Ministerie van Infrastructuur en Milieu

Towards an extreme wind climatology for Dutch Water Defenses

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Framework motivation extreme wind climate project

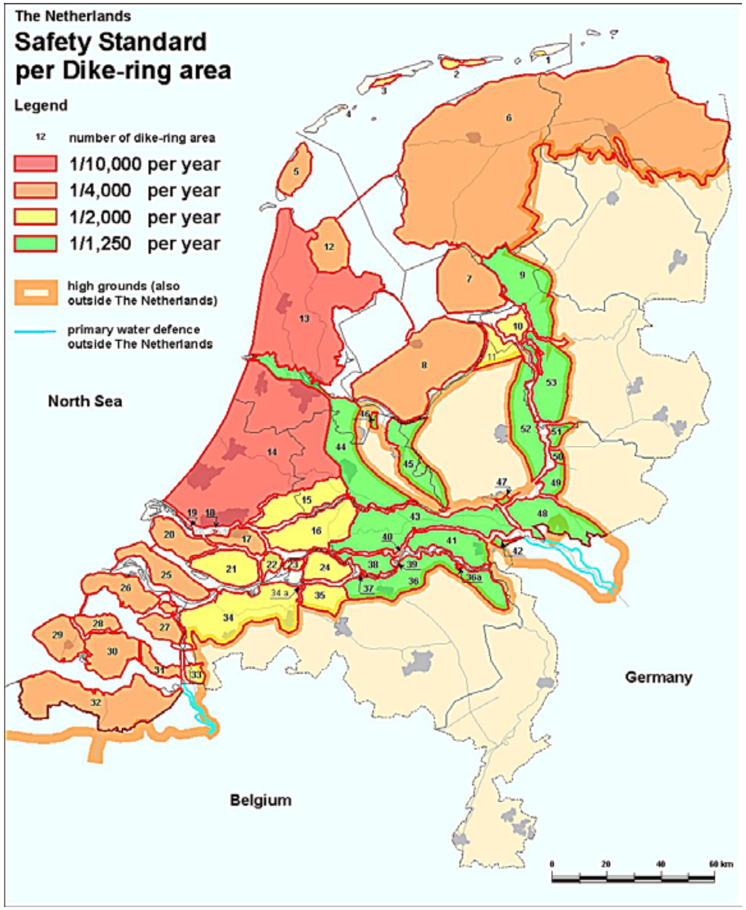
- According to the Dutch Water Act (“Waterwet, 2009”) the strength of the Dutch primary water defences must be checked every 6 years for the required level of protection from loads with return periods varying from 1,250 to 10,000 years.

- 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

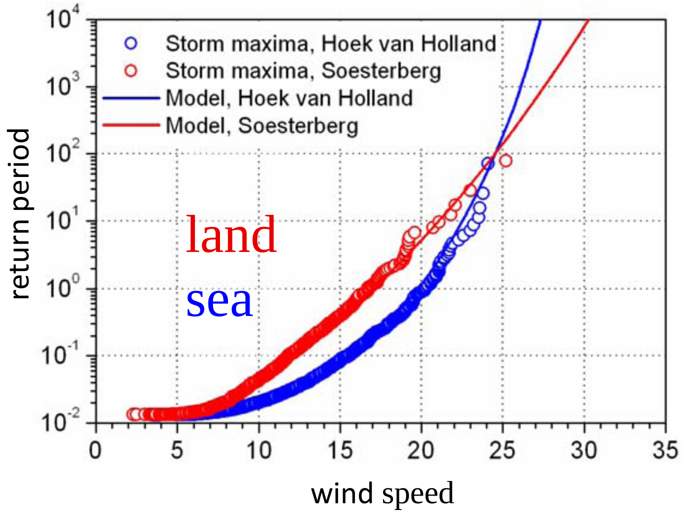
- Interpolate 'potential wind' between measurement sites
  - local roughness is used to convert wind into 'potential wind' over standard roughness

