Using mesoscale weather data to guide short-term measurement campaigns for resource assessment within the RECAST project

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RECAST
Reduced Assessment Time

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TOWARDS Using mesoscale weather data to guide short-term measurement campaigns for resource assessment within the RECAST project

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Motivation...

- Measurement campaigns are expensive
- RECAST aims to reduce campaign duration by better utilizing and combining available models and measurement

- Mesoscale model data is cheap, abundant and provides a wealth of information
- The accuracy is not known a priori
- **How can mesoscale data be used to guide the selection of timing and duration of short (< 1 year) measurement campaigns?**

Image from the NEWA project

Possible a priori uses of mesoscale models for short campaigns...

- **Wind climate and events**
  - Likelihood of capturing important events
  - **Likelihood of well sampled wind climate**
  - **Likelihood of high predictability**
- Measurement conditions
  - Likelihood of sufficient air contaminants for LIDAR
  - Likelihood of LIDAR beam obstruction from e.g. low clouds
- Logistics and safety
  - General weather conditions,
  - Likelihood of extreme events: wind, heat, precipitation, lightning

Datasets...

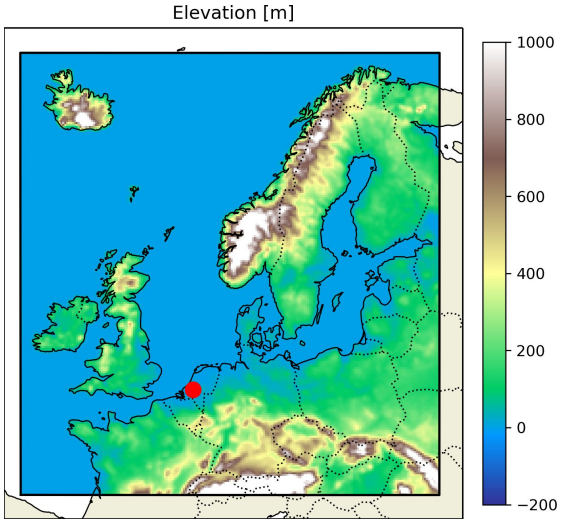
Measurements

- Cabauw mast
- 80 m
- 2001-2017

- Similar results observed for other Northern European sites, e.g. at Høvsøre

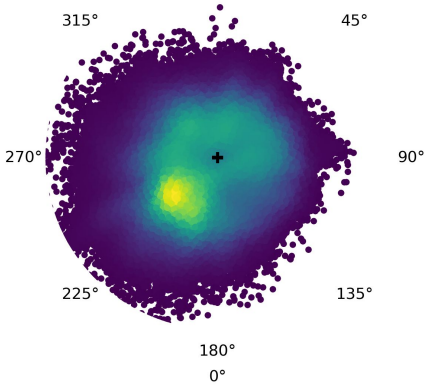
Mesoscale data

- WRF
- 2001-2017
- $\Delta x, y$ = 10 km
- $n_z = 41$
- MYJ PBL scheme

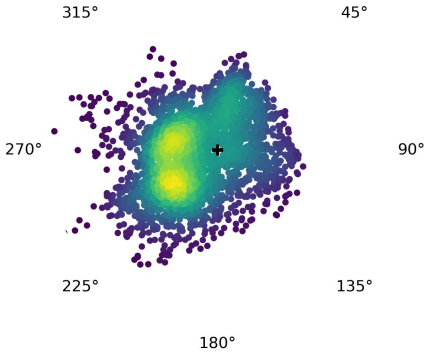


WS & WD Point cloud

Long-term “truth”



Short-term measurements



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Wind climate histogram

Long-term “truth”

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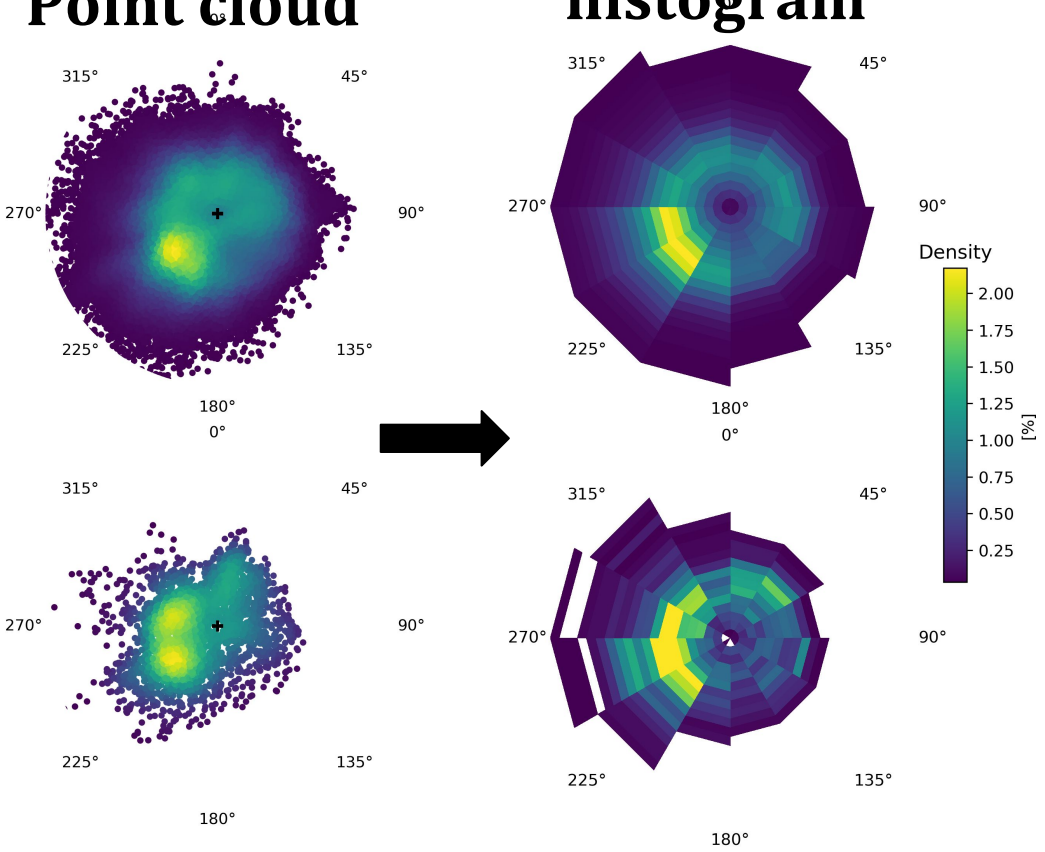

