Deltares
Enabling Delta Life

CoSMoS
an operational model system to simulate storm impacts along the Dutch Coast

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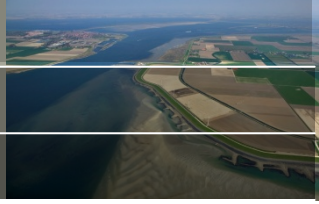
Deltares, The Netherlands

Acknowledgments



FloodControl 2015 - innovation programme funded by Dutch government aimed at improving operational flood protection around the world

MICORE – EU research project on morphological impacts and coastal risks during extreme storm events

USGS Coastal Marine Geology group in Santa Cruz (Patrick Barnard)

Motivation

Hinterland well protected by dikes and sandy dunes (1:10,000 year storm)

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Motivation

What about people and property on and seaward of dunes?

They risk flooding under more common than normative storm conditions.

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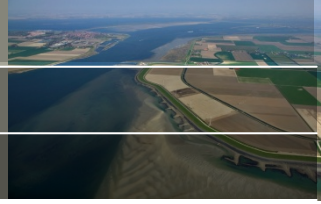
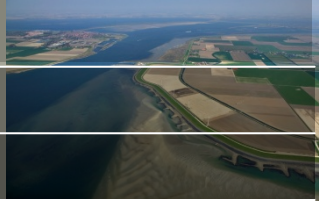
Summary



- Development of an operational wave and tide model system
  - Storm conditions (run-up and erosion)
  - Rip currents
  - Provide boundary conditions for BeachWizard data assimilation system
- Nested model approach
- WAVEWATCH III, coupled Delft3D-FLOW - SWAN and Xbeach
- Results presented on web interface with Google Earth plug-in
- Validation of system for 2009 and a number of large storm
- Up-to-date bathymetry from Argus camera system in combination with Beach Wizard at selected sites (not yet operational)

Conclusions



- Model does reasonably well with tides, waves and dune erosion
- More validation needed
  - Beach/dune erosion
  - Rip currents
  - BeachWizard

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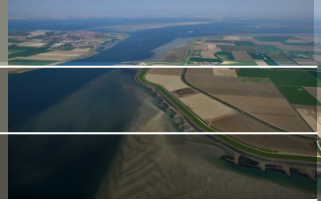
CoSMoS



- Easily relocatable and easy to add new models
  - Dutch coast
  - California
  - Hawaiian Islands
  - Gulf of Mexico
- Easy to run in forecast mode or to study historic and future scenarios
- Automated nesting between different models
- Matlab
- System runs on Windows machine
- Simulations submitted to Linux cluster or Windows machine
- 48 hour forecasts (cycle every 12 hours)
- Deterministic approach

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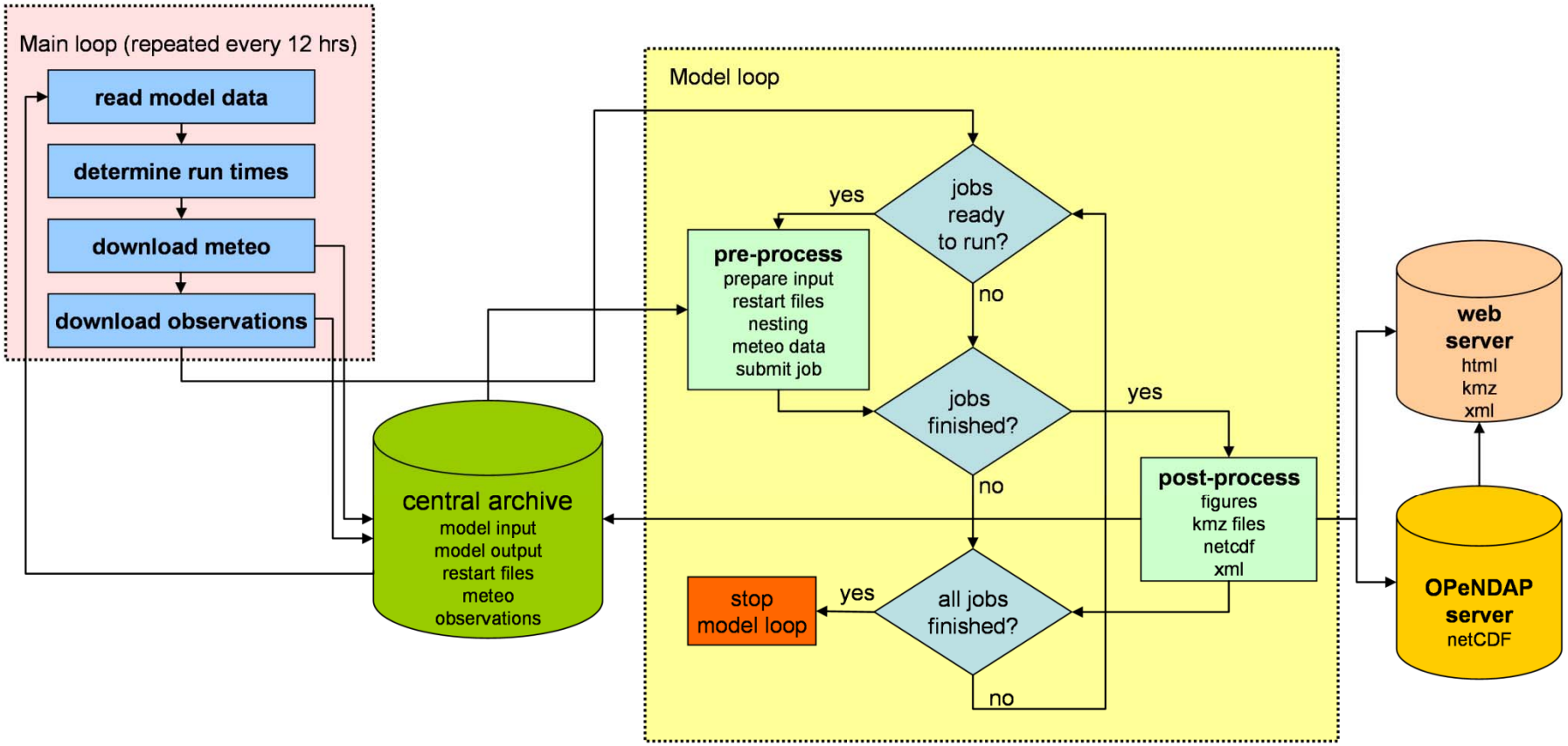
Work flow



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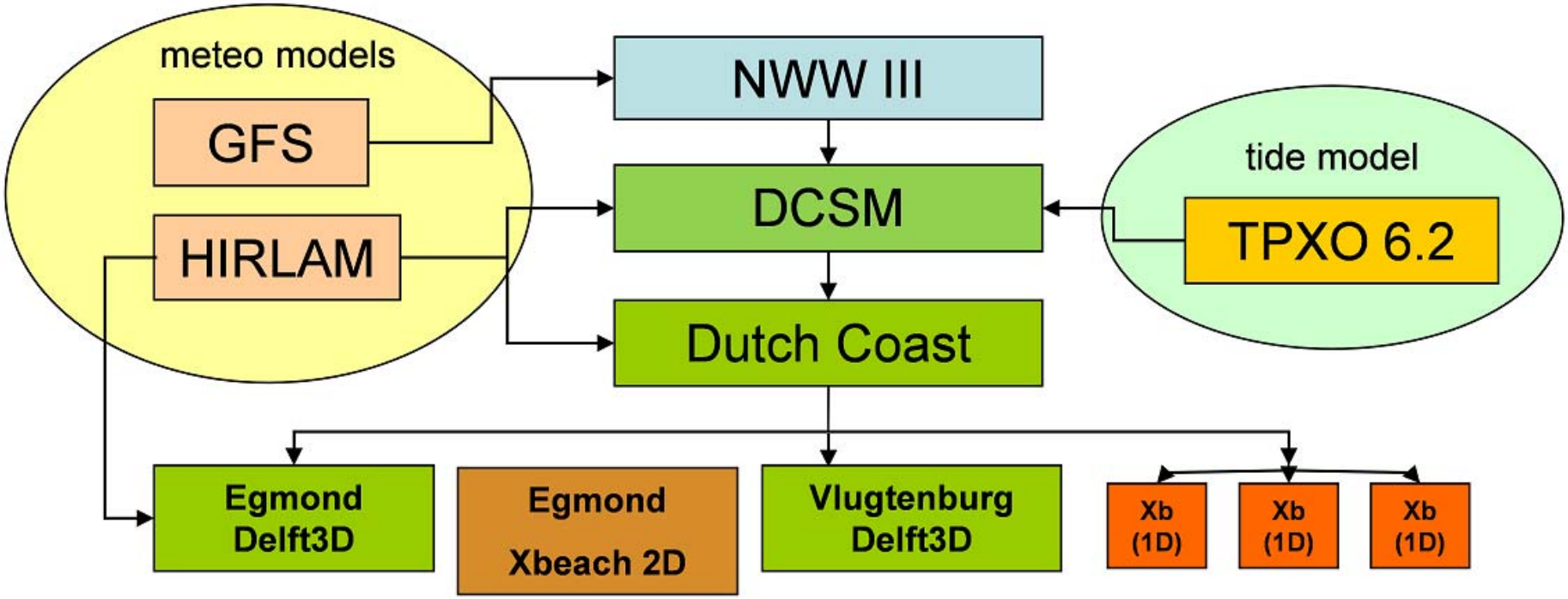
Models - CoSMoS Dutch Coast



