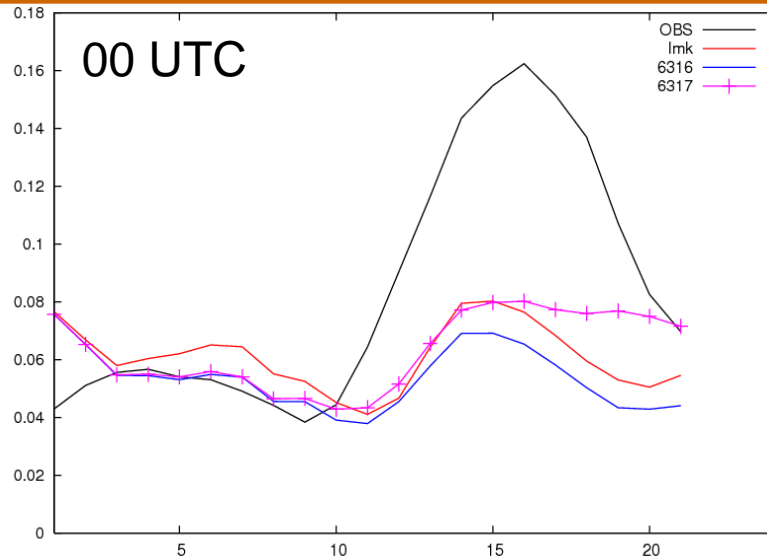


Sensitivity of boundary conditions

Remark: Operational COSMO-DE uses 3 hour old forecasts of COSMO-EU as boundary values

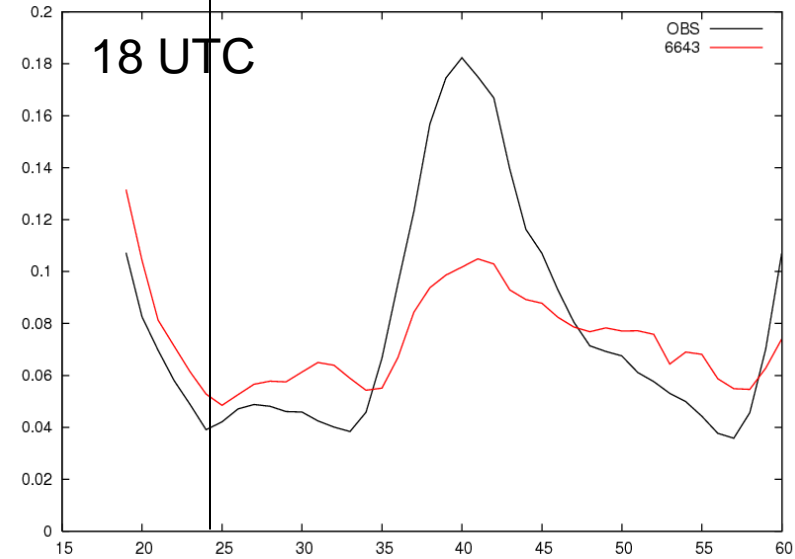
