F131ijsse[001-008]: Lake IJssel

Purpose

The wave conditions at the transect of measurement poles (FL47/48/49) at Lake IJssel, in the northwest of the Netherlands, can be used to study wave growth with short wind fetches and the shape of wave spectra with SWAN, see Deltares (2013).

Situation

Lake IJssel (Figure 1) is approximately 20 by 60 km in size. Up to 1932, prior to the construction of a dam, Lake IJssel and Lake Marken were connected to the Wadden Sea, together forming the Zuiderzee. A significant part of its shores consists of dykes that were constructed between 1928 and 1976. At present, Lake IJssel is a large lake with a typical depth of about 4-5 m, and has a fairly flat, sandy bottom. The lake is therefore shallow compared to its horizontal dimensions. Wind and wave data for this lake are available from 1997 onwards. Seven SWIVT cases (f130ijsse[001-007]), based on the data from 1997 to 2007 to 2007, do already exist.

For the investigation of wave growth with short fetches, wind, wave and waterlevel data from FL48 and FL49 are used, while wind data from FL47 is used as a check (Table 1).

Table 1. Measuring locations

**) computed from first wet grid point in bathymetry file (135427;542179)*

id	name	X [m RD]	Y [m RD]	(shortest) distance from shore* [m]
FL48	Oude Zeug	136908	542962	1675
FL49	Oude Zeug Kust	136204	542590	880
FL47	IJsselmeer midden N	144020	547225	9970

Case selection

For the study on short fetches, Deltares (2013) selected five moments with more or less constant wind above 10 m/s and with a constant direction within 30˚ from the dike normal. The reason for selecting five similar situations is to increase the statistical reliability. Time 2 is included because of its high wind velocity and large waves. However, the wind direction of Time 2 is not optimal for short fetch analysis. Table 2 lists the selected moments.

For the study on the spectral shape, just one moment was selected. This one is not included in the SWIVT database.

Table 2 Selected times and observed wind, water levels and wave heights in winter season 2011/2012 for SWAN simulations with short fetches

	Date and time [CET]	Wind speed [m/s]	Wind direction		Water level [m to SWL]	H_{m0} at FL 48 obs [m]
			[˚N]	[˚ w.r.t transect]		
t1	9 Dec 2011 4:00	14.9	249	7	-0.38	0.61
t2	3 Jan 2012 12:00	21.6	206	36	-0.13	1.06
t3	3 Jan 2012 23:00	14.6	249	7	-0.14	0.58
t4	4 Jan 2012 16:00	11.4	245	3	+0.05	0.39
t5	5 Jan 2012 0:00	16.6	229	13	-0.06	0.78

Model setup

The starting point of the short fetch SWAN simulations is a stationary 1d base run for each of the five times in Table 2. The 1d transect is orientated along the instrument transect, which is perpendicular to the coast (242˚N). They constitute the first five cases in Table 2.

As mentioned in Section 3.6 of Deltares (2013), a lot of sensitivity runs were performed for Time 3. These consist of a large amount of 1D runs, with varying grid resolution and physics settings, and two 2D runs (with varying domains, see Figure 2). In SWIVT, three of them are included (SWIVT cases f131ijse[006-008]). Note that the major difference between SWIVT case f131ijsse003 and f131ijsse006 is in the orientation of the 1D transect: in case f131ijsse003 this is oriented along the instrument transect (242˚), and in case f131ijsse006 this is oriented along the wind direction (249˚)[1].

All eight SWIVT cases are summarized in Table 3. The first column in Table 3 refers to the SWIVT case number, so 001 refers to f131ijsse001, etc..

[1] Due to the fact that in case f131ijsse006 the transect does not coincide with the instruments and we need to assume that the instruments are on this transect, we assume momentarily that the instruments are located on slightly different locations: FL49 = (136197,542638) and FL48 = (136915,542914). These are the coordinates at which SWAN will generate output (as imposed in f131ijsse006.loc). In the observed files, we give the correct coordinates of FL48 and FL49, as given earlier in this document. This means that there is a mismatch between the FL48 (FL49) coordinaten in the SWAN output and in the observed files.

