WinterWind
Skellefteå, 2017-02-07

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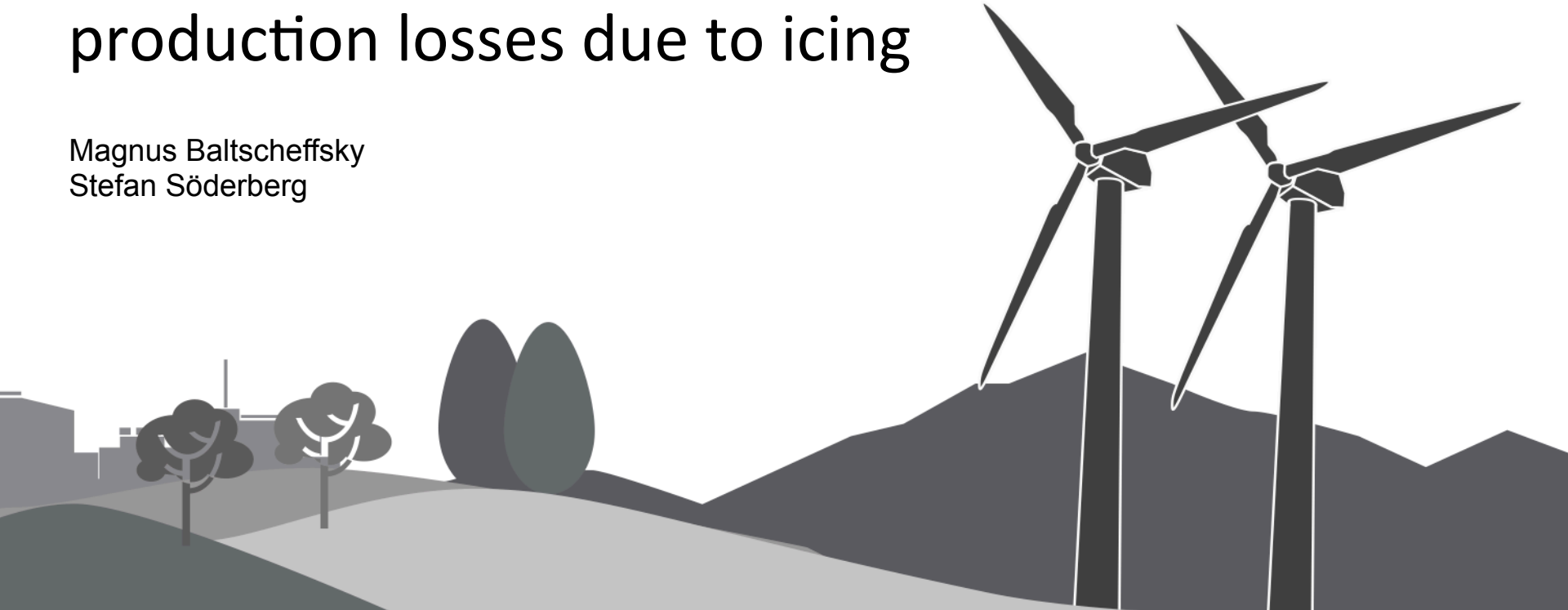
Probabilistic long term correction of production losses due to icing