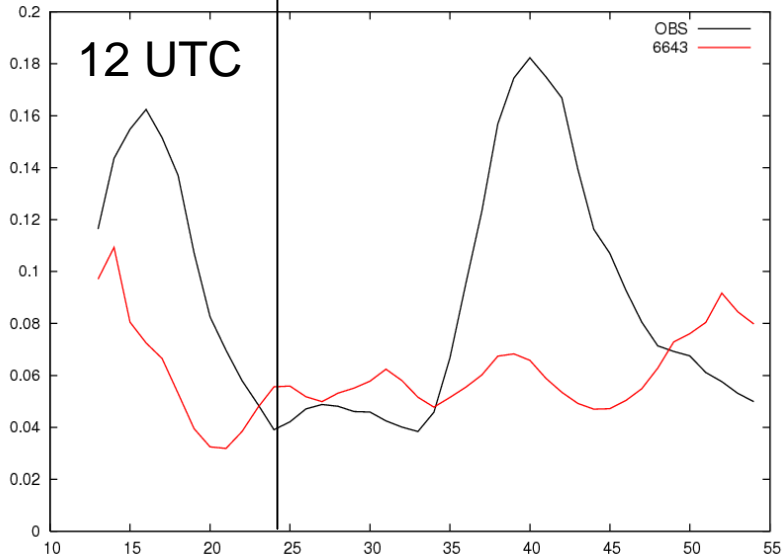
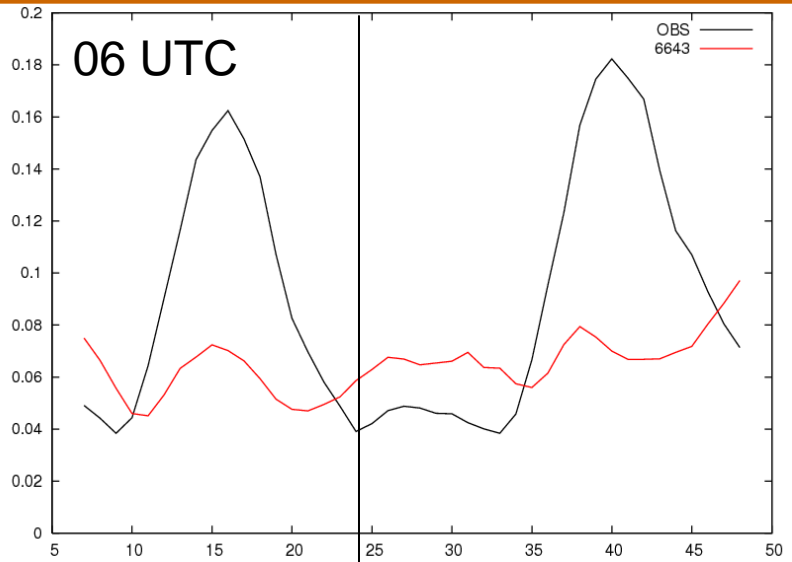
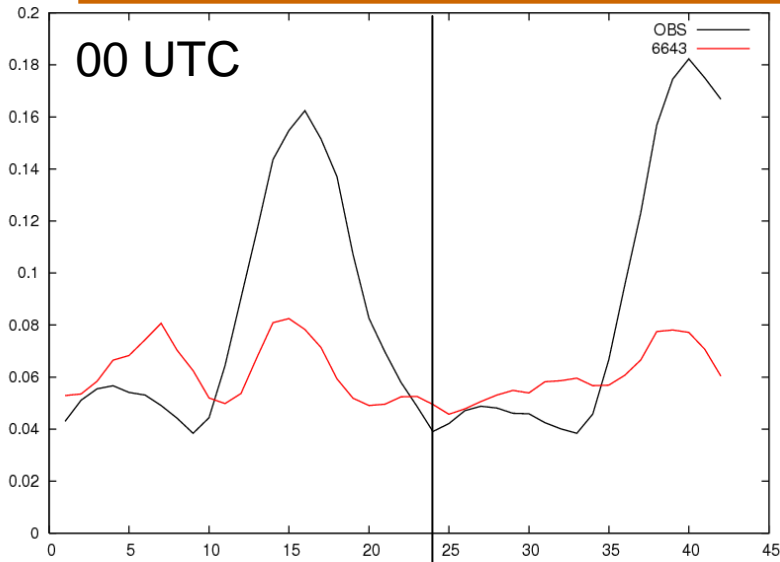
- Take undelayed COSMO-EU forecasts
- Take COSMO-EU analysis (line with plus sign)