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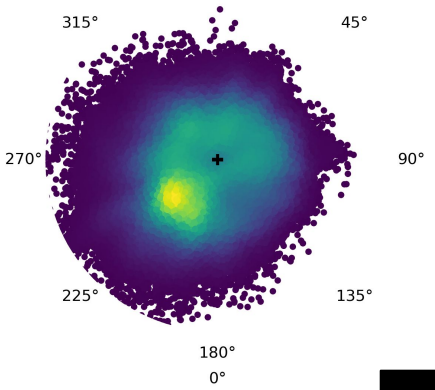
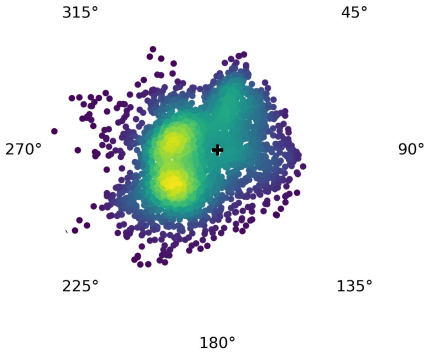
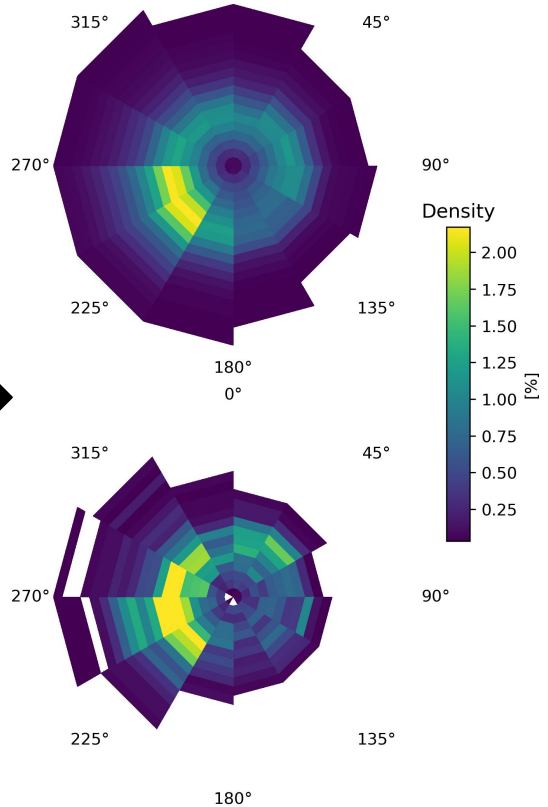
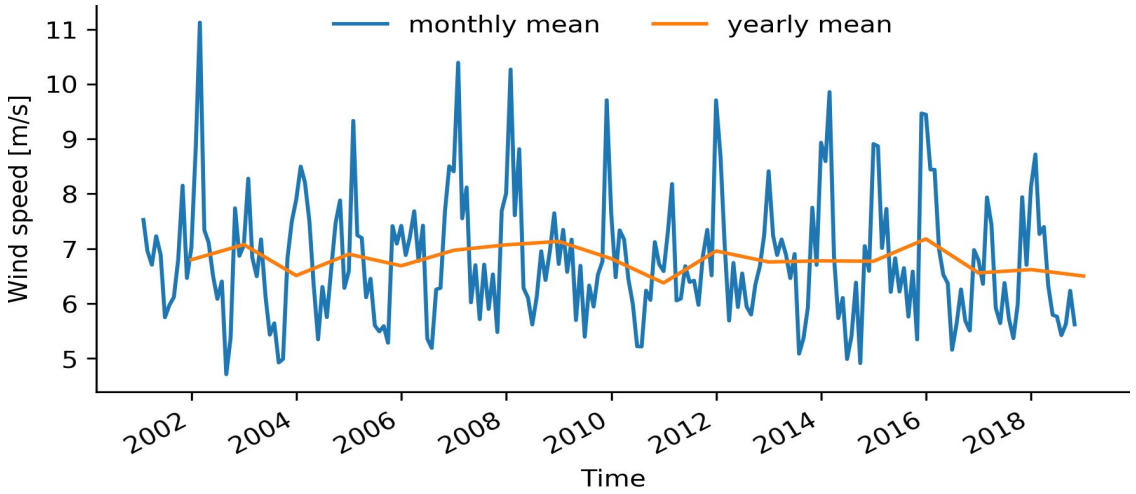


