

# Combining Ensembles of NWP and Observation-based Nowcasting at DWD to Improve Convective Precipitation Forecasts

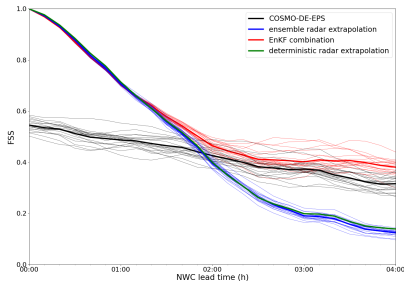
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Deutscher Wetterdienst

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6 November 2019

Radar-based Nowcasting

Shortest-range NWP

FSS for NWP, NWC and combined ensemble - period May/June 2016 (threshold: 25 dBZ; boxsize = 22 km)



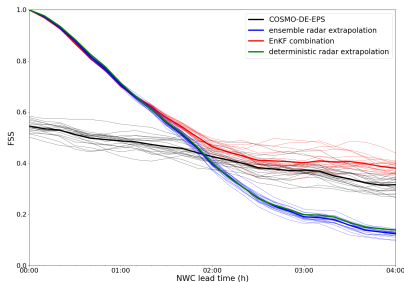
## Radar-based Nowcasting

- initialization every 5 min; quickly available
- predictability depends on spatial scale (Venugopal et al., 1999)

## Shortest-range NWP

- initialization every 3 h; available approx. 1:40h afterwards
- forecast quality is affected by initial conditions, parametrizations, model resolution

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## Aim

**Combining Nowcasting and NWP to preserve the best quality of both forecasts.**



## Objectives

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**How do different methods perform?**

## What do we need for this?

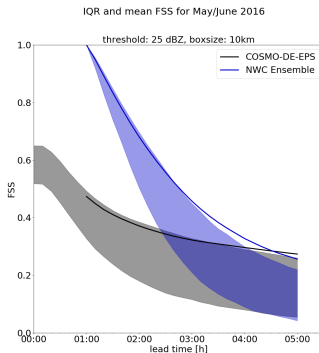
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- Nowcasting and NWP forecasts realized as ensembles
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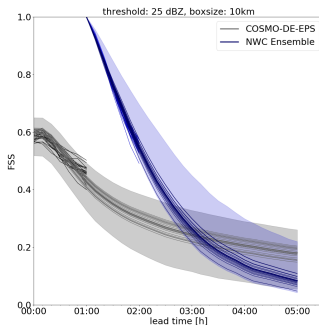
## Forecast skill as basis for combination

- **climatological weighting**
- Method adapted from Kober et al. (2012)
- Evaluation of forecasts for a training period
- Construct weighting functions for each threshold
- Combining pre-computed exceedance probabilities by the appropriate weighting function
- **Combination in probability space**

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- Nowcasting and NWP forecasts realized as ensembles
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IQR and mean FSS for May/June 2016 + short term verification



## Forecast skill as basis for combination

- **dynamical weighting**
- Adjustments on the method described before
- Additional short-term evaluation of recent forecasts
- Current NWP quality is extrapolated
- Quality as weighting of the ensemble members
- **Combination in probability space**

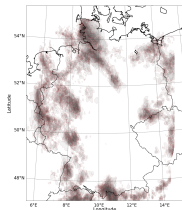
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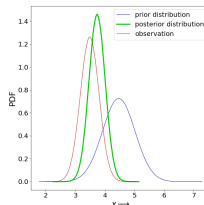
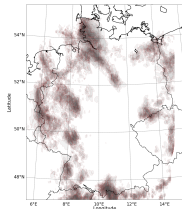
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**Correction step: NWP as  
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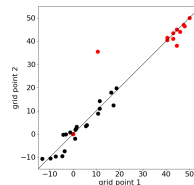
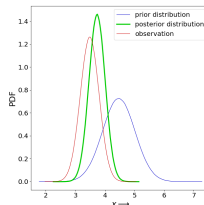
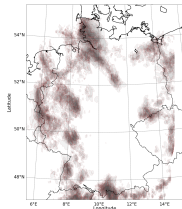
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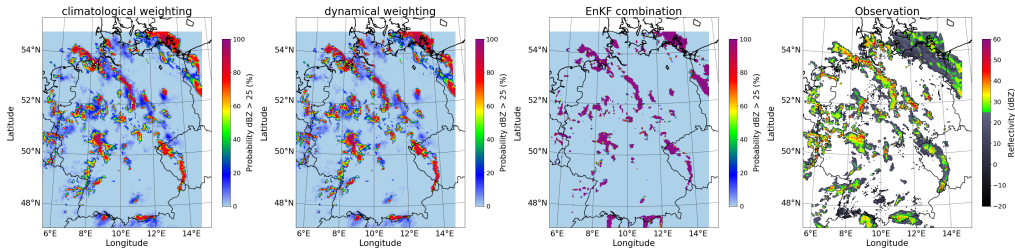
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Dimensionality reduction