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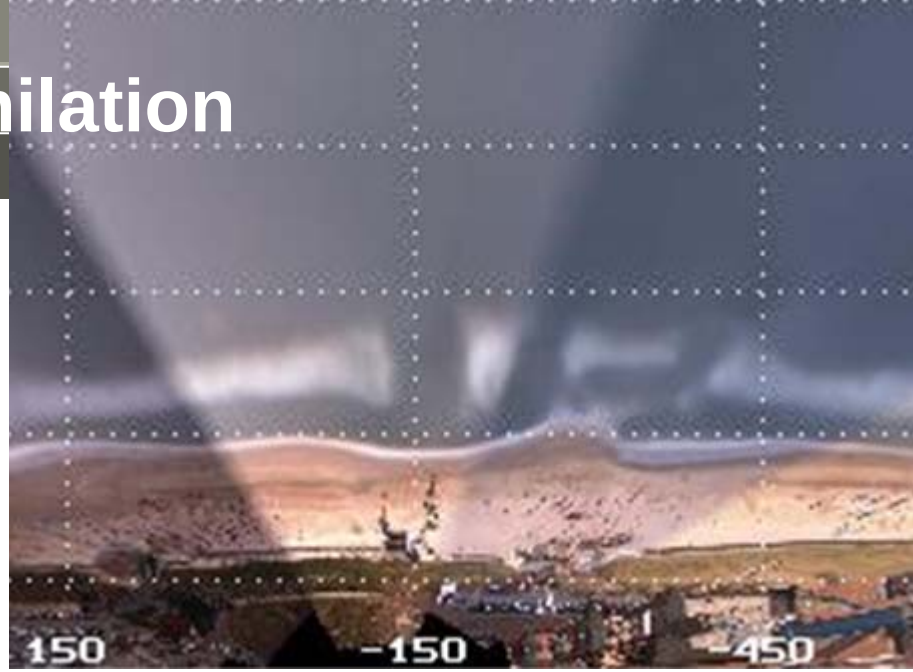
BeachWizard data assimilation

- We need up-to-date bathymetry
  - Beach-dune erosion and run-up
  - Timing, location of rip currents



Egmond aan zee, 26 August 2009

- Compares observed wave dissipation patterns from ARGUS video imagery with computed patterns
- Adjusts model bathymetry where differences are seen
- Uses relation between breaking intensity and local depth

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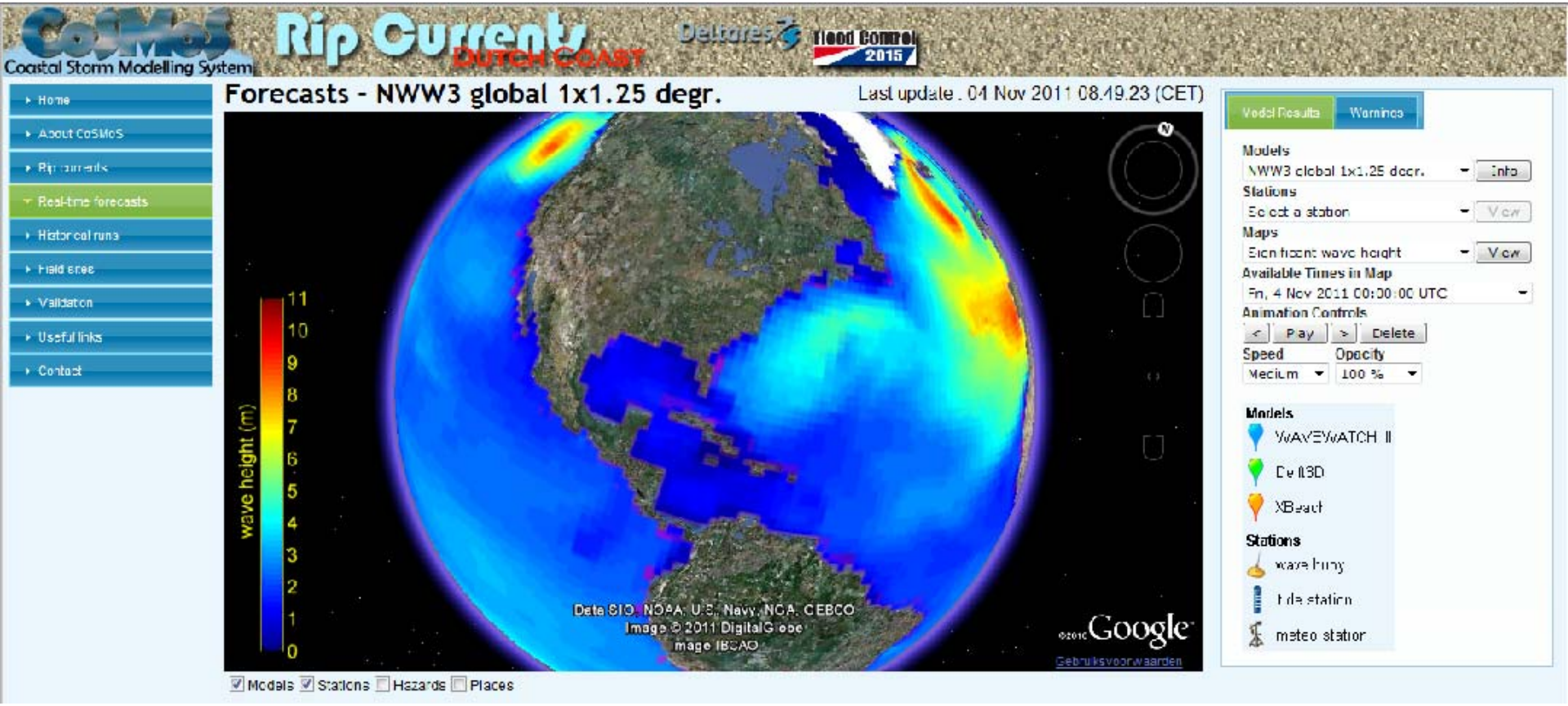
WAVEWATCH III



