Netherlands Enterprise Agency

Questions & Answers Online seminar (webinar) Morphodynamics Borssele WFS I en II

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Nr	Question	Answer
1	The definition of RSBL and MaxSBL seems conservative in this case as you calculate the static seabed as cutting completely the sand features. How would you reduce the conservatism?	This is explained in the report. Deltares is not cutting features. By subtracting the static seabed from the full bathymetry, Deltares distinguishes between the mobile and the static seabed components. Later Deltares added the migrated mobile components to the static seabed again. The only conservatism in the values is related to 1. An uncertainty band (survey inaccuracies and megaripple elevations) and 2. by calculating an envelope of possible future seabeds based on three estimates for the migration direction and three estimates for the migration rates of the sand waves. Due to the complex nature of the Borssele seabed this does not seem to be an overly conservative approach. After all, the sand wave orientations and migration directions/rates are varying significantly throughout the site.
2	Some windturbine foundations, such as monopiles, require scour protection by means of filter and armour rock. Is there a risk that morphodynamics jeopardize the integrity of such scour protection in the period 2015-2046?	Yes, depending on the location, the morphodynamic activity can influence the integrity of a scour protection. For example, when installing a scour protection on the top of a sand wave, the scour protection will have to be able to deal with a gradually lowering seabed. This is not impossibe, but should be taken along in the design of the protection.
3	Are there large differences in megaripple height within e.g. the Borssele Wind Farm Site I?	There is quite some variation in mega-ripple height. Table 3.8 (which can be found on page 25 of the report) provides non-exceedance curves of the mega-ripple dimensions, for both wind farms sites. Also note that typically the megaripple crests are larger (=higher) than the megaripple troughs.
4	What will be the influence of major civil infrastructures (e.g. Zeebrugge, Deltawerken and Maasvlakte) on the long term behaviour of the morphology in this area?	Large infrastructural works mainly influence the nearshore area, the effect diminishes as you move offshore. For example, for Maasvlakte II in Rotterdam an effect was seen upto 6km offshore. Since the BWFZ is located much further offshore, Deltares expects very limited effects of such large scale projects.

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5	You just showed in video that the direction of the moving sandwave is quite well known - why are you still considering for each individual sandwave a movement going in two directions? I can imagine that you only do this for an area where the sandwaves converge / diverge.	The video showed a visualisation of one of the 9 considered combinations of migration speed and direction. This visualisation was created for illustrative purposes only; it does not present an accurate prediction of the future seabed, but merely one possible prediction. To predict future seabed level variations, all potential migration directions and speeds have to be considered. This is why Deltares uses the envelope of 9 bathymetry estimates, instead of a single best guess. Please also note that Deltares only calculates with two possible directions (NE and SW), if the sand waves in that local transect show migration in two directions. In the example in the presentation (sheet 39/60), this particular transect shows a clear preference for southwest-directed migration.
6	Where is this seabed features classification based upon (literature)?	The classification was based on e.g. Ashley (1990), with a classification of offshore dunes in size. Later mobility was added to the size-classification in several references (e.g. Morelissen et al (2003).
7	Having the cable installation in mind, would it be possible to have a more detailed analysis of the exact sea level differences over time? I assume this difference can be derived from the available bathymetries at BSI and BSII from years 2010 and 2015. Will it be part of the Deltares time-series?	Deltares assumes that seabed levels are meant here (instead of sea level, which would be water surface). So, more detailed spatial analyses of bed level differences in time is possible, as long as the bathymetric data is in sufficiently high spatial resolution. The grid size in the study was 5 x 5 m for the older surveys and 1x1m for the 2015 survey, which was then downsampled for most of the analysis to be able to compare with the older surveys. More precision in time would need more surveys in time. The time series at Deltares comprises 3 surveys in time and was made available by the Netherlands Hydrographic Office, Royal Netherlands Navy (2000 and 2010) and Deep (2015).
8	Can you confirm that 9 predictions per year until 2046 are done and that the average of those 9 predictions is taken as the "standard" bathymetry each year? which are the boundary conditions for every prediction?	There are indeed 9 predictions per year. But these are not combined to form an averaged prediction. Instead, the outer envelope of these bathymetries are taken to obtain the RSBL and MSBL. So these are based on a total of 279 bathymetry predictions (i.e. 31 years * 9 bathymetries)

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9	You mentioned earlier the possibility of self burial for the Inter Array cables: would you be able to determine how long it would take for a cable to self bury if installed in the trough between 2 sand dunes?	In the presentation it was mentioned that in case of an upward predicted seabed movement, that closely around offshore foundations, the seabed will most likely not rise. This is not caused by the structure effectively stopping the sand wave, but by local scour around the foundation. Cables are buried underneath the seabed and will therefore not cause local scour. Therefore, the cable burial depth increases if the seabed is rising. In case cables are installed on top of the seabed without trenching/burying them, these cables might self bury, but this is related to local sediment transport processes and the shape of the cable. Note however, that the cable might also freespan along certain sections due to local scour. The timescales of local processes are always much smaller than the timescales of large-scale morphodynamic processes such as sand wave migration: it may take decades before a migrating sandwave has effectively covered the entire cable. This time period is strongly dependent on the location inside the windfarm. During all this time the cable is exposed to anchors, fishnets, dropped objects and so on. If you want to consider an approach of installing cables on top of the seabed, it is recommended to investigate these local processes as well.
10	Is the seabed form analysis completed in GIS or do you use other software packages?	Most of the processing is done in MATLAB, with in-house written scripts, tailored for this specific methodology. GIS software was used mainly for pre-processing of the raw data and post-processing the results (i.e. generating maps).
11	Are you able to model the future seabed bathymetry considering the monopile structures in place? Will the structures have a lot of influence on the sand wave mobility?	The scale of the sand waves is much larger than the area of influence of a typical foundation. The foundation will thus not influence the migration of the sand waves, but of course it will have a local effect. Local scour is very well predictable, but this is not within the scope of this study.
12	How do you assess the amplification of the 100 years wave height and periods, caused by the sea bed level fluctuations?	It is certainly possible to assess such wave amplification, this is however not part of this study. These aspects are being investigated in for instance Joint Industry Project Wifi (Wave Impact against FIxed structures). Please also note that the resolution of the metocean study is also an important aspect for such an investigation.
13	You mentioned earlier the possibility of self burial for the Inter Array cables: would you be able to determine how long it would take for a cable to self bury if installed in the trough between two sand dunes?	Regarding the self burial time: with the available data it is certainly possible to predict this, however this was not within the scope of this study.
14	You list a zone: possible with additional measures to be taken: What are those measures?	These additional measures depend on your design. For example, a monopile has different requirements than a jacket or an inter-array cable.

