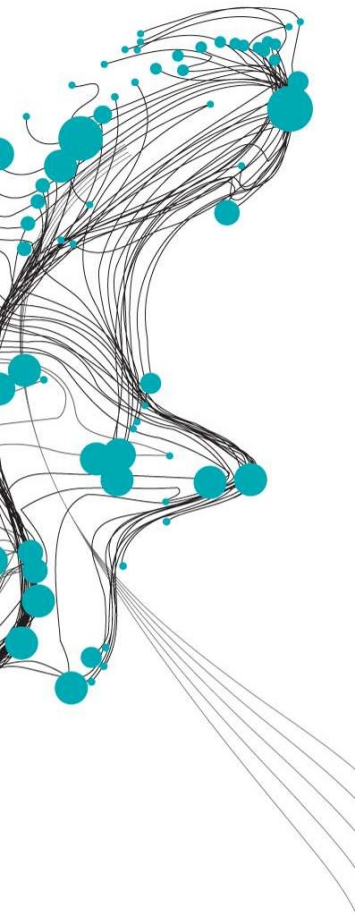

UNDER THE SEA(BED)

SENSITIVITY ANALYSIS OF THE NON-MOBILE REFERENCE LEVEL FOR HIGH-VOLTAGE CABLES IN THE NORTH SEA

More and more offshore wind farms are installed in the Dutch North Sea, with plans to expand capacity fifteenfold by 2050. The electricity generated is transmitted to the onshore grid via submarine cables, which are lowered into the seabed to protect them against external threats. To account for seabed mobility, the cables are lowered relative to a Non-Mobile Reference Level (NMRL), designed to maintain minimum protective cover of sediment throughout the cable operation phase and to minimise life cycle costs, even when the seabed changes due to sand wave migration. However, this 3D reference level involves uncertainties that have previously not been thoroughly evaluated and quantified.

Therefore, this study aimed to evaluate the uncertainties in the Non-Mobile Reference Level as determined by WaterProof in the offshore seabed of the Dutch North Sea by testing various settings of the method and using various bathymetric inputs. To this end, bathymetric data was collected, reprojected, and corrected from four different data sources, three of which were used to establish the NMRL in two different locations. With four tested settings and four tested various methods for handling and using input data, this study tried to evaluate uncertainties within the NMRL.

The NMRL established with WaterProof's method showed to be sensitive to parameter setting changes. The most sensitive parameter in WaterProof's method is the percentile setting, selecting the representative per cross-section. Varying the period between surveys has a small effect on the NMRL, but since it is easy to implement, it is recommended to include the monthly accuracy in the method as this reduces the uncertainty. During these experiments, it was also found that there is almost no difference in the moving average depth per 5 m or 25 m cable relative to the Most Recent Seabed Level MRSL and the NMRL. This implies that there is no need to obtain the moving average depth of 5 m; instead, the moving average per 25 m is recommended to be used.

The three different repositories have been utilised to compare the bathymetric data. While publishing the same data, differences were found. A mean difference of up to 21 cm and a shift in the horizontal plane of 29 m were found between the repositories, seriously affecting the NMRL. Due to the large differences between the bathymetric data of the repositories, it is not possible to combine the different repositories to obtain migration rates and growth rates of sand waves.

Besides using different repositories (see Figure 1), the grid resolution and grid origin were varied. Due to the method of comparison, no quantitative conclusions can be drawn. Despite this, the NMRL was shown to be sensitive to the repository used. During this research, it was also found that the method of interpolation from 2D cross-sections to the 3D NMRL has limiting effects on increasing the resolution of the bathymetric data. For further research, it is recommended that the most sensitive parameter, i.e. the percentile, is further investigated. Also, when using different repositories, the question of whether it would be possible to extrapolate the seabed found in other repositories by using the observed sand wave migration and growth rates rose. The author sees potential in this, but further research should be done to see whether this form of combination between repositories can be made.

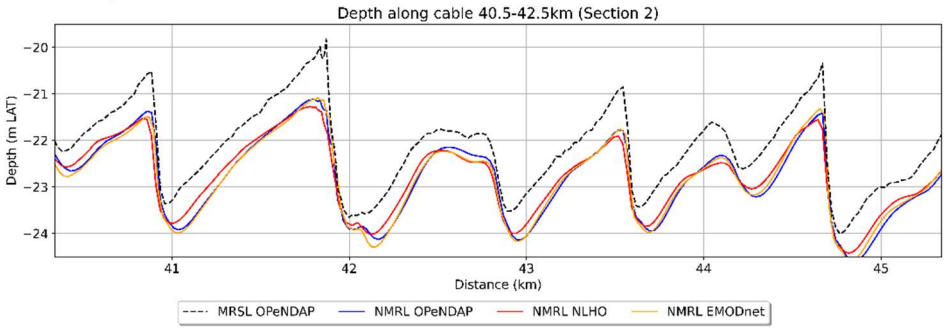

Figure 1: Non-Mobile Reference level determined from the three different repositories utilized in this thesis, using the same surveys (corrected by mean difference and shift in horizontal plane). Displayed together with the Most Recent Seabed level obtained from the Deltares OPeNDAP repository.

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