F160ww07z[001-020]: Western Wadden Sea 2007

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

As mentioned above, westerly storm conditions in the Wadden Sea provide the opportunity to study finite depth wave growth over the shallow Wadden Sea interior. The focus of the Witteveen + Bos (2010) study is on the following processes: (i) finite-depth wave growth, (ii) wave-current interaction and (iii) penetration of North Sea waves into the Wadden Sea.

Case selection

Information on the selected storm moments is given in the table below (taken from Witteveen & Bos (2010)).

	code	water level EIELSGT	wind		H_{m0} EIELSGT	T_{h0} EIELSGT	H_{m0} BREEZBTNI1
		m + NAP	U_{10} [m/s]	Dir [°N]	H_{m0} [m]	T_{h0} [°N]	H_{m0} [m]
January 2007:							
18-Jan-07 16:00	f160ww07z001	0.94	20.84	269	4.36	243	1.30
18-Jan-07 17:30	f160ww07z002	1.53	22.20	266	5.55	260	1.54
18-Jan-07 18:40	f160ww07z003	1.85	24.46	276	5.57	267	1.77
18-Jan-07 19:50	f160ww07z004	2.06	23.61	277	5.61	270	1.98
18-Jan-07 21:10	f160ww07z005	2.14	22.52	283	7.16	276	1.91
19-Jan-07 12:30	f160ww07z006	0.19	15.58	277	3.59	277	0.99
19-Jan-07 14:00	f160ww07z007	-0.17	15.81	277	3.54	280	0.87
November 2007:							
08-Nov-07 22:20	f160ww07z008	1.01	15.07	324	3.53	305	0.98
08-Nov-07 23:40	f160ww07z009	0.78	16.70	322	4.68	315	0.93
09-Nov-07 00:50	f160ww07z010	0.70	18.12	320	6.09	322	1.16
09-Nov-07 02:20	f160ww07z011	0.79	18.13	316	6.16	321	0.98
09-Nov-07 03:00	f160ww07z012	0.94	18.37	320	5.90	324	1.25
09-Nov-07 06:40	f160ww07z013	2.67	16.93	321	6.28	329	1.34
09-Nov-07 08:10	f160ww07z014	2.75	17.45	332	6.15	329	1.56
09-Nov-07 10:10	f160ww07z015	2.12	18.40	324	7.36	332	1.51
09-Nov-07 12:00	f160ww07z016	1.37	17.26	328	6.35	334	1.31
09-Nov-07 13:40	f160ww07z017	0.86	17.91	329	6.73	335	1.22
09-Nov-07 14:50	f160ww07z018	0.73	16.68	324	7.00	340	1.14
09-Nov-07 17:30	f160ww07z019	1.39	15.82	325	6.17	346	1.04
09-Nov-07 21:40	f160ww07z020	1.22	14.04	322	5.13	336	0.85

Model setup

The computational grid is shown in Figure 4.1.

Default settings

The physical settings applied are:

```
GEN3 WESTH
WCAP WESTH cds2=5.0e-05 br=0.00175 p0=4.0 powst=0.0 powk=0.0  &
        nldisp=0.0 cds3=0.8 powfsh=1.0
QUAD iquad=2 lambda=0.25 Cnl4=3.0e+07
LIMITER ursell=10.0 qb=1.0
FRIC JONSWAP cfjon=0.038
BREA WESTH alpha=0.96 pown=2.5 bref=-1.39630 shfac=500.0
TRIAD trfac=0.1 cutfr=2.5
```

In order to have sufficient converged results, accuracy settings are applied. The following convergence criteria are applied:

```
NUM STOPC dabs=0.00  drel=0.01  curvat=0.001  npnts=99.  STAT mxitst=80  alfa=0.001
```

The computations are carried out with and without a refraction limiter, which limits the refraction of the low frequency waves. For the computation with a refraction limiter the following setting is included:

```
REFRL 0.2 2
```

Remark concerning the computation

The computational grid is so fine, that running on ordinary PC's may lead to memory allocation errors. The error file Errfile (which is SWAN) then gives the following message:

Terminating error: Allocation problem: array AC2 and return code is 179

The computation should then be run on a bigger computer, or on a parralel machine. Note that SWIVT is not designed to let SWAN run on parrallel machines. You may however run the simulation on such a machine, and then copy the output back into the SWIVT directories.

