Intraseasonal evolution of the number of wind storms in the multi-model DEMETER data base

Freie Universität Berlin Institut für Meteorologie

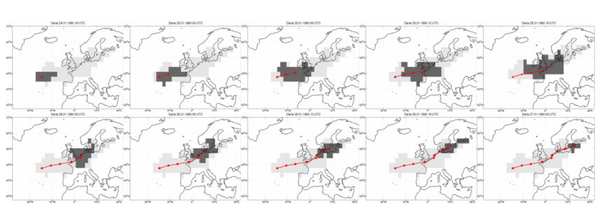
Dominik Renggli, Gregor C. Leckebusch and Uwe Ulbrich
(Mail: dominik.renggli@met.fu-berlin.de)

Outlines

- Recently, limited but significant seasonal dynamical prediction skill was found for the NAO (Müller et al. 2005; Johansson 2007). The close relation between the NAO and **winter storms over the North Atlantic and Europe** motivates studies of a possible predictability of winter storm climate.
- The **assessment of systematic errors** in seasonal climate forecasts is a prerequisite for proper analyses of the predictability of a certain parameter.
- The **intraseasonal cycle** of the relative **number of wind storms per month** (November-April, scaled to ERA40 seasonal mean) in the 9 member ensemble DEMETER models of the ECMWF (SCWF), MetOffice (UKMO) and MeteoFrance (CNRM), run from 1959-2001, are analysed.
- The DEMETER model data are compared with ERA40 reanalysis data for the North Atlantic/European region.
- Wind storms are identified by means of a tracking algorithm based on the 10m wind speed.

1. Wind Storm Identification

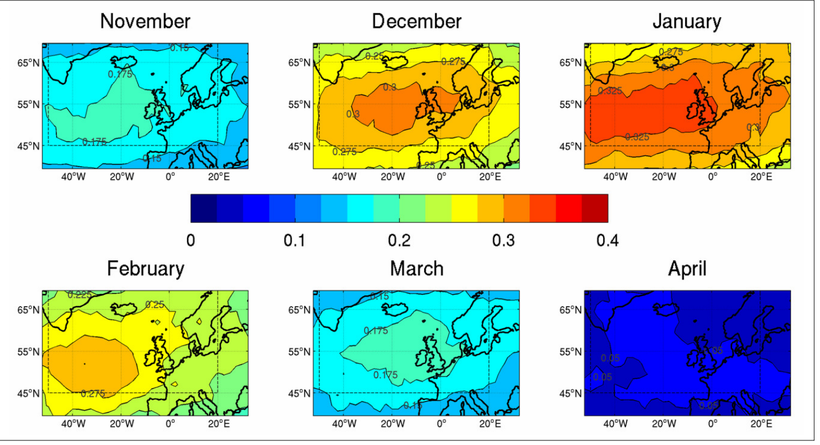
- Wind storms defined as spatial and temporal coherent exceedances of the local wind 98th percentile (Leckebusch et al., submitted)
- For a valid event, 3 criteria have to be satisfied:
  1) exceedance of the local 98th wind percentile at adjacent grid boxes
  2) minimum total area of ~350 x 350 km² at every time step
  3) minimum lifetime of 24 hours
- Contiguous time steps linked via nearest neighbour tracking (maximal distance between neighbours 720 km)
- Calculation of position, extent, wind speed etc. for every time step
- **Data:** 10m wind speed (code 165/166) for ERA40 and 3 DEMETER models (SCWF, UKMO, CNRM) 1959-2001 at 2.5° spatial and 6 hours temporal resolution in the North Atlantic/ European region (-60°W-40°E/32°N-78°N)
- As an example wind storm "Daria" (25.-27.01.1990):



2. Intraseasonal Evolution

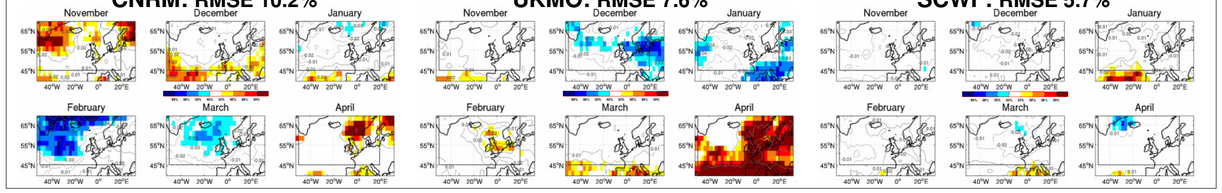
ERA40:

- Number of events per month and grid box increases from November (0.15-0.20) to the highest values in January (0.25-0.35) and nearly vanishes in April
- Highest number of events is found in the eastern North Atlantic throughout the season
- Number of wind storm events measured as events per grid box (counted within a radius of 7.5°)
- Mean monthly number of events in January occurred in the dashed box (-50°-20°E/45-70°N) ~7.4