Magnus Baltscheffsky
Stefan Söderberg



Business

- Atmospheric modelling
- Cold climate studies
- Weather Forecasts

Research

- Wind Power in Forests
- Farm-Farm Interaction
- NEWA
- Cold Climate

ICING

Cloud water droplets & T< 0

↓

Accretion of ice on turbine blade

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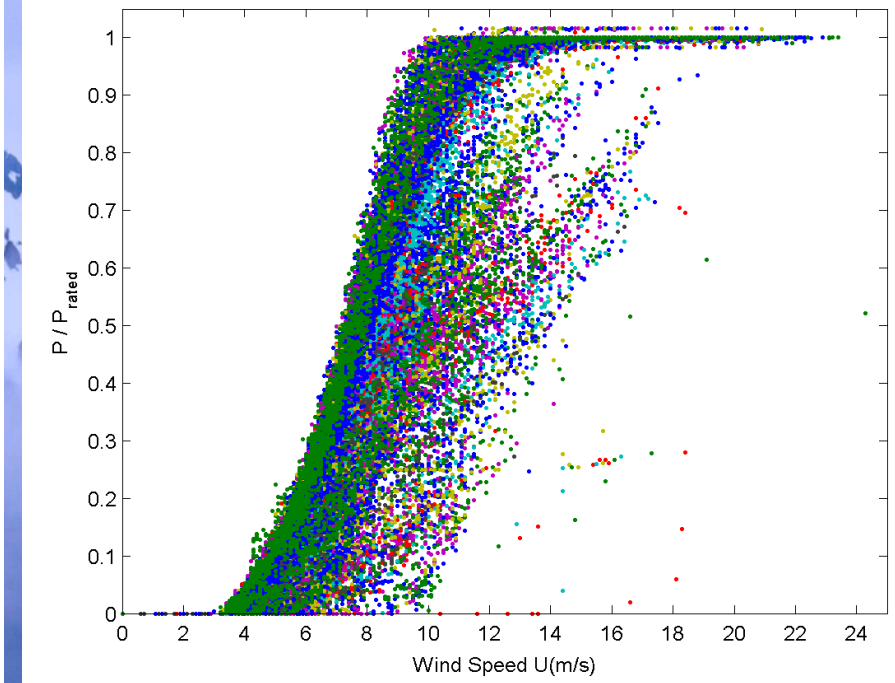
Reduced efficiency of turbine



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Model chain

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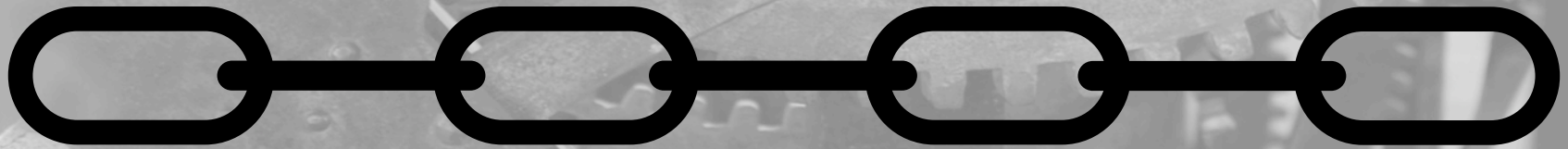

- WRF model
- High resolution
- Microphysics

2013
2016

- Makkonen
- Turbine blade
- De-icing

2013
2014

- WICE
- SCADA

2013

- 30yrs
- Condensates
- **LT correction**

2012
2015
2017

Model chain

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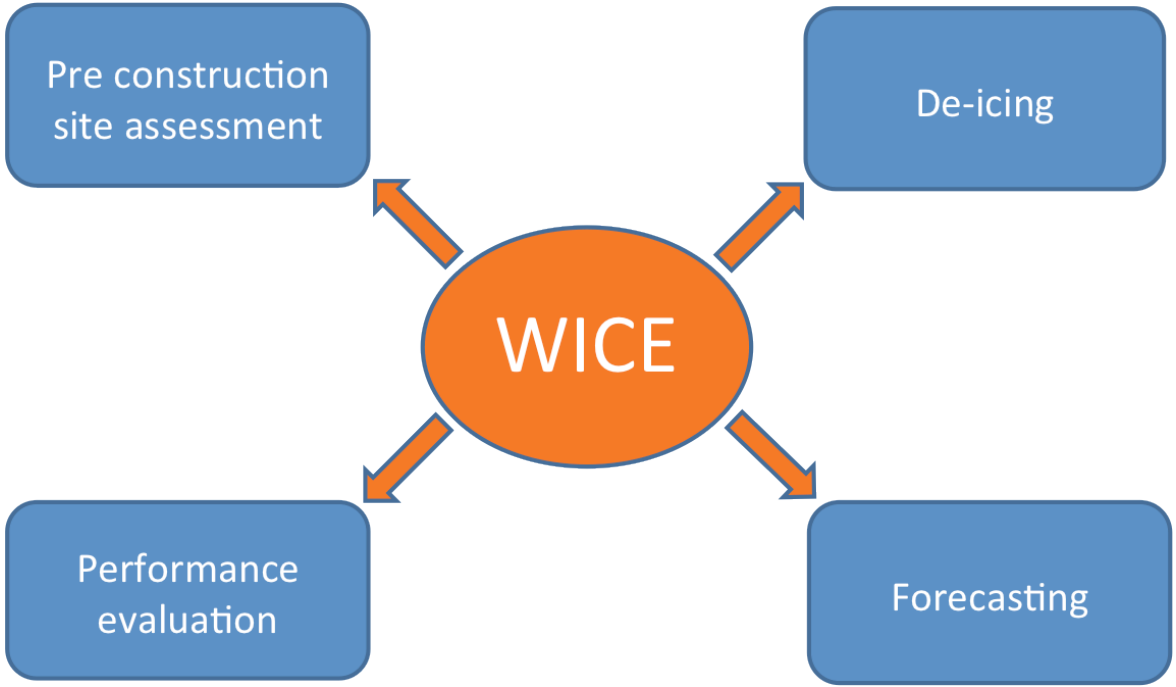