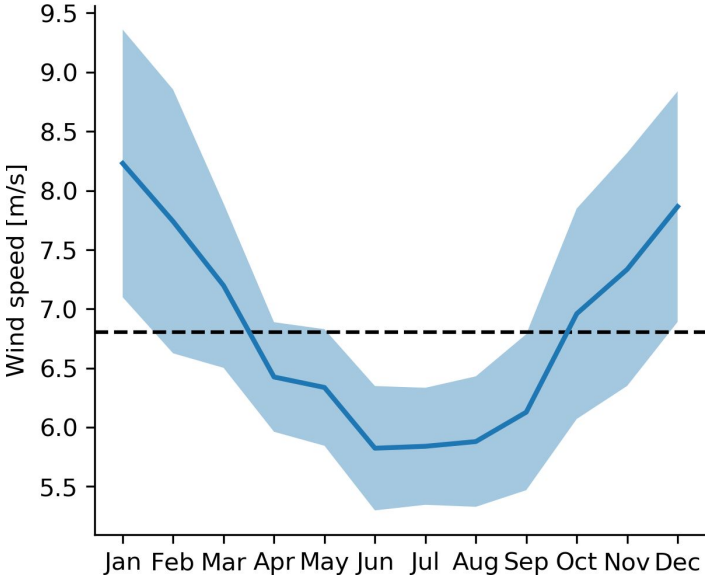




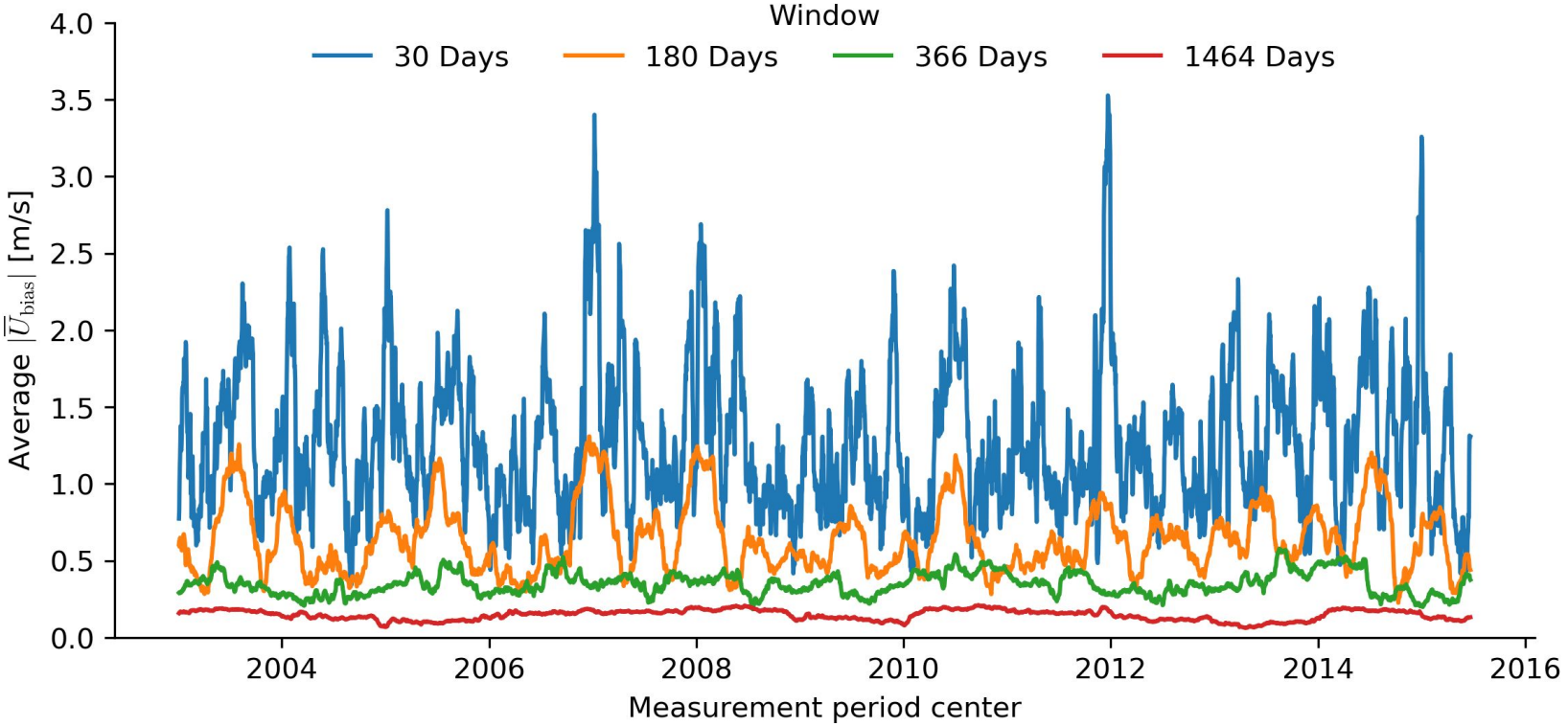
Error = Sector weighted average mean wind speed bias

Seasonal variations....





Error of estimated wind climate by measurement window size...



