A161-11

Radar-based Ensemble Nowcasting: predictability analysis

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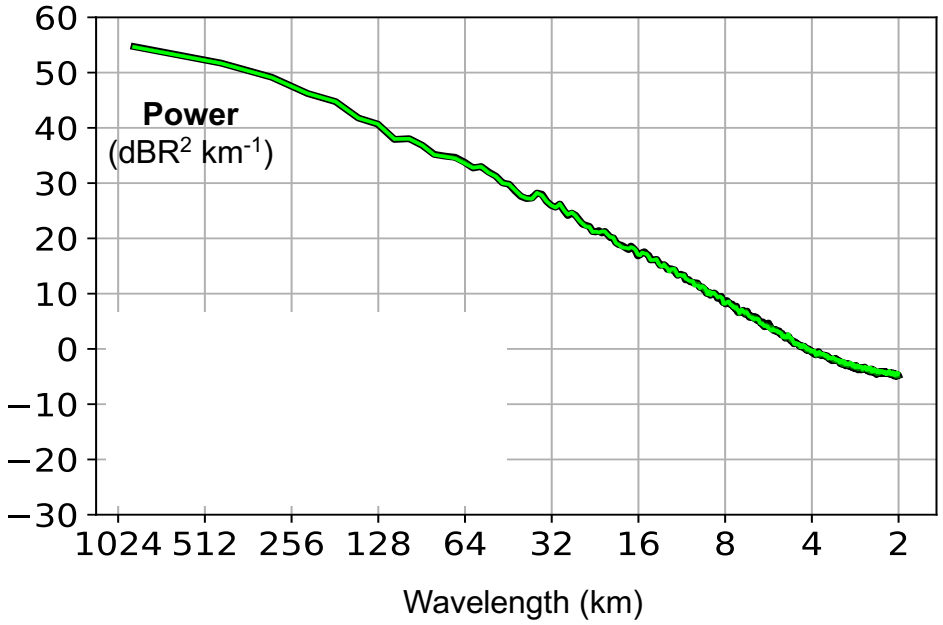
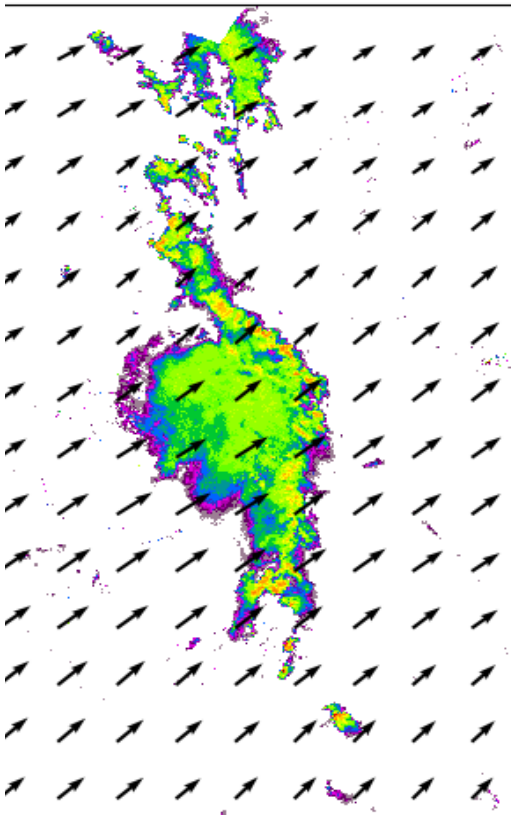
Motivation

How to improve advection-based prediction of precipitation?

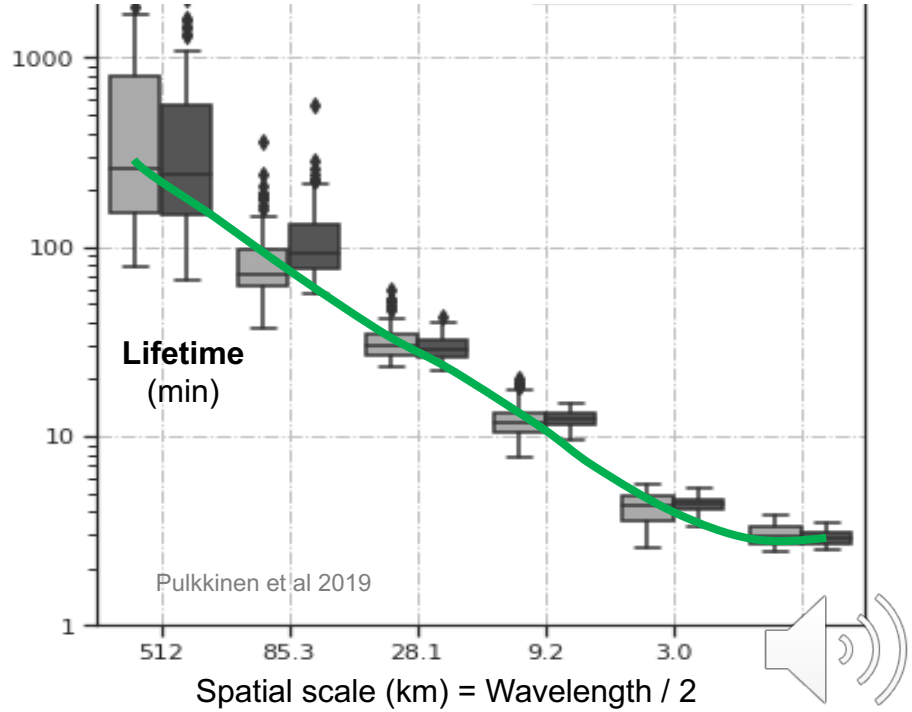
Scaling behavior of rain (Seed 2003) – SPROG approach

