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Probabilistic forecasting of icing and production losses

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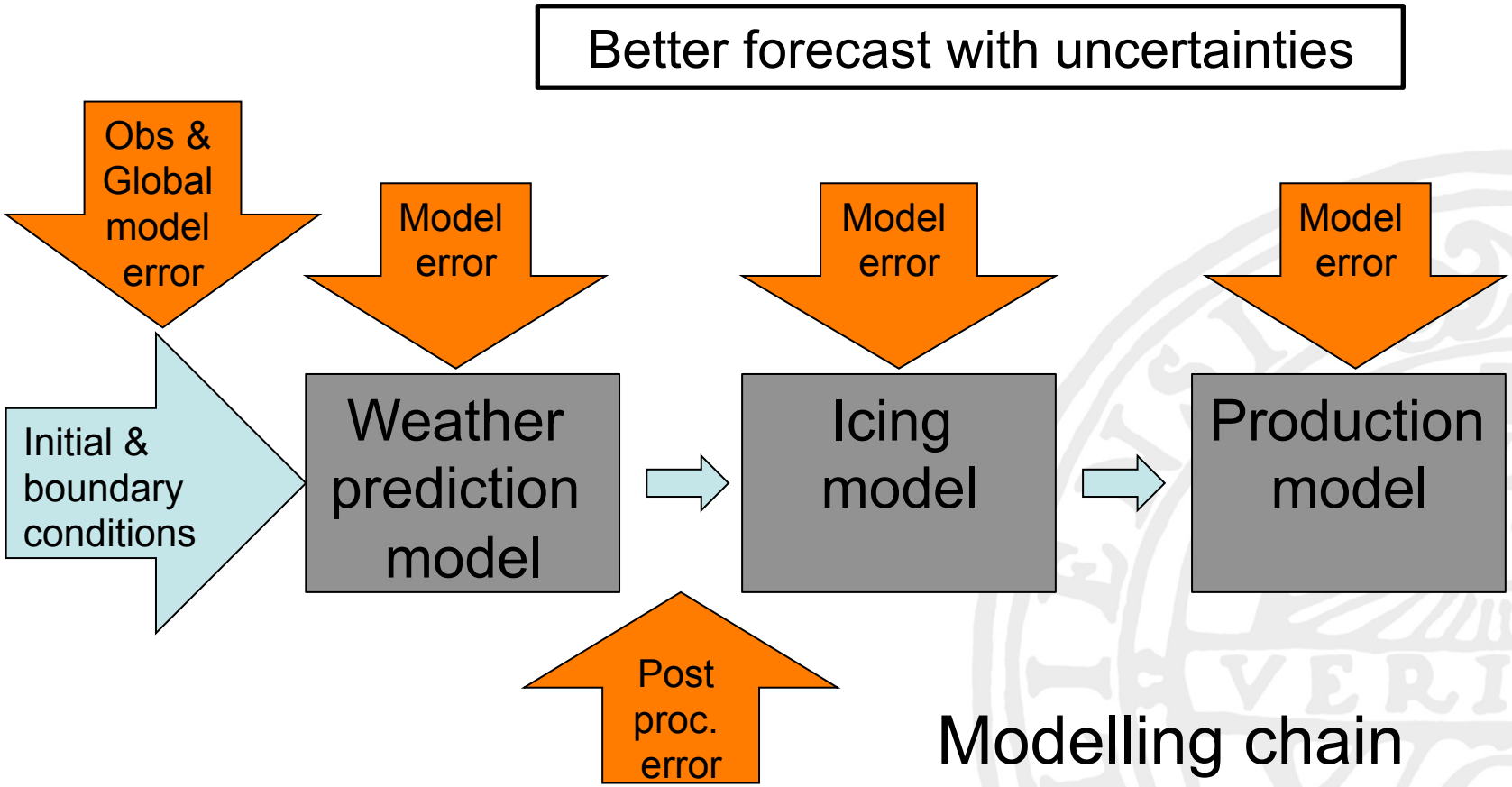
Why do we need probabilistic forecasting?



