Impacts of offshore wind farms on waves and sediment transport

Environmental mapping and screening of areas for offshore wind in Denmark

Danish Energy Agency

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Appendix:

NOMENCLATURE

Abbreviation	Description
BHS	German Federal Maritime and Hydrographic Agency
DEM	Digital Elevation Model
DTM	Digital Terrain Model
$\mathbf{H_{m0}}$	Modelled Significant Wave Height
$\mathbf{H_s}$	Measured Significant Wave Height
MEA	Mean Absolute Error
MSL	Mean Sea Level
MWD	Mean Wave Direction
NCCS	Norwegian Center for Climate Services
RMSE	Root Mean Squared Error
SI	Scatter Index
SMHI	Swedish Meteorological and Hydrological Institute
$\mathbf{T_p}$	Peak Wave Period
UTM	Universal Transverse Mercator
VD	Vertical Datum
WGS84	World Geodetic System 1984

1. Preface

This report contributes to the project "*Environmental mapping and screening of areas for offshore wind in Denmark*" initiated in 2022 by the Danish Energy Agency. The project aims to support the long-term planning of offshore wind farms by providing a comprehensive overview of the combined offshore wind potential in Denmark. It is funded under the Finance Act 2022 through the programme "Investeringer i et fortsat grønnere Danmark" (Investing in the continuing greening of Denmark). The project is carried out by NIRAS, Aarhus University (Department of Ecoscience) and DTU Wind.

The overall project consists of four tasks defined by the Danish Energy Agency (https://ens.dk/energikilder/planlaegning-af-fremtidens-havvindmoelleparker):

1. Sensitivity mapping of nature, environmental, wind and hydrodynamic conditions.
2. Technical fine-screening of areas for offshore wind based on the sensitivity mapping and relevant technical parameters.
3. Assessment of potential cumulative effects from large-scale offshore wind development in Denmark and neighbouring countries.
4. Assessment of barriers and potentials in relation to coexistence.

This report addresses one component of each of the first three tasks. Specifically, it provides an overview of areas within Danish offshore regions that are likely to be particularly vulnerable to offshore wind farm development regarding waves based on wind data provided by DTU Wind, considering the wind in a scenario without wind farms as well as two scenarios with wind farms in the years 2021 and 2030, respectively.

The spectral wave modelling was conducted based on wind data from a single year (2019), which hinders interannual comparisons. However, in order to address the impact of wind farms on waves, the natural annual/monthly variation have been analyzed with the use of existing wave data for the years 1988 to 2024 at several locations. Section 4 specifies the data sources used in the sensitivity mapping for waves and outlines additional existing data. Similar for the sediment transport capacity analysis is listed in Section 9.2.

It is important to recognize that sensitivity mapping serves as a dynamic tool, which can be updated as new data becomes available.

2. Summary

The Danish Energy Agency commissioned this report to support the long-term planning for offshore wind development in Denmark. The report focuses on the potential impact on waves and sediment transport due to current and future offshore wind development in the North Sea, Kattegat, inner Danish Waters and western Baltic Sea.

Large-scale development of offshore wind can affect hydrodynamics both within and beyond the wind farms and may affect factors such as water transport, current conditions, waves, resuspension, sediment transport, salinity, and temperature. These hydrodynamic alterations have the potential to impact environmental conditions in areas within and around wind farms. Thus, investigating the potential impact on hydrodynamic factors such as waves and sediment transport due to offshore wind development is an important part in the assessment of potential environmental and cumulative impacts.

In order to address this, the report presents the results from both wave modelling and sediment transport modelling of three scenarios: 1) a baseline scenario with no wind farms present, 2) a current (2021) wind farm scenario and 3) a future 2030 wind farm scenario. The wave modelling was conducted for a large area covering the North Sea and the western Baltic Sea, whereas the sediment transport modelling was conducted for three stretches along the Danish coastline. The input data for the wave model are based on simulated wind data from the year 2019 and are calibrated using data from buoy recordings for the same period. The impact on waves is assessed through the impact on the mean wave direction and the significant wave height.

The results from the wave modelling indicate that current wind farms (in operation in 2021) exert minimal influence on wave conditions. Compared to the results from the current wind farm scenario, the future large-scale offshore wind farm development (2030 scenario) generally causes larger reductions in significant wave heights. However, upon examining the annual variation in wave climate, it is observed that the changes in mean significant wave height attributable to the wind farms are significantly smaller than natural fluctuations for the west coast of Jutland and in Kattegat. In contrast, the reduction in significant wave height observed in the Baltic Sea due to wind farms approaches the annual and monthly standard deviation. Generally, for the North Sea, Kattegat and the Baltic Sea, the natural mean wave direction varies by several degrees, and the impact of the wind farms is considered negligible in comparison to these inherent variations.

The sediment transport modelling results show, similarly to the impact on waves, that the impact on sediment transport is larger for the future wind farm scenario (2030) compared to the current wind farm scenario. Comparison between the selected coastal stretches indicate that the impact at Hjelm Bugt in the Baltic Sea is larger compared to the impact along the west coast of Jutland bordering the North Sea, which may indicate that the wave climate in the Baltic Sea is more sensitive to impacts from future offshore wind farm development. It is important to note, however, that the annual variation in the wave climate indicates a larger change compared to the impact introduced by wind farms.

3. Introduction

Large-scale offshore wind farms have been documented to affect hydrodynamics both within and beyond the wind farms, extending over many kilometres (van Duren, et al., 2021; Arneborg, et al., 2024). These effects include a reduction in wind resource efficiency behind large wind farms due to the wake effect, along with localized impacts from turbine foundations.

Water transport, current conditions, waves, resuspension, sediment transport, salinity, and temperature may also be affected, causing changes in mixing and stratification patterns. These hydrodynamic alterations have the potential to impact environmental conditions and exacerbate oxygen depletion in areas within and around wind farms (Daewel, et al., 2022; Maar, et al., 2025).

3.1. Scope of work

The aim of this report is to produce a sensitivity map showing how the presence of wind farms in the North Sea, Kattegat and Baltic Sea affects the wave climate and for three coastal sections the sediment transport capacity. For this purpose, a spectral wave model was used to simulate the following three cases:

1) **Baseline scenario**: a scenario without any wind farm installed based on the wind in 2019.
2) **Current scenario, 2021**: current situation including existing Danish offshore wind turbines utilising the wind in 2019.
3) **Future scenario, 2030**: scenario following the future large-scale offshore wind development in Danish sea areas: the North Sea, Kattegat, Belts and the Baltic Sea utilising the wind in 2019.

The scenarios are executed based on calculation from DTU Wind (Hahmann, et al., 2025a; 2025b) and using the 2D MIKE Spectral Wave model by DHI.

Furthermore, to assess the impact of changes in wave climate on coastal longshore sediment transport, the sediment transport capacity calculated with use of LITPACK was evaluated along three distinct coastal sections for the Baseline scenario, as well as for the Current (2021) and Future (2030) wind farm scenarios.

3.2. Coordinate System

Unless stated otherwise, the Vertical Datum (VD) throughout the report is Mean Sea Level (MSL), while the geographic coordinate system is WGS84 EPSG:7416 ETRS89 UTM32N.

4. Background data

The upcoming sections provide the background information utilized for numerical modelling. This chapter encompasses descriptions of metocean and meteorological conditions, such as wave observations and bathymetric data. The wind data is described in Hahmann, et al., (2025a; 2025b).

4.1. Bathymetry

One of the main inputs to the spectral wave model is the Digital Terrain Model (DTM). A DTM is a digital representation of the terrain or ground surface of a specific area or location. It is a three-dimensional model that provides information about the elevation, slope, and other topographic features of the terrain.

DTMs are created using Digital Elevation Models (DEMs), which are datasets that provide information about the elevation of the ground surface.

The DTM used for the model originates from the combination of two different sources of data: the European Marine Observation and Data Network 2023 (EMODnet, 2023), reported in Figure 4.1, and the digital nautical charts obtained from the application MIKE C-Map from DHI, shown in Figure 4.2.

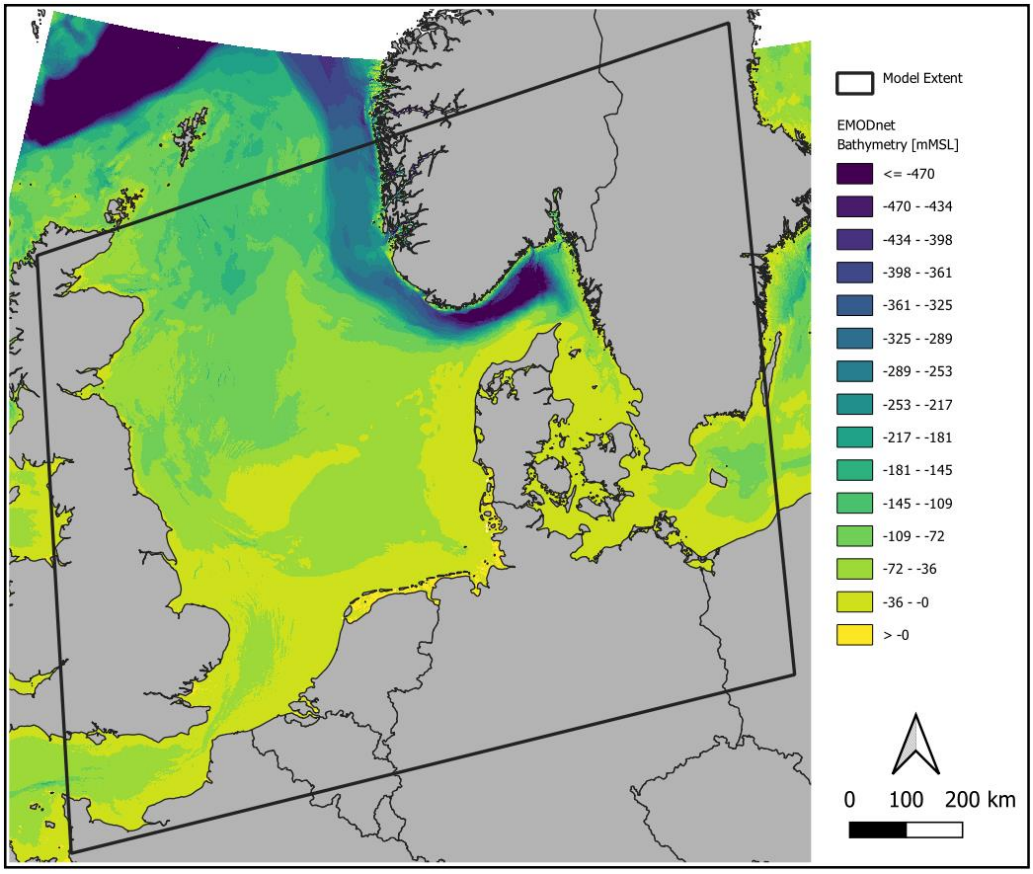


Figure 4.1: Extent of the model area (black box) with EMODnet Bathymetry used for the interpolation of the mesh for the spectral wave model.

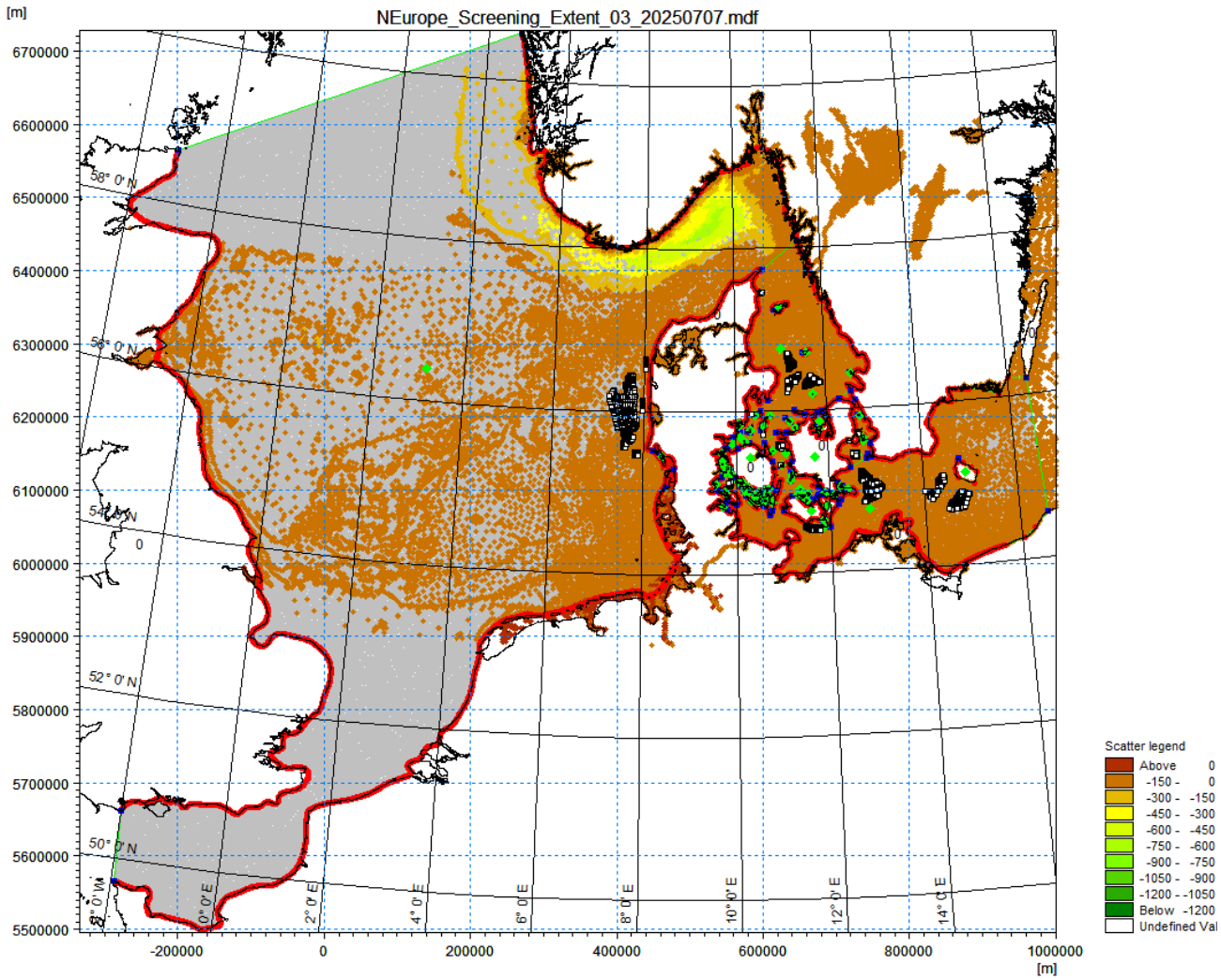


Figure 4.2: MIKE C-Map scatter data of water depths for the North Sea and Baltic Sea used for the interpolation of the mesh for the spectral wave *model.*

4.2. Wind forcing

Wind and pressure used as forcings for the simulations have been developed by DTU Wind and are described in detail in Hahmann, et al. (2025a; 2025b).

4.3. Wave observations

To validate/calibrate the spectral wave model, wave buoy recordings related to the simulated period (January-December 2019) are key for an accurate description of the physical processes. Four sources of data provided wave measurements within the area of study (see Figure 4.3 for buoy locations):

- The Copernicus Marine In Situ TAC: The In Situ TAC component of the Copernicus Marine Service ensures consistent and reliable access to a range of in situ data for the purpose of service production and validation;
- The Swedish Meteorological and Hydrological Institute database (SMHI);
- The Norwegian Center for Climate Services (NCCS);

- The German Federal Maritime and Hydrographic Agency (BSH) which provides in the "Report on the oceanographic conditions at site O-1.3" (German Federal Maritime and Hydrographic Agency (BSH), 2021) a description of the marine monitoring instrument that records at a location close to the Arkona Basin.

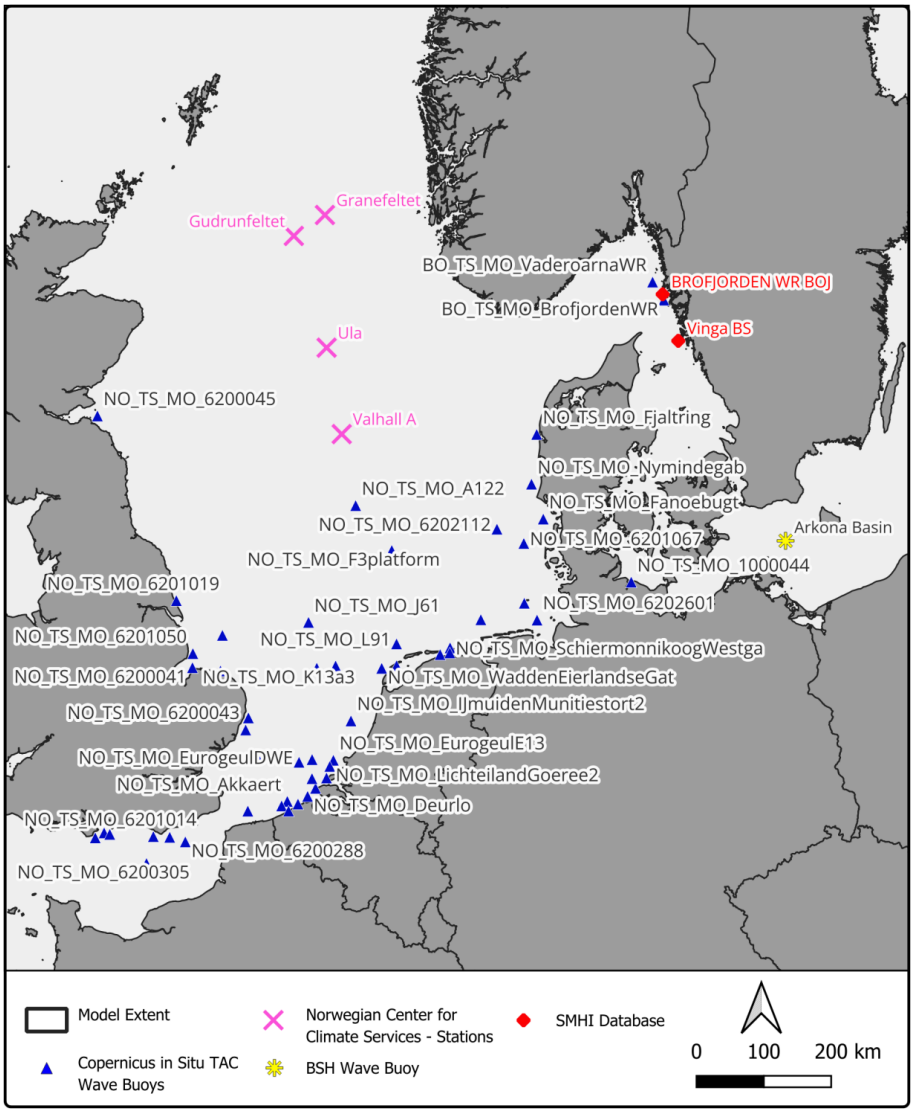


Figure 4.3: Location of the retrieved wave measurements.

The retrieved observed wave data are characterized by significant wave height (H_s), peak period (T_p), and mean wave direction (MWD). However, although all stations recorded H_s, only a few provided information on period and direction.

The collected measurement data underwent a comprehensive quality check to determine which stations provided reliable time series of wave parameters and which could only be used to evaluate the general patterns of the simulated wave data. A description of each recovered measurement station, i.e. location, time-zone and coverage (%) is reported in Appendix A.

Three representative stations for each side were selected to be following reported, while the time-series of H_s and T_p for the other stations are placed in Appendix B.

The stations selected for comparison and reported in the main body of this report are listed in Table 4.1 and shown in Figure 4.4.

Table 4.1: Stations selected for calibration of the spectral wave model.

Station ID	Longitude [deg]	Latitude [deg]	Time	Coverage (%)
NO_TS_MO_F3platform	4.727	54.853	UTC 0	95
NO_TS_MO_A122	3.816	55.417	UTC 0	85
NO_TS_MO_6202112	7.15	55.200	UTC 0	100

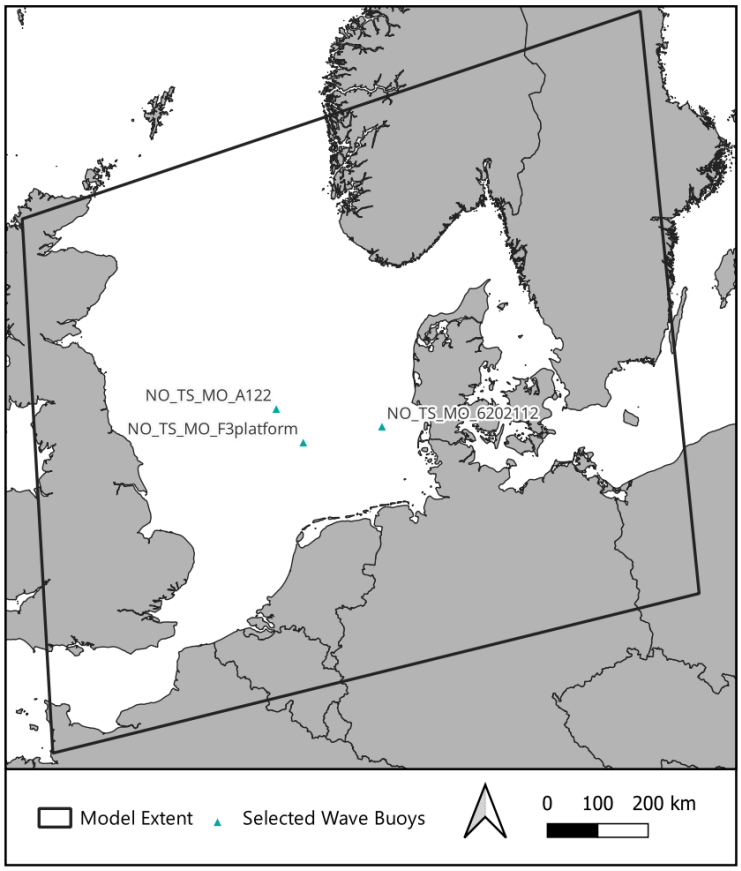


Figure 4.4: Location of the stations selected for calibration of the SW model.

The time series of significant wave height and peak period (when available) for each of the selected stations is reported in Figure 4.5 to Figure 4.7.

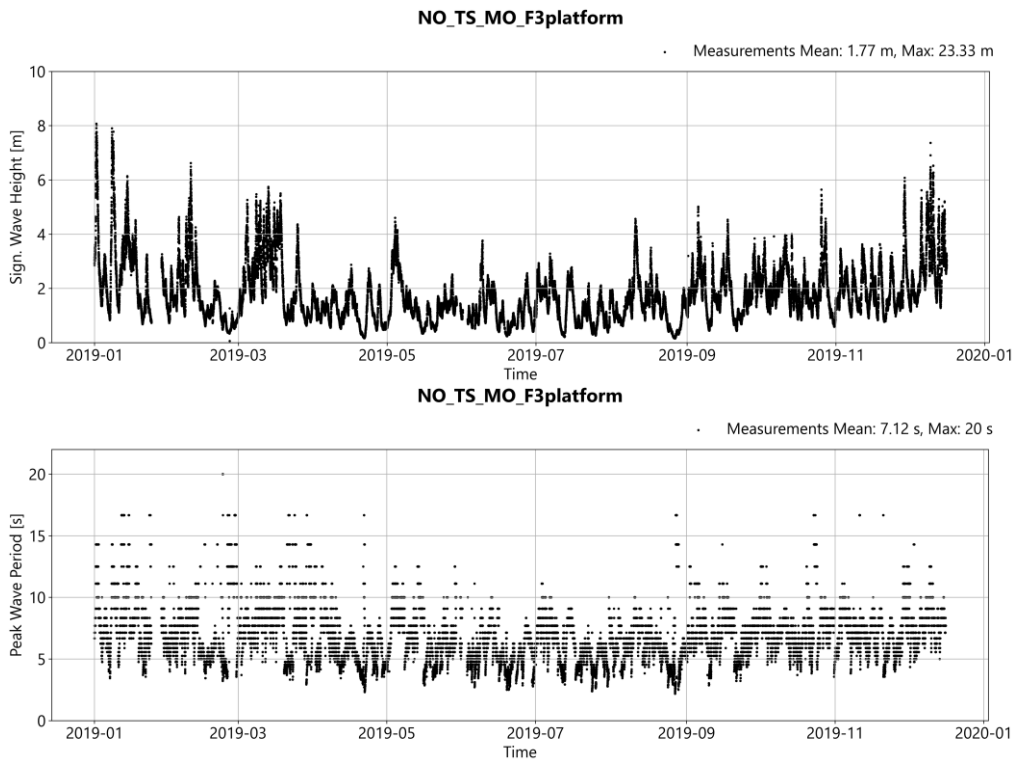


*Figure 4.5: Significant wave height (top) and peak period (bottom) recorded at the station **NO_TS_MO_F3platform.***

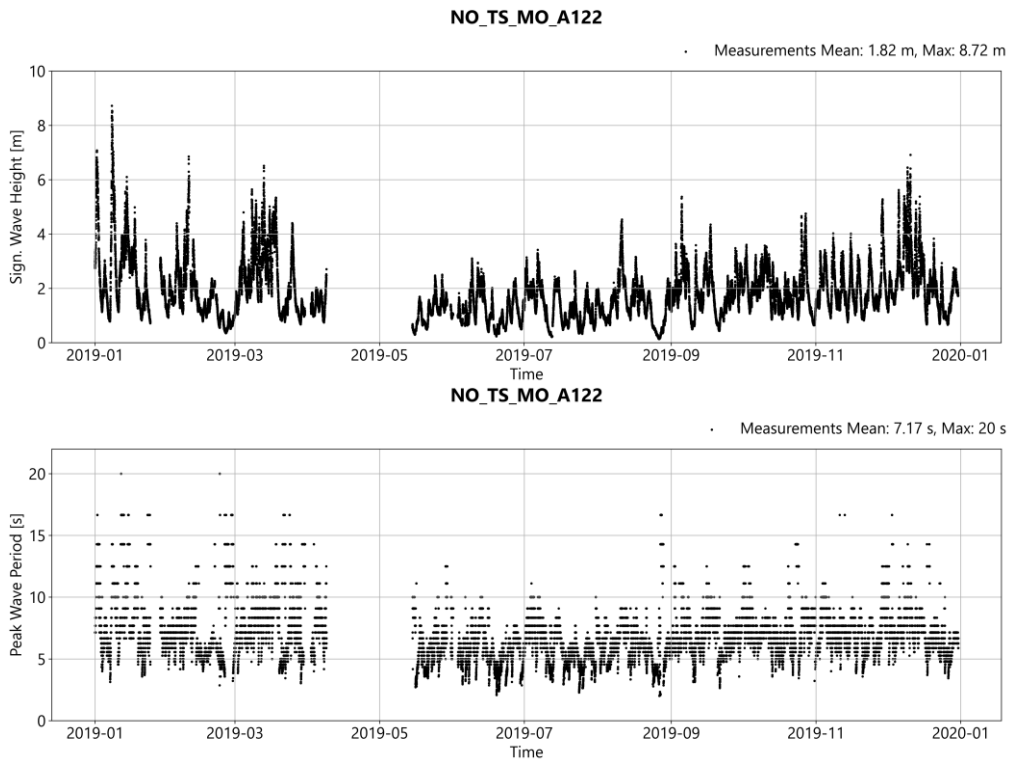


*Figure 4.6: Significant wave height (top) and peak period (bottom) recorded at the station **NO_TS_MO_A122.***

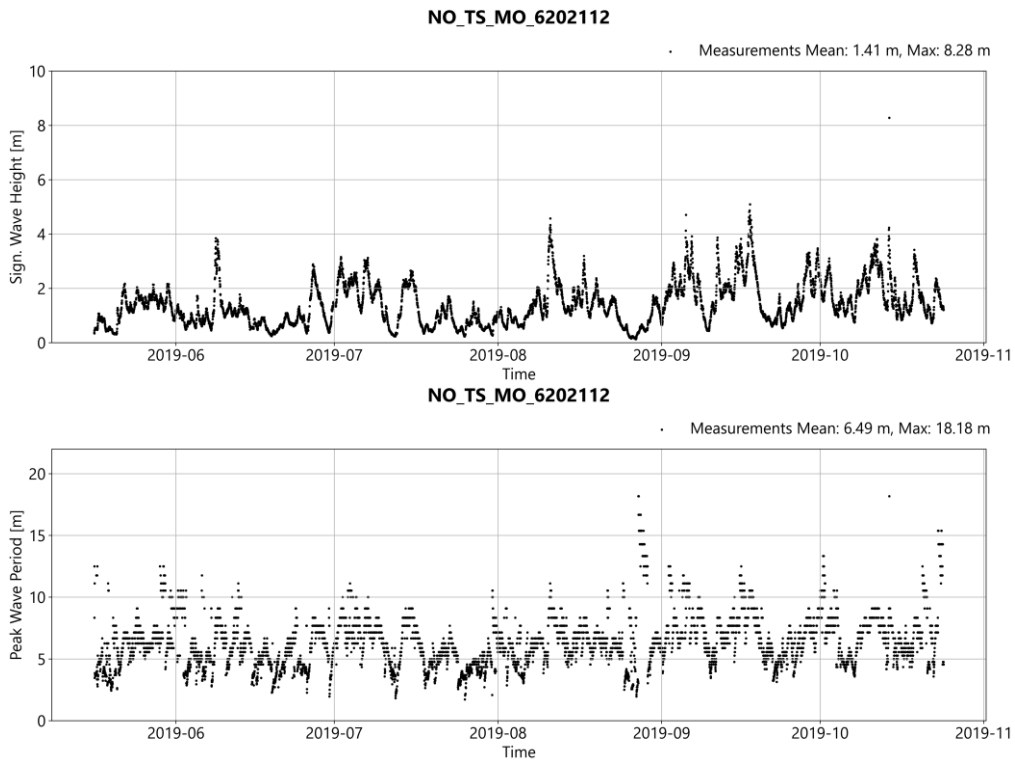


*Figure 4.7: Significant wave height (top) and peak period (bottom) recorded at the station **NO_TS_MO_6202112.***

The comparison between the wave parameters recorded at three selected stations and the modelling results are presented and discussed in Section 6.3.

It is important to highlight that in the case of the retrieved Arkona Basin station, there is a 30-minute interval between recordings, and the time steps never correspond to the simulated time step. The data was interpolated in order to be compared to the spectral wave model results.

5. Methodology

A spectral wave model was used to simulate the wave climate in Danish waters to assess the impact of existing and future offshore wind farms. For each scenario, a distinct wind forcing file was applied, all reflecting wind conditions from 2019, a "typical" year that is representative of the climatological conditions, but accounting for varying configurations of scenarios for wind farms; Current (2021 wind farms) and Future (2030 wind farms), within the study area (Hahmann, et al., 2025a; 2025b). Figure 5.1 presents an overview the locations of the wind farms includes in the current (2021) and future (2030) scenarios, respectively.

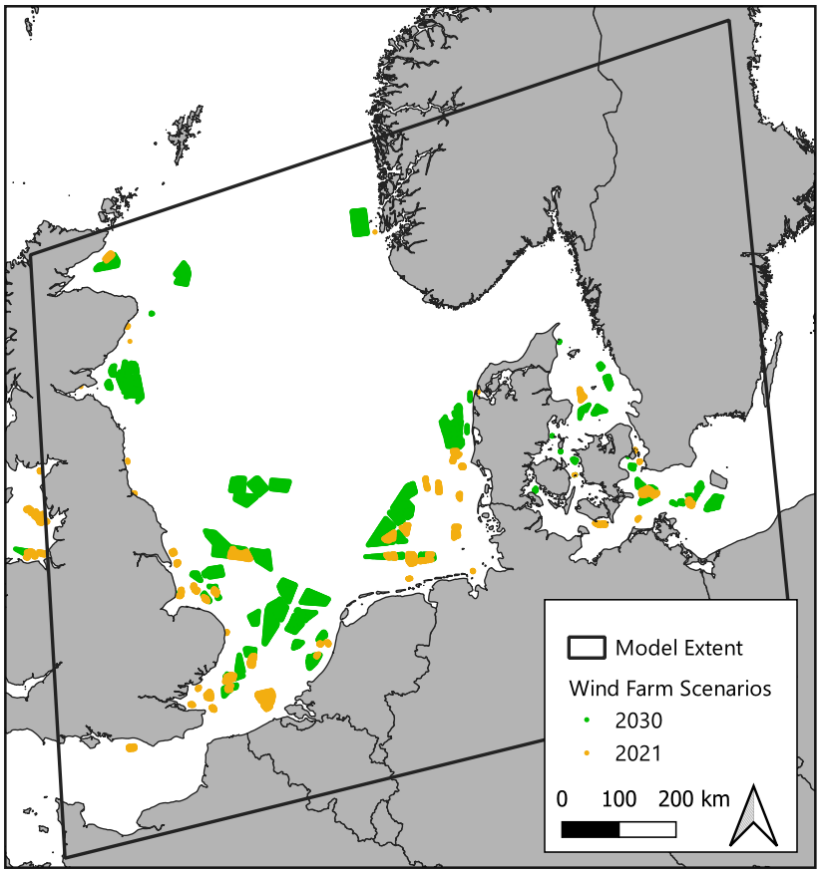


Figure 5.1: Overview of the location of the currently present wind farm parks (orange) and of the future large-scale development in the North Sea, Kattegat, and the Baltic Sea (green).

Prior to assessing potential impacts, the base model is calibrated using the collected wave measurements mentioned above, see 4.3.

5.1.1. Spectral wave model

MIKE 21 Spectral Wave Model (SW) is a computer-based simulation tool used for analyzing and predicting wave characteristics in coastal and offshore environments.

The MIKE 21 SW utilizes spectral wave theory to simulate the transformation and propagation of ocean waves. It takes into account various factors such as wind, currents, bathymetry (seafloor topography), and wave interactions to accurately predict wave height, direction, period, and other wave parameters.

The MIKE 21 SW module is capable of modelling the growth, decay, and transformation of wind-sea and swell waves in coastal and offshore areas. Its engine includes the following physical processes:

- Wave growth by wind,
- Non-linear wave-wave interaction,
- Wave-current interaction,
- Dissipation of energy due to white capping,
- Dissipation of energy due to bottom friction,
- Dissipation of energy due to depth-induced wave breaking,
- Refraction and shoaling due to variation in water depth,
- Effect of time-varying water depth and currents,
- Effect of ice coverage,
- Diffraction,
- Reflection and
- Influence of structures such as Wave/Tidal Energy Converters (WEC/TEC)

The main computational features in MIKE 21 SW are:

- Source functions based on state-of-the-art 3rd generation formulations,
- Fully spectral and directionally decoupled parametric formulations,
- In-stationary and quasi-stationary solutions,
- Optimal degree of flexibility in describing the bathymetry and the ambient flow conditions using depth-adaptive and boundary fitted unstructured mesh,
- Coupling with hydrodynamic flow module for modelling wave-current interaction and time-varying water depth,
- Flooding and drying in connection with time-varying water levels,
- Extensive range of model output parameters (e.g. wind-sea, swell, air-sea interaction parameters, radiation stresses, wave spectra, etc.) and
- Parallelization using Open MP and MPI techniques.

The model uses a flexible mesh based on unstructured triangular or quadrangular elements and applies a finite volume numerical solution technique. The 2024 version of MIKE 21 SW was used in the present study. Further details are provided in DHI (2021).

6. Model setup and calibration

This section introduces the core of the calculations in the present study: DHI's MIKE 21 SW module and the SW model built specifically for it.

6.1. Computational grid

Figure 6.1 shows the computational mesh and boundaries of the SW model. The resolution of the SW model was selected as a balance between maintaining reasonable computational time.