Space





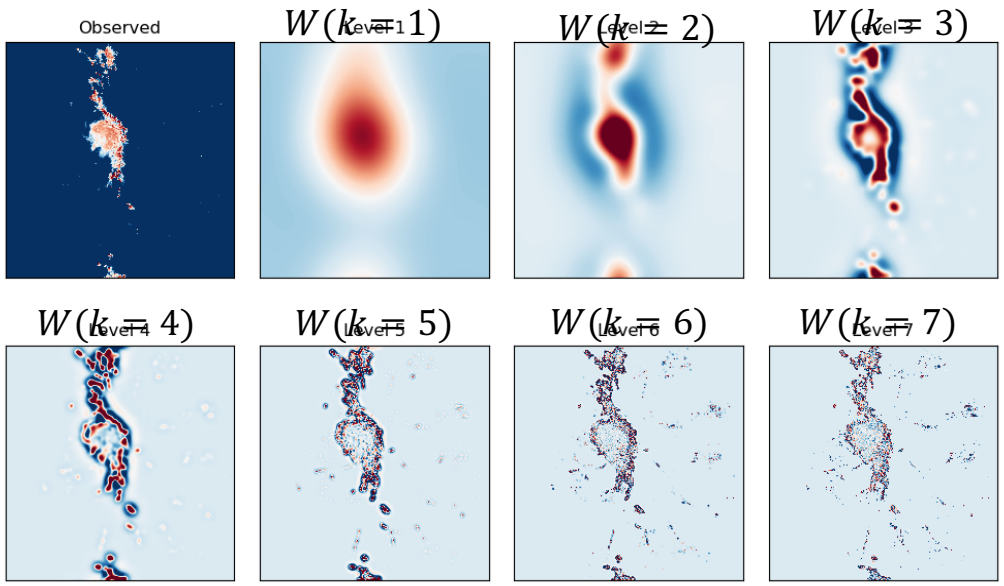
Time



The AR(p) parameters control the
rate of evolution at each cascade level consistent
with the expected lifetime

Spatial decomposition

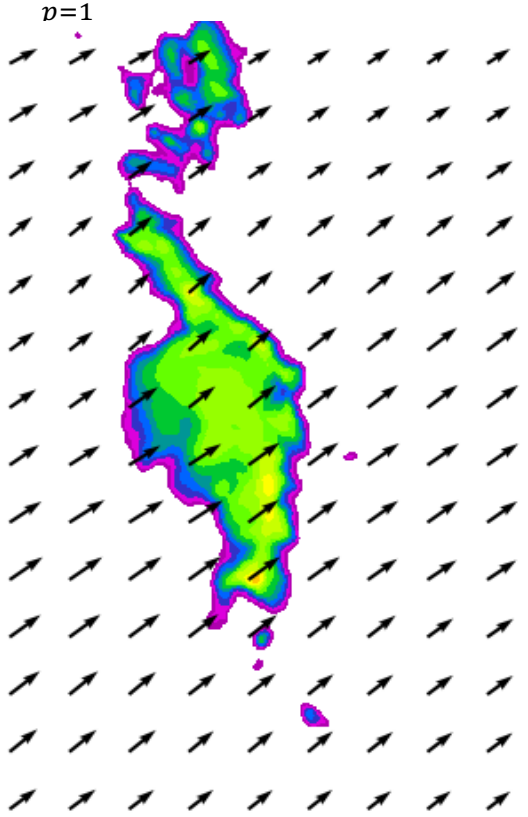
$$\mathrm{R}(x,y) = \mu + \sum_{k=1}^{n} \sigma(k) W(k,x,y)$$



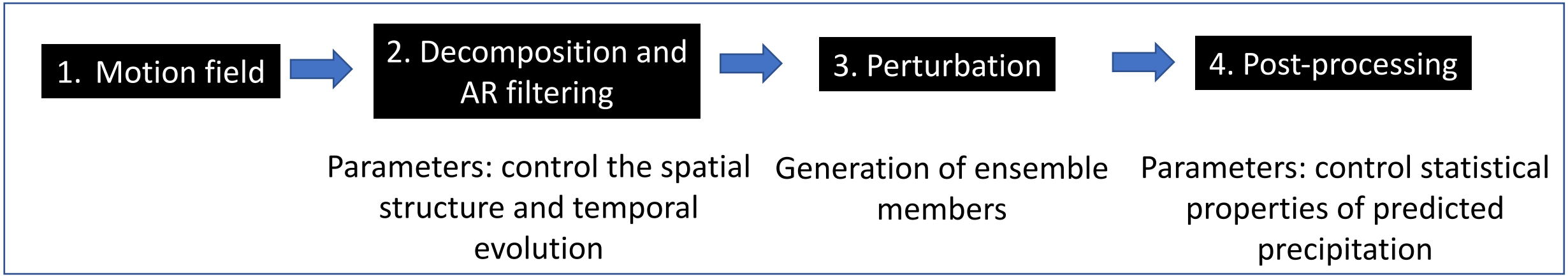
$$= \mu + \sum_{k=1}^{n} ($$

Temporal evolution

$$W(t,k) = \sum_{p=1}^{2} \varphi^{p}(k) W(t-p,k) + \varphi^{0}(k) \varepsilon(t,k)$$