Table 3 SWIVT cases

	Date and time [CET]	Wind speed [m/s]	Wind direction		Water level [m to SWL]	Remarks
			[˚N]	[˚ w.r.t transect]		
001	9 Dec 2011 4:00	14.9	249	7	-0.38	1d base run
002	3 Jan 2012 12:00	21.6	206	36	-0.13	1d base run
003	3 Jan 2012 23:00	14.6	249	7	-0.14	1d base run
004	4 Jan 2012 16:00	11.4	245	3	+0.05	1d base run
005	5 Jan 2012 0:00	16.6	229	13	-0.06	1d base run
006	3 Jan 2012 23:00	14.6	249	7	-0.14	1d run (cf. R1d05Kt3a)
007	3 Jan 2012 23:00	14.6	249	7	-0.14	2d run (cf. R2d20Wt3x(*))
008	3 Jan 2012 23:00	14.6	249	7	-0.14	2d run (cf. R2d20Wt3a(*))

(*) For these SWIVT cases, the Komen settings are used, whereas in the original study the Van der Westhuysen settings were used.

Default settings

In the base run, the Komen settings for generation due to windinput and dissipation due to white capping are used for all SWIVT cases:

```
$ --- Fysische parameter settings
GEN3 KOM
WCAP KOM cds2=2.36E-5 stpm=3.02E-3 powst=2 delta=0 powk=1
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 dabs=0.00  drel=0.01  curvat=0.001  npnts=99.  STAT mxitst=100
alfa=0.001

$ *** Integrate over frequency range [FMIN,FMAX] to obtain wave parameters
QUANT HS TMM10 TM01 TM02 FMIN 0.2 FMAX 1.5    (*)
```

(*) For cases f131ijsse007 en f131ijsse008, we have put FMIN = 0.1 Hz instead of 0.2 Hz. This in order to be consistent with the frequency range of the SWAN computations, which is [0.2 Hz,1.5 Hz] for the first six cases, and [0.1 Hz, 1.5 Hz] for these last two cases.

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

References

Deltares (2013). Evaluation of SWAN spectra at Dutch Lakes. Deltares Report 1206011-002-HYE-002, Mrt 2013.