The resolution progressively varies from the offshore area of the North Sea to the internal region between Sweden and Denmark, where the majority of the offshore wind farms are situated. Offshore and along the coasts of Great Britain and Germany, the resolution is 2 km^2, which decreases to 1 km^2 as it approaches the Baltic Sea.

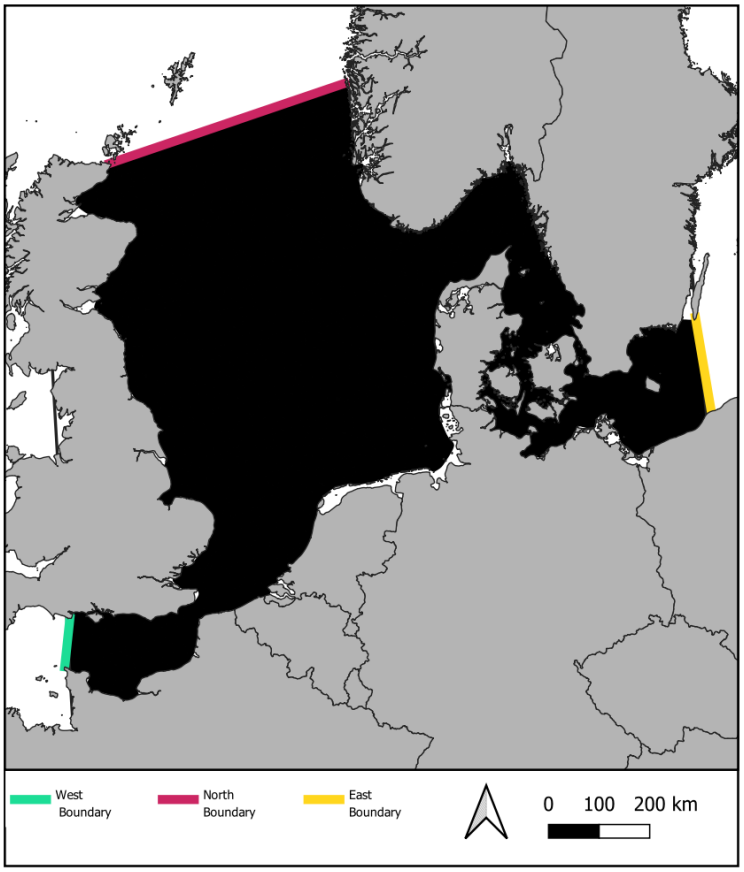


Figure 6.1: Computational mesh and boundaries defined for the spectral wave model of the North Sea, Kattegat, Belts and Baltic Sea.

6.2. Model set-up

The model setup is summarized in Table 6.1. When not otherwise specified, the configuration of the SW model follows the default setup.

Through a calibration process, the best fit between modelled data and measurements was obtained by increasing the value of the air-water interaction parameters so that the energy dissipation within the domain decreased.

Table 6.1: Summary of the SW model settings.

Setting	Value
MIKE Version	MIKE 2024
Mesh resolution	6,417 km^2 (at the boundaries) to 23 km^2 (at the project area)
Simulation period	Jan 1st 2019 00:00 to Dec 31th 2019 23:00
Spectral Formulation	Fully Spectral formulation, Instationary Formulation
Energy Transfer	Included quadruplet-wave interaction
Growth parameter	1.3
Wave age tuning parameter	0.011
Background Charnock parameter	0.01
Atmospheric forcing	DTU generated Wind
Boundary Conditions	ERA5

6.3. Model calibration

Time-series of three wave parameters (modelled significant wave height (H_{m0}), peak wave period (T_p) and mean wave direction (MWD)) were extracted at the wave buoys' locations and validated against the available measurements to calibrate the model and obtain an accurate description of the physical processes involved in the wave dynamics and propagation.

Three representative stations were selected to be reported in the following, while the comparison between the model results and the other stations is placed in Appendix C. The stations selected for comparison and reported in the present section are listed in Table 4.1.

The comparison between final model results and measurements is presented in terms of time-series, scatter plots, and statistical coefficients such as:

- The **Correlation Coefficient**, which quantifies the strength of a linear relationship between two variables, with values from -1 to 1. A value of -1 indicates a perfect negative correlation, where one variable increases as the other decreases, while a value of 1 represents a perfect positive correlation, where both variables move in the same direction;
- The **Bias**, which refers to a systematic error that causes an estimator to deviate from the true population value. Bias occurs when the method of collecting, measuring, or interpreting data consistently skews results in a particular direction, leading to inaccurate or misleading conclusions;
- The **Mean Absolute Error** (MAE), representing the average magnitude of errors in a model's predictions, without considering their direction (positive or negative). It ranges from 0 to infinity. A lower MAE indicates a model with more accurate predictions;
- The **Root Mean Square Error** (RMSE), that RMSE reflects the average magnitude of prediction error, with larger errors given more weight due to the squaring. The RMSE can range from 0 to infinity, and a lower RMSE indicates more accurate predictions;
- The **Scatter Index** (SI) is a standard metric for wave model intercomparison and represents a normalized measure of error. The SI can be presented as percentage. Lower values of SI correspond to a better match between observations and modelled values, and in the context of significant wave height, reports of the scatter index (SI) in the literature range between from 0 to 20% (0.20) for hindcasts with sophisticated models and high quality wind fields (Howard, et al., 2009).

The statistical coefficients are presented in Table 6.2, while the comparison of the time-series of measurements and modeled parameters is presented in Figure 6.1 to Figure 6.12 and in Appendix C.

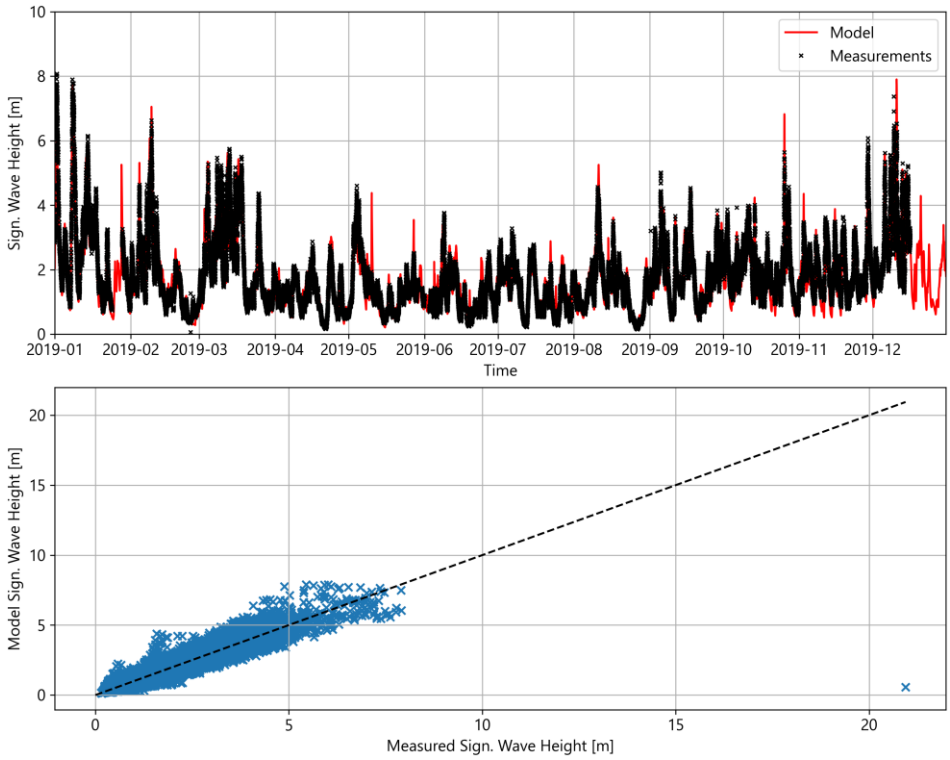


Figure 6.1: ***Station ID NO_TS_MO_F3platform*** *- Comparison model vs. measurements of yearly time series of the significant wave height.*

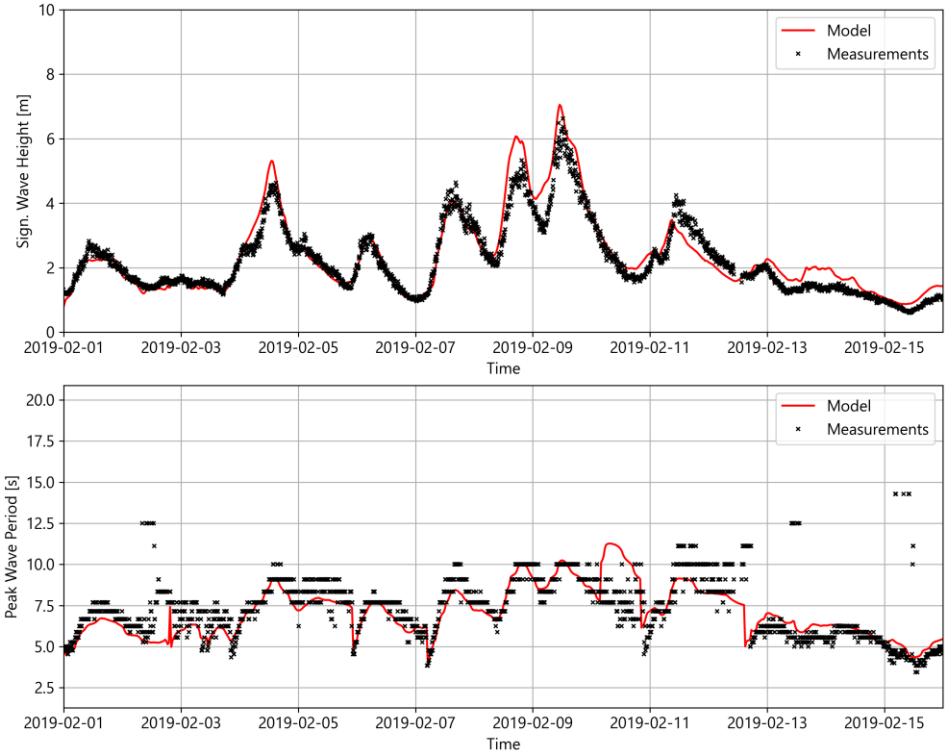


Figure 6.2: ***Station ID NO_TS_MO_F3platform*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 01-02-2019 to 15-02-2019.*

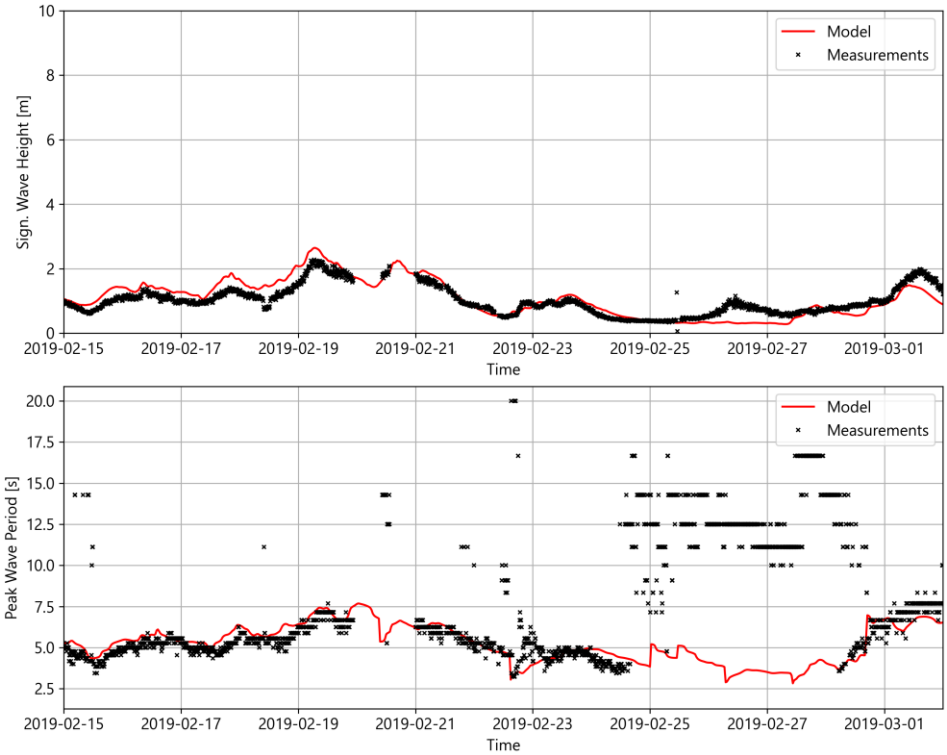


Figure 6.3: ***Station ID NO_TS_MO_F3platform*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 15-02-2019 to 01-03-2019.*

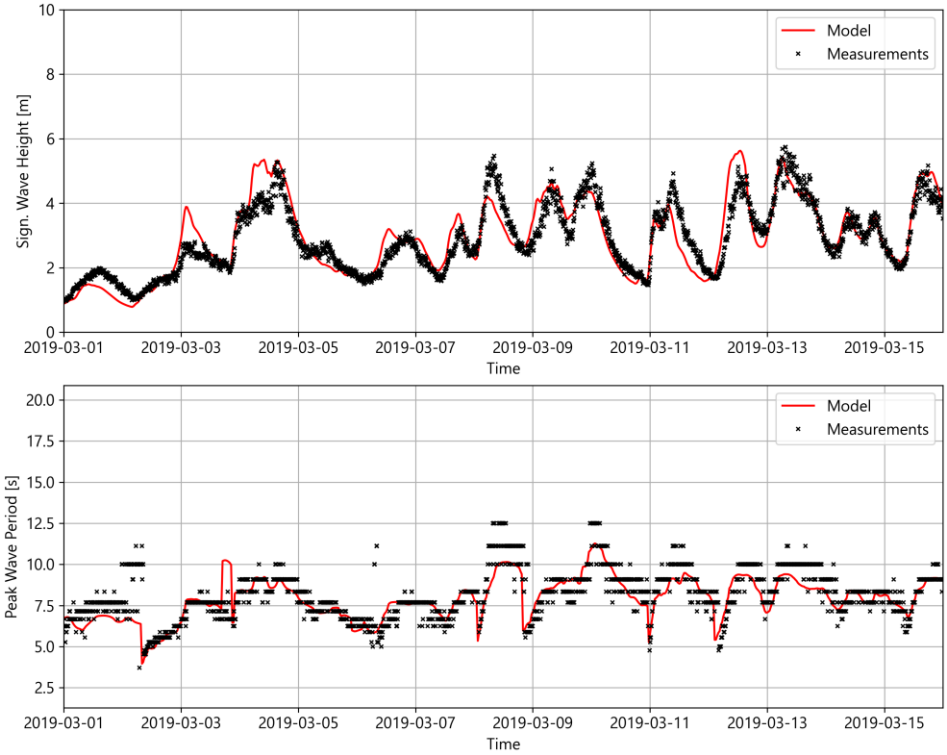


Figure 6.4: ***Station ID NO_TS_MO_F3platform*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 01-03-2019 to 15-03-2019.*

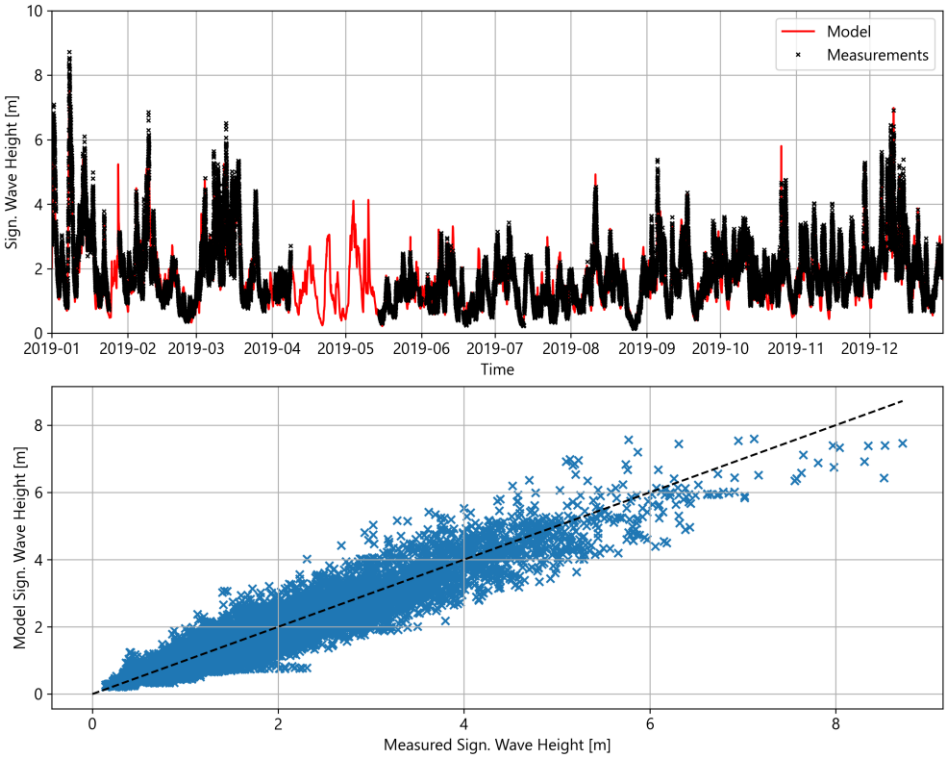


Figure 6.5: ***Station ID NO_TS_MO_A122*** *- Comparison model vs. measurements of yearly time series of the significant wave height.*

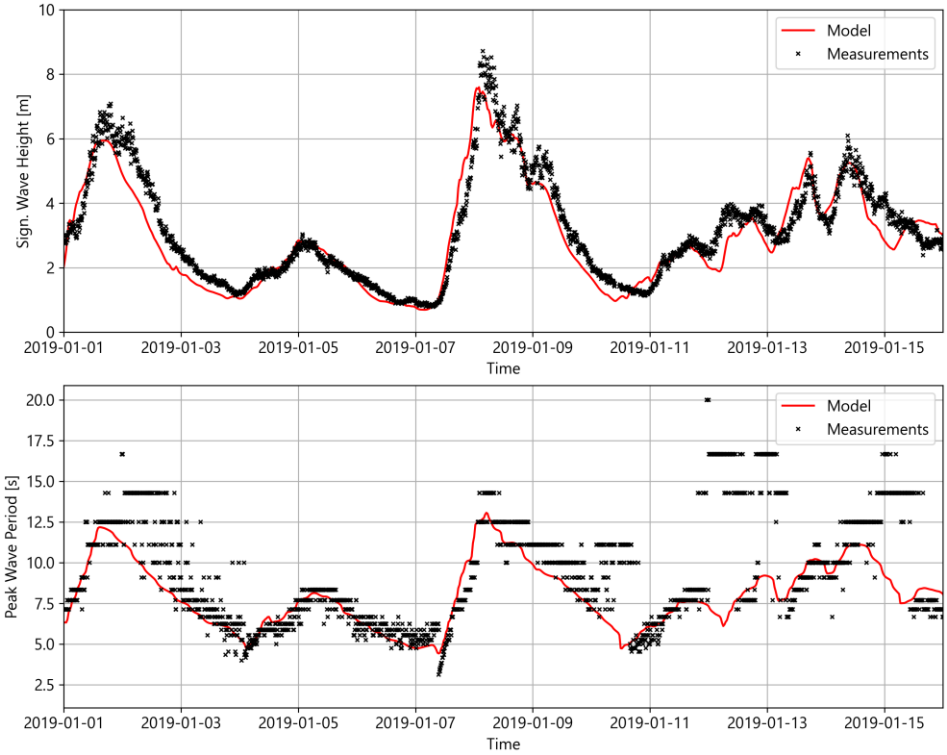


Figure 6.6: ***Station ID NO_TS_MO_A122*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 01-01-2019 to 15-01-2019.*

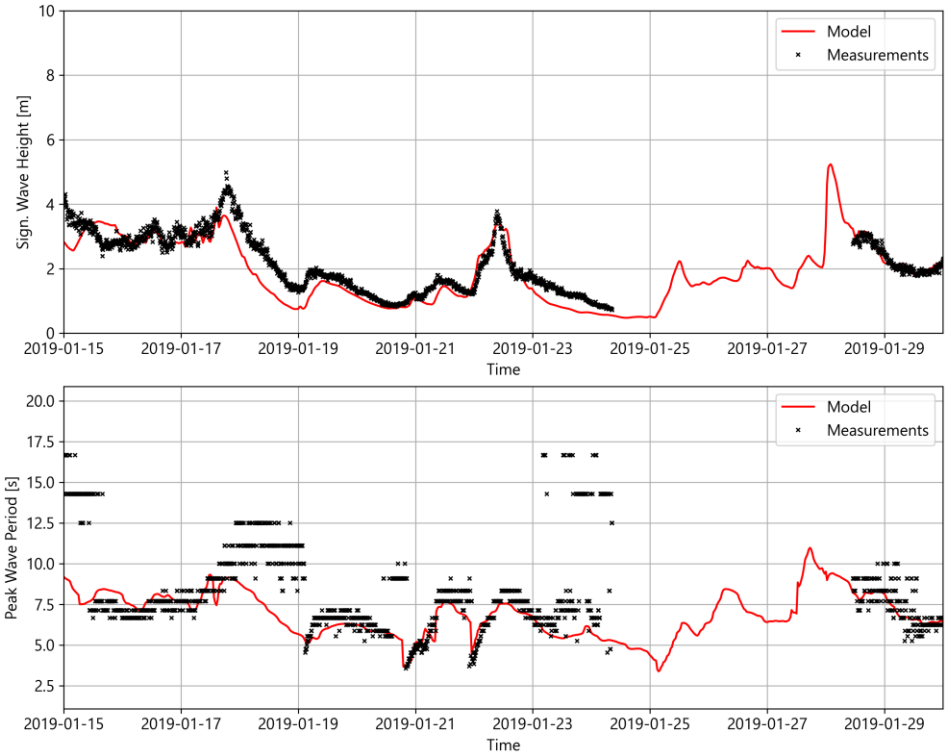


Figure 6.7: ***Station ID NO_TS_MO_A122*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 15-01-2019 to 01-02-2019.*

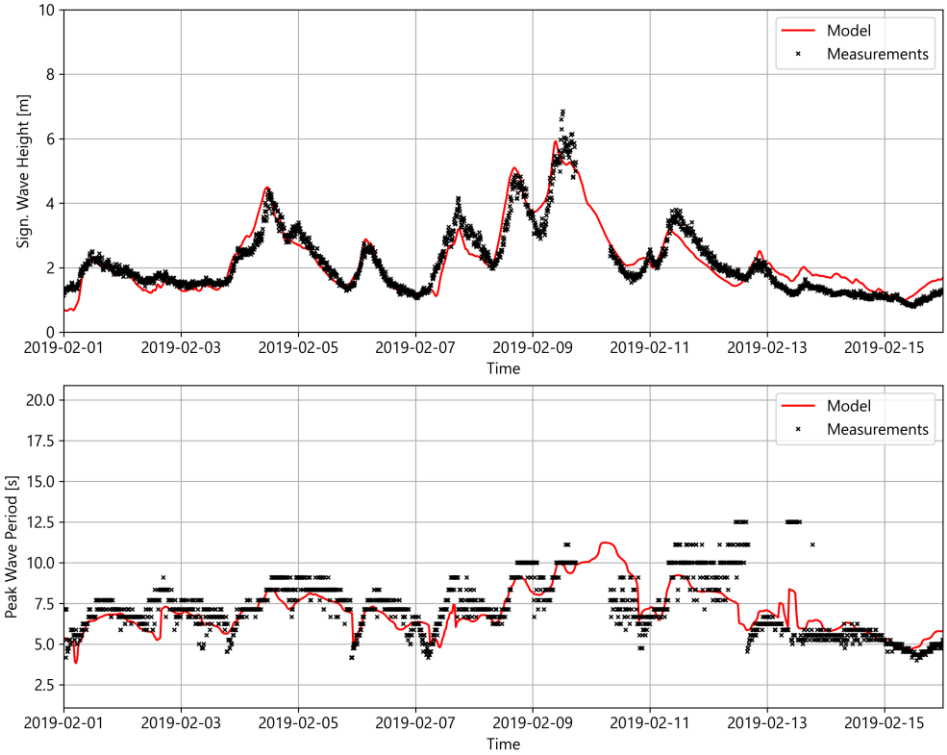


Figure 6.8: ***Station ID NO_TS_MO_A122*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 01-02-2019 to 15-02-2019*

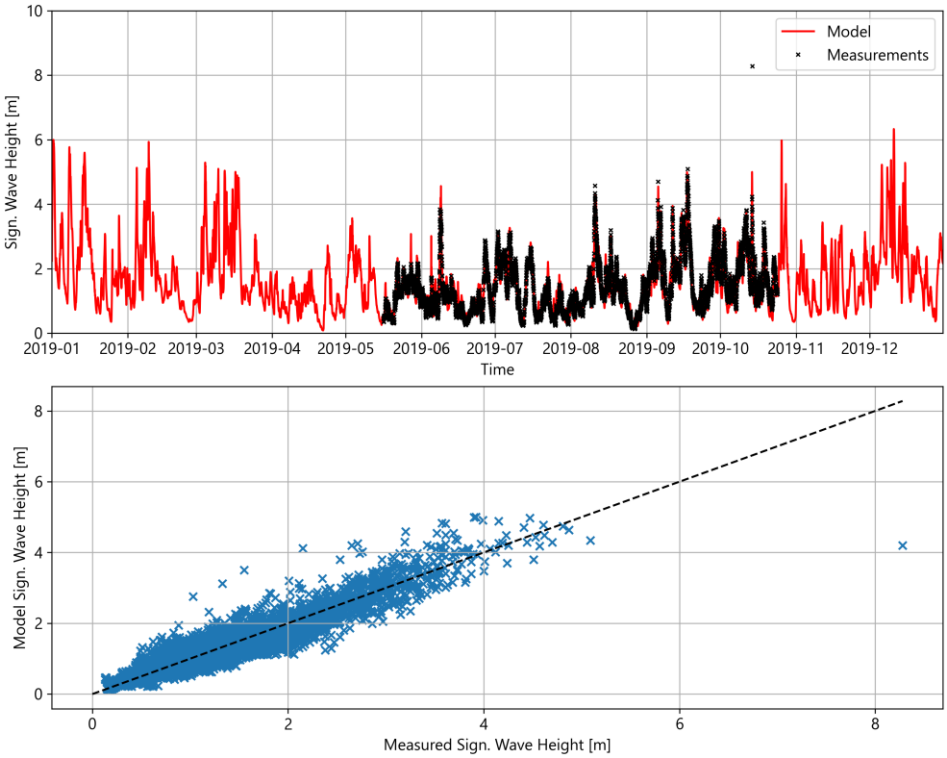


Figure 6.9: ***Station ID NO_TS_MO_6202112****- Comparison model vs. measurements of yearly time series of the significant wave height.*

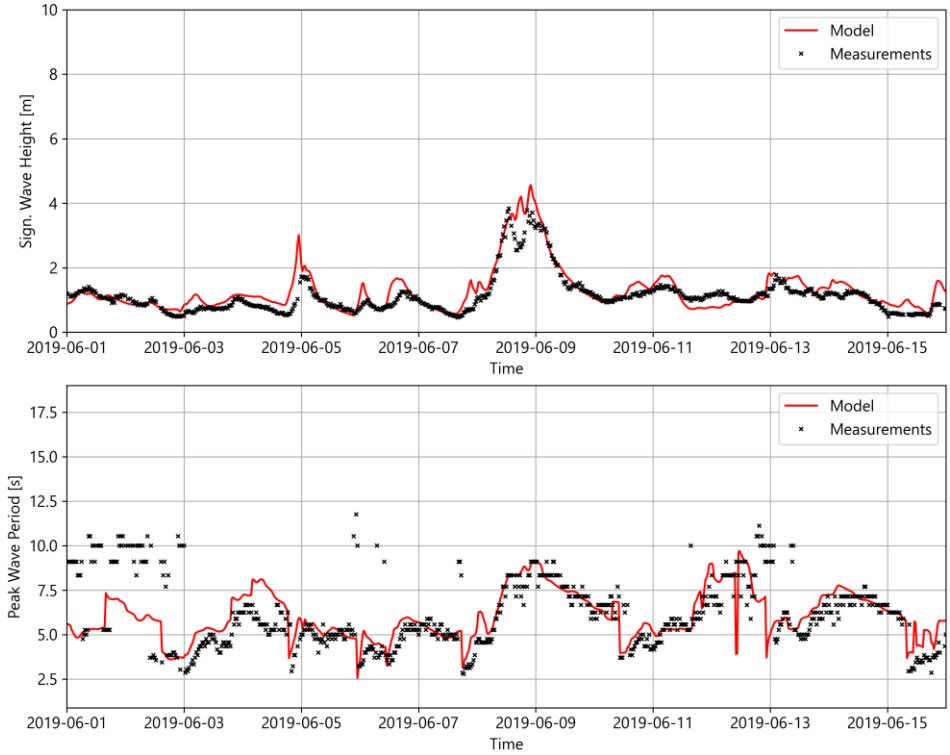


Figure 6.10: ***Station ID NO_TS_MO_6202112*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 01-06-2019 to 15-06-2019.*

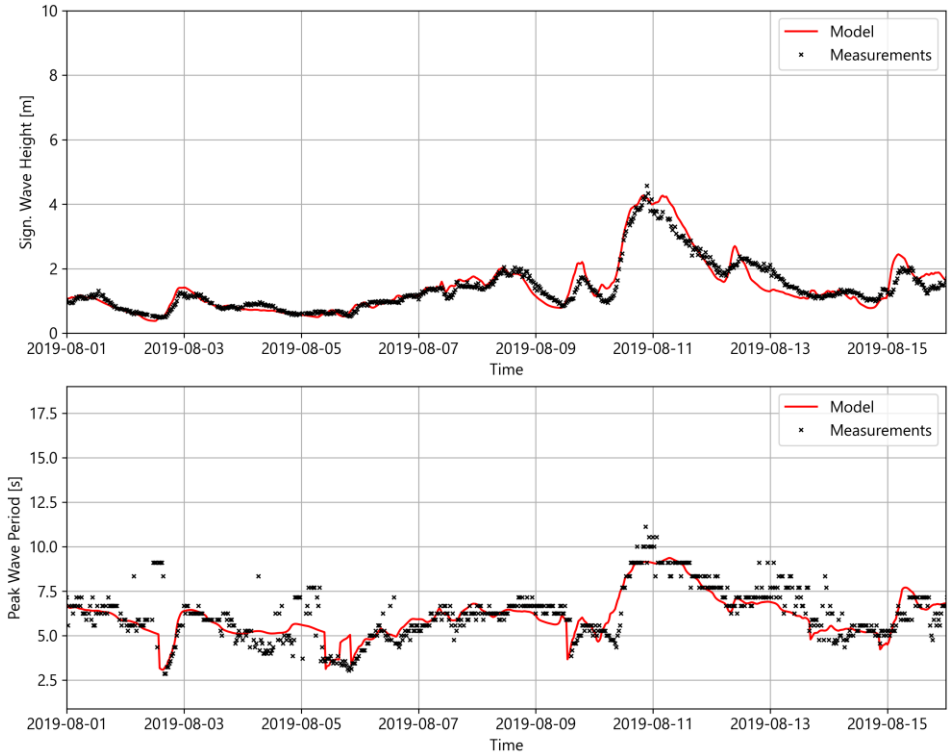


Figure 6.11: ***Station ID NO_TS_MO_6202112*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 01-08-2019 to 15-08-2019.*

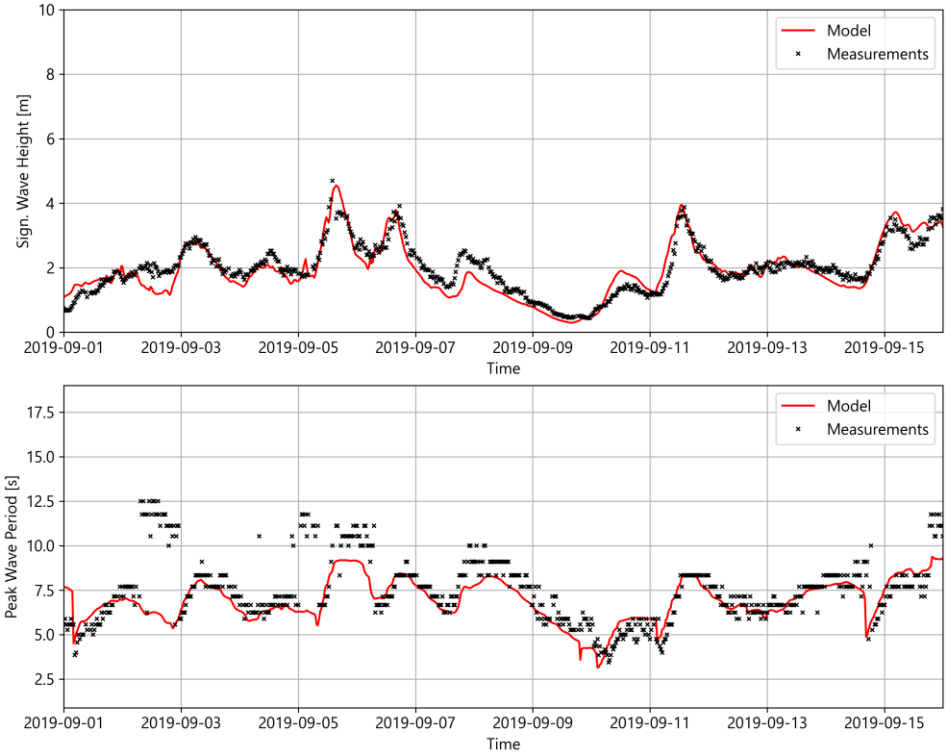


Figure 6.12: ***Station ID NO_TS_MO_6202112*** *- Comparison model vs. measurements: time series of the significant wave height (top) and peak wave period (bottom). Period: 01-09-2019 to 15-09-2019.*

Table 6.2: Correlation coefficient, Bias, MAE, RMSE and SI for the comparison between simulated and measured significant wave height at three selected locations (stations).

	Parameter: Sign. Wave Height				
Station ID	**Correlation Coefficient**	**Bias**	**MAE**	**RMSE**	**SI**
NO_TS_MO_F3platform	0.93	+0.11	0.22	0.33	0.23
NO_TS_MO_A122	0.94	-0.05	0.28	0.37	0.20
NO_TS_MO_6202112	0.93	+0.00	0.21	0.29	0.20

Despite the model's tendency to overestimate some of the peak values of significant wave height, the comparison figures indicate that the overall pattern of model results aligns well with the measurements. This is evidenced by a scatter index (SI) close to 0.2 and a correlation of 0.93 to 0.94, which is regarded as indicative of good agreement. Since the comparison between scenarios with and without the wind farm is relative, the resulting impact of the model's tendency to overestimate peak values of significant wave height is considered negligible and will hence not influence the overall conclusions drawn from the modelled results.

7. Results baseline

To better understand the wave climate in Danish waters, the modelled significant wave height (H_{m0}) was extracted from the results of the baseline case, thus without taking into account the presence of wind farms in the domain, at three locations: one in the Baltic Sea, one in Kattegat and one offshore Jutland, in the North Sea west of Hvide Sande. The locations are shown in Figure 7.1 with details in Table 7.1.

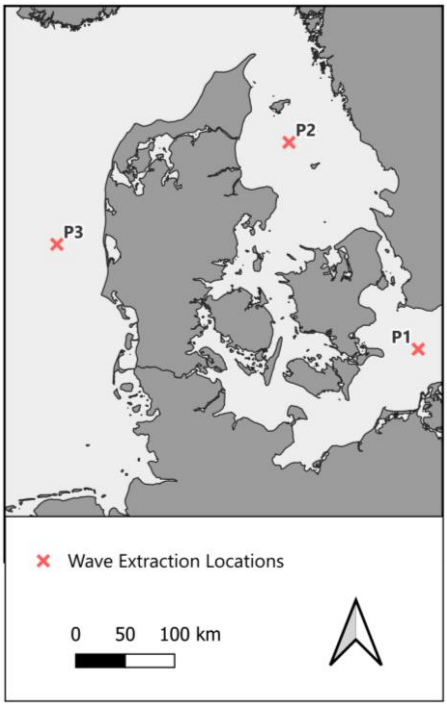


Figure 7.1: Locations of extraction of significant wave height and mean wave diretion for Baseline case assessment.

