Effect of assimilation of radar reflectivity and satellite data on a very-short range forecast of heavy convective rainfalls

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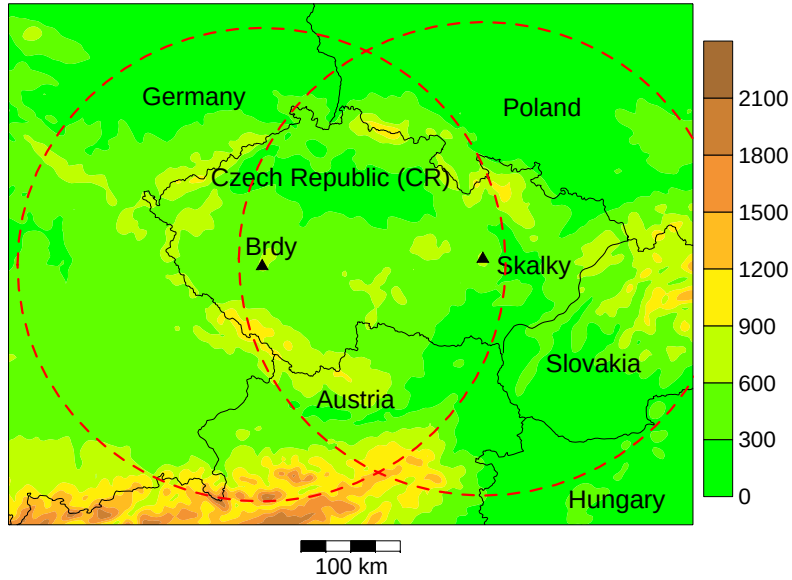
Content

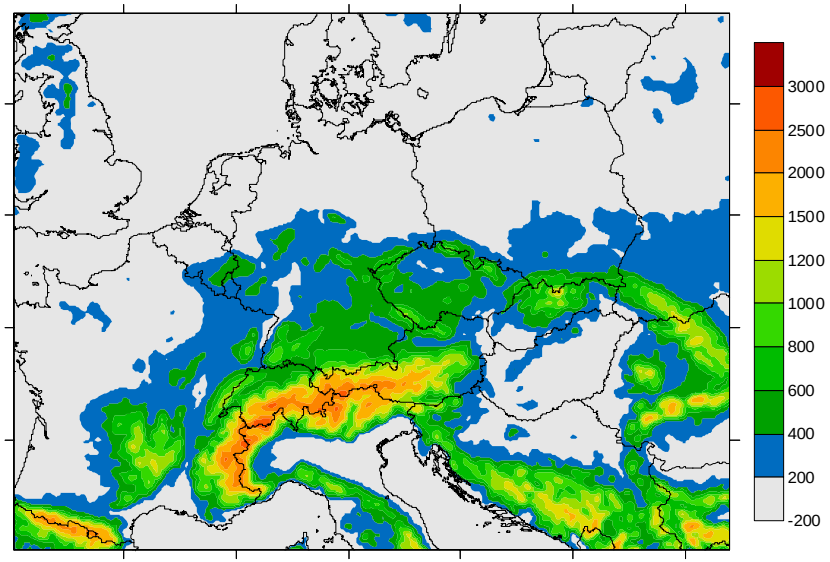
- NWP model
- Assimilation methods
  - Radar reflectivity
  - Satellite
- Examples
- Conclusions

NWP model COSMO 4.0

- Non-hydrostatic
- Δx = 2.8 km, Δt = 30 s
- explicit precipitation
- hydrometeors
  - rain
  - snow
  - ice
  - graupels



- Δx = 10 km
- cumulus parameterization



Assimilated data

- Radar reflectivity
  - Two C-band radars
  - Resolution 1km x 1km, Δt=10 min., CAPPI 2km
  - Z-R α=200, β=1.6
  - Radar + gauge
- Satellite data - MSG
  - The same projection as radar data
  - Δt=15 min., resolution about 4km x 4km
  - Channels: IR10.8 μm, VW6.2 μm

Assimilation of radar data

WVC (water vapour correction):

Correction of q_V is based on the difference

D = "observed precipitation" - "model precipitation"

method: nudging

IF(D > 0)

