Differences in precipitation nowcasting using one and two moment microphysics and assimilation of extrapolated radar reflectivity

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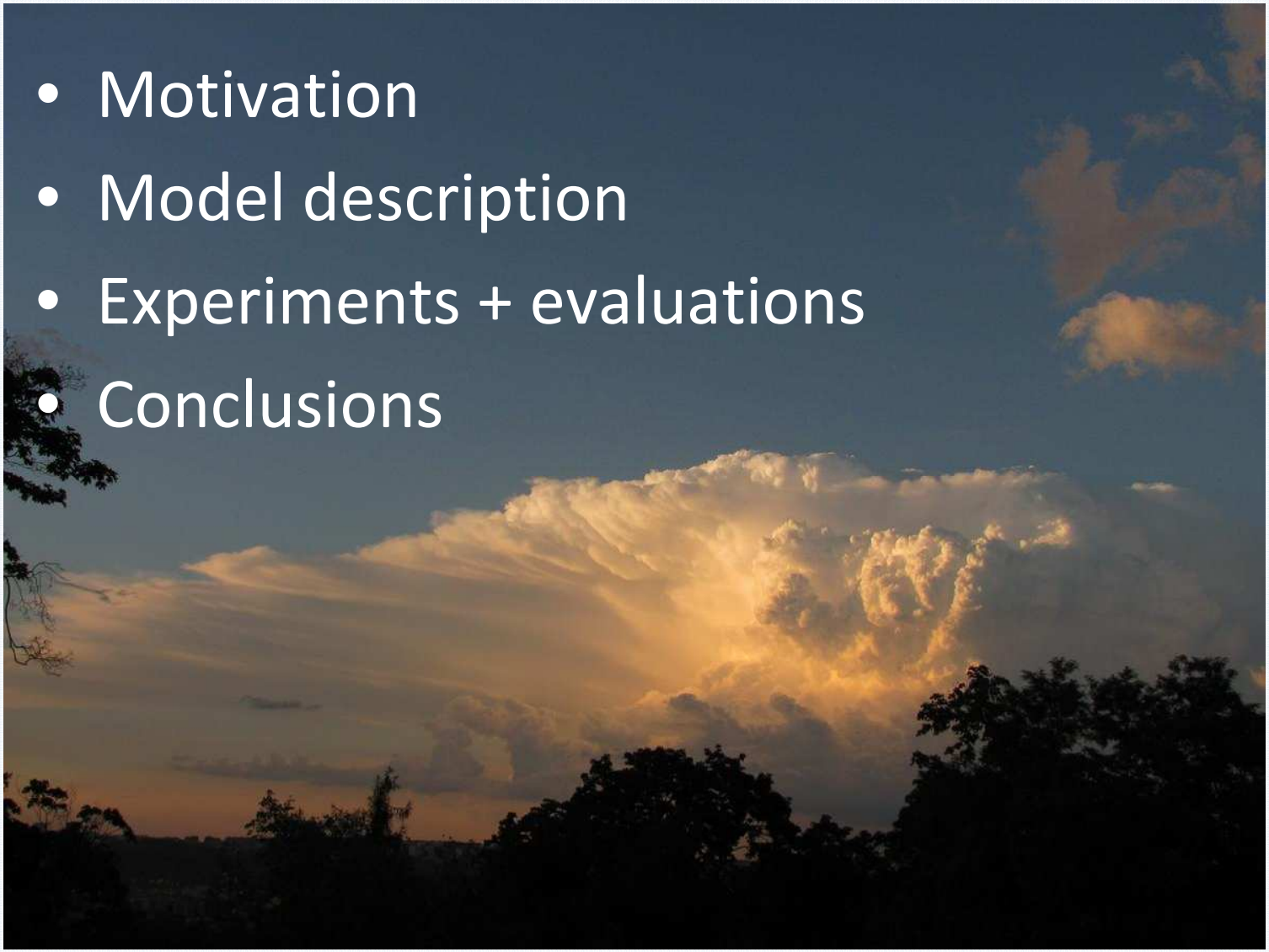
Layout



- Motivation
- Model description
- Experiments + evaluations
- Conclusions

Motivation

13.7.2002 Chocerady foto ÚFAAVČR

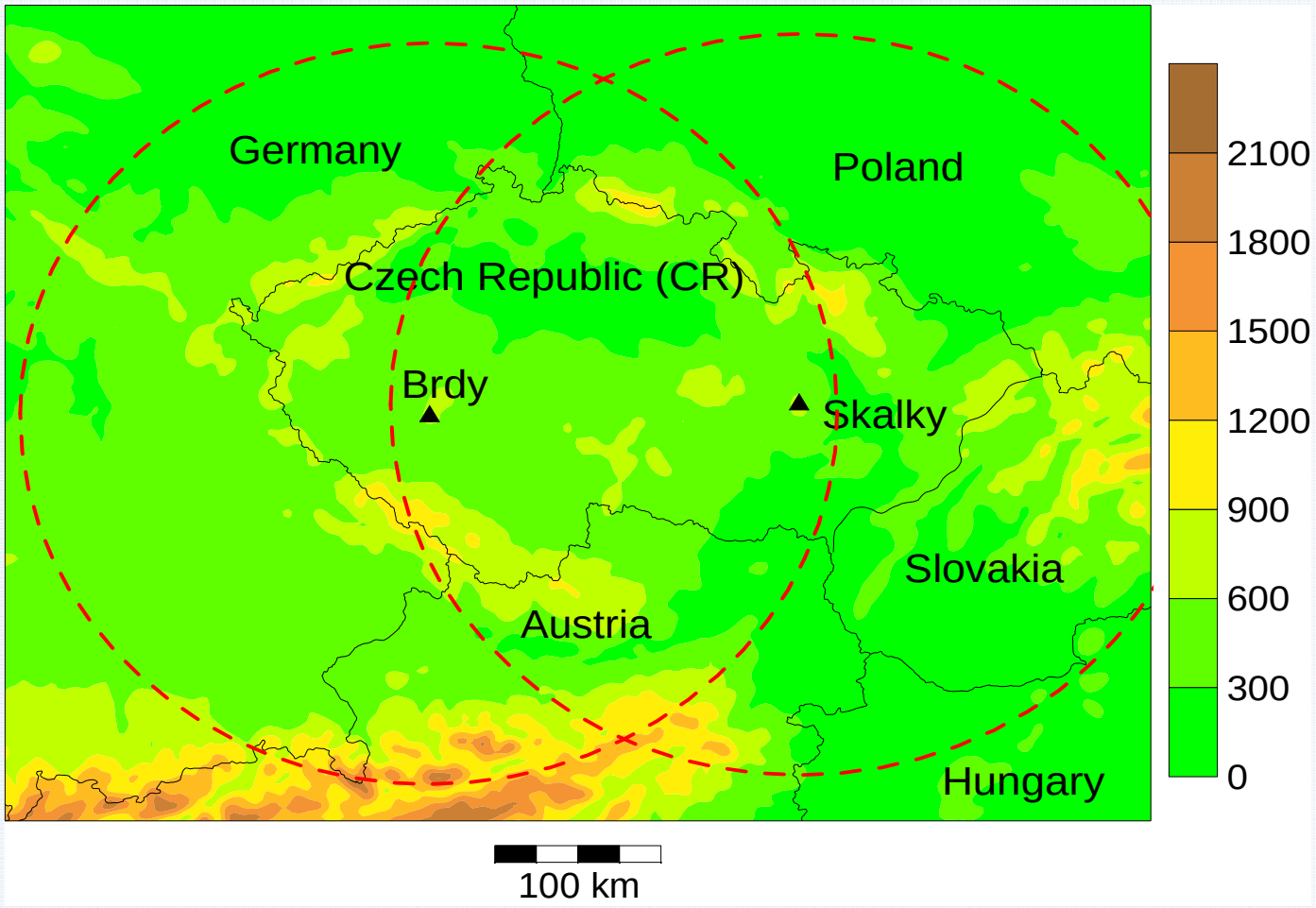
15.7.2002 Olešnice http://www.chmi.cz/poboc/BR/