http://cosmos.deltares.nl

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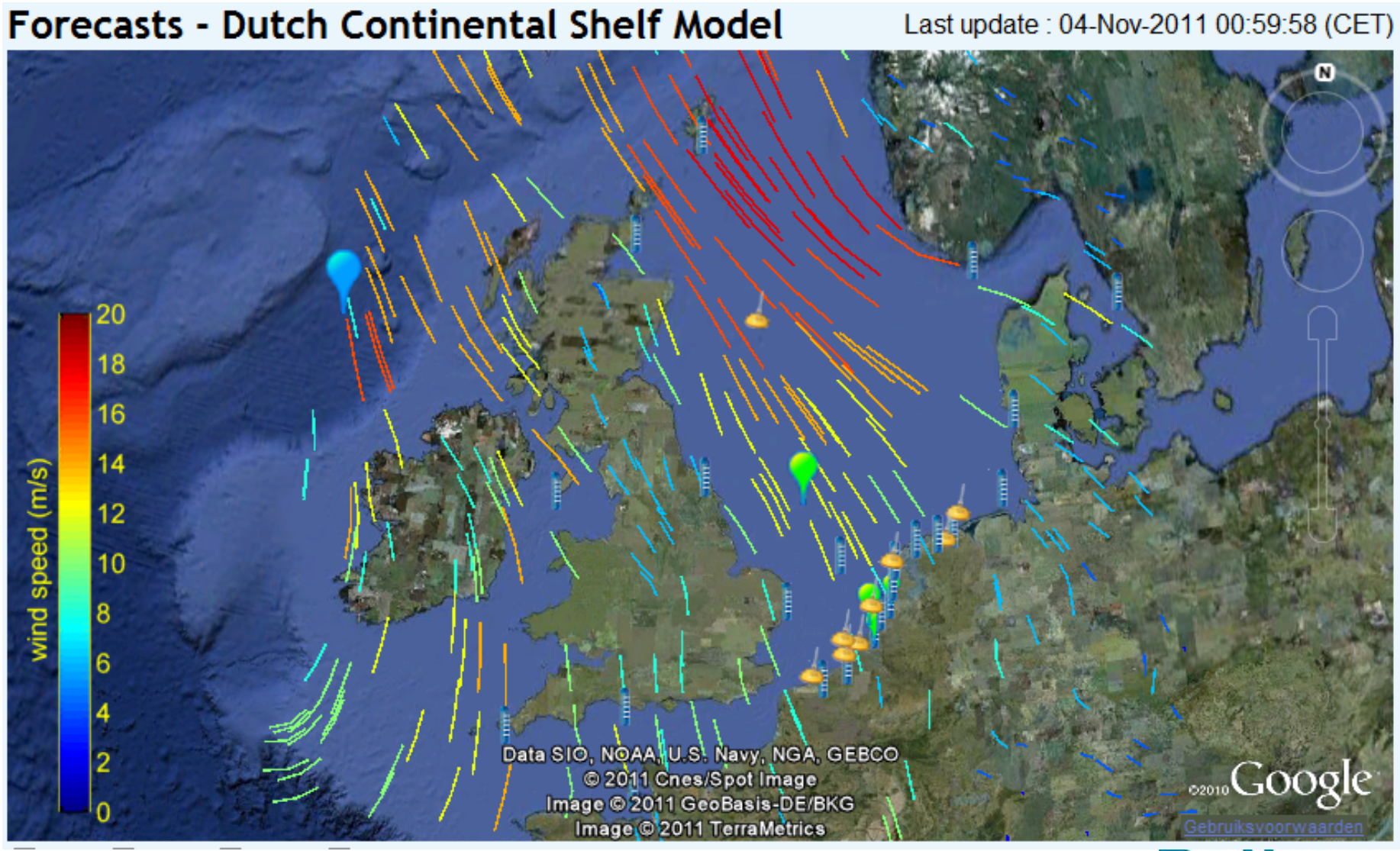
Continental Shelf Model (DCSM)



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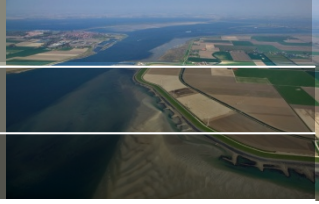
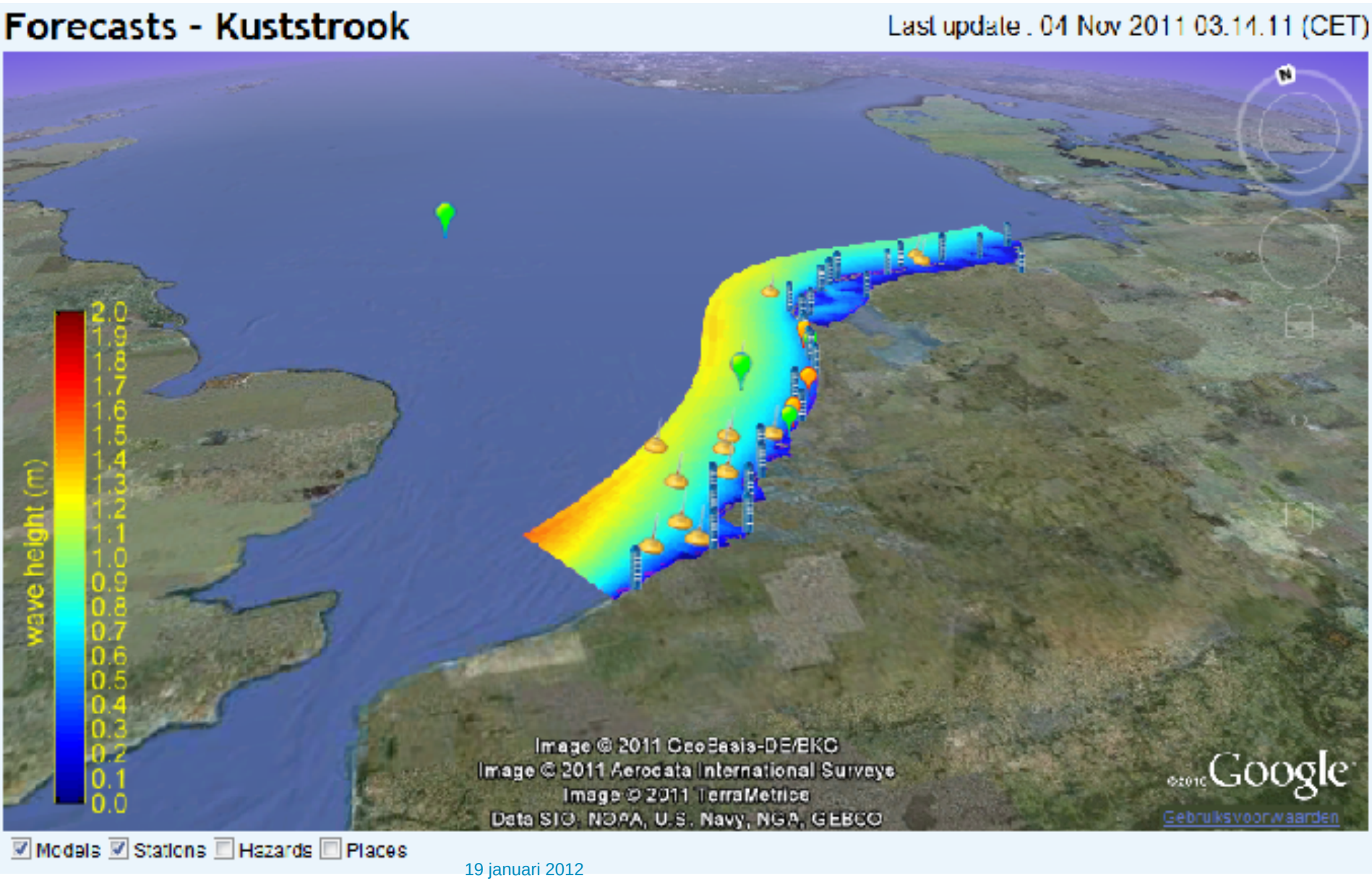
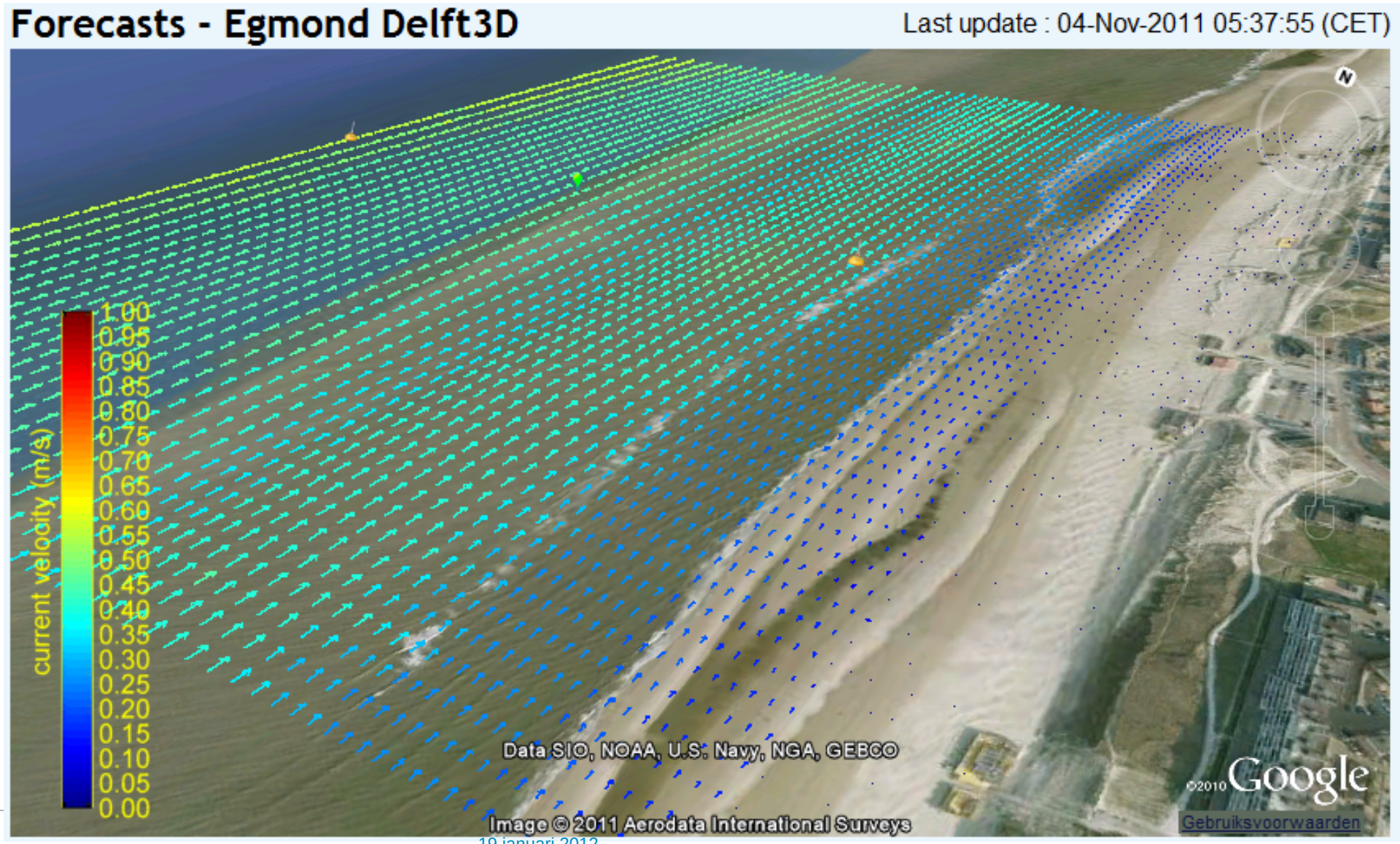
Dutch Coast Model

