Very short range precipitation forecast by the COSMO NWP model using radar and satellite data

Z. Sokol, D. Řezáčová, P. Zacharov

Institute of Atmospheric Physics
ASCR, Prague, Czech Republic

Layout

- Motivation
- NWP model
- Assimilation methods
  - Radar reflectivity
  - Extrapolated radar data
- Examples
- Conclusions

Flash floods

NWP model COSMO 4.6

Configuration

- Δx = 2.8 km, Δt = 30 s
- 281 x 211 x 50
- explicit precipitation
- hydrometeors

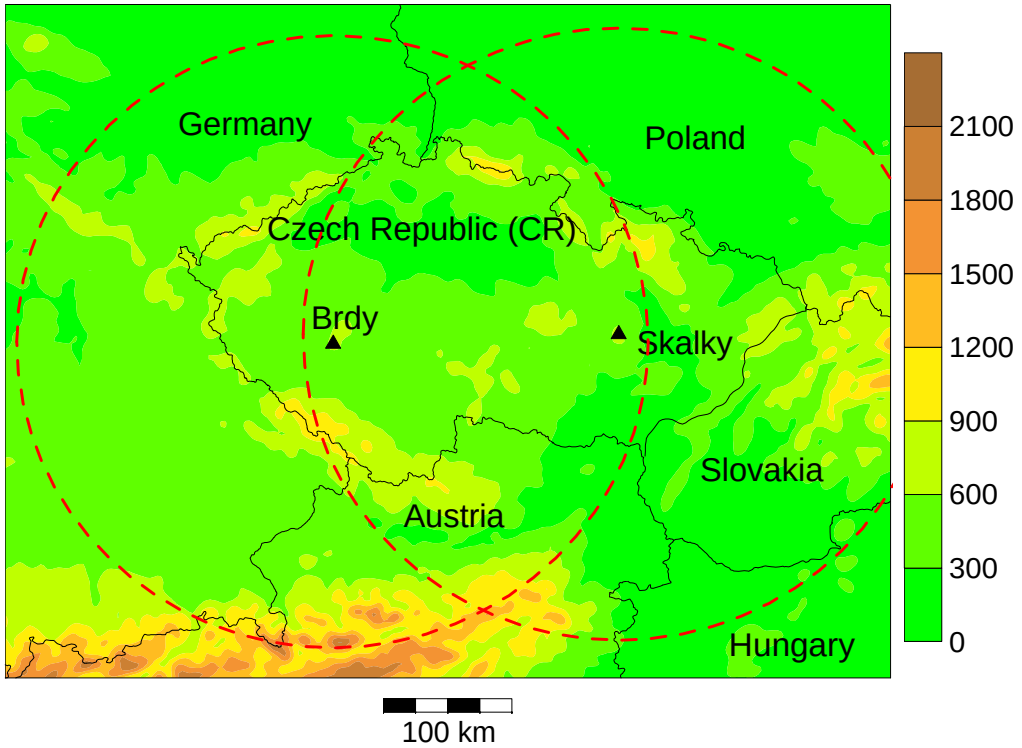
(rain, snow, ice, graupels)

Initial conditions

- forecasts of COSMO-EU

Boundary conditions

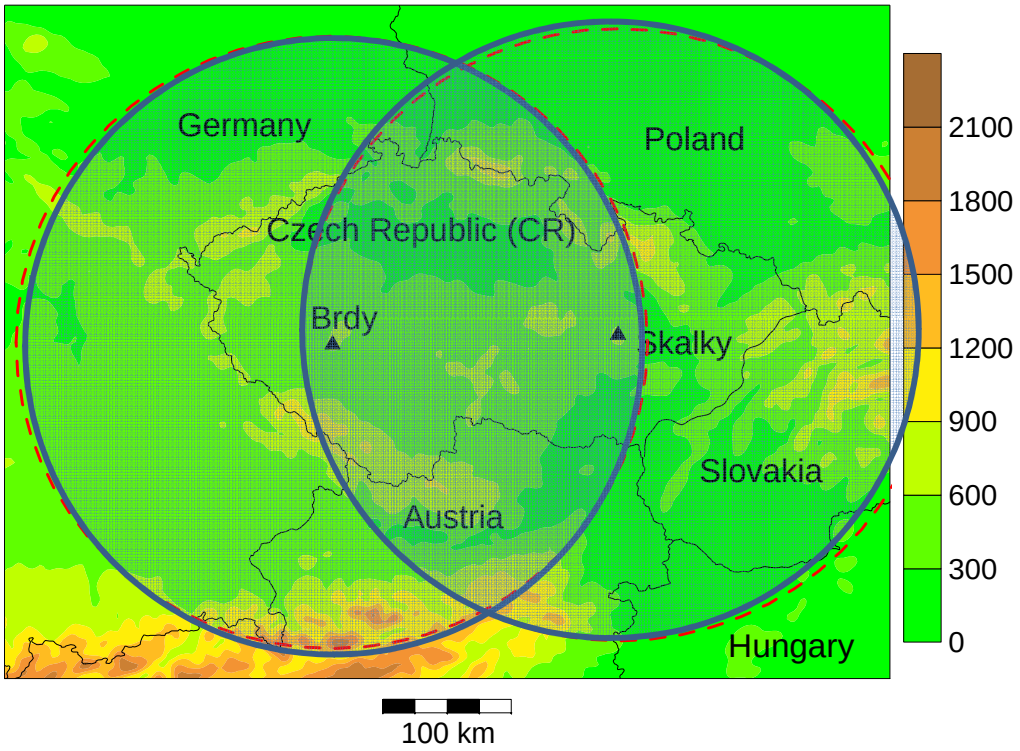
- forecasts of COSMO-EU
- every 1h



780 km x 590 km

Radar data

- Observations
  - two C-band radars
  - resolution 1km x 1km, Δt=10 min., CAPPI 2km
- Assimilated data
  - rain rates
  - Z-R α=200, β=1.6
- Forecast verification
  - Radar + gauge