Model configuration

- Modified COSMO 4.18
- Microphysics
  - One moment cloud microphysics
  - Two moment cloud microphysics (Seifert, Beheng, 2006) + hail
    Cloud condensation nuclei (CCN):
    'continental CCN' itype_gsp=2483 (CC)
- Horizontal resolution of 2.8 km
- Basic initial and boundary conditions derived from COSMO EU
- Assimilation of radar reflectivity including 1h extrapolation of latest observed data (model water vapour correction)

Model domain

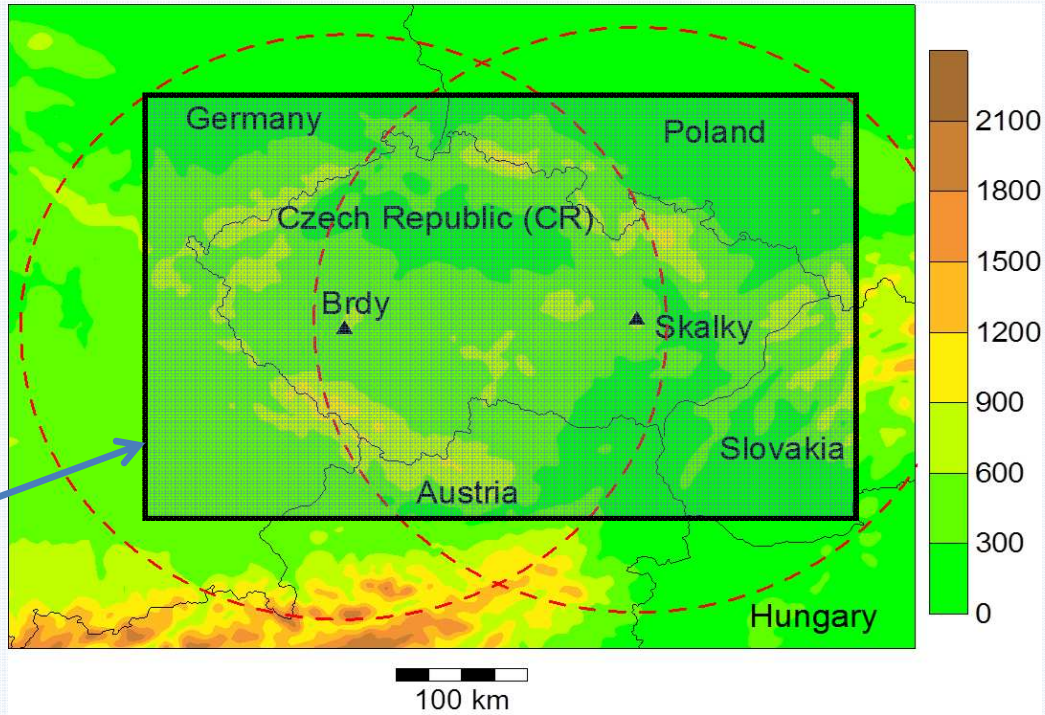
Resolution 2.8 km: Δt=30s, 50 vertical levels, 281x211



Radar data

- **Observations**
  - two C-band radars
  - resolution 1km x 1km,
    Δt=10 min.,
    CAPPI 2km

- **Forecast verification**
  - Radar + gauges



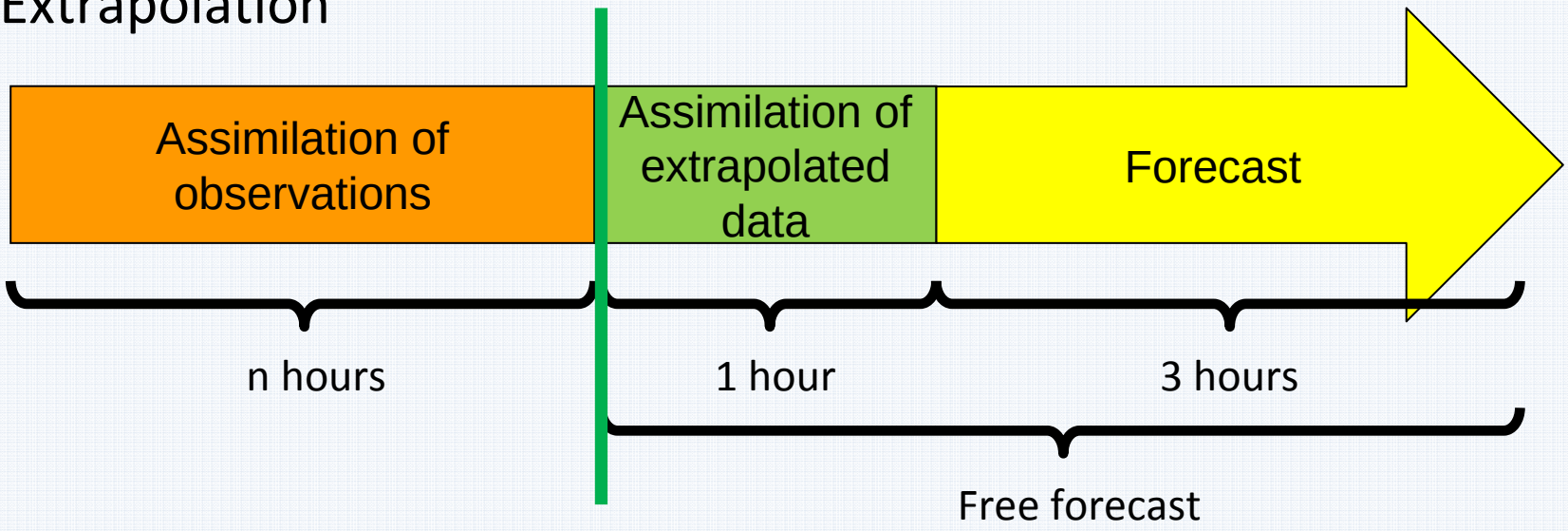
Assimilation of extrapolated reflectivity

