NORMAS

Report

WAVECALCULATION FOR SITE SEYDISFJORDUR

Wind-generated waves, ocean swell, diffraction and refraction
Attachment to site survey report.

For Haafell ehf.

Performed by: Asle R. Seljeseth

Control by: Olve Vangdal

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Contents:

1.0 Overview site and summary

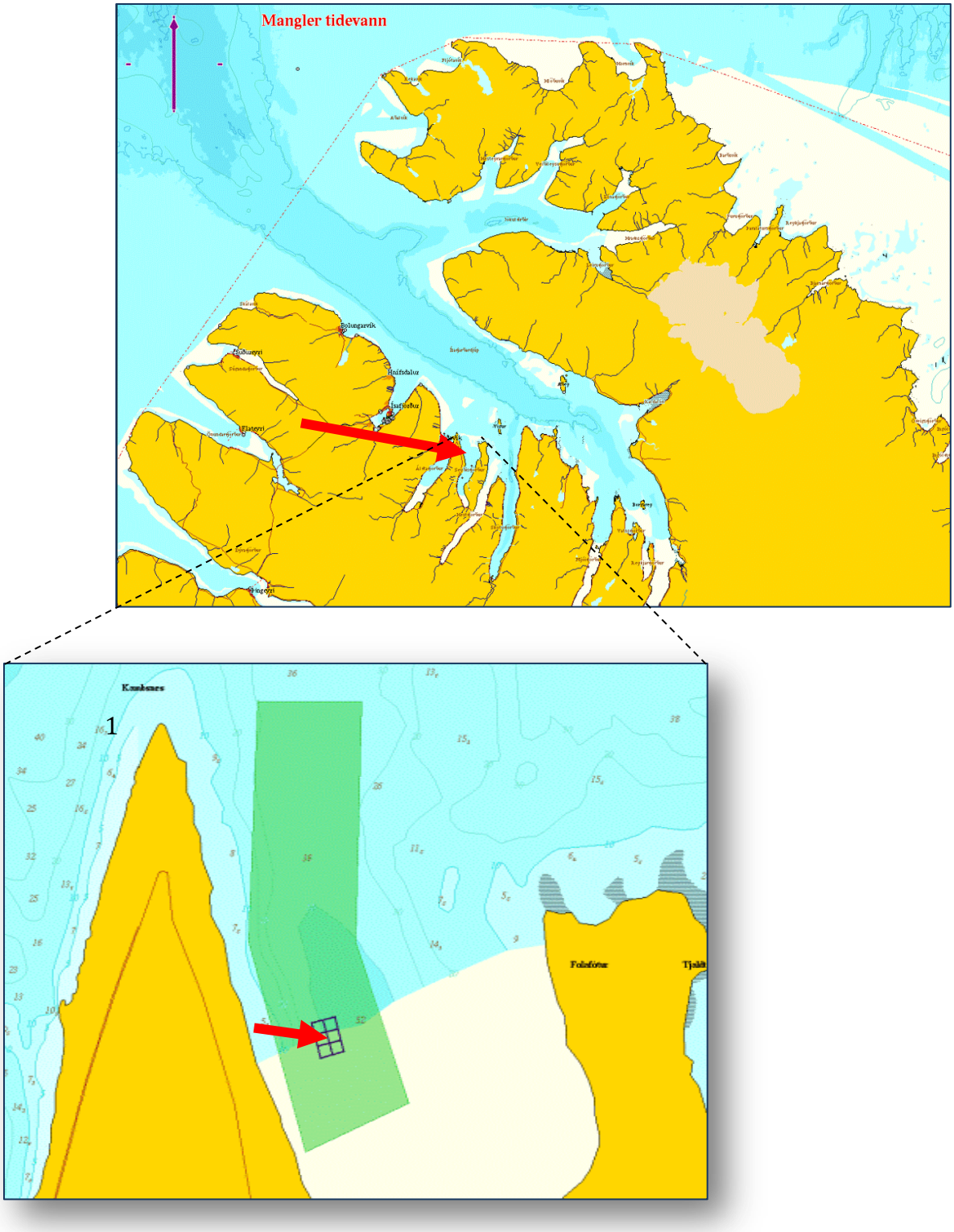


Fig. 1. Overview site. Red arrows shows site and calculation point for Table 1.

Summary of results for selected directions:

It is obtained results from the centerposition of the fishfarm as shown in fig 1. Highest performing wave for eight directions are summarized in Table 1.

Position UTM27:

1. 413043/ 7324526

Table 1: Combined waves, swell and wind waves:

Return period 10 years										
Heading			**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
Wind U10	From dir.	**m/s**	28	30	30	27	27	28	30	24
Swell	**Hs**	**m**	0.8	-	-	-	-	-	0.2	0.8
	Tp	**s**	12.1	-	-	-	-	-	10.7	12.1
	Direction	**° From**	355	-	-	-	-	-	1	353
Combined wind generated waves and swell	**Hs**	**m**	3.0	2.7	1.8	1.1	1.2	1.0	1.4	2.2
	Tp	**s**	6.5	5.7	5.1	3.1	3.5	3.5	7.4	6.5
	Direction	**° From**	4	25	58	139	168	190	335	354
Return period 50 years										
Heading			**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**
Wind U10	From dir.	**m/s**	30	32	32	29	29	30	32	26
Swell	**Hs**	**m**	1	-	-	-	-	-	0.3	0.9
	Tp	**s**	13.8	-	-	-	-	-	12.1	13.8
	Direction	**° From**	357	-	-	-	-	-	6	356
Combined wind generated waves and swell	**Hs**	**m**	3.3	3.0	2.0	1.2	1.2	1.0	1.5	2.5
	Tp	**s**	6.5	6.5	5.1	3.5	3.9	3.9	7.4	6.5
	Direction	**° From**	4	25	58	138	169	191	335	354

2.0 Purpose, assumptions and precision

The purpose of this analysis is to document the wave heights at a farming site acc. requirements in NS9415: 2009. This report emphasizes the importance of communicating the results of calculations carried out in the site, and provide an general overview of any variations in wave height at the site. The report is intended as a supplement/ annex to the site survey report. This report specifically describes Hs (significant wave height) and Tp (peak period) from ocean swell and wind-driven waves. These are important parameters for capacity calculations of technical equipment in aquaculture installations. Several parameters from the runs may be extracted afterwards if desired.

Background information as source material and the theory behind waves and calculations performed in SWAN (Simulation Waves Near Whore) is not emphasized in this report. Noomas can upon request send information or answer questions directly.