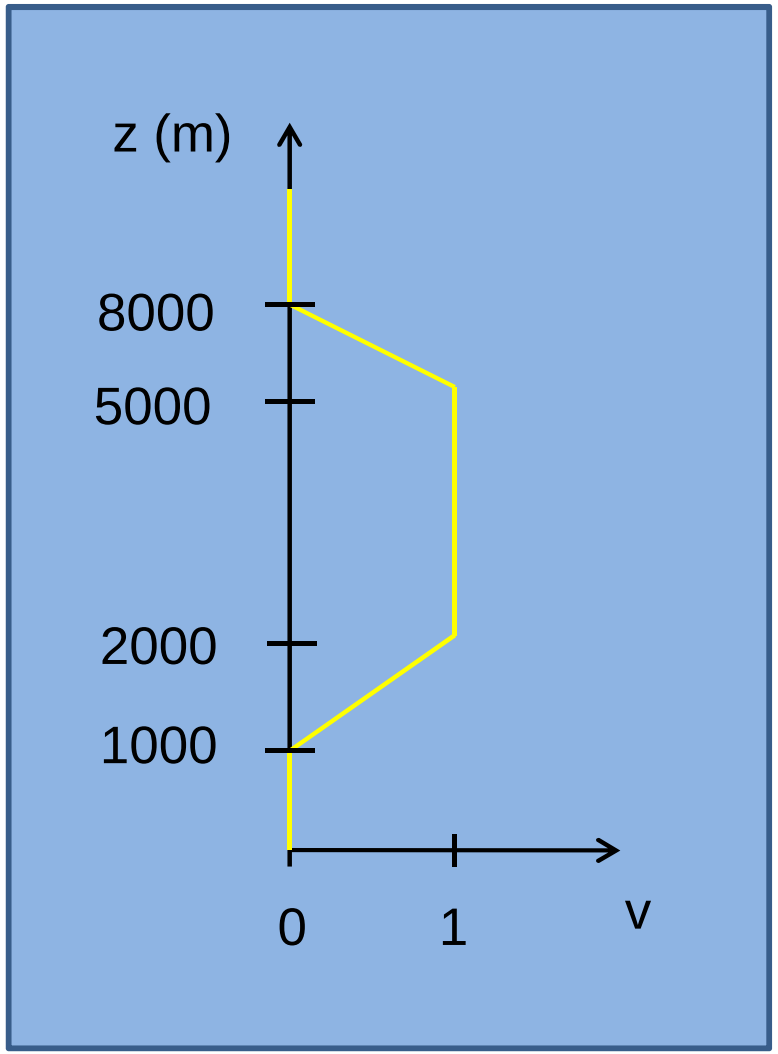
Assimilation of radar reflectivity by model water vapour correction Δq_V

$$\Delta q_V = \boldsymbol{f}\,(\, r_{RADAR} - r_{NWP};\, q_{sat})$$

$r_{RADAR} > r_{NWP} \quad \Rightarrow \quad \Delta q_V > 0$

$r_{RADAR} < r_{NWP} \quad \Rightarrow \quad \Delta q_V < 0$

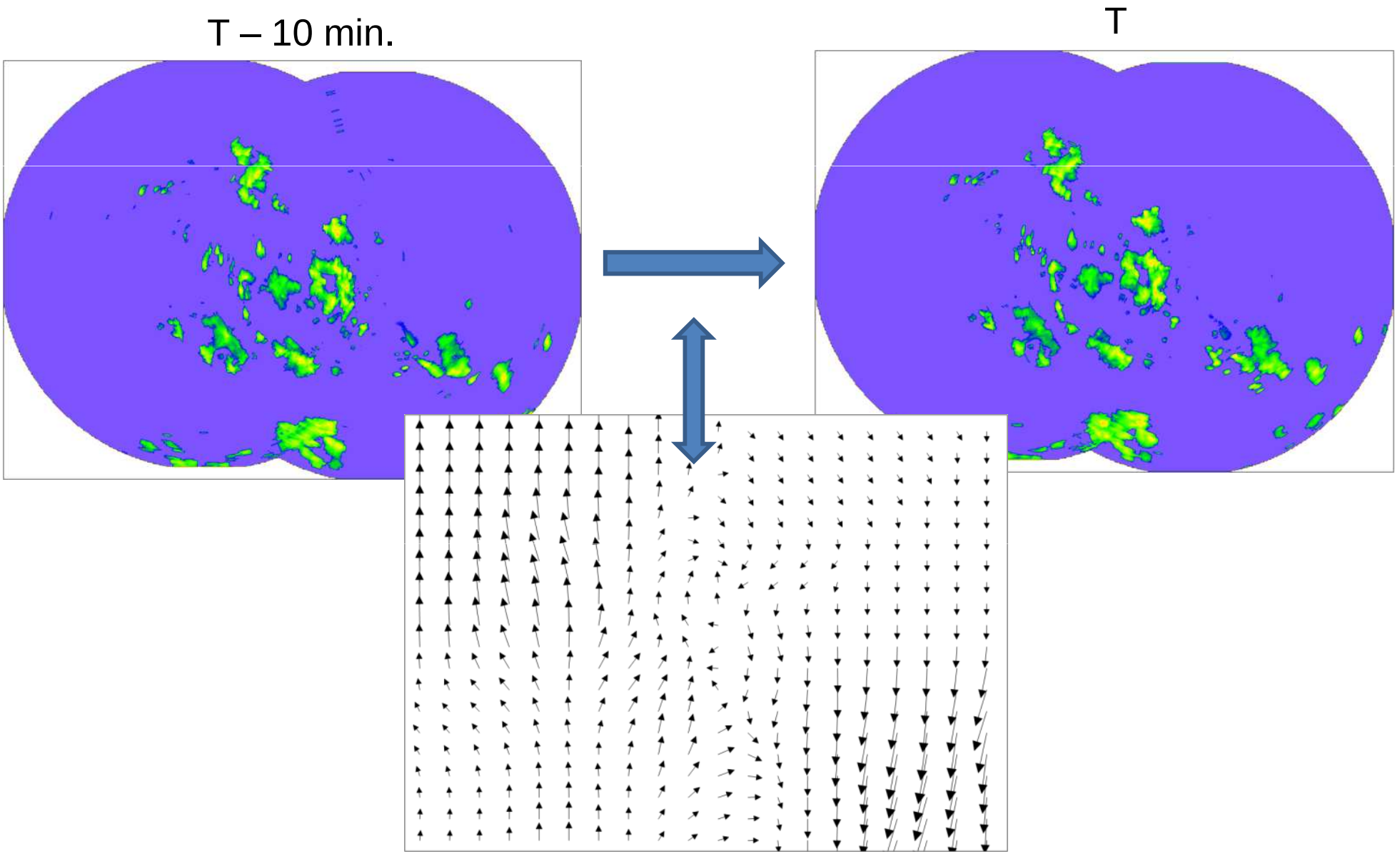
$$q_{i,j,k}^{new} = q_{i,j,k}^{old} + \Delta q * v(z_k)$$



