F140slote[001-005]: Lake Sloten

Purpose

Lake Sloten, in the north of the Netherlands, displays comparable finite depth wave growth as found in the shallow Wadden Sea interior. As a result, this field site is suitable for complementing the data set for studying the performance of SWAN with respect to finite depth wave growth in the Wadden Sea interior.

Situation

Lake Sloten is approximately 4.5 by 3 km in size (Figure 1). It has a flat, sandy bottom with a characteristic water depth of about 1.7 m. The lake is therefore shallow compared to its horizontal dimensions. Wind and wave data for this lake have been observed at the station SL29 over the period 1999 to 2007, and have been extensively validated and analysed by Bottema (2007). In addition, this data have been considered in hindcast and analysis studies by Bottema (2006), Van der Westhuysen et al. (2007) and Alkyon (2008).

For the investigation of finite depth wave growth, the dominant wind direction sector of SW-W is relevant. For these wind directions, the wave and wind observation station SL29 (see Figure 1) is well-situated, corresponding to a characteristic fetch length about 2.9 km. Over this fetch, a number of physical processes are found relating to finite depth wave growth (Alkyon 2008): in addition to the dominant role of the deep water source terms (wind input, whitecapping and quadruplet interaction), depth-induced breaking and bottom friction are important. The observed spectra show evidence of nonlinear triad interactions (e.g. Bottema 2007). Given the approximately constant water depth (except for slight seasonal variation and storm setup), the relative importance of the various source terms depends on the relative shallowness of the wave condition, and hence on the prevailing wind speed. Since Deltares (2008a) demonstrated the general agreement between finite depth wave fields here and in the Wadden Sea interior, this is considered a relevant field site for a Wadden Sea validation data set.

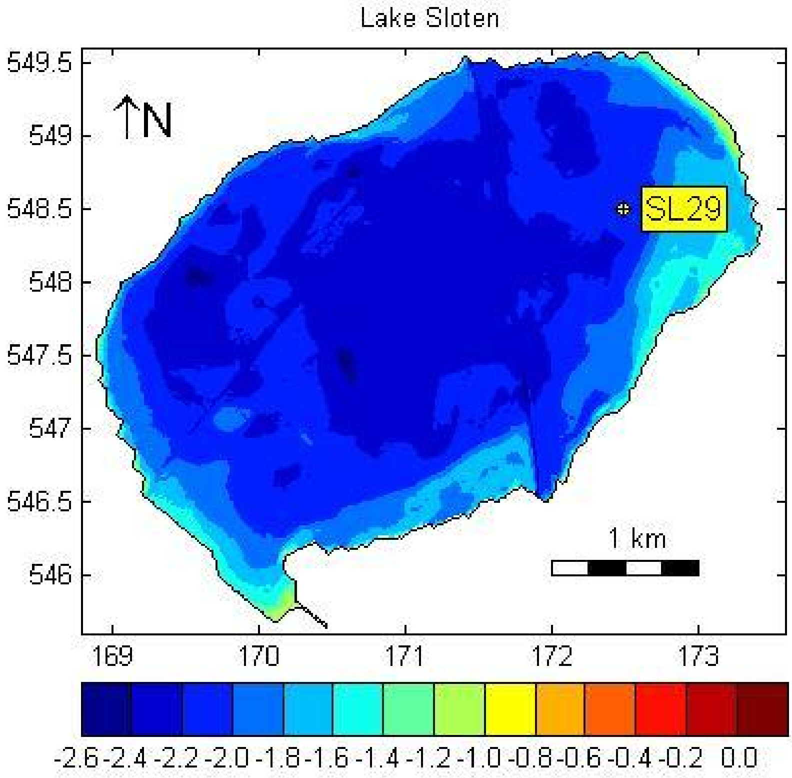

Figure 1, Bathymetry Lake Sloten

Case selection

Bottema (2006, 2007) considered three criteria for the selection of nine representative test cases for Lake Sloten from the records of 1999-2007, namely: (a) stationarity, (b) representativeness and (c) the absence of experimental errors. Concerning stationarity, all selected cases for Lake Sloten have less than a few percent wind speed change per hour, and less than a few degrees wind direction change. Also, all cases were checked for representativeness. That implies that for given wind conditions, the measured wave conditions should be no outlier with respect to other cases, but rather a central estimate. Furthermore, all potential calibration cases were thoroughly screened for experimental errors (see Bottema 2007). Deltares (2008a) made a selection of five cases from the proposed data set of Bottema (2007), omitting cases with either very short fetches or relatively low wind speeds, which make them less suitable for studying finite depth wave growth. These five selected cases, which are fully applicable to the present purpose, are presented in Table 1 below:

Case	Nr	Date	Time	d	U_{10}	U_{dir}	H_{m0}	T_p	$T_{m-1,0}$	T_{m02}
				[m]	[m/s]	[^{o}N]	[m]	[s]	[s]	[s]
SLB	001	12/2/2002	13-14h	1.69	15.0	253	0.47	2.86	2.53	1.95
SLC	002	26/2/2002	14-15h	1.83	20.8	243	0.70	3.45	2.98	2.39
SLE	003	27/10/2002	15-16h	1.67	21.4	252	0.71	3.23	2.96	2.30
SLF	004	20/3/2004	20-21h	1.66	19.4	241	0.66	3.13	2.85	2.27
SLH	005	18/1/2007	12-13h	1.66	21.9	234	0.66	3.23	2.92	2.27

Table 1: Selected calibration cases (and their characteristics) for Lake Sloten, based on Deltares (2008a). Observations taken at station SL29. The number Nr refers to the casename, i.e. F140slote001 is case SLB etc.

The specific motivations for the selection of the validation cases presented in Table 1 are:

- SLB: typical intermediate case (some depth-limitation)
- SLC: highest water level for near-9 Beaufort winds
- SLE: strongest depth-limitation measured so far
- SLF: case to support high H_{m0}/d value of case SLE
- SLH: strongest wind case with wind along the SW-NE axis of the lake

Model setup

These field cases are modelled using a regular computational grid covering the entire lake. Since Lake Sloten is enclosed, no wave boundary conditions are required. Waves and water levels were observed by a capacitance probe at station SL29. Wind information was also observed at station SL29. The time-averaged wind speed and direction (over 1 hour) of this station are applied uniformly over the model domain. Currents and water level setup are not included in the model setup

Both the completeness and quality of this set of observational data is considered as being good. The data set is suitable for studying finite depth wave growth, such as found in the Wadden Sea interior.

Default settings

The following settings are default for this case:

```
$ --- Fysische parameter settings
GEN3 WESTH
QUAD iquad=2 lambda=0.25 Cnl4=3.0E7
LIMITER ursell=10 qb=1.0
FRICTION JONSWAP cfjon=0.067
BREA CON alpha=1.0 gamma=0.73
TRIAD trfac=0.05 cutfr=2.5

$ --- Numerieke parameter settings
NUM STOPC 0.00 0.01 0.001 99.5 STAT mxitst=50  alfa=0.001

$ *** Integrate over frequency range [FMIN,FMAX] to obtain wave
parameters
QUANT HS TMM10 TM01 TM02 FMIN 0.08 FMAX 1.5
```

For the remainder of the settings, we refer to the SWAN command files.

References

Alkyon (2008). Analysis of SWAN hindcasts Wadden Sea, Oosterschelde and Slotermeer. Alkyon Report A2085, May 2008.

Bottema, M. (2006). Gedrag van het SWAN-golfmodel met en zonder nieuwe diepwaterfysica, met nadruk op korte strijklengtes (in Dutch), RWS RIZA werkdocument 2006.057X.

Bottema, M. (2007). Measured wind-wave climatology Lake IJssel (NL). Main results for the period 1997-2006. Report RWS RIZA 2007.020, July 2007.

Deltares (2008a). Observed finite depth wave growth limit in the Wadden Sea. Deltares Report H5107.35, July 2008.

Van der Westhuysen, A. J., M. Zijlema, and J. A. Battjes (2007). Nonlinear saturation-based whitecapping dissipation in SWAN for deep and shallow water. Coastal Engineering 54, 151-170.

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