Table 7.1: Description of the locations of extraction of wave conditions.

ID	X	Y	Area
P1	762483.01	6102118.35	Baltic Sea
P2	631675.33	6312239.29	Kattegat
P3	396695.01	6208658.55	North Sea

The annual wave roses for the three locations are shown in Figure 7.2, which highlights the following observations:

- For the Baltic Sea location (P1, first rose on the left), while the predominant wave direction in 2019 was from the southwest, wave directions from west to northwest were equally significant in terms of magnitude,
- For the Kattegat area (P2, middle rose), data reflects minimal directional dependency, likely due to its sheltered conditions and the fetch, in contrast to the more defined directional patterns observed at the other two sites, and
- Like P1, the North Sea location (P3, off the Jutland coast) shows that the primary wave directions extend from north-northwest to south-southwest.

The annual wave roses for the three locations in Figure 7.1 are reported in Figure 7.2.

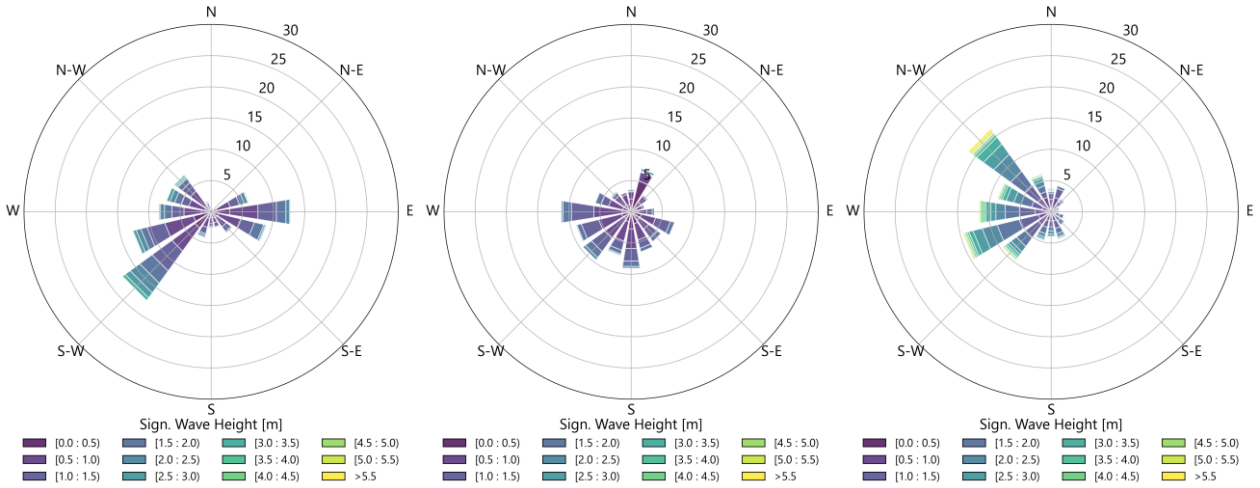


Figure 7.2: Annual wave rose for selected locations, from left to right, P1 (Baltic Sea), P2 (Kattegat) and P3 (North Sea).

8. Impact on waves

As previously mentioned, the assessment of the wave climate impact is based on a single year (2019) and compares the current (2021) wind farm scenario and with a future (2030) wind farm scenario with respect to the impact on waves. This comparison between the two scenarios is presented in the below section 8.1. To evaluate the significance of these impacts, the general wave climate and its variations on an annual and monthly basis have been analysed and compared to the identified effects, which is presented in section 8.2.

8.1. Wave impact from wind farm scenarios

The impact of current and future wind energy development on wave climate is evaluated by comparing the differences in significant wave heights between:

- Baseline and Current wind farms, i.e. year 2021,
- Baseline and Future wind farms within the considered domain, i.e. year 2030.

The difference is calculated for both the annual average and the monthly average, but only the annual results are included in the main body of this report (see Figure 8.2). In addition to the overall results for the studied domain, a detailed view of the area of primary interest, specifically certain waters within the Danish Exclusive Economic Zone (EEZ), is provided (see Figure 8.3 and Figure 8.4), where the results are shown without and with wind turbines marked respectively.

The monthly differences, for the whole domain and for the Danish Waters, can be found in Appendix F.

Based on the processed results, it is generally noted that:

- Referring to the whole domain (Figure 8.1 and Figure 8.2), the already installed wind farms generate little to no disturbance compared to the wave conditions calculated in the absence of offshore wind farms. Indeed, the decrease in annual averaged significant wave height ranges from -0.1 m to 0.0 m,
- With regards to the area of primary interest, the waters within the Danish (EEZ) (Figure 8.3 and Figure 8.4), the already installed wind farms do not affect the significant wave height (EEZ is not shown on figures, and it is evident from Figure 8.3 and Figure 8.4 that only very small areas categorized with a -0.05 m to -0.03 m change in the significant wave height is shown within the Danish EEZ),
- In reference to the whole domain (Figure 8.1 and Figure 8.2), the Future (2030) wind farm scenario affects the baseline wave conditions to a larger degree compared to the current wind farm scenario. The decrease in annual averaged significant wave height ranges from -0.2 m to 0.0 m, where the largest decrease is reached in the area between the Netherlands and England because of the high density of wind turbines (see figure 4 in Hahmann, et al. (2025b)) and
- For the Future (2030) wind farm scenario in the waters within the Danish (EEZ) (Figure 8.3 and Figure 8.4), the annual average of significant wave height is affected by the installed wind turbines in the North Sea, Baltic Sea and in the Kattegat area, with a maximum change in significant wave height of approximately -0.1 m (only a small area within the Danish EEZ in the Baltic Sea is modelled to experience a change in significant wave height of -0.15 m to -0.1 m). Along the coast of Jutland the maximum change in wave height is less than -0.05 m.

With regard to the observed seasonal variation, in relation to the year 2019, the following are observed:

- In January, where higher significant wave heights (H_{m0}) generally are observed compared to other months, the changes for the Future scenario exceed -0.2 meters, particularly along the coastlines of the Netherlands and Great Britain. For the Current scenario, a maximum of -0.1 m is observed in January only within the wind farms in the southern area of the North Sea and Baltic Sea,

- West of Jutland, waves predominantly come from west and northwest, except in April, June and August. In April, the prevailing directions are northeast to southeast, while in June and August the prevailing direction is Southwest (see Appendix D). This variability results in varied patterns of wave reduction in response to the presence of wind farms along the western coast of Jutland,
- For both wind farm scenarios, the prevalence of a specific direction, or a range of directions, is less pronounced in the Kattegat and the Baltic Sea than the North Sea, as it is observed in Figure 7.2 and
- Based on the monthly wave roses for P1 (located in the Baltic Sea) reported in Appendix D, a shift is observed in the prevailing wave direction from westerly to easterly directions from April to June for both wind farm scenarios. The pattern shows that reduced wind speeds are associated with lower wave heights, particularly in areas near the coastline from April to July.

Based on the monthly wave roses for P2 reported in Appendix D, the following seasonal variations are observed for both wind farm scenarios:

- The highest waves come from Northwest to Southwest between February to October, except for April which, as November, shows an important southeasterly component. This is reflected in the pattern of influence of the reduction of wind speed on the wave heights. Indeed, the reduction appears to affect the area closer to the coastline in April and November,
- In general, during the summer period (from May onwards), the reduction in wave height becomes less pronounced as an overall milder wave climate is observed, with a maximum decrease in significant wave height down to -0.2 meters (see Appendix E and Appendix F) and
- In general, the seasonal variation is more easily spotted for the Future scenario due to the larger impact.

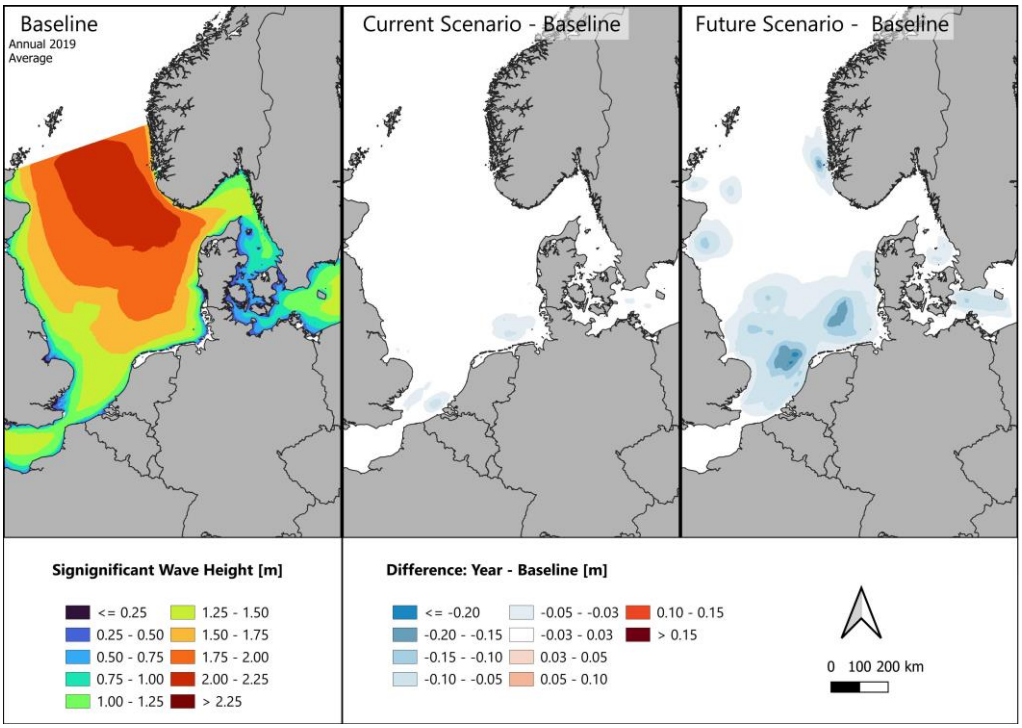


Figure 8.1: ***Whole model domain - Baseline and Baseline vs. Scenarios.*** *Left: annual average significant wave height (m), Mid: Scenario 2021 minus Baseline, Right: Scenario 2030 minus Baseline.*

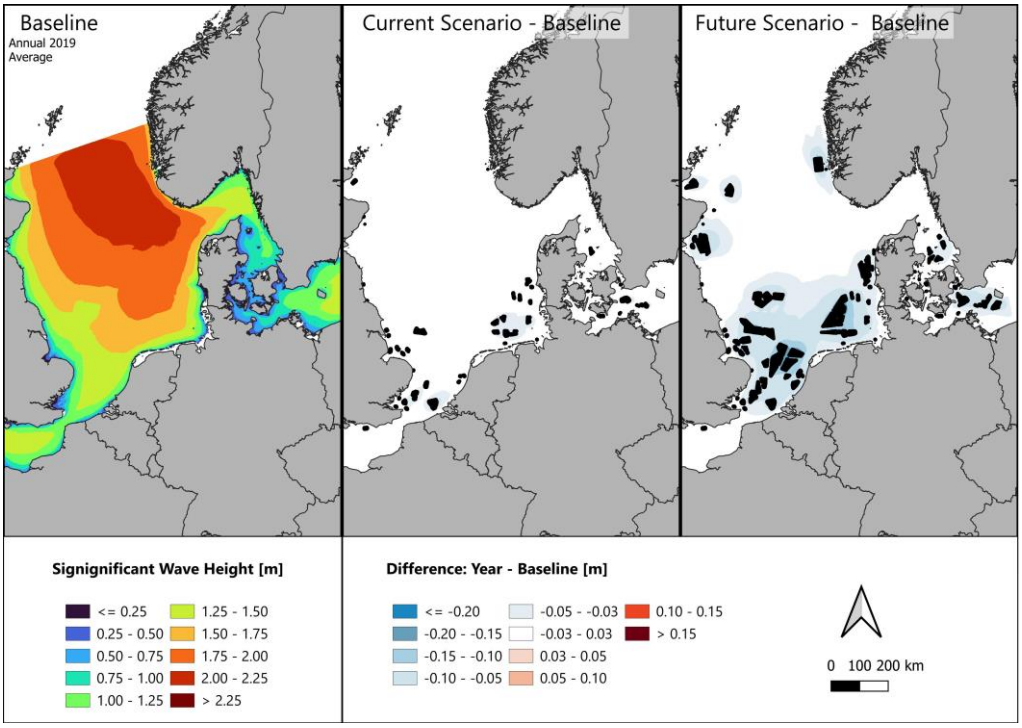


Figure 8.2: ***Whole model domain - Baseline and Baseline vs. Scenarios.*** *Left: annual average significant wave height (m), Mid: Scenario 2021 minus Baseline, Right: Scenario 2030 minus Baseline. "Mid" and "Right" marked with the wind farms.*

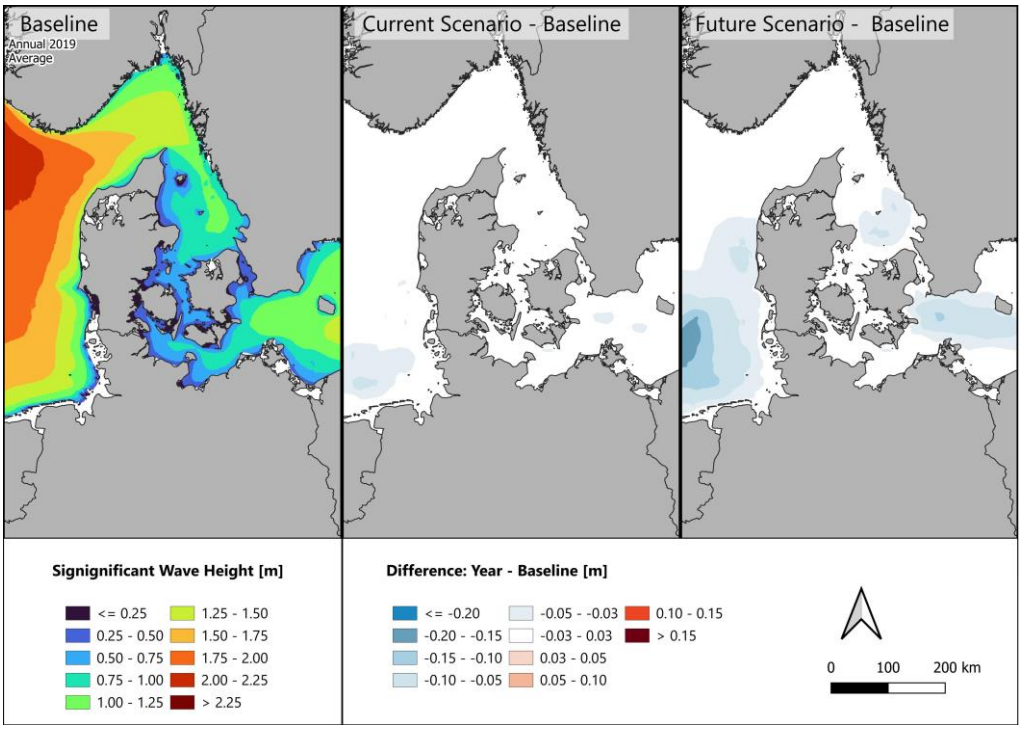


Figure 8.3: ***Danish Waters - Baseline and Baseline vs. Scenarios.*** *Left: annual average significant wave height (m), Mid: Scenario 2021 minus Baseline, Right: Scenario 2030 minus Baseline.*

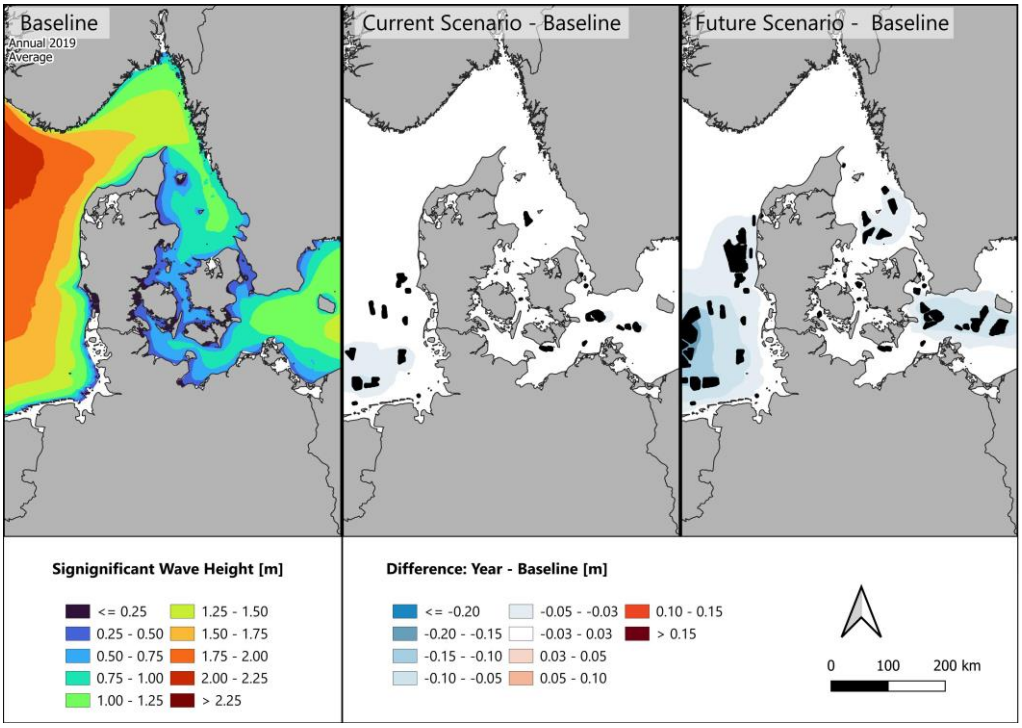


Figure 8.4: ***Danish Waters - Baseline and Baseline vs. Scenarios.*** *Left: annual average significant wave height (m), Mid: Scenario 2021 minus Baseline, Right: Scenario 2030 minus Baseline. "Mid" and "Right" marked with the wind farms.*

8.2. Annual and monthly variation

The influence of wind farm installations in Danish waters was further evaluated by extracting and comparing wave parameters, specifically, significant wave height (H_{m0}) and mean wave direction (MWD), from the "Atlantic-European North West Shelf- Wave Physics Reanalysis" wave model, AENWS, (Copernicus, 2025) and across simulated scenarios: the baseline scenario, the Current (2021) scenario, and the Future (2030) scenario . The locations where results were extracted are illustrated in Figure 8.5 and detailed in Appendix G.

To evaluate the significance of changes in wave conditions induced by the presence of wind farms in the Current and Future wind farm scenarios, the calculated annual and monthly variations were compared with the corresponding means and standard deviations derived from AENWS wave dataset. This allows the influence of offshore wind farms on the wave climate in Danish waters to be compared to natural variations in the wave climate on annual and monthly basis.

Statistical analysis was performed on wave data covering the period from 1988 to 2024. For each year, the mean annual and mean monthly significant wave height (H_{m0}) and mean wave directions (MWD) were calculated. An interannual evaluation was then carried out to obtain the overall annual mean, the monthly mean values, and the corresponding standard deviations. Thus, the standard deviation indicates how much the mean H_{m0} and the MWD varies from year to year, or for the same month across different years. The annual and monthly calculated statistics for the wave data are reported in Table 8.1 to Table 8.4, in the first and second columns for MWD and fifth and sixth columns for mean H_{m0}.

The third and fourth as well as the seventh and eighth columns of Table 8.1 to Table 8.4 show the difference between the annual or monthly MWD and mean H_{m0}, respectively, calculated from the modelled impact for the Current and Future windfarm scenarios compared to the Baseline Scenario.

Although all 16 points were analysed, this section presents the results for four of them (2, 8, 12 and 13), shown in Figure 8.5, while the remaining results, along with detailed information for each location (Appendix G), are provided in Appendix G. The results for the four selected locations are reported in Table 8.1 to Table 8.4.

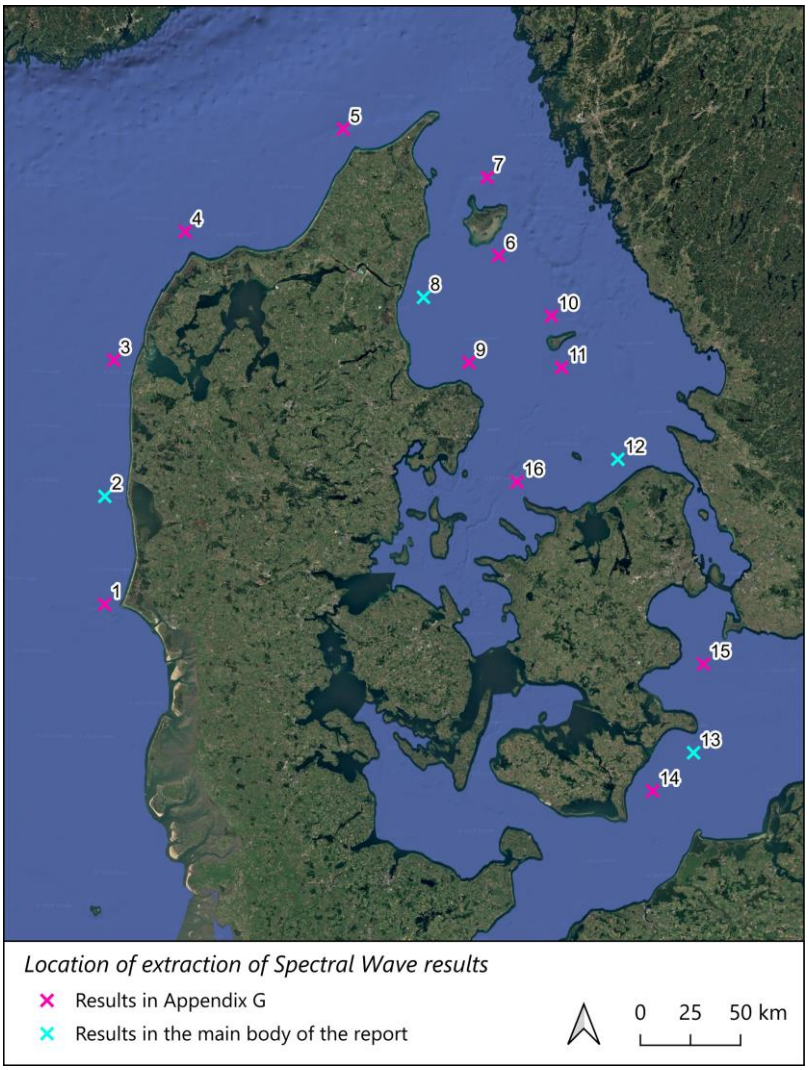


Figure 8.5: : Locations of extraction of significant wave height and mean wave diretion.

Based on the results for Point 2, located west of Jutland, presented in Table 8.1, the following key observations have been identified:

- **Wave Direction Statistics:** The mean annual and mean monthly wave directions vary between 265°N and 292°N. This range is consistent with the location of the measurement point and indicates a general stability of predominant wave directions throughout the year. The lowest standard deviation for MWD corresponds to the annual mean, which shows that the variability of MWD from year to year is smaller than the variability observed for individual months across different years.

- **Impact of Wind Farm Scenarios on Direction**: Changes in wave direction due to wind farm scenarios are minimal. The Current Scenario results in an annual shift of 0.2°, while the Future Scenario shows a change of 0.4°. Monthly differences generally stay within ±1.7°, except for April under the Future Scenario (9.0°), which, although notable, remains within the bounds of natural variability.

- **Wave Height Statistics**: The annual AENWS wave statistics indicate relatively stable conditions, with an annual mean H_{m0} of 1.46 m and a low standard deviation of 0.11 m, suggesting moderate wave energy at this site. Monthly averages vary from 1.09 m in May to 1.95 m in January, and standard deviations range from 0.20 m to 0.50 m, highlighting increased variability during the winter season.

- **Impact of Wind Farm Scenarios on Wave Height**: The impacts of both wind farm scenarios on significant wave height is limited. The Current scenario shows an annual change of approximately -0.01 m, with monthly variations generally between -0.03 m and 0.00 m. The Future scenario indicates a slightly larger reduction in significant wave height, with an annual change of -0.05 m and monthly differences up to -0.06 m (notably in May, July, August, and September). Overall, these results suggest only a slight decrease in wave energy under both scenarios, with changes remaining negligible compared to natural variability.

- **Overall Interpretation**: Both wave direction and wave height impacts from wind farms are negligible compared to natural seasonal variability in the location of Point 2. While the future scenario shows slightly larger reductions in significant wave height and minor directional shifts, these changes do not exceed thresholds that would significantly alter the local wave climate.

*Table 8.1: **Point 2** - Annual and monthly statistical results based on AENWS data, showing mean and standard deviation of mean wave directions (first two columns), the differences between calculated annual and monthly mean wave directions across the defined scenarios (third and fourth column), mean and standard deviation of significant wave height (fifth and sixth column), and the differences between calculated annual and monthly significant wave height across the defined scenarios (seventh and last columns).*

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	276.6 °	5.8 °	0.2 °	0.4 °	1.46	0.11	-0.01	-0.05
Jan	269.8 °	26.8 °	0.0 °	-0.1 °	1.95	0.50	0.00	-0.03
Feb	272.3 °	21.2 °	0.4 °	1.5 °	1.83	0.50	-0.01	-0.05
Mar	276.2 °	26.7 °	0.2 °	0.4 °	1.54	0.38	-0.01	-0.04
Apr	292.1 °	20.1 °	-1.0 °	9.0 °	1.18	0.27	-0.01	-0.03
May	292.1 °	19.3 °	0.0 °	-0.2 °	1.09	0.21	-0.01	-0.06
Jun	292.4 °	14.5 °	0.4 °	1.7 °	1.16	0.20	-0.02	-0.05
Jul	287.3 °	14.2 °	0.4 °	0.5 °	1.13	0.23	-0.01	-0.06
Aug	279.3 °	16.9 °	0.9 °	1.5 °	1.17	0.22	-0.02	-0.06
Sep	279.1 °	24.4 °	0.4 °	0.2 °	1.39	0.32	0.00	-0.06
Oct	265.5 °	22.7 °	0.7 °	0.6 °	1.61	0.27	-0.01	-0.05
Nov	268.1 °	30.0 °	-9.1 °	-6.9 °	1.71	0.37	-0.02	-0.05
Dec	270.1 °	24.1 °	0.0 °	0.3 °	1.83	0.45	-0.01	-0.04

Similar patterns and conclusions were identified across all other selected locations, with expected variations reflecting differences in local wave climates. As shown in Table 8.2, the specific observations for Point 8, located in Kattegat near the east coast of northern Jutland, are as follows:

- **Wave Direction Statistics:** The annual and monthly mean wave directions span from 104°N to 208°N, which aligns with the geographical position of the measurement point. Unlike Point 2, this wide range indicates a high variability in dominant wave directions throughout the year. The lowest standard deviation for MWD corresponds to the annual mean, confirming that interannual variability is smaller than the variability observed across individual months. Consistent with the broader range of mean directions, Point 8 exhibits generally higher annual and monthly standard deviations compared to Point 2, varying from 25° to nearly 90°.

- **Impact of Wind Farm Scenarios on Direction:** When comparing natural variability to the modeled wind farm impact on MWD, the impact remains below 5° in both scenarios, which is well within the natural directional variability simulated by AENWS.

- **Wave Height Statistics**: Due to its location, Point 8 reflects a milder wave climate than Point 2, though similar trends are observed. Annual statistics show relatively stable conditions, with a mean significant wave height of 0.55 m and a very low standard deviation (0.02 m). Monthly means range from 0.37 m to 0.70 m, with slightly higher values during winter, and monthly standard deviations between 0.06 m and 0.13 m. While monthly variability exceeds annual variability, the overall magnitude of wave heights is lower, resulting in smaller differences and reduced variability.

- **Impact of Wind Farm Scenarios on Wave Height**: The Current scenario shows almost no change (annual difference 0.00 m, monthly differences mostly -0.01 m to 0.00 m). Depending on the month considered, the Future scenario can indicate a slightly larger reduction that in no case exceeds -0.01 m. Overall, these results suggest only a slight decrease in wave energy under both scenarios for the position of this point. Despite the smaller gap between natural variability and wind farm-induced changes compared to Point 2, the differences remain negligible relative to natural variability.

- **Overall Interpretation**: Both wave direction and wave height impacts from wind farms are negligible compared to natural seasonal variability at Point 8.

*Table 8.2: **Point 8** - Annual and monthly statistical results based on AENWS data, showing mean and standard deviation of mean wave directions (first two columns), the differences between calculated annual and monthly mean wave directions across the defined scenarios (third and fourth column), mean and standard deviation of significant wave height (fifth and sixth column), and the differences between calculated annual and monthly significant wave height across the defined scenarios (seventh and last columns).*

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	167.9 °	25.0 °	-0.1 °	-0.2 °	0.55	0.02	0.00	-0.01
Jan	171.0 °	54.8 °	0.2 °	-1.4 °	0.70	0.13	0.00	-0.01
Feb	158.2 °	79.2 °	-0.3 °	-0.9 °	0.68	0.12	0.00	-0.01
Mar	158.1 °	55.5 °	-0.6 °	-0.3 °	0.58	0.09	0.00	0.00
Apr	104.3 °	78.9 °	-0.9 °	-1.2 °	0.48	0.07	0.00	-0.01
May	146.9 °	87.9 °	0.5 °	2.4 °	0.42	0.06	0.00	0.00
Jun	201.3 °	69.7 °	0.6 °	-0.2 °	0.39	0.07	0.00	0.00
Jul	208.3 °	56.0 °	3.2 °	4.4 °	0.37	0.07	0.00	-0.01
Aug	188.2 °	62.0 °	-0.1 °	0.6 °	0.42	0.08	-0.01	-0.01
Sep	166.7 °	63.8 °	2.3 °	3.3 °	0.55	0.10	0.00	-0.01
Oct	161.9 °	43.1 °	0.8 °	-0.2 °	0.66	0.11	0.00	-0.01
Nov	151.5 °	64.7 °	-0.4 °	-0.7 °	0.70	0.10	-0.01	-0.01
Dec	168.4 °	58.4 °	0.8 °	0.9 °	0.67	0.09	-0.01	-0.01

The following observations were drawn from Table 8.3 for Point 12, located in southern Kattegat north of Zealand:

- **Wave Direction Statistics:** The annual mean wave direction is 292°N, with a very low annual standard deviation (9.3°), indicating stable long-term directional conditions. Monthly mean directions vary significantly, from 277°N (January) to 326°N (April), and monthly standard deviations range widely (13.4° to 62.0°), confirming strong seasonal variability and directional spread.

- **Impact of Wind Farm Scenarios on Direction:** Differences between the wind farm scenarios and the baseline scenarios are minimal, generally within ±2.5°, which is well below the natural monthly variability (up to 62°). The largest deviations occur in July (-2.5°) and October (-2.4°) under the Future scenario, but these remain negligible compared to the natural variability.

- **Wave Height Statistics**: Annual mean significant wave height is 0.65 m, with a low annual standard deviation (0.05 m), indicating mild wave conditions at this location. Monthly means range from 0.50 m (May) to 0.83 m (January), with standard deviations between 0.11 m and 0.23 m, showing higher variability during winter months.

- **Impact of Wind Farm Scenarios on Wave Height**: The Current scenario shows almost no change (annual difference 0.00 m, monthly differences mostly -0.01 m to 0.00 m). The Future scenario indicates slightly larger reductions in significant wave height, up to -0.03 m in several months, but these remain small relative to natural variability.

- **Overall Interpretation**: Both wave direction and wave height impacts from wind farms are negligible compared to natural seasonal variability at Point 12. While the future scenario shows slightly larger reductions in significant wave height and minor directional shifts, these changes do not exceed thresholds that would significantly alter the local wave climate.

*Table 8.3: **Point 12** - Annual and monthly statistical results based on AENWS data, showing mean and standard deviation of mean wave directions (first two columns), the differences between calculated annual and monthly mean wave directions across the defined scenarios (third and fourth column), mean and standard deviation of significant wave height (fifth and sixth column), and the differences between calculated annual and monthly significant wave height across the defined scenarios (seventh and last columns).*

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	292.4 °	9.3 °	-0.3 °	-1.5 °	0.65	0.05	0.00	-0.02
Jan	277.5 °	42.0 °	0.1 °	-0.1 °	0.83	0.23	0.00	-0.03
Feb	286.9 °	47.9 °	-0.3 °	-1.0 °	0.80	0.21	0.00	-0.03
Mar	291.0 °	38.7 °	-0.4 °	-1.8 °	0.66	0.18	-0.01	-0.03
Apr	325.7 °	48.0 °	1.0 °	1.6 °	0.54	0.14	-0.01	-0.01
May	318.2 °	30.3 °	-0.3 °	-1.4 °	0.50	0.11	0.00	-0.03
Jun	302.9 °	13.4 °	0.9 °	-1.3 °	0.54	0.13	-0.01	-0.03
Jul	299.5 °	16.2 °	-0.9 °	-2.5 °	0.53	0.14	0.00	-0.03
Aug	294.2 °	30.6 °	0.2 °	-0.7 °	0.55	0.14	0.00	-0.02
Sep	296.9 °	35.1 °	-0.4 °	-1.8 °	0.64	0.16	0.00	-0.03
Oct	281.1 °	33.4 °	-0.7 °	-2.4 °	0.72	0.15	0.00	-0.01
Nov	288.5 °	62.0 °	-1.2 °	0.1 °	0.74	0.16	0.00	-0.01
Dec	279.4 °	40.4 °	0.4 °	-0.4 °	0.80	0.19	0.01	-0.01

The observations for Point 13, located south of Møn in the Baltic Sea, shown in Table 8.4, are as follows:

- **Wave Direction Statistics:** The annual average wave direction is 188°N, accompanied by a standard deviation of 29.5°, indicating a high variability in dominant wave directions throughout the year. Monthly averages span from 112.7°N in April to 214.2°N in July, while monthly standard deviations range between 45.5° (January) and 74.6° (May), suggesting that Point 13 generally experiences a high variability in dominant wave directions throughout the year.

- **Impact of Wind Farm Scenarios on Direction:** Changes in wave direction due to wind farm scenarios are limited. The Current Scenario results in an annual shift of 0.7°, while the Future Scenario shows a change of 3.3°. Monthly differences generally stay within ±5°, which is well within the bounds of the natural variability at this location.

- **Wave Height Statistics:** The annual mean significant wave height is 0.68 m, with a standard deviation of 0.04 m, suggesting mild wave conditions at this location. Monthly averages vary from 0.49 m in June to 0.87 m in January, and standard deviations range from 0.09 m to 0.18 m, with higher values during winter.

- **Impact of Wind Farm Scenarios on Wave Height:** the Current scenario shows negligible impact, with monthly differences typically between -0.03 m and 0.00 m. The Future scenario presents greater changes in wave height, reaching up to -0.10 m in April, and thus exceeding the standard deviation for this month. Generally, for Point 13, however, the impacts from the wind farm scenarios are limited when compared to natural variation.

- **Overall Interpretation:** The impact of wind farms on both wave direction and wave height is limited in comparison to natural variability. Although the Future scenario introduces a reduction in mean significant wave height in April exceeding the natural variation, these changes are larger than for the other points but not substantial enough to significantly affect the local wave climate.