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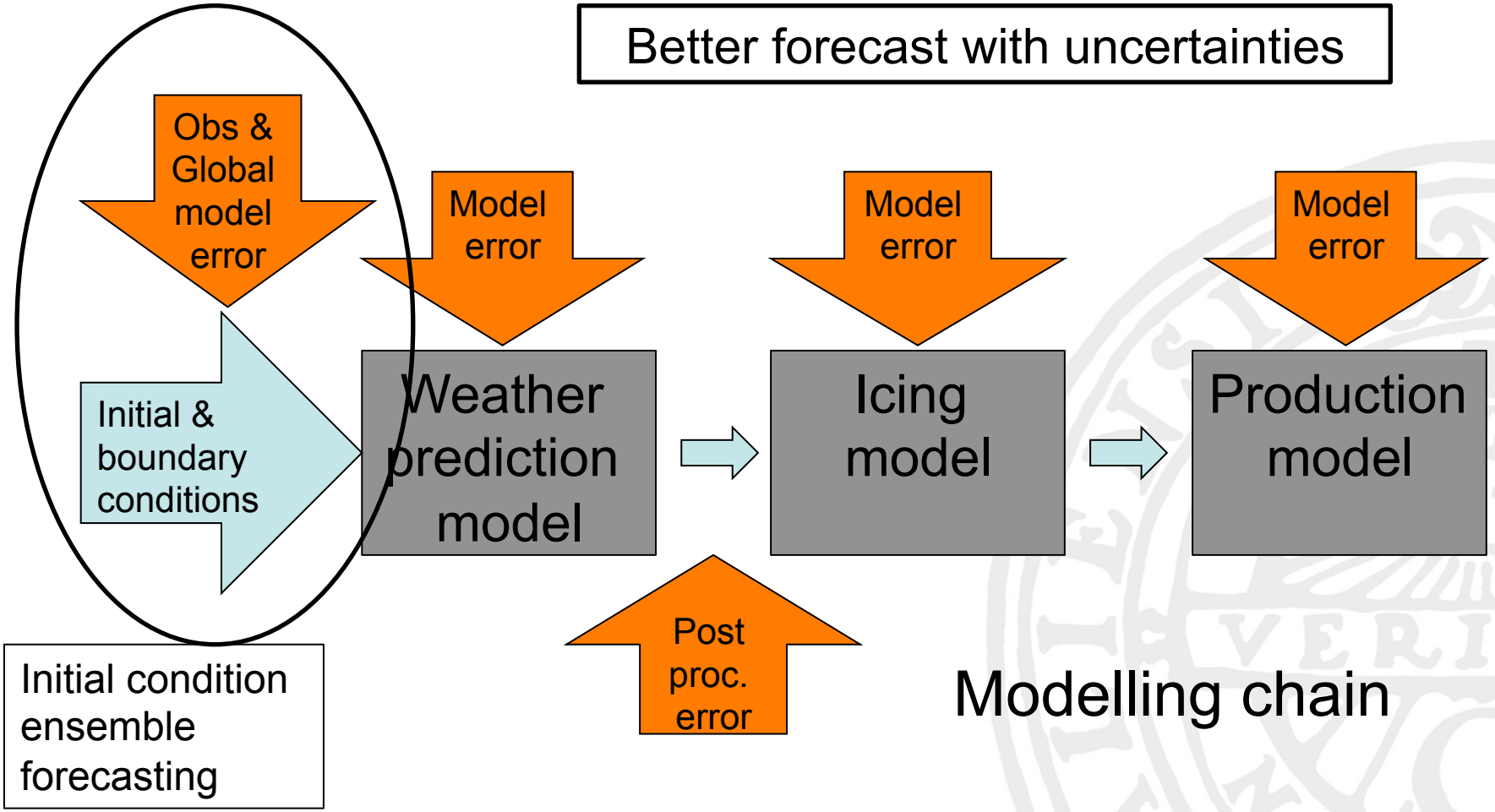
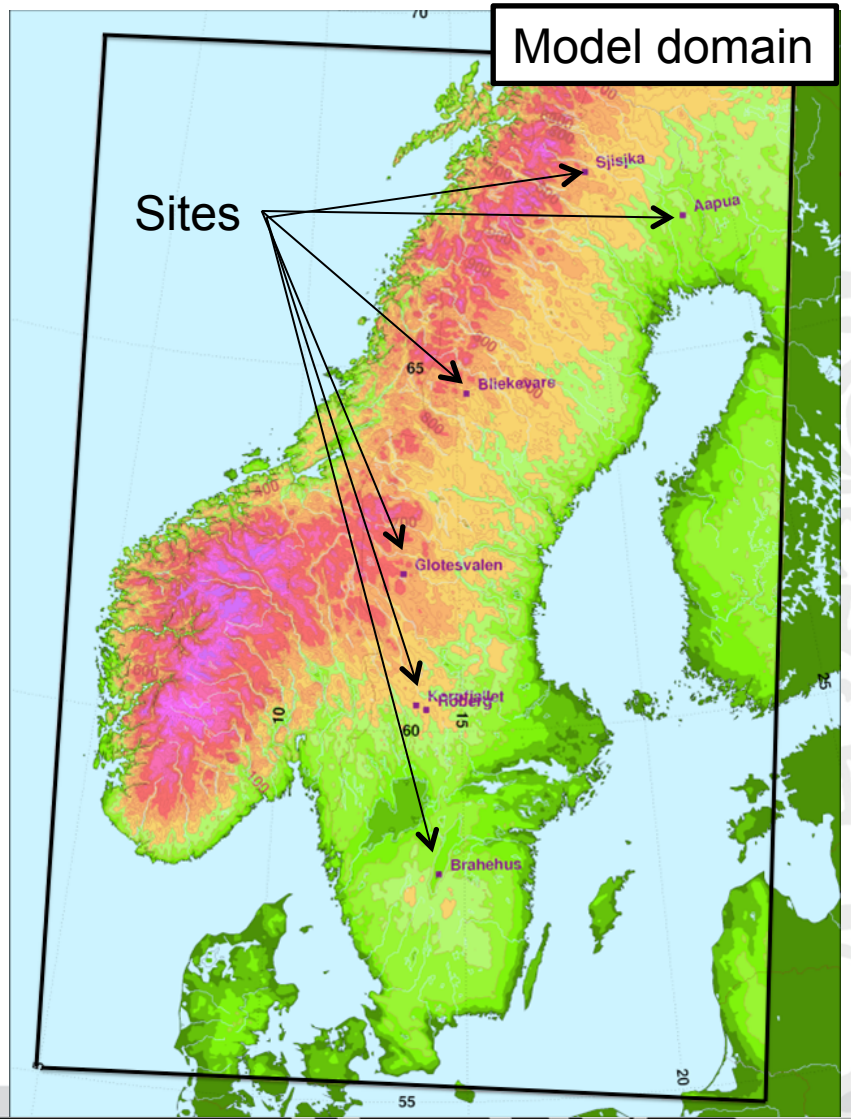


The weather prediction model

- HarmonEPS
- 2.5 km and 65 levels
- 1 control member
- 10 perturbed members based on the ECMWF EPS
- Period: 26/12-2011 - 8/1-2012
- Forecasts 00,06,12,18 UTC (+42 h)