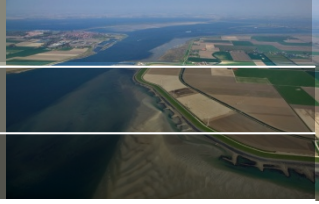




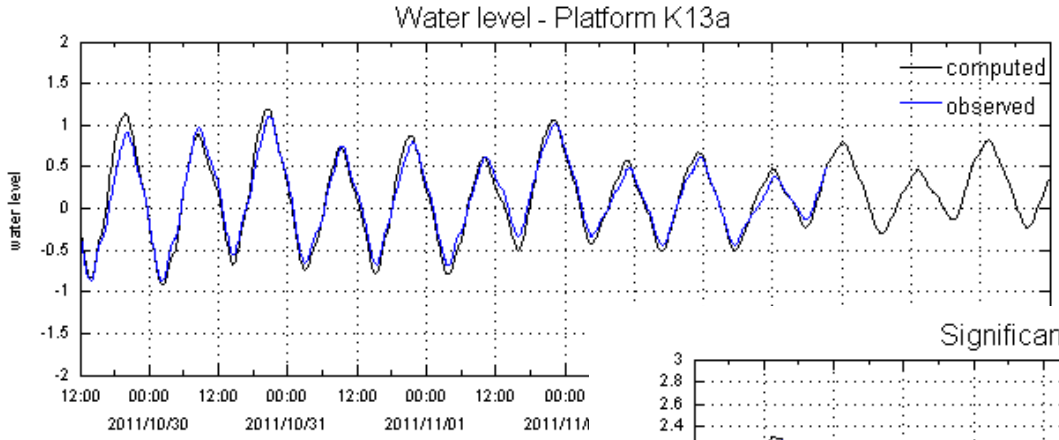
Egmond (Delft3D)