*Table 8.4: **Point 13** - Annual and monthly statistical results based on AENWS data, showing mean and standard deviation of mean wave directions (first two columns), the differences between calculated annual and monthly mean wave directions across the defined scenarios (third and fourth column), mean and standard deviation of significant wave height (fifth and sixth column), and the differences between calculated annual and monthly significant wave height across the defined scenarios (seventh and last columns).*

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	188.2 °	29.5 °	0.7 °	3.3 °	0.68	0.04	-0.01	-0.04
Jan	201.7 °	45.5 °	-0.6 °	-2.2 °	0.87	0.18	-0.01	-0.02
Feb	186.9 °	68.9 °	-0.0 °	-0.2 °	0.85	0.16	-0.01	-0.03
Mar	173.2 °	59.6 °	-0.1 °	-0.3 °	0.73	0.14	0.00	-0.01
Apr	112.7 °	73.5 °	0.5 °	0.7 °	0.62	0.09	-0.03	-0.10
May	116.9 °	74.6 °	0.3 °	5.3 °	0.55	0.09	-0.01	-0.04
Jun	206.9 °	72.4 °	0.8 °	4.4 °	0.49	0.12	-0.02	-0.05
Jul	214.2 °	58.6 °	1.4 °	2.2 °	0.50	0.09	-0.01	-0.03
Aug	202.0 °	55.7 °	1.5 °	3.6 °	0.52	0.09	-0.02	-0.02
Sep	187.4 °	64.3 °	0.6 °	0.7 °	0.67	0.11	-0.01	-0.03
Oct	189.2 °	49.3 °	-0.0 °	0.9 °	0.79	0.15	-0.01	-0.03
Nov	187.8 °	56.8 °	1.0 °	2.7 °	0.80	0.10	0.01	-0.04
Dec	203.0 °	47.4 °	0.1 °	0.0 °	0.85	0.12	0.00	-0.02

8.3. Conclusion on wave impact

A comparative analysis of conditions without wind farms versus those with wind farms in 2021 and projected for 2030 indicates that wind farms lead to a reduction in significant wave height on both annual and monthly scales as described in section 8.1.

The analysis comparing conditions with and without wind farms is based on data from 2019. To account for natural annual and monthly variations, wave data—including significant wave height and mean wave direction—were examined using information from Copernicus (2025) for the years 1988 to 2024. This analysis covers 16 locations, ranging from the west coast of Jutland, through the inner Danish waters, to the Baltic Sea.

The study, described in section 8.2, indicates that natural variation exceeds the variation attributed to both the 2021 wind farm scenario and projections for 2030 along the west coast of Jutland and in the Kattegat area by approximately an order of magnitude. In contrast, the reduction observed in the Baltic Sea due to wind farms is greater and approaches the annual and monthly standard deviation, suggesting that the Baltic Sea is more sensitive towards the establishment of wind farms with relation to the wave climate, compared to the Kattegat and the North Sea.

9. Impact on sediment transport

9.1. Introduction

The establishment of wind farms in Danish and neighbouring waters results in changes to wave patterns. Such modifications have the potential to affect longshore sediment transport rates, which may consequently impact the ongoing evolution of the shoreline.

To investigate how these changes in wave climate affect the coastal longshore sediment transport, the sediment transport capacity has been calculated along three coastal stretches for the Baseline scenario, as well as for the Current (2021) and Future (2030) wind farm developments in the North Sea, Kattegat, and the Baltic Sea. The following stretches are included in the analysis:

- Løkken to Hirtshals.
- Ferring to Hvide Sande.
- Hjelm Bugt.

The locations of the three coastal stretches are presented in Figure 9.1.

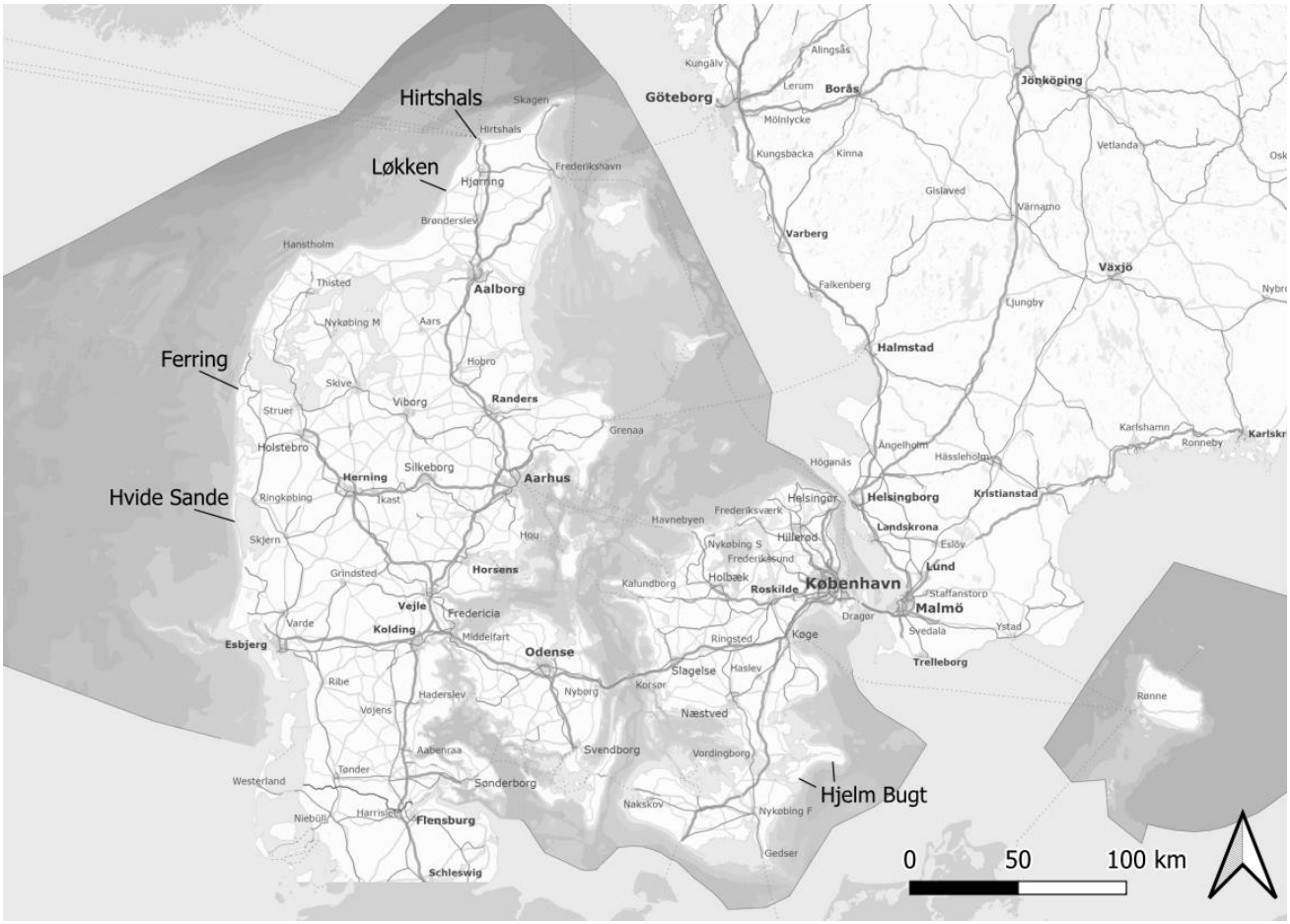


Figure 9.1: Location of the three stretches investigated for impact on longshore sediment transport.

The sediment transport capacity is the upper theoretical limit for the amount of sediment that waves and currents can transport under specific hydrodynamic conditions. It reflects the potential for sediment movement, based on the assumption that there is an unlimited supply of sand available.

On the other hand, the actual sediment transport is the real amount of sediment that is moved by waves and currents in a given place and time. This depends not only on the transport capacity but also on the availability of sediment, grain size, distribution, and other environmental factors such as vegetation or man-made structures.

Changes in the net longshore sediment transport gradients along the coast may lead to sediment deposition if the gradient is negative, or erosion if the gradient is positive.

9.1.1. Løkken to Hirtshals

As illustrated in Figure 9.2, the longshore sediment transport between Løkken and Hirtshals is predominantly directed northward (Kystdirektoratet, 2022). Previous studies have estimated the magnitude of the net longshore sediment transport to be in the range of 400,000 – 900,000 m^3/yr (Kystdirektoratet, 2001; DHI, 2000).

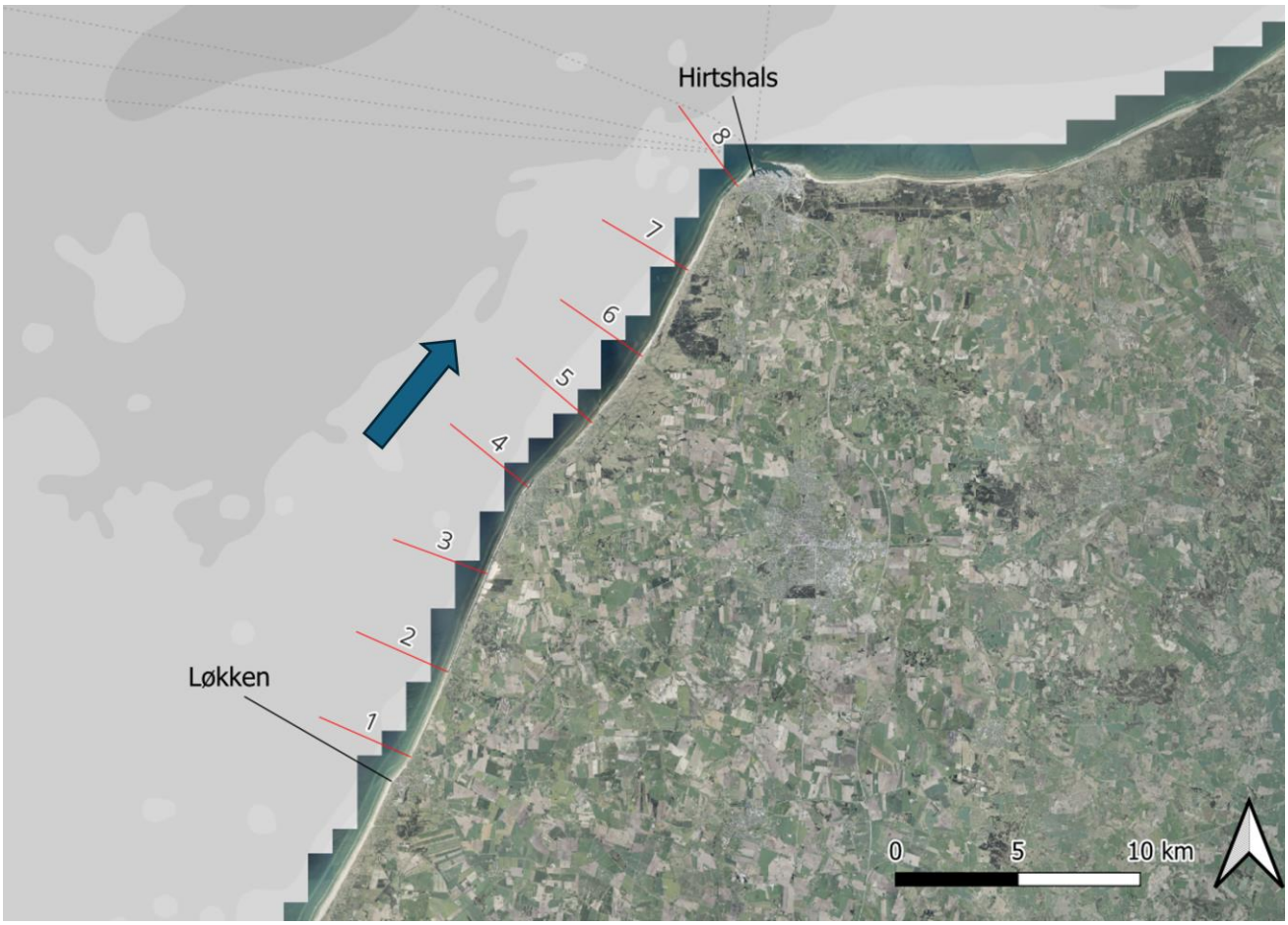


Figure 9.2: Coastal stretch from Løkken to Hirtshals. Blue arrow indicates the net sediment transport direction (Kystdirektoratet, 2022). Placements of the eight profiles are indicated by red lines perpendicular to the coast. Orthophoto: 2024.

9.1.2. Ferring to Hvide Sande

As illustrated in Figure 9.3, the longshore sediment transport between Ferring and Hvide Sande is predominantly directed southward (Kystdirektoratet, 2022). North of Ferring, the transport is directed northward, resulting in a point near Ferring where the net longshore sediment transport is approximately 0 m^3/year. From this point, sediment diverges both northward and southward. In a previous study, the magnitude of the net longshore sediment transport at Hvide Sande was estimated to be approximately 400,000 m^3/year (DHI, 2000).

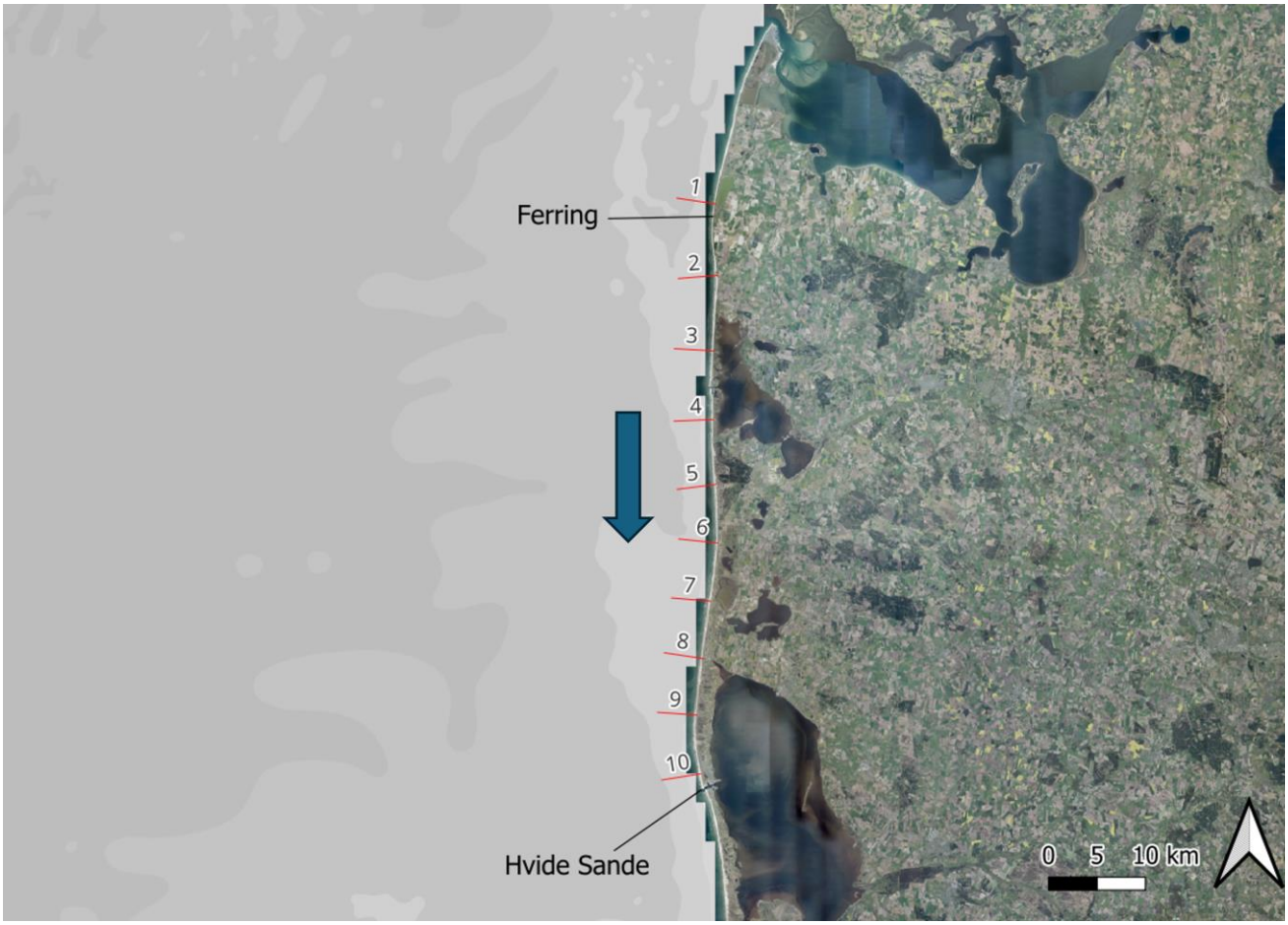


Figure 9.3: Coastal stretch from Ferring to Hvide Sande. Blue arrow indicates the net sediment transport direction (Kystdirektoratet, 2022). Placements of the ten profiles are indicated by red lines perpendicular to the coast. Orthophoto: 2024.

9.1.3. Hjelm Bugt

As illustrated in Figure 9.4, the longshore sediment transport in Hjelm Bugt is predominantly directed westward (Kystdirektoratet, 2022). However, an orthophoto from spring 2019 suggests that the sediment transport was eastward at that time. Figure 9.4 presents the orthophoto from the northern part of Hjelm Bugt, showing erosion on the east side of the groynes and sediment accumulation on the west side. This pattern indicates that sediment was transported from west to east, becoming trapped by the groynes and resulting in sediment build-up and a wider beach on their western side.

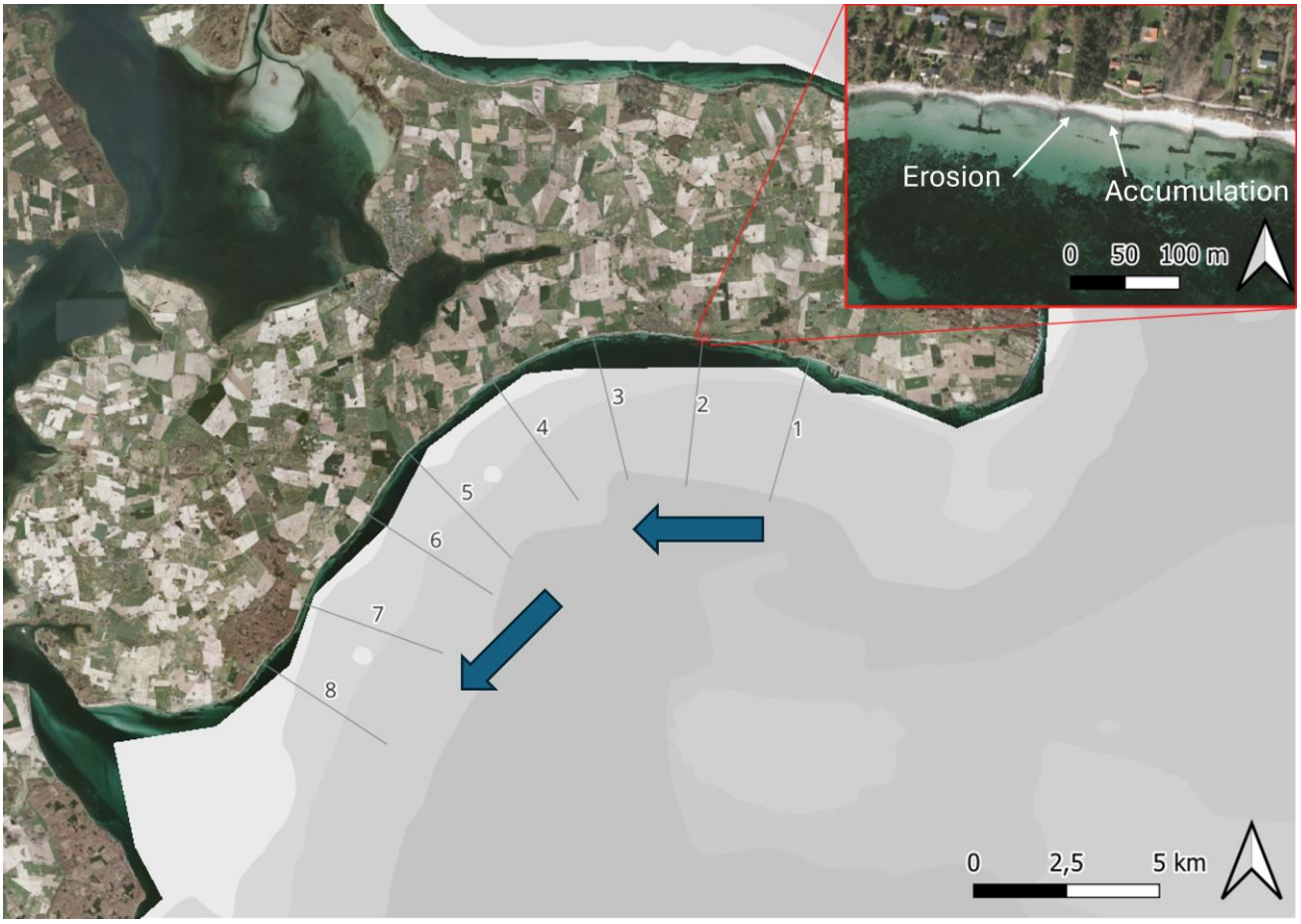


Figure 9.4: Erosion and accumulation in groyne field in the northern part of Hjelm Bugt. Blue arrow indicates the net sediment transport direction (Kystdirektoratet, 2022). Placements of the eight profiles are indicated by grey lines perpendicular to the coast. Orthophoto: 2019.

9.2. Data

The sediment transport capacity is calculated in cross-shore profiles along the selected coastal stretches. These profiles are a crucial input to the LITDRIFT model (DHI, 2024).

Along the west coast of Jutland, the Danish Coastal Authority (Kystdirektoratet) conducts regular measurements of coastal profiles at predefined locations spaced approximately 1 km apart. These profiles extend from the top of the dune to about 4 km offshore.

At Hjelm Bugt, no measured cross-shore profiles are available. Instead, elevation data for the dry part of the profile is extracted from the Danish elevation model (SDFI, 2025), while depth data is obtained from the Danish depth model (Geodatastyrelsen, 2024). These datasets are combined to form complete profiles, with the gap between land and sea data filled using linear interpolation.

9.2.1. Profile orientation

The orientation of each cross-shore profile is determined as the line perpendicular to the coastline at the profile location. To achieve this, the coastline is coarsely digitized to capture the average orientation over the distance represented by each profile, thereby excluding minor undulations. The orientation is then assigned to each profile based on this smoothed coastline.

9.2.2. Sediment grain size

Sediment characteristics are described by the mean grain size (D_{50}). For the Løkken to Hirtshals and Ferring to Hvide Sande stretches, the mean grain size is based on sediment samples from the 2 m depth contour, as presented in DHI (2000). For Hjelm Bugt, the mean sediment grain size is assumed to be 0.2 mm. Table 9.1 shows the D_{50} values for all profiles.

Table 9.1: Mean sediment grain size (D_{50}) used in the model. The grain sizes are provided for each profile at the three locations (see Figure 9.2 to Figure 9.4 for profile positions).

Location	Profile	D_{50} [mm]
Løkken to Hirtshals	All	0.17
Ferring to Hvide Sande	1	0.31
Ferring to Hvide Sande	2	0.30
Ferring to Hvide Sande	3	0.29
Ferring to Hvide Sande	4, 5	0.27
Ferring to Hvide Sande	6	0.26
Ferring to Hvide Sande	7, 8	0.25
Ferring to Hvide Sande	9, 10	0.24
Hjelm Bugt	All	0.20

9.2.3. Waves

Wave parameters (significant wave height (H_{m0}), peak wave period (T_p), and mean wave direction (MWD)) are extracted from the MIKE SW model at points located approximately 10 km offshore along the coast. This ensures that the wave time series are representative of the conditions at the corresponding cross-shore profiles.

9.3. Methods

The DHI LITDRIFT model is used to calculate the longshore sediment transport capacity. LITDRIFT simulates wave transformation across the cross-shore profile—from the offshore point to the coastline—and the resulting wave-driven currents. Based on the computed hydrodynamics, the model estimates the longshore sediment transport along each profile.

Required input for LITDRIFT includes:

- Bathymetry in cross-shore profiles
- Orientation of cross-shore profiles
- Time-series of:
    - Root-mean-square wave height
    - Peak wave period
    - Mean wave direction
- Sediment median grain size (D_{50})

9.3.1. Wave height conversion

The wave heights extracted from the wave model are significant wave heights (H_{m0}). Since the LITDRIFT model requires root-mean-square wave heights (H_{rms}), the following conversion is applied:

$$H_{rms} = \frac{H_{m0}}{\sqrt{2}}$$

9.3.2. Limitations

While the LITDRIFT model provides valuable insights into longshore sediment transport dynamics, several limitations should be noted:

- In this analysis, the model simulations are based on a single year of wave data. This makes the results sensitive to the waves occurring that year which may not be fully representative for the wave climate at the analyzed locations. As a result, the long-shore sediment transport may be different that year compared to other years.
- The model assumes a constant sediment grain size (D_{50}) across each cross-shore profile. In reality, sediment characteristics often vary across the profile due to natural sorting processes, wave action, and sediment sources. This simplification may affect the accuracy of transport estimates.
- The LITDRIFT model focuses exclusively on longshore sediment transport and does not account for cross-shore transport processes such as onshore-offshore sediment exchange, bar migration, or storm-induced erosion and recovery. These processes can significantly influence beach morphology and sediment budgets.
- The model assumes an open natural coastline without man-made structures. However, all three coastal stretches include features such as groynes and breakwaters. These structures can locally modify wave conditions and influence sediment transport patterns that are not captured by the model.
- The model does not include morphological updating, meaning that changes in the seabed or shoreline due to sediment transport are not fed back into the hydrodynamic calculations. This limits the model's ability to simulate evolving coastal systems over time.

Despite these limitations, the model output can be used for evaluating the overall impact on sediment transport from the two wind farm scenarios compared to the baseline situation as the comparison is relative. Unlike the documented effects on the significant wave height, longshore sediment transport reflects cumulative influences based on hourly data, taking into account not only significant wave height, but also changes in wave period and mean wave direction. For example, when considering sediment transport from Ferring to Hvide Sande, the movement can occur either northward or southward. By analysing the sediment transport, it is possible to determine if one direction is more impacted than the other, which may result in either deposition or erosion.

9.4. Results

Figure 9.5, Figure 9.7 and Figure 9.9 present the simulated longshore sediment transport capacity for the coastal stretches from Løkken to Hirtshals, Ferring to Hvide Sande, and Hjelm Bugt, respectively. Each figure shows the simulated longshore sediment transport capacity in both directions along the shore for the baseline scenario. Additionally, the figures illustrate the changes in transport capacity in both directions and net transport for the current and future scenarios relative to the baseline.

Figure 9.6, Figure 9.8 and Figure 9.10 present the simulated net longshore sediment transport capacity for the three scenarios together with annotation of whether the gradient in transport capacity leads to erosion or accumulation in the profile. Additionally, for the current and future scenarios, it is indicated whether more or less sediment is eroded or accumulated in the profile compared to the baseline.

At **Løkken to Hirtshals**, the simulated longshore sediment transport capacity highlights the following observations:

- **Baseline:** The sediment transport is directed northward along the entire coastal stretch, with an overall increase towards Hirtshals, as expected.
- **Current scenario (2021):** Compared to the baseline, only minor changes are observed in the transport capacity in both directions and net transport capacity across all profiles (<±0.7% and <±0.4%, respectively). Consequently, the changes in erosion and accumulation due to the current wind farm scenario are minimal.
- **Future scenario (2030):** Compared to the baseline, all profiles exhibit an increase in northward transport. Profiles 4 and 8 show a decrease in southward transport, while the remaining profiles indicate an increase. However, the changes remain small (<±1.3%). The relatively larger increase in northward transport capacity results in an overall increase in net transport capacity across all profiles, particularly between profiles 4 and 8. Due to differences in the increase of net transport capacity, erosion is intensified in profiles 4, 7, and 8, while accumulation increases in profiles 5 and 6.

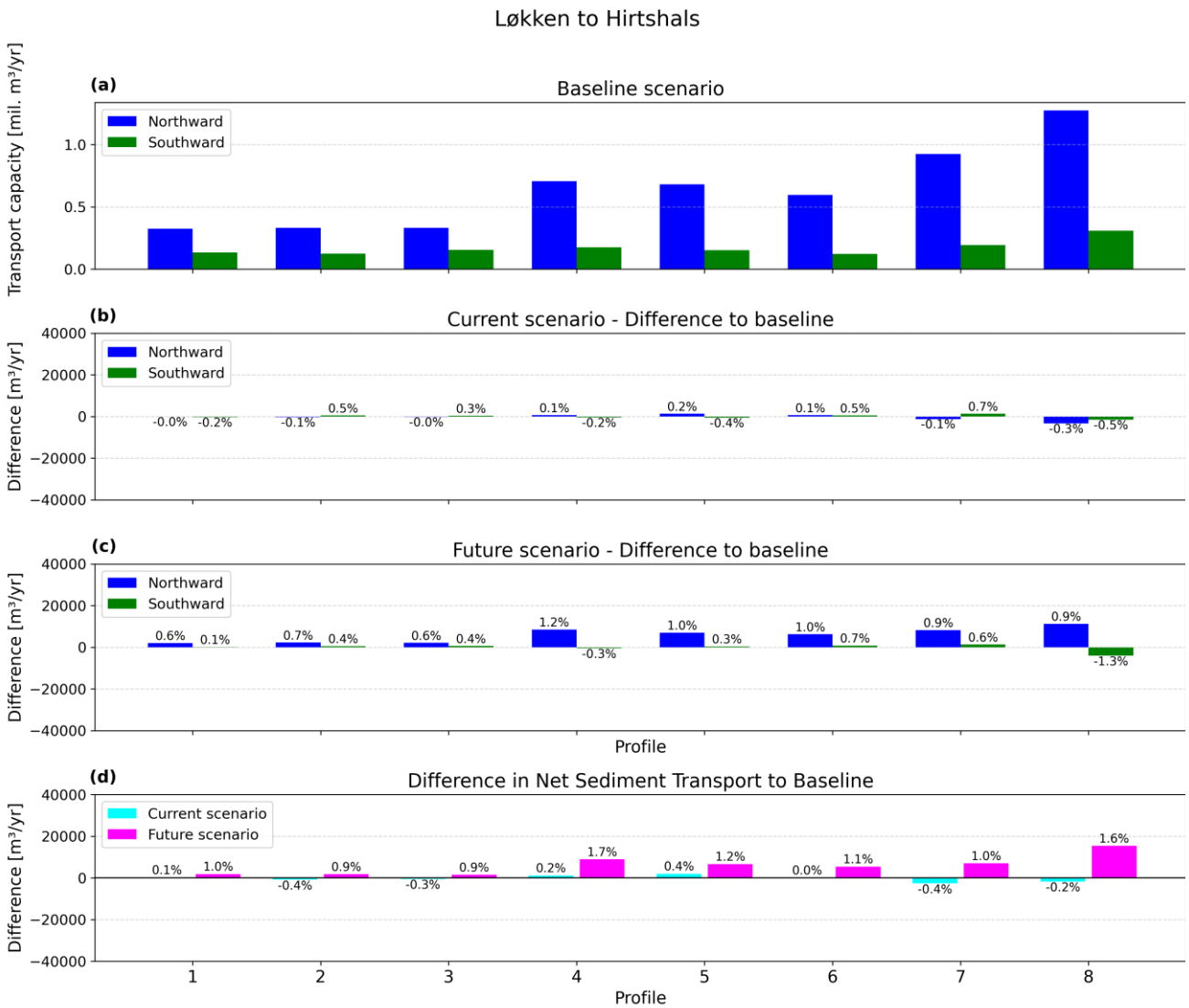


Figure 9.5: Simulated longshore sediment transport capacity in both directions for Løkken to Hirtshals for the baseline scenario (a). Difference in sediment transport capacity in both directions between the baseline and the current scenario (b),

between the baseline and the future scenario (c) and difference in net sediment transport capacity for both scenarios (d). Note that in panel (d), positive values indicate northward transport, and negative values indicate southward transport.

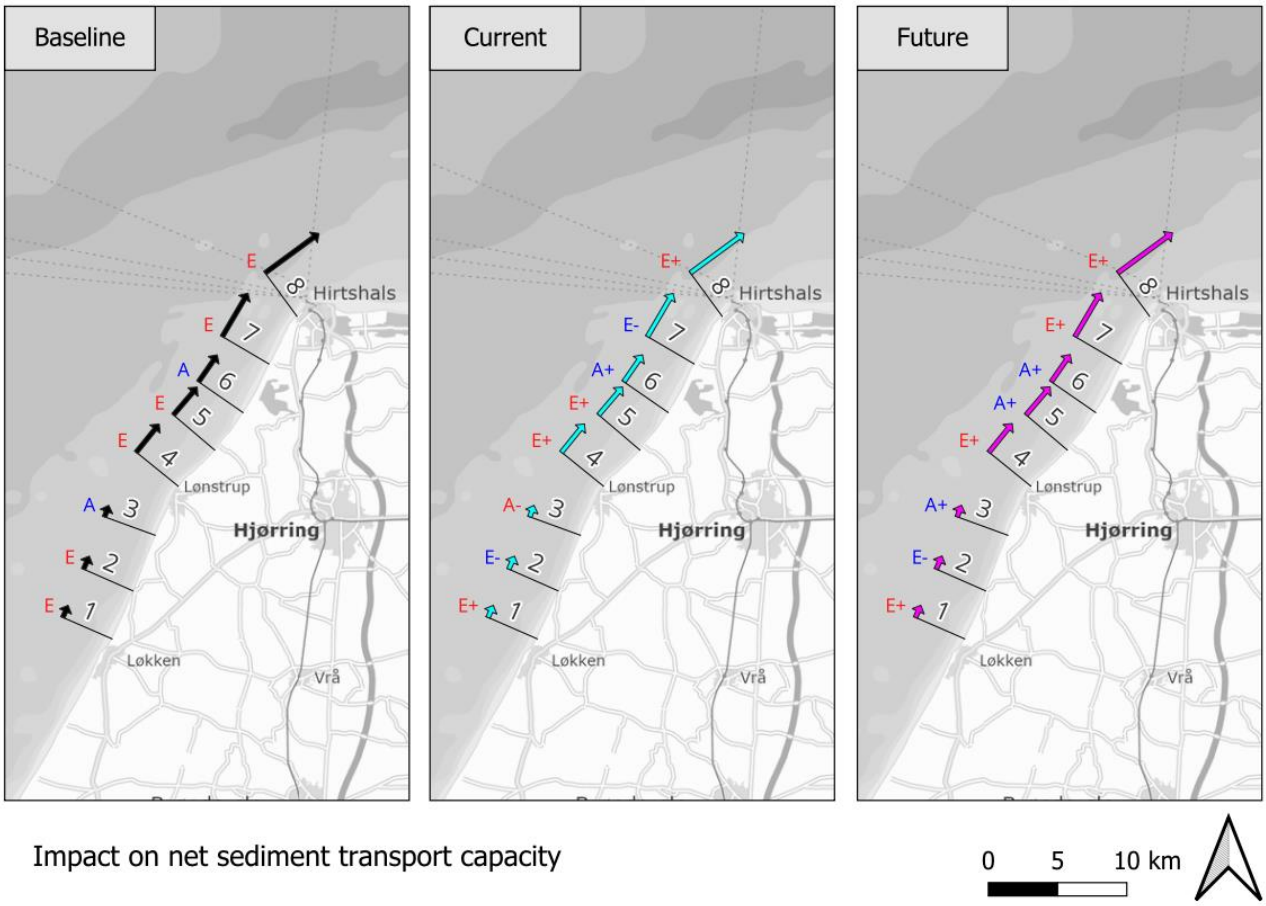


Figure 9.6: Direction and magnitude of simulated net sediment transport capacity for the Baseline, Current (2021) and Future (2030) scenario are indicated by the arrows. Based on the gradient in transport capacity, it is shown whether the profile experience erosion (E) or accumulation (A). In the current and future scenarios, it is noted whether the erosion or accumulation has increased (+) or decreased (-), and whether more (blue) or less (red) sediment is being transported to the profile.