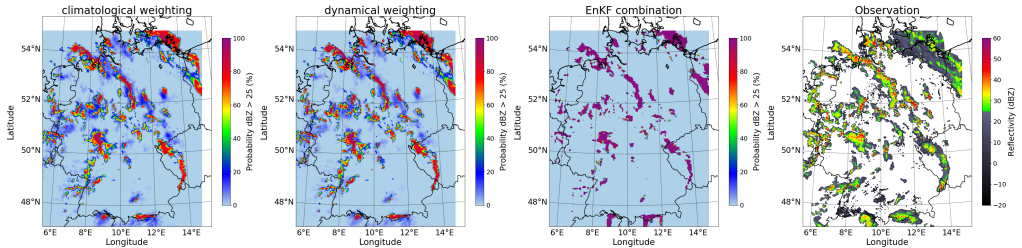


Exceedance probabilities of the different combination methods 2016/06/25 12 UTC + 60 min



→ 60 min lead time

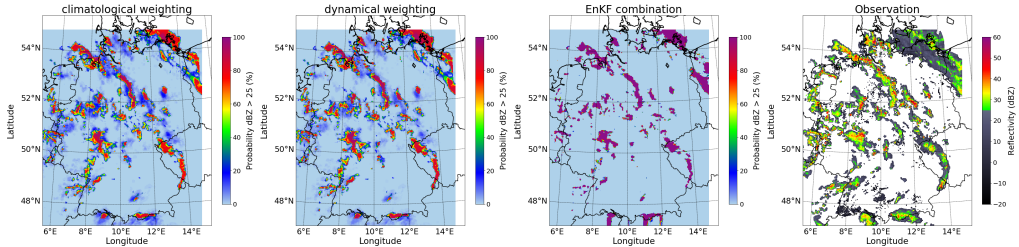
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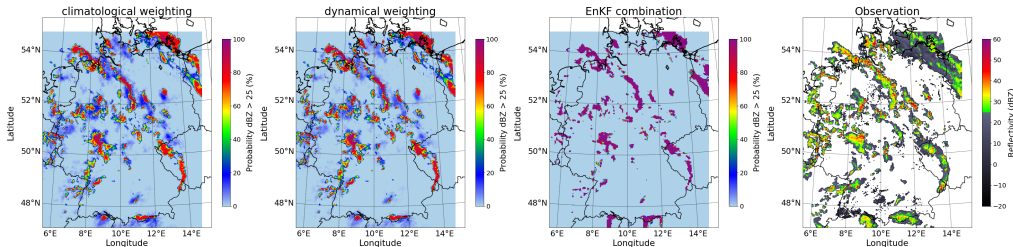


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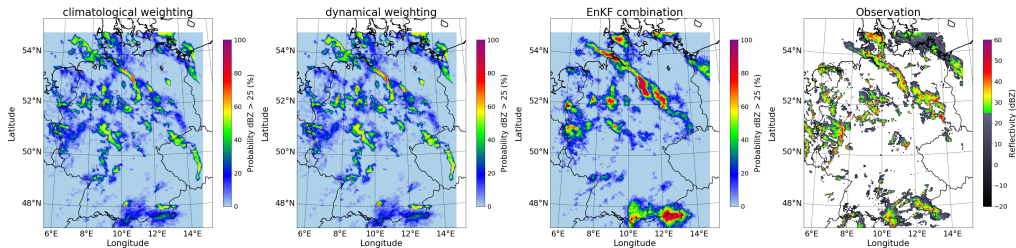
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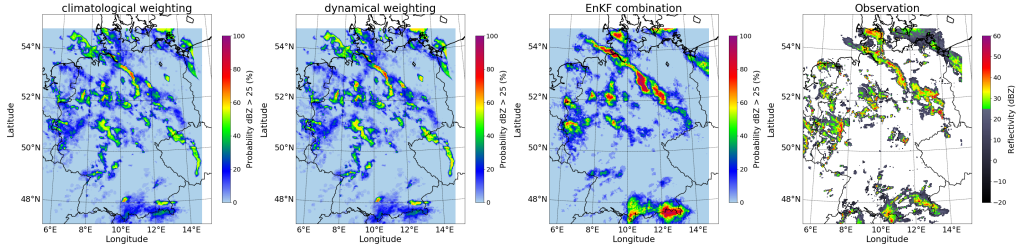
- high probabilities from Nowcasting/low probabilities from NWP
- Mismatches in localization visible → fading-in/fading-out with increasing lead time