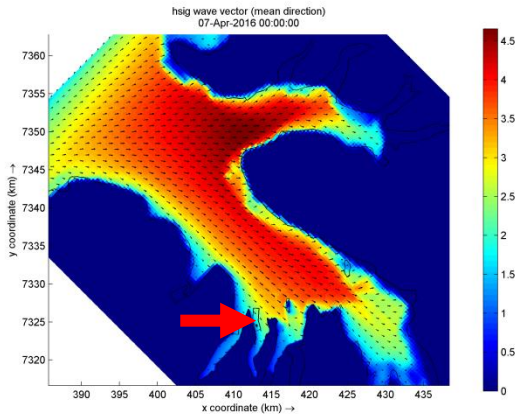
The program which is used for computation of wave conditions in this report is the most accurate available P. T. How much time you can put in to validate and calibrate the results and quality assurance input bathymetry (bottom topography), offshore environmental status and more, will be crucial.

3.0 Method

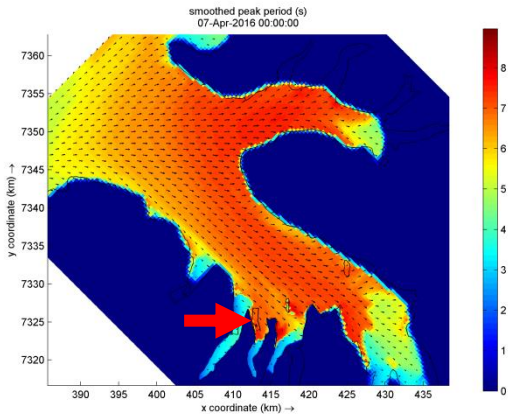
It is estimated ocean swell and wind generated waves with diffraction and refraction in JONSWAP (Joint North Sea Wave Observation Project) spectrum into the site from bathymetric nature regionally and locally. It is used the leading and reputable program SWAN in Delft3d, using 3rd generation wave model. This is a numerical wave model where it is regarded with full wave spectrum from all directions and depths in each calculation point (grid points) from the periphery of the calculation area (grid) into the specific location. It is in this calculation generated offshore waves with max Hs 10.4 m and Tp 14.5 s at current wind speeds. Source of boundary input by report Öldufarsreikningar fyrir mögulegt fiskeldi á norðanverðum Vestfjörðum, may 2013.