At **Ferring to Hvide Sande**, the simulated longshore sediment transport capacity highlights the following observations:

- **Baseline:** The net sediment transport is directed southward along the entire coastal stretch, as expected. The erosion and accumulation pattern varies along the coast.
- **Current scenario (2021):** Compared to the baseline, only minor changes are observed in southward transport capacity across all profiles (<0.8%). Profiles 1–3 exhibit a slight increase (<0.5%) in northward transport capacity, while profiles 4–10 show a decrease, reaching up to -2.2% in profile 10.
- **Future scenario (2030):** All profiles show a decrease in both northward and southward transport capacity. The decrease in northward transport is relatively uniform (6%–10%), while the decrease in southward transport ranges from 1%–5%. Despite the decrease in transport capacity in both directions, the net transport capacity increases in all profiles except profile 10. This is due to a larger reduction in

northward transport compared to southward transport. The most significant changes in net transport capacity occur in profiles 1–4, where the decrease in southward transport is relatively small compared to the decrease in northward transport. These changes in net transport capacity result in increased erosion in profiles 1 and 2, due to a rising transport gradient between them. From profile 3 onwards, the remaining profiles—except profile 6—experience reduced erosion or increased accumulation, as the transport gradient decreases.

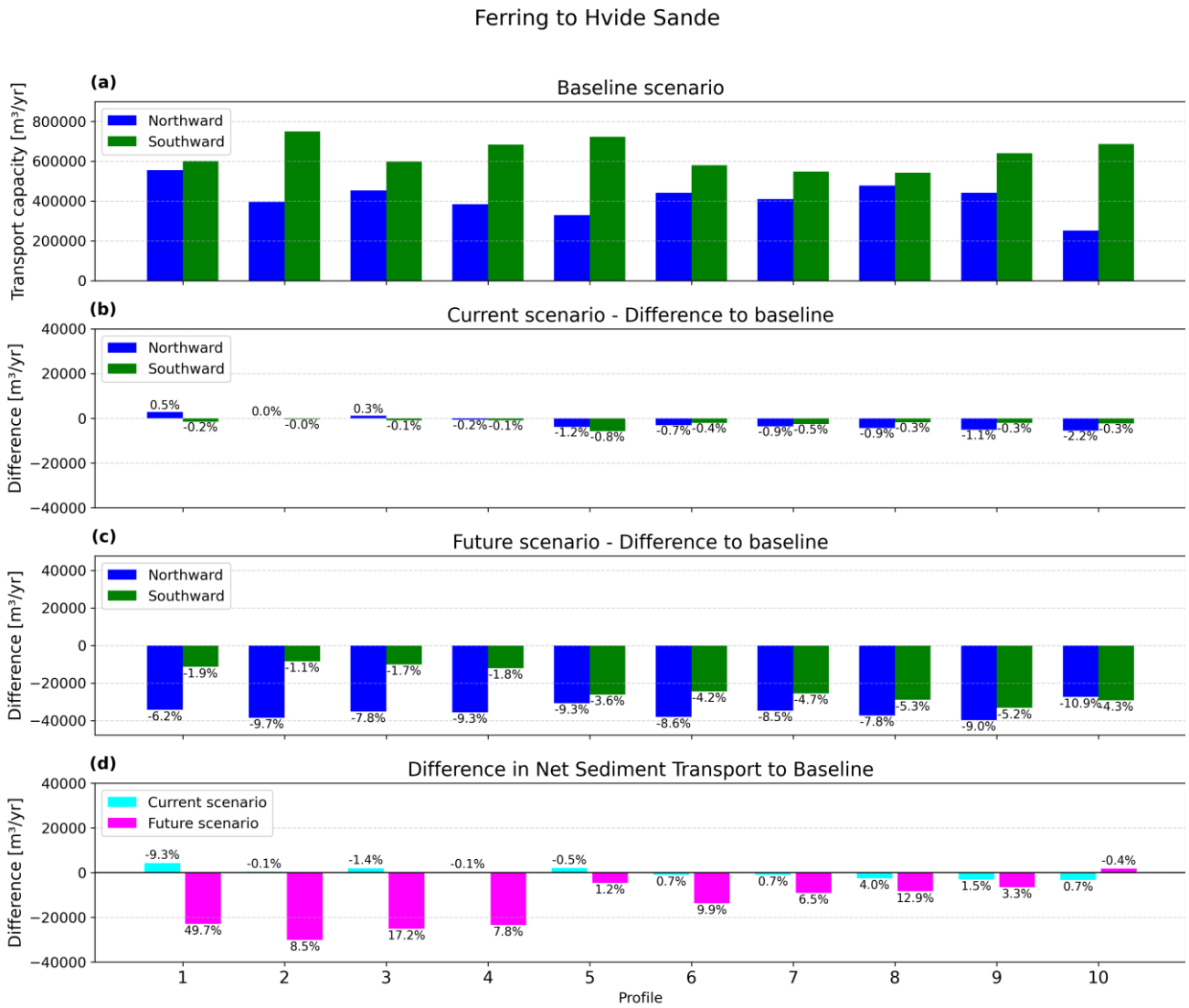


Figure 9.7: Simulated longshore sediment transport capacity in both directions for Ferring to Hvide Sande for the baseline scenario (a). Difference in sediment transport capacity in both directions between the baseline and the current scenario (b), between the baseline and the future scenario (c) and difference in net sediment transport capacity for both scenarios (d). Note that in panel (d), positive values indicate northward transport, and negative values indicate southward transport.

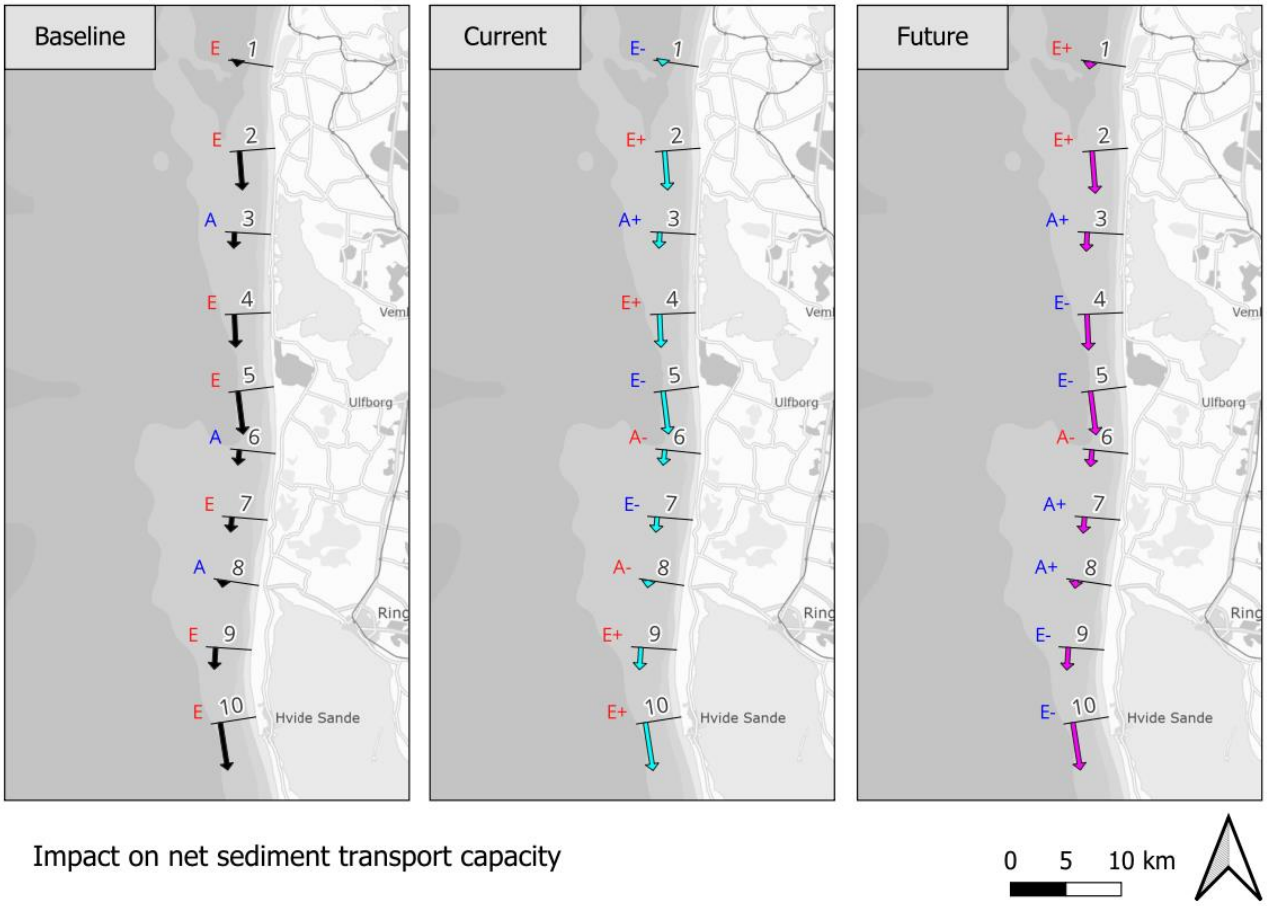


Figure 9.8: Direction and magnitude of simulated net sediment transport capacity for the baseline, Current (2021) and Future (2030) scenario are indicated by the arrows. Based on the gradient in transport capacity, it is shown whether the profile experience erosion (E) or accumulation (A). In the Current (2021) and Future (2030) scenarios, it is noted whether the erosion or accumulation has increased (+) or decreased (-), and whether more (blue) or less (red) sediment is being transported to the profile.

At **Hjelm Bugt**, the simulated longshore sediment transport capacity highlights the following observations:

- **Baseline:** In the northern part of the bay (profiles 1–5), sediment transport is directed eastward, while in the rest of the bay, it is directed westward.
- **Current (2021) scenario:** Compared to the baseline, the eastward transport capacity in the current scenario shows only minor changes across all profiles (<1.4%).
- **Future (2030) scenario:** All profiles show a decrease in eastward transport, although this is minor compared to the decrease in westward transport.
- **Current (2021) and Future (2030) scenarios:** Westward transport capacity has decreased substantially in all profiles except profiles 1 and 2, primarily due to reduced wave energy from the west. This results in an increase in net transport capacity in profiles 3–5, and a decrease in profiles 6–8, where the net sediment transport is westward.
- **Baseline:** The net sediment transport capacity increases away from the point of divergence, leading to erosion in the middle of the bay (profiles 3–7) and accumulation in profiles 1, 2, and 8.
- **Current (2021) and Future (2030) scenarios:** No clear trend is observed in the changes to erosion and accumulation patterns.

- It is noteworthy that sediment transport is typically westward throughout the bay (see section 9.1.3) Therefore, a reduction in westward transport may lower both the magnitude of net sediment transport and the associated gradients.

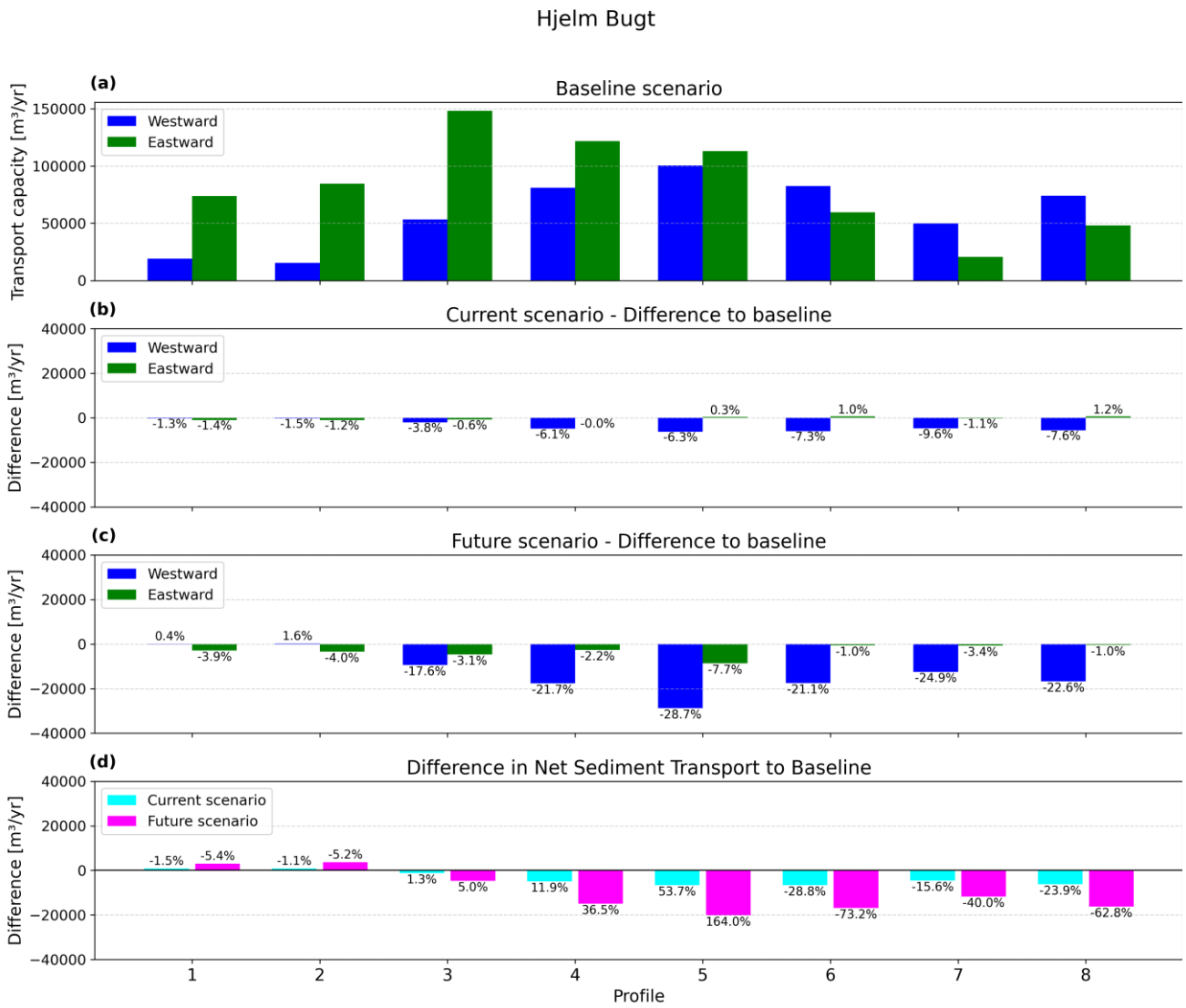
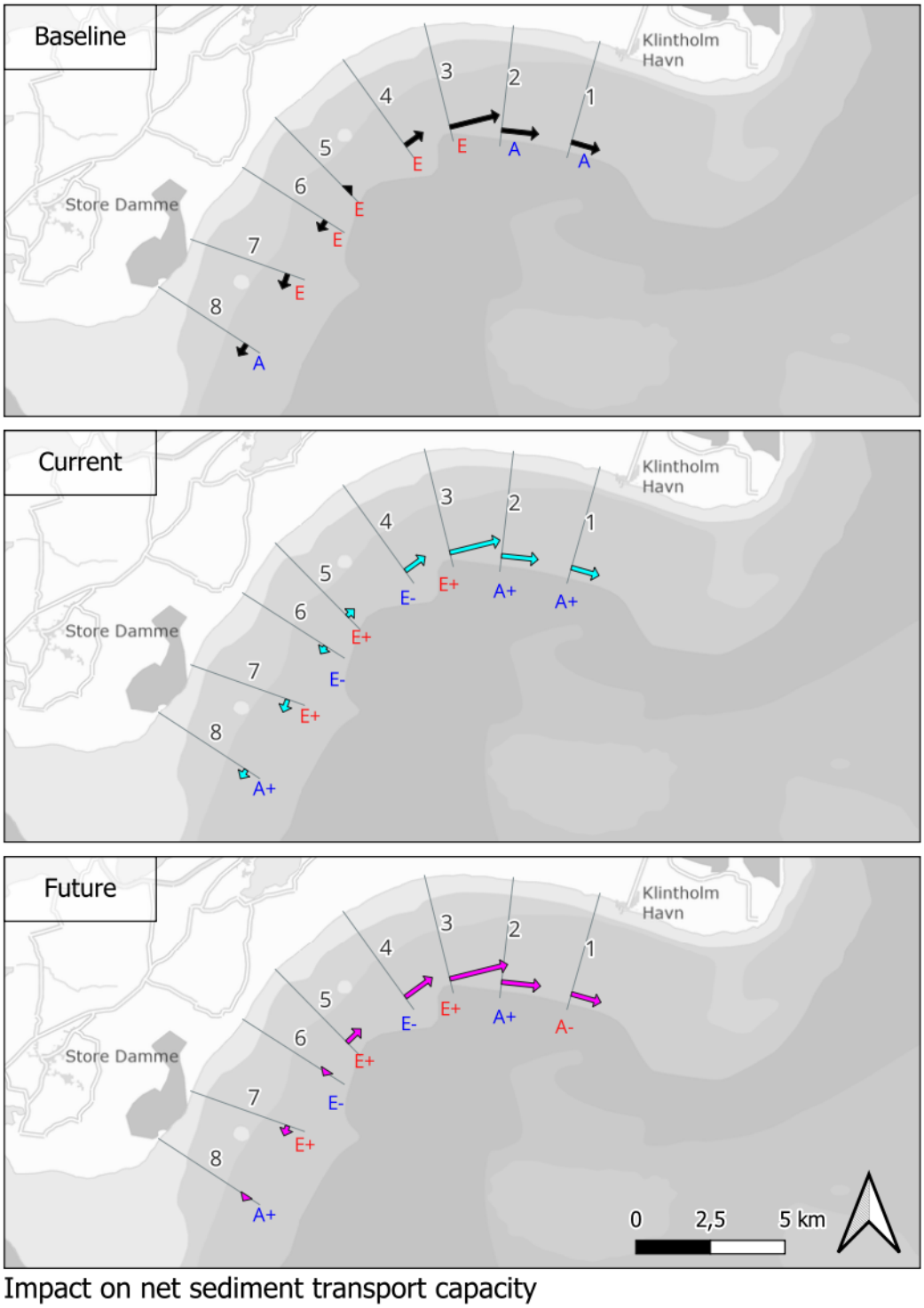


Figure 9.9: Simulated longshore sediment transport capacity in both directions for Hjelm Bugt for the baseline scenario (a). Difference in sediment transport capacity in both directions between the baseline and the current scenario (b), between the baseline and the future scenario (c) and difference in net sediment transport capacity for both scenarios (d). Note that in panel d positive values indicate a net northward transport and negative values indicate a net southward transport. Note that in panel (d), positive values indicate westward transport, and negative values indicate eastward transport.



Impact on net sediment transport capacity

Figure 9.10: Direction and magnitude of simulated net sediment transport capacity for the Baseline, Current (2021) and Future (2030) scenario are indicated by the arrows. Based on the gradient in transport capacity, it is shown whether the profile experience erosion (E) or accumulation (A). In the current and future scenarios, it is noted whether the erosion or accumulation has increased (+) or decreased (-), and whether more (blue) or less (red) sediment is being transported to the profile.

9.5. Uncertainty analysis

To examine the model's limitations, profile orientations along the Ferring to Hvide Sande coast were adjusted by ±2° from baseline. Longshore sediment transport capacity was then calculated using these altered orientations.

A change in profile orientation of 2° is equivalent to altering the wave climate by 2°. The comparison between the baseline and sensitivity model runs shows that the magnitude of transport capacity in both northward and southward directions vary by 6,000 to 43,000 m^3/year, corresponding to a change of approximately 1% to 8%.

In section 8.2 at a location offshore Hvide Sande, the annual MWD standard deviation is found to be above 5° and the monthly between 10° to 30°, indicating that the longshore sediment transport on annual basis experience change on a larger scale than may be expected given by the wind farms.

9.6. Conclusion on sediment transport impact

Overall, the modelled impact on sediment transport is larger for the Future (2030) scenario compared to the Current (2021) scenario, and the impact at Hjelm Bugt in the Baltic Sea is larger compared to the impact along the west coast of Jutland bordering the North Sea, which may indicate that the wave climate in the Baltic Sea is more sensitive to impacts from future offshore wind farm development.

It is important to note, however, that the annual variation in the wave climate indicates a larger change compared to the impact introduced by wind farms.

Also, although the results show that offshore wind farms can influence coastal processes, the current analysis is insufficient to draw definitive conclusions about long-term coastline development or morphological changes.

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Appendix A: Available measurements of waves

Location and list of stations with measurements covering the year 2019.

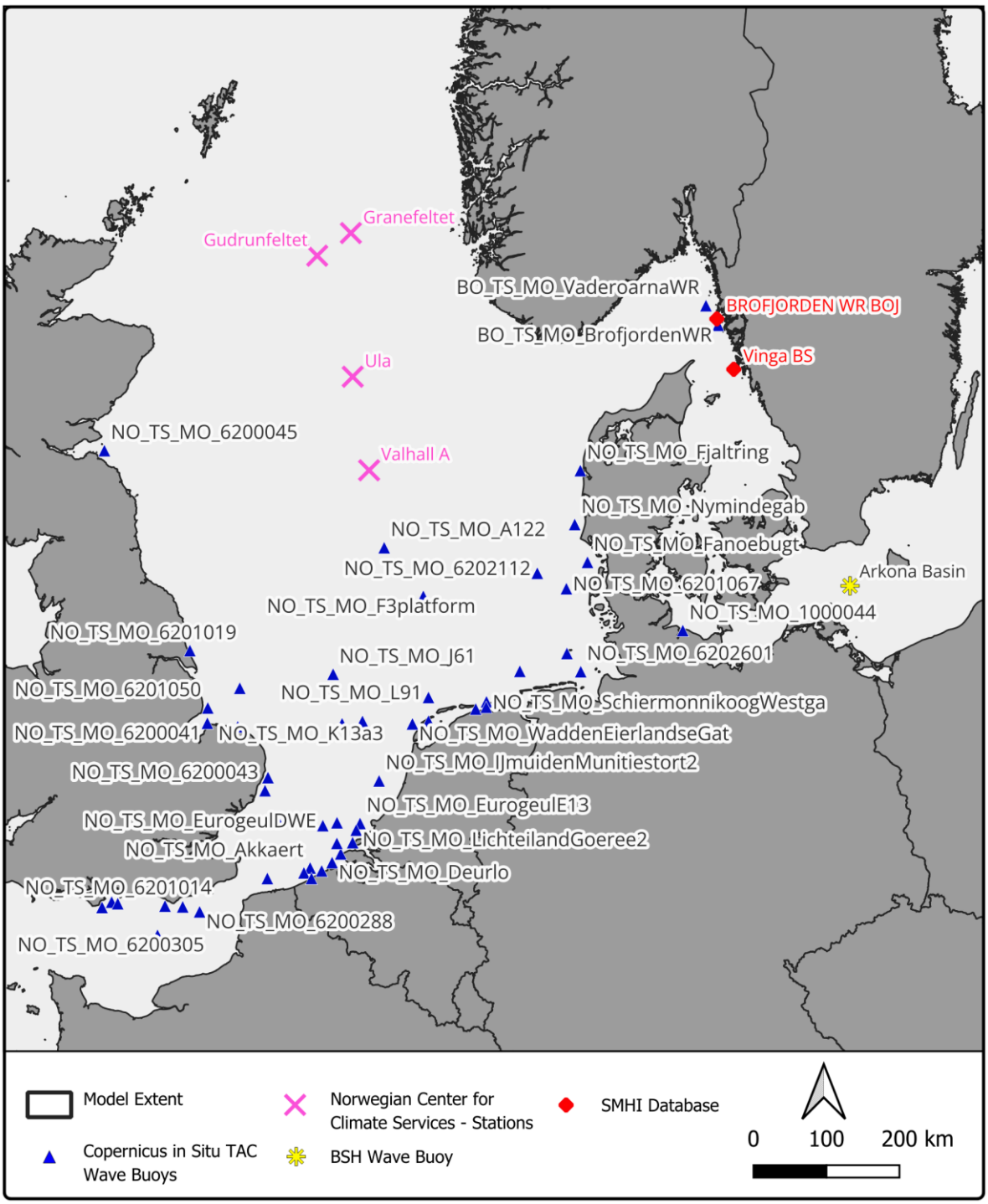
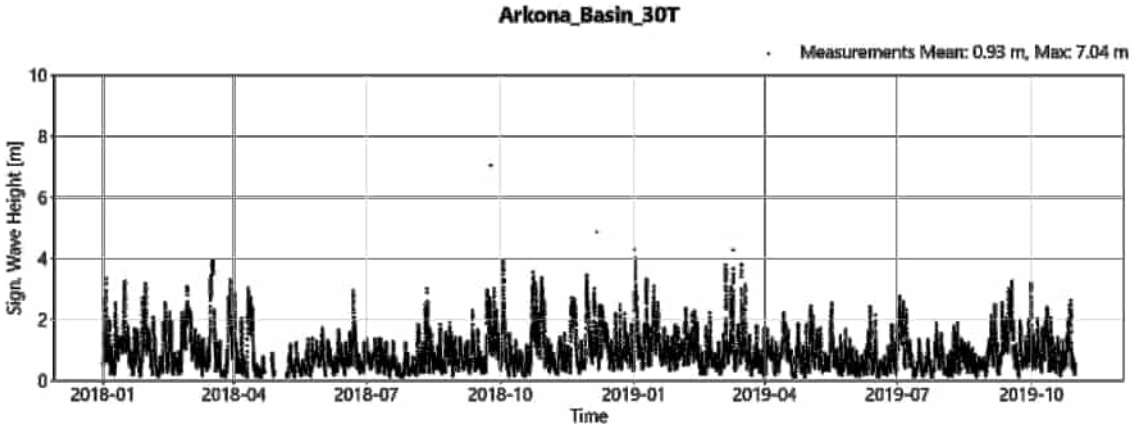


Figure 10.1: Location of the retrieved wave measurements for 2019.

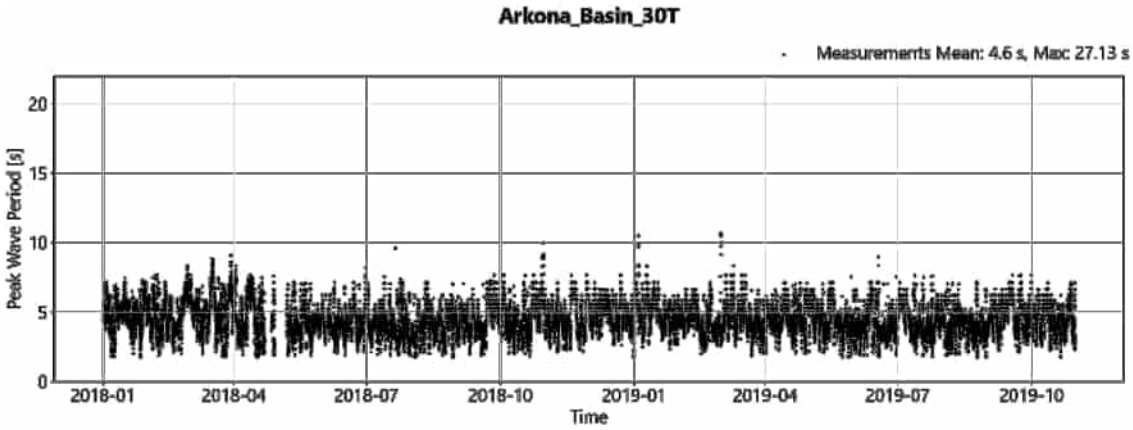
Station ID	Longitude [deg]	Latitude [deg]	Time	Coverage (%)
BO_TS_MO_BrofjordenWR	11.225	58.251	UTM0	100
BO_TS_MO_VaderoarnaWR	10.953	58.496	UTM0	86
NO_TS_MO_1000044	10.267	54.500	UTM0	97
NO_TS_MO_6200041	0.475	53.058	UTM0	100
NO_TS_MO_6200042	1.100	53.058	UTM0	100
NO_TS_MO_6200043	1.784	52.312	UTM0	100
NO_TS_MO_6200044	1.579	51.570	UTM0	93
NO_TS_MO_6200045	-2.504	56.188	UTM0	100
NO_TS_MO_6200170	2.000	51.240	UTM0	90
NO_TS_MO_6200288	0.754	50.746	UTM0	100
NO_TS_MO_6200289	1.054	53.532	UTM0	100
NO_TS_MO_6200305	0.000	50.400	UTM0	100
NO_TS_MO_6201010	-1.129	50.650	UTM0	100
NO_TS_MO_6201011	-0.959	50.732	UTM0	100
NO_TS_MO_6201012	-0.839	50.723	UTM0	100
NO_TS_MO_6201015	0.417	50.783	UTM0	100
NO_TS_MO_6201019	-0.067	53.917	UTM0	100
NO_TS_MO_6201050	0.447	53.245	UTM0	100
NO_TS_MO_6201058	2.109	51.953	UTM0	100
NO_TS_MO_6201059	1.817	52.476	UTM0	100
NO_TS_MO_6201067	7.783	55.017	UTM0	85
NO_TS_MO_6201068	6.839	53.985	UTM0	80
NO_TS_MO_6202112	7.150	55.200	UTM0	44
NO_TS_MO_6202600	7.818	54.219	UTM0	93
NO_TS_MO_6202601	8.114	53.996	UTM0	97
NO_TS_MO_A122	3.817	55.418	UTM0	100
NO_TS_MO_Akkaert	2.819	51.416	UTM0	100
NO_TS_MO_AWG	5.950	53.500	UTM0	100
NO_TS_MO_Deurlo	3.242	51.504	UTM0	100
NO_TS_MO_DomburgerRassen	3.399	51.620	UTM0	100
NO_TS_MO_EurogeulDWE	3.000	51.948	UTM0	100
NO_TS_MO_EurogeulE13	3.737	52.010	UTM0	100
NO_TS_MO_Europlatform3	3.276	51.999	UTM0	100
NO_TS_MO_F3platform	4.727	54.854	UTM0	96
NO_TS_MO_IJmuidenMunitiestort2	4.058	52.550	UTM0	100
NO_TS_MO_J61	2.950	53.817	UTM0	100
NO_TS_MO_K13a3	3.220	53.218	UTM0	100
NO_TS_MO_K141	3.633	53.267	UTM0	96
NO_TS_MO_Kwintebank	2.706	51.349	UTM0	100
NO_TS_MO_L91	4.961	53.614	UTM0	100
NO_TS_MO_LichteilandGoeree2	3.670	51.926	UTM0	96
NO_TS_MO_MeetboeiWEO1	6.518	53.617	UTM0	96
NO_TS_MO_MeetboeiWEW1	6.368	53.620	UTM0	96
NO_TS_MO_SchiermonnikoogNoord	6.167	53.596	UTM0	96

Station ID	Longitude [deg]	Latitude [deg]	Time	Coverage (%)
NO_TS_MO_SchiermonnikoogWestgat	6.165	53.529	UTM0	100
NO_TS_MO_Schouwenbank2	3.306	51.745	UTM0	100
NO_TS_MO_StortemelkBoei	4.989	53.323	UTM0	100
NO_TS_MO_WaddenEierlandseGat	4.662	53.277	UTM0	100
BROFJORDEN WR BOJ	11.5734	57.6234	UTM2	100
Vinga BS	11.2229	58.2513	UTM2	44
Arkona Basin	13.859	54.884	UTM1	N/A
Valhall A	3.393	56.278	UTM1	100
Ula	2.846	57.408	UTM1	100
Granefeltet	2.487	59.165	UTM1	100
Gudrunfeltet	1.744	58.845	UTM1	100

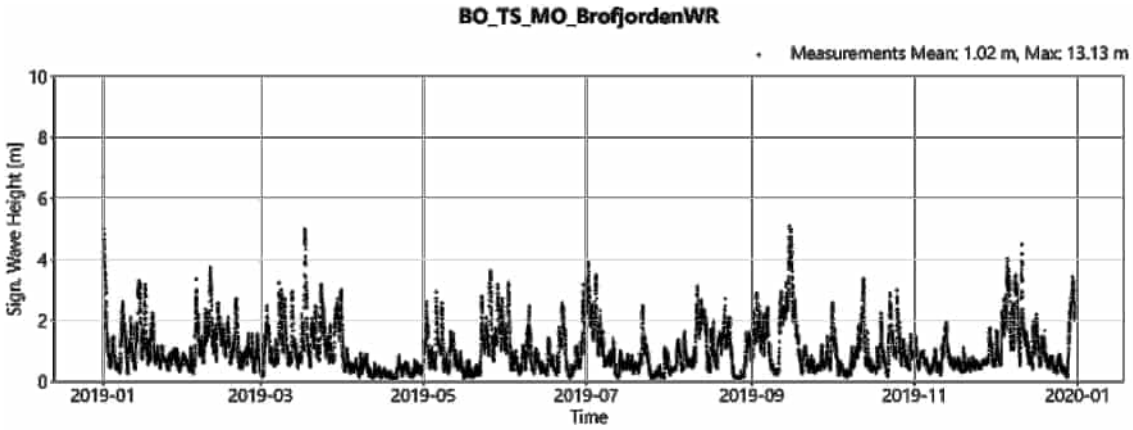
Appendix B: Time-series of significant wave heights



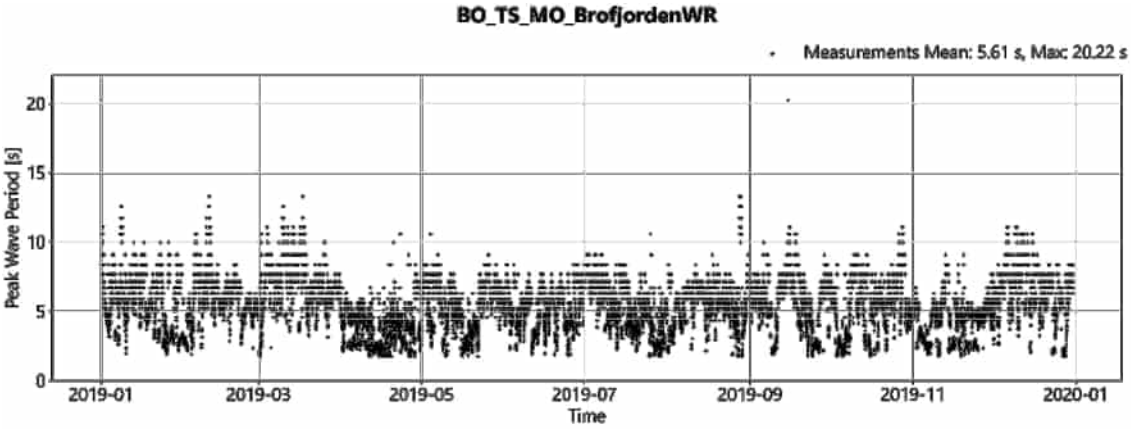
Arkona_Basin_30T_Hs: TS_plot_Arkona_Basin_30T_Arkona_Basin_30T