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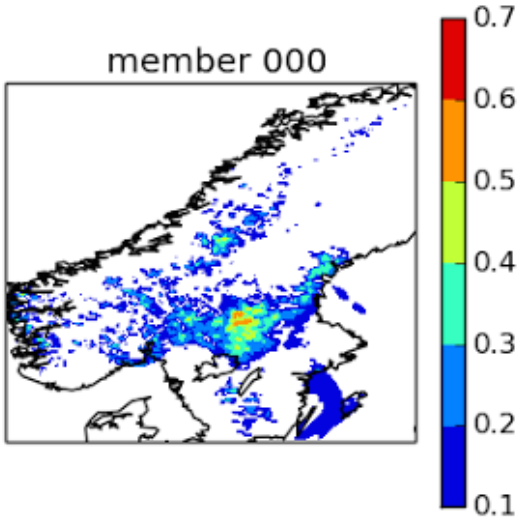
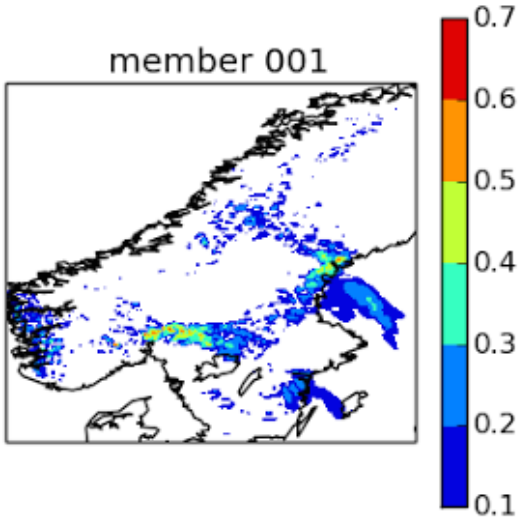
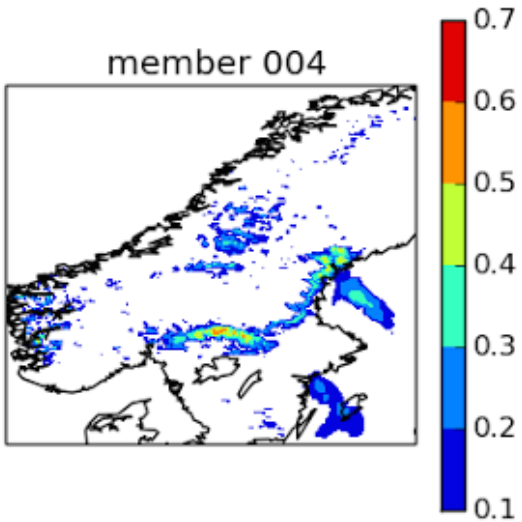
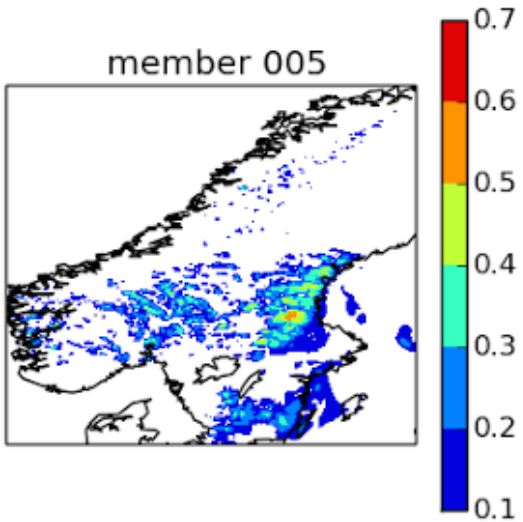
Method: Ensemble forecasting

Cloud water 100 m height (g/kg)









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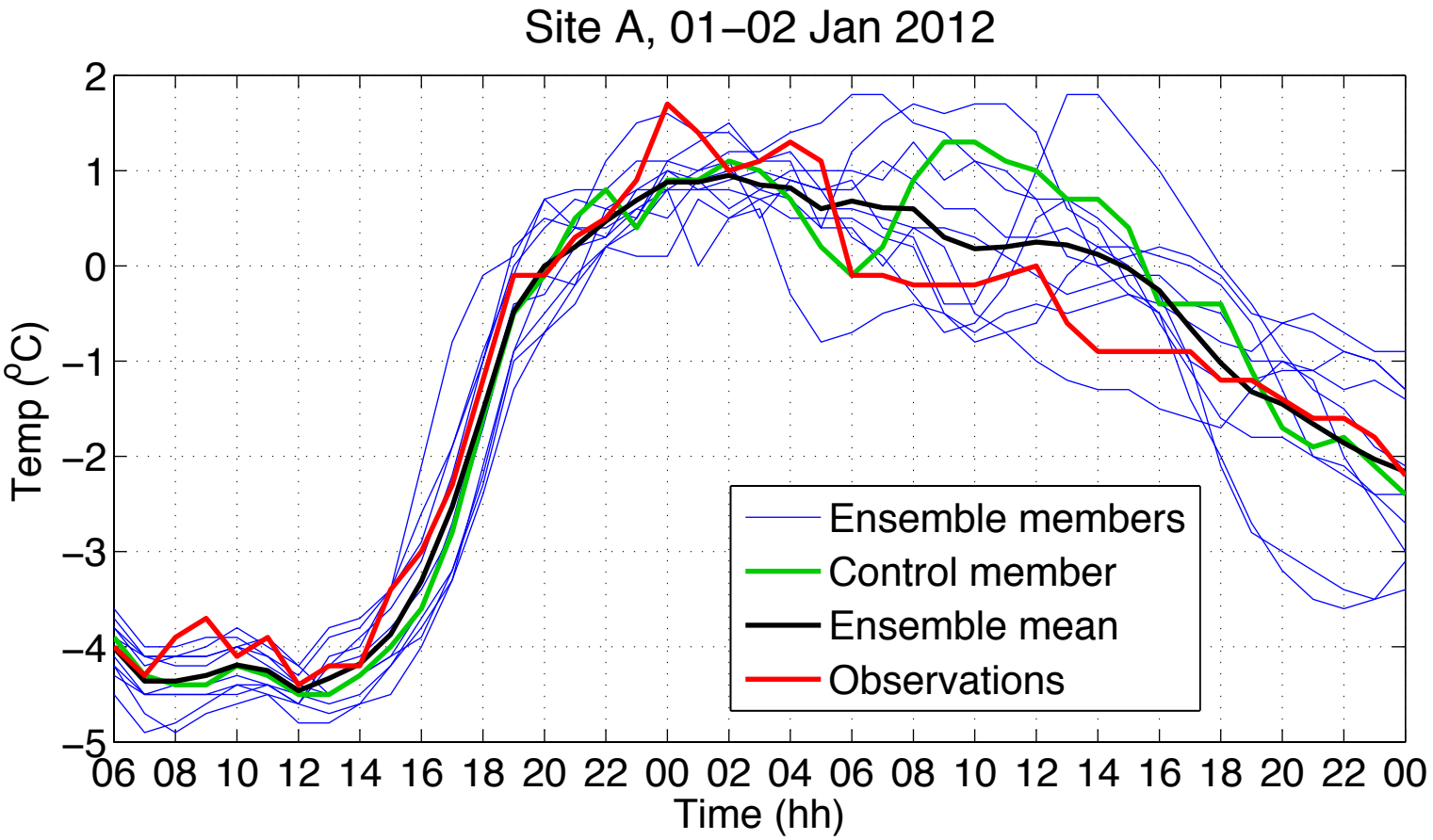
Method: Ensemble forecasting