Cascade Decomposition and Spatial Filtering – STEPS Nowcast

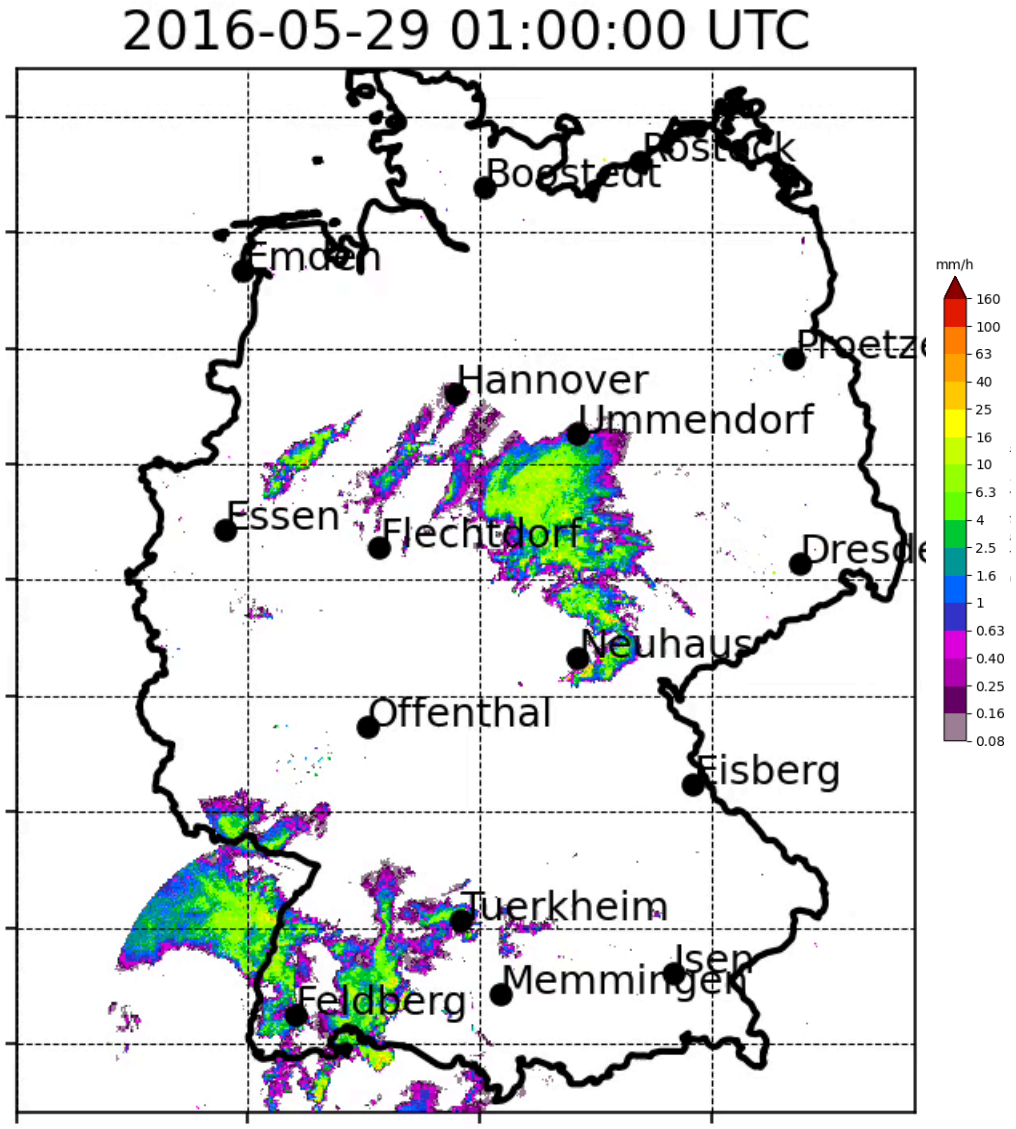


SPROG nowcasting (Seed 2003)

STEPS nowcasting (Bowler et al 2006)

*Pulkkinen, S., D. Nerini, A. Perez Hortal, C. Velasco-Forero, U. Germann, A. Seed, and L. Foresti, 2019: **pySTEPS**: an open-source Python library for probabilistic precipitation nowcasting (v1.0). *Geosci. Model Dev.*, **12 (10)**, 4185–4219, doi:10.5194/gmd-12-4185-2019

Precipitation events collected by the DWD C-band radar network



Parameters:

- AR-order (memory) – 1 or 2
- Scale Levels (resolution) – 3, 6, or 12
- Post-processing (statistical properties)
  - Mean
  - Cumulative distribution function (CDF)

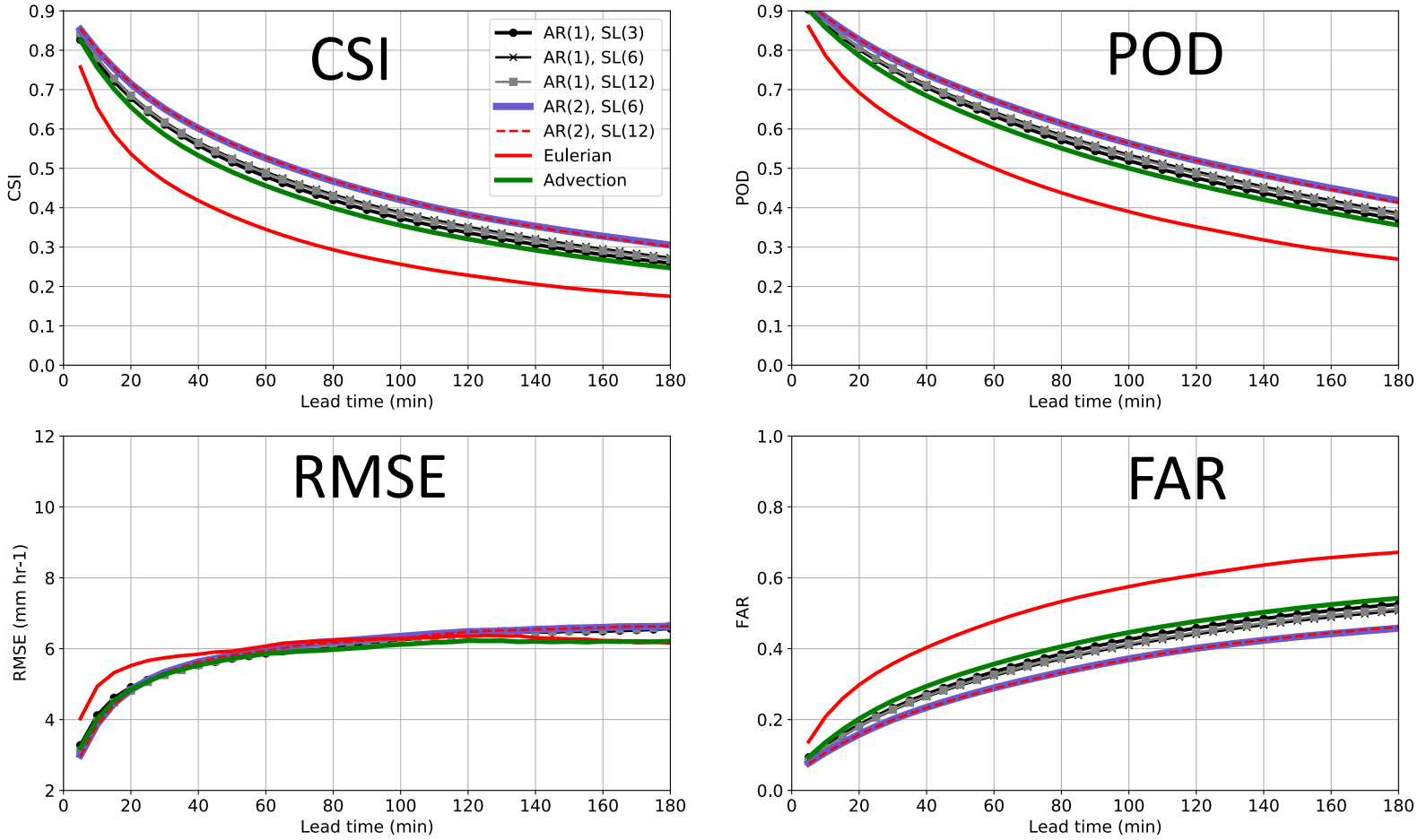
Performance:

- Rainfall rate thresholds (light-heavy)

The predictability properties of precipitation allow the formulation of an improved nowcasting approach

Parameters at R_{th} = 0.1 mm h^{-1} :