Assimilation of extrapolated radar reflectivity

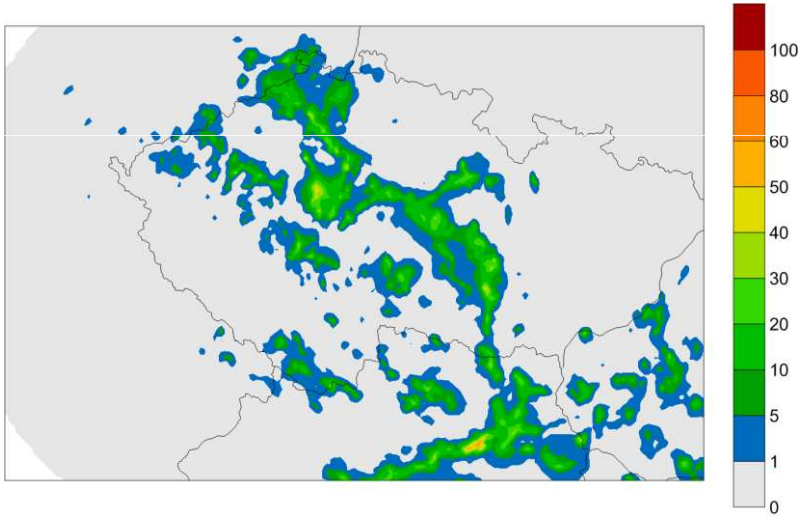
- Motion field is derived from consecutive radar observations
- Radar reflectivity is extrapolated using lagrangian trajectories (back propagation algorithm)