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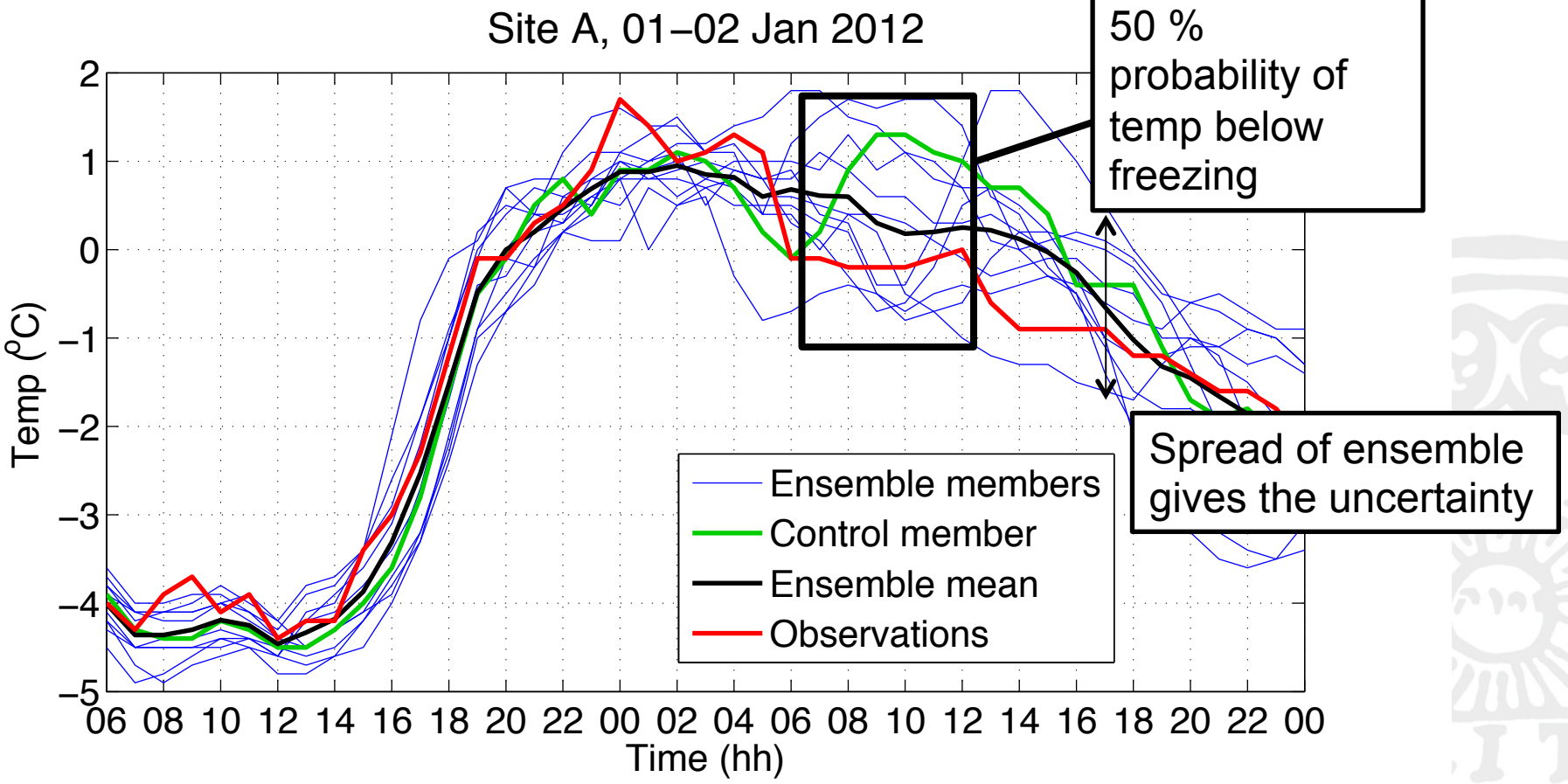
Method: Ensemble forecasting