Production loss

- WICE – Combination of physical and statistical modelling
- Based on SCADA data from existing wind farms

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Data used

- WRF data, 9km+3km+1km resolution
  - 4 different sites
  - 3 years
- Met mast wind speed
  - Nasudden, Gotland
  - 20yrs

Long term correction methods

1. Linear Regression
2. WTech ice correction
3. Production loss index correction
4. AnEN

AnEn – theory

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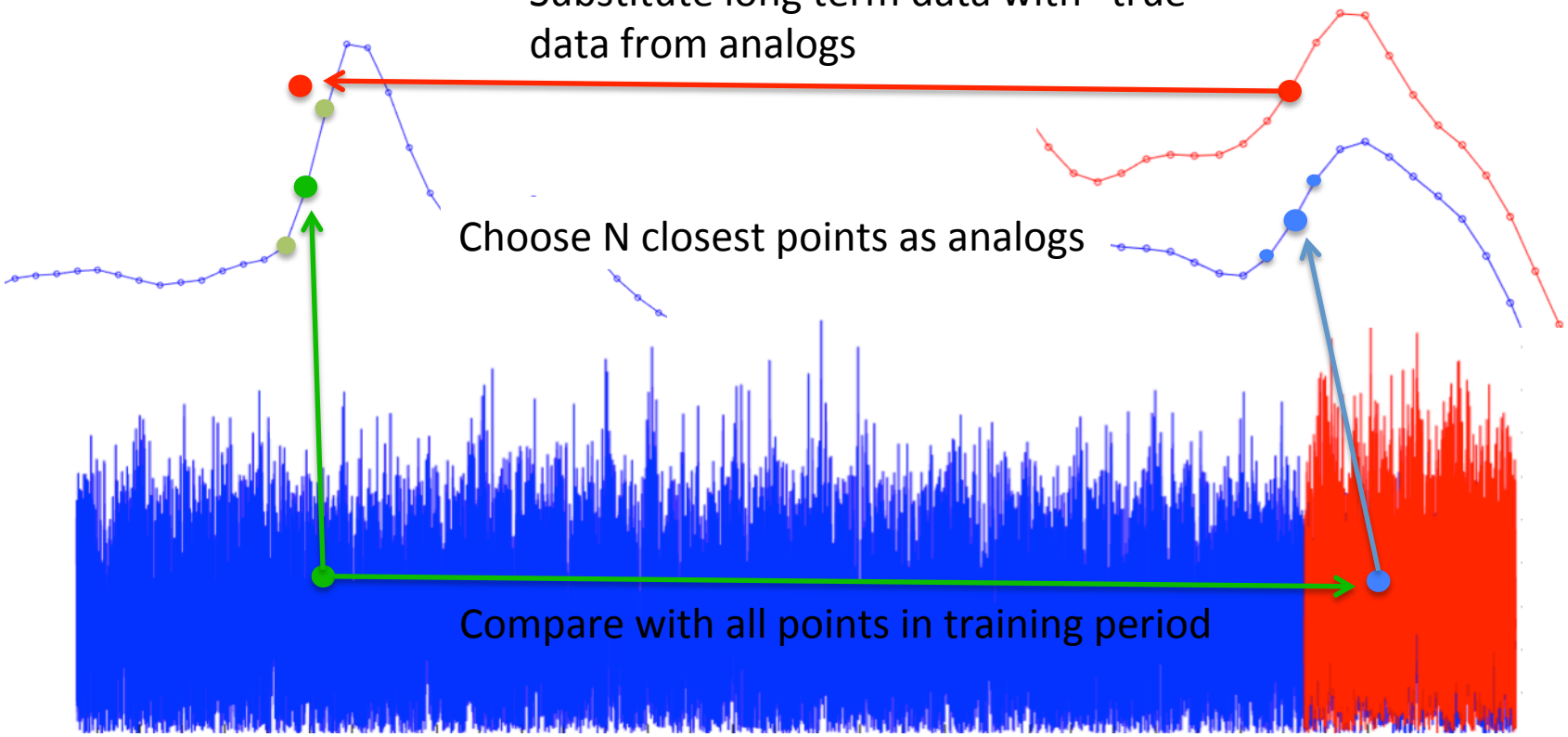