4.0 Results overview: Combined waves from W, NW, N and swell from W, NW, N.

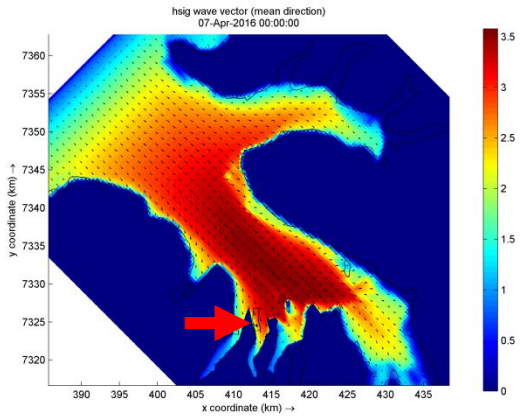
Hs - wind from 270°



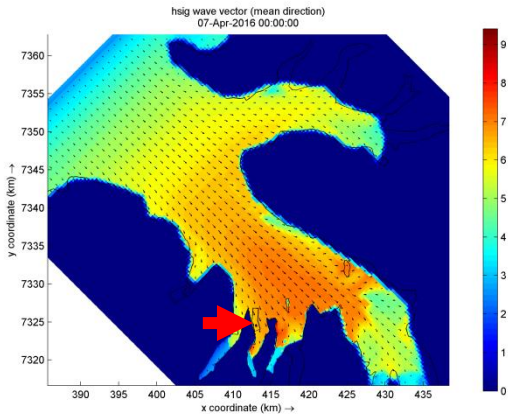
Tp – wind from 270°



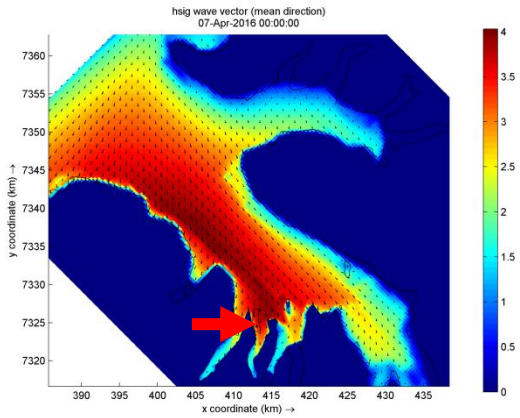
Hs – wind from 315°



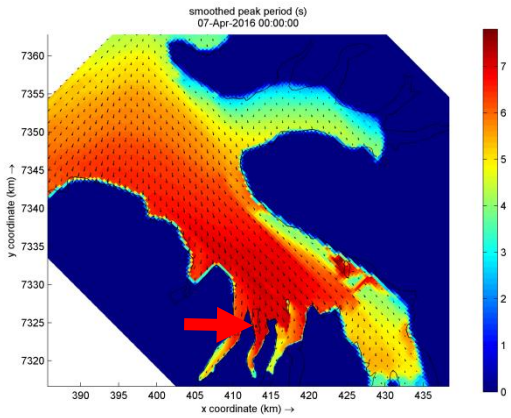
Tp – wind from 315°



Hs – wind from 360°



Tp – wind from 360°



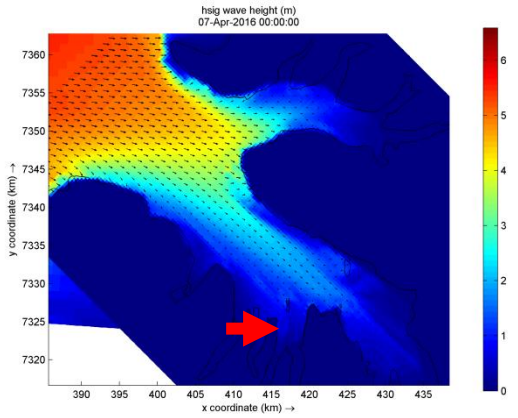
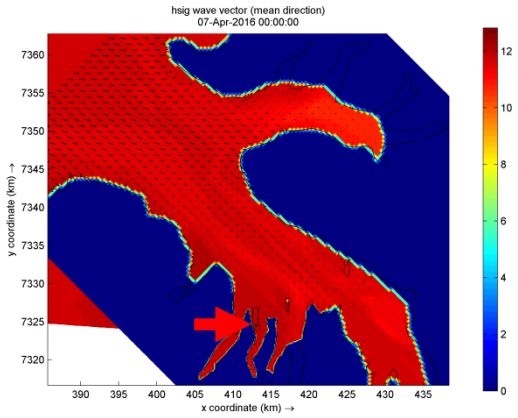
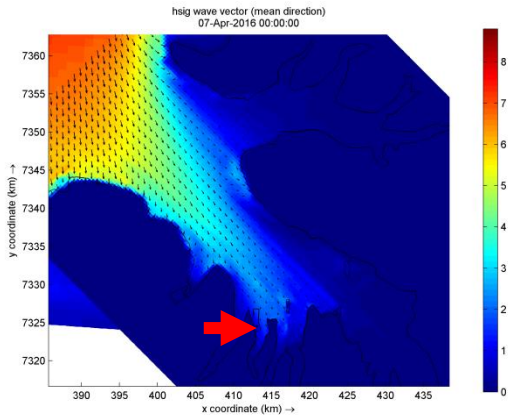
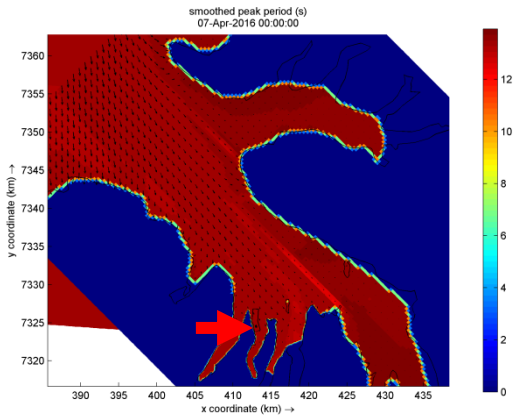
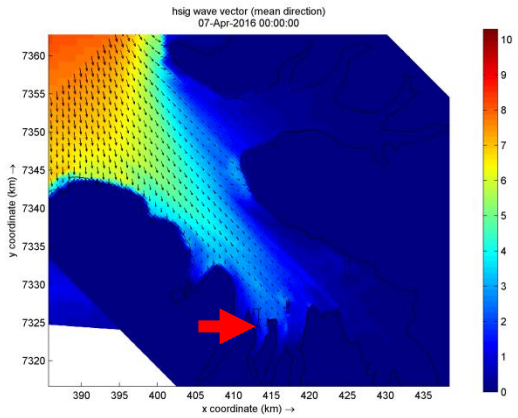
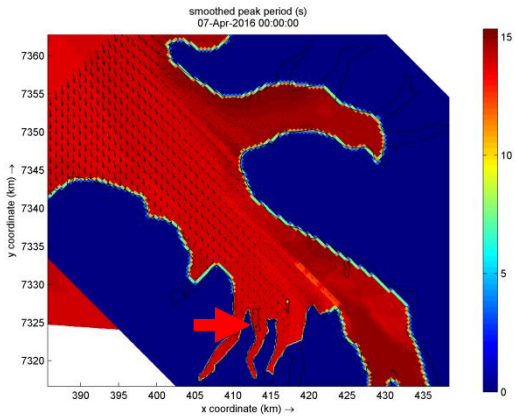
Hs – without wind swell from 270˚	Tp - without wind swell from 270˚
	
Hs – without wind swell from 315˚	Tp - without wind swell from 315˚
	
Hs – without wind swell from 360˚	Tp - without wind swell from 360˚
	

Fig. 2. As shown in the figures the ocean waves are breached down before it reaches the site (red arrow). Hs is indicated in the left column and corresponding Tp in the right column.

5.0 Results detailed: Combined waves from N, NE, E, SE, S, SW, W, NW and swell from S.

Combined waves with 50-years returnperiod wind from North:

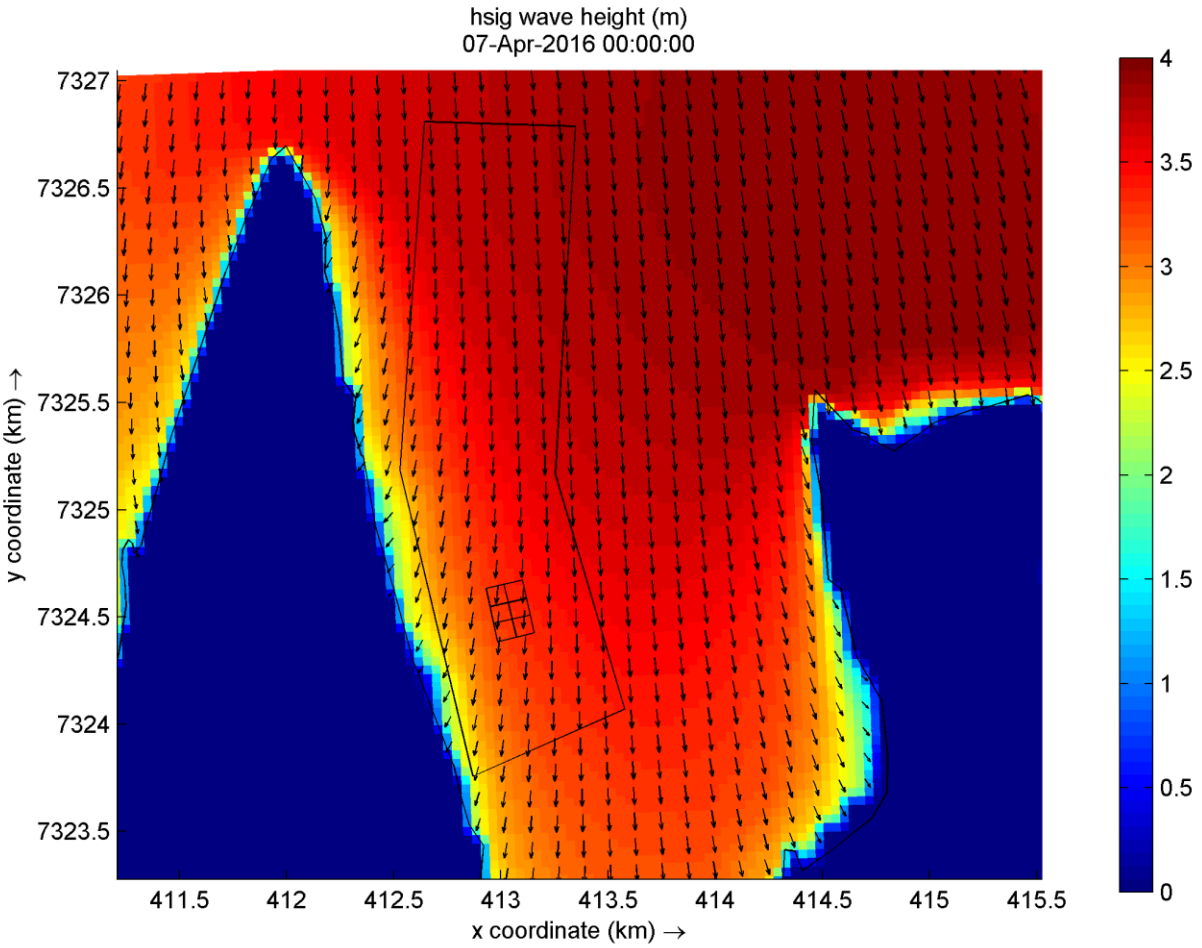


Fig. 3. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Combined waves with 50-years returnperiod wind from Northeast:

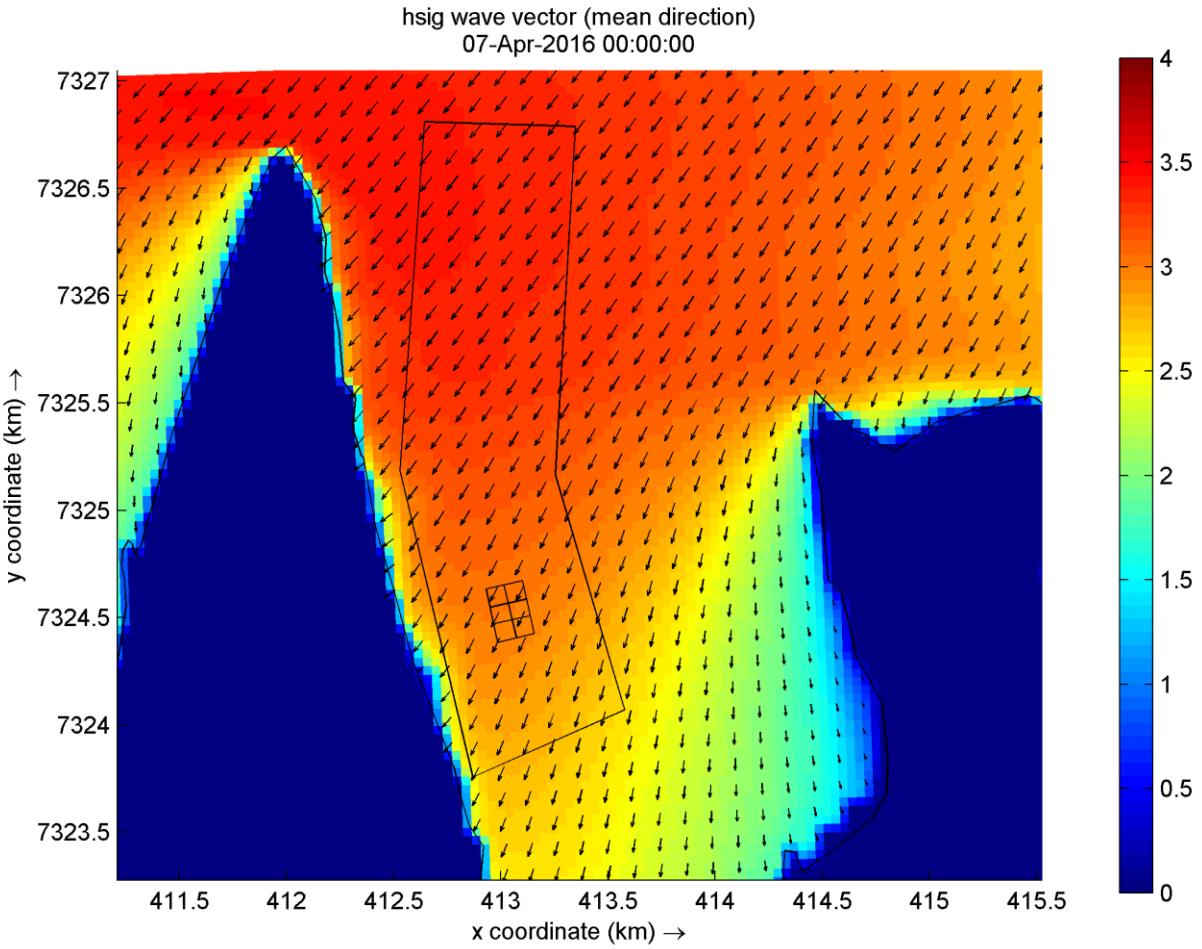


Fig. 4. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Combined waves with 50-years returnperiod wind from East:

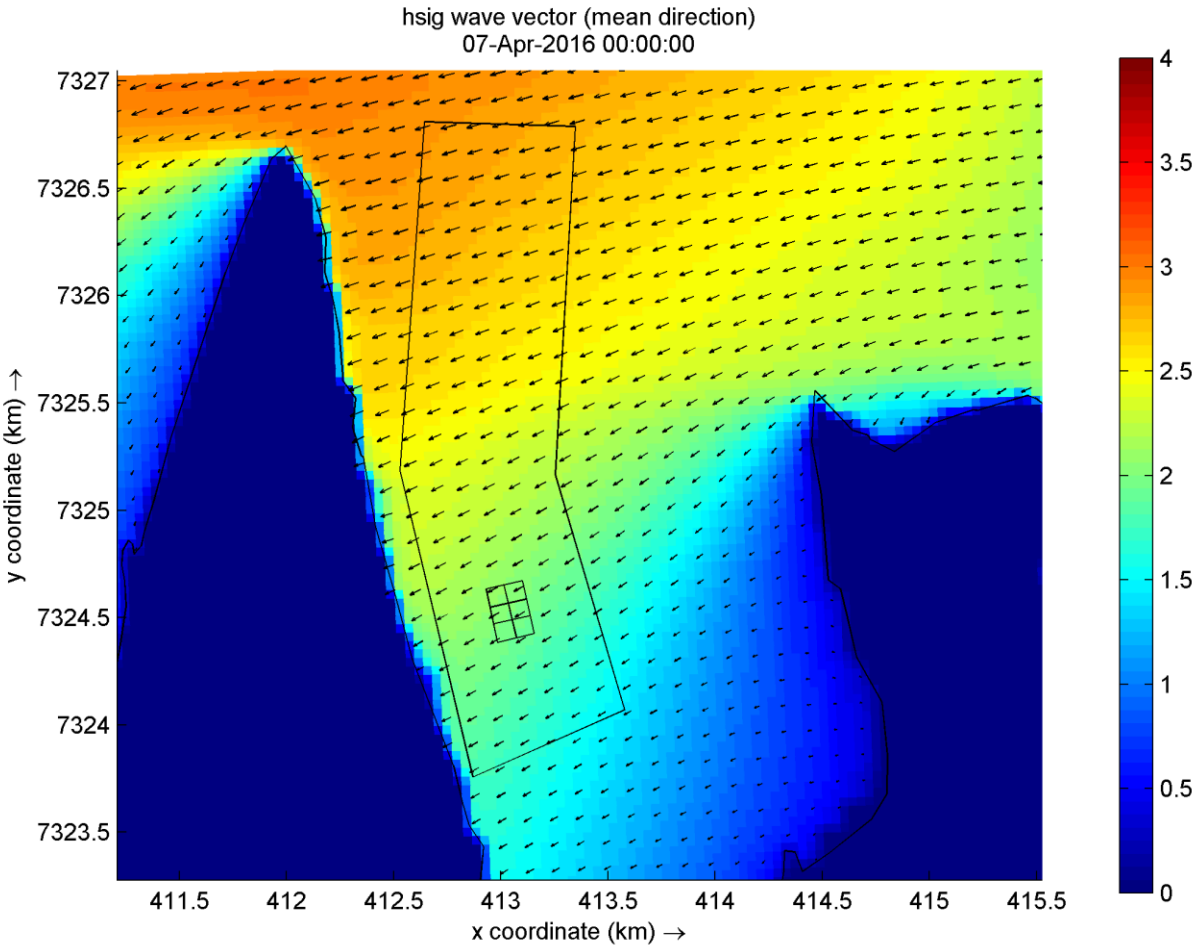


Fig. 5. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Combined waves with 50-years returnperiod wind from Southeast:

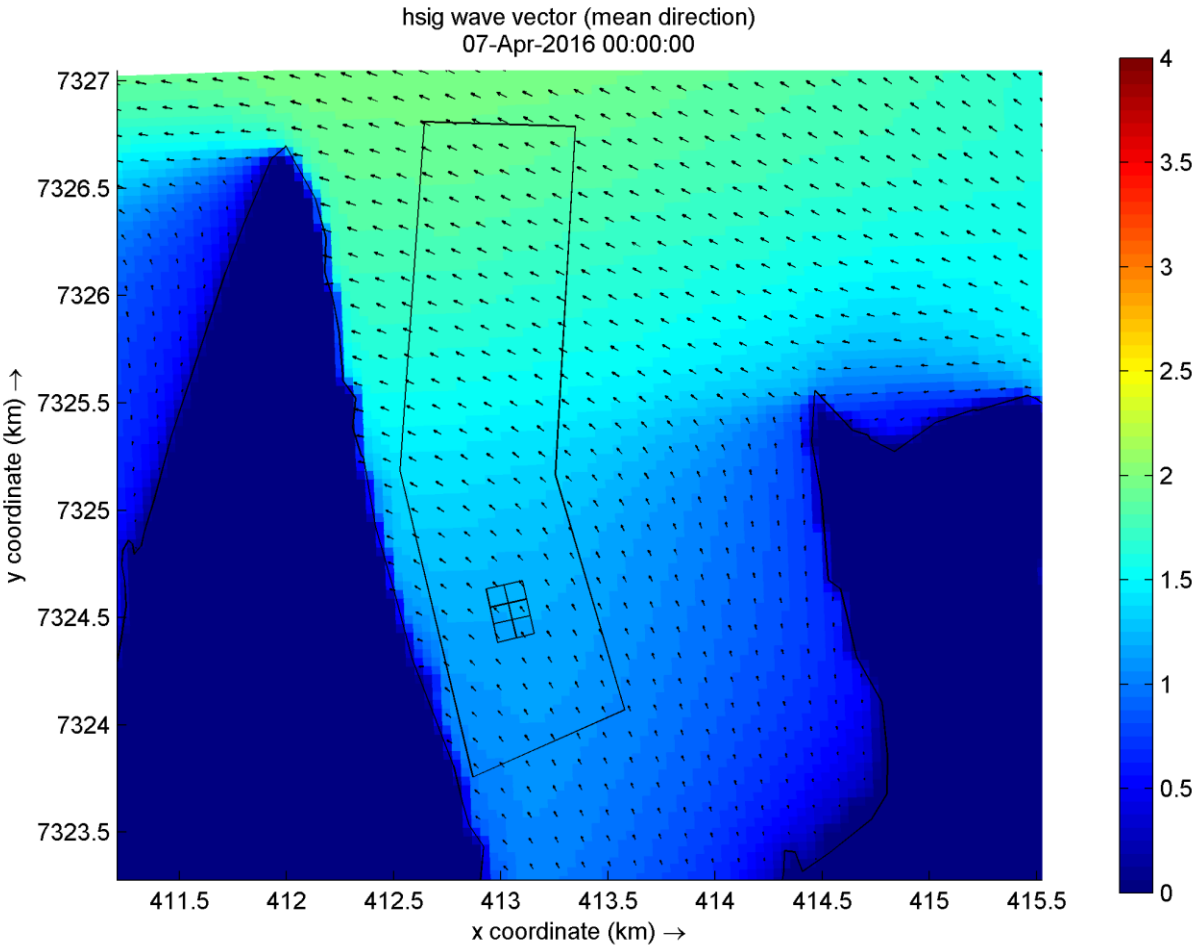


Fig. 6. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Combined waves with 50-years returnperiod wind from South:

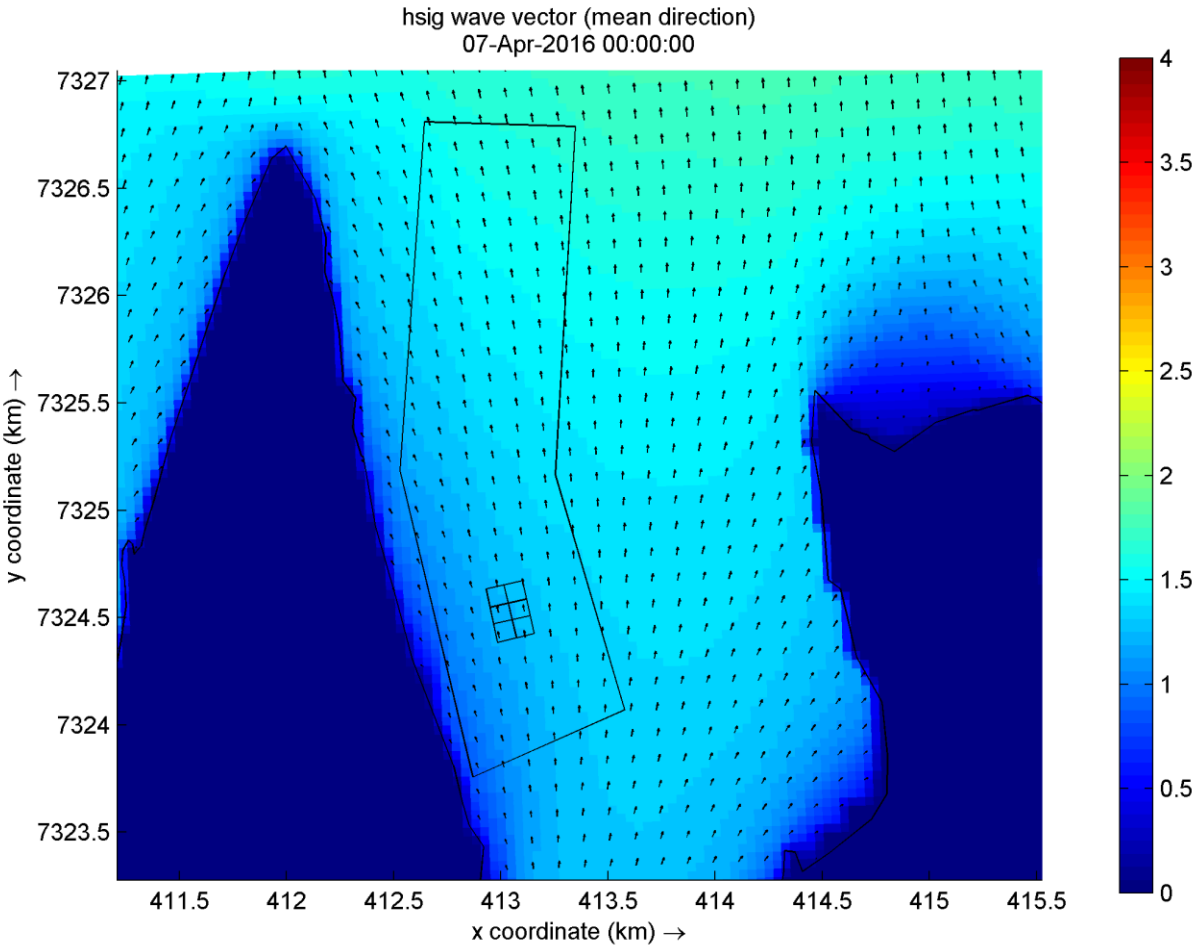


Fig. 7. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Combined waves with 50-years returnperiod wind from Southwest:

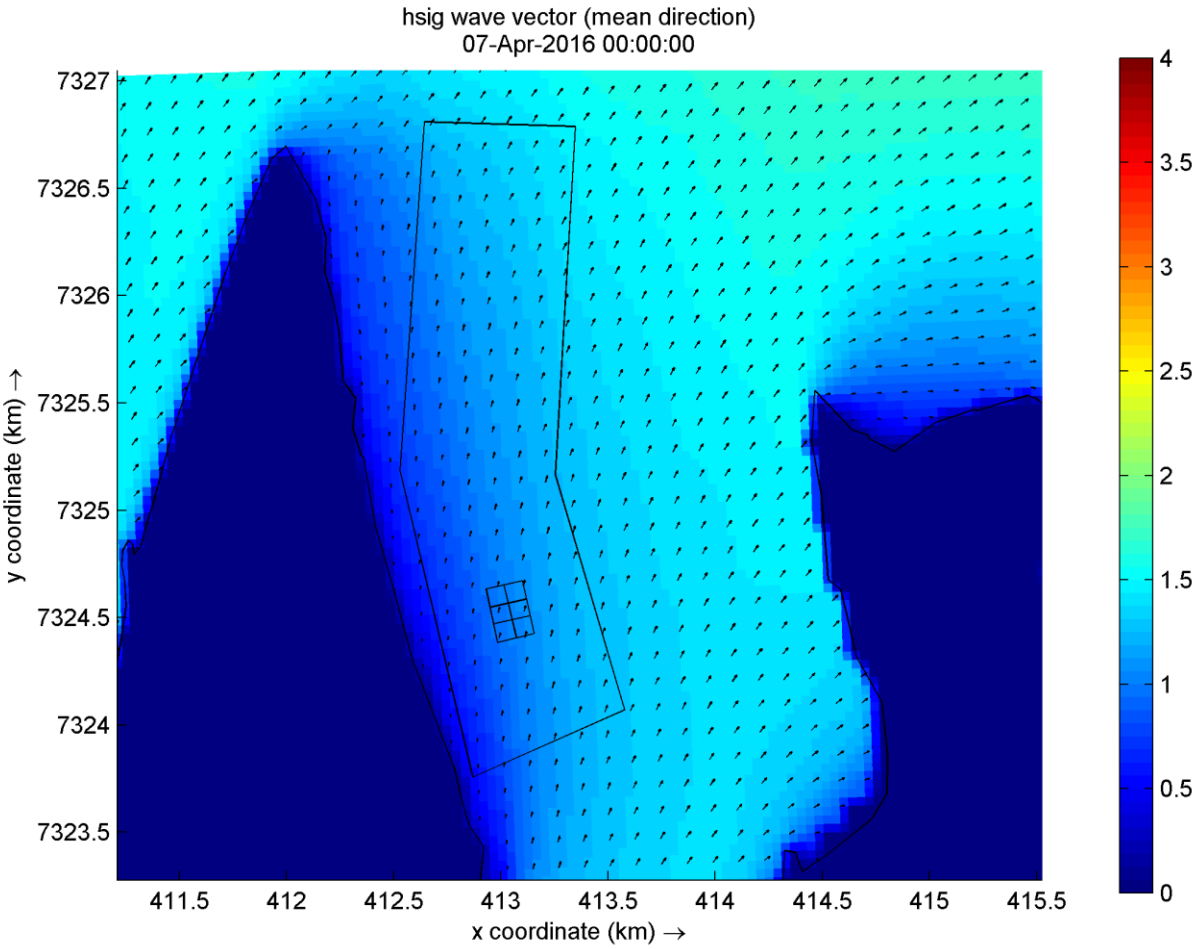


Fig. 8. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Combined waves with 50-years returnperiod wind from West:

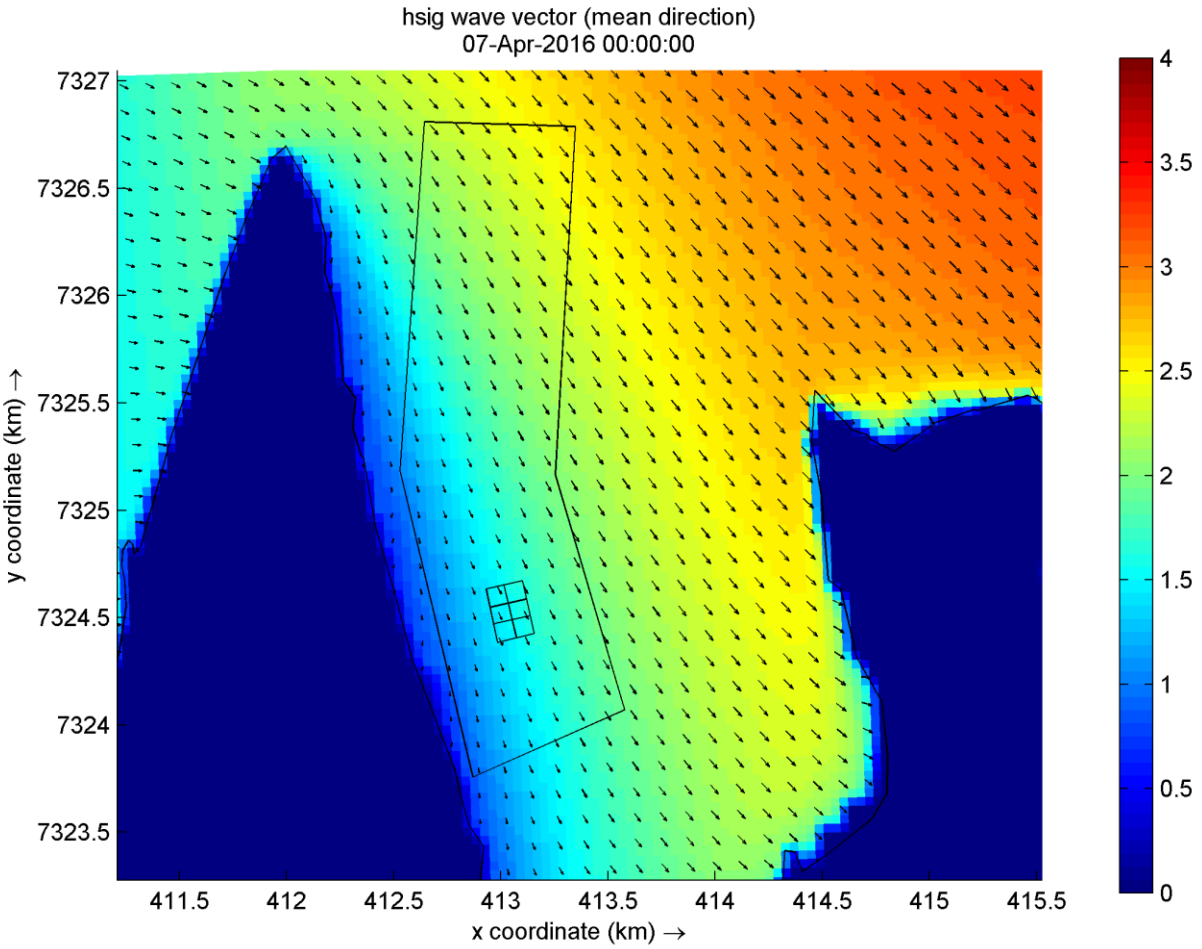


Fig. 9. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Combined waves with 50-years returnperiod wind from Northwest:

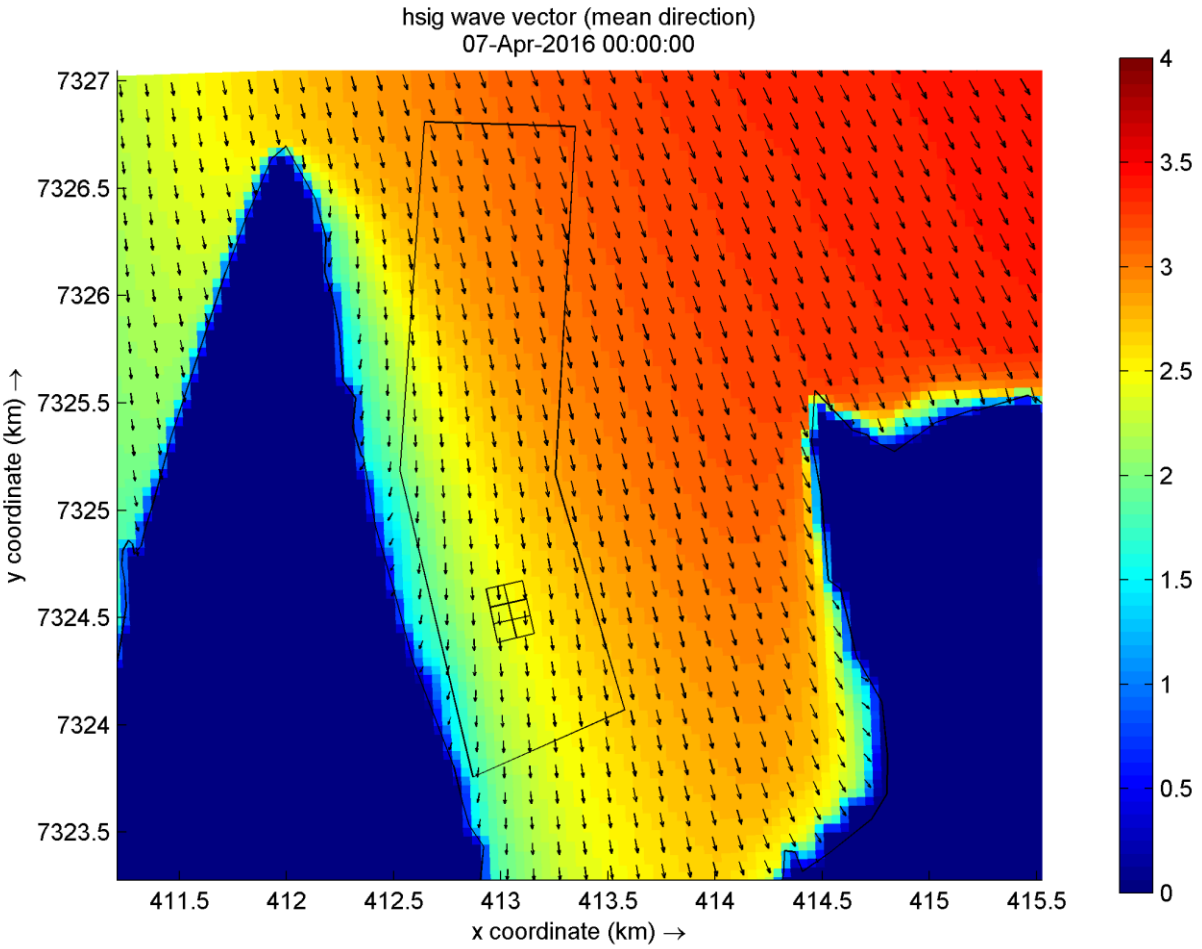


Fig. 10. Wave heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 4.0 m. The arrows indicate wave direction.