Ensemble mean is expected to outperform individual forecasts over time

Method: Ensemble forecasting

Forecast 06 +18-42 hours generates a forecast for the next day

Weather prediction model

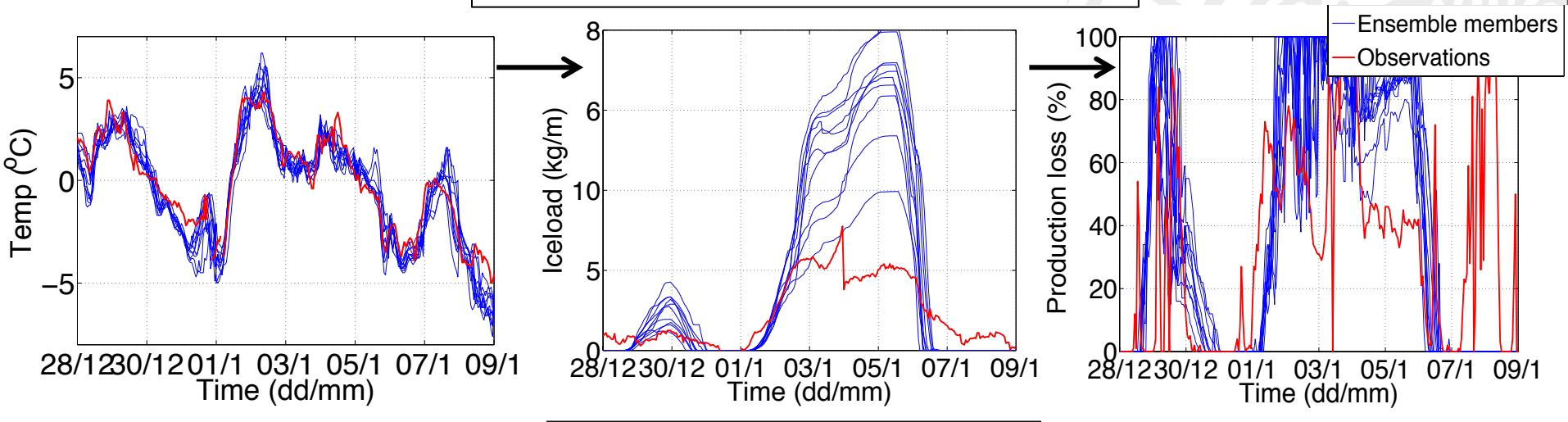
Icing model

Production model

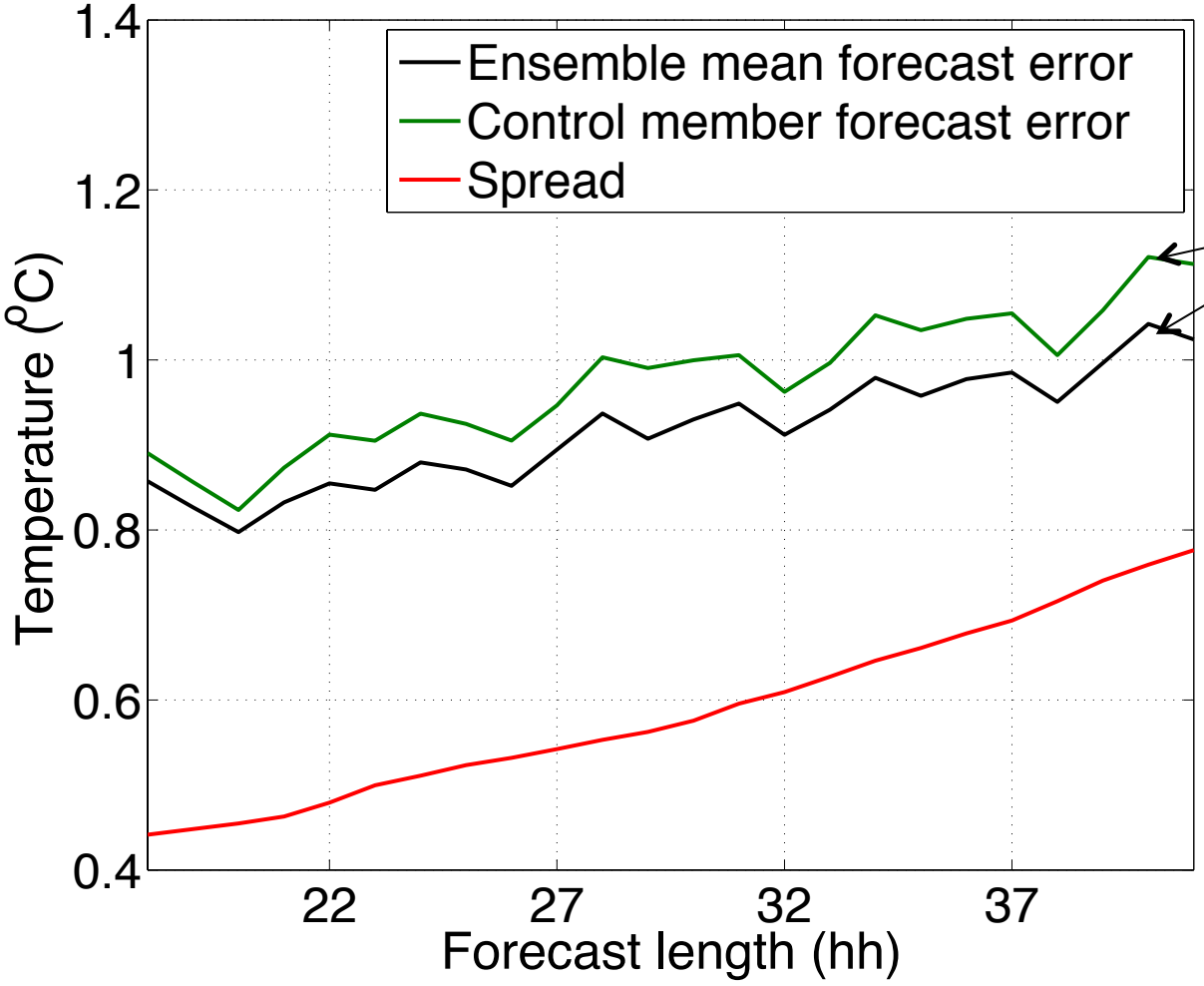
Output

Ensemble

Two week period, 2011-2012, Site B



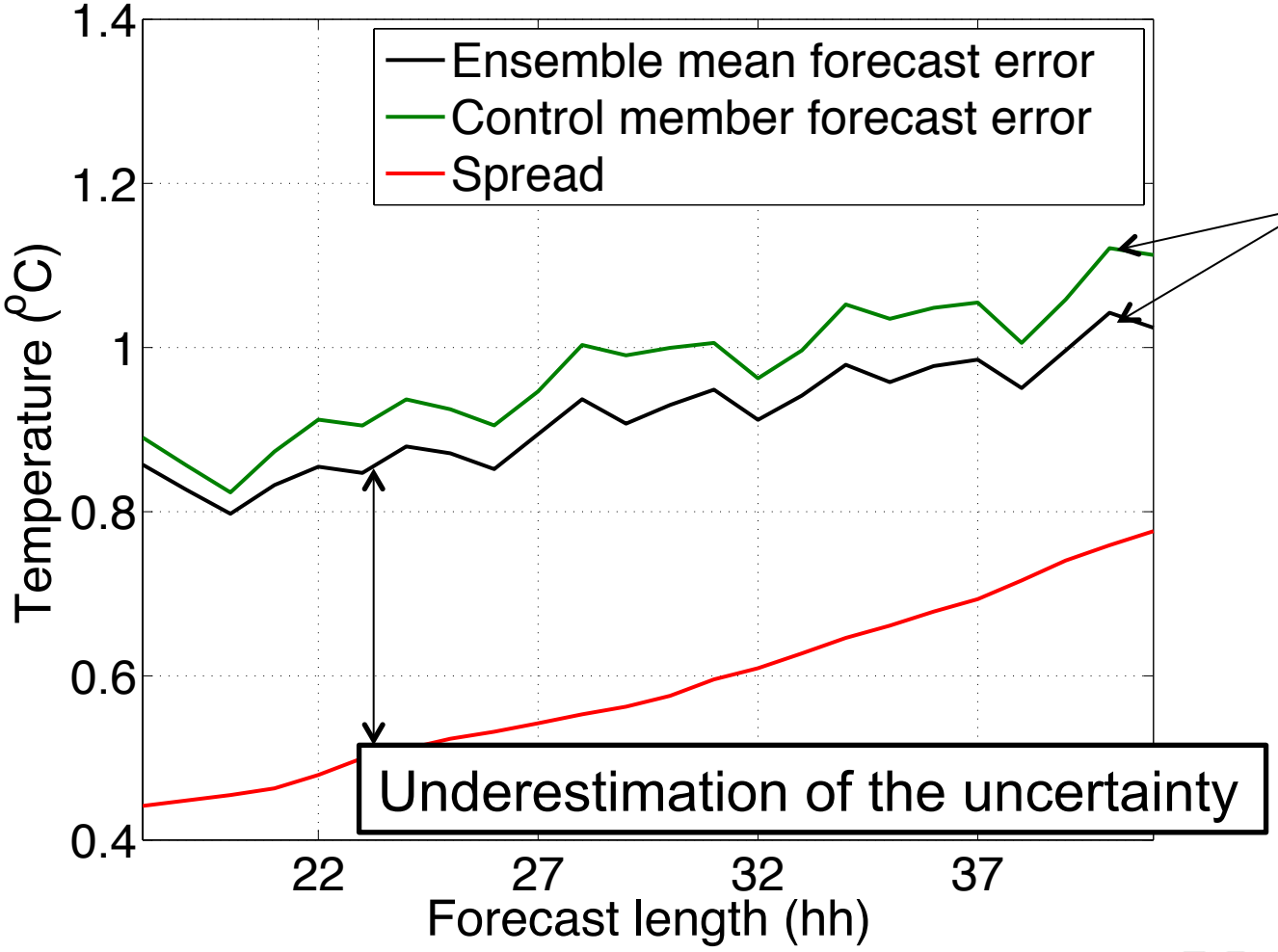
Weather forecast: Spread/skill of the ensemble