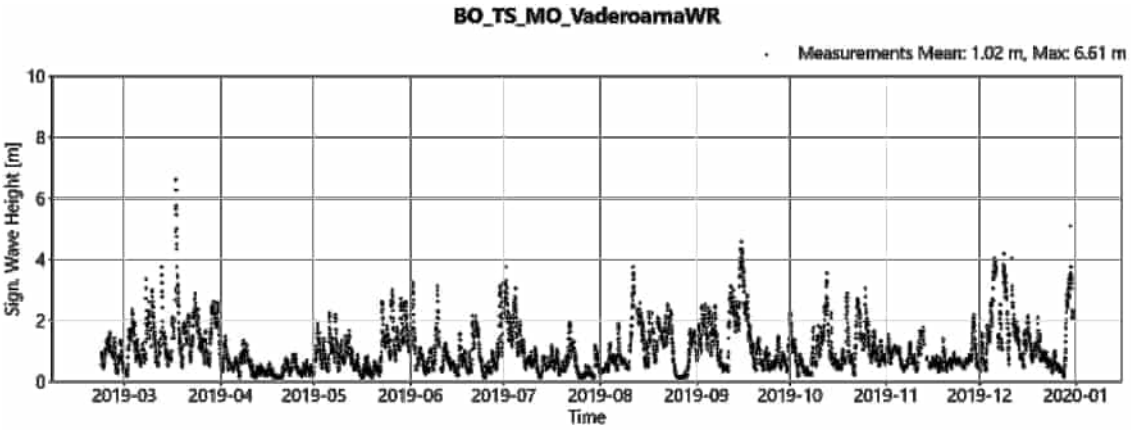
Arkona_Basin_30T_Tp: TS_plot_Arkona_Basin_30T_Arkona_Basin_30T



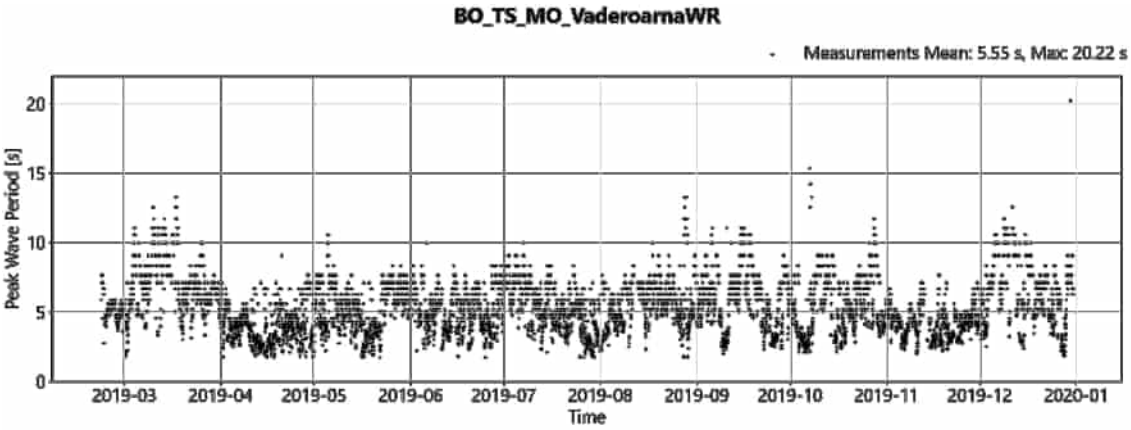
BO_TS_MO_BrofjordenWR_Hs: TS_plot_BO_TS_MO_BrofjordenWR_BO_TS_MO_BrofjordenWR



BO_TS_MO_BrofjordenWR_Tp: TS_plot_BO_TS_MO_BrofjordenWR_BO_TS_MO_BrofjordenWR



BO_TS_MO_VaderoarnaWR_Hs: TS_plot_BO_TS_MO_VaderoarnaWR_BO_TS_MO_VaderoarnaWR



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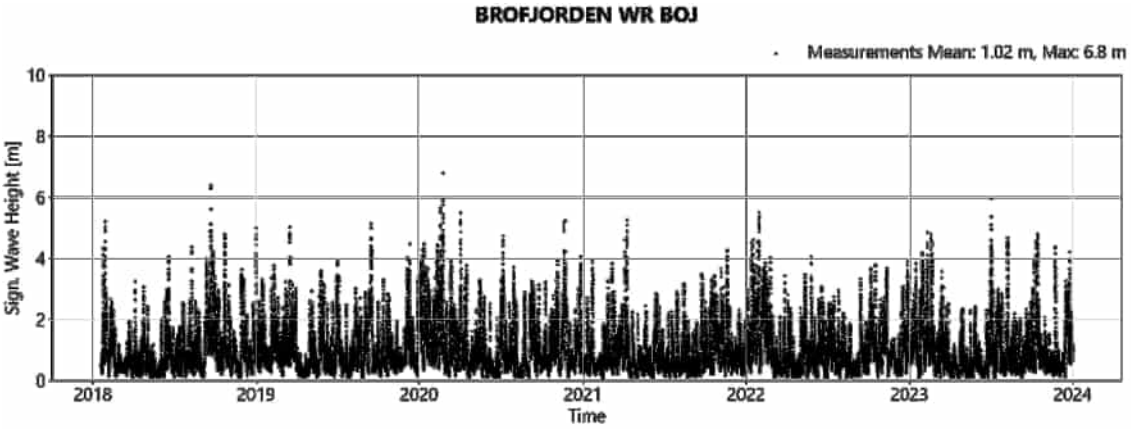
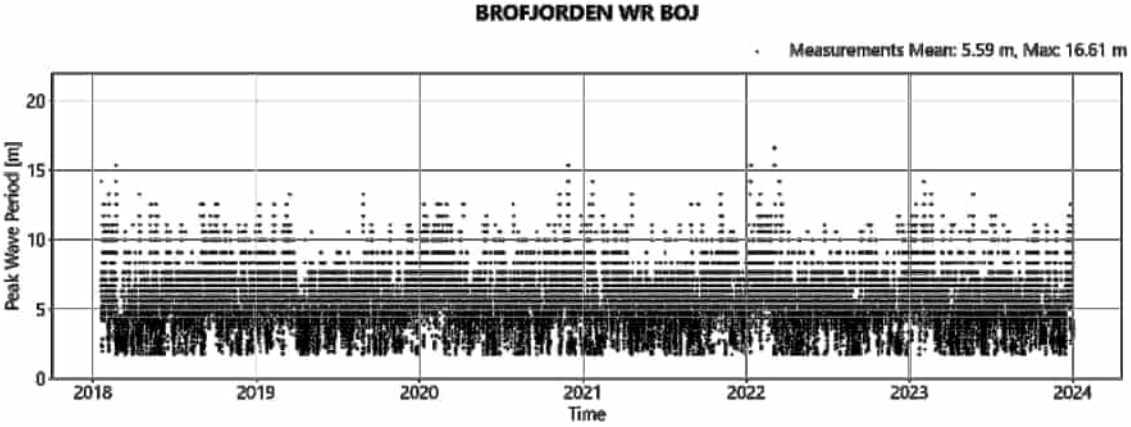


BROFJORDEN WR BOJ_Hs: TS_plot_BROFJORDEN WR BOJ_BROFJORDEN WR BOJ



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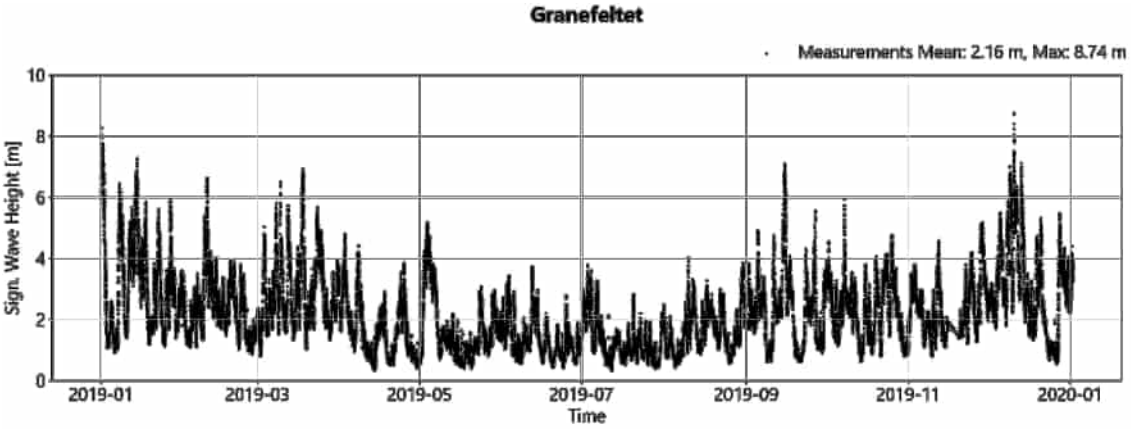
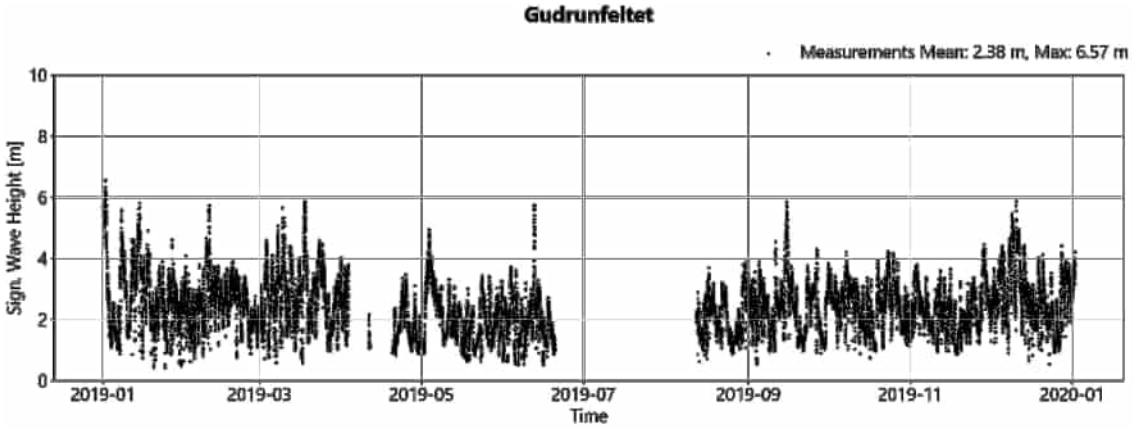
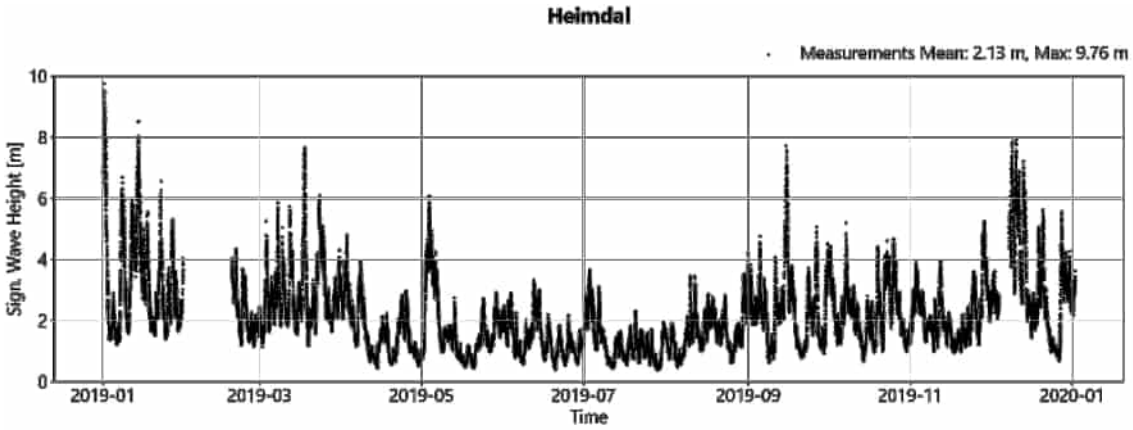


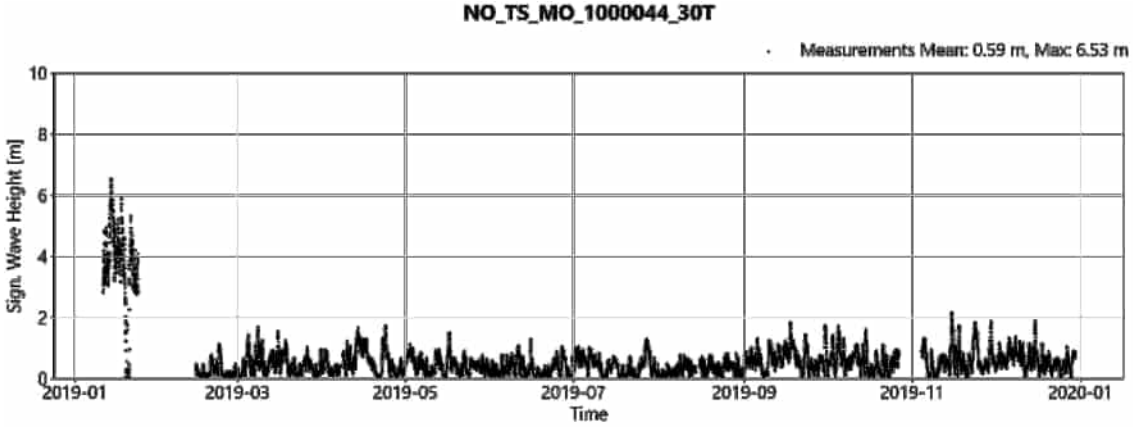
Granefeltet_Hs: TS_plot_Granefeltet_Granefeltet



Gudrunfeltet_Hs: TS_plot_Gudrunfeltet_Gudrunfeltet



Heimdal_Hs: TS_plot_Heimdal_Heimdal



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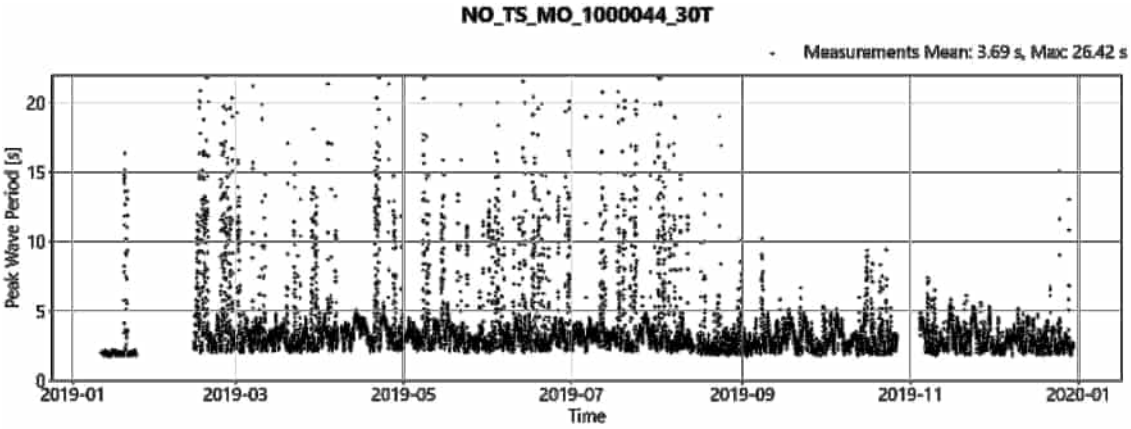

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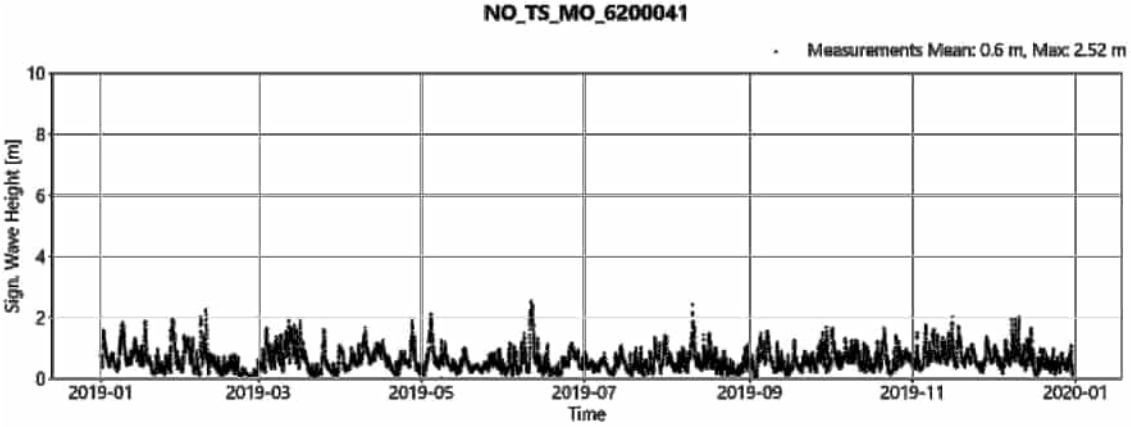

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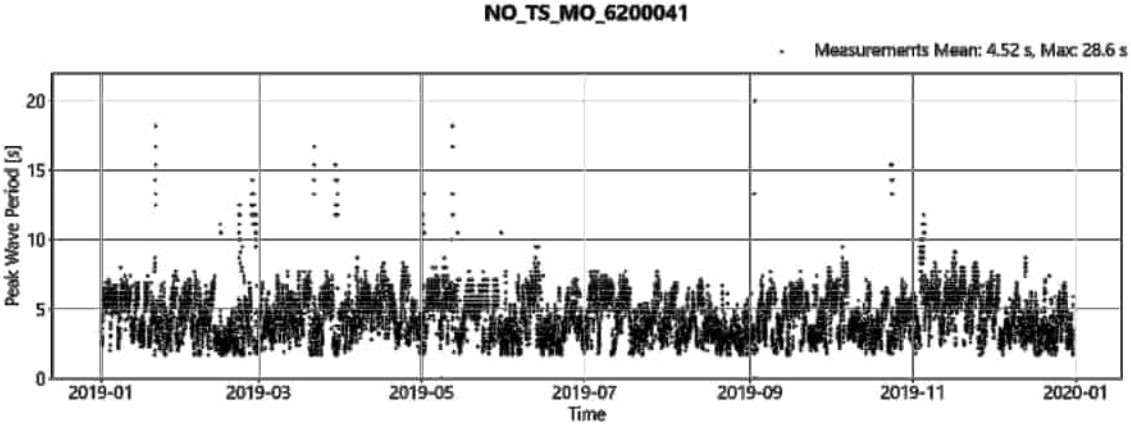

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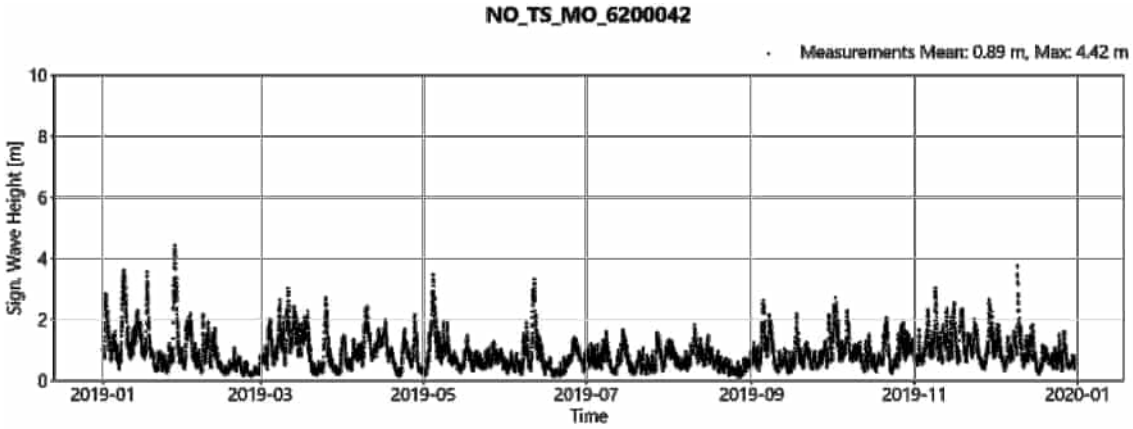

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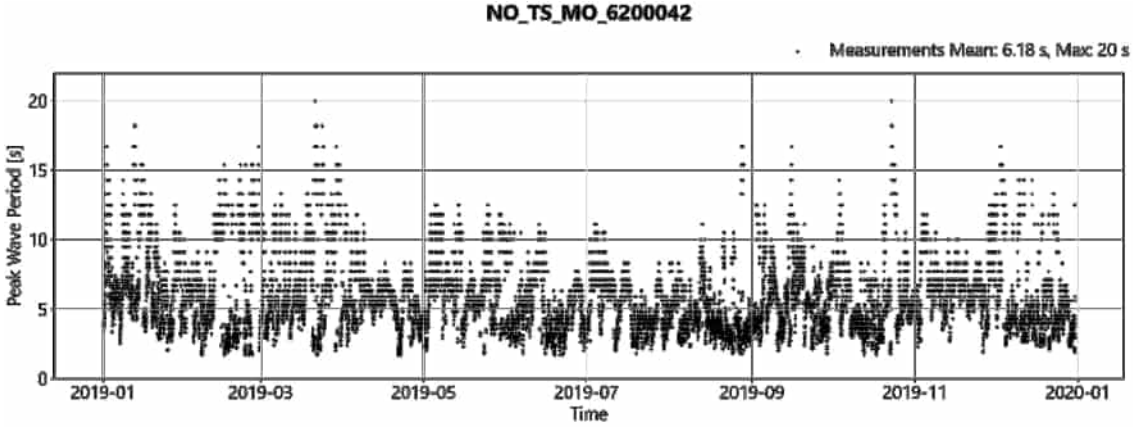

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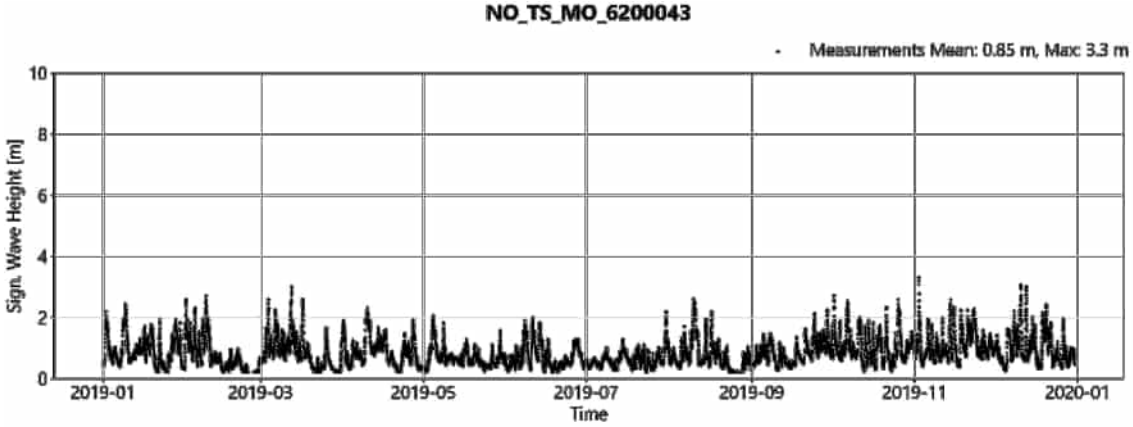

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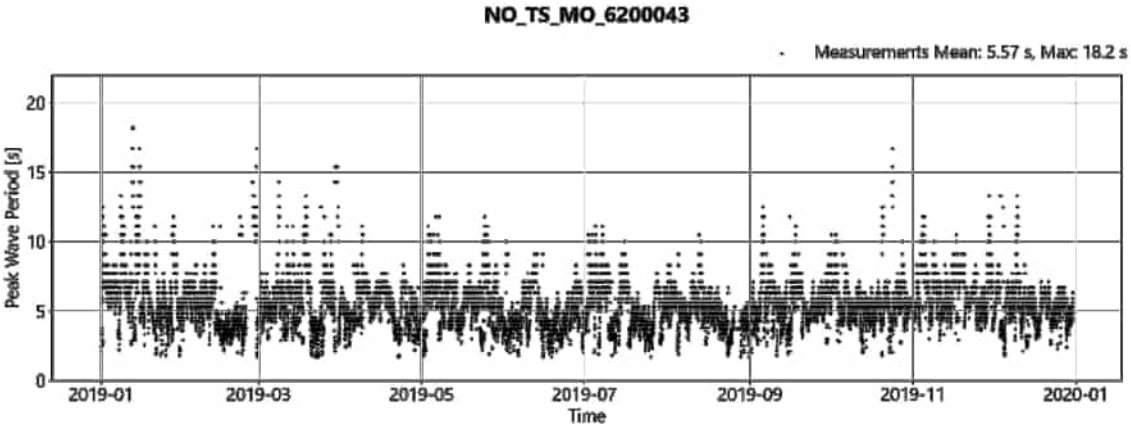

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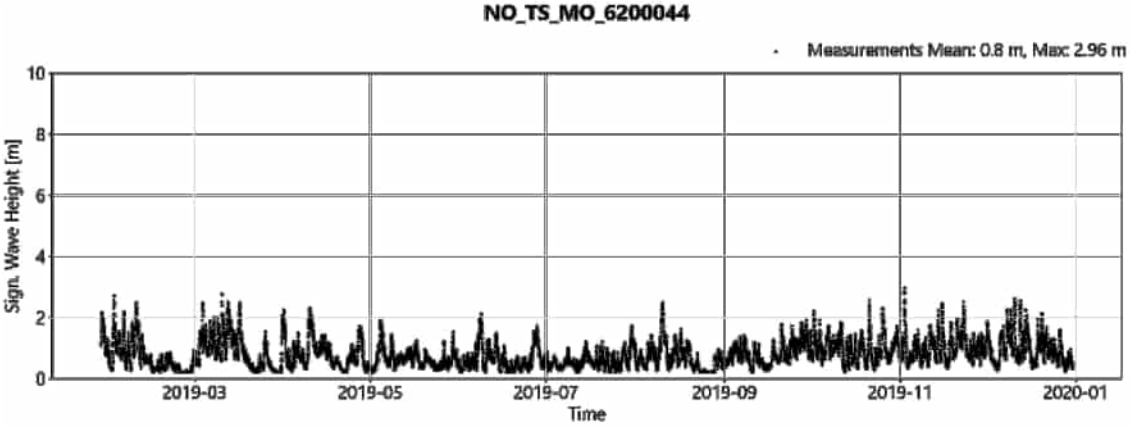

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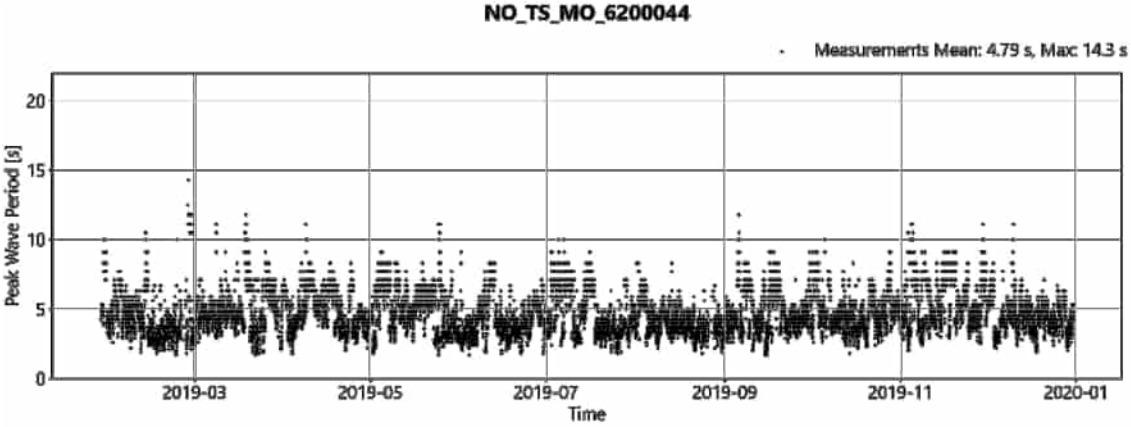

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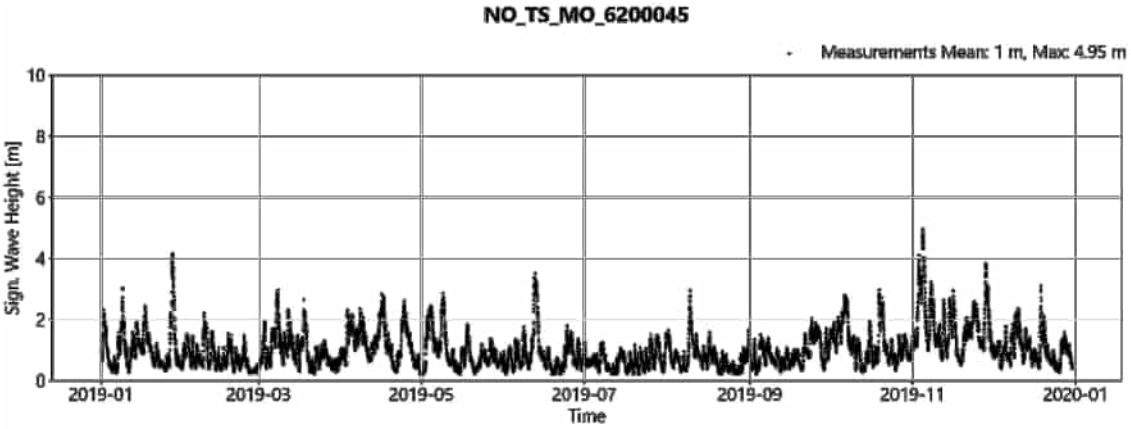

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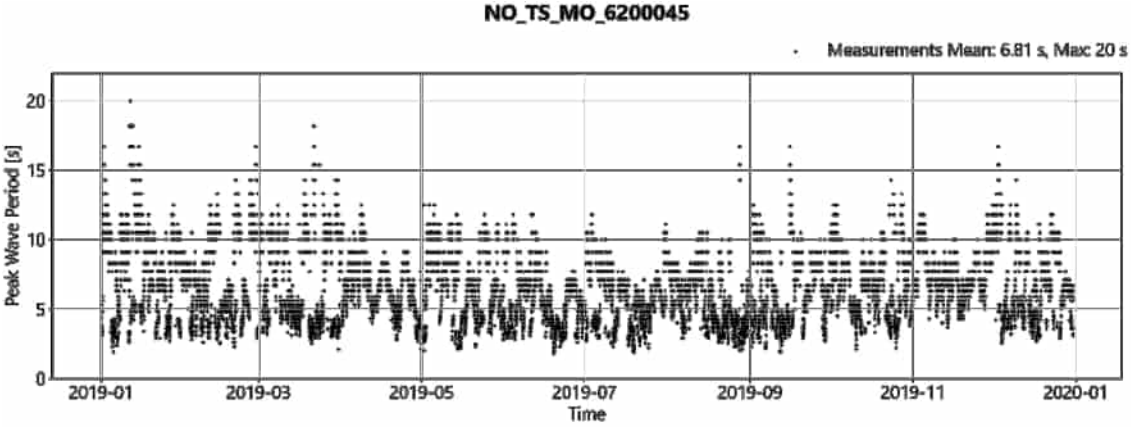

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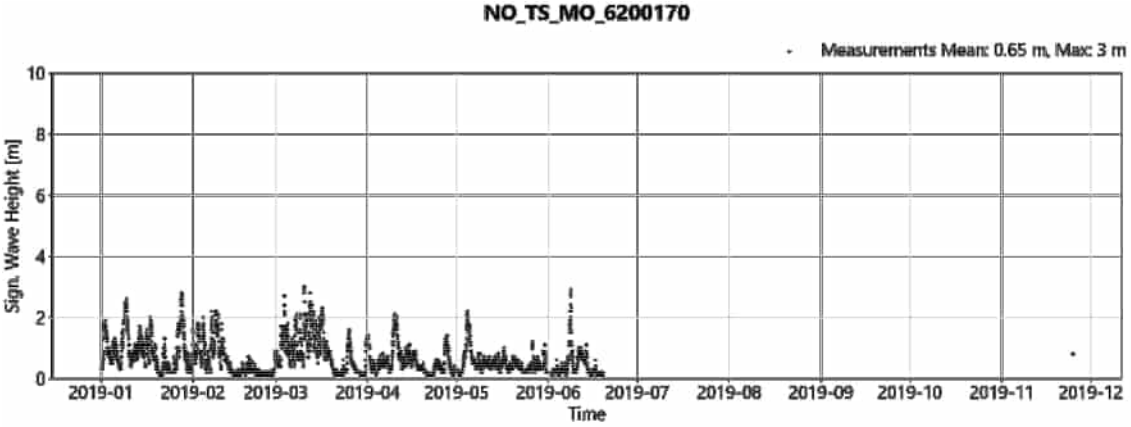

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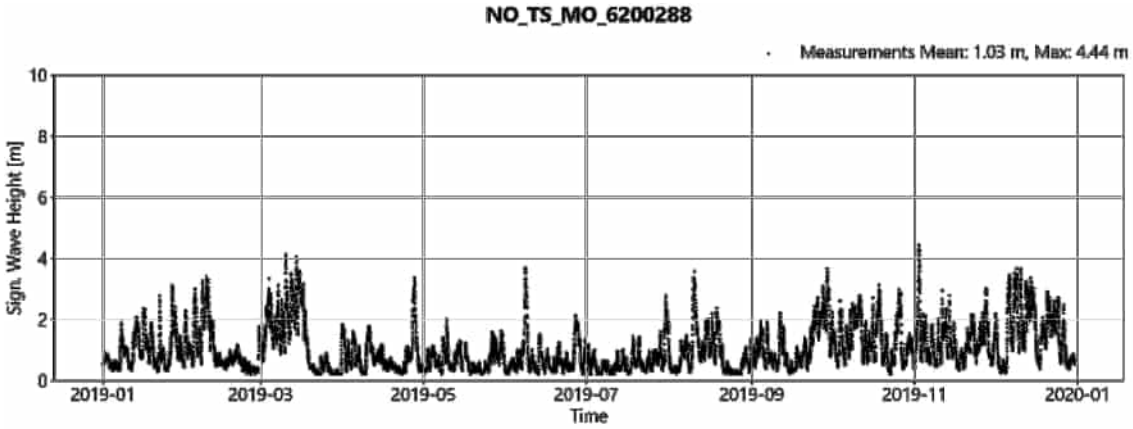

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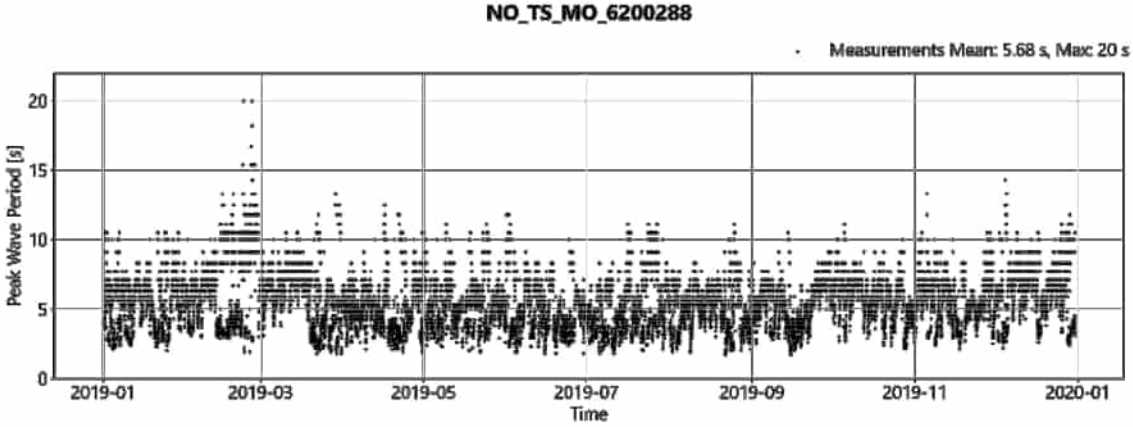