- 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

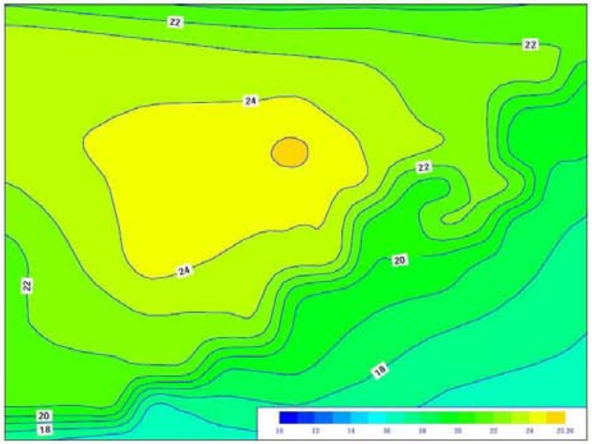
- Hard to interpolate from land stations to water surfaces
  - Neglecting stability and differences in ABL over land and sea is not justified.
  - 'Potential wind' is a tricky concept
  - Actually, paradoxical results were found when comparing coastal and land station extreme statistics



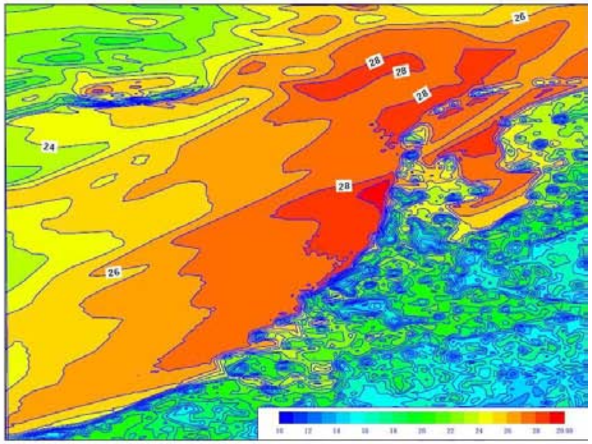
- Method does not give information on time and space characteristics of storms
  - Gets more important as compound failure mechanisms are being considered instead of instanteneous load thresholds

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



ERA-Interim



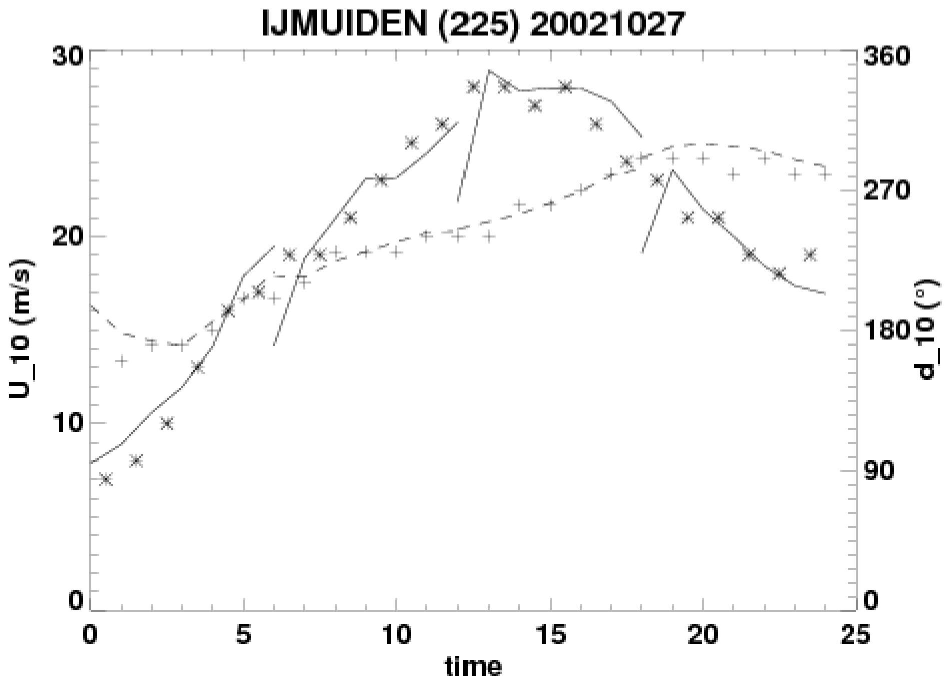
Harmonie_Arome

NB: left and right same color scale!