AnEn – wind speed

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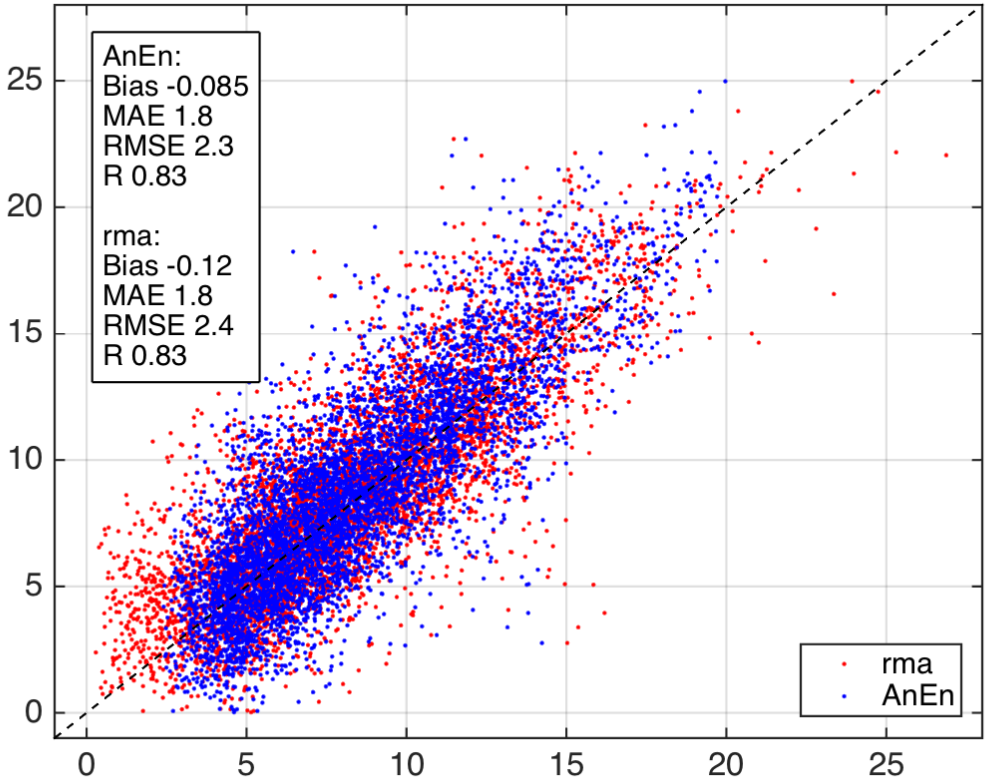