$q_{v,k}^{new} = q_{v,k} + DIF$

ELSE

$q_{v,k}^{new} = q_{v,k} - DIF$

k … vertical level

DIF depends on:

- D at ground
- z (artificial vertical profile)
- empirical constants

Assimilation of MSG data

$q_{v,k}^{new} = q_{v,k} + DIF$

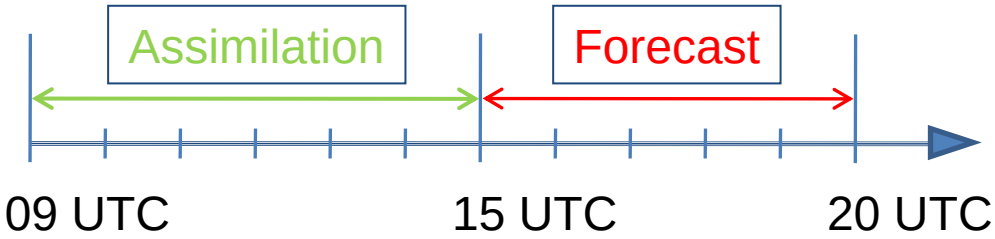
DIF > 0

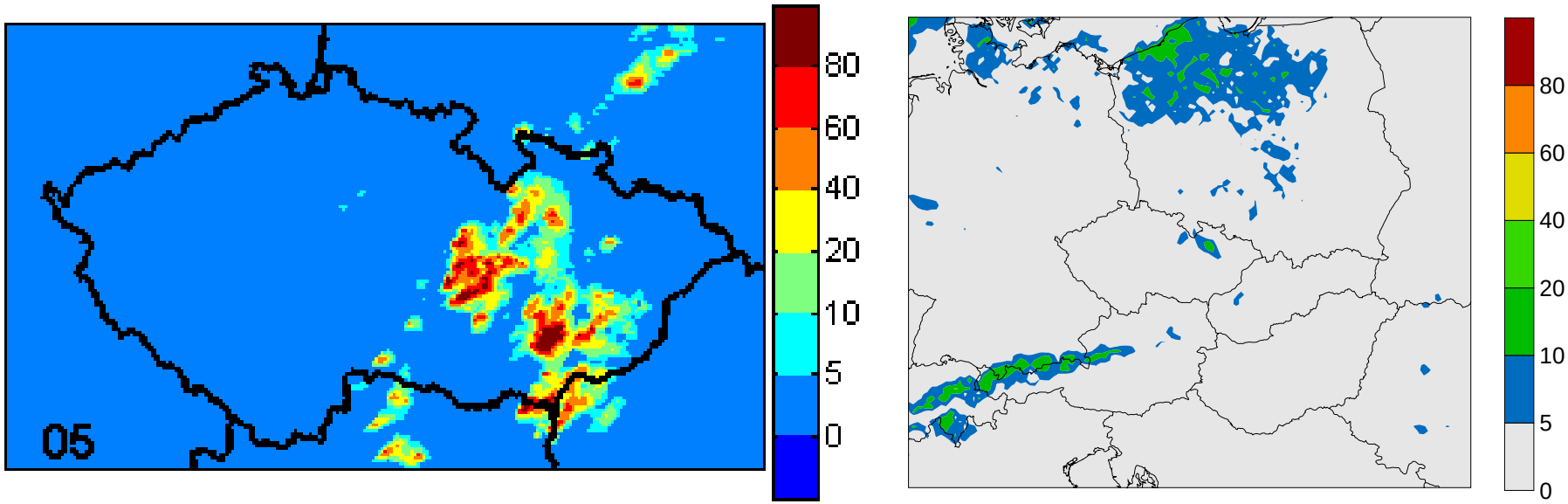
- Precipitating clouds ... IR10.8 – VW6.2 ≤ 8 K
- $q_r + q_s + q_g = 0$
- z < 10 km (cloud top derived from IR10.8)

DIF depends on:

- Difference of IR10.8 – VW6.2
- z

26 June 2006

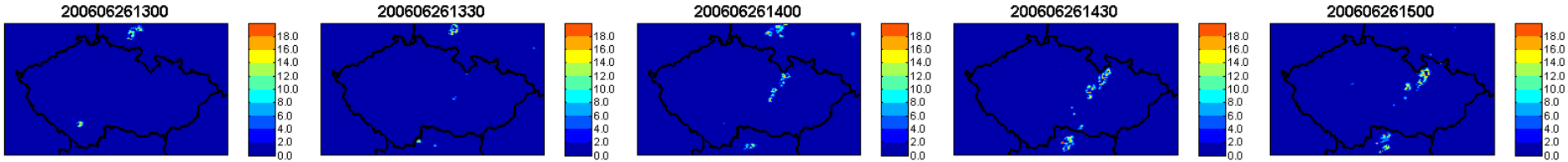




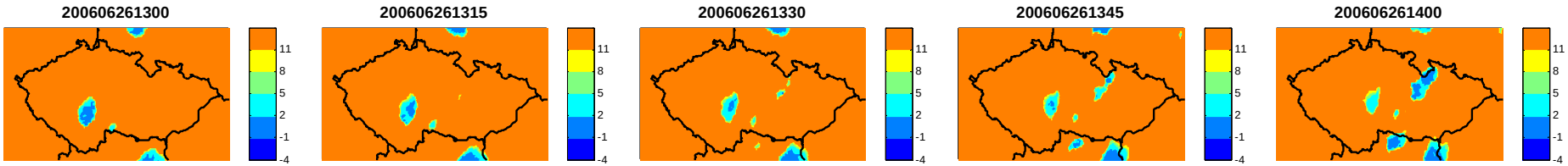
Precipitation 15 – 20 UTC

26 June 2006

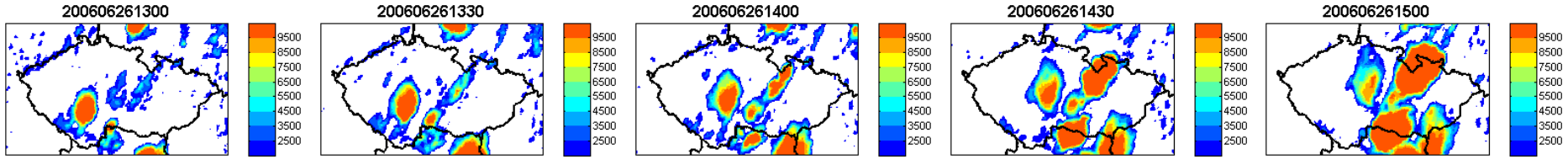
Observed radar data [mm/h]