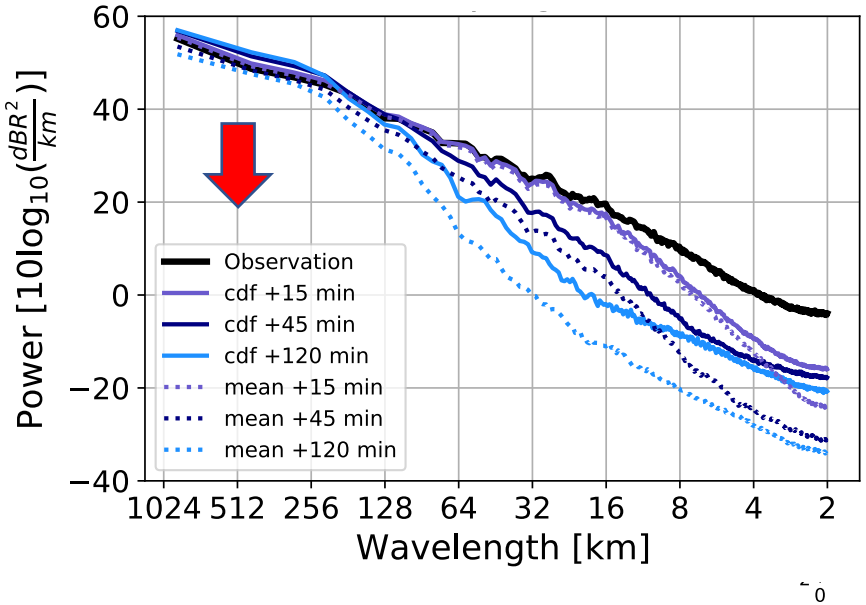
- AR order and
- Number of decomposition levels

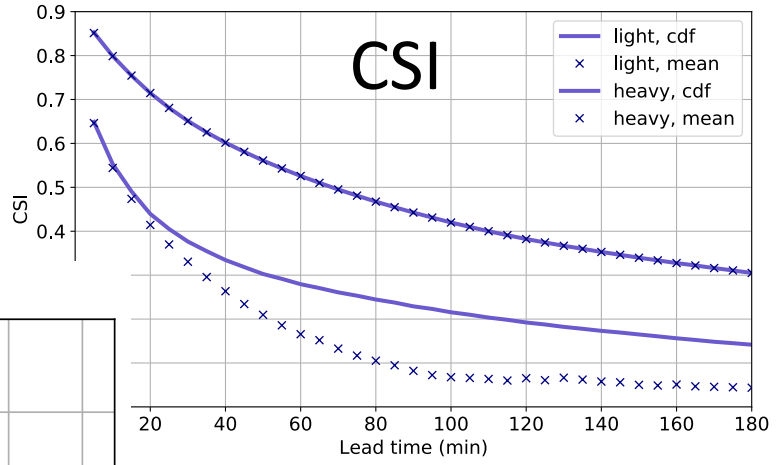


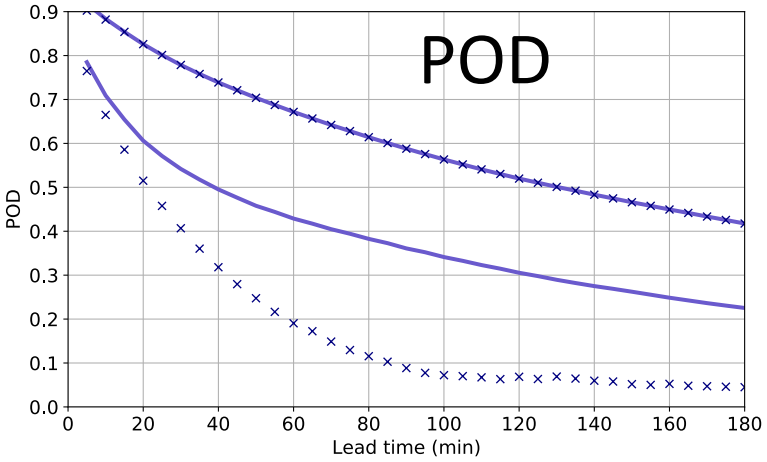
The selection of the post-processing plays a roll on the nowcasting skill

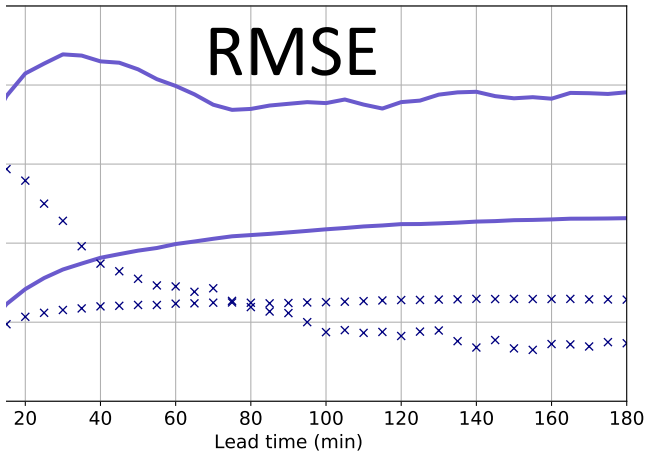
Parameters at R_{th} = 0.1 mm h^{-1} and 5.0 mm h^{-1} : AR(2) and SL(6)

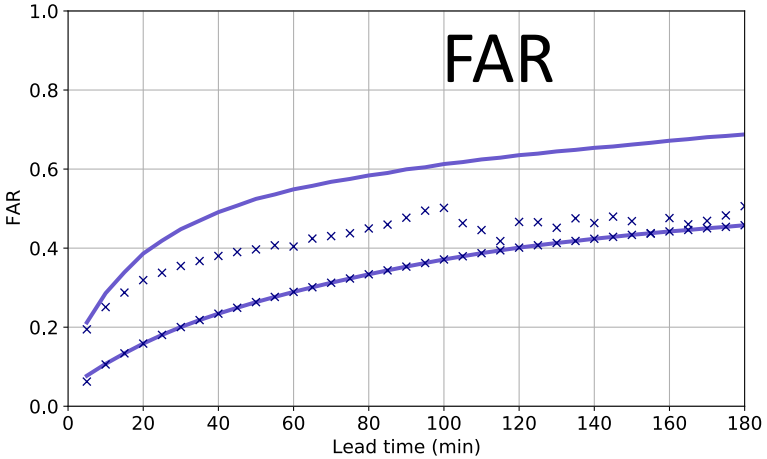
- Prob. Matching – Mean
- Prob. Matching – CDF