- Correction of model water vapour mixing ratio:

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

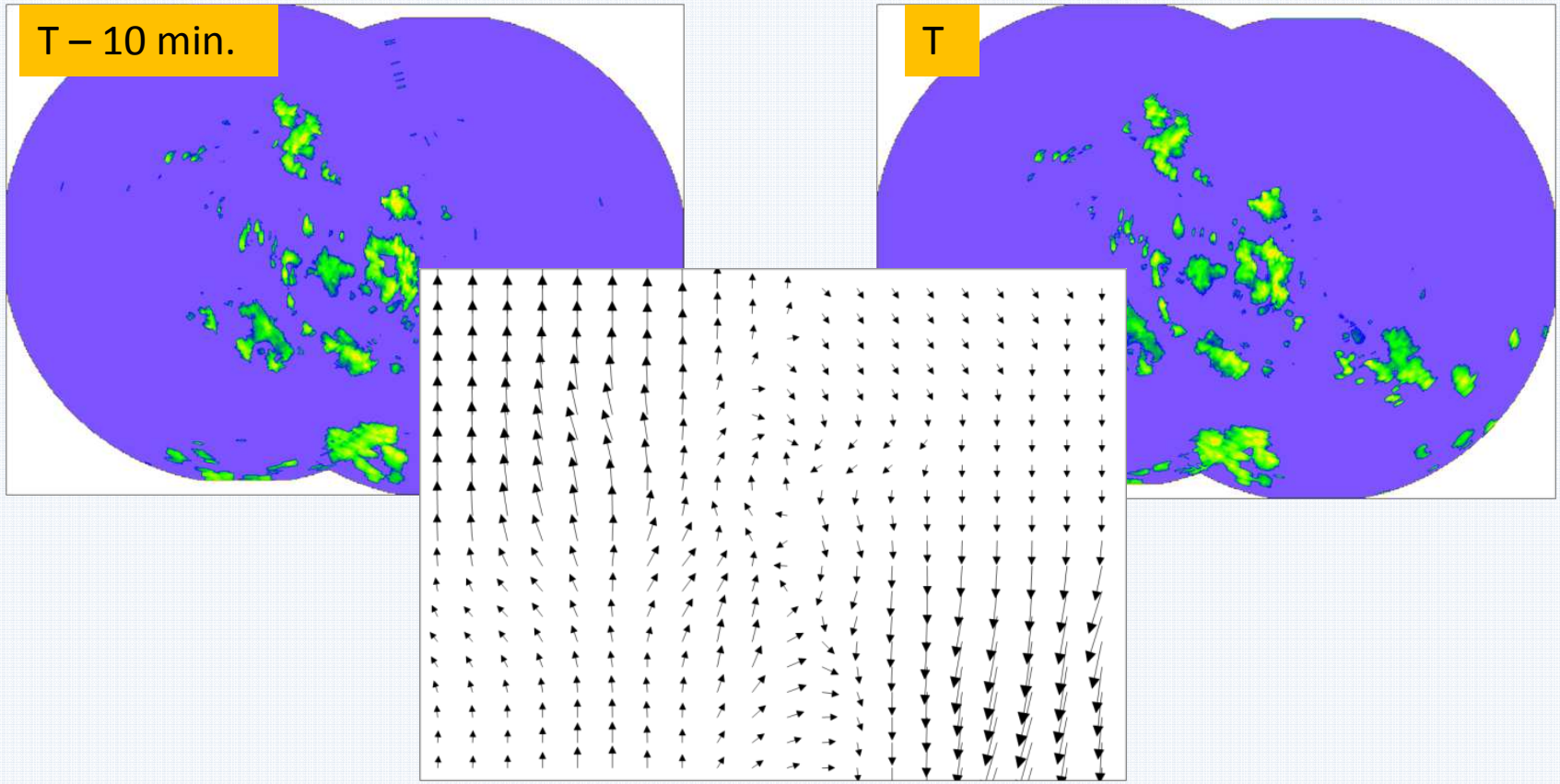
$r_{RADAR} < r_{NWP} \Rightarrow \Delta q_V < 0$