Sensitivity of boundary data



Long term forecast over 42 hours

Long term forecast over 42 hours



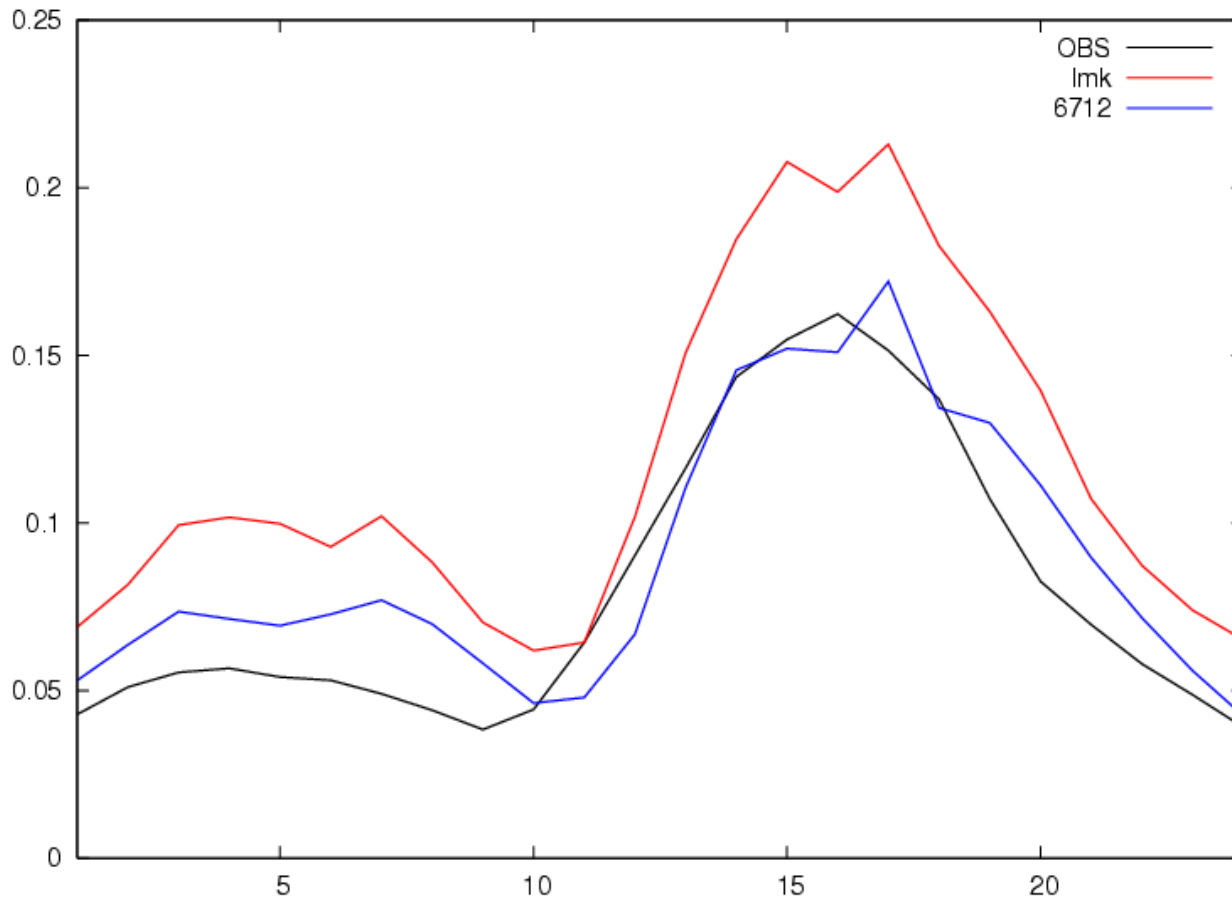
State of the art

Use the current operational configuration (COSMO V4.6) with all improvements and changes of:

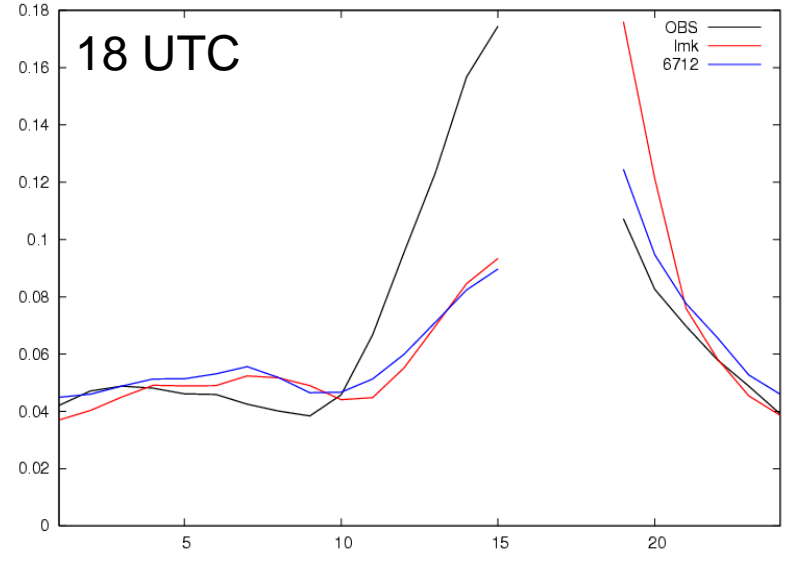
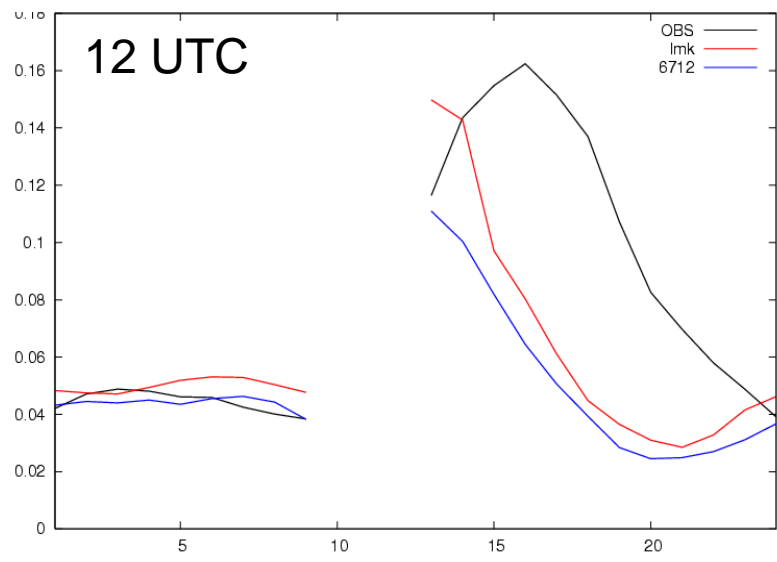
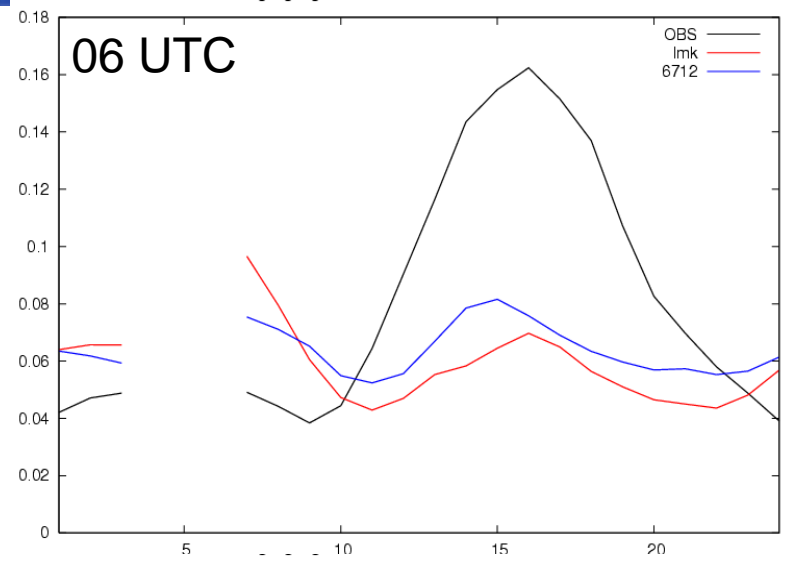
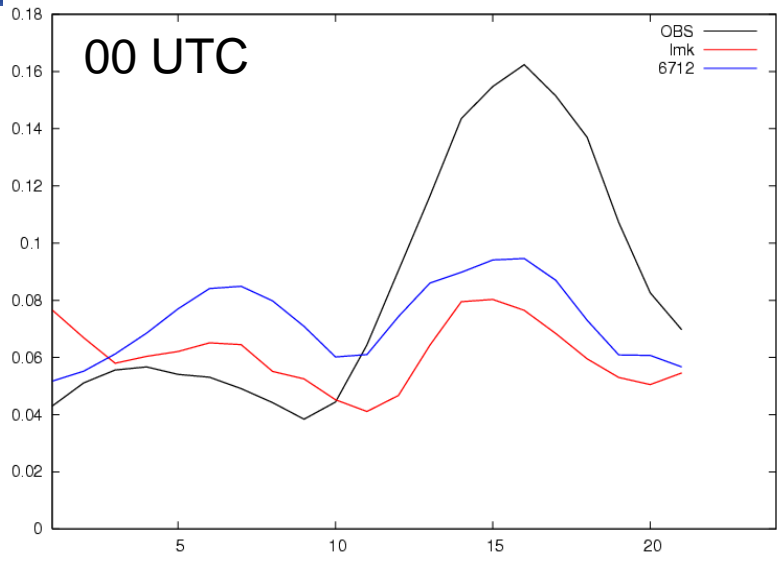
- physical parameterisations (tur_len)
- data assimilation (netCDF)
- dynamics
- ...

State of the art

assimilation



State of the art





There is no satisfying explanation of that short cuming, yet.

So, what we can still hope is, that the convective events I investigated in my studies are a bit unusual.



Conclusion

- The performance of COSMO-DE in forecasting convective events is not very satisfying and it varies more by the starting time of integration than by different initial or boundary conditions.
- The best performance seems to be achieved by runs starting at 0, 18 and 21 UTC, the worst by 9 UTC runs.
- The behaviour remains also for 42 h forecasts.
- The optimisation of the physical parameterisations provide a little better performance but there is still much room for improvement.
- Please keep in mind: If you develop something within COSMO-DE, test you modification at several starting times. It might be changing your result significantly.