F104am10z[001-015]: Amelander Zeegat 2010

Purpose

Besides assessing SWANs performance of predicting wave penetration into the Amelander Zeegat under ambient currents, these cases were meant to experience with the use of radar wave data as validation material. Therefore, available data in the Amelander Zeegat was gathered and a number of moments during different tidal stages was selected with suitable data available. The selected storms of January 28th, October 20th and October 24th 2010 were not so severe, but the most energetic there is with radar data available. The eight selected times on January 28th were simulated in six different ways, varying in current input and wave current formulation. The seven selected times in October were studied with 'simplified' and 'realistic' SWAN settings. SWIVT contains the 'realistic' settings. The Delft3D current fields that were used as input for the SWAN computations have been thoroughly validated with the radar current observations. After the comparison between SWAN results and buoy measurements the radar wave parameters were considered in the wave analysis. Spatial patterns of the wave direction and wave length as observed by the radar were compared with the SWAN results. Later during the study spectral radar information was received for one moment in time which helped in evaluating the reliability of the radar data and gave the possibility to compute additional wave parameters. From the radar intensity spectra wave lengths and directions were computed on a specified frequency domain. Furthermore, a first attempt was made to transform the radar intensity spectra to wave energy density spectra and to assess significant wave heights, which were compared with buoy observations and SWAN results.

Case selection – Janary 2010 storm

Starting point for the storm selection is the availability of radar data of the storm of January 27/28, 2010. Another consideration is the preference for a rather high (>3 m) and constant wave height at AZB11/12. Next, various tidal stages (following current, opposing current, slack tide) are chosen. Further considerations are the quality of the wave buoy observations and the stationarity, magnitude and direction of the wind. This led to the eight selected times listed in the table below. The SWIVT case name is f104am10z00X, where integer X is in the most left column. Please note that the SWAN input for wind speed and wind direction is different from the values in Table 4.2 in Deltares (2010). See Section 4.4.4 in Deltares (2010). In the table below, the windspeed and wind direction as used in the SWAN simulations are given.

	time on 28 Jan 2010 [GMT]		current speed [m/s]	current dir [from°N]	wind speed in SWAN simulations [m/s]	wind direction in SWAN simulations [from °N]	observed wave height H_{m0} [m]	observed wave period T_p [s]	observed water level [m+NAP]
			near AZB32	near AZB32	SWAN	SWAN	AZB11	AZB11	Nes
1	2:11	flood	1.0	343	12.4	330	3.37	8.3	- 0.05
2	3:18	flood	1.4	345	11.5	330	3.41	9.1	+ 0.50
3	3:58	flood	1.5	345	11.0	320	2.99	9.1	+ 0.83
4	5:19	flood	1.2	345	10.3	330	3.22	9.1	+ 1.44
5	6:39	slack	0.1	26	9.6	320	3.35	10.0	+ 1.70

6	7:59	ebb	1.1	162	9.4	320	3.33	9.1	+ 1.41
7	9:09	ebb	1.4	157	9.4	310	3.26	10.0	+ 0.98
8	9:49	ebb	1.3	156	10.3	330	3.18	10.0	+ 0.71

At the first four times (t1 through t4), there is a flood current with speeds over 1 m/s in the Borndiep channel between Ameland and Terschelling near AZB32. At t5 the water level at Nes has its maximum (NAP +1.7 m) and the flow is almost absent. During times t6, t7 and t8 the waves encounter ebb currents of more than 1 m/s. The wind is moderate (5-6 Beaufort, ca. 8-13 m/s), and mainly from the northwest.

Not all buoys provided reliable data at all selected times. There is no suitable data at all from buoys AZB51, AZB52 and AZB61. The waves measured by buoy AZB62 are during most moments of the storm too small to consider (The wave height reaches a maximum of 0.35 m, see Figure 4.3). Despite this, sufficient validation data is available. In the present study the focus is rather on the locations of buoys AZB21, AZB31, AZB32, AZB42 because these are located within the radar area and/or strongly influenced by current. Buoy AZB31 shows some anomalies around time t2, but the data of the other seven times can be used.

Case selection – October 2010 storm

Seven moments in the October 2010 storm are studied, see Deltares (2011). The SWIVT case name of each storm moment is f104am10z0XX, where integer XX is in the most left column in the table below.

The wind speed during the northwestern storm of October 20, was some 12-15 m/s (“strong breeze”, 6-7 Bft). The significant wave height at the outer buoys AZB11 and AZB12 was over 4 m. We selected the high tide situation (t1 HW sl) and the maximum off shore wave height (t3 LW fl). The other times (t2 EBB) and (t4 flood) were selected for their ebb respectively flood current in combination with water levels above 1 m+NAP at Nes.

The next storm occurred a few days later on October 24. This storm was more severe, both in terms of wind, waves and water levels. The wind (“gale”, 8 Bft; wind speed above 20 m/s) turned from west to north-northwest. Buoys AZB11 and AZB12 observed significant wave heights of more than 5 m. The selected times include the maximum off shore wave height with strong currents (t6 FLOOD), the maximum water level at Nes (t7 HW sl) and an ebb situation with high off shore waves (t5 LW ebb).

Unfortunately, buoy AZB32 was lost in October 2010. All other buoys provided reliable data at all selected times.