Motion field – COTREC method

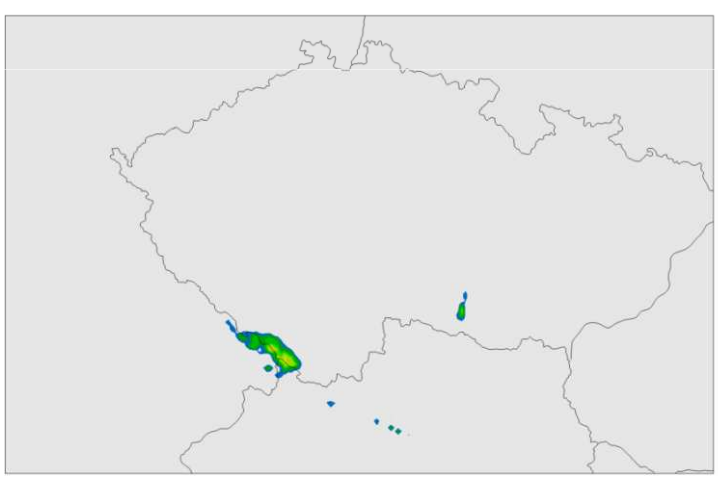


01 June 2008

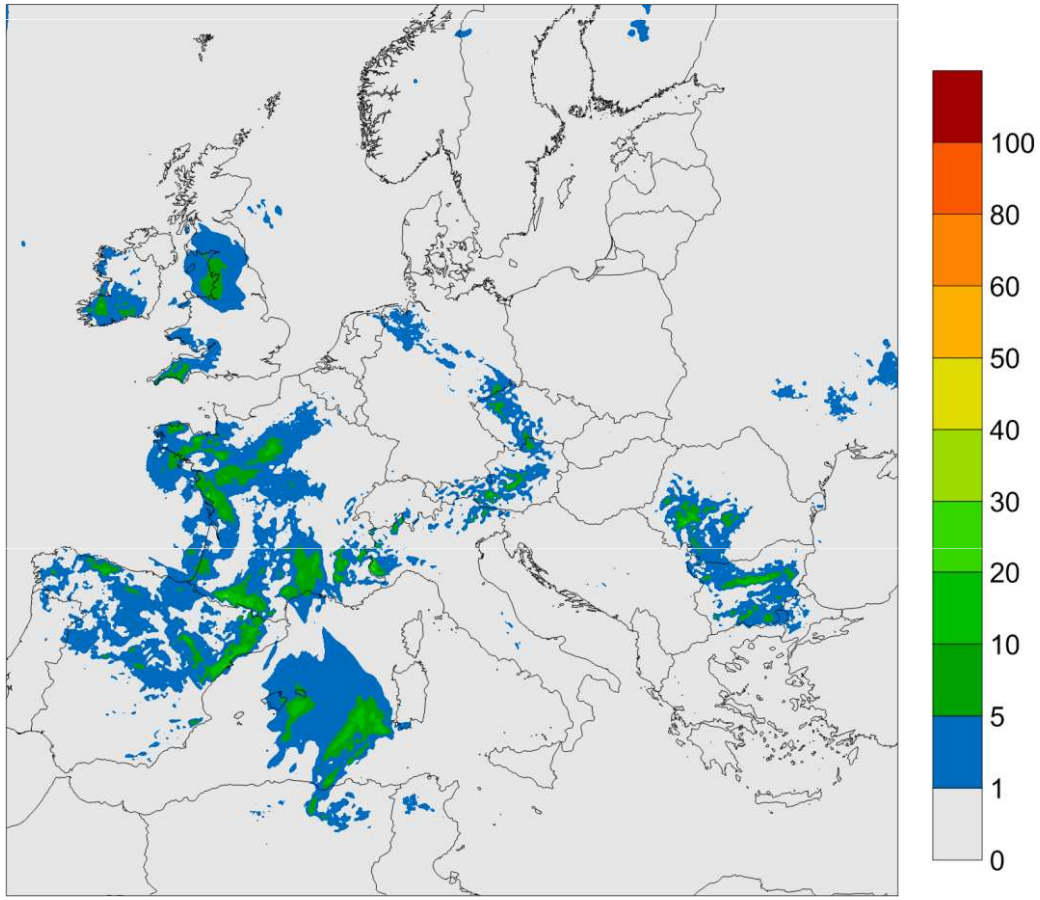
Obs. precipitation 12-18 UTC



COSMO-CZ: precipitation 12-18 UTC



COSMO-EU: precipitation 12-18 UTC



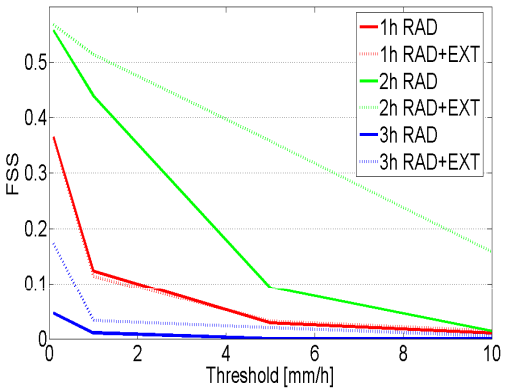
Assimilation: 09 – 14 UTC