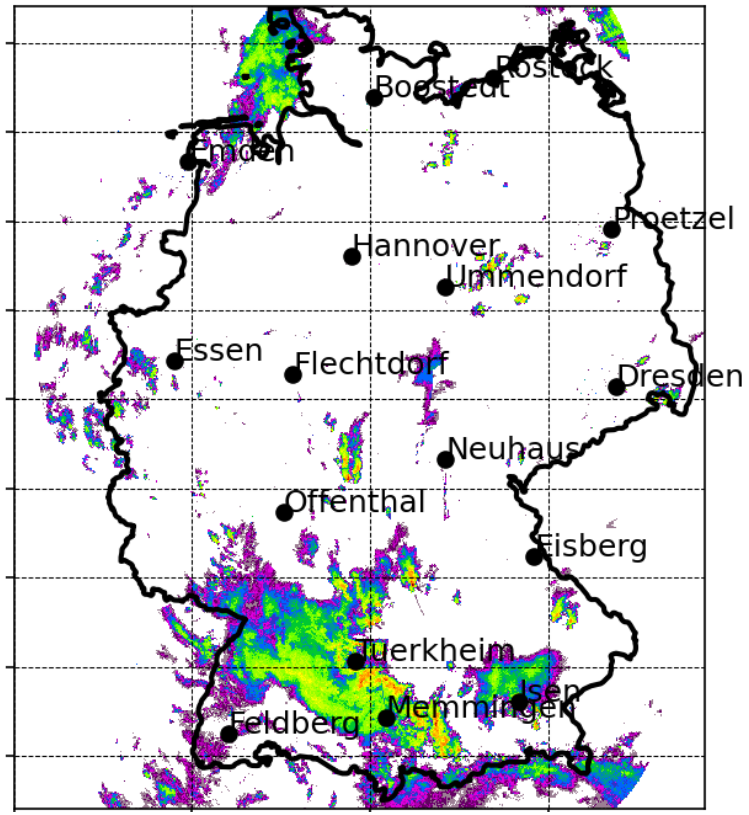




Different realizations to consider uncertainties (growth-decay) are obtained by perturbing the AR process

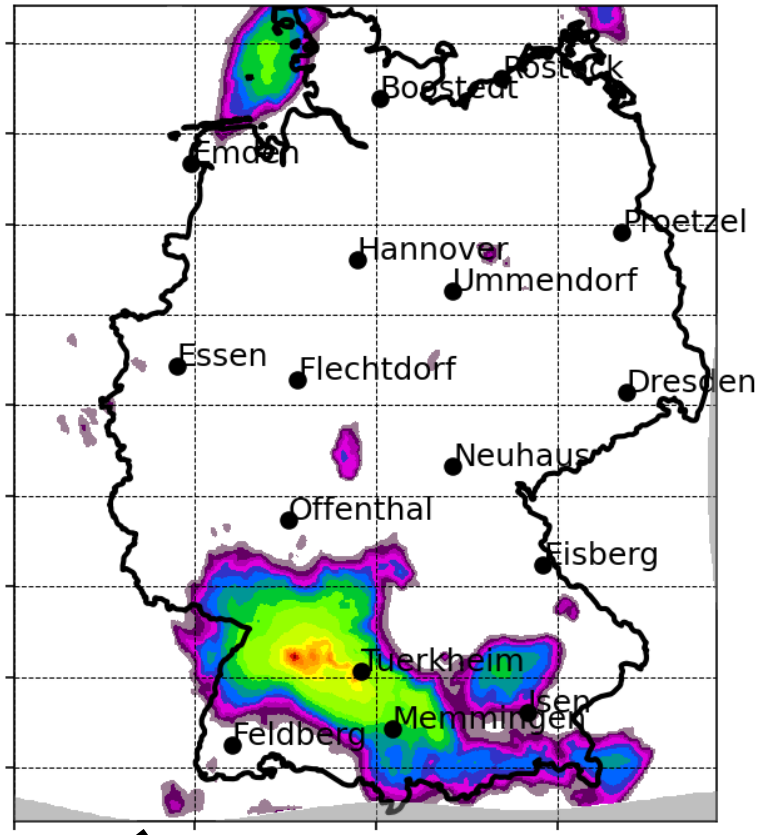
Observation

2016-05-29 16:00:00 UTC



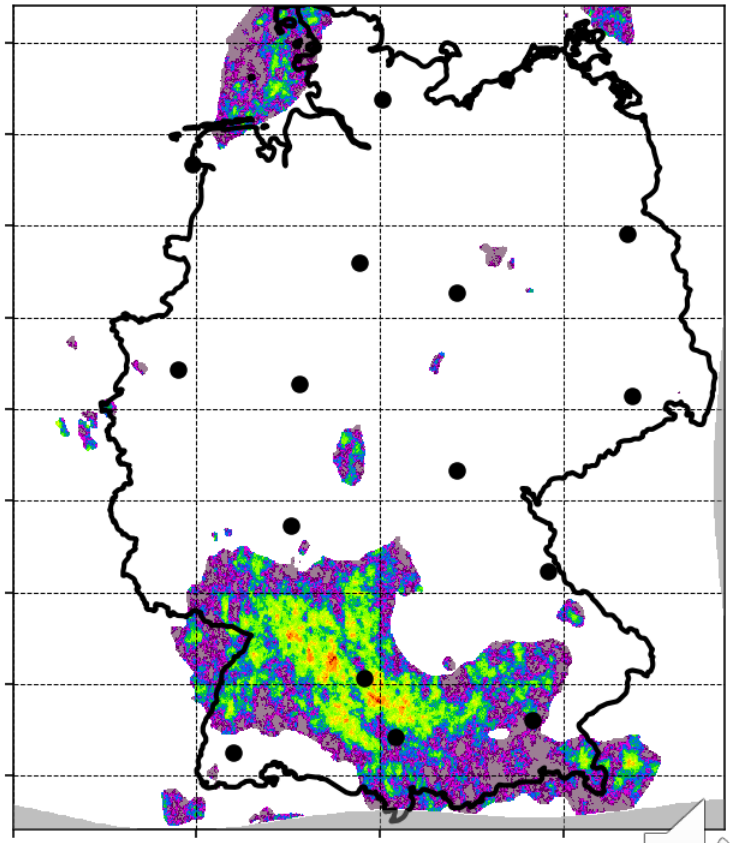
Prediction (1 h)