The ensemble mean reduces the forecast error

Average of 10 observation sites, 60-100 m height

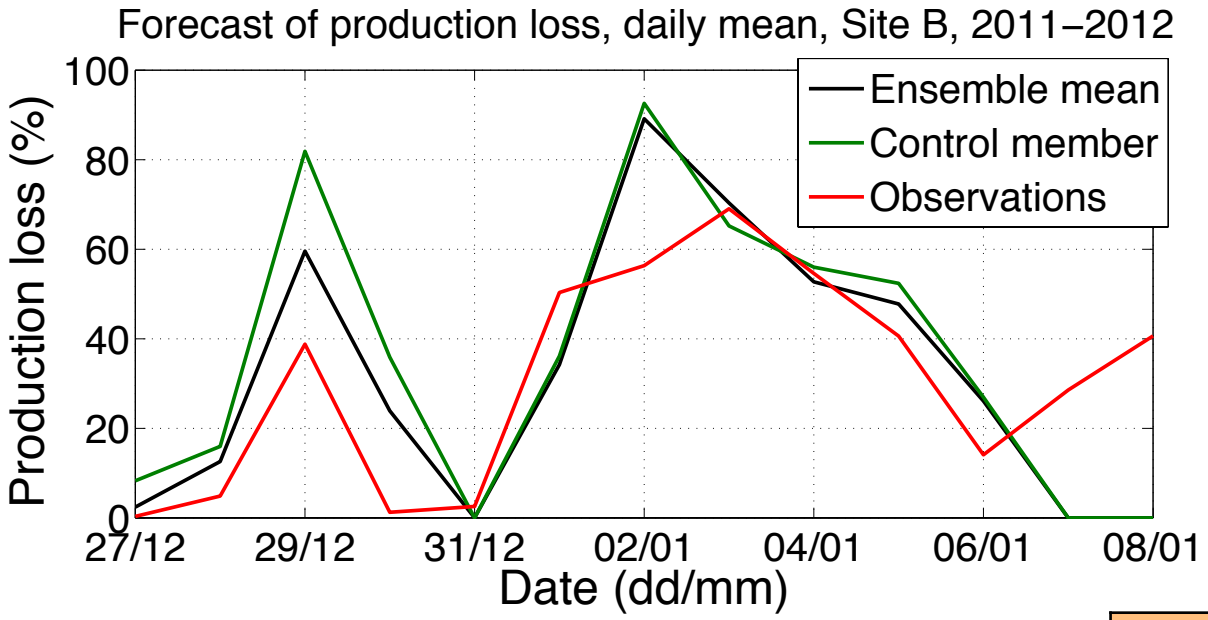
Weather forecast: Spread/skill of the ensemble



The ensemble mean reduces the forecast error

<u>Ideally:</u>
Spread of ensemble= Forecast error of ensemble mean

Results: Production loss

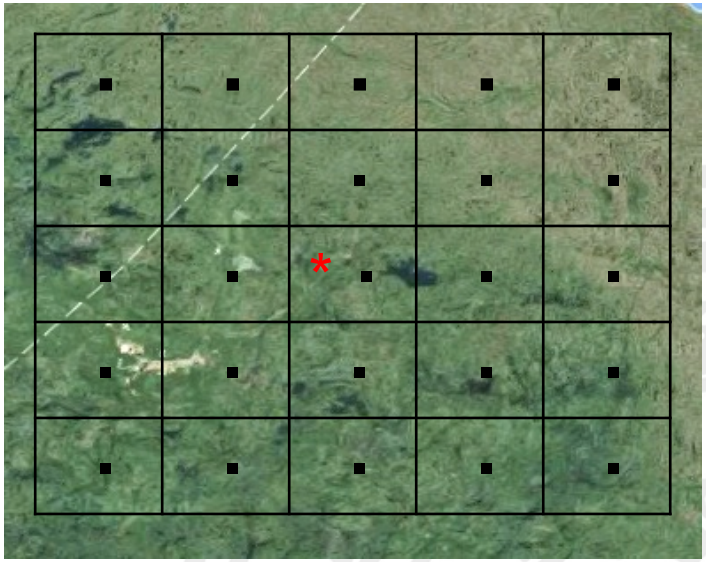


Based on 3 sites

Reduction in RMSE of forecasted production losses	
Ensemble mean/single forecast	12 %