Case		day /time Oct 2010 [GMT]	situation *	model current speed [m/s]	model current dir [from °N]	observed wind speed [m/s]	observed wind dir [from °N]	observed wave height H_{m0} [m]	observed wave period T_p [s]	observed water level [m+NAP]
				near AZB32	near AZB32	Wierumer gronden	Wierumer gronden	AZB11	AZB11	Nes
09	t1	20/ 07:00	HW sl	0.2	160	13.4	333	3.66	11.1	+1.83
10	t2	20/ 09:10	EBB	1.3	160	12.1	323	3.77	10.0	+1.13
11	t3	20/ 14:00	LW fl	0.6	360	13.1	313	4.36	10.0	-0.24
12	t4	20/ 18:00	flood	0.9	360	12.5	330	3.96	11.1	+1.15
13	t5	24/ 03:20	LW ebb	0.6	160	19.3	307	5.35	10.0	+0.12
14	t6	24/ 06:00	FLOOD	1.6	350	19.0	320	5.15	10.0	+1.11
15	t7	24/ 09:00	HW sl	0.2	160	15.2	326	4.02	10.0	+2.11

Table 2.2 Selected times for the Amelander Zeegat simulations
**) sl=slack; fl=flood; HW=high water; LW=low water; the capital EBB (t2) and FLOOD (t6) indicate high current velocities*

Model setup

The model setup of the January storm is discussed in Section 4.4 of Deltares (2010). The employed model settings are those of series C, see Section 4.4.1 of Deltares (2010).

The model setup of the October storm is discussed in Chapter 4 of Deltares (2011). The employed settings are those of series C, i.e. with enhanced dissipation on negative current gradients.

References

Deltares (2010). Wave propagation under influence of currents. Deltares report 1202119-003-HYE-0002, date 19 November 2010.

Deltares (2011). Comparison SWAN, Pharos and radar wave observations. Deltares report 1204199-002-HYE-0009, version 2, date 22 december 2011.

Acknowledgements

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Figure

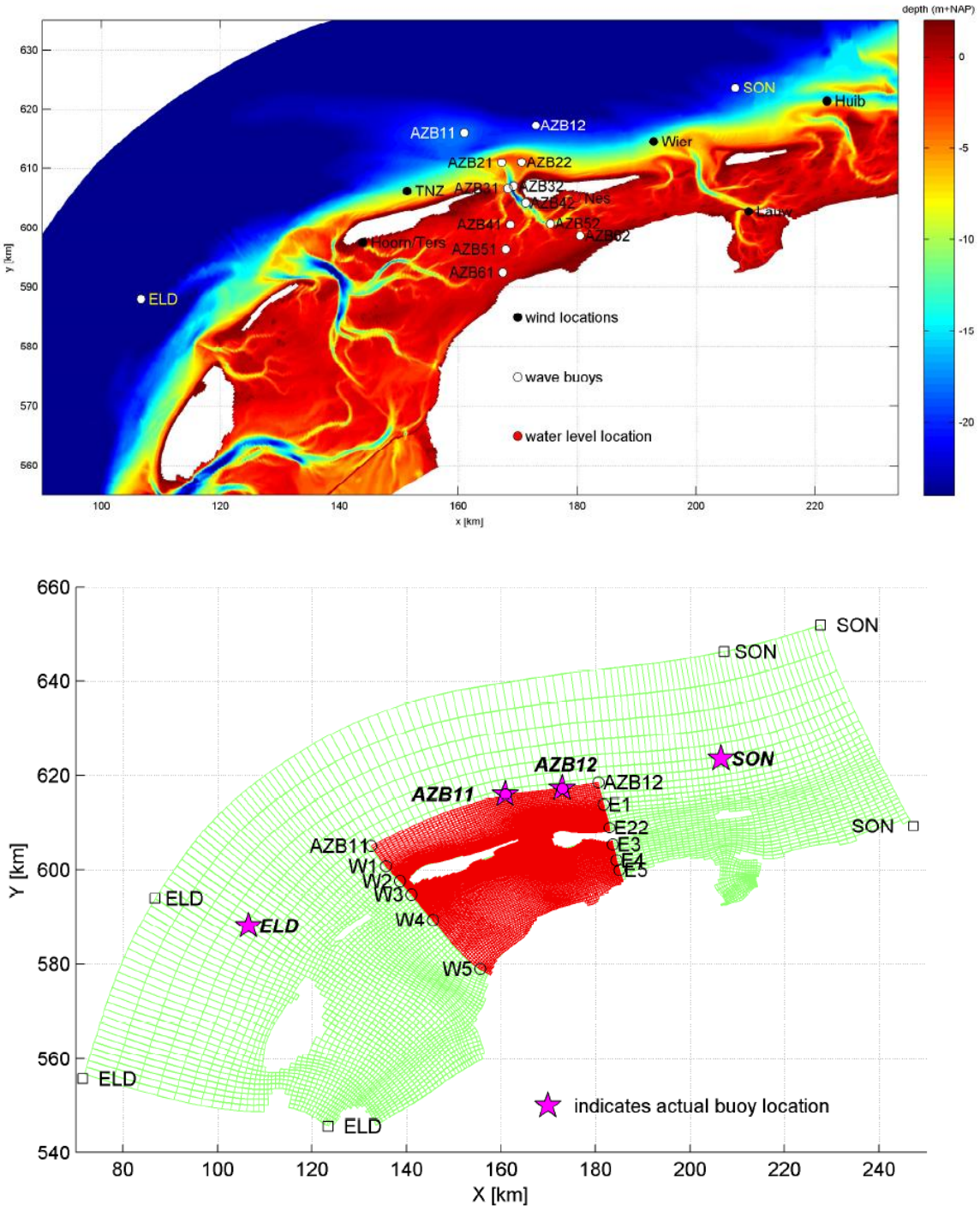

Figure. January and October 2010 model