Towards an extreme wind climatology for Dutch Water Defenses

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According to the Dutch Water Act (“Waterwet, 2009”) the strength of the Dutch primary water defences must be checked every 6 years for the required level of protection from loads with return periods varying from 1,250 to 10,000 years.

The assessment is carried as follows
1. Determine Hydraulic Boundary Conditions
2. Apply safety assessment regulation to dike systems

One of the primary inputs:
high-quality extreme wind climate

nb: sustained winds rather than gusts!
Traditional approach

• Based on series of wind observations

• Interpolate ‘potential wind’ between measurement sites
  - local roughness is used to convert wind into ‘potential wind’ over standard roughness

• Length time series is typically 20-40 yr
• Gives 100-yr return periods in the order of 30m/s (coast) to 25m/s (inland)

• NB: For storm surges, measurements series of more than a century exist.
Drawbacks

- Hard to interpolate from land stations to water surfaces
  - Neglecting stability and differences in ABL over land and sea is not justified.
  - ‘Potential wind’ is a tricky concept
  - Actually, paradoxical results were found when comparing coastal and land station extreme statistics

- Method does not give information on time and space characteristics of storms
  - Gets more important as compound failure mechanisms are being considered instead of instantaneous load thresholds
New approach: High-resolution reanalysis

- Harmonie_Arome model (2.5km grid) driven by ECMWF ERA-Interim
- Re-analysis of all storms in 1979 – present (i.e. several years of simulation covering 30 yrs of storms)
- Extreme wind climate will be based on this re-analysis, and include time and space dependencies
- Model will be validated and calibrated with observations

Re-analysis of 25 January 1990, 18 UTC

NB: left and right same color scale!
First results:

- 6 major storms have been simulated
- settings (domain size, cycling of runs, model settings etc.) still being optimized
Harmonie: model roughness and 10m wind (1990012518)
First results

- Harmonie captures temporal and spatial storm structures quite well.

- Depending on applied roughness length, wind speed in neighboring grid-cells can be significantly different.

- Stability changes have a clear effect on the wind speed.

- Relation with observations has to be established.
Use of scatterometry

- For verifying spatial structure, scatterometry measurements will be used.
- In *MyWave*, assimilation of scatterometry into Harmonie will be studied and used (talk Sofia Caires and Martin Verlaan).
Conclusions

• High-resolution models are a powerful tool for realistic re-analyses of extreme storms

• Scatterometer measurements quite valuable in assessing how well models represent small-scale structures

• Planned for MyWave: assimilation of ASCAT into Harmonie

Thank you for your attention!