F999am07z015: Tidal inlet Ameland 2013

Purpose

The aim is to assess the SWAN model performance in non-stationary mode for the Sinterklaasstorm (December 5/6, 2013). The Sinterklaasstorm is a severe storm in terms of water levels and wind velocities, for which wave observations are available in the Wadden Sea. Hereto the starting point is the model set up as applied in WTI2011 (legal assessment of Dutch flood defences in 2011). The area of interest is the tidal inlet of Ameland. This area is interesting because of the tidal effects and the sensitivity for changing wind. Moreover, an extensive stationary hindcast study is already available for that area, concerning the storm of 5/6 December 2013 (SWIVT case f105am13z) which is used to compare against the non-stationary model results.

Furthermore, the sensitivity of different time-steps and maximum number of iterations is assessed to get an insight about the accuracy, computational effort, and convergence behaviour of a non-stationary model based on different settings.

Situation

The storm of 5/6 December 2013 is simulated in SWAN using a period from 3rd of December to 7th of December. An early start time was used to make sure that there is sufficient time for the numerical model to adapt to the wind and wave conditions.

Model setup

Two curvilinear computational grids were used to carry out the simulations. The large grid ‘G1’ generates wave boundary conditions for the eastern and western side of the detailed grid ‘G2’, which covers the area of interest being the tidal inlet of Ameland up to the Frisian coast. The buoys AZB11 and AZB12 lie more or less on the northern model boundary of G2 and provide boundary conditions for this smaller domain.

Wave boundary conditions were set to the wave boundaries similar to the SWAN runs in stationary mode, but in the non-stationary mode the wave boundary conditions are set for the entire period from 3rd to 7th of December.

The HARMONIE wind fields are available with a one hour time step. In the SWAN simulations HARMONIE wind fields are applied on a regular grid with 2.5 km x 2.5 km grid size. The water level and current fields are available with a 30 minute time step obtained from Delft3D simulations. The SWAN simulations make use of non-uniform time-varying water level and current fields, interpolated to the curvilinear SWAN grids. Currents are only applied on the G2 grid.

The following model settings for the physics are employed:

```
GEN3 WESTH

WCAP WESTH cds2=5.0E-5 br=1.75E-3 p0=4. powst=0 powk=0 nldisp=0.0

      cds3=0.80 powfsh=1.0

QUAD iquad=2 lambda=0.25 Cnl4=3.00e+07
```

```
BREA WESTH alpha=0.96 pown=2.5 bref=-1.39630 shfac=500.

TRIAD trfac=0.100 cutfr=2.500

FRIC JONSWAP cfjon=0.038
```

The mode is chosen as:

```
MODE NONSTAT
```

The compute statement is followed by `'NONSTATIONARY'`, this is the way to run a non-stationary run.

The first order, backward in space, backward in time (BSBT) scheme was used for the spatial discretization. For relatively small areas, the spatial discretisation is not critical. The numerical settings are, both for grid G1 and G2:

```
PROP BSBT

NUM ACCUR 0.01 0.01 0.01 98 NONSTAT mxitns=5
```

A time step of 10 minutes is used with the output stored every 30 minutes.

References

Deltares (2015). 1220082-007 Comparison stationary vs non-stationary SWAN runs. Wadden Sea hindcast 5/6 Dec 2013

Acknowledgements

The hindcast is part of the WTI study commissioned by Rijkswaterstaat-Centre for Water Management in The Netherlands.

Figure

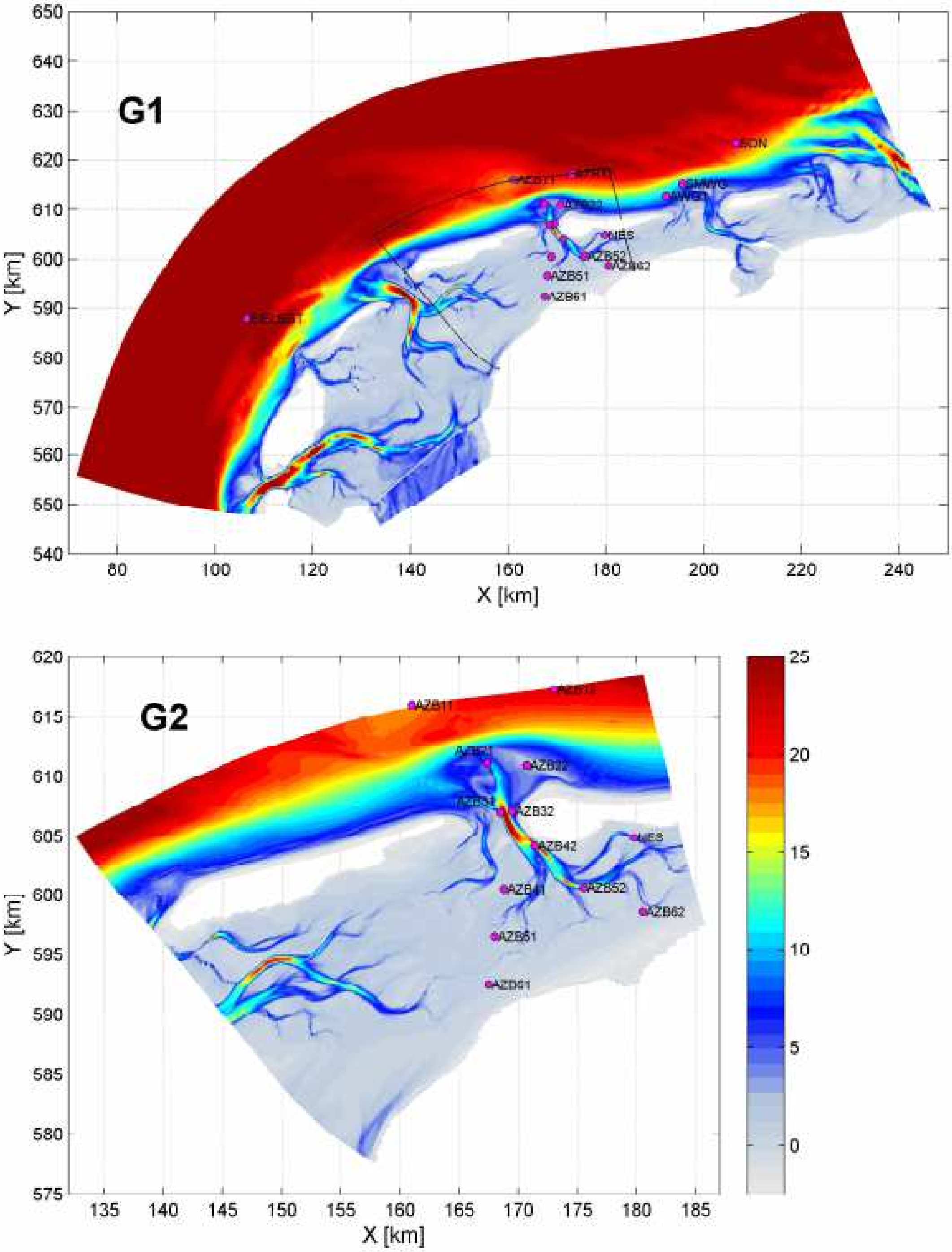

Figure. Bathymetry computational grids