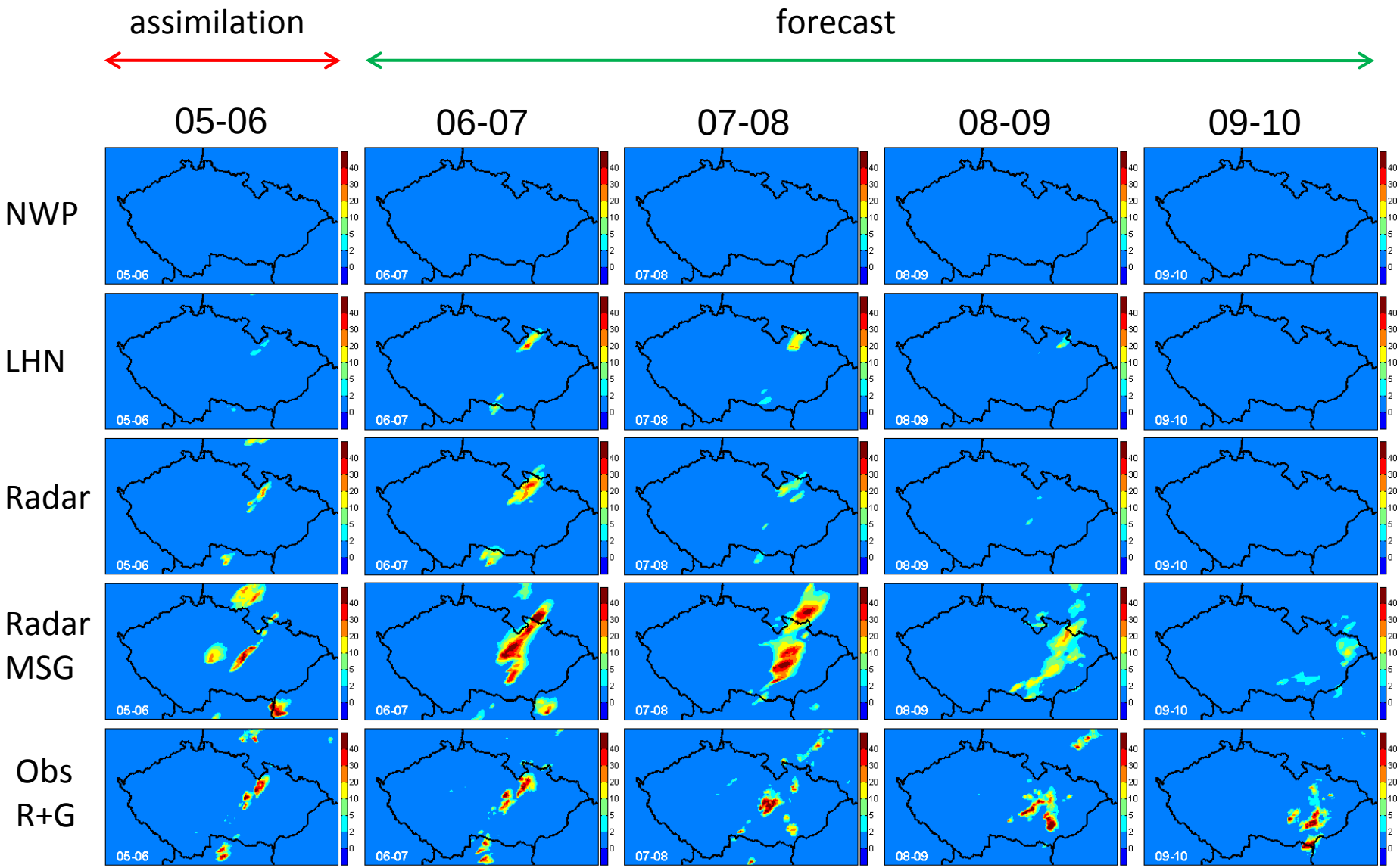
Precipitating clouds IR10.8-IR6.2 [K]



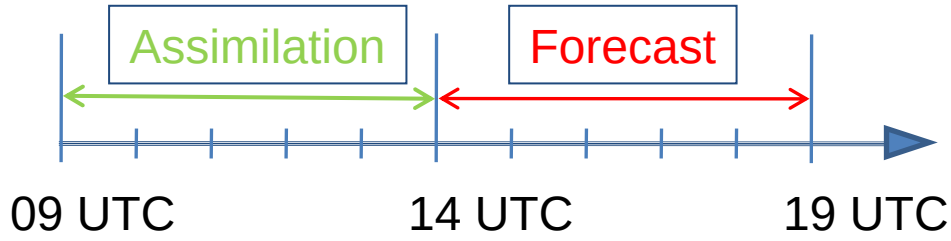
Cloud heights IR10.8 [km]