OBS | RAD | RAD + EXT | EXT

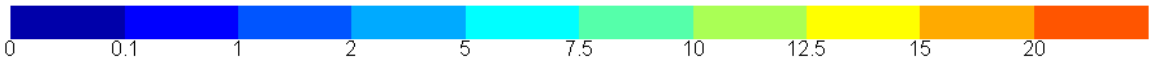
14-15 UTC

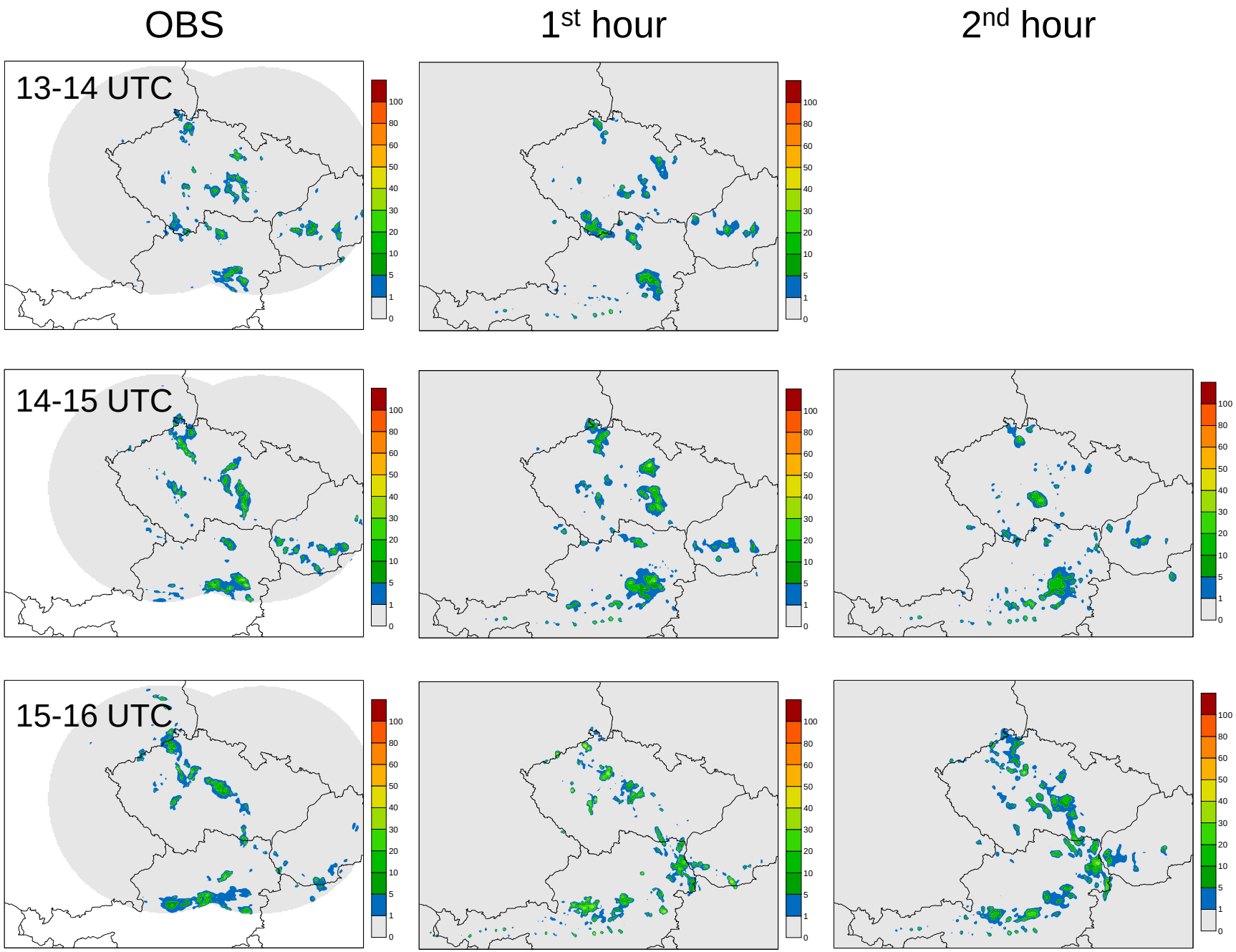
15-16 UTC

16-17 UTC



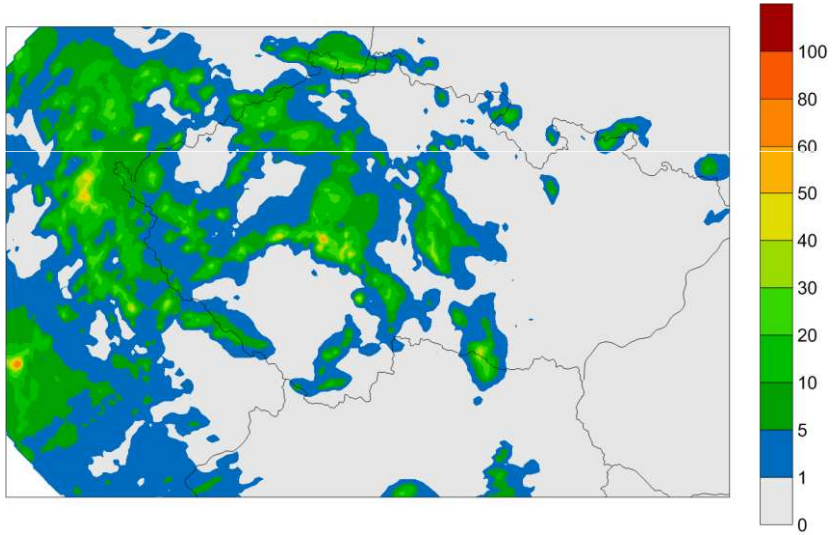
9x9 grids



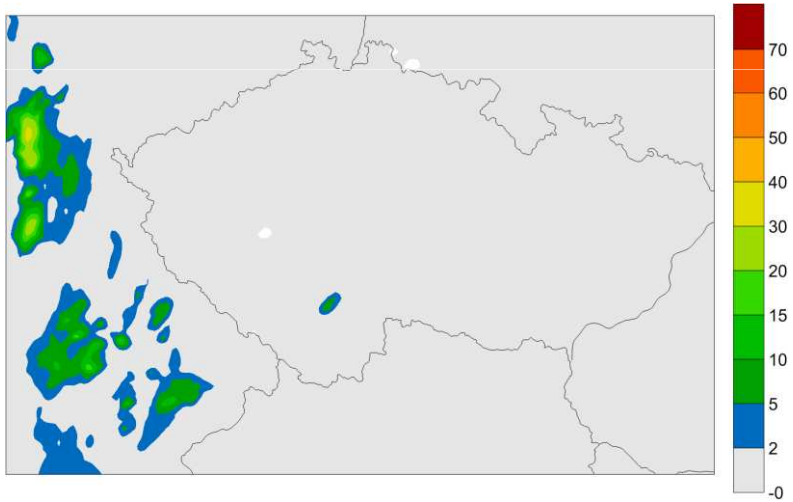

OBS
1st hour
2nd hour
13-14 UTC
14-15 UTC
15-16 UTC
100
80
60
50
40
30
20
10
5
1
0