20160529 1700 UTC

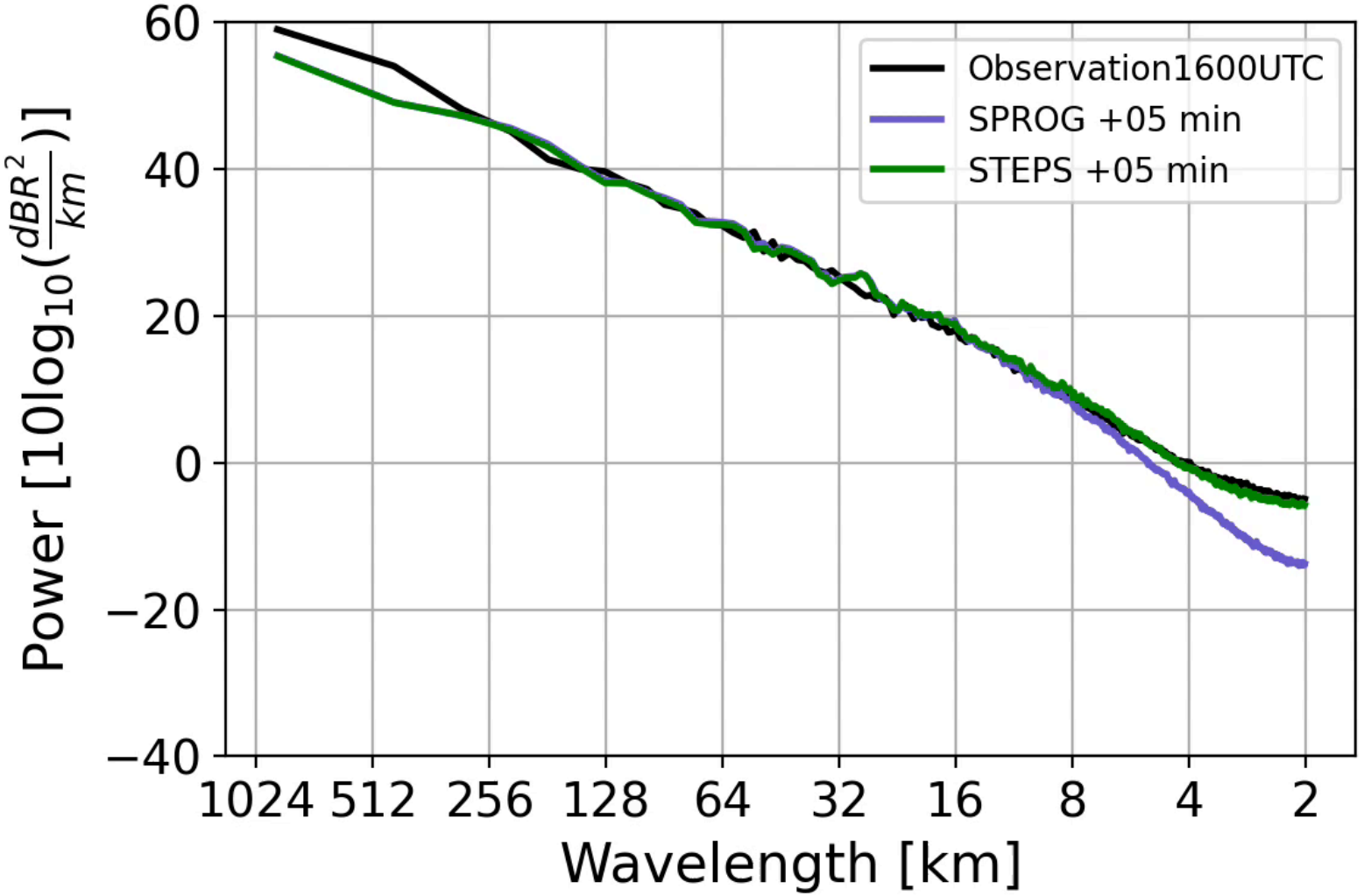


Prediction (1 h)