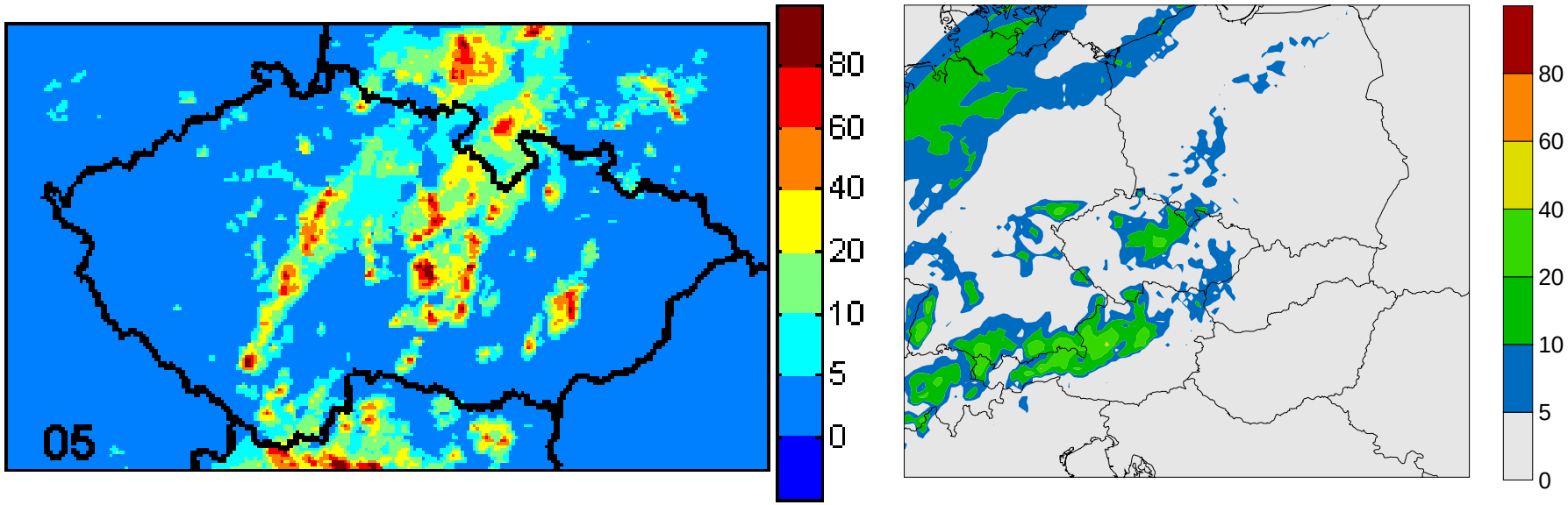


26 June 2006: hourly precipitation 14-19 UTC



30 May 2005

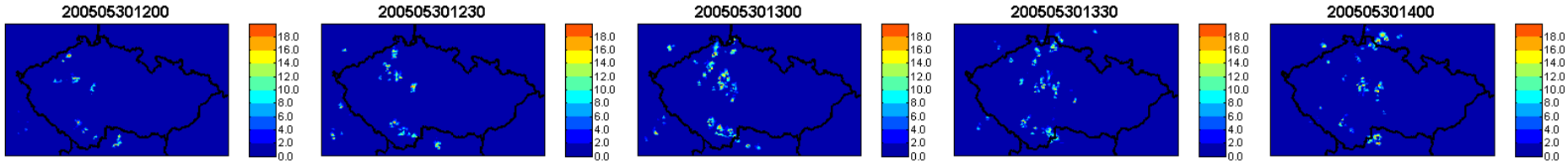




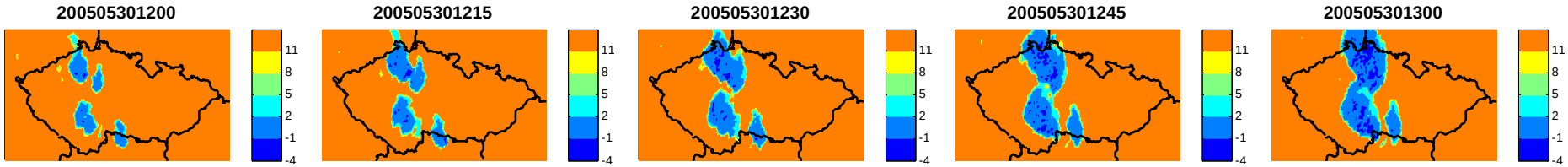
Precipitation 14 – 19 UTC

30 May 2005

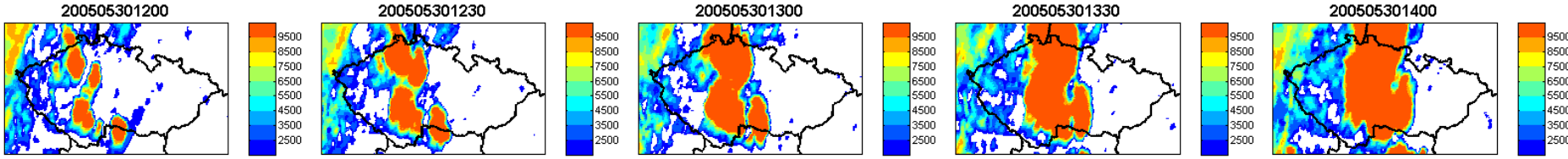
Observed radar data [mm/h]



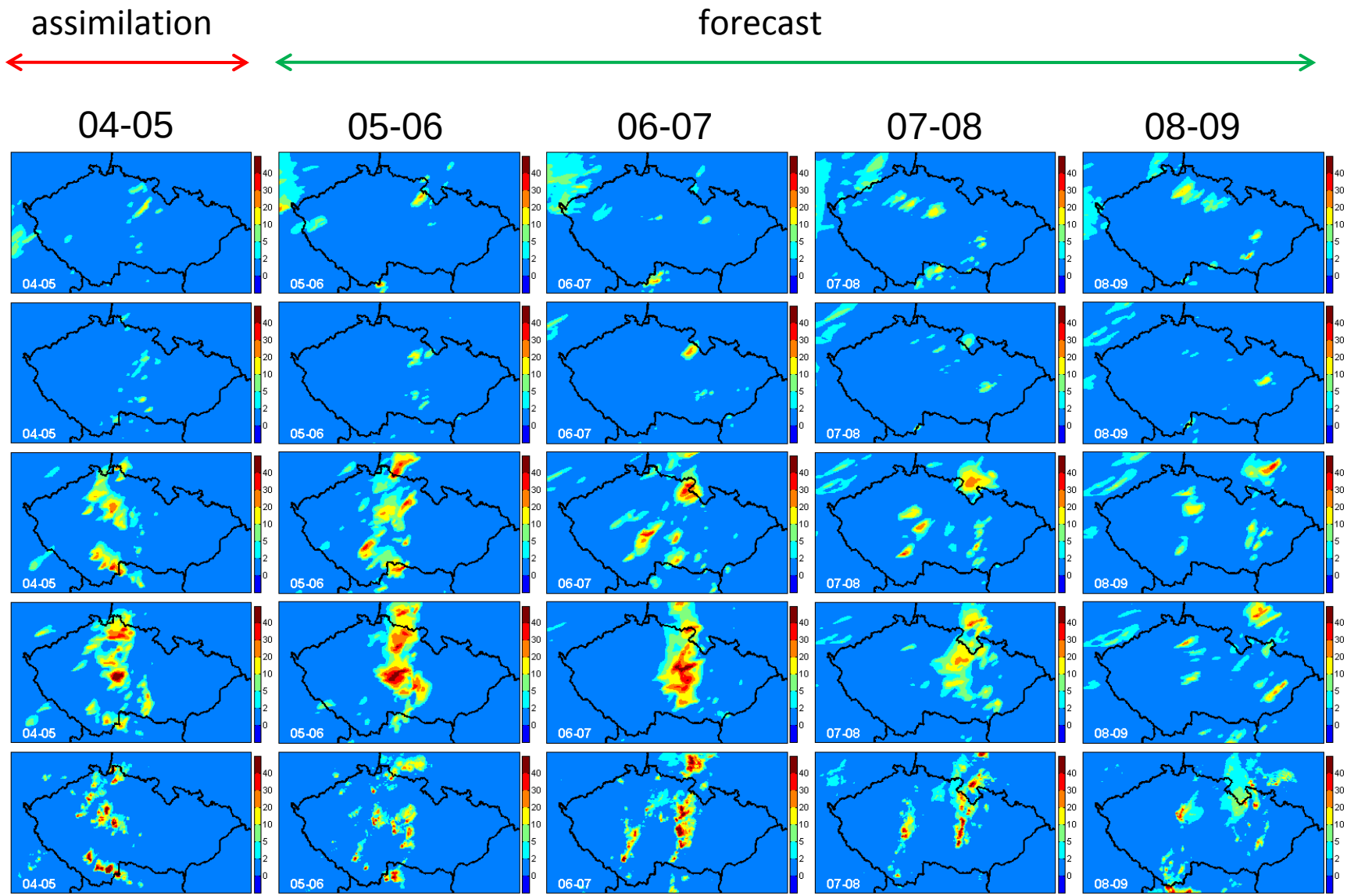
Precipitating clouds IR10.8-IR6.2 [K]



Cloud heights IR10.8 [km]



30 May 2005: hourly precipitation 13-18 UTC



Conclusions

- Assimilation significantly improves precipitation forecast for the next 3-5 hours.
- In general the assimilation of combined radar and MSG data yields better or comparable forecasts than the assimilation of radar data only.
- Problems with MSG data:
  - Relationship: MSG data – rain rates
  - The assimilation of combined radar and MSG data sometimes overestimates precipitation forecasts.
- The assimilation influence precipitation forecast for the next 3-6 hours.

Acknowledgement:
DWD (COSMO model)
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Thank you