F103am06z[001-004]: Amelander Zeegat 2006

Purpose

The storm conditions important for the design of the sea defences along the mainland coasts of Friesland and Groningen are due to winds from the westerly to northwesterly directions. These conditions have been investigated in a number of recent hindcast studies. For the northwesterly storm direction, a number of wave-related physical processes are found: depth-induced wave breaking and nonlinear triad interaction are found to occur over the ebb tidal delta. Through the tidal inlet and in the tidal channel, the penetration of low-frequency waves and wave-current interaction occur. Over the shallow Wadden Sea interior, local finite-depth wave growth is found, which can occur with or without the influence of an ambient current. For westerly storm conditions, the mentioned physical processes relating to North Sea waves entering through the tidal inlet become relatively less important (although, due to the refractive turning of offshore westerly waves, not negligible). Finite-depth wave growth, on the other hand, becomes more prominent, due to the increased fetch length for westerly winds.

Situation

The shallow Dutch Wadden Sea region (Figure 3.1, top panel) is enclosed by a series of barrier islands and the mainland coasts of Friesland and Groningen. Tidal inlets are found between the barrier islands, each featuring an ebb tidal delta, one or more main tidal channels, and a complex system of smaller channels and flats extending into the Wadden Sea interior. The Amelander Zeegat (Figure 3.1, bottom panel) is found between the barrier island of Terschelling (to the west) and Ameland (to the east). The inlet is shielded from offshore wave attack by an ebb tidal delta with a minimum depth of -3 m NAP, inshore of which the Borndiep, a deep tidal channel reaching -28 m NAP, is found, ending in a complex system of tidal channels and flats in the Wadden Sea interior. Apart from the tidal channels, the Wadden Sea interior is shallow and flat, with a bed level of approximately -1 m NAP.

Case selection

Table 1 presents an overview of the selected 2006 storm instants and corresponding environmental conditions considered in the above-mentioned stationary hindcast studies. See Alkyon (2007b).

Time	Code	U10 [m/s]	Wind direction	W.level Nes
08/02/2006, 19:30	f103am06z001	16.0	340	1.8
09/02/2006, 01:00	f103am06z002	10.3	317	0.5
09/02/2006, 07:00	f103am06z003	13.7	317	1.7
09/02/2006, 11:00	f103am06z004	17.9	312	0.7
09/02/2006, 14:00	f103am06z005	12.0	339	0.4

Note that case f103am06z005 is not available in SWIVT.

Model setup

For the 2006 storm moments, four rectangular grids (the same ones as for the December 2005 study, also described in Alkyon (2007b). The computational grids used for the February 2006 cases are presented in the bottom panel of Figure 3.3. A series of four rectangular grids is used, namely one coarse grid (Grid 1) covering the overall model domain, and three nested fine grids (Grid 2 to 4) positioned along the main tidal channel. The wave boundary conditions are obtained from the buoys AZB11 and AZB12, and are imposed on the outer boundary of Grid 1.

Water levels and current fields have been provided by RIKZ, computed using the WAQUA hydrodynamical model. As noted above, significant errors have been found in these computed water level and current fields, which should be corrected before this data set is applied.

References

Alkyon (2007b). Analysis SWAN hindcast tidal inlet of Ameland: Storms of 17 December 2005 and 9 February 2006. Alkyon report A1725R5R4, February 2007.

