Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

Towards an extreme wind climatology for The Netherlands based on downscaling ERA-Interim with the HARMONIE-AROME high-resolution model

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- **We develop a new extreme wind climatology for the assessment of Water Defences.**
- **Joint project of KNMI and Deltares for the Netherlands National Water Authority RWS.**
- **Based on high-resolution model simulations validated by wind measurements.**
- **Harmonie-Arome model driven by the ERA-Interim re-analysis over 1979-present.**
- **First results for 14 cases indicate that the model simulates extreme storms quite well.**

1. Introduction

- Millions of people in the Netherlands live and work in areas protected from flooding by dikes.
- Extreme wind climatology is essential for setting the requirements on water defences.

2. Limitations old method

- Traditionally, extreme wind climate based on station observations.
- However, difficulties when extrapolating, especially from land to water.
- Also, limited information on pattern in space and time.

3. New: model simulations

- We start from ERA-Interim re-analysis from ECMWF. The resolution of ERA-Interim, ≈ 80km, is too coarse for our purposes.
- We use the Harmonie-AROME model for dynamical downscaling of ERA-Interim. Harmonie is a numerical weather forecast model that has a resolution of 2.5km.

3.1 Harmonie set-up

- A model domain of 489x489 gridpoints, (green area B in Figure A), was found to be adequate.
- Every 6h, a new Harmonie run starts from an ERA-Interim analysis. We use the Harmonie fields from +1h forecast time onward.
- For the drag coefficient over water, we use the ECUME formulation.

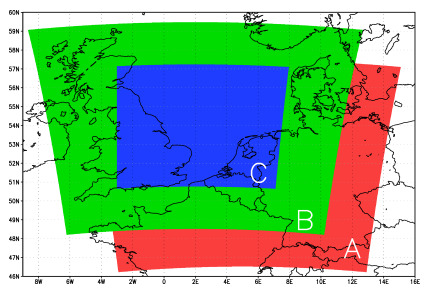

Figure A. *The green model domain B was found adequate for simulating extreme storms. Domain C is too small and domain A does not cover a sufficient part of the North Sea.*

3.2 Selected storms

- We have selected 14 major storms in the period 1980-2011 with varying characteristics as test cases.

4. Results

4.1 Small-scale features

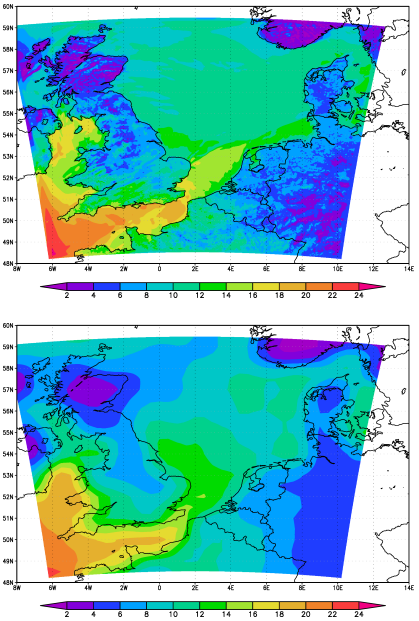

Figure B. *Harmonie simulation (top) of the wind field at 25 January 1990 06h compared to ERA-Interim (bottom).*

- Harmonie simulates many more small-scale features (mostly coastal or land) than ERA-Interim (Figure B).
- The Harmonie results are closer to observations than the ERA-Interim results (not shown).

4.2 Model vs. observation

- For brevity, we focus here on intercomparisons of modeled maximum wind speed with observations.
- Collocation at a nearby ('optimal') gridpoint often works better than at the nearest gridpoint, due to roughness effects (Figure C).

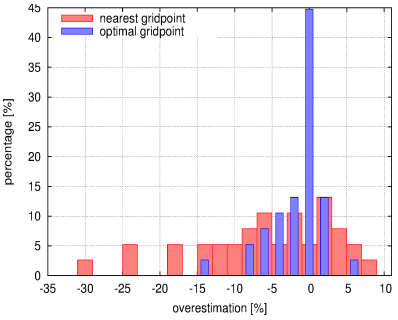

Figure C. *Histograms of overestimation of modeled storm maxima for the nearest gridpoint (red) and the optimal gridpoint (blue). The optimal gridpoint is within 7.5 km of the measurement location.*

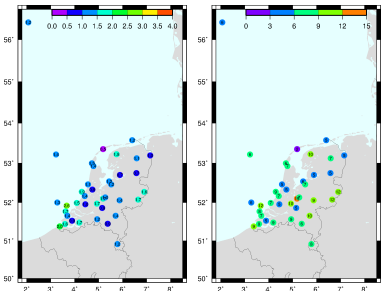

Figure D. *Root-mean-square error (m/s) of modeled maximum wind speeds (left) and scatterindex (right).*

- Typically, modeled maximum wind speeds are within 12% of observed values (Figure D and Figure E).

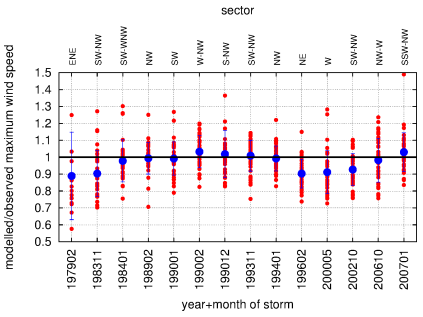

Figure E. *Ratio of modeled and observed wind speed maxima for each storm and each location (red); for each storm averaged over the locations (blue).*

5. Outlook

- We will simulate all major storms in the period 1979-2012.
- This will be the basis for an extreme value analysis for return levels of 10^3 – 10^4 yr and corresponding temporally and spatially varying extreme wind fields.
- See Caires et al., NH5.7, EGU2013-1361.

6. Conclusion

A high-resolution numerical weather prediction model, such as Harmonie-Arome, is a suitable tool for estimating the wind fields of extreme storms over the Netherlands.

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