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15	You mention that the seabed close to the foundations will not rise significantly because local scour protection will prevent this. Does this mean that if you place a monopile foundation in the through between 2 sand waves, install scour protection around the foundation, and then the upstream sand dune starts moving, the dune would move around the monopile and its scour protection, rather than moving uniformely and covering the scour protection as well?	Yes, that is correct.
16	I have a hard time imagining a 5 m high dune that is migrating uniformely opening a gap because of a scour protection 50 cm high around a monopile.	It is not the scour protection that causes the gap, but the foundation that is protected by the scour protection. (i.e. the reason why you would install a scour protection in the first place). Also note that a typical thickness of a scour protection is larger than 0.5m, meaning that only a few meters of local scour already erodes away the approaching sand wave.
17	Did you make a literature review concerning migration / direction speed for seabed features? Did you consider to assess seabed mobility based on available information from the near-by windfarms in the belgium part of the North Sea?	Deltares did do a literature study and Deltares has experience with morphodynamic studies for some of the Belgium wind parks as well. Migration rates of sand waves are spatially variable in the North Sea (including Belgium shelf), so rates are based on local analyses. We extrapolated the rates from the data analysis to the future, which includes some assumptions; hence the band width coming from the envelopes of predicted future bathymetries. Examples of the assumptions are 1. sand waves maintaining their shapes and 2. limited effect of storms on the sand wave amplitudes.
18	Did you consider that the seabed features are oscillating and not moving in one preferred direction? This is one of the major conclusions from 10 years of bathymetry (e.g. thorntonbank)	Deltares did see some oscillating sand waves in some of the transects in our datasets as well. This oscillating movement is captured in the exceedance curves of sand wave migration at each considered transect. However, the number of data sets (3) was not sufficient to fully capture such oscillating movement and the envelope will therefore result in a wider range of sand wave migration, which is conservative. Note that the variability is already quite significant within the Borssele area. Some of the features observed in Belgium windfarms are observed here as well, but there are also differences.
19	Is it possible to get two different classification zones overview maps: one for lowering and one for rising?	This data was not delivered, as it was not part of the scope. You can construct these datasets yourself by computing the difference between RSBL and the 2015-bathymetry (this map was also delivered as "Maximum seabed lowering") for the classification of the maximum seabed lowering. Similarly, compute difference between MSBL and 2015-bathymetry (this map was also delivered as "Maximum seabed lowering") for the classification of the maximum seabed rising. Specific requests fall outside the scope of the study for RVO.

Nr	Question	Answer
20	Is the influence of the dredging area beside Borssele included into your studies?	The influence of dredging is not included in the study.
21	What is the net-sedimentation/net-erosion on the two wind farm sites? From the last 25 years and expected for the next 25 years?	The analysis of the static bathymetries revealed that there is no measurable net erosion/sedimentation in the period 2000-2015. The net area-averaged bed level differences were less than 1mm. Deltares considered it safe to assume that over a 30 year period net erosion/sedimentation will also stay negligible and much smaller than bed level differences due to migration of seabed features.
22	Is the timeseries for each "point"/area on the seabed available? The classifications zones are useful for layout but not for cable planning, here more detailed information is needed.	The bathymetry data (2000/2010) can be downloaded here: http://offshorewind.rvo.nl/file/view/33717212/gis-morphodynamical-desk-study-wfs-all-deltares and here (2015, but only for BWFS-I and II): http://offshorewind.rvo.nl/file/view/33763372/gis-morphodynamical-desk-study-wfs-i-and-ii-deltares-2015 The 9 predicted bathymetries for each year are not made available, see also answer below.
23	The RSBL and MSBL are now only presented for the timespan 2015-2046. For several reasons (cable burial depth, maintenance strategy, etc.) it would be beneficial to have a predicted bathymetry for each year. Can the bathymetry predictions on which the RSBL and MSBL are based be made available as well?	No, the yearly bathymetry predictions can not be made available because they simply do not exist: the study did not predict the bathymetry for each year. Instead, the potential bathymetric change for each year was determined and the envelope of all these predictions resulted in the RSBL and MSBL. It would be possible to take such an envelope for different (smaller) time spans (e.g. calculating the RSBL and MSBL for 2015-2020), but this was not within the scope of this study.
24	Do these classification zones include the uncertainty in seabed level?	Yes, these are included in the classification zones.
25	Can you recommend software to read/process the supplied GIS data?	The data can be accessed with GIS software such as ArcGIS and can then be exported to ascii-format.