Swell without wind from North (50- years Hs offshore):

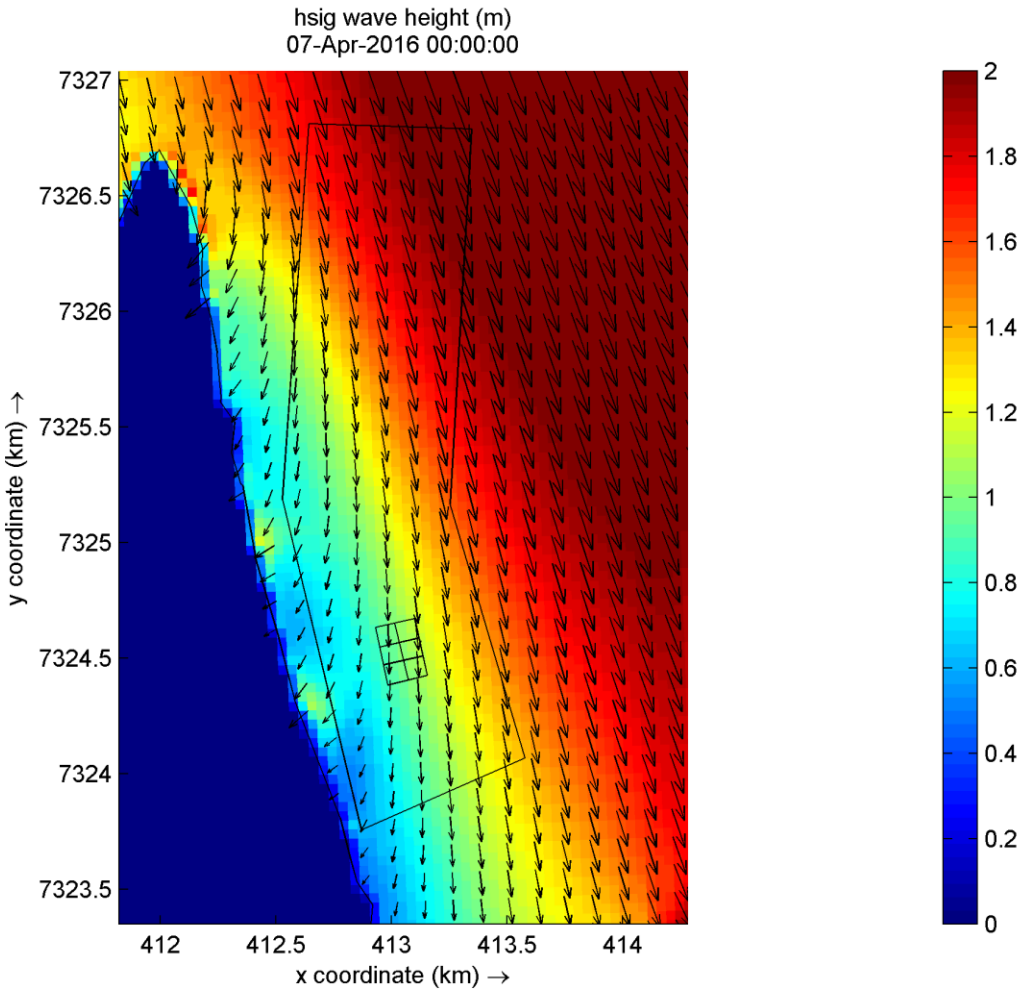


Fig. 11. Swell heights are indicated in color where dark blue is Hs = 0.0 m to dark red Hs = 2.0 m. The arrows indicate wave direction.

Frequency spectrum in calculation point by combined waves and swell from the most exposed directions.

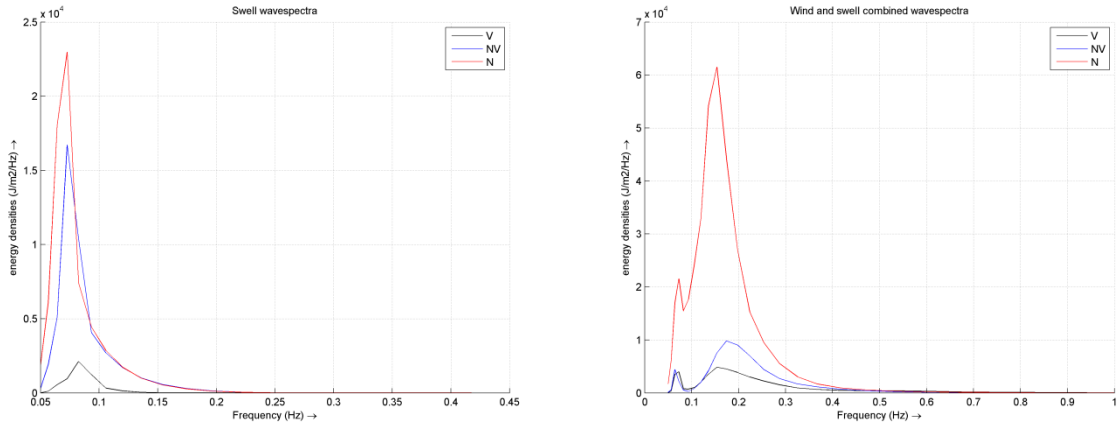


Fig. 12. As shown in the figures above there is most energy in wind-generated waves coming in from the North. The long-period component is clearly a minor part of the energy spectrum by winds from these directions relative to the wind-generated waves with 10-50 years return period from North.

6.0 Conclusion

The results presented in SWAN with combined ocean swell and wind-generated waves with refraction and diffraction, shows that long-periodic waves affecting the site at lower wind speeds from Northwest and North. Most at risk are the site by strong winds (10-50 year return period) from North. Wave spectrum will therefore be dominated by wind-generated waves from North. With wind from West and North West the long-periodic component will be more prominent but general energy will be much lower. The long-period component contributes less to the wave height for combined waves by these conditions.

Table 1 page 4 summarizes the results of numerical calculations with SWAN in the directions which are believed to be affected by the waves of the ocean in combined state. In addition, there are included wind-generated waves for the site in eight directions.

The coast outside this site will be exposed to ocean swell from storm fields located both close to the Icelandic coast and far away. This may cause the Tp to appear slightly differently depending on where storm fields moves. Also reflections and resonance due to local topography may affect Tp.

The results of combined state of wind-generated waves and ocean swells with refraction and diffraction should be included in capacity calculations for the main structures and mooring system at the site.