- Extrapolation



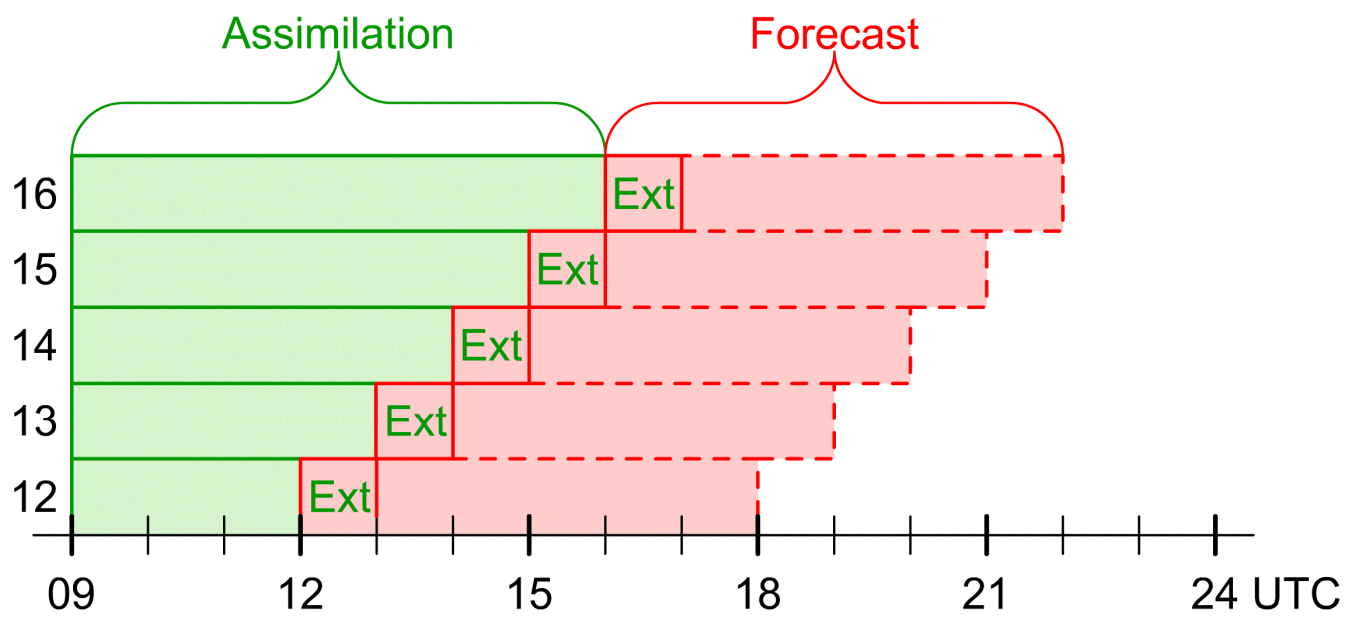
Extrapolation of radar reflectivity

- COTREC method



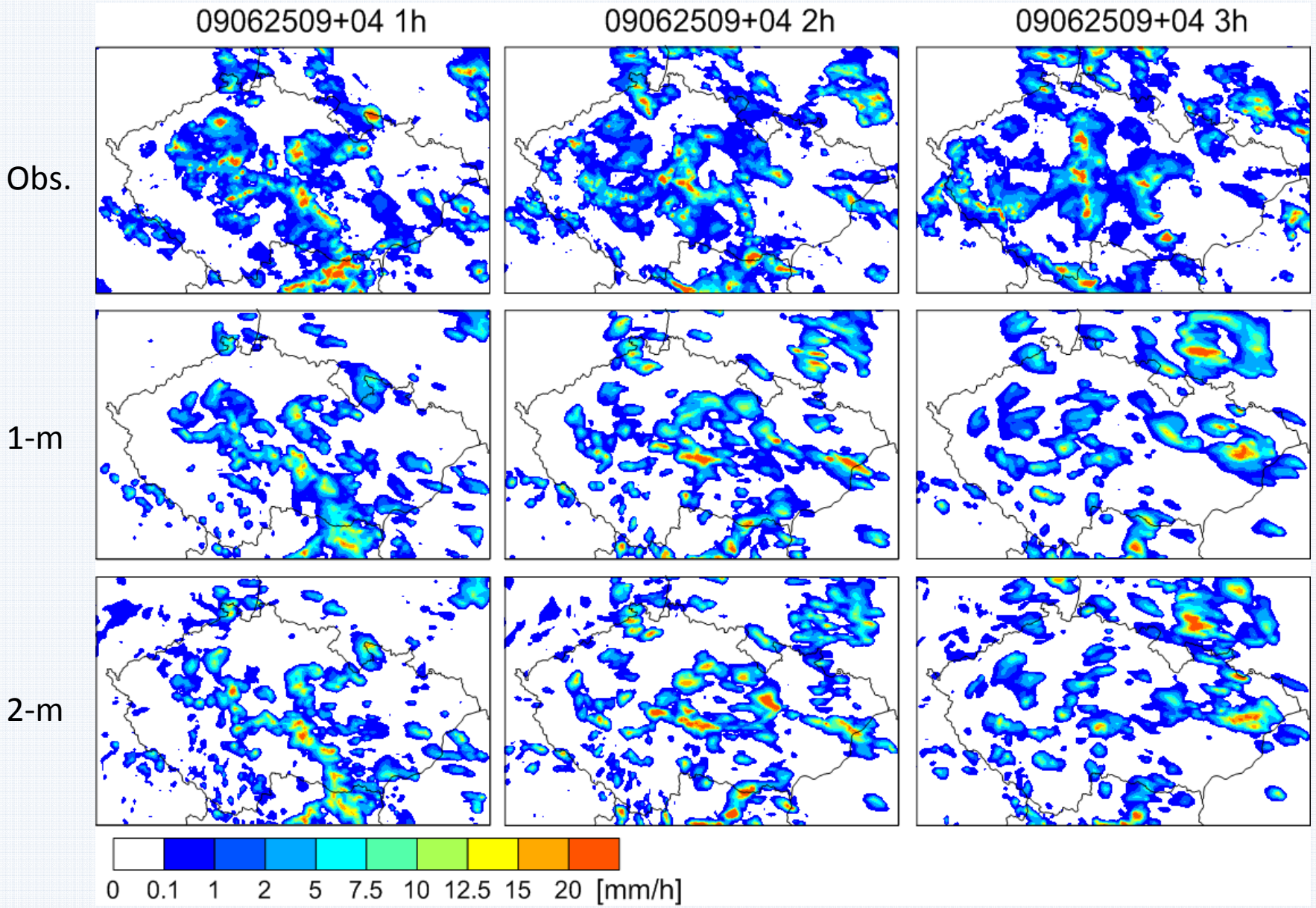
Forecasts

- 9 days from June, July 2009
- 5 forecasts for each day



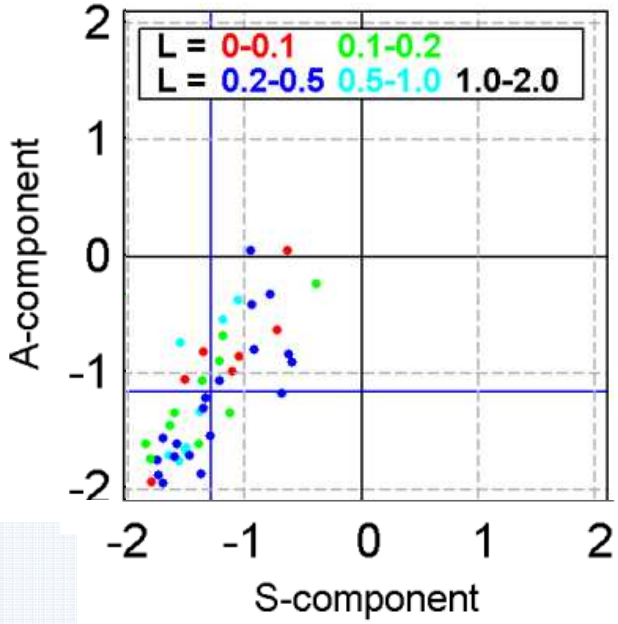
Evaluation of the forecasts

- Differences between 1-m and 2-m
- Hourly precipitation:
  - 1st, 2nd and 3rd h
- Subjective evaluations
- Verification measures:
  - FSS (Roberts and Lean, 2008)
  - SAL (Wernli et al., 2008)
- Rain rate distribution using 15 min. data