AnEn – wind speed

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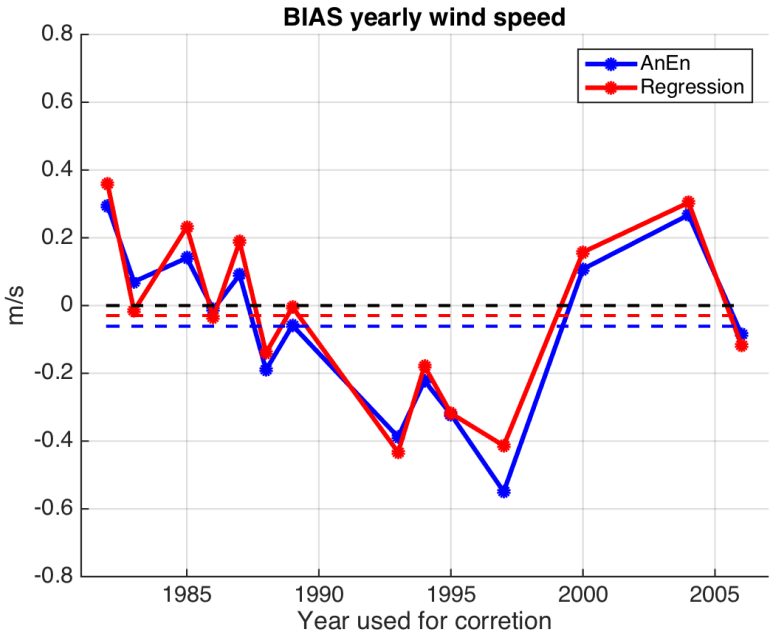