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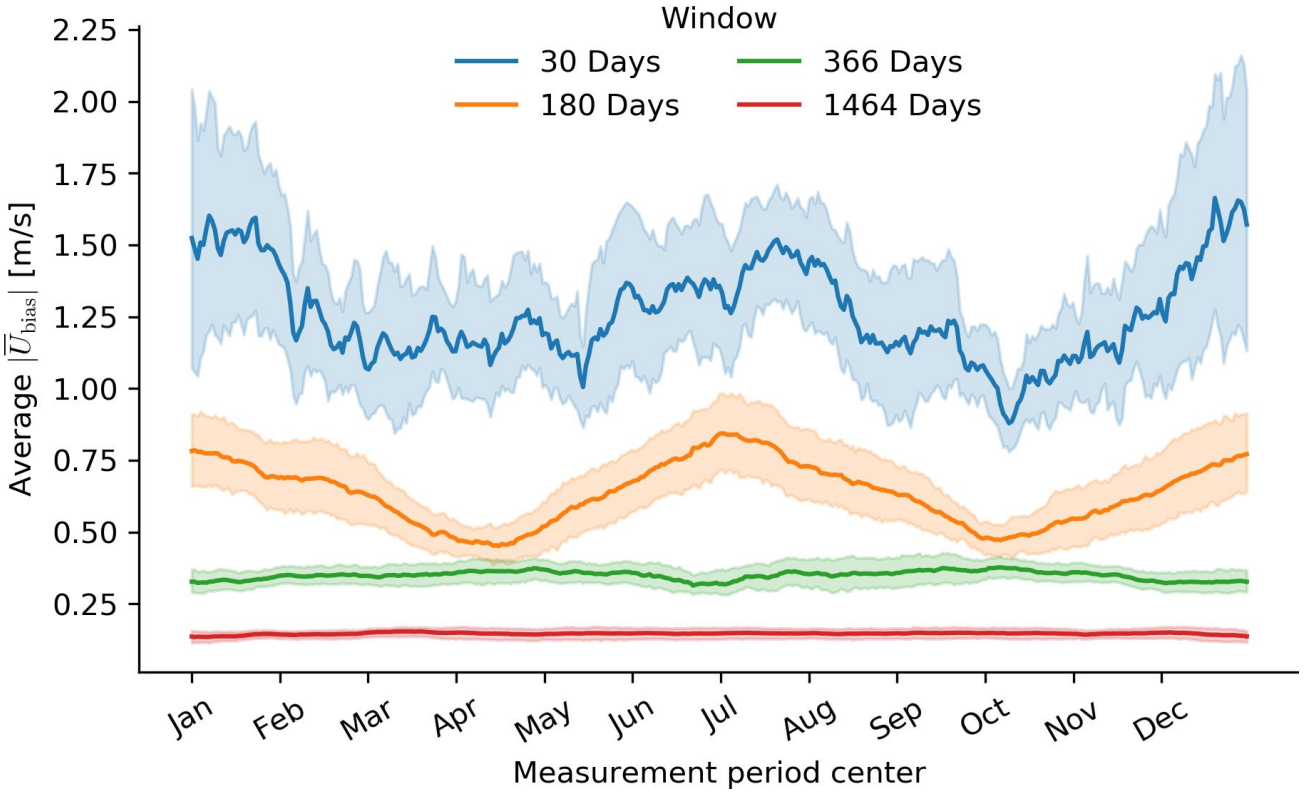
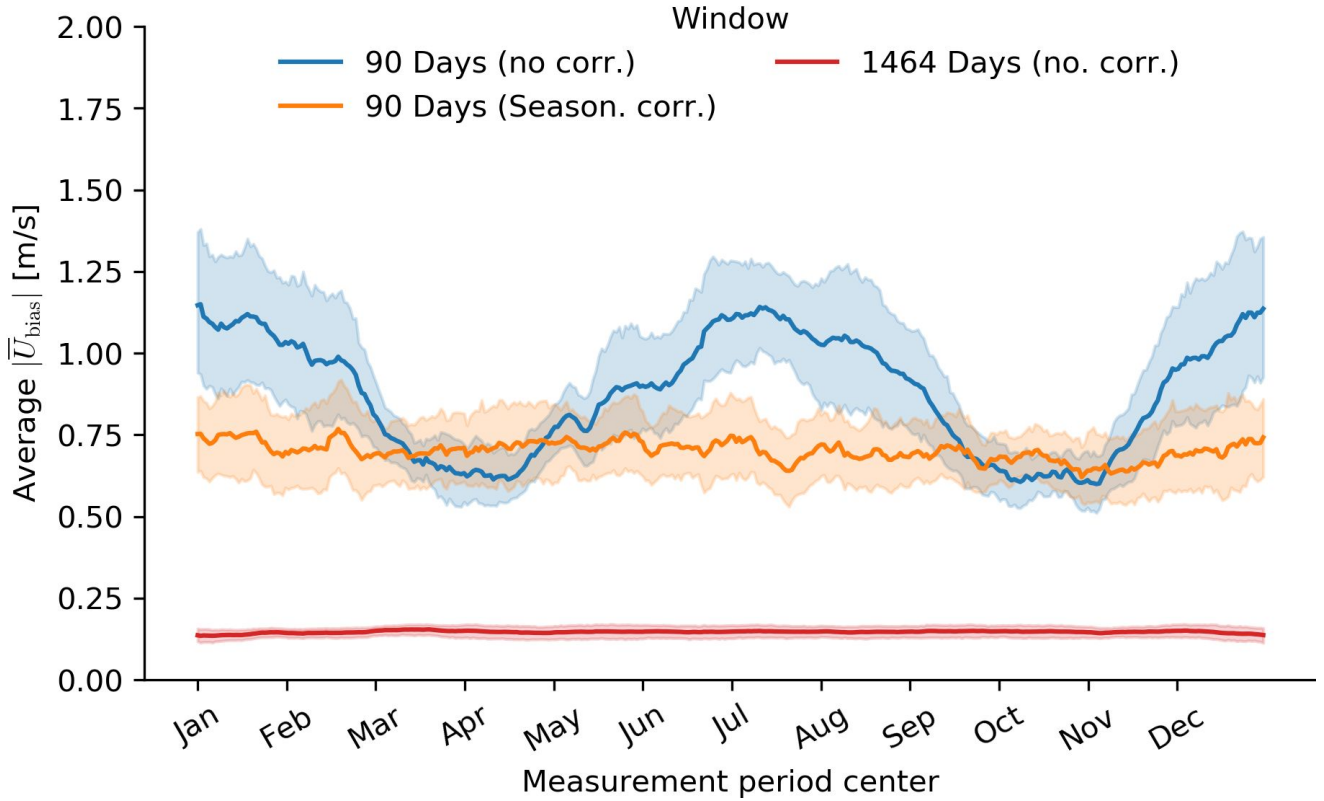


Seasonal correction....

- **Wind speed scaling**

$$\tilde{Y}_i^{ST} = Y_i^{ST} \frac{\overline{X_i}^{ST}}{\overline{X_j}^{LT}}$$

Seasonal correction....