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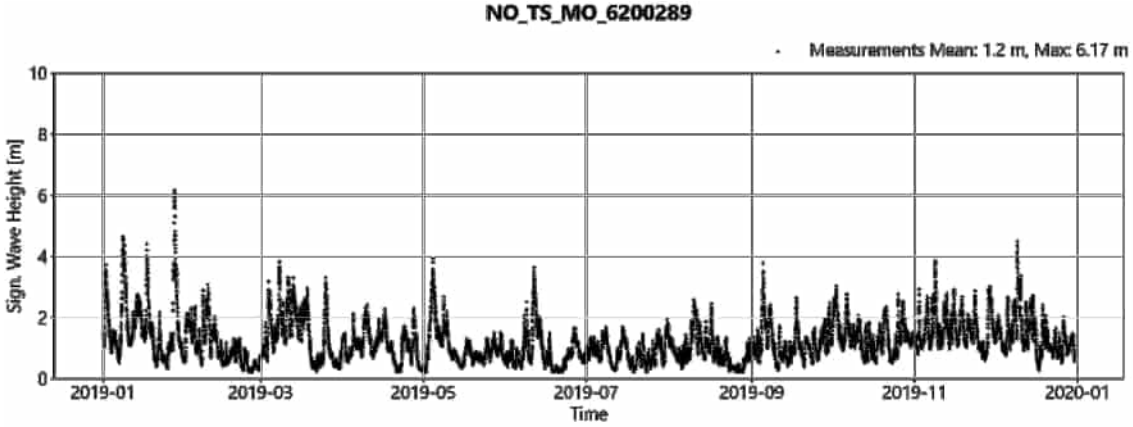

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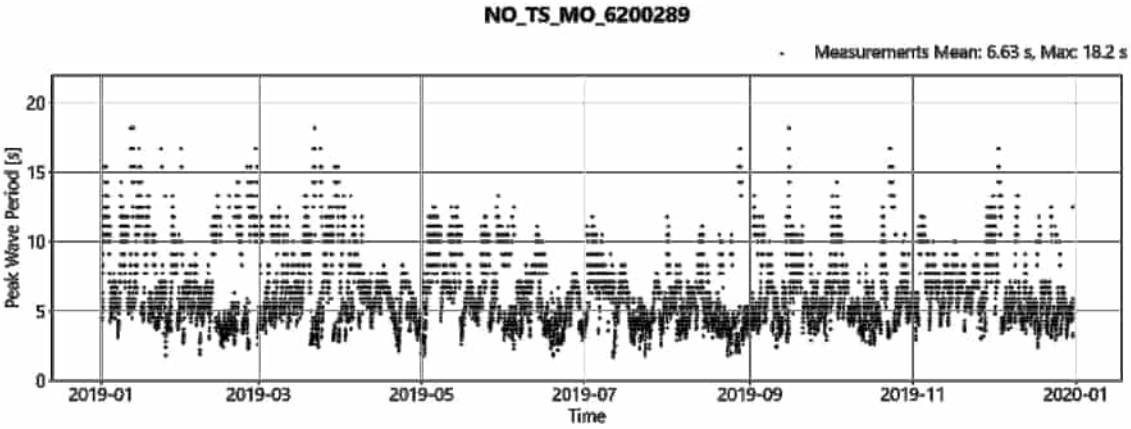

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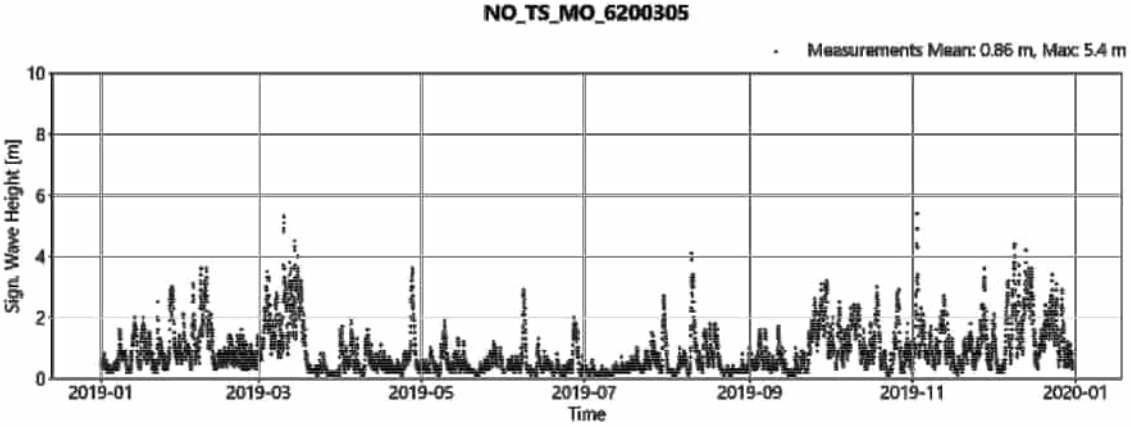

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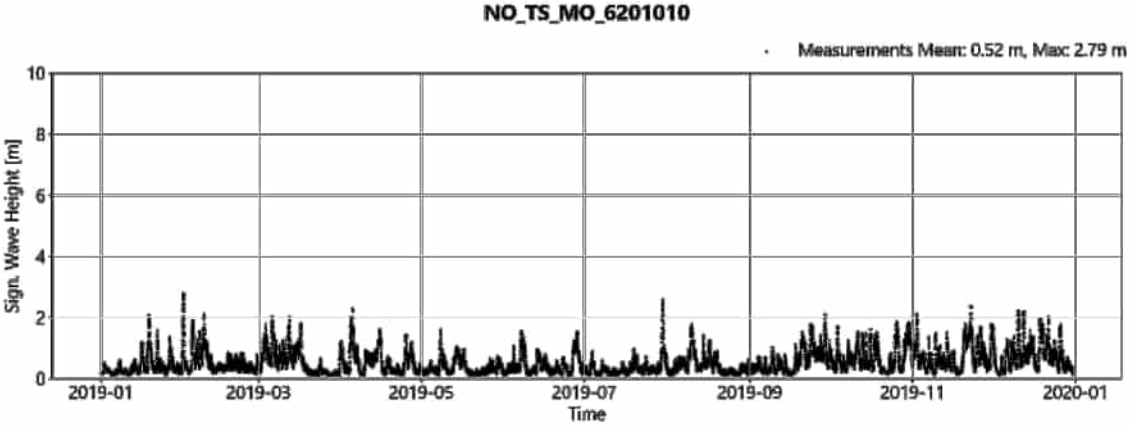

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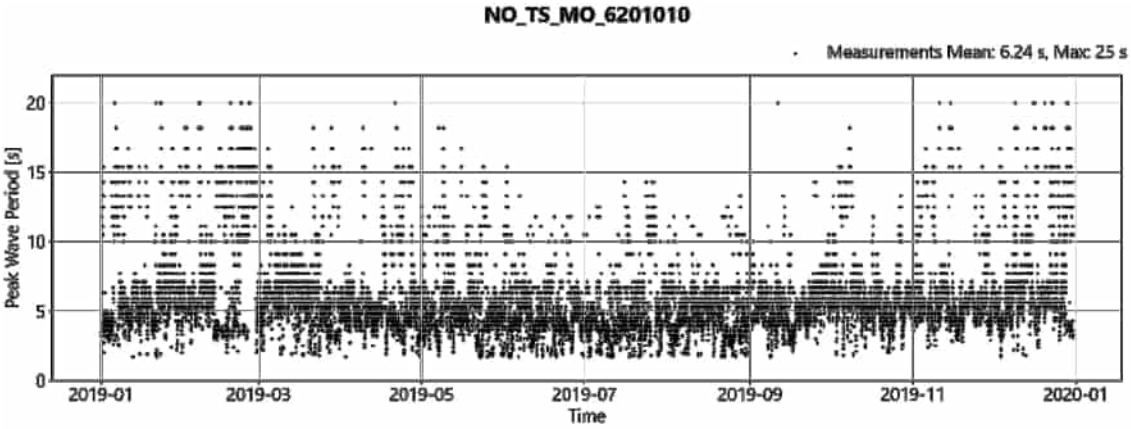

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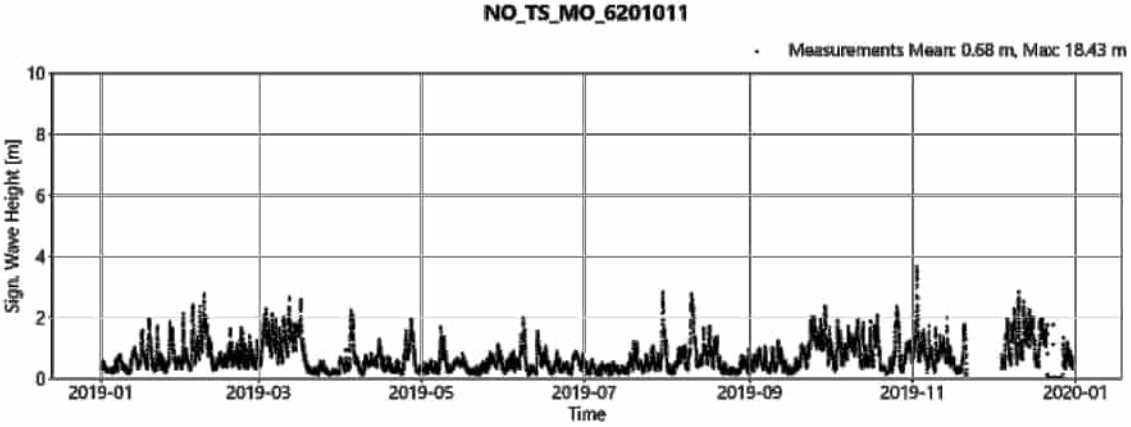

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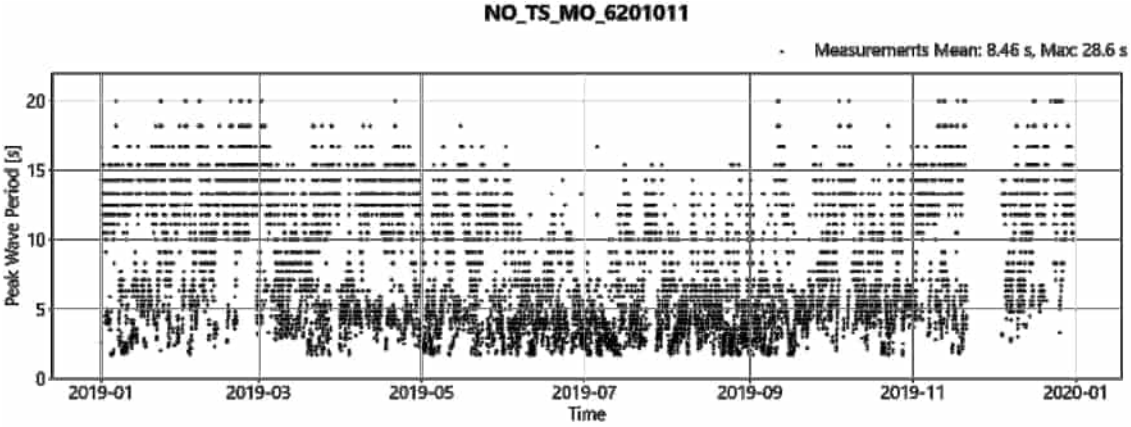

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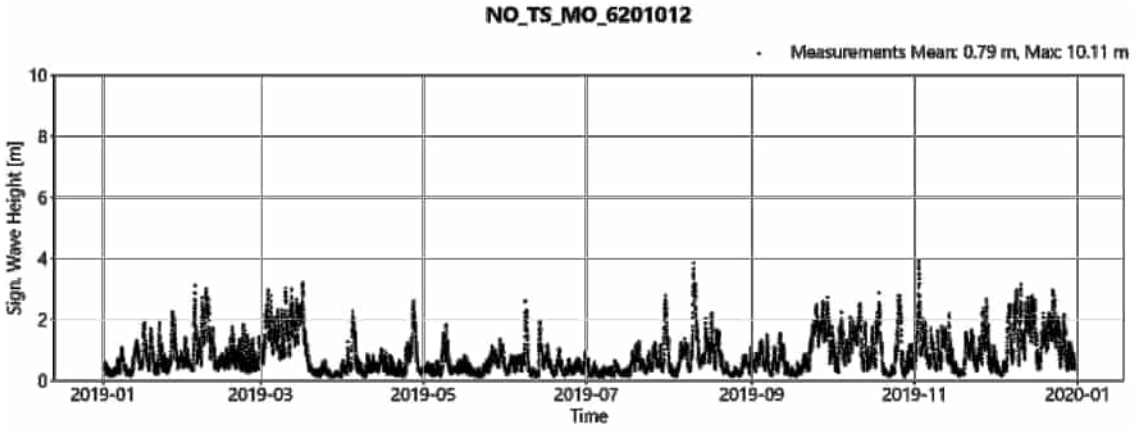

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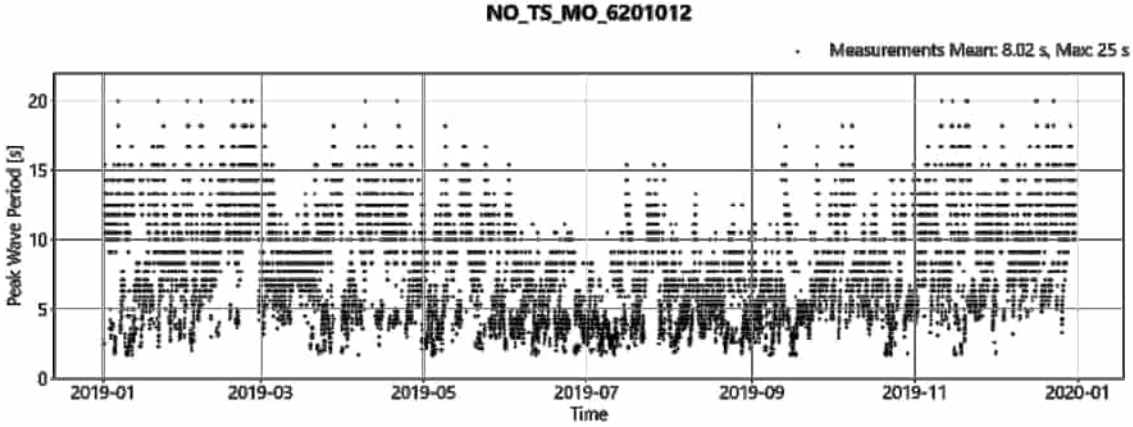

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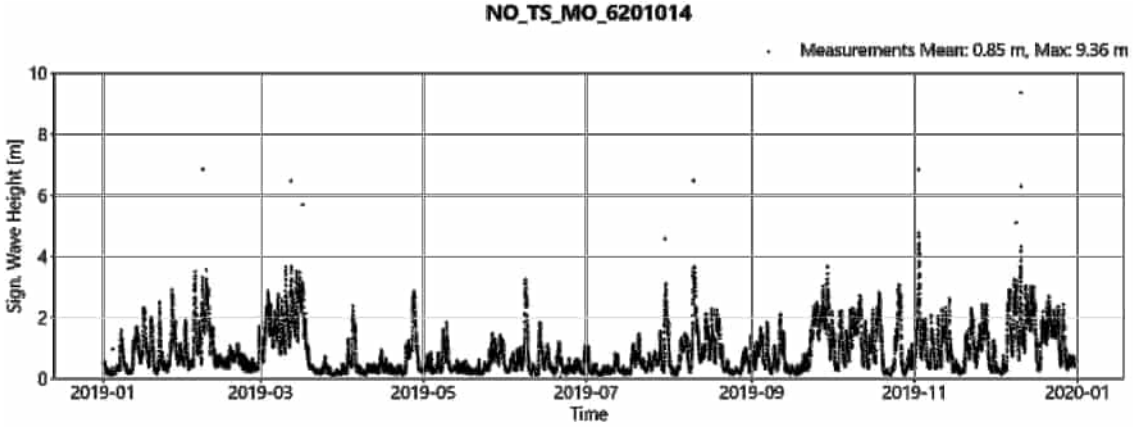

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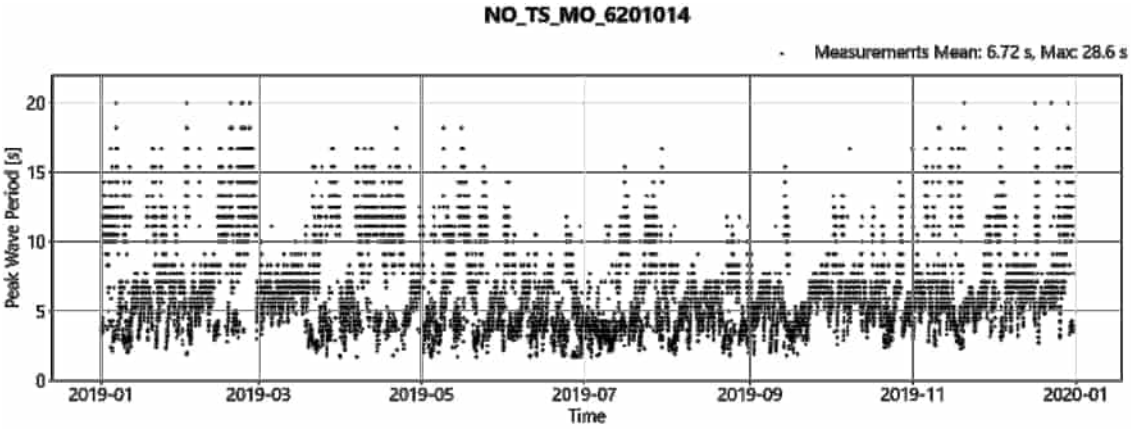

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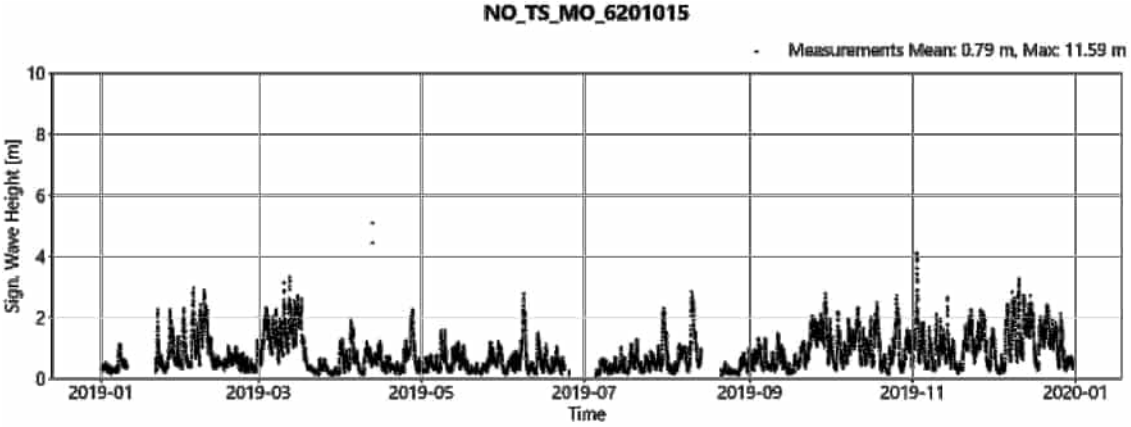

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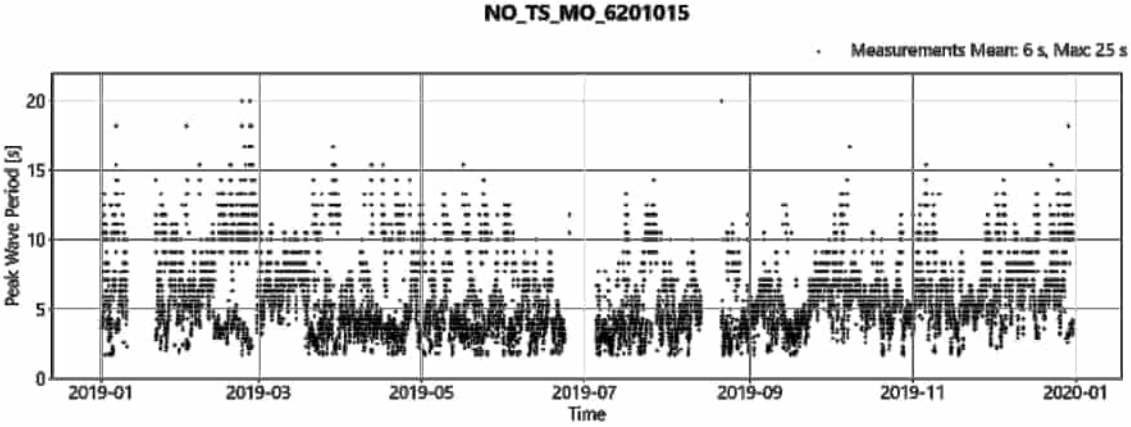

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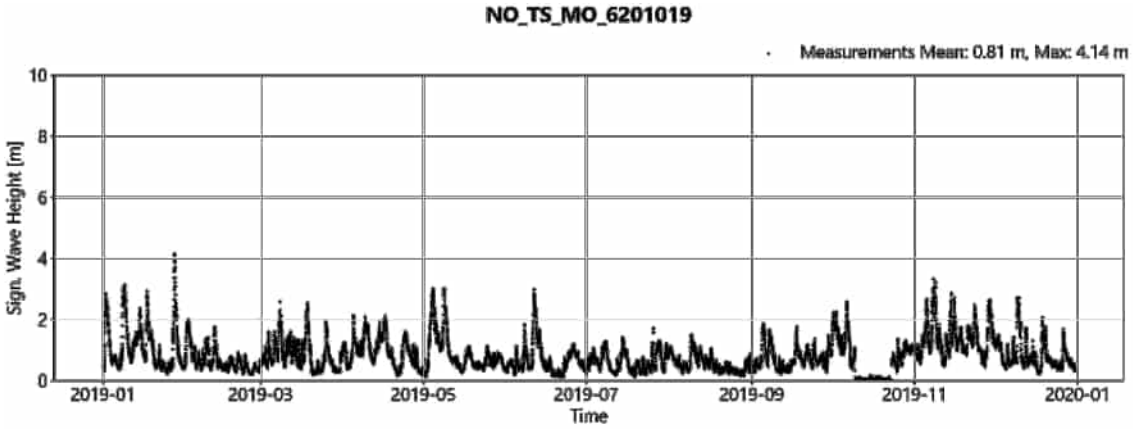

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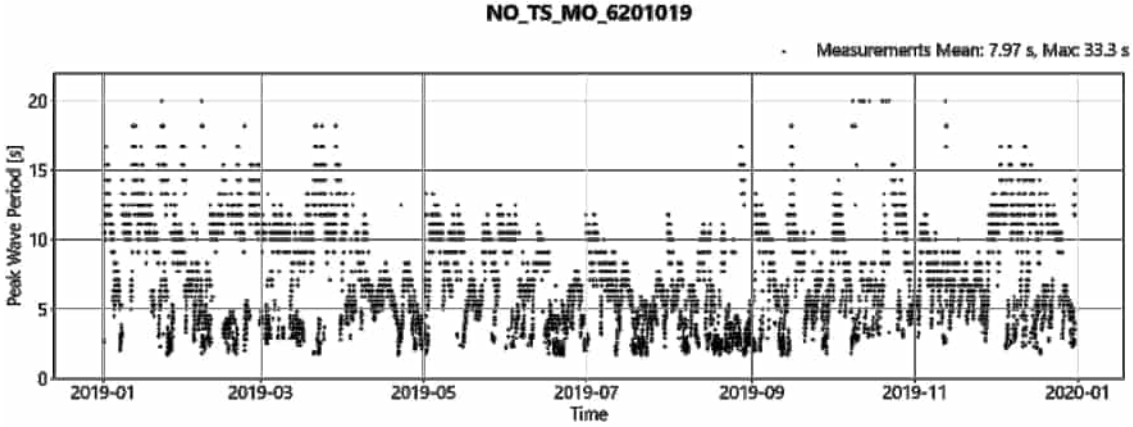

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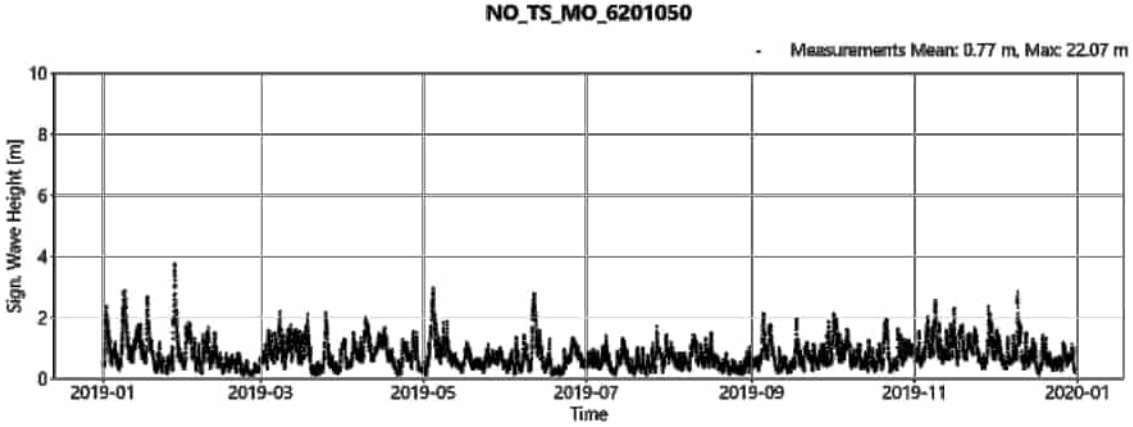

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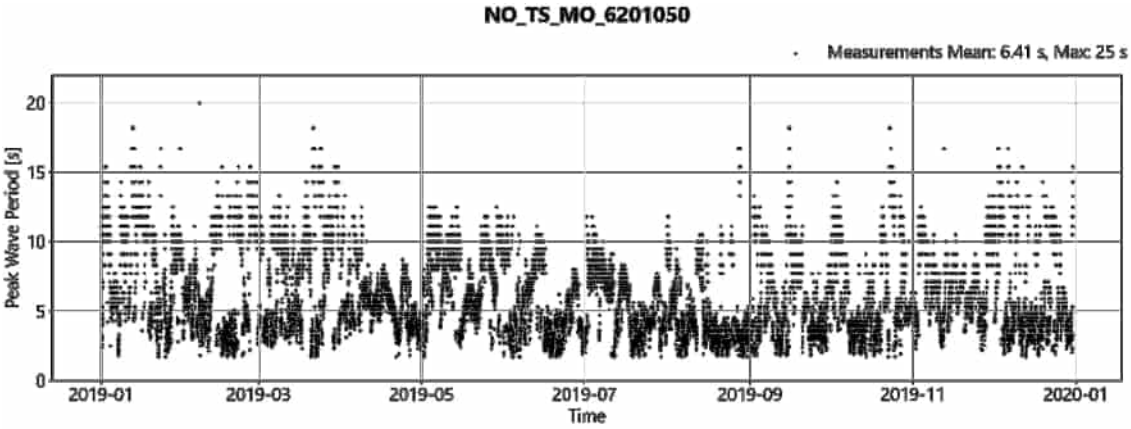

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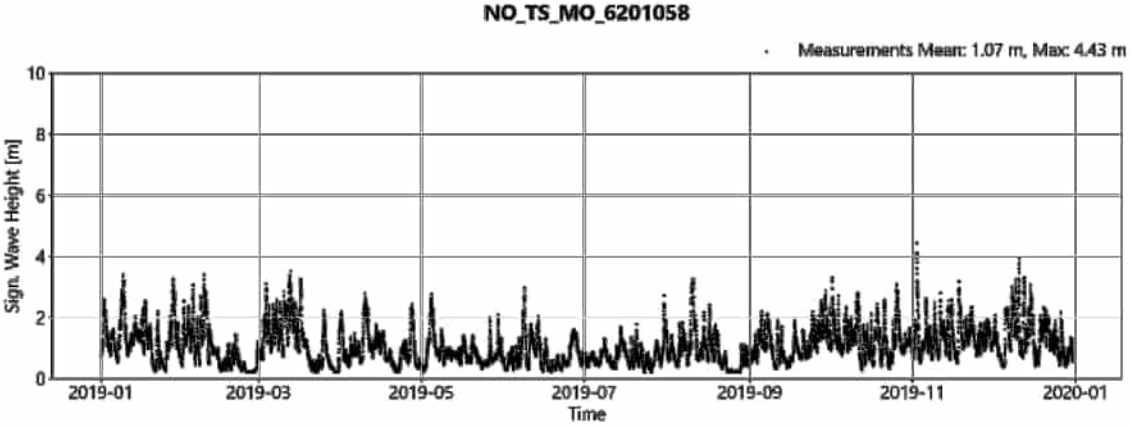

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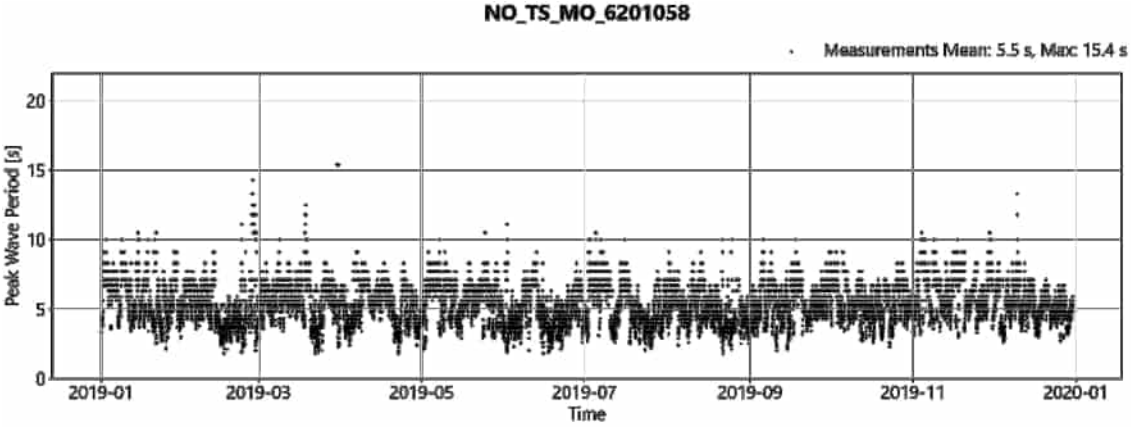

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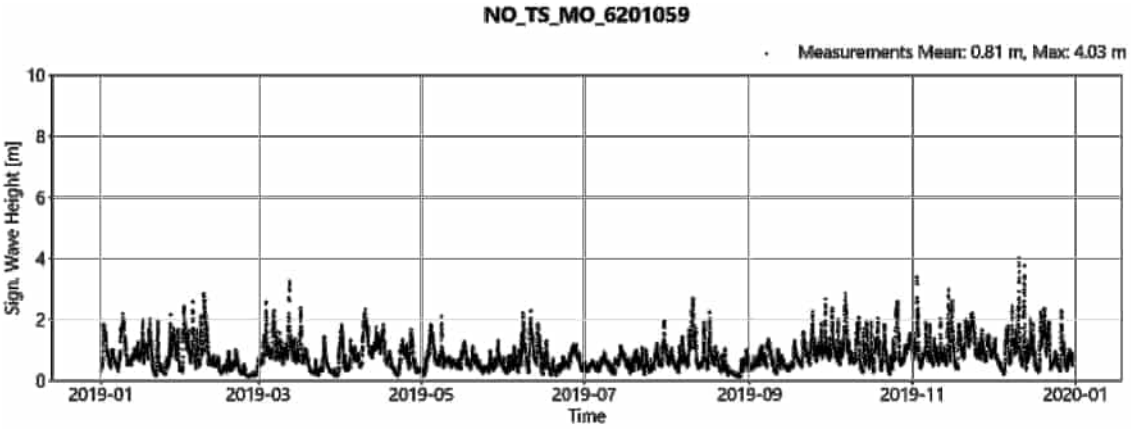

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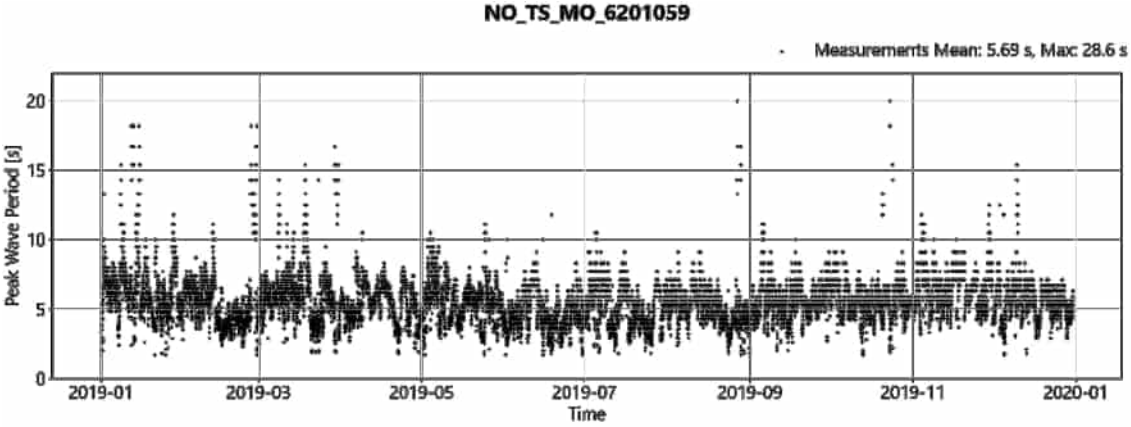

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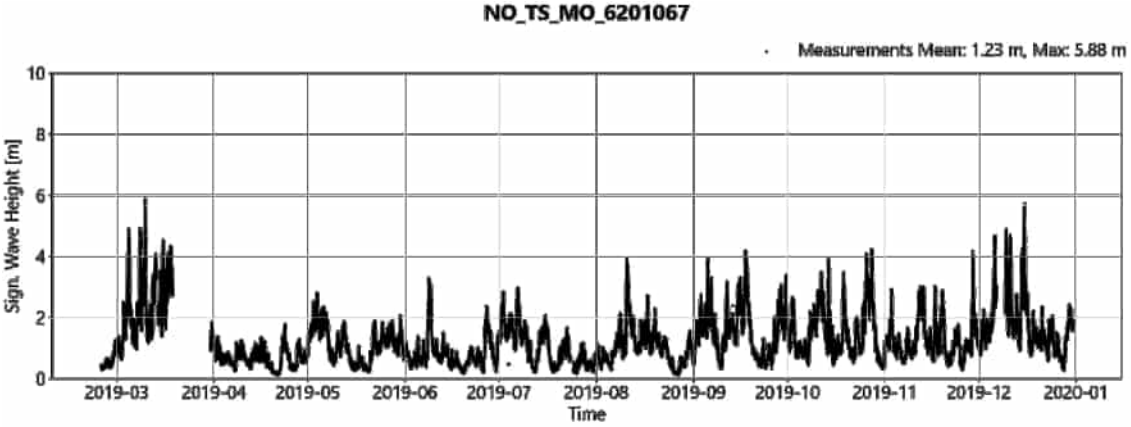

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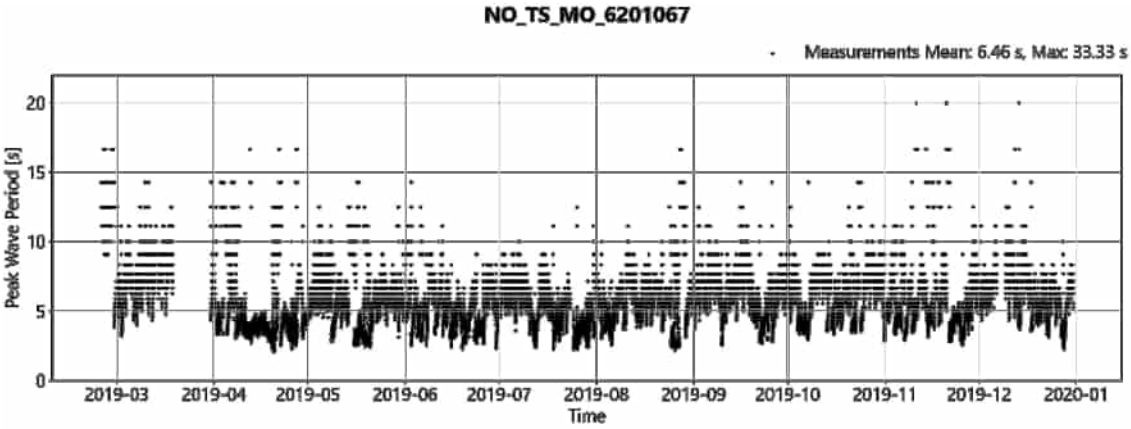