03 July 2008

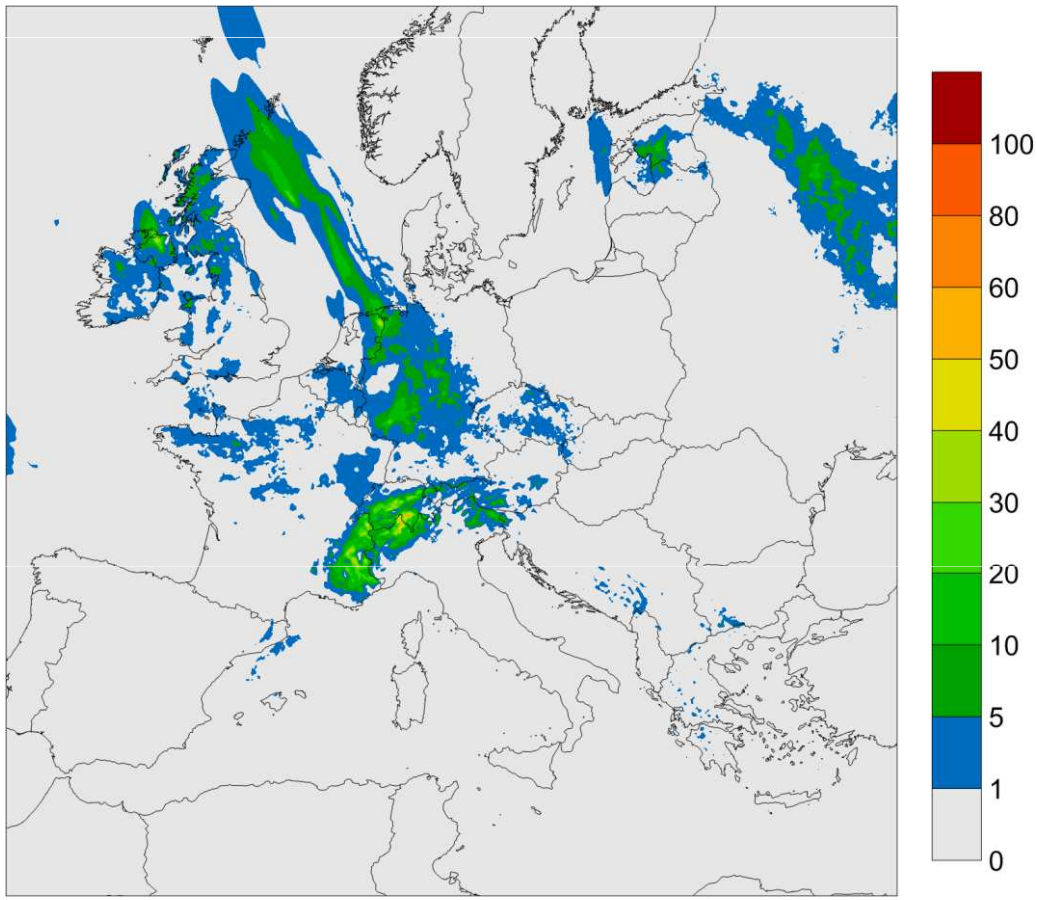
Obs. precipitation 12-18 UTC



COSMO-CZ: precipitation 12-18 UTC



COSMO-EU: precipitation 12-18 UTC



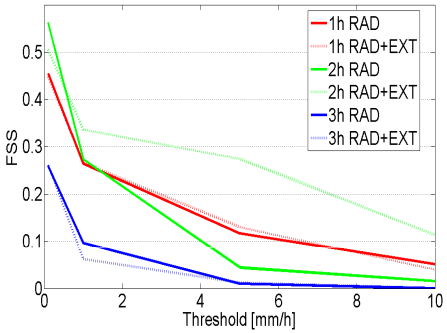
Assimilation: 09 – 14 UTC

OBS | RAD | RAD + EXT | EXT