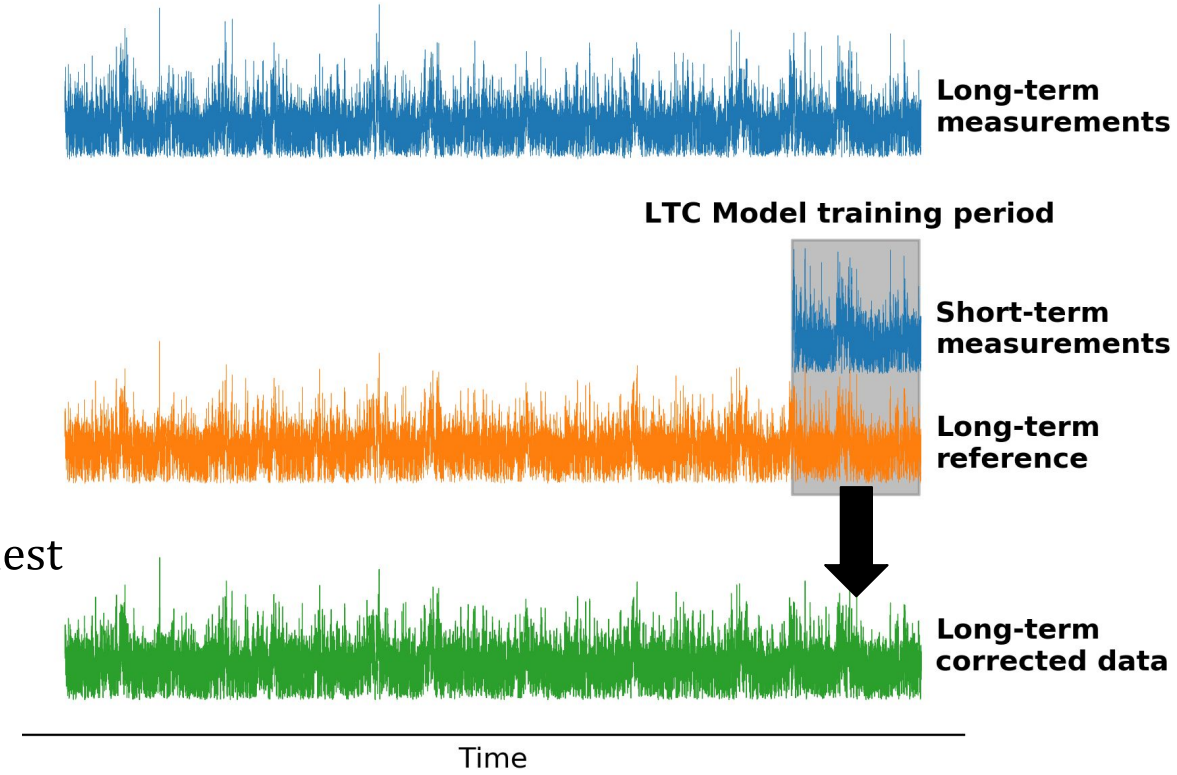


Long-term correction...

- Supervised learning
- Many different strategies
  - **Linear models**
  - Non-linear models
  - Probabilistic models
  - Neural networks

- For illustration, the simplest form is used

$$y_i = \beta_0 + \beta_1 x_i$$



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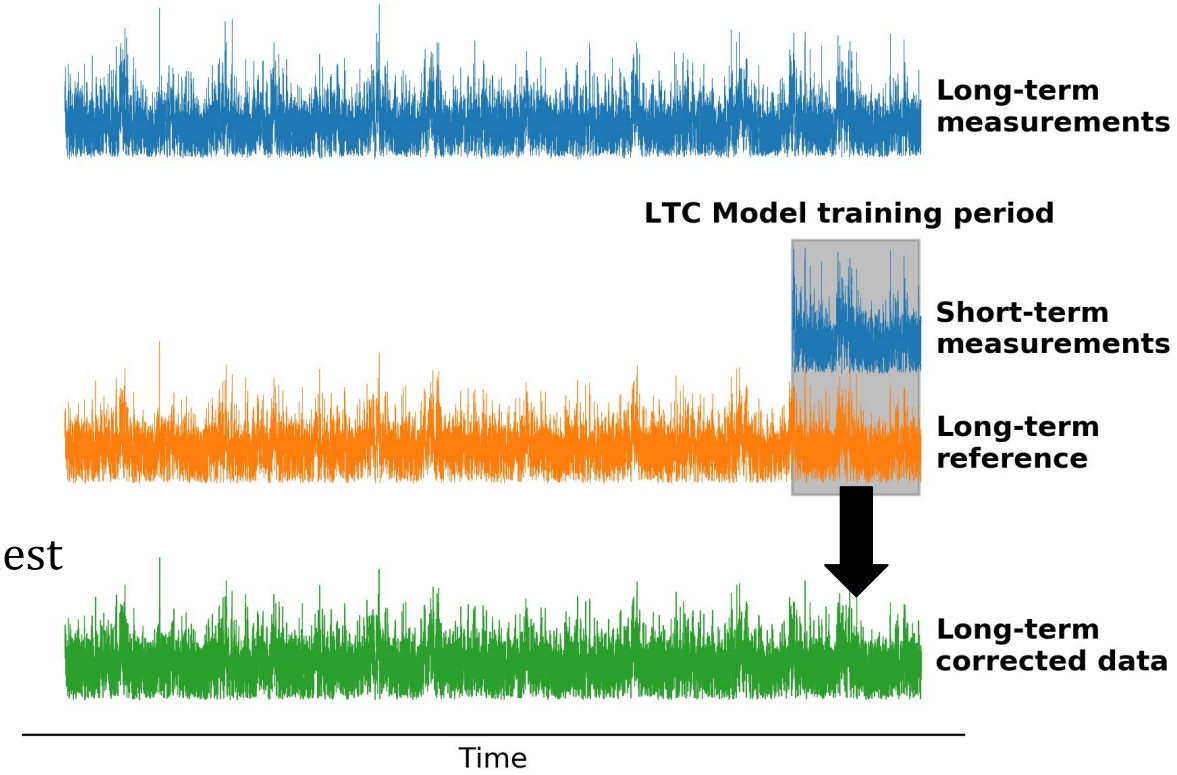
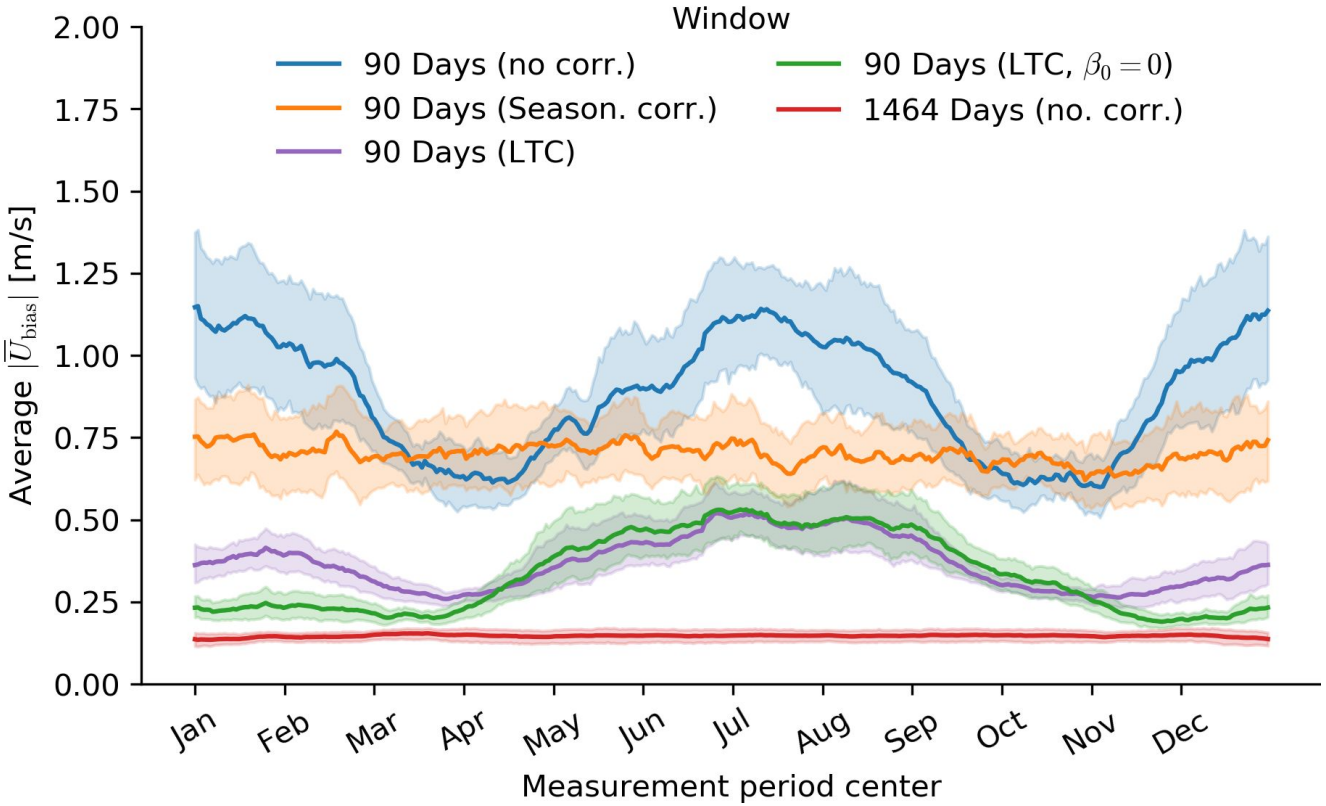
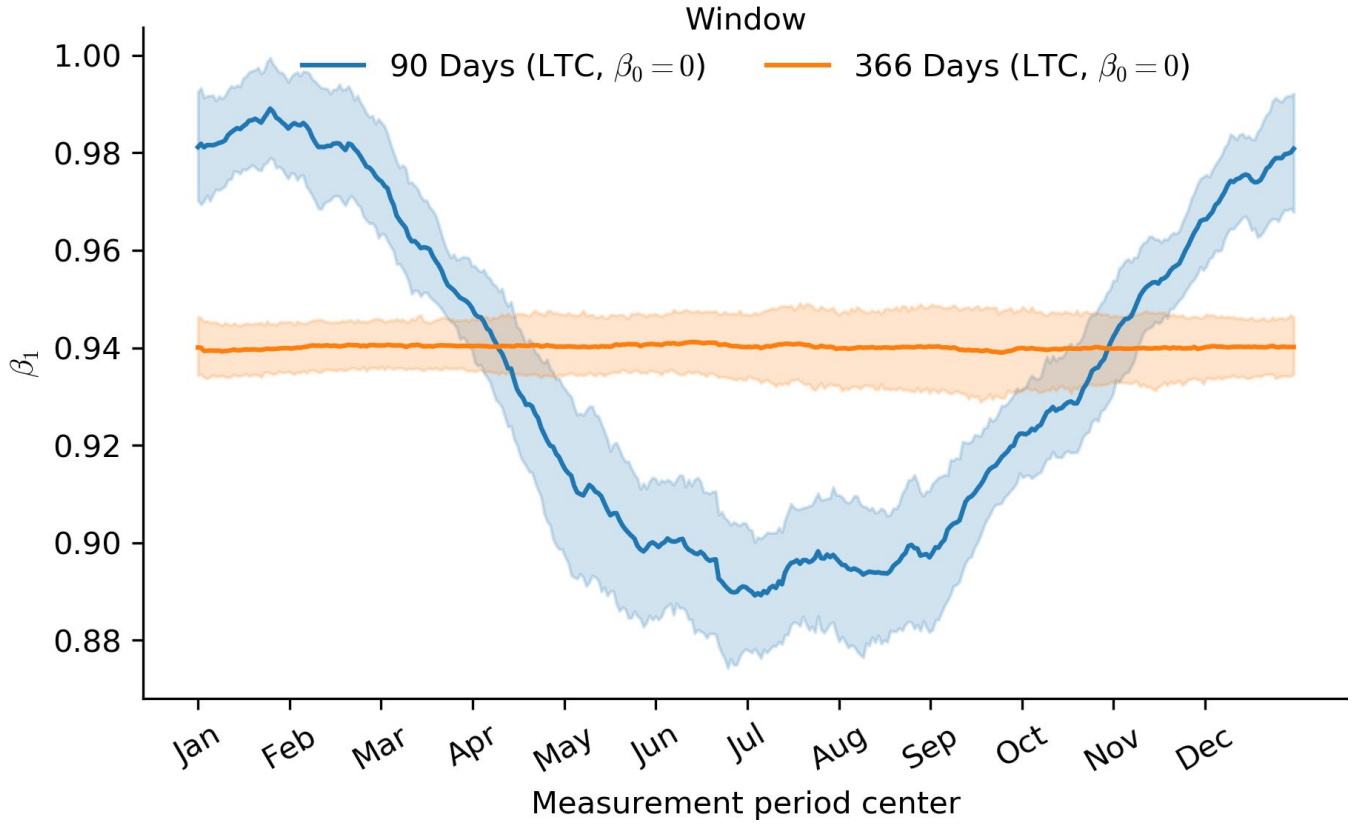


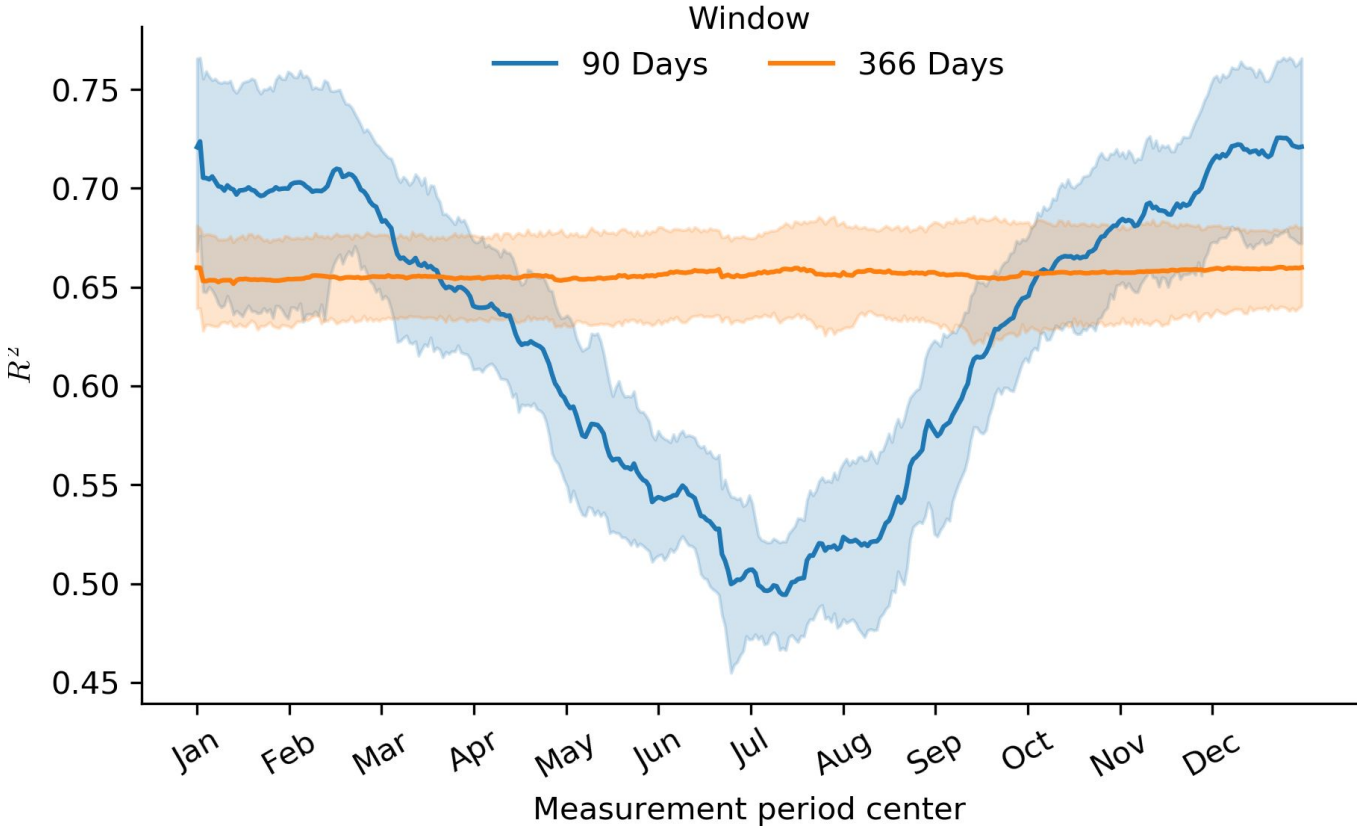
Long-term correction...