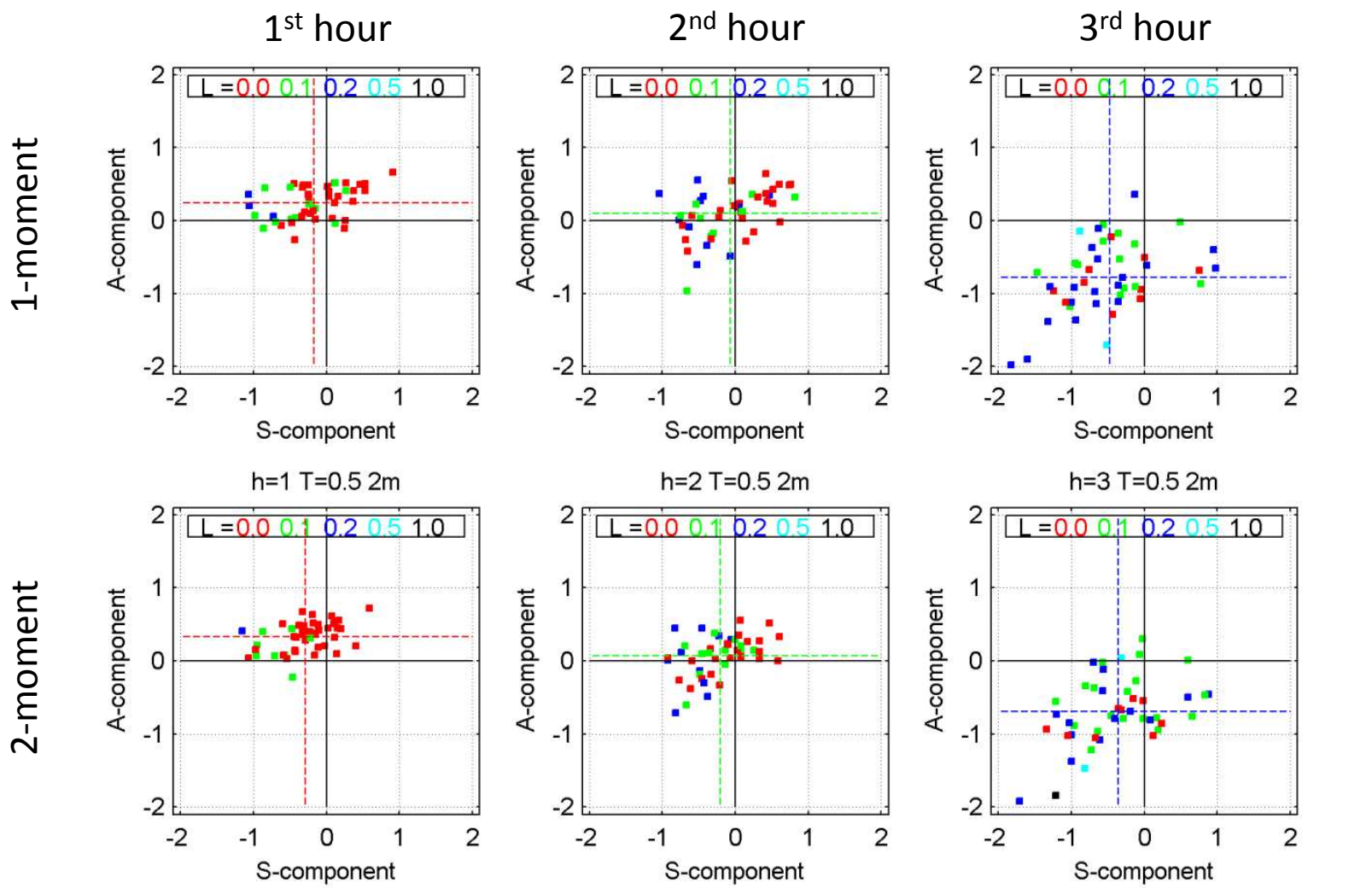

09062509+04 1h
09062509+04 2h
09062509+04 3h
Obs.
1-m
2-m
0 0.1 1 2 5 7.5 10 12.5 15 20 [mm/h]

SAL – object-based quality measure

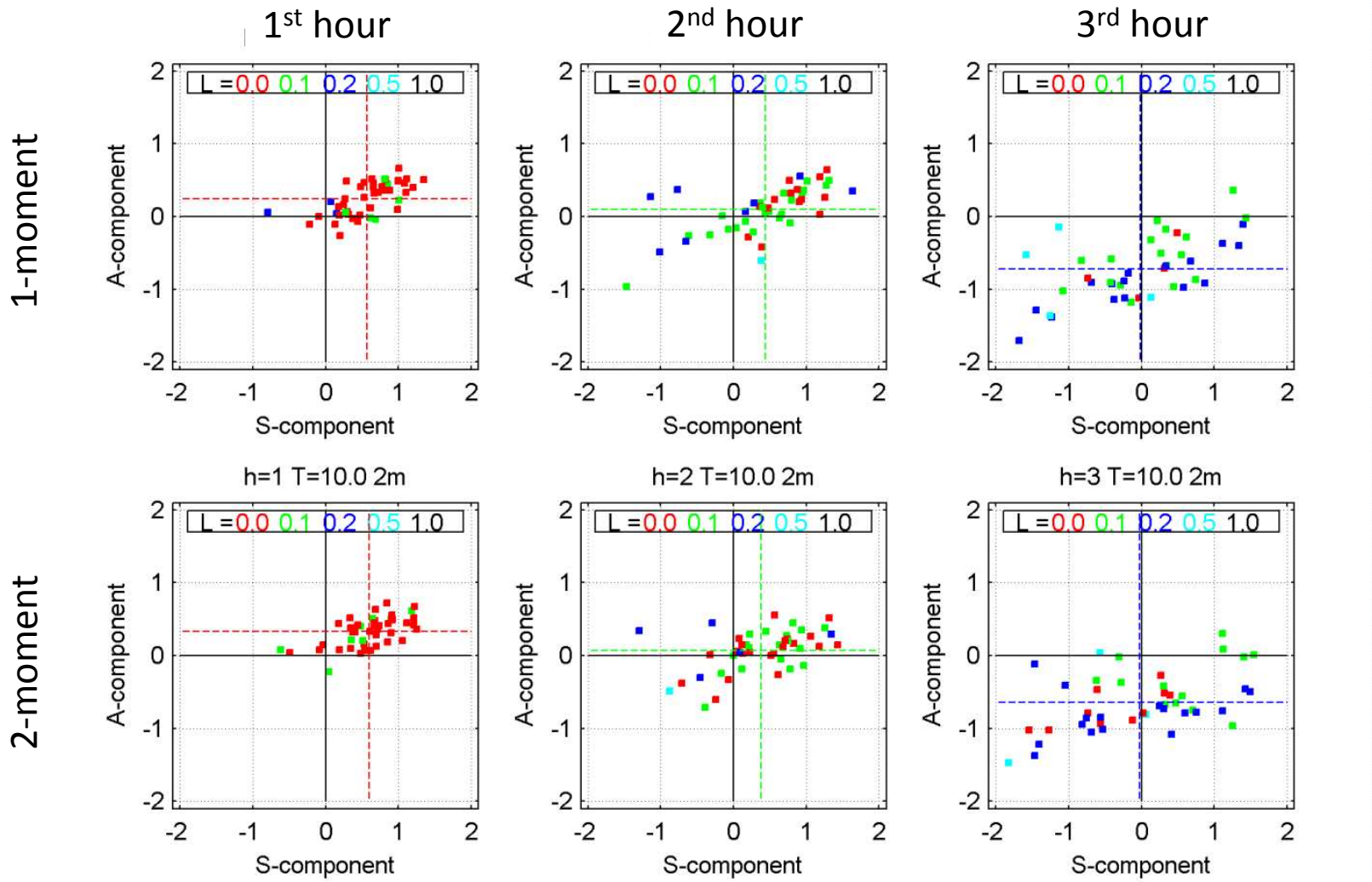
- S (structure) : [-2, 2]
  - 2 model precipitation area is large and/or flat
  - -2 model precipitation area is small and/or peaked
- A (amplitude) : [-2, 2]
  - -2 underestimation
  - 2 overestimation
- L (location) : [0, 2]