Addition to the ensemble: Neighbourhood method

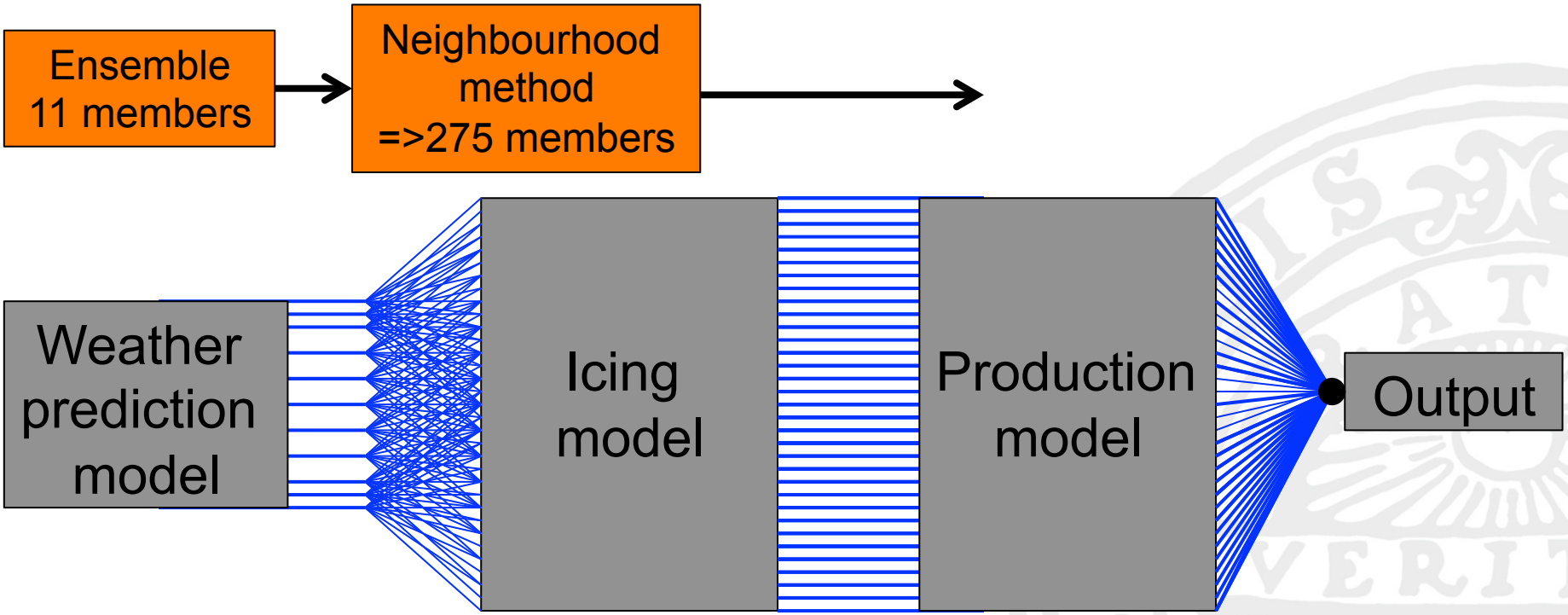
- An approach to represent some uncertainties in the model
- Treats neighbouring grid points (5x5, 25 grid points) as equally likely forecasts