Acknowledgements

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Figure

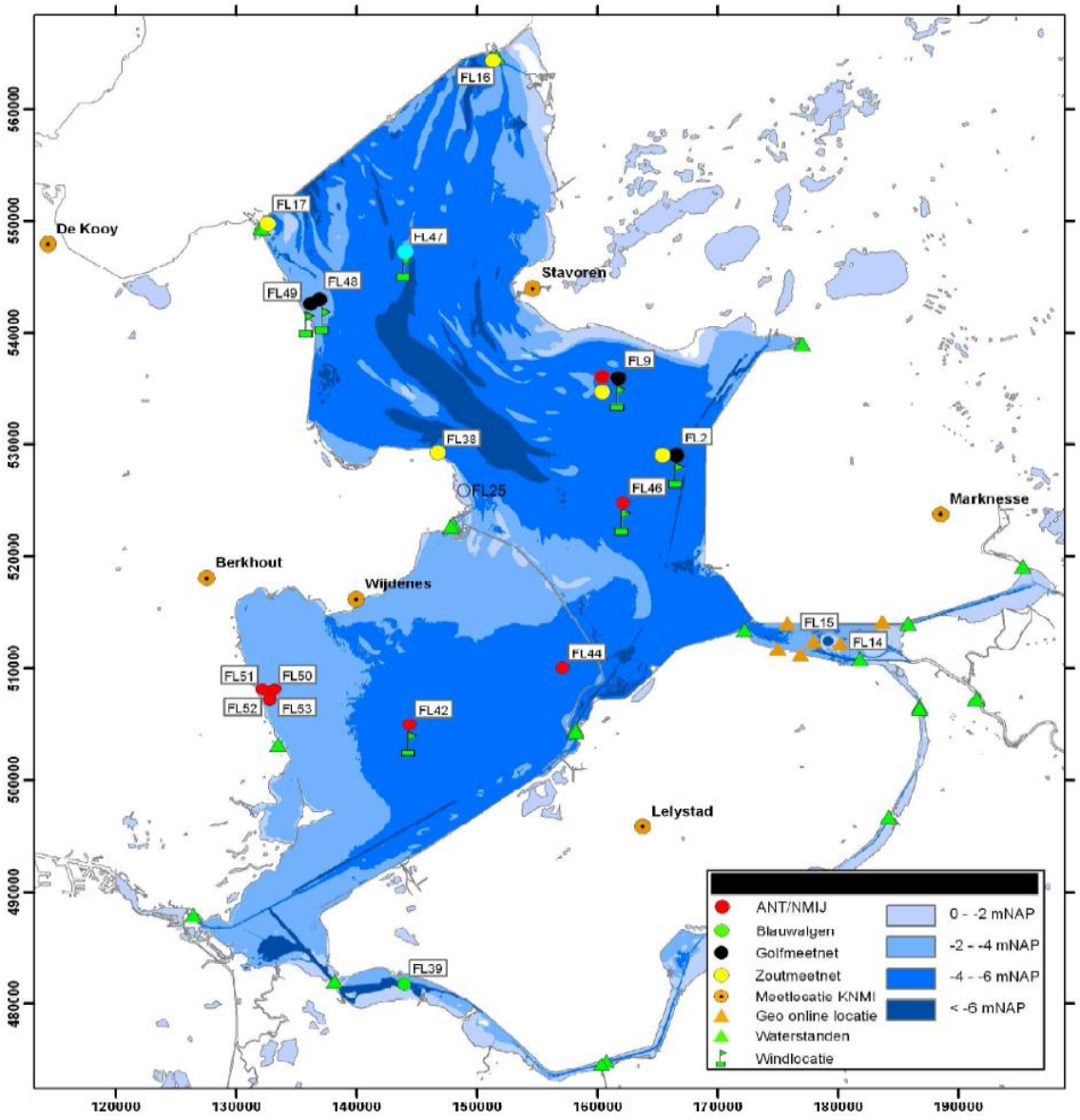

Figure 1. Lake IJssel and measurement locations.

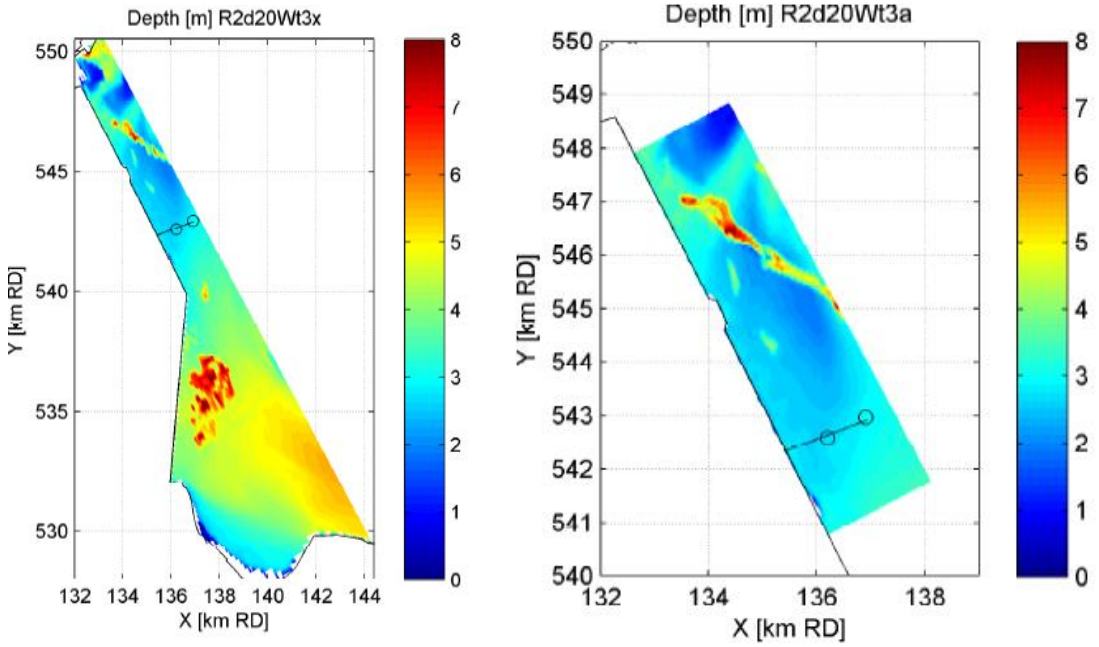

Figure 2. Domain of run f131ijsse007 (R2d20Wt3x) (left) and f131ijsse008 (R2d20Wt3a) (right)