References

Witteveen & Bos (2010a). Verification of SWAN in western Wadden Sea. Hindcast January and November 2007 storms.

Acknowledgements

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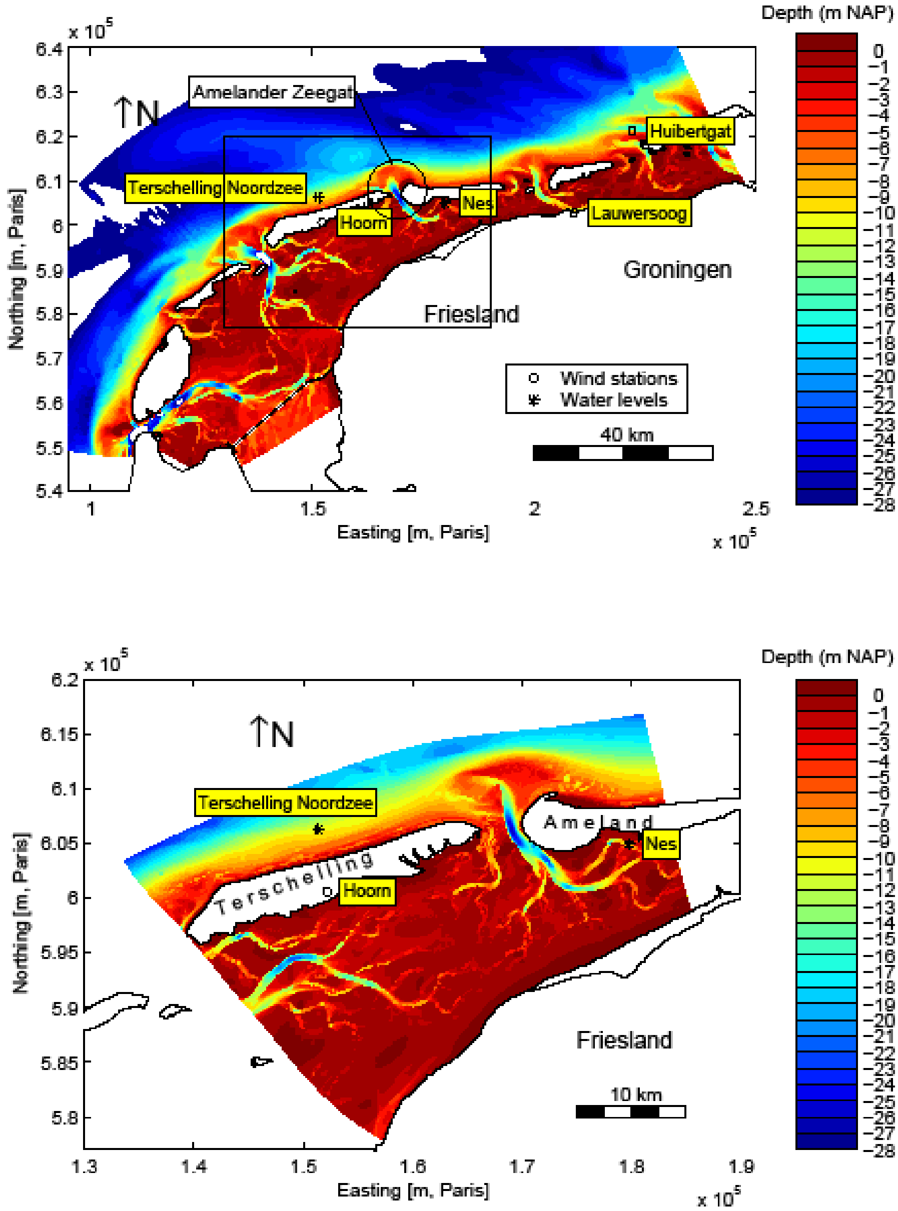
Figure



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

figure 4.1. Computational grid (every 10th gridline) and output locations