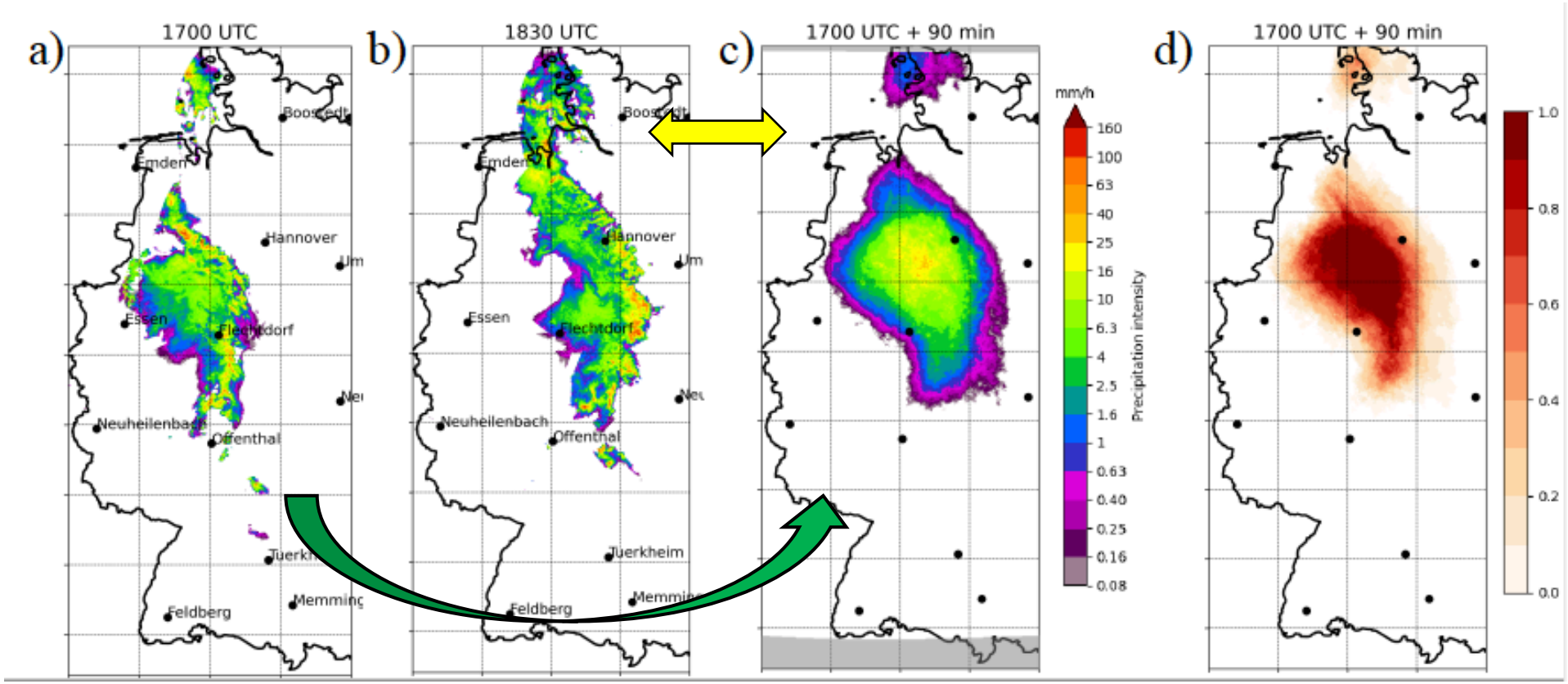
20160529 1700 UTC

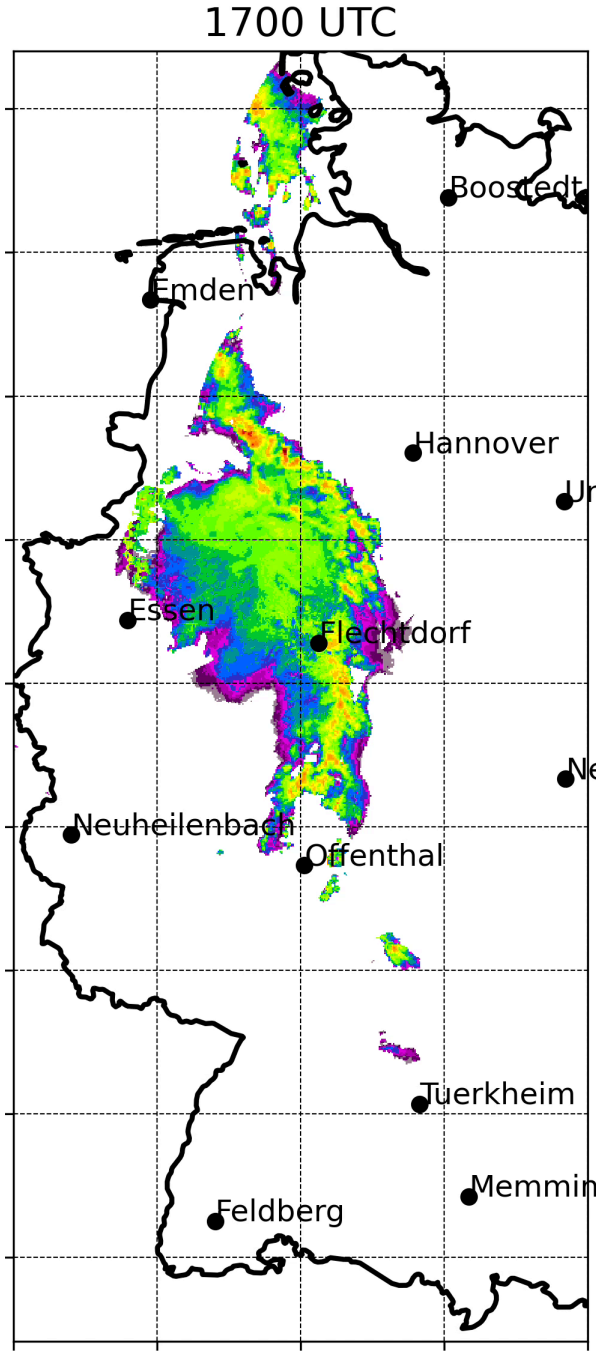


Now a prediction captures the spatial variability at small scales

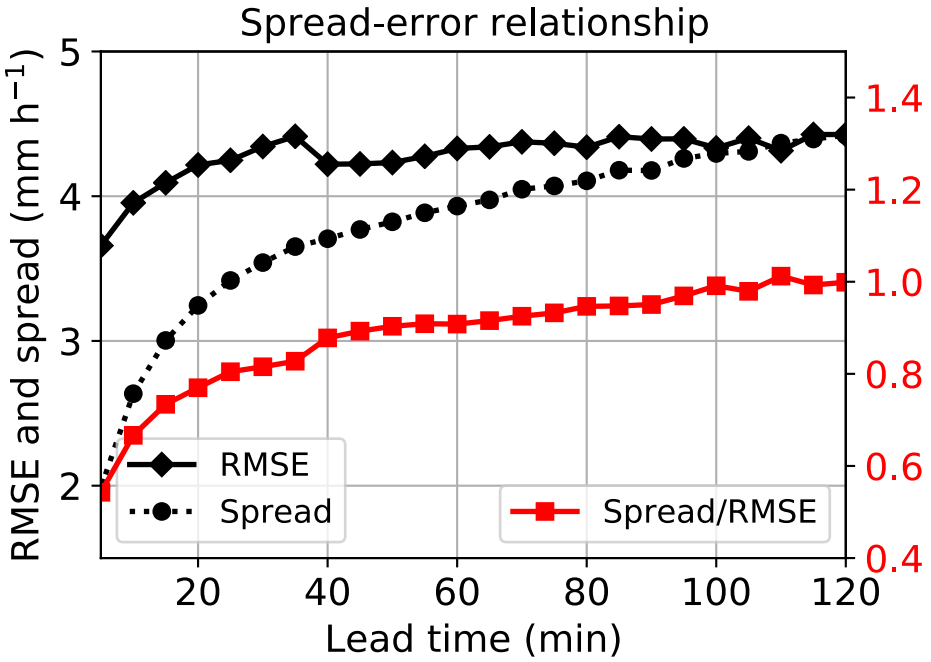


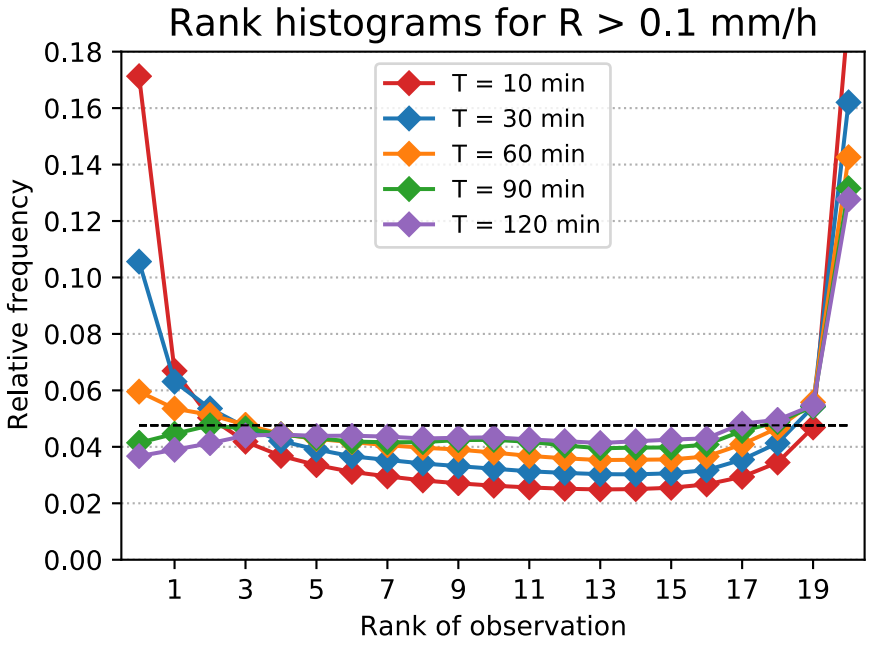
A prediction example of 20 members (90 min lead time)