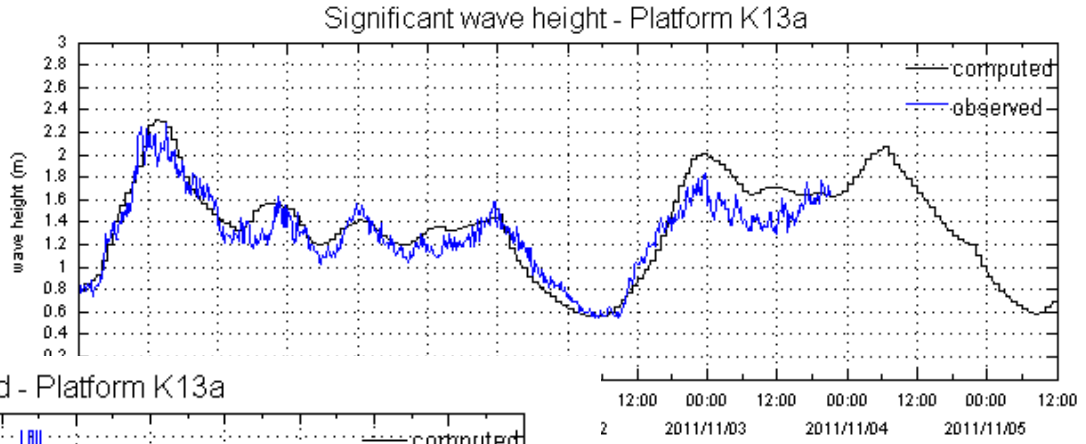


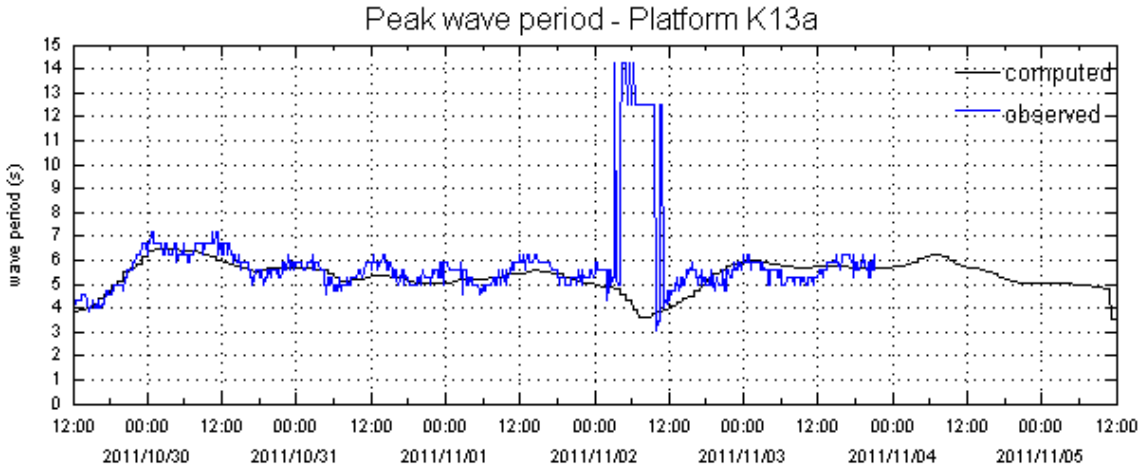
Xbeach profile models



Recent result Platform K13







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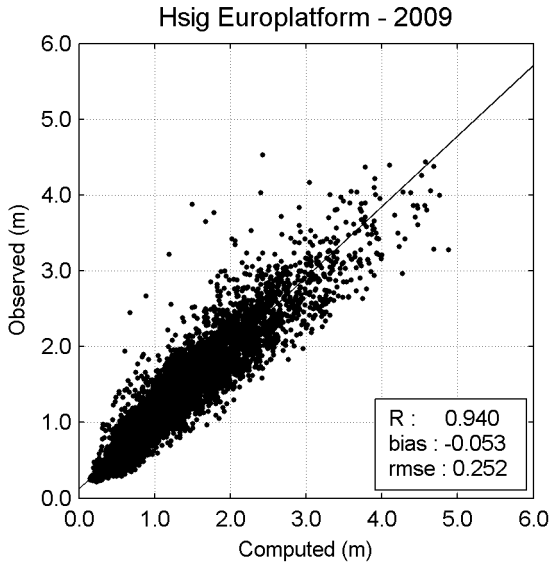
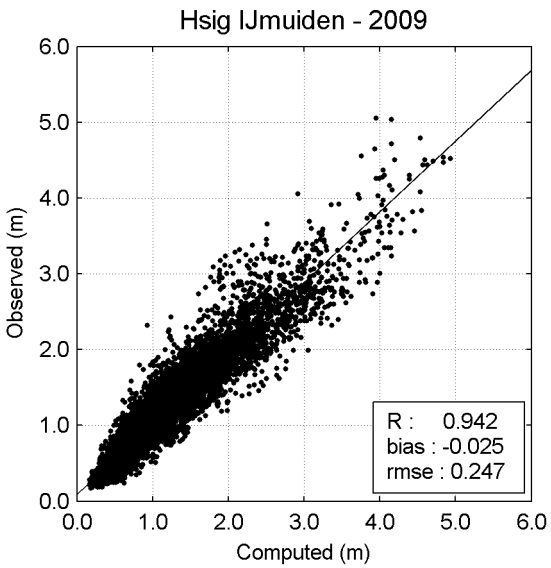
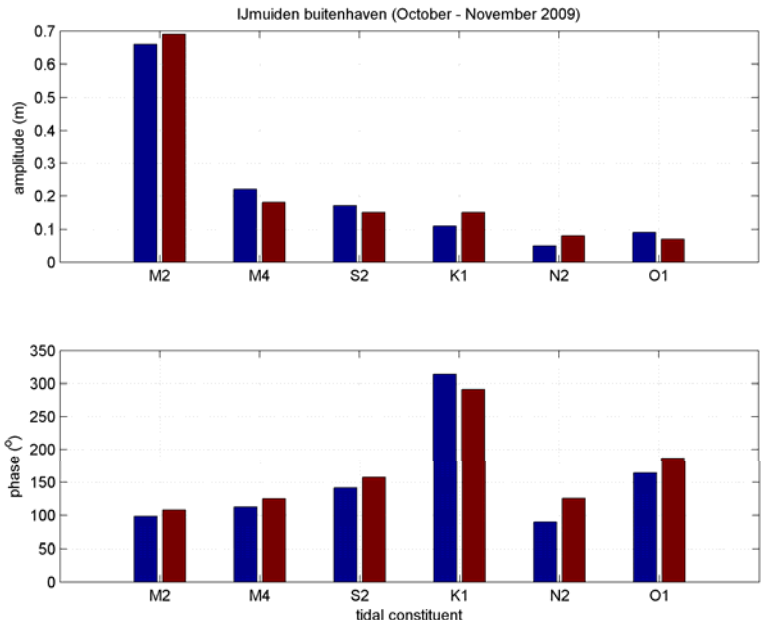
Hydrodynamic validation – 2009 hindcast

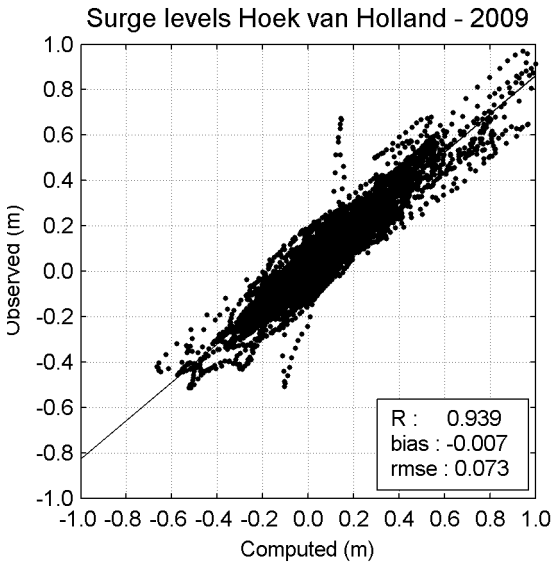




Wave heights at Europlatform and IJmuiden

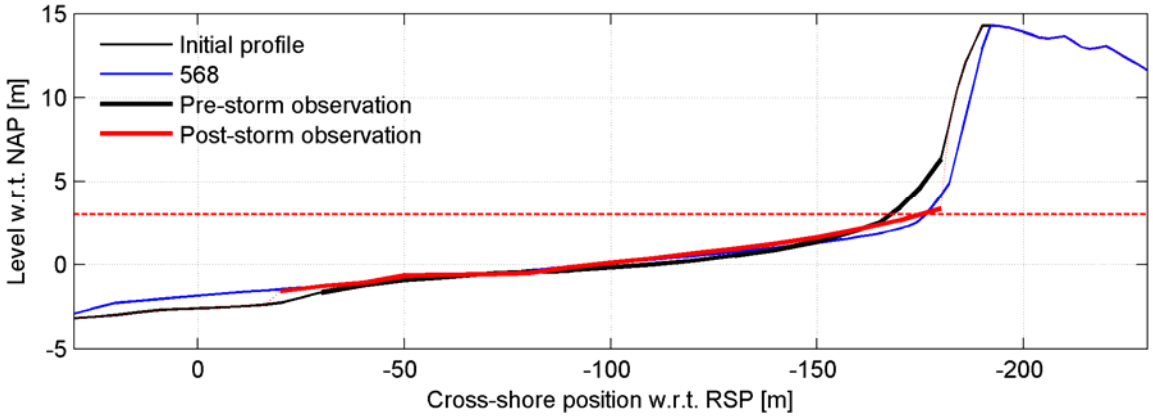
Water levels at Hook of Holland





Morphodynamic validation

Julianadorp (no. 568)

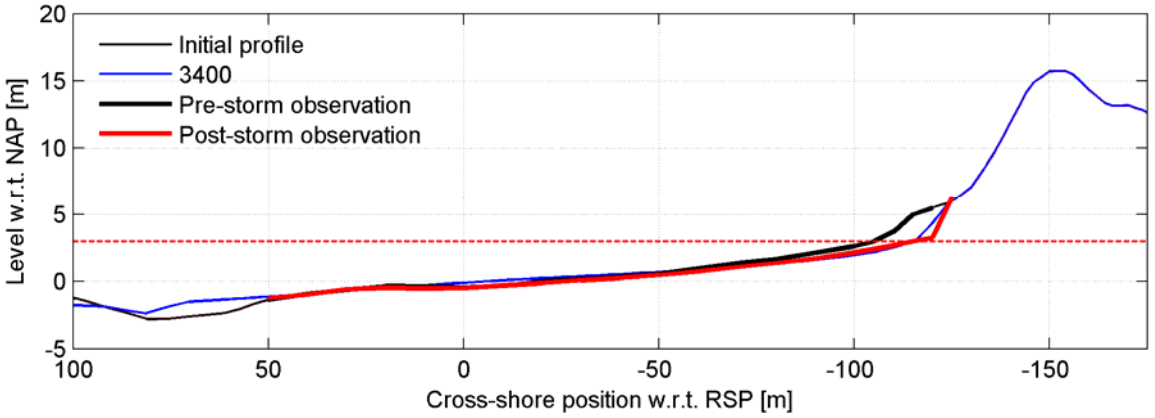


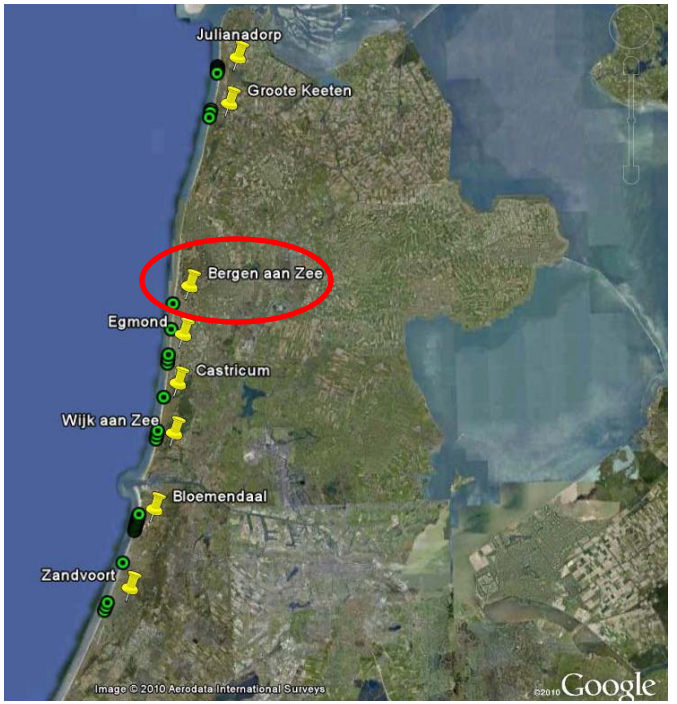
January 3rd 1976
Largest storm since the 1953 storm disaster