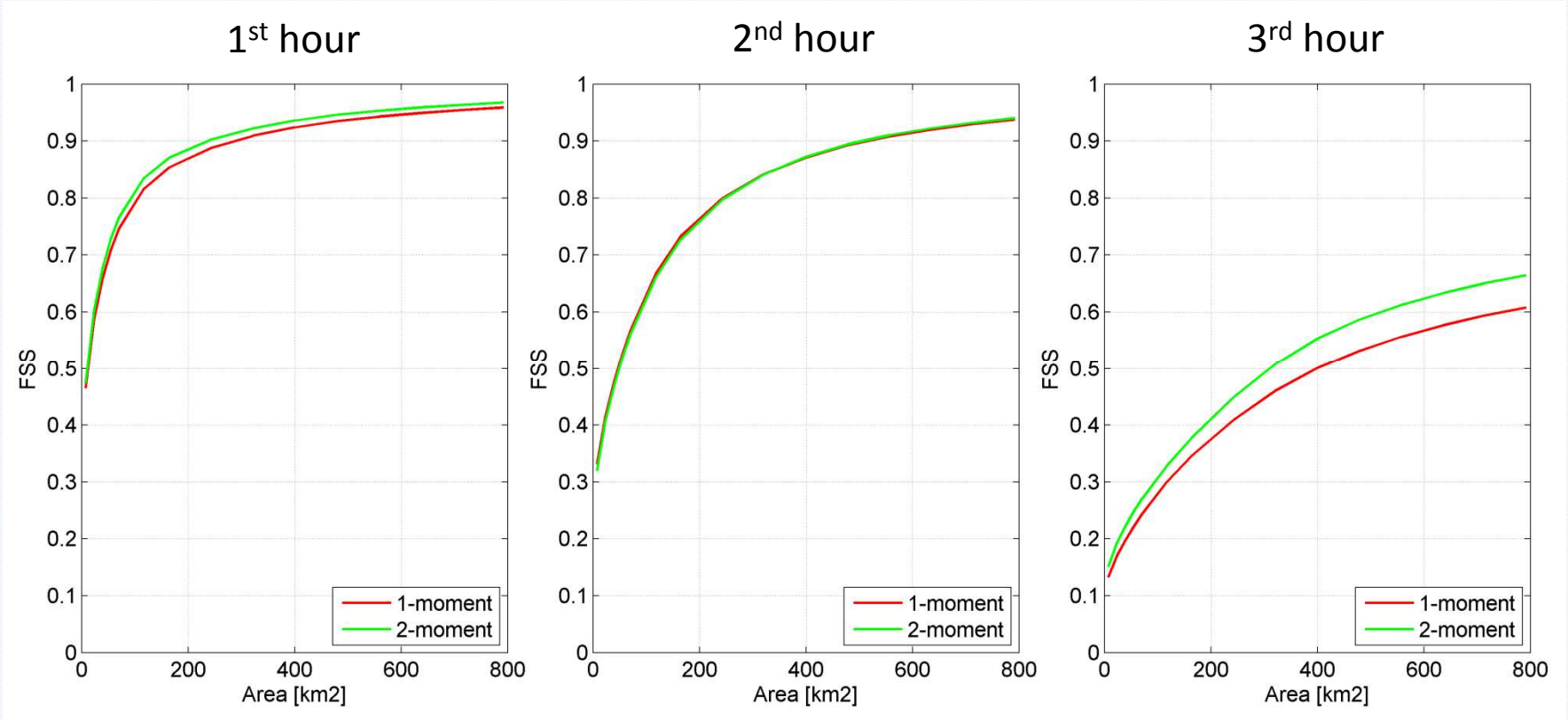
SAL, T=0.5 mm/h: comparison 1-m, 2-m



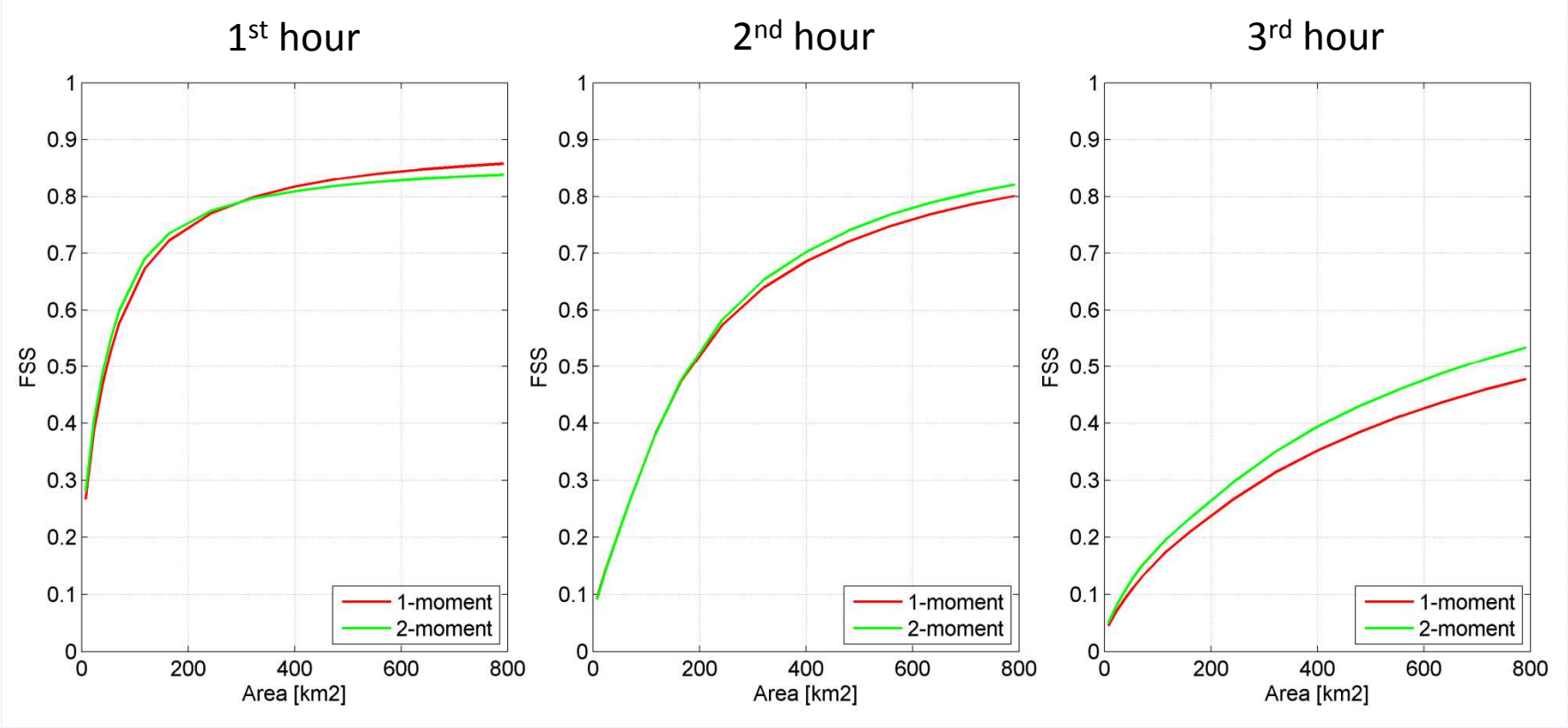
SAL, T=10 mm/h: comparison 1-m, 2-m



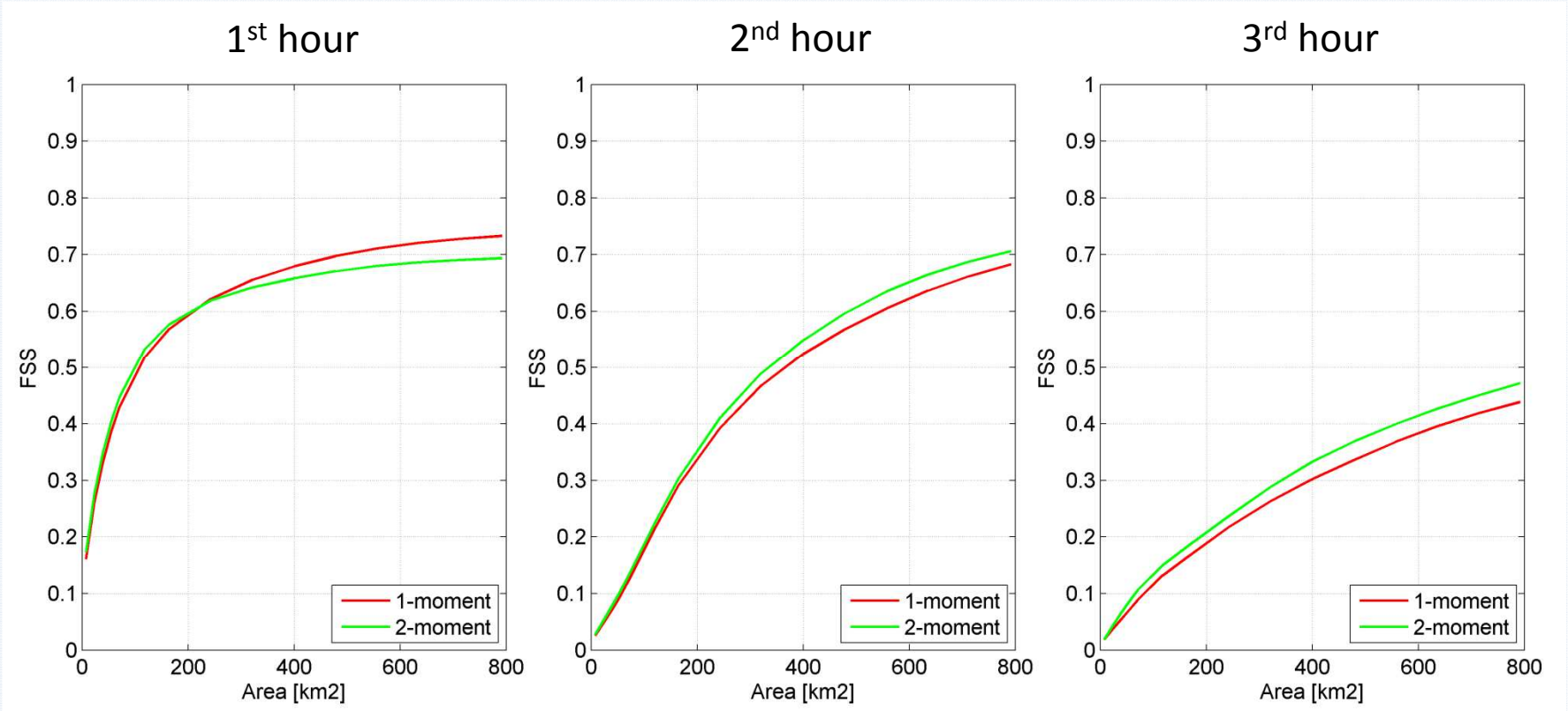
FSS, T=1 mm/h: comparison 1-m, 2-m



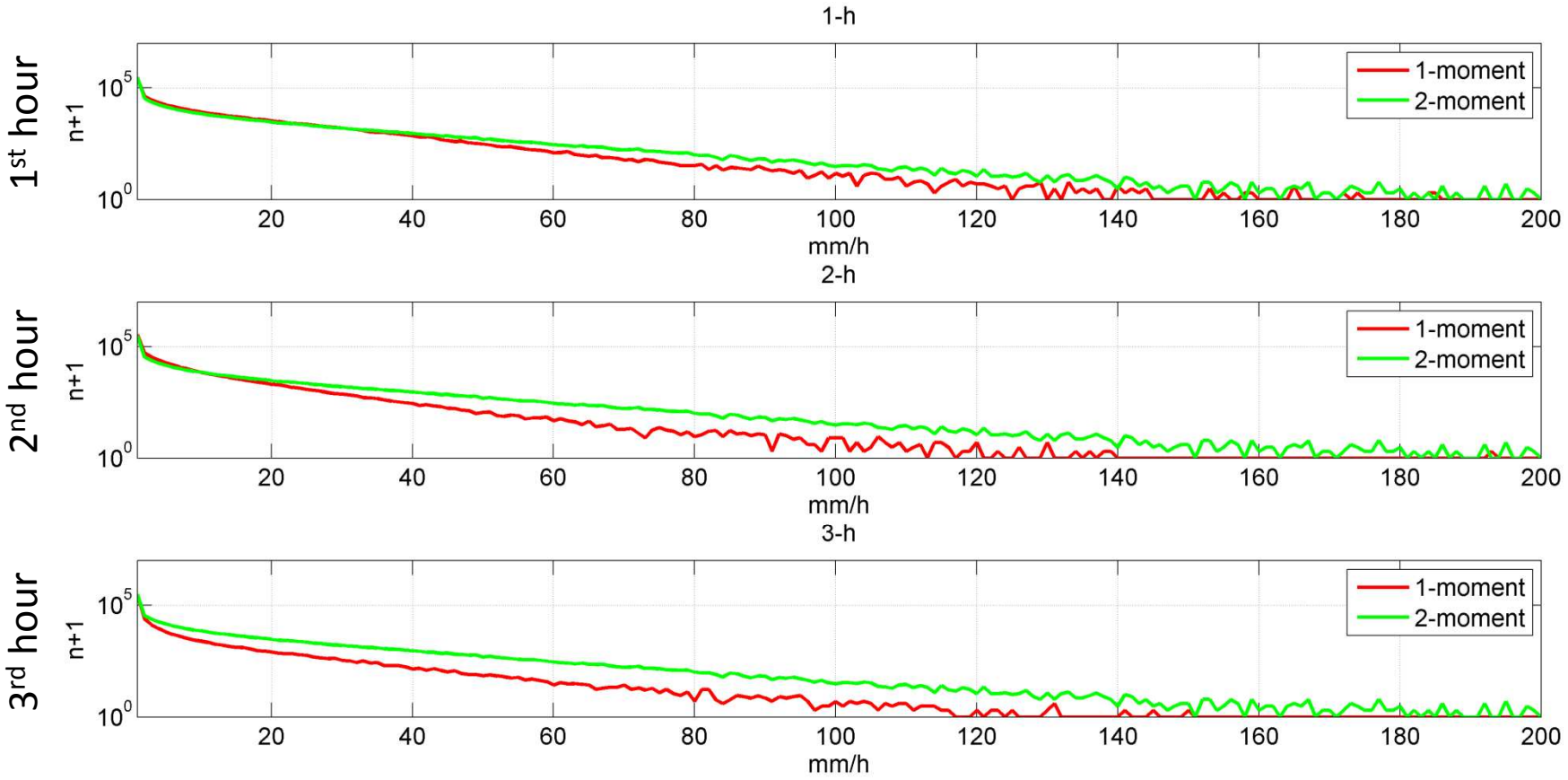
FSS, T=5 mm/h: comparison 1-m, 2-m