Acknowledgements

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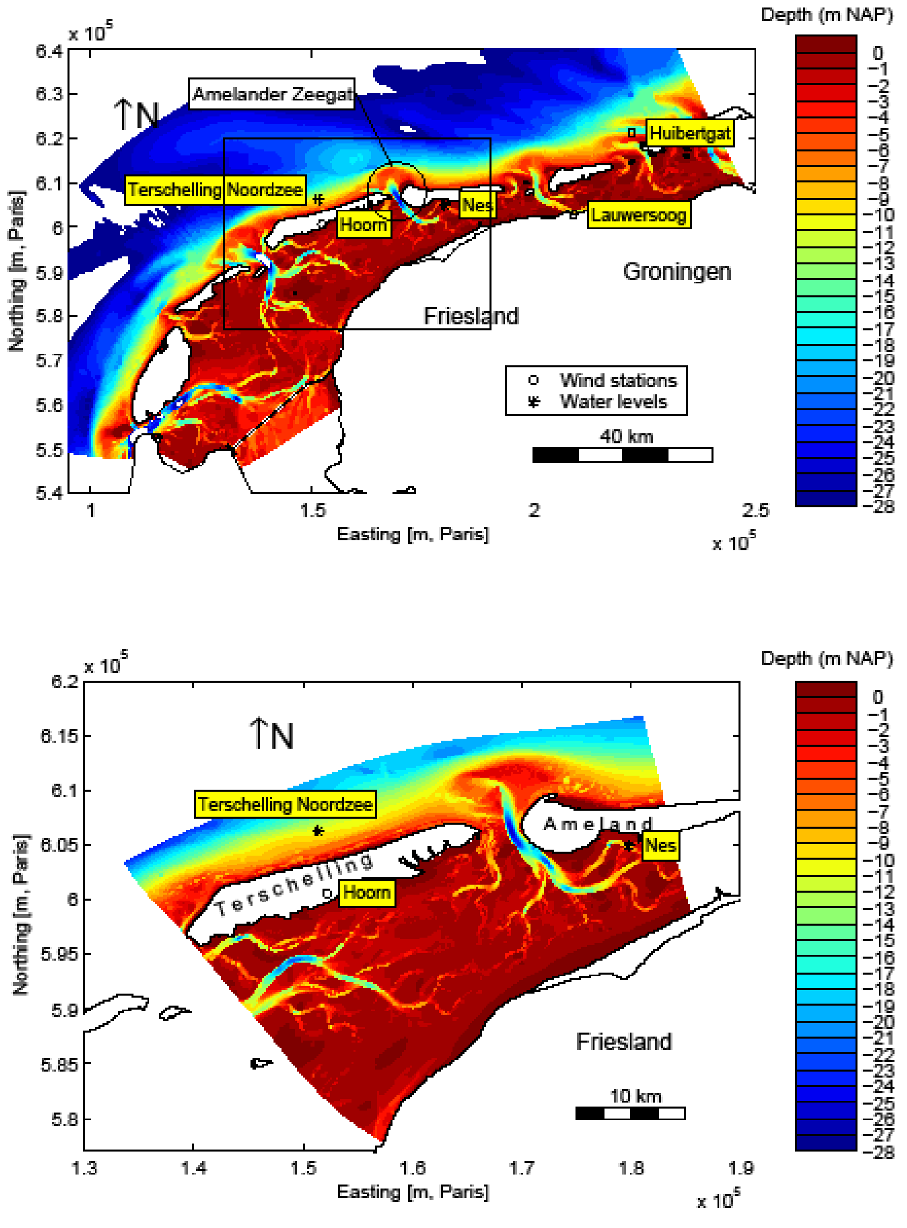
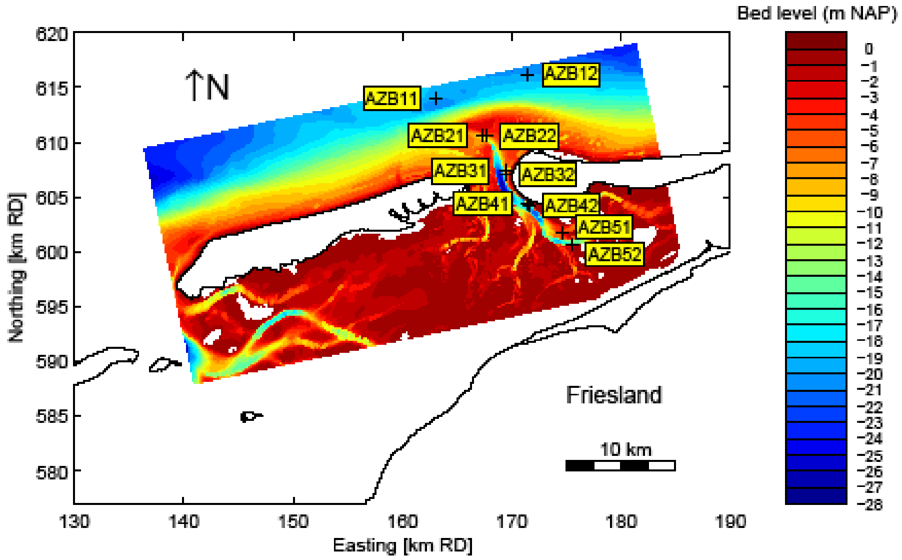
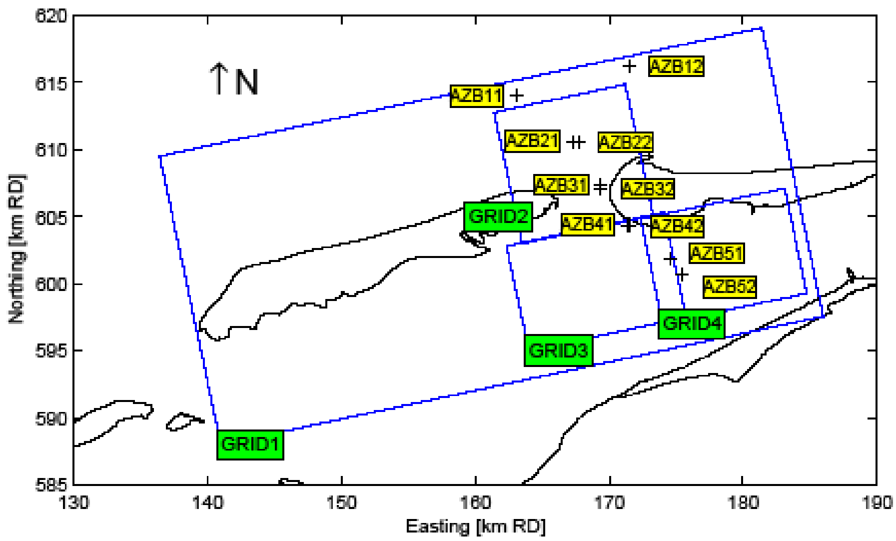
Figure



Bathymetry of the Amelander Zeegat in the Wadden Sea, the Netherlands with locations of wind, wave and water level observation stations	Validation cases SWIVT	
DELTARES	H5107.66	Fig. 3.1





Field case of Amelander Zeegat for the storm of 16–17 December 2005. Wave buoy locations (top) and computational grids (bottom)	Validation cases SWIVT	
DELTARES	H5107.66	Fig. 3.3