Previously presented by Van der Werff at Coastal Sediments 2011

Morphodynamic validation

Bergen aan Zee (no. 3400)





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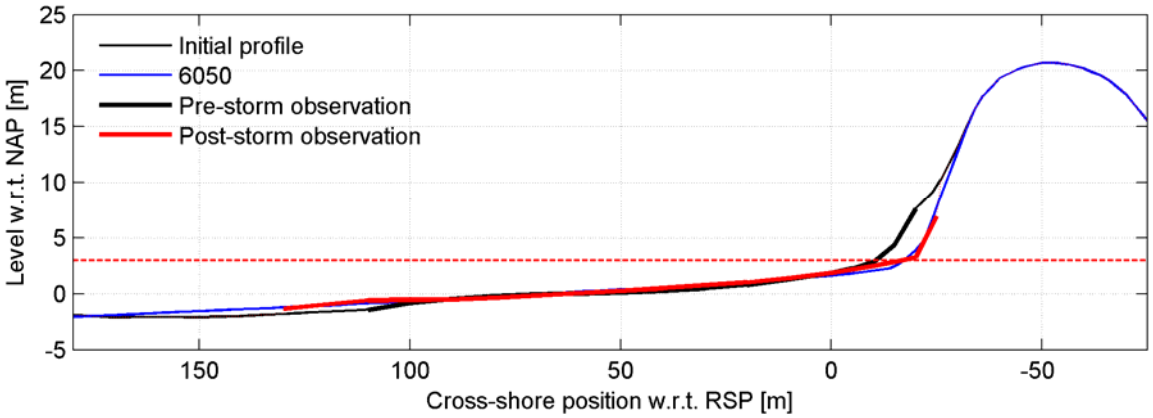
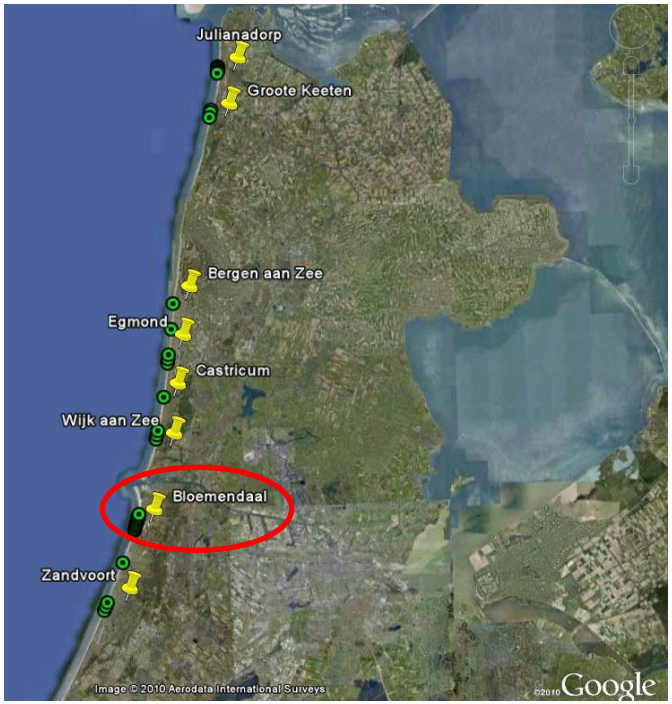
Morphodynamic validation

Bloemendaal (no. 6050)





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The 1953 storm

Killed 1800 people
100,000 people homeless

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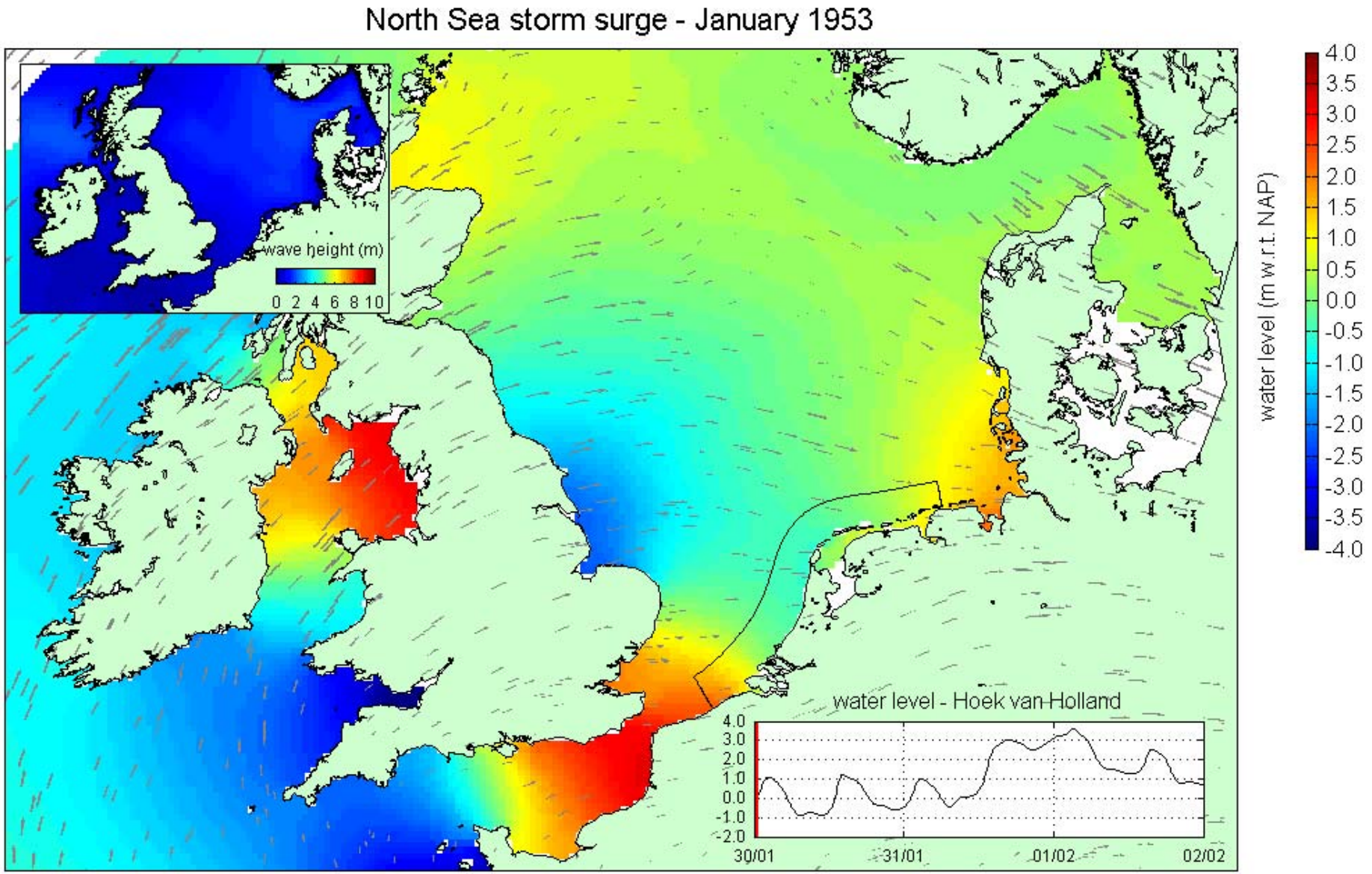
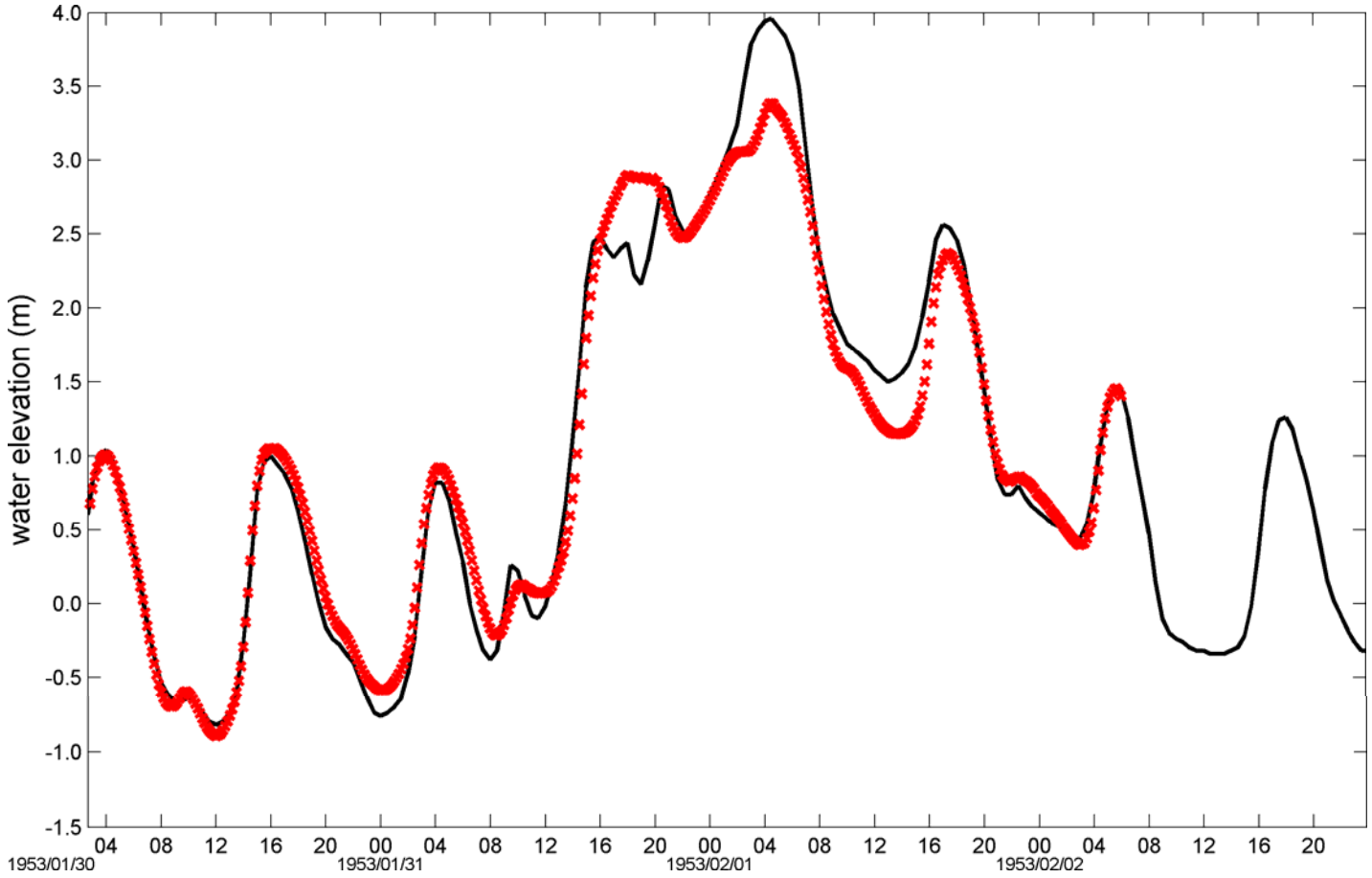
The 1953 storm



