Uncertainty Quantification for Wind Power Forecasts in Cold Climates

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This project is supported by Energymyndigheten.

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Image from: https://www.novascientia.net/articles/225/A-song-of-Ice-and-Wind-turbines

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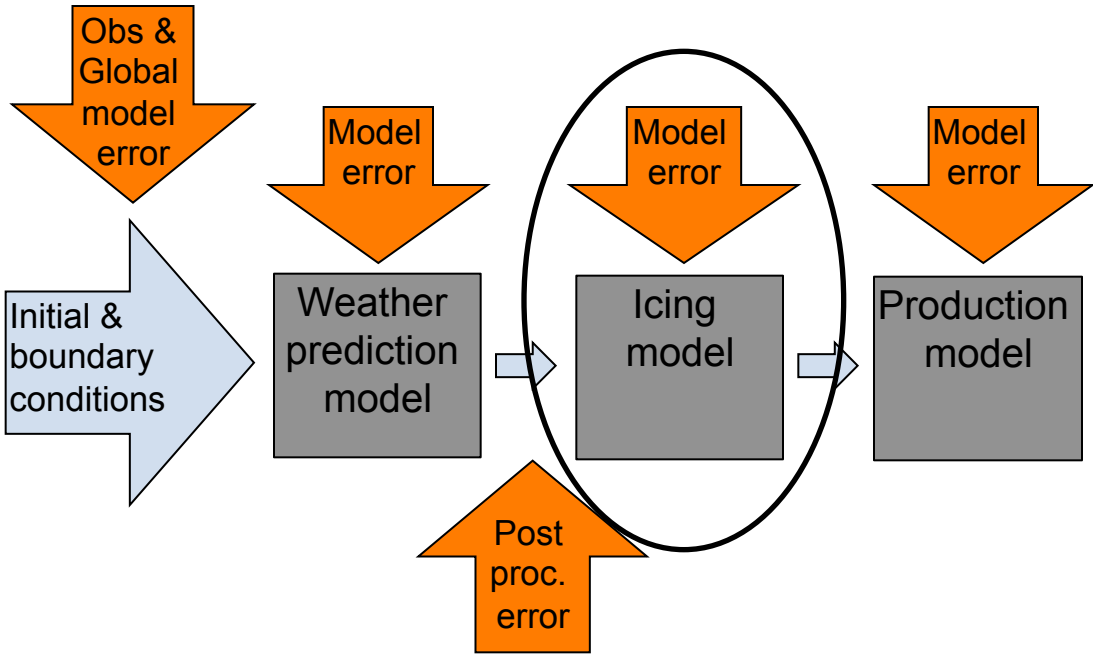
Uncertainties in the modelling chain

Goal: Quantify the uncertainty of the *icing model*



Uncertainty quantification method

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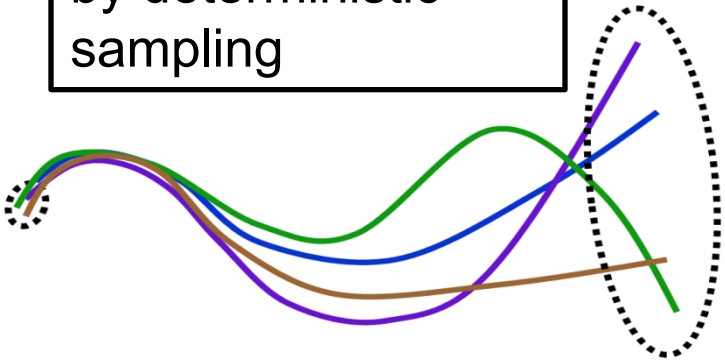
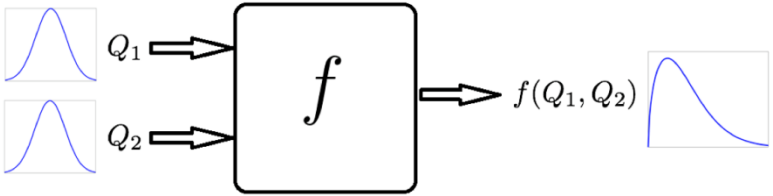
Optimize number of ensemble members by deterministic sampling

Needed: Uncertainty in input parameters



Output: Uncertainty of the result



http://www.dwd.de/EN/research/weatherforecasting/num_modelling/bilder/04_ensemble_methoden_abb1_en.png?__blob=normal&v=3

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Uncertain parts of the icing model

The icing model is based on the Makkonen model (Makkonen 2000) with some additions.