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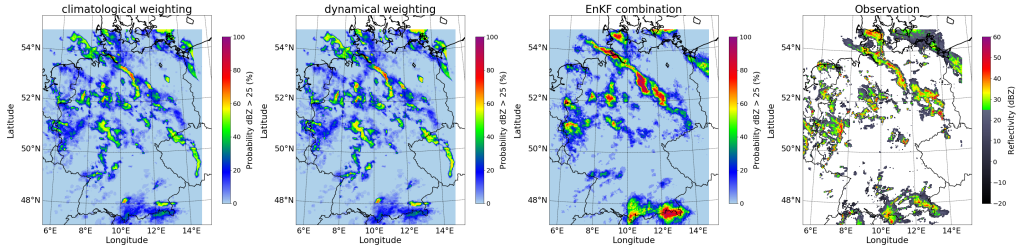
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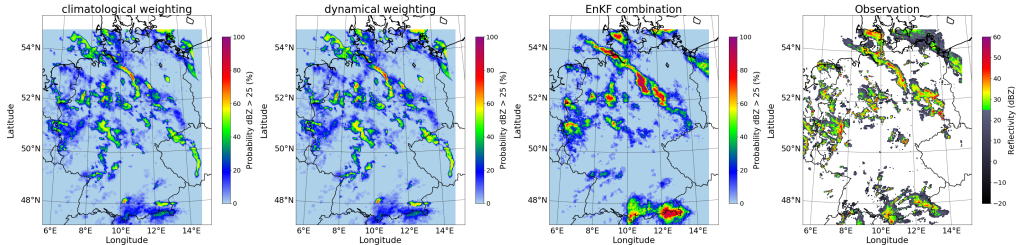
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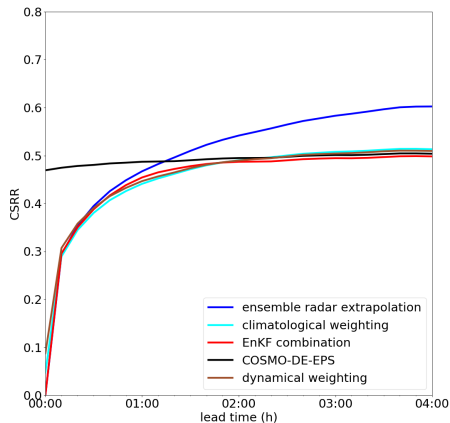
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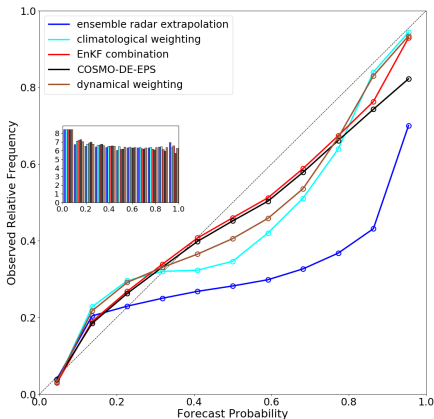
- Less spread in Nowcasting + weighting → higher probabilities
- Larger spread in NWP + weighting → lower probabilities

CSRR for NWP, NWC and combined forecasts  
8 case days of May/June 2016 (threshold: 25 dBZ)