Water levels Hook of Holland 1953



RED COMPUTED

BLACK OBSERVED

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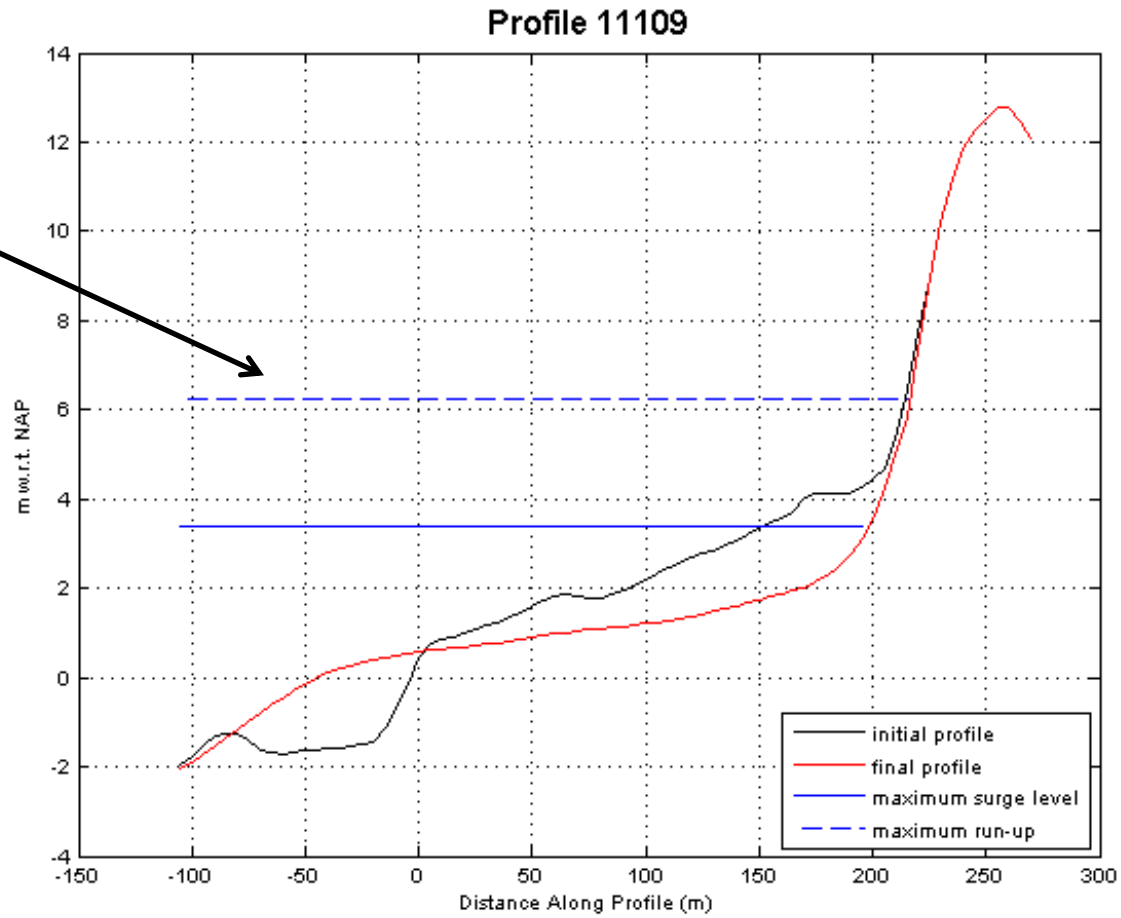
Erosion Delfland 1953

Infragravity run-up, not short wave



Observed dune erosion ~90 m^3/m along Delfland coast
Computed dune erosion ~60 m^3/m