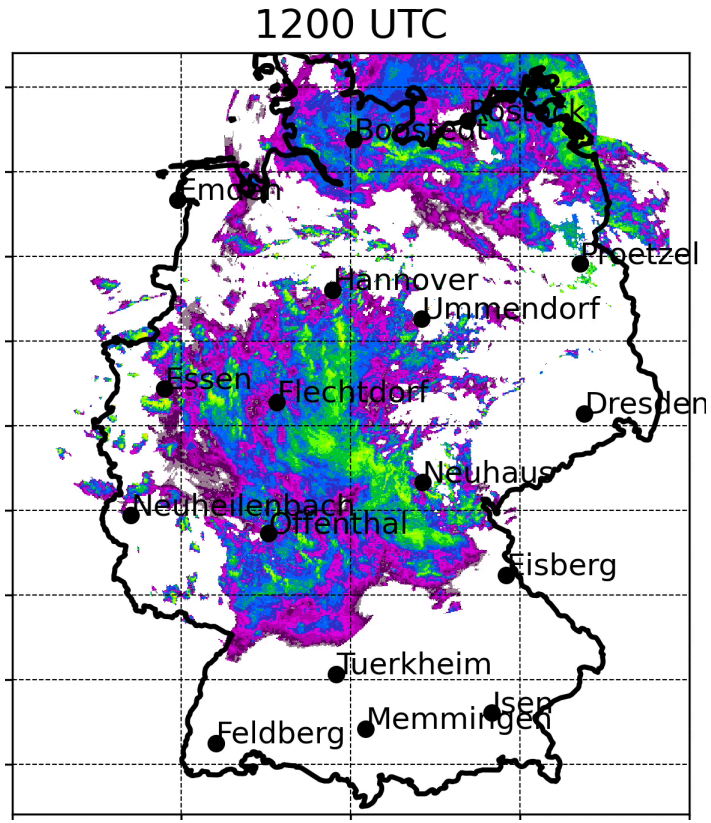


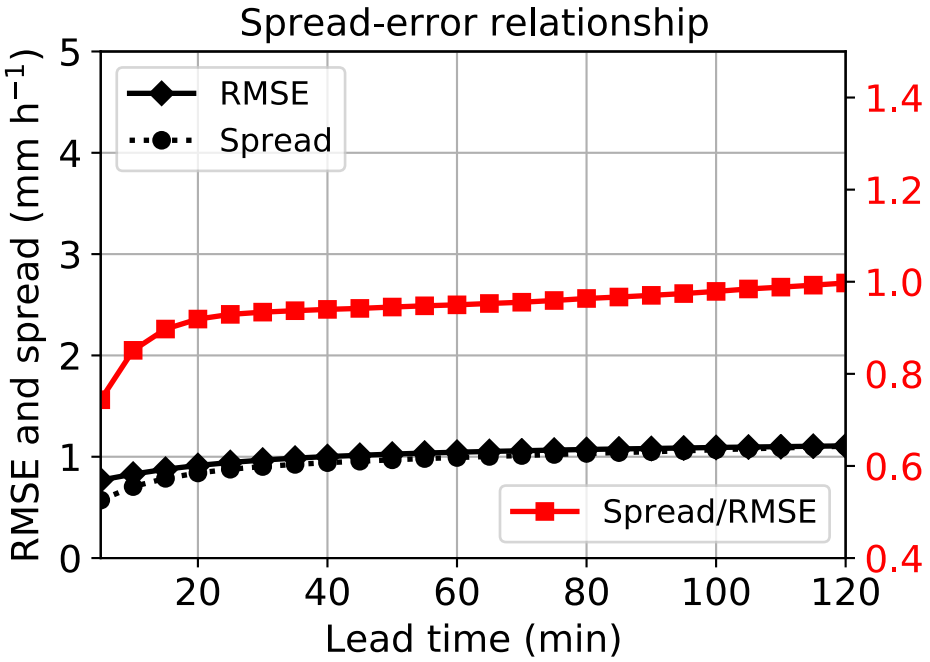
Convective precipitation: the ensemble members are not dispersive enough (underestimate uncertainty)

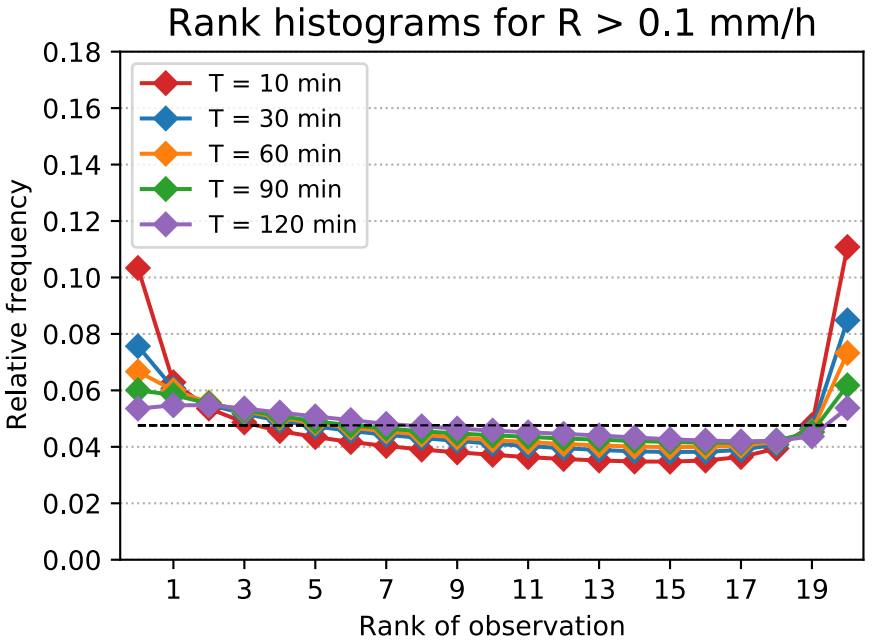




Moderate precipitation: the ensemble members seem to be dispersive enough







Conclusions

1. The configuration of STEPS parameters related to the AR process, spatial decomposition, and post-processing allows for improved nowcasting skills.

2. Ensemble members shown an equiprobable realization in light and moderate precipitation but not dispersive enough in heavy precipitation.

3. Fast and reliable radar-based nowcasting approach for the generation of ensemble members reliable up to ~2 hr.

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RealPEP website: https://www2.meteo.uni-bonn.de/realpep/doku.php