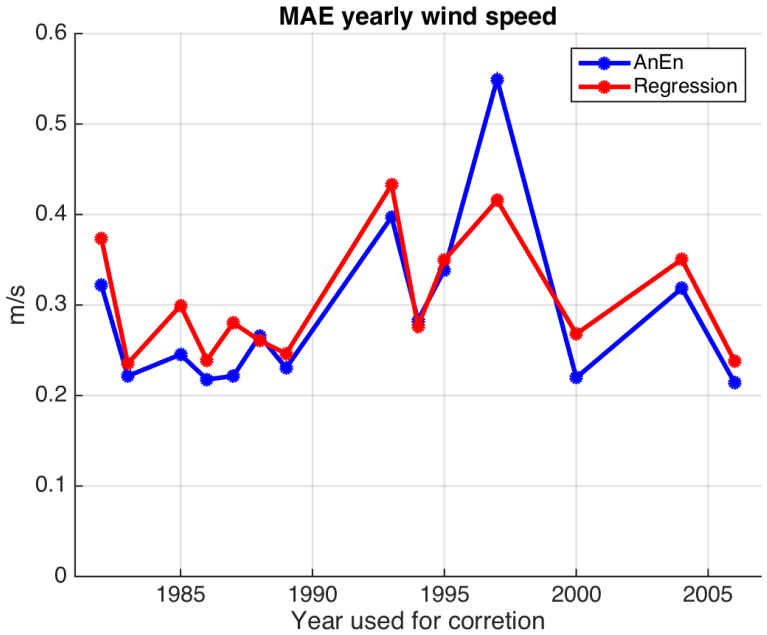

Ploss – all methods

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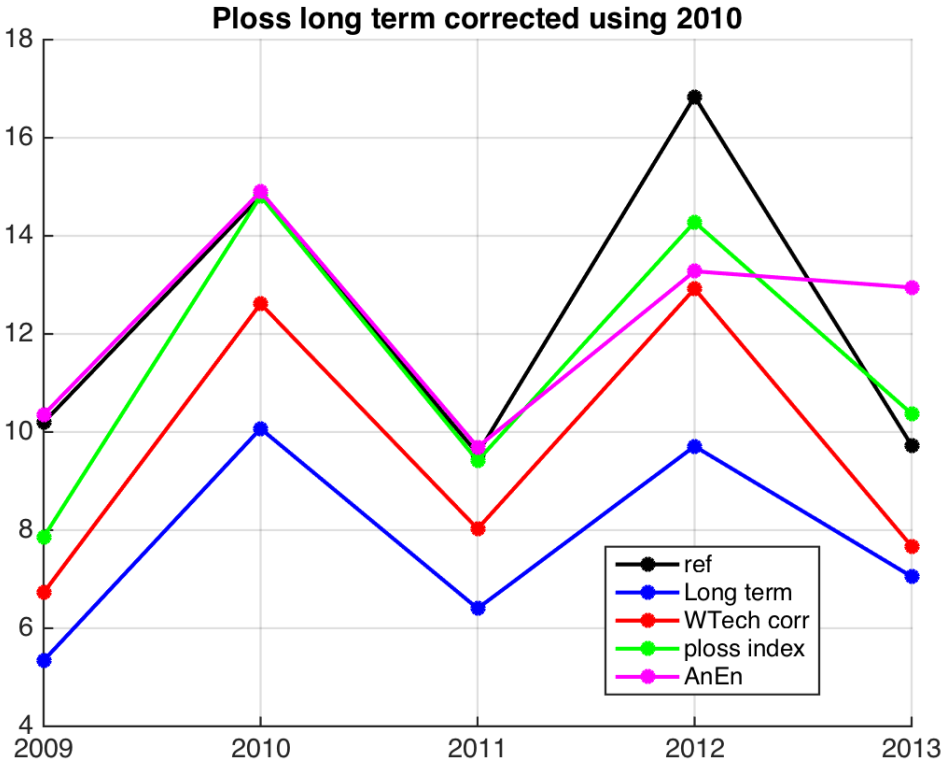

AnEn – ploss

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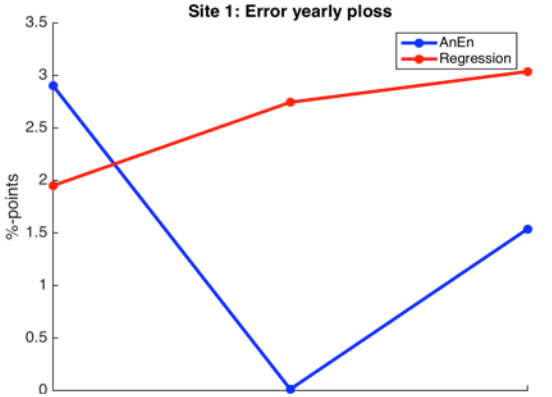

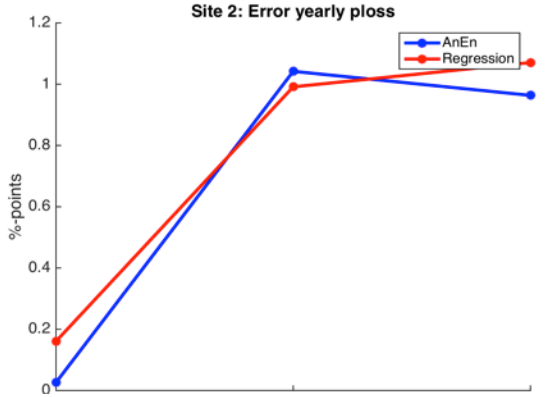

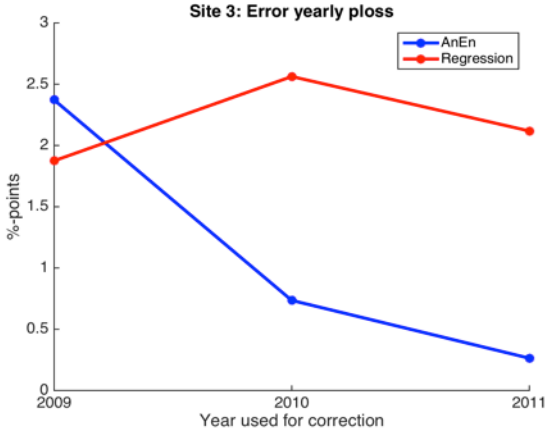

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Summary

1. Long term correction of icing is complex
2. Wtech AnEn shows promise but needs more work
3. Ensemble mean – loose some variation but smaller bias
4. How do we reduce sensitivity to year used?

Outlook

1. PCA of input
2. Further development of optimisation algorithm
3. Explore ways of benefitting from probabilistic results

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Thank you!

Magnus Baltscheffsky

Mobile: +46(0)70 863 19 63

Email: magnus@weathertech.se