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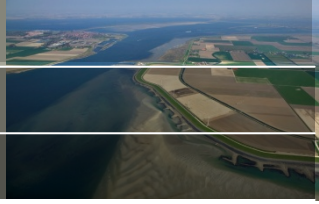
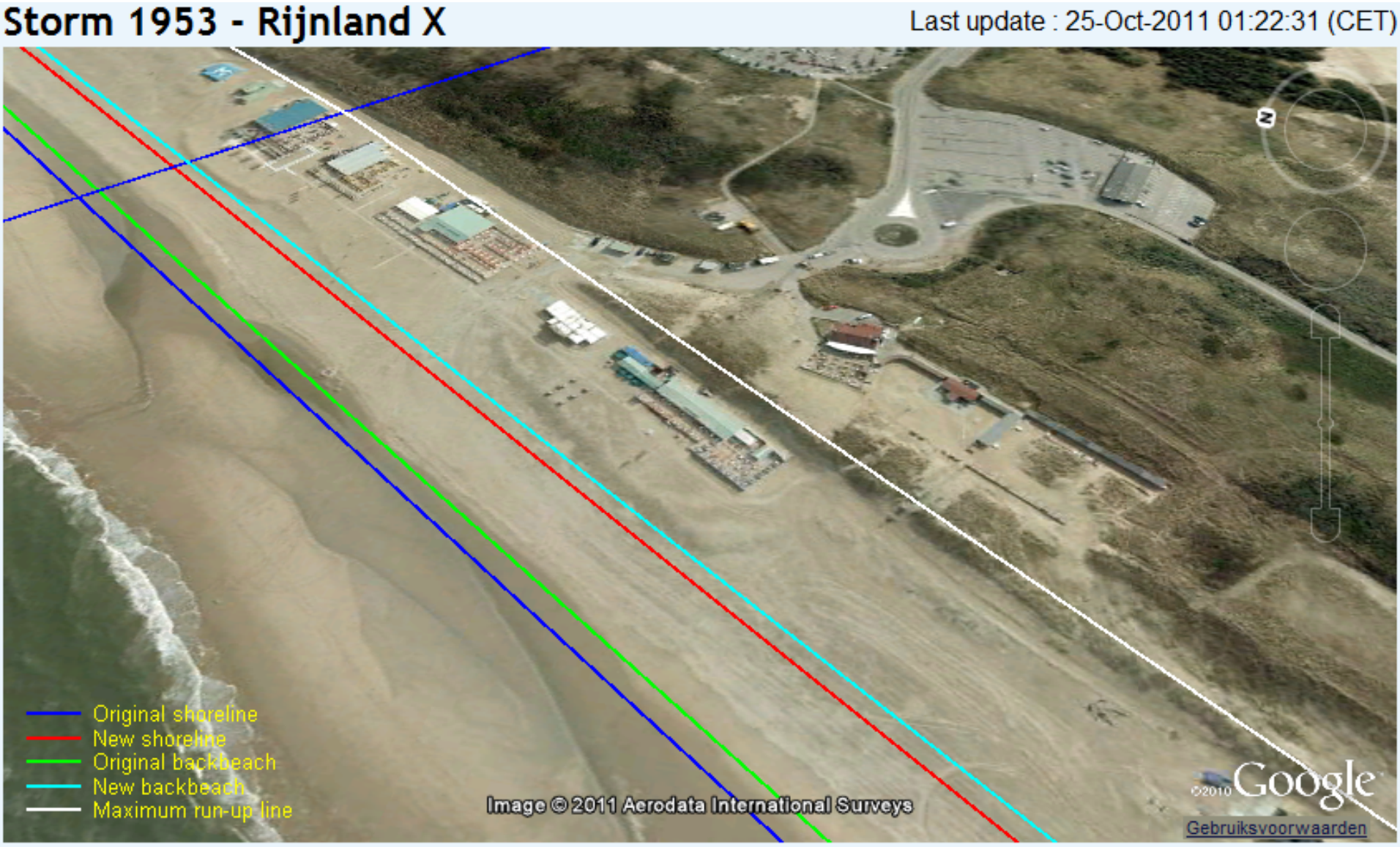
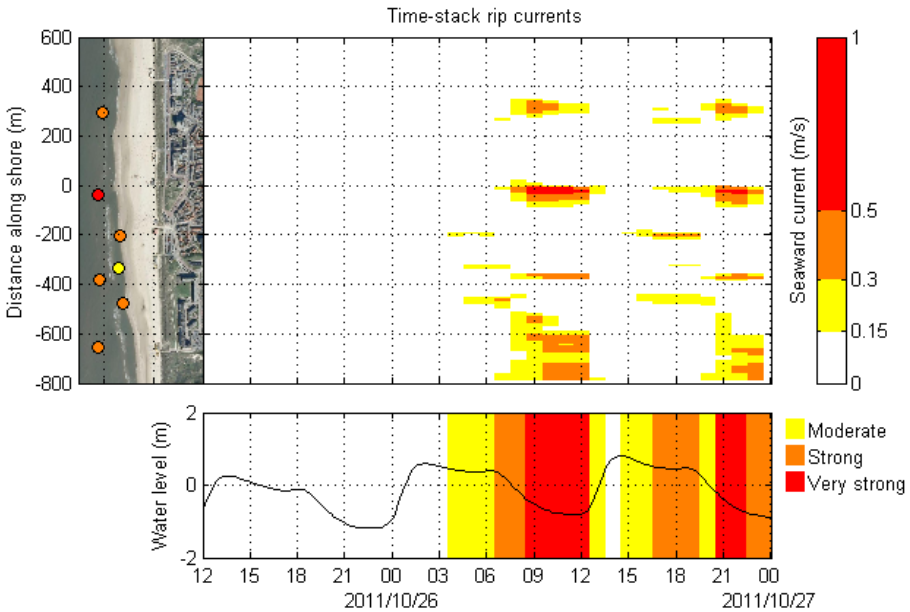
Run-up and erosion

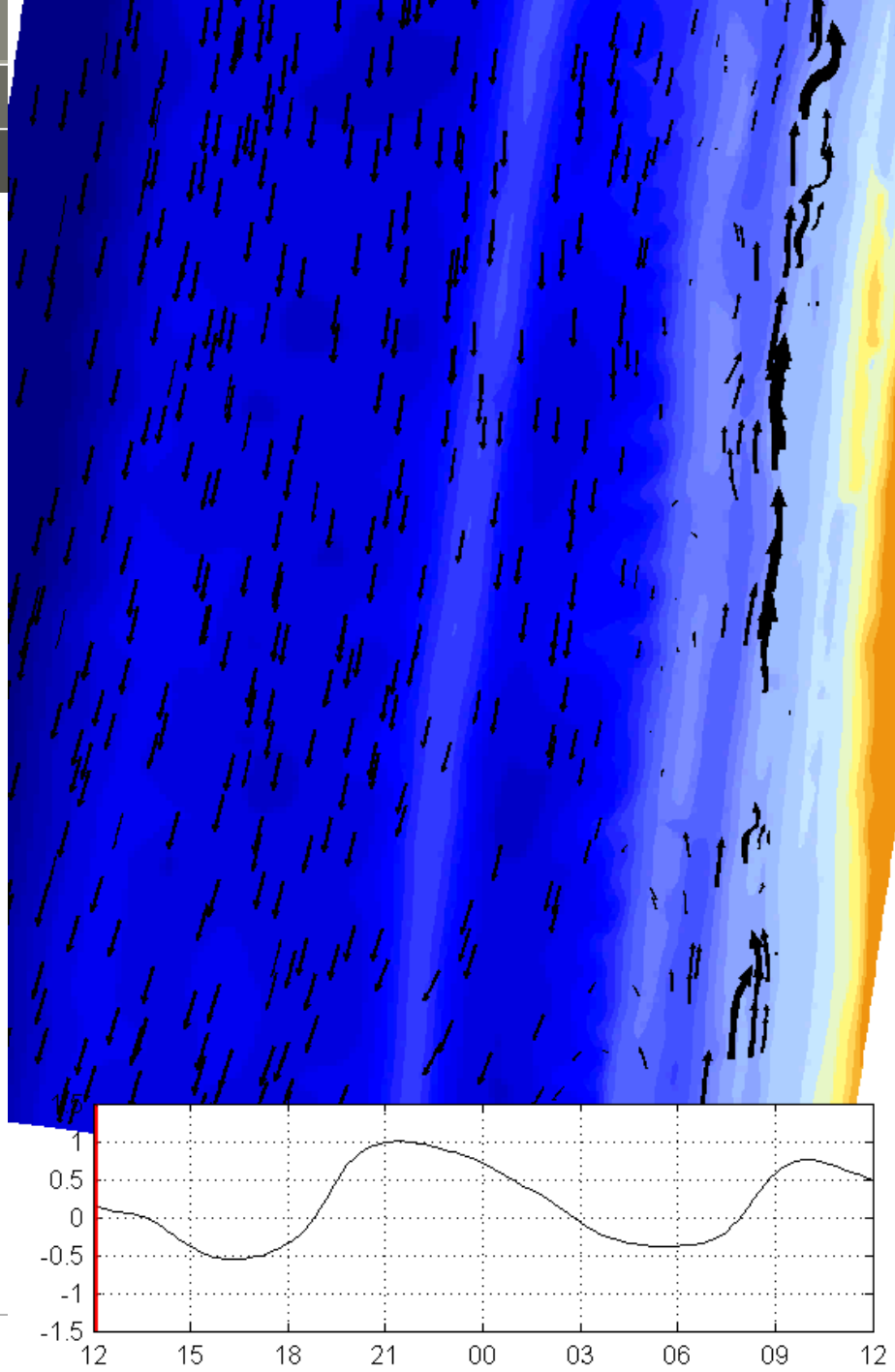




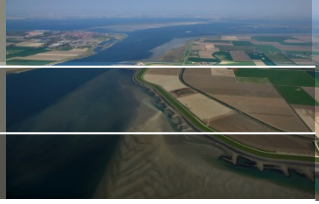
Rip currents Egmond



Latest bathymetry obtained from Argus/ BeachWizard



Conclusions



- Development of operational system
  - Open source: www.openearth.eu
- Model does reasonably well with tides and waves
- More validation needed
  - Beach/dune erosion
  - Rip currents
  - BeachWizard
- We are waiting for a storm. A big one preferably.