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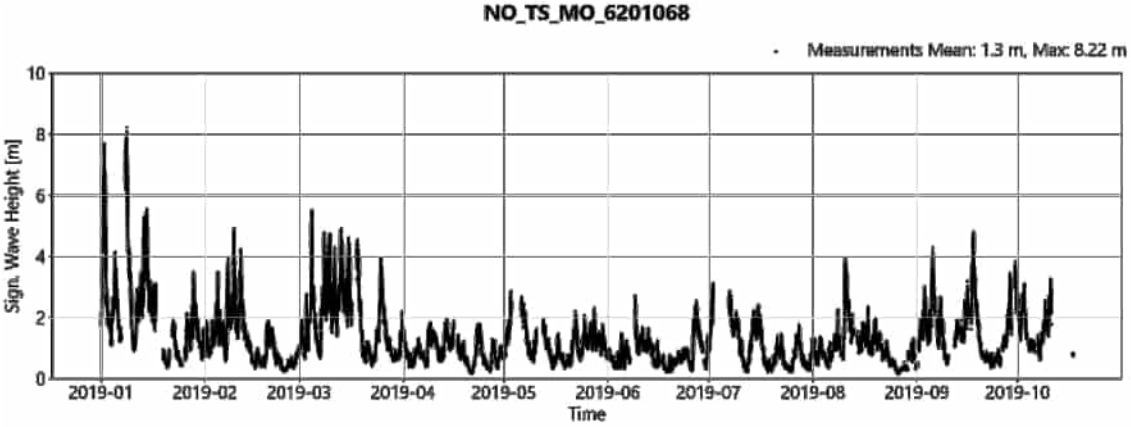

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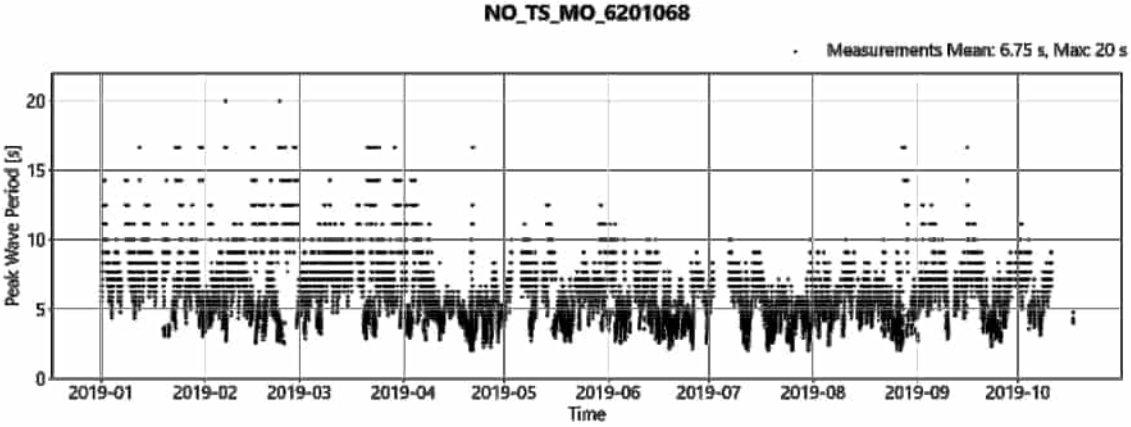

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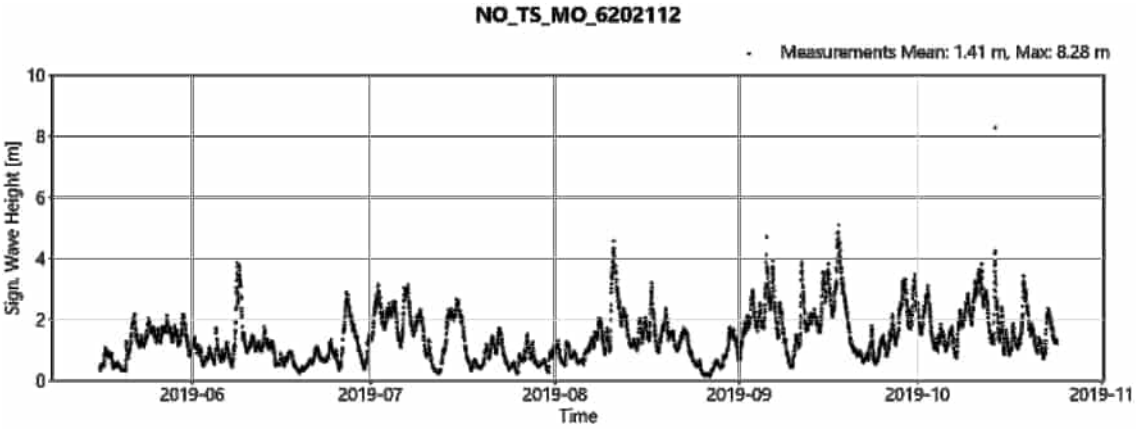

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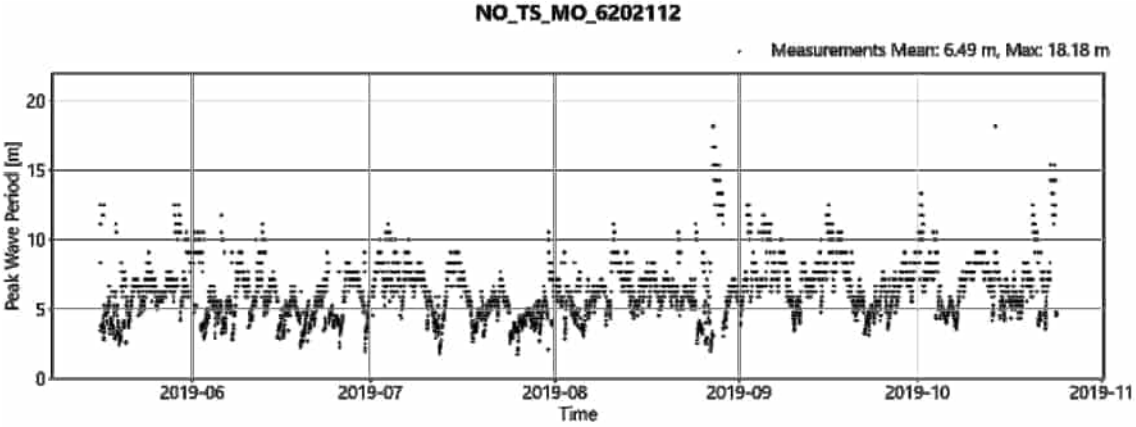

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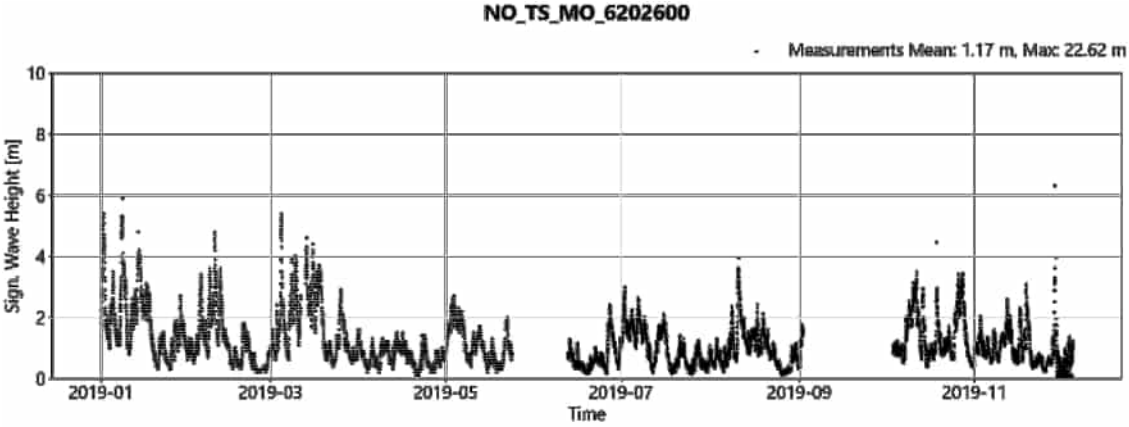

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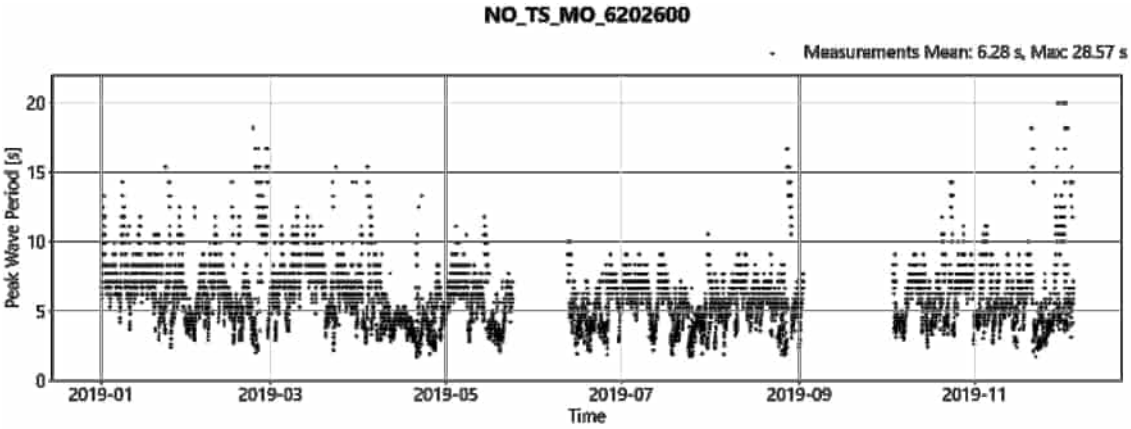

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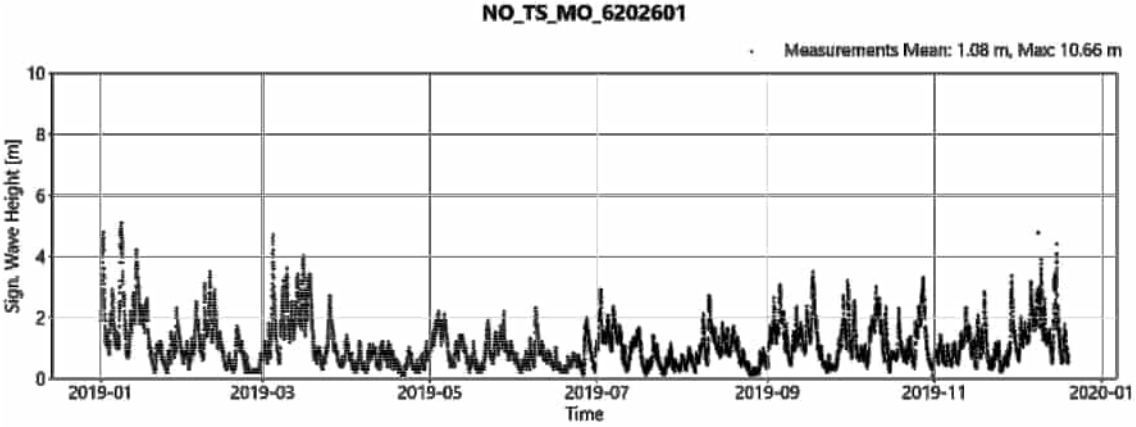

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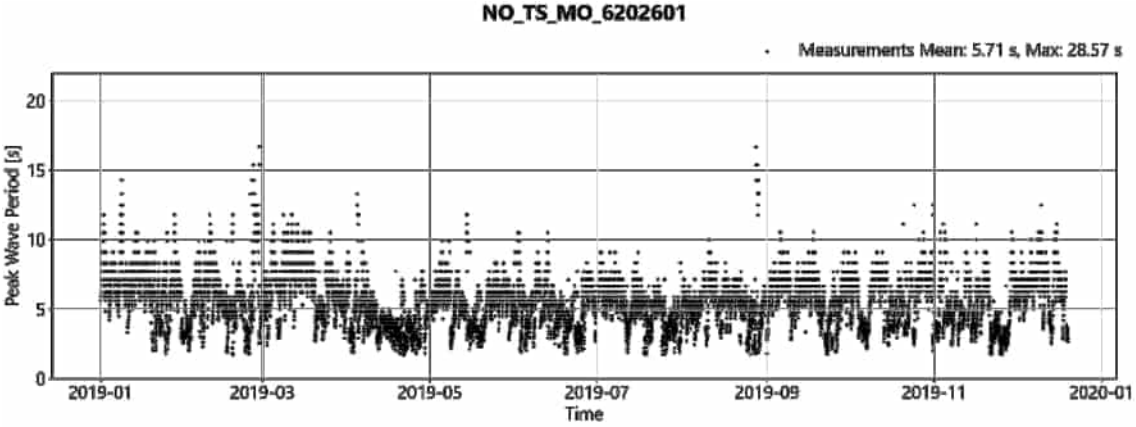

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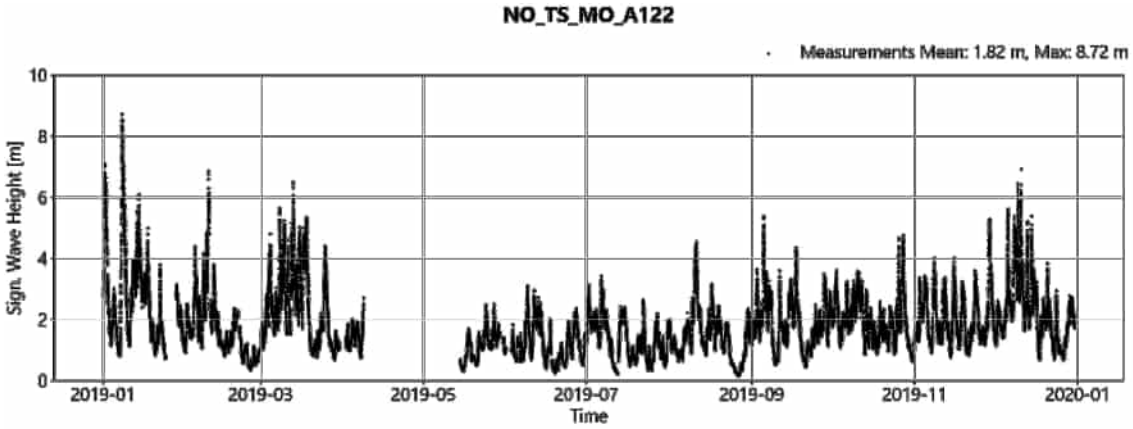

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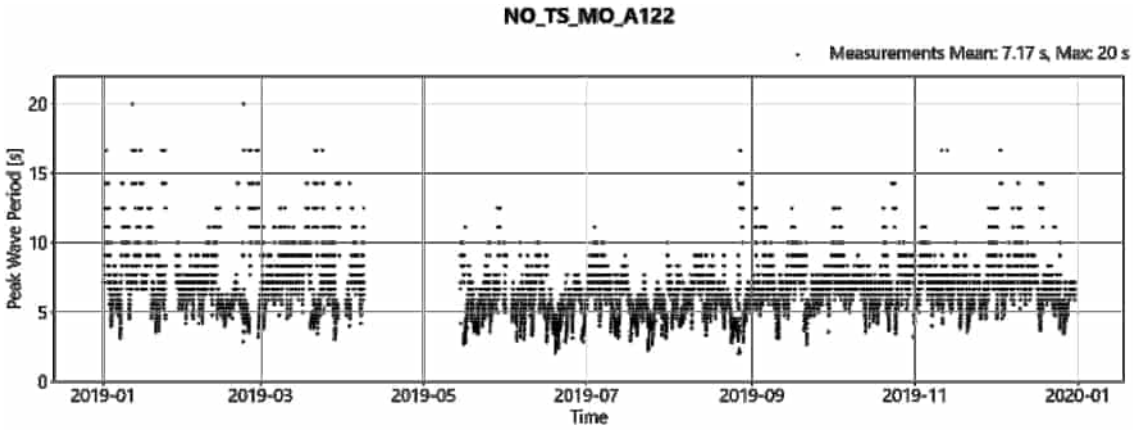

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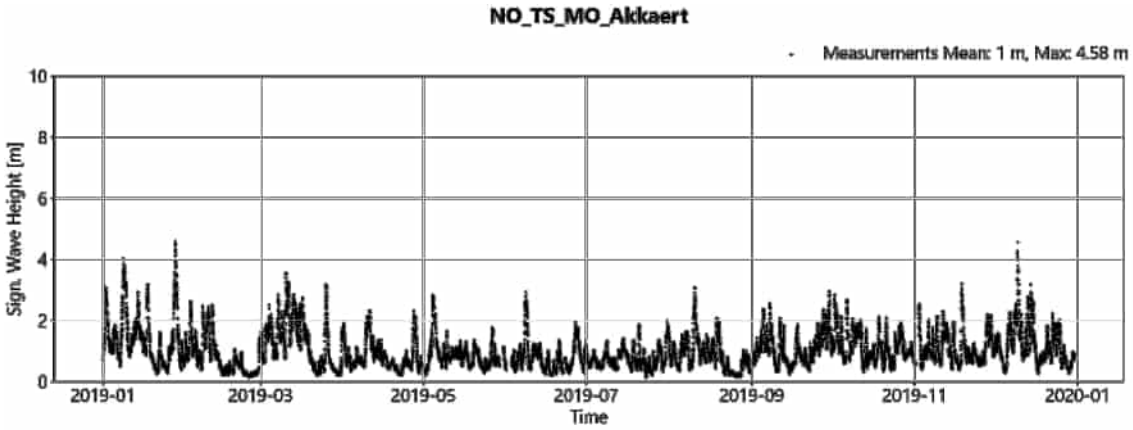

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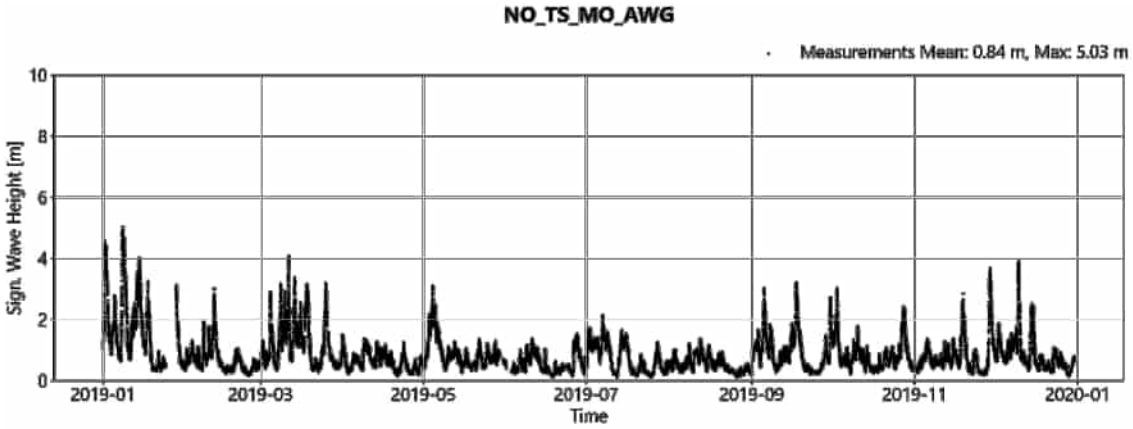

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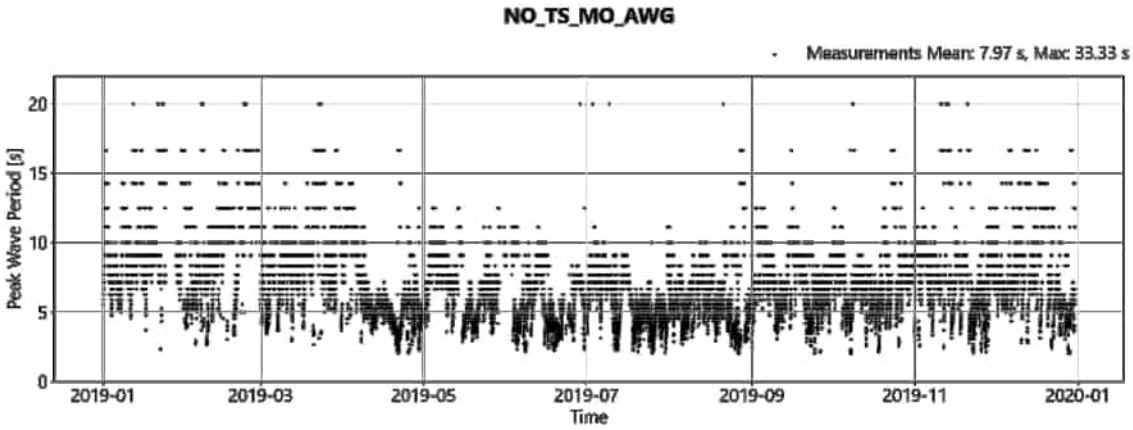

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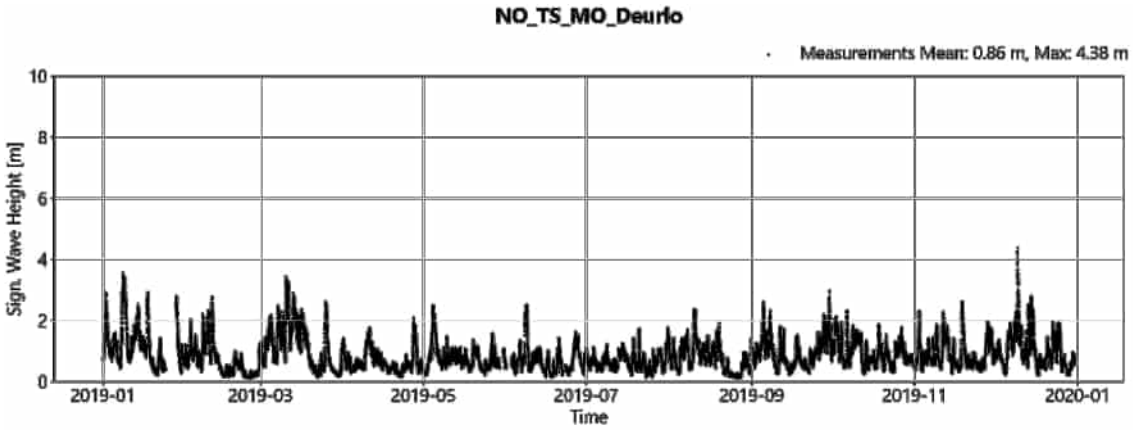

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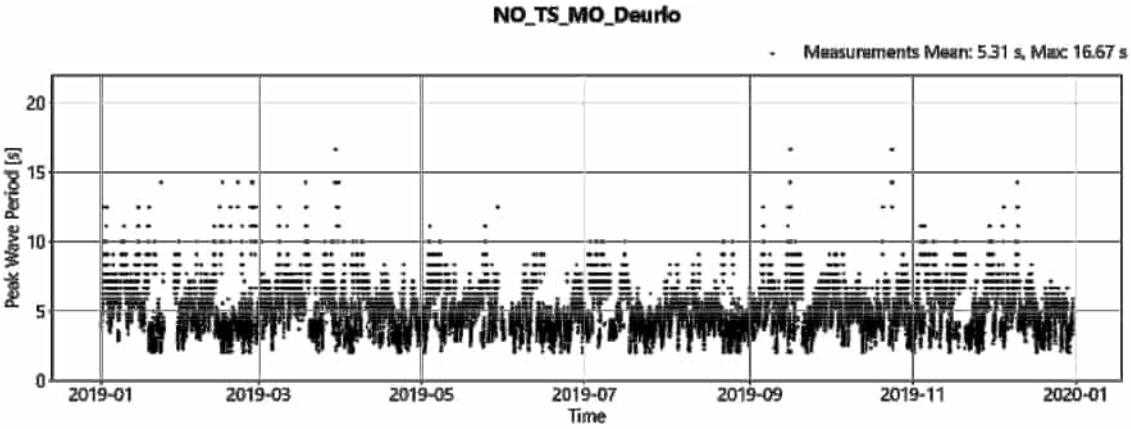

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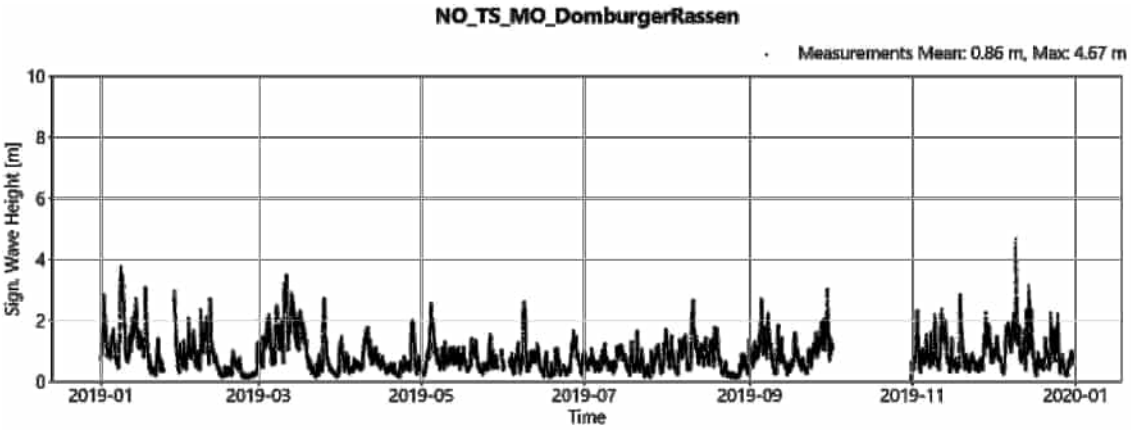

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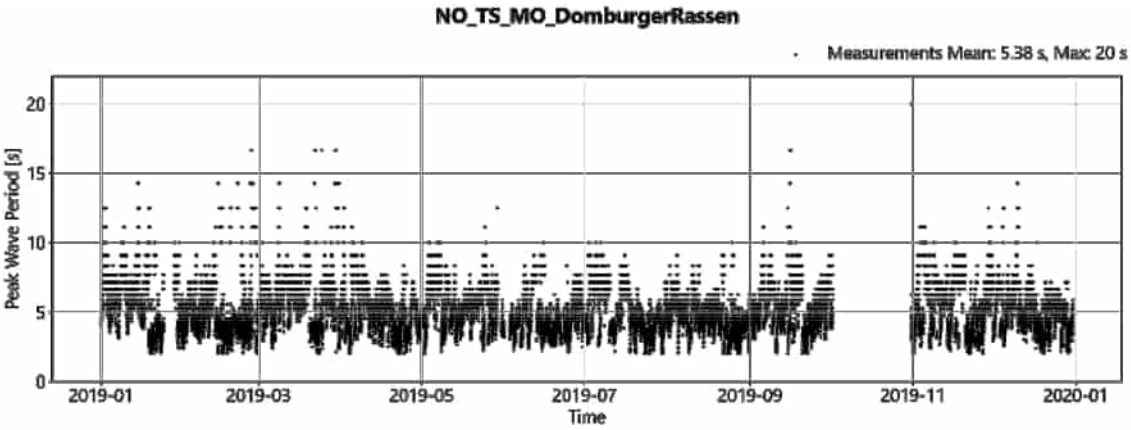

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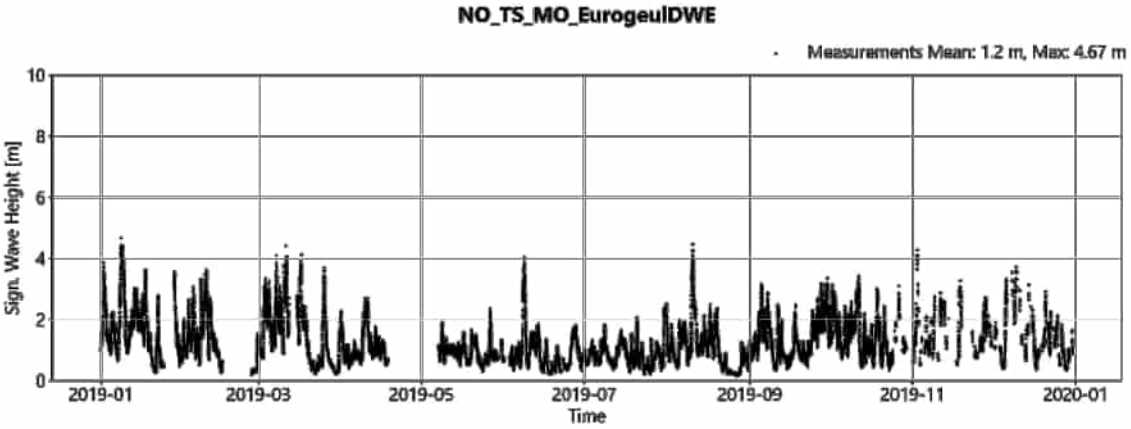
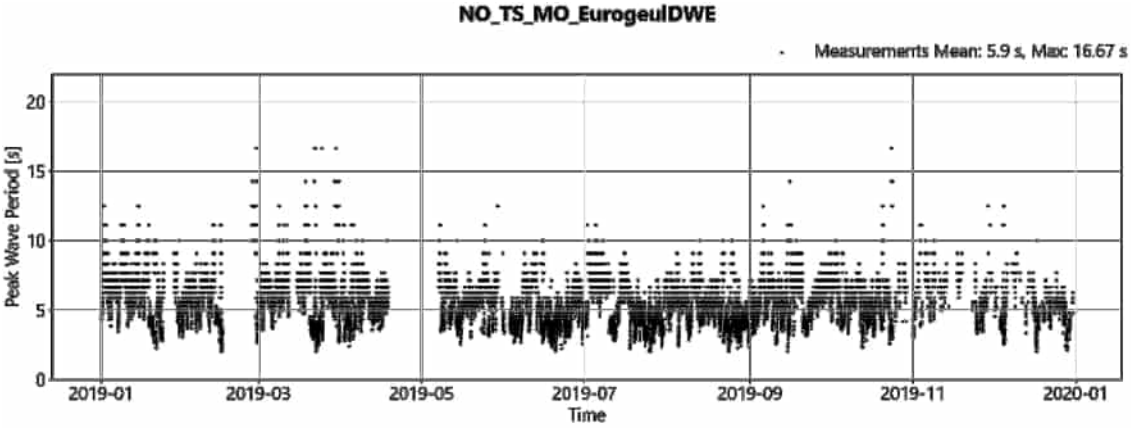


NO_TS_MO_EurogeulDWE_Hs: TS_plot_NO_TS_MO_EurogeulDWE_NO_TS_MO_EurogeulDWE



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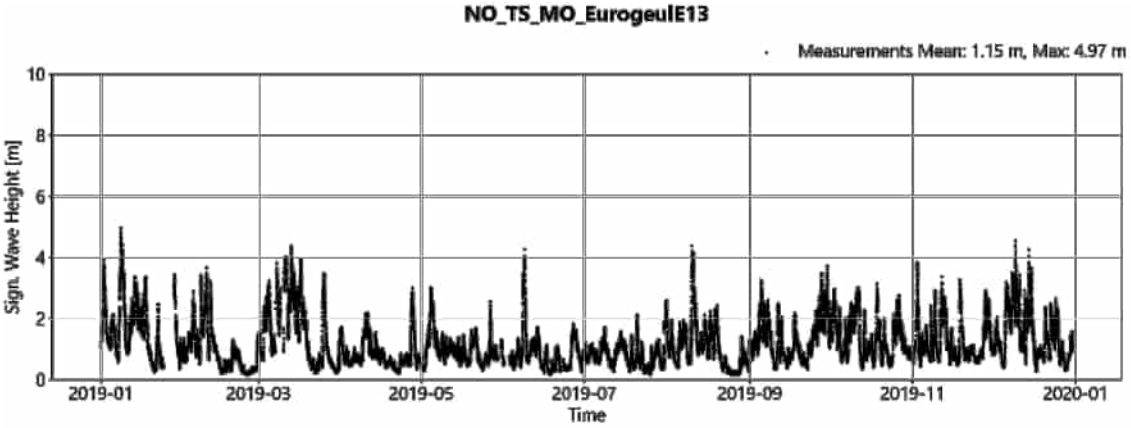

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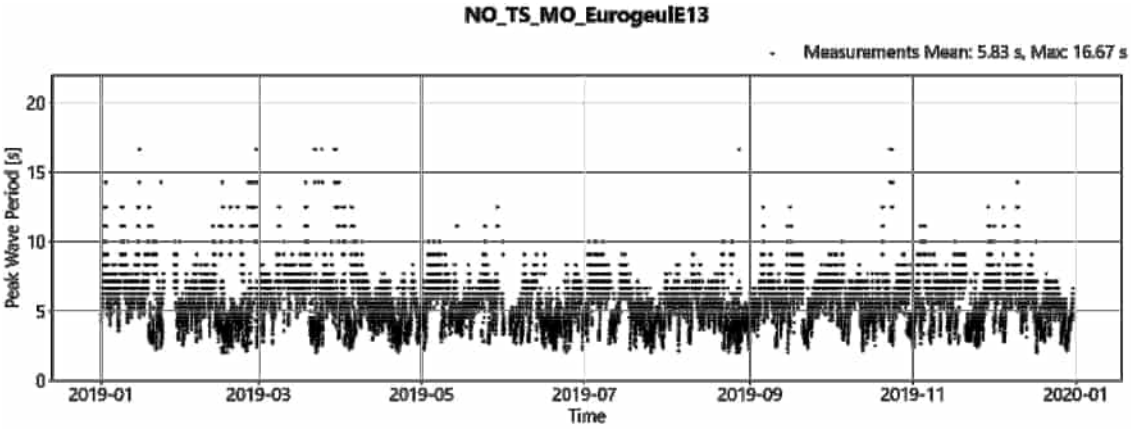

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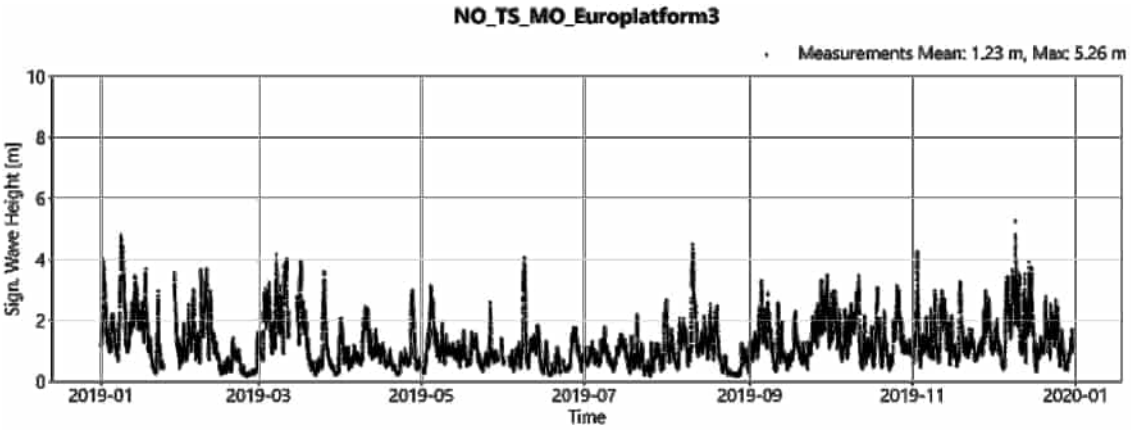

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