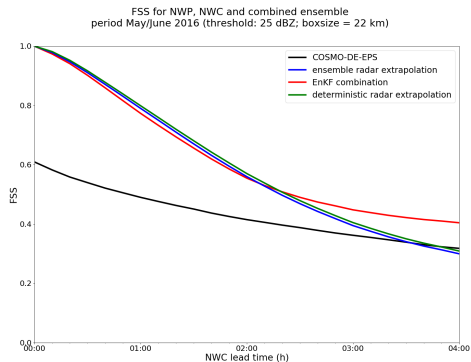


- Evaluation for 8 case days in May/June 2016
- Hourly initializations between 11 and 23 UTC

Reliability diagram for NWP, NWC and combined forecasts  
8 case days of May/June 2016 (threshold: 25 dBZ)

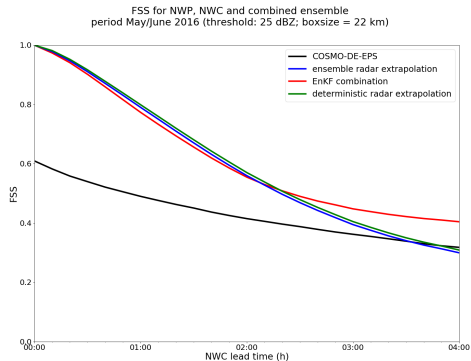


- Climatological and dynamical weighting exhibit a deficiency for probabilities around 50 %
- Possibly caused by the shown fading-in/fading-out problem
- EnKF combination agrees with NWP depending on the transition towards the NWP
- Increase at high forecasted probabilities induced by the small spread at short lead times

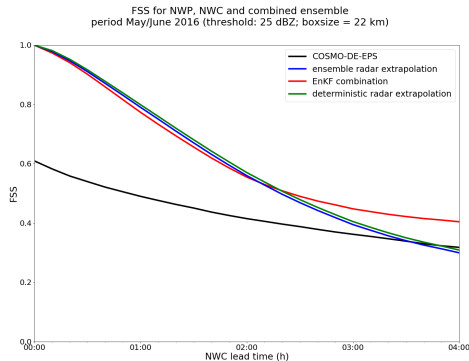


→ 31 days of May/June 2016

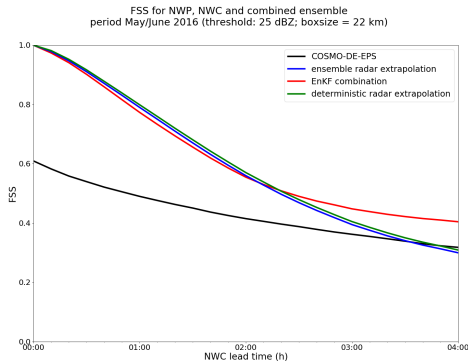
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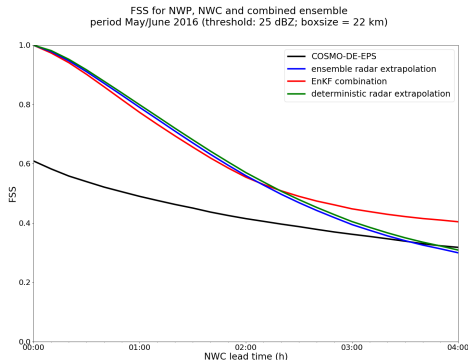


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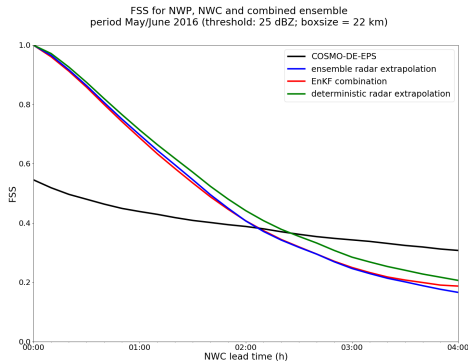


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  - ▶ High/low reflectivity coverage
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- Lower FSS till +2 h → induced by the small spread or interpolation issues
- Higher resolution than the effective model resolution may cause higher FSS at the end



- Low reflectivity coverage with an increase with time
- Small spread in Nowcasting ensemble leads to following Nowcasting too long

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## → How do different methods perform?

- ▶ In CSRR all methods show a well transition between Nowcasting and NWP
- ▶ Weighting function methods exhibit a fading-in/fading-out of probabilities when mismatches between Nowcasting and NWP occur
- ▶ EnKF combination reveals insufficient spread at short lead times
- ▶ Best forecast skill is reached when there's a large reflectivity coverage of the domain decreasing with time