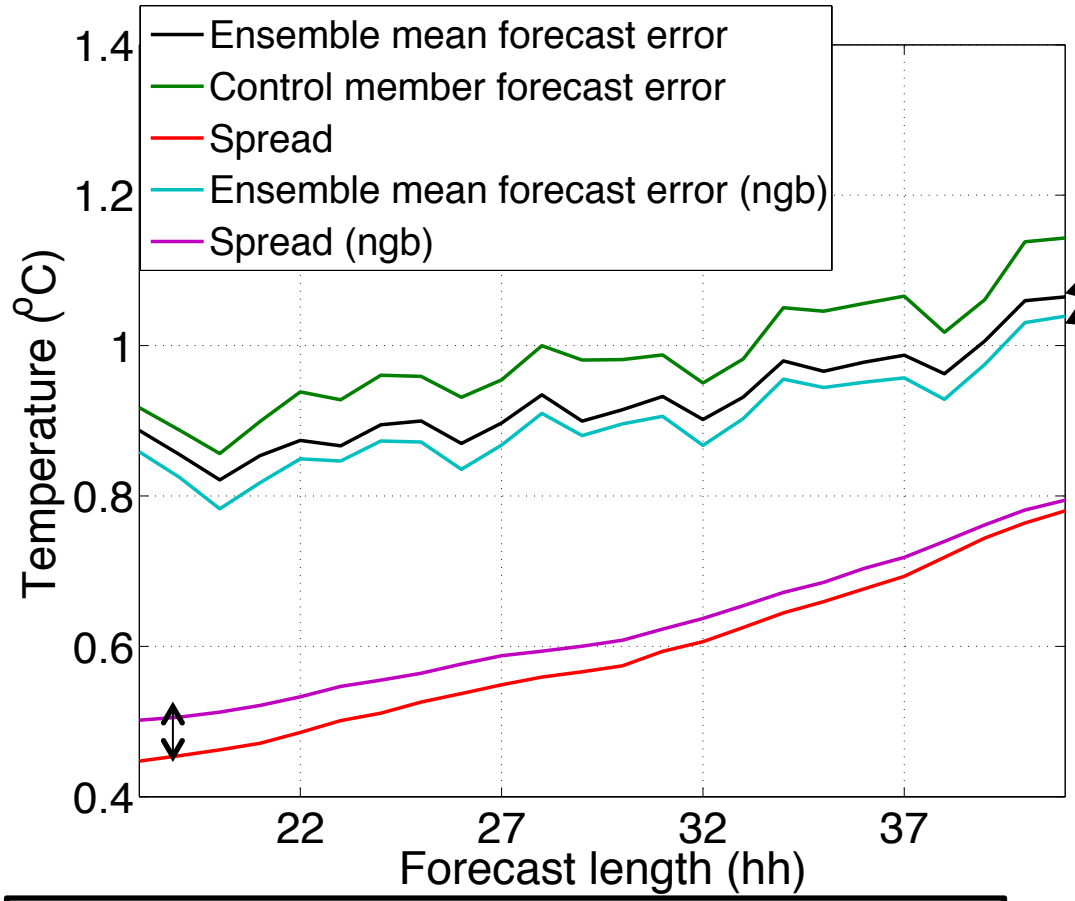
▪- Grid point

*- Observation

Method: Ensemble forecasting + Neighbourhood method



Weather forecast: Spread/skill of the ensemble



Larger reduction of the forecast error with ensemble + neighbourhood

Increased spread with ensemble + neighbourhood method

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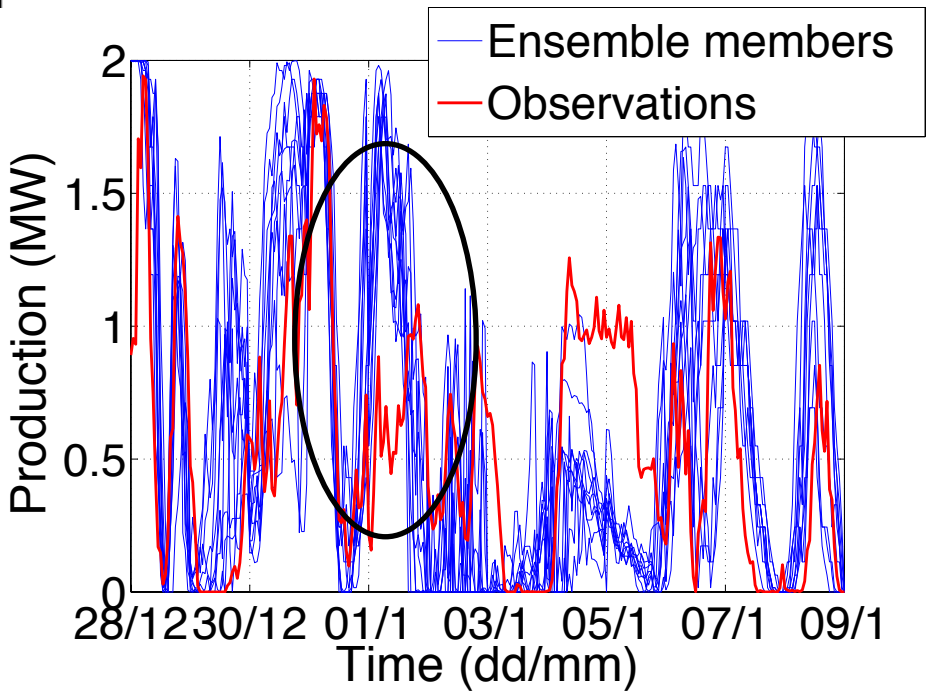
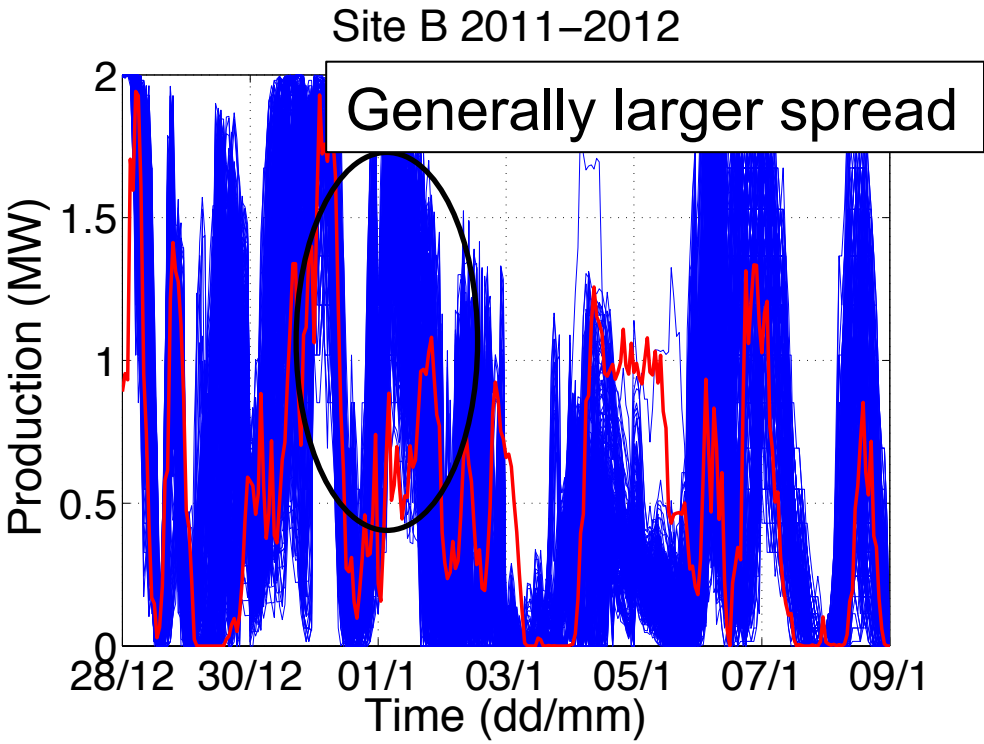
Results: Ensemble vs Ensemble + Neighbourhood



Ensemble



Ensemble + neighbourhood

Results: Production loss, Ensemble + neighbourhood method

Reduction in RMSE of forecasted production losses	
Ensemble mean/ single forecast	12 %
Ensemble mean/ single forecast (+Neighbourhood)	16 %

Based on 3 stations

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Summary & future plans

- 2-week period of ensemble forecasts
- Ensemble spread provides uncertainty estimations
- Currently the uncertainty is underestimated
- Ensemble mean consistently better than the control member
- Ensemble + Neighbourhood method improves ensemble mean and uncertainty estimations

Future plans

- Extend database of ensemble forecasts
- Probabilistic forecast over entire modelling chain

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Thank you!