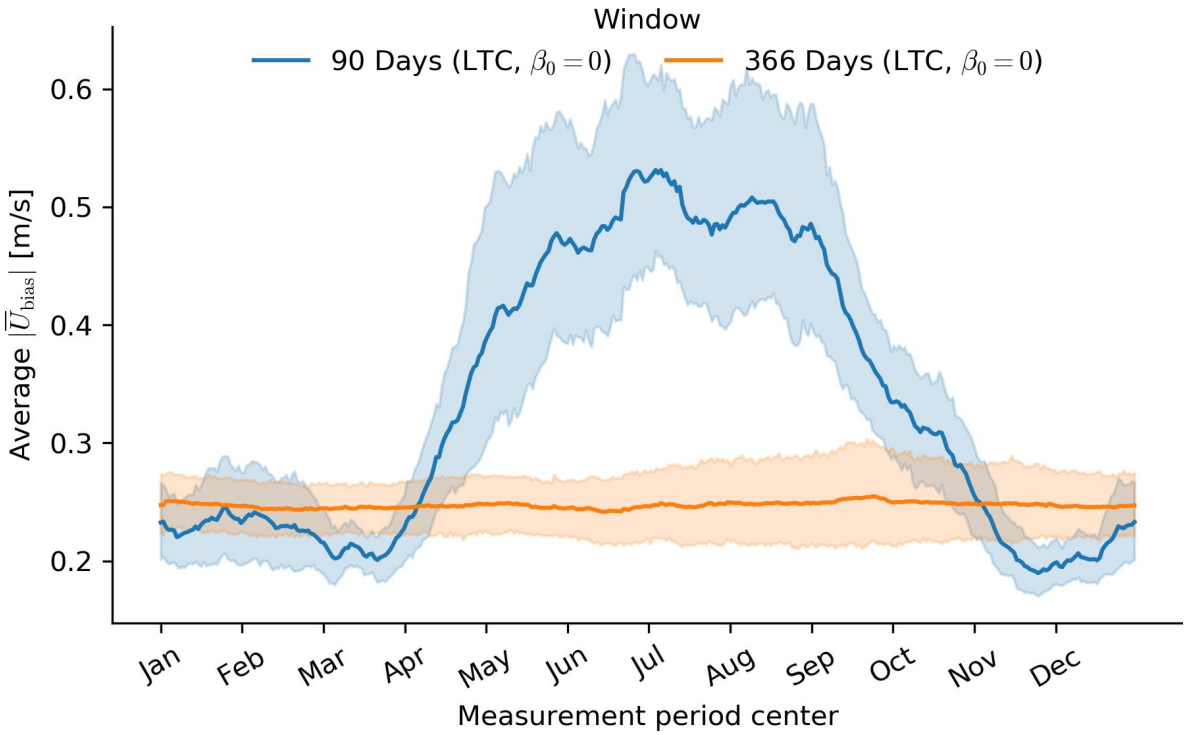
LTC coefficient seasonal variation...



Seasonal predictability...

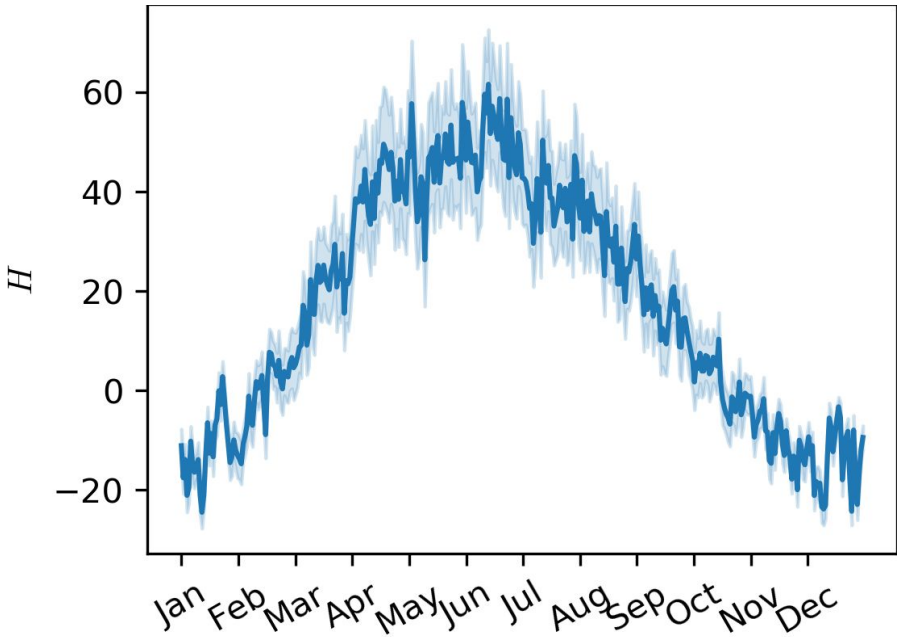


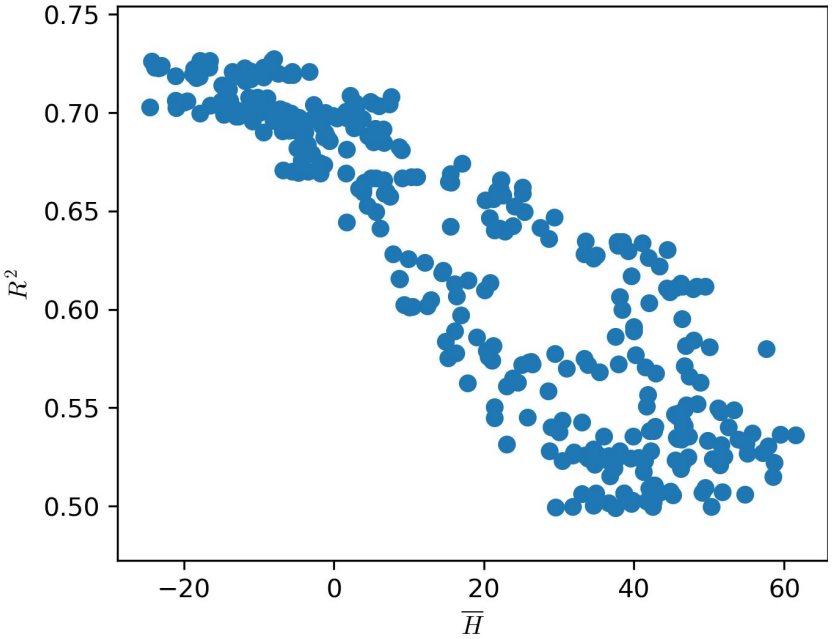
Error larger in low predictability season...



What can we use a priori as a proxy for predictability?

Governing scales - synoptic vs. small meso and micro scales, e.g. thermals





Take aways...

- For short campaigns it matters when you measure
- High predictability periods preferable for LTC model training
  - Mesoscale data can give indication of predictability
- Seasonal variation of LTC model coefficient(s)
  - Can mesoscale model data be used to correct for this?
- Centering campaigns on cross-over point of mean seasonal bias cycle can reduce the need for (seasonal) correction
- Many caveats
  - Limited dataset
  - Simple terrain
  - Simple LTC method

Thank you

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