Looking for an offshore wind champion: a tight race over the Baltic Sea

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Lidar measurements

- Lidar measurements from four sites
  - Wind profiles up to 300 m
  - 1 – 4 years of data
Four reanalyses tested

<table>
<thead>
<tr>
<th>Global</th>
<th>Global</th>
<th>Europe</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>40x55 km</td>
<td>17x31 km</td>
<td>11x11 km</td>
<td>3x3 km</td>
</tr>
<tr>
<td>3 h *</td>
<td>1 h</td>
<td>1 h</td>
<td>30 min *</td>
</tr>
</tbody>
</table>

* to be able to compare: calculating hourly values from all observations and reanalyses

... and of course a lot of differences regarding vertical resolution, data assimilation, model setup, ...
In our paper

1. General wind characteristics
   - Wind profile
   - Wind speed distributions
   - Taylor diagrams
   - Average wind shear

2. Low level jets
   - Hits, false alarms, correct rejections, misses
   - Frequency bias
   - Annual and diurnal cycle
   - Core height and core speed

Mesoscale phenomena are very common in the coastal zone (sea breeze, low level jets, boundary layer rolls, ...)

Wind speed

Core height and core speed

normal

low level jet

wind speed
Wind profile
Average wind shear as a measure of the loads on the turbine

15 MW offshore wind turbine

MERRA2 not included due to poor vertical resolution
Low level jets can form in many different ways.

Typical formation over Baltic Sea:
- late spring/early summer: warm air advected over colder water, stability increases, frictional decoupling

But also:
- sea-breeze induced LLJs, coastal jets, ...

Fall-off criteria tested: 1 m/s and 2 m/s
Frequency bias

\[ \text{FBIAS} = \frac{\text{Total predicted}}{\text{Total observed}} \]
• MERRA2: vertical resolution not good enough

• ERA5 and UERRA better than NEWA regarding wind profiles and 1:1 correspondence in Taylor diagram

• But NEWA has better average wind shear (loads on turbine)

• Mesoscale phenomena are important in coastal areas, UERRA describes LLJs best (but diurnal cycle cannot be trusted!)