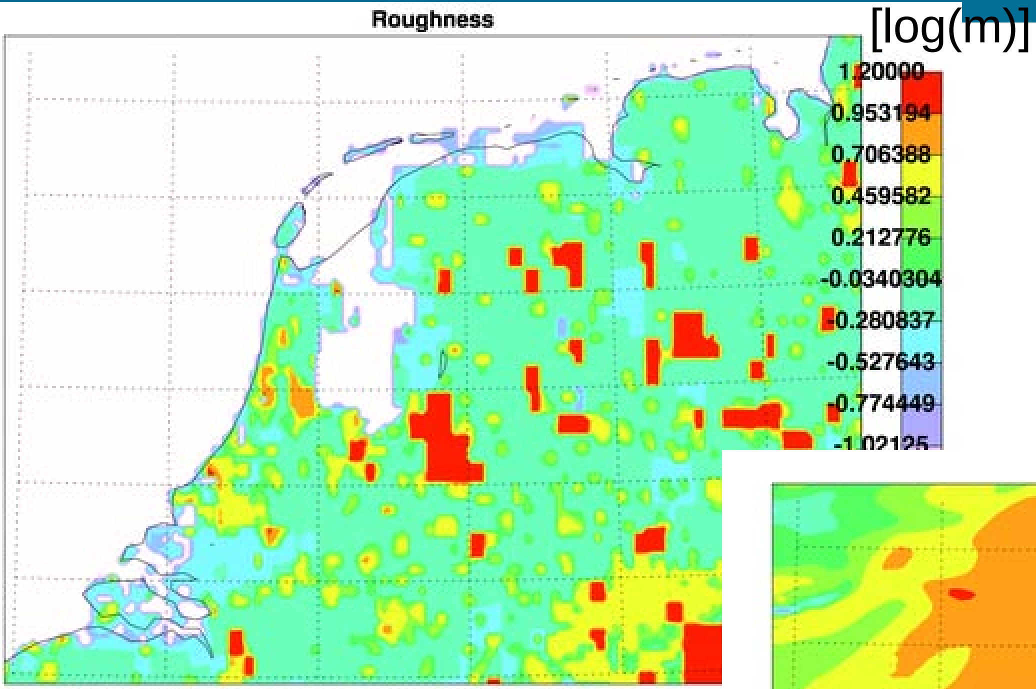
Re-analysis of 25 January 1990, 18 UTC

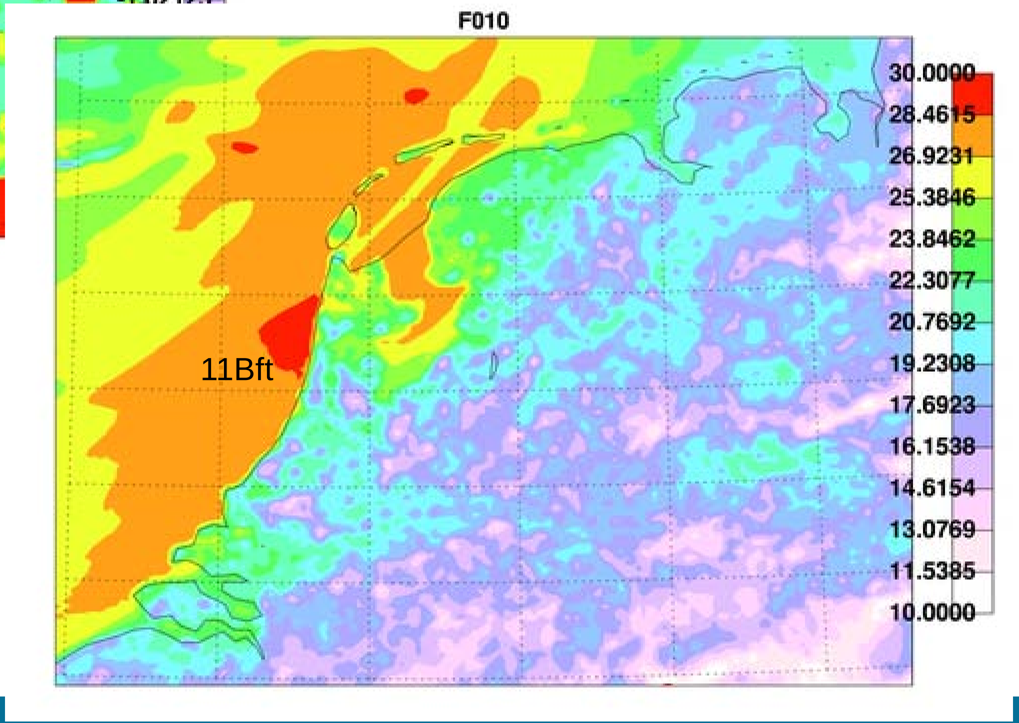
First results:

- 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)



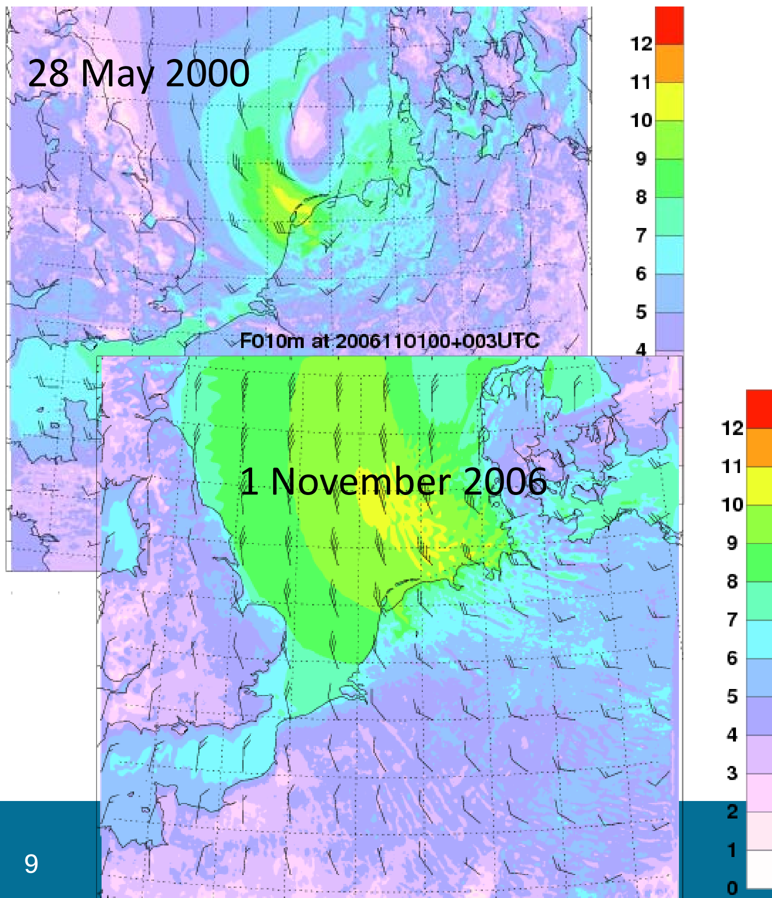


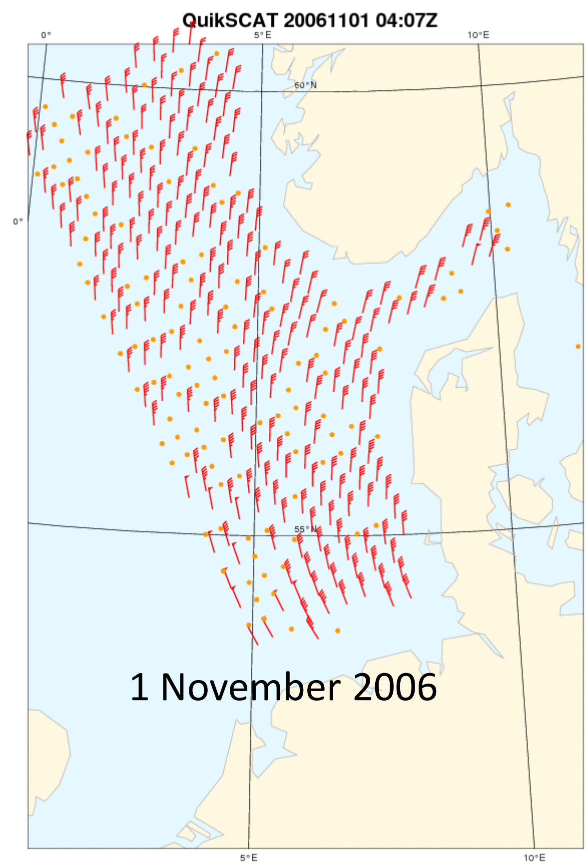
First results

- 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 assesssing how well models represent small-scale structures

- Planned for *MyWave*: assimilation of ASCAT into Harmonie

Thank you for your attention!