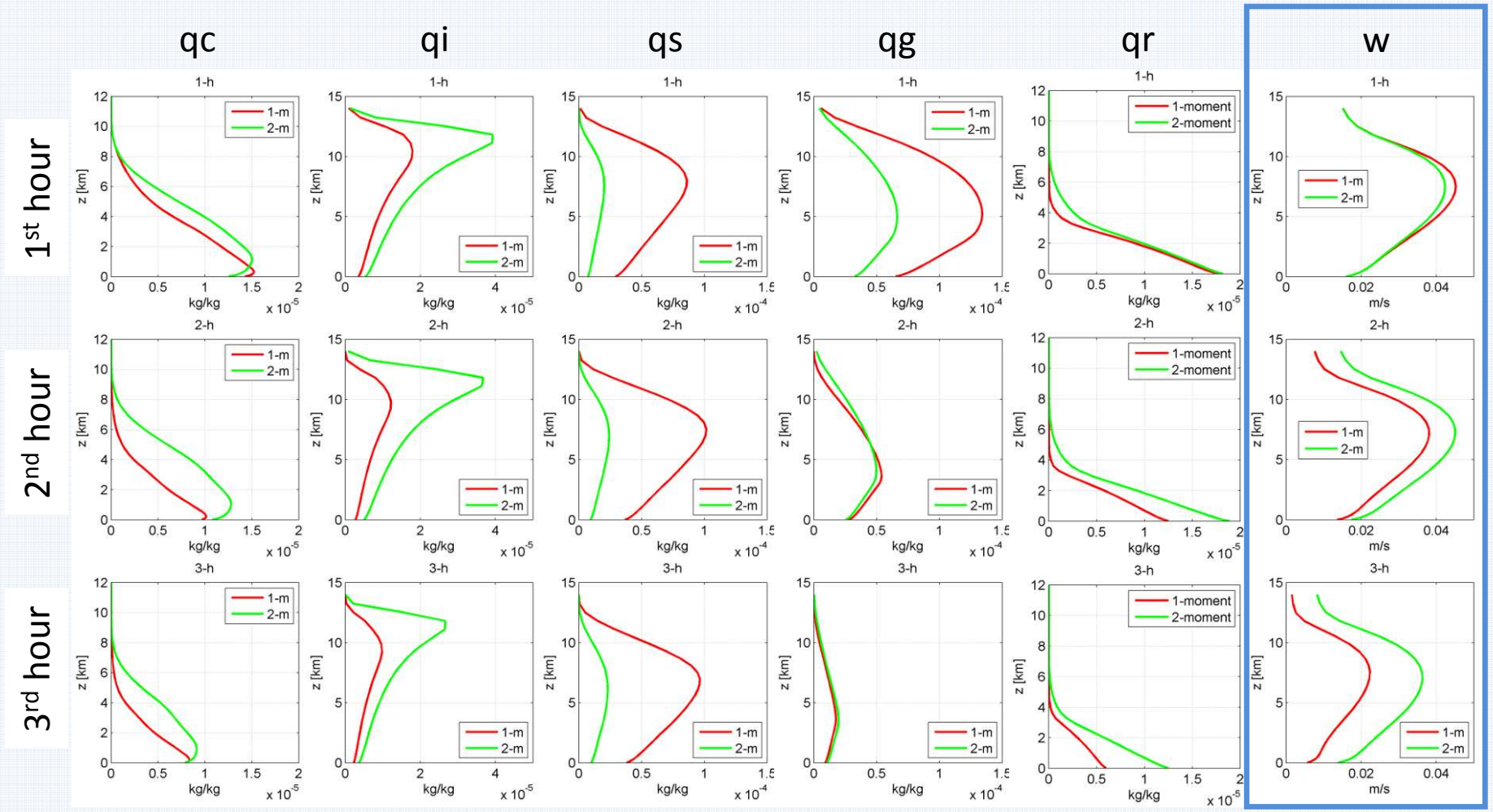
FSS, T=10 mm/h: comparison 1-m, 2-m



Rain rate distributions



Mean vertical profiles of qc, qi, qs, qg, qr and w



Conclusions

- 1-moment and 2-moment microphysics yield comparable precipitation forecasts in terms of SAL and FSS.
- Distributions of rain rate differ for 1-moment and 2-moment microphysics. 2-moment microphysics forecasts higher rain rates with higher frequency.
- Vertical profiles of qc, qi, qg, qs, qr and w are different for 1-moment and 2-moment microphysics.

Acknowledgement

- 2-moment cloud parameterization code was kindly provided by Axel Seifert.
- Data were provided by DWD and CHMI.

Thank you for your attention