Uncertain parameters and estimated variation:

Ice shedding factor

Mean: 8

Std: 4

Droplet number concentration

Mean: 300 cm^{-3}

Std: 200 cm^{-3}

Wind erosion (Used when Wind speed > 5ms^{-1})

Mean: 10 g/ms^{-1}

Std: 5 g/ms^{-1}

Heat transfer coefficient - accretion efficiency & sublimation

(Altering nusselt number with constant)

Mean: 0.03

Std: 0.02

Optimization of ensemble size with deterministic sampling

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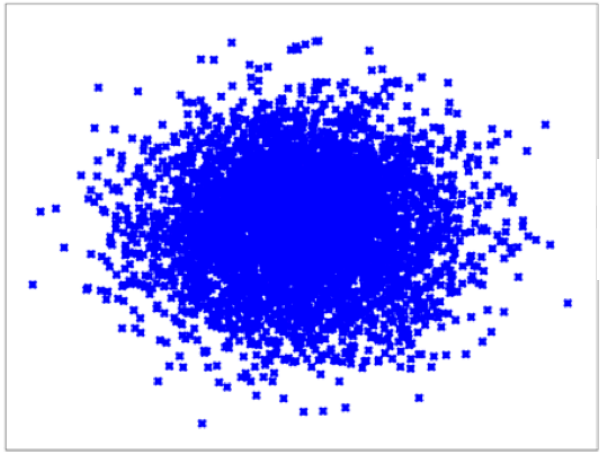
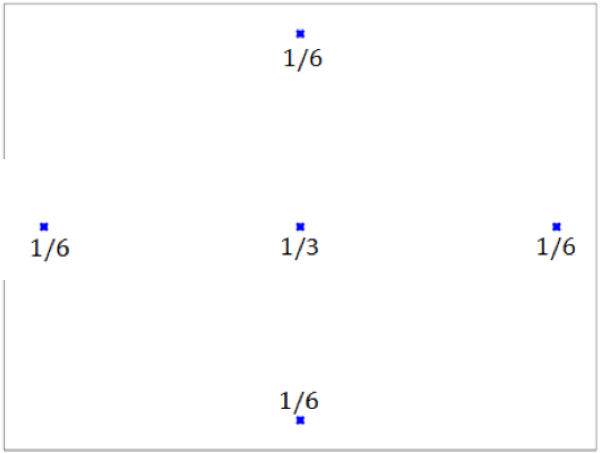
Random sampling



Deterministic sampling



Deterministic sampling is a method used to optimize ensemble size for uncertainty estimations.

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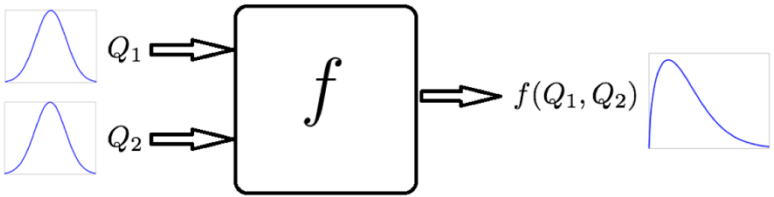
Expected results

Deterministic sampling can generate an efficient estimation of the icing forecast uncertainty for operational use!



Challenges

- Most uncertainties is in the input from the NWP model?
- Limited observations of icing
- Non-linear model requires more complex deterministic sampling.
- Covariance between uncertain parameters?