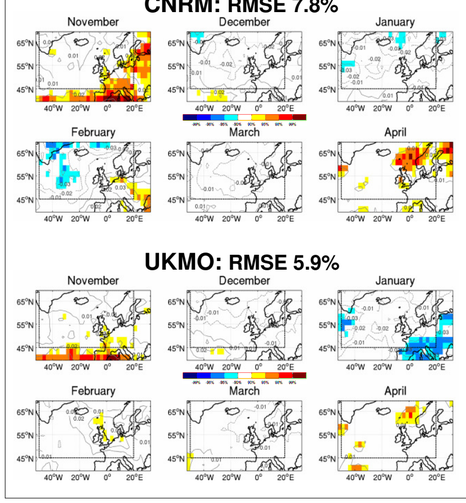


DEMETER Models: (Absolute difference to ERA40 and its significance, RMSE aggregated over dashed box)

- Overall **good agreement** of the seasonal cycle and the position of the centre of maximum activity
- Deviations and significance depending on model and month
- Smallest deviations in SCWF; over-(under-) estimation early (later) in the season in CNRM, contrarious deviations in UKMO

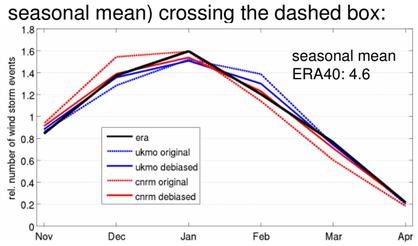


4. Debiased Intraseasonal Evolution



- Deviations and their significance **markedly reduced**
- RMSE in CNRM reduced from 10.2% to 7.8% (-24.1%)
- RMSE in UKMO reduced from 7.6% to 5.9% (-22.9%)
- RMSE in SCWF (not shown) reduced from 5.7% to 5.0% (-12.7%)
- In CNRM some region (e.g. continental Europe) with deterioration

- Number of wind storm events (scaled with seasonal mean) crossing the dashed box:

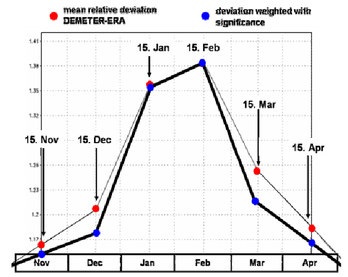


Confidence levels of original deviations						
Model	Nov	Dec	Jan	Feb	Mar	Apr
UKMO	16%	69%	42%	***91%***	14%	31%
CNRM	74%	***94%***	2%	45%	***86%***	68%

- UKMO: RMSE reduced from 9.0% to 5.7%
- CNRM: RMSE reduced from 10.7% to 4.4%
- Remaining deviations not significant (**<80%**)

3. Bias Correction Scheme

- Based on difference of wind speed climatology in DEMETER models and ERA40
- Correction scheme consists of following steps:
  1. Deviation of relative monthly percentiles (scaled with mean of all monthly percentiles) in 10 wind speed classes (<10th percentile, 10th-20th percentile, ... , >90th percentile) at every grid box (●)
  2. Weighting of deviations with its significance (T-Test) → correction factors (●)
  3. Linear temporal interpolation of correction factors for every time step and wind speed class (——●——)
  4. Interpolated weighted correction factors of the respective wind speed class applied for every time step and grid box



- Applied on the original DEMETER models wind speed data
- Debiased wind storm events identified by the tracking algorithm based on the debiased wind speed data

Summary

- The **intraseasonal cycle** of the number of **wind storm events** is **accurately reproduced** in the three considered DEMETER model ensembles, indicating that the data can be used for predictability studies of winter wind storm climate.
- The deviations measured as RMSE (aggregated over the North Atlantic/European region: -50°-20°E/45°-70°N) range between 5.7% to 10.2%.
- However, **significant deviations exist**, depending on model, month and region. In general, differences to ERA40 are smallest for the ECMWF model and largest for the MeteoFrance model.
- The application of a **bias correction scheme** taking into account the models and ERA40 monthly wind speed climatology **markedly reduces the deviations** and their significance.
- How far the seasonal predictability is affected by the bias correction scheme is subject of ongoing work.

Refrences:

Johansson, A. (2007): **Prediction Skill of the NAO and PNA from Daily to Seasonal Time Scales**. *J. Climate*, 20, 1957-1975.

Leckebusch, G. C. et al. (2008): **Development and Application of an Objective Storm Severity Measure for the Northeast Atlantic Region**. Submitted to *Meteorologische Zeitschrift*.

Müller, W. A. et al. (2005): **Probabilistic seasonal prediction of the winter North Atlantic Oscillation and its impact on near surface temperature**, *Clim. Dyn.*, 24, 213-226.