Predictability assessment of climate predictions within the context of the NEWA project

V.Torralba\textsuperscript{1}, A.Soret\textsuperscript{1}, S.Lozano\textsuperscript{2}, N.Cortesi\textsuperscript{1}, R.Marcos\textsuperscript{1}, J.Sanz\textsuperscript{2}, F.J.Doblas-Reyes\textsuperscript{1,3}

\textsuperscript{1}Barcelona Supercomputing Center, Barcelona (BSC), Spain
\textsuperscript{2}National Renewable Energy Centre (CENER), Spain
\textsuperscript{3}Institució Catalana de Recerca i Estudis Avançats (ICREA), Spain
Objective: Creation and publication of a high-resolution dataset of wind conditions in Europe to be used as a key tool for the wind energy sector.

- Wind resource information
- Site suitability conditions
- Wind predictability

Task 3.2 (Earth Sciences Department (BSC) - CENER): Development of information about wind predictability at different time horizons.
Weather forecasts

<table>
<thead>
<tr>
<th>Time Horizon</th>
<th>Weather Predictability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-15 days</td>
<td>Sub-seasonal</td>
</tr>
<tr>
<td>10-32 days</td>
<td>1-15 months</td>
</tr>
<tr>
<td>2-30 years</td>
<td>Decadal</td>
</tr>
</tbody>
</table>

Climate predictions

- Sub-seasonal
- Seasonal
- Decadal

Climate projections

- 20-100 years

---

# Data description

<table>
<thead>
<tr>
<th>Variable</th>
<th>10-m wind speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target season</td>
<td>Winter (December- January- February)</td>
</tr>
</tbody>
</table>
| Climate prediction systems | • **Sub-Seasonal**: ECMWF Monthly Prediction System, NCEP Ensemble and CMA model  
                          • **Seasonal**: ECMWF System 4, MF System 4, Glosea5 |
| Reanalyses     | ERA-Interim, MERRA-2, JRA-55                        |
| Verification measures | • Correlation  
                          • RPSS (Ranked Probability Skill Score) |
Methodology

Predictability assessment of near-surface wind speed

Skill evolution with the lead time

Predictability from NAO and ENSO
Methodology

Predictability assessment of near-surface wind speed

- Skill evolution with the lead time
- Predictability from NAO and ENSO
- Sub-seasonal time-scales
  - Comparison of the predictability of 10-m wind speed in different prediction systems.
Sub-seasonal predictability in Europe

Correlation

Target: Week 2nd – 8th February 2015

18 days-ahead

ECMWF

11 days-ahead

NCEP

4 days-ahead

CMA
Sub-seasonal predictability in Europe

Target period: DJF

ECMWF

Forecast time: 19-25

Forecast time: 12-18

Forecast time: 5-11

NCEP

CMA

RPSS

Target: Week 2nd – 8th February 2015
Methodology

Predictability assessment of near-surface wind speed

Skill evolution with the lead time

Predictability from NAO and ENSO

Sub-seasonal time-scales

Comparison of the predictability of 10-m wind speed in different prediction systems.

Seasonal time-scales

Analysis in European region and in specific locations.
Seasonal predictability in Europe

ECMWF System 4

Target: Boreal Winter (December-January-February)

Correlation

3 months-ahead
2 months-ahead
1 months-ahead
0 month-ahead

RPSS

3 months-ahead
2 months-ahead
1 months-ahead
0 month-ahead

-0.9 -0.7 -0.5 -0.3 -0.1 0.1 0.3 0.5 0.7 0.9
Seasonal predictability at specific locations

ECMWF System 4

Target: Boreal Winter (December-January-February)

Fino met Mast park

Alaiz experimental park
**Methodology**

**Predictability assessment of near-surface wind speed**

- **Skill evolution with the lead time**
  - **Sub-seasonal time-scales**
    - Comparison of the predictability of 10-m wind speed in different prediction systems.
  - **Seasonal time-scales**
    - Analysis in European regions and in specific locations.

- **Predictability from NAO and ENSO**
  - **Impact maps**
    - Evaluation of the relationship between modes of variability and wind speed.
Wind speed drivers: ENSO and NAO

ERA-Interim

Target: Boreal Winter (December-January-February)

Impact maps of NINO and NAO over 10-m wind speed

NINO +

NINO -

NAO +

NAO -
# Methodology of the predictability assessment

## Predictability assessment of near-surface wind speed

### Skill evolution with the lead time

**Sub-seasonal time-scales**
- Comparison of the predictability of 10-m wind speed in different prediction systems.

**Seasonal time-scales**
- Analysis in European regions and in specific locations.

### Predictability from NAO and ENSO

**Impact maps**
- Evaluation of the relationship between modes of variability and wind speed.

**Reconstructed wind speed**
- A linear model has been developed to predict 10-m wind speed based on NAO.
NAO seasonal forecasts

1) Construction of linear model based on ERA-Interim (NAO, 10-m wind speed)

2) NAO seasonal prediction (PC-based) from S4 SLP seasonal forecasts

3) NAO seasonal forecast is introduced in the linear model (from step 1) to estimate 10-m wind speed seasonal predictions

4) Validate 10-m wind speed predictions estimated from NAO model with the direct output from S4
Conclusions and prospects

• This study describes the methodology to produce predictability information for the wind industry that can complement the model chain used to develop the New European Wind Atlas.

• Subseasonal prediction systems display statistically significant levels of skill for the three lead times, but the ECMWF Monthly Prediction System displays the best performance.

• Seasonal prediction system shows potential skill in some regions, however the sources of predictability need to be further explored.

• NAO has a marked effect upon wind speed in Europe.

• These results can enhance our confidence in the ability of the systems to predict wind speed.

Next steps

1) Verification against other data bases
2) Application of bias-correction techniques
3) Assessment of different forecast systems
4) Summarize all information in easy interpretable format
Thank you

veronica.torralba@bsc.es