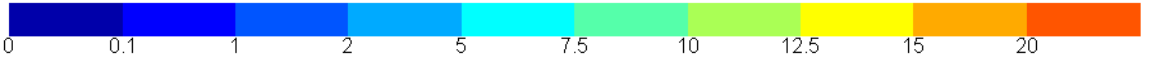
14-15 UTC

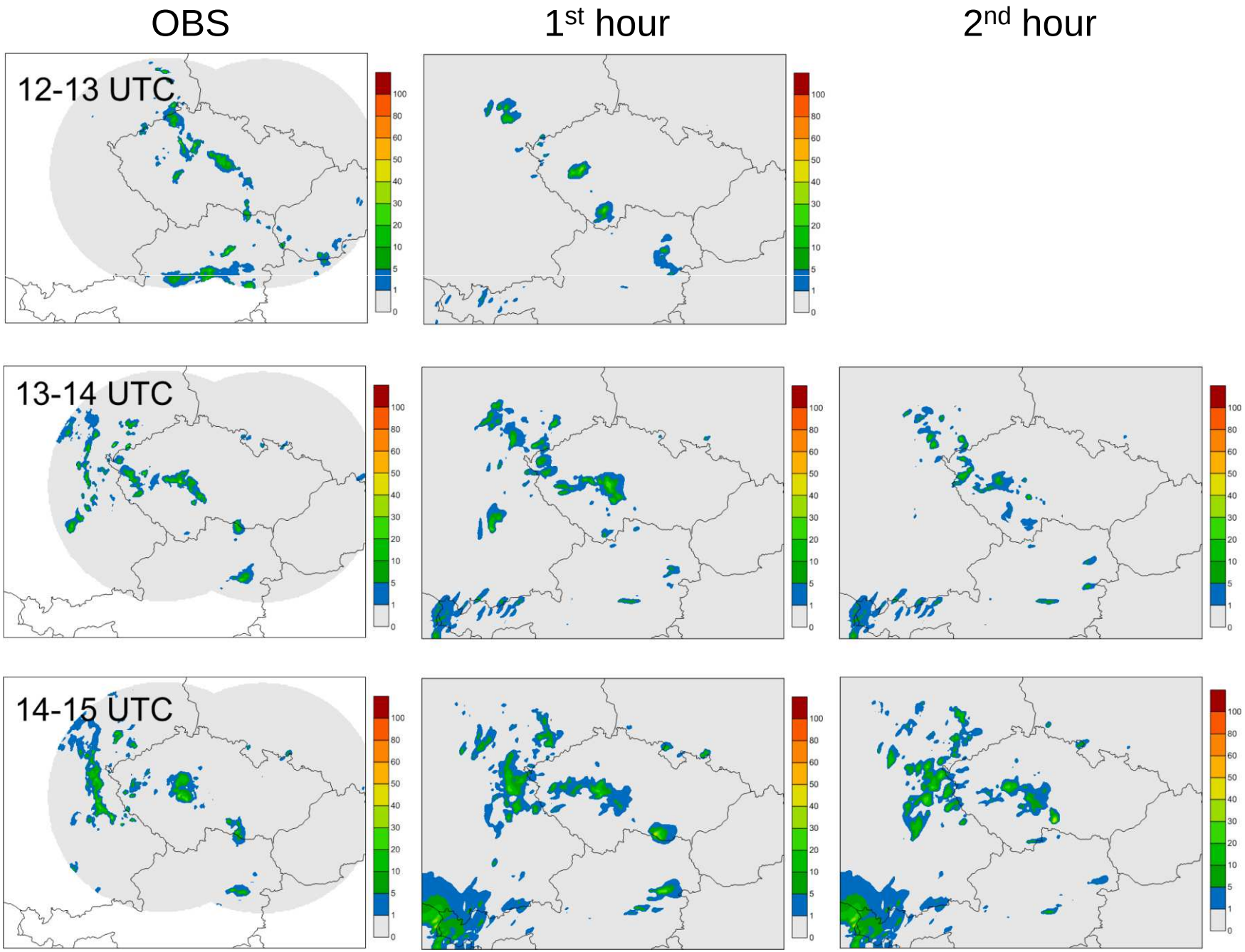
15-16 UTC

16-17 UTC



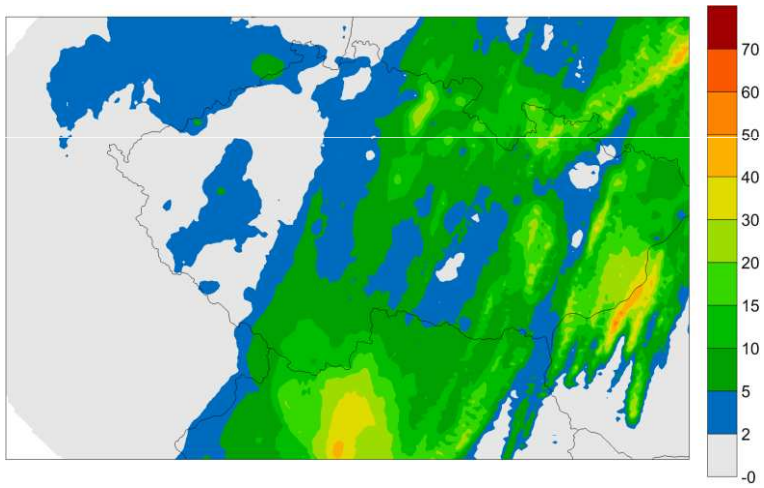
9x9 grids



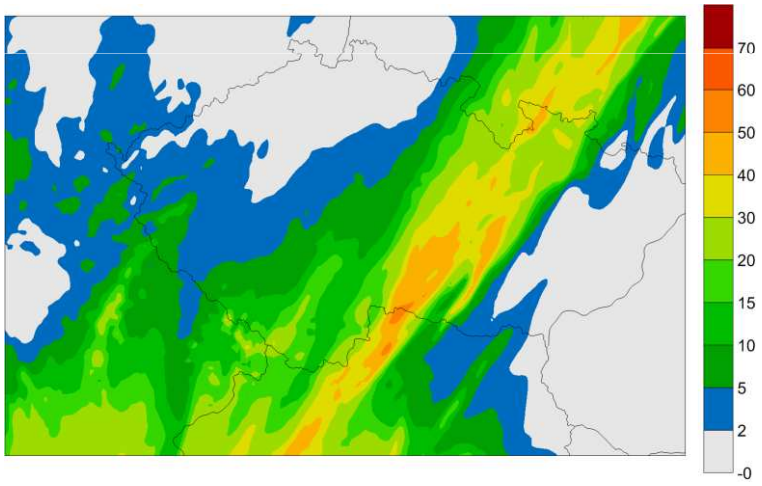

OBS
1st hour
2nd hour
12-13 UTC
13-14 UTC
14-15 UTC
100
80
60
50
40
30
20
10
5
1
0

15 August 2008

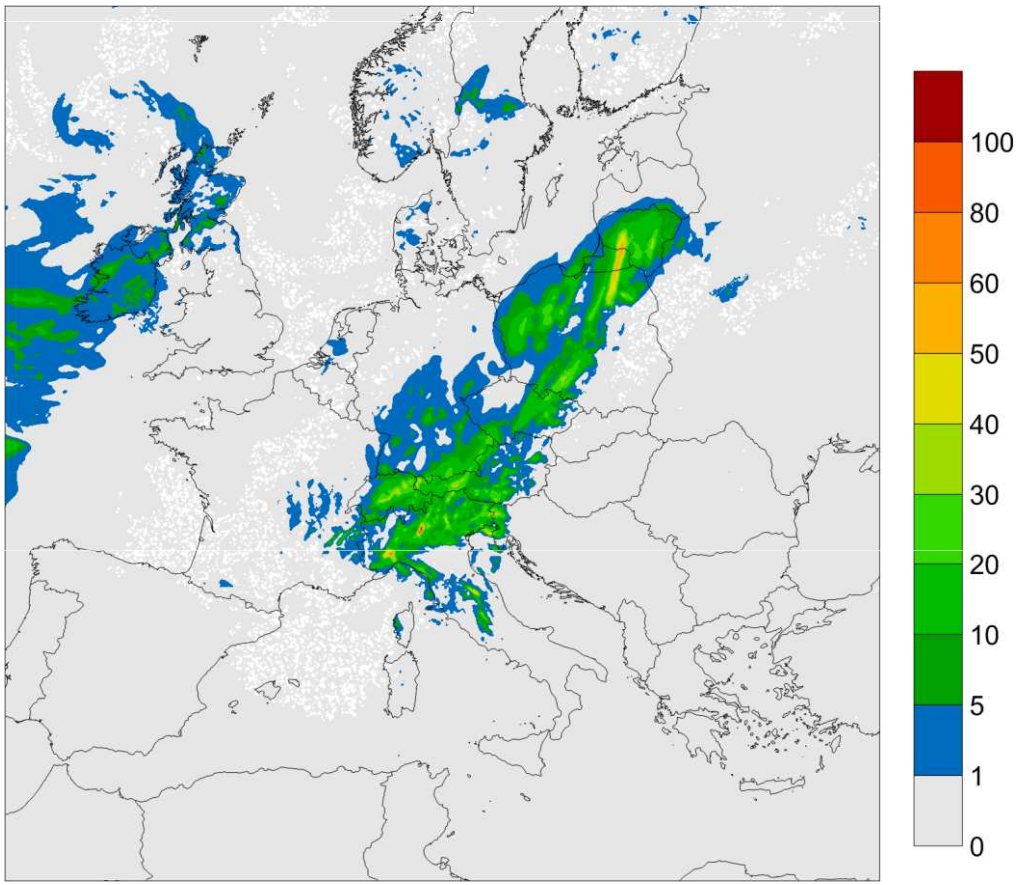
Obs. precipitation 12-18 UTC



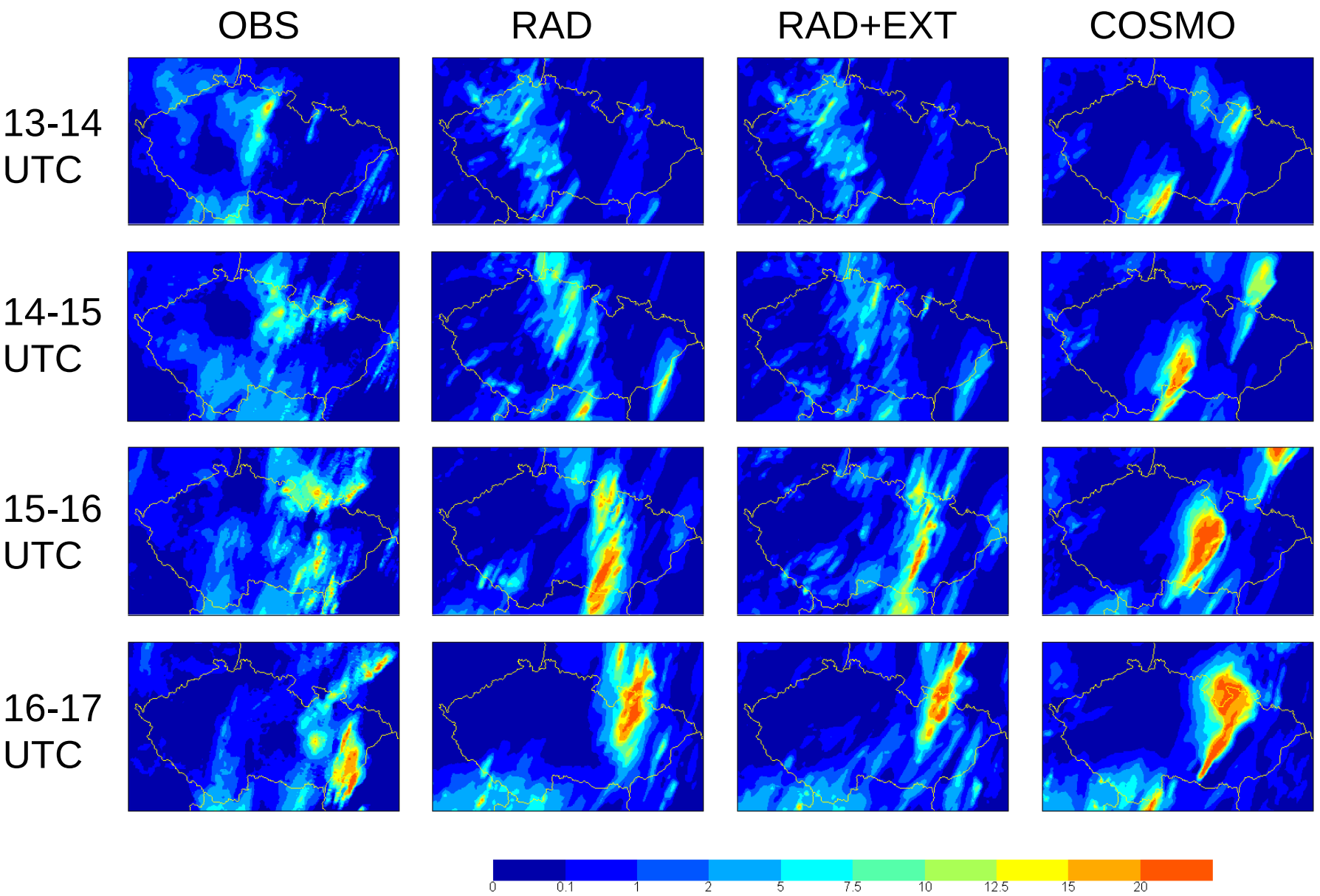
COSMO-CZ: precipitation 12-18 UTC



COSMO-EU: precipitation 12-18 UTC



Assimilation: 09 – 14 UTC



Conclusions

- The WVC assimilation method improves precipitation forecasts.
- Assimilation of radar data can trigger precipitation processes.
- Assimilation of extrapolated data usually improves precipitation forecasts for 2nd and 3rd hour.
- Small area restricts the length of the forecast.

Acknowledgement

DWD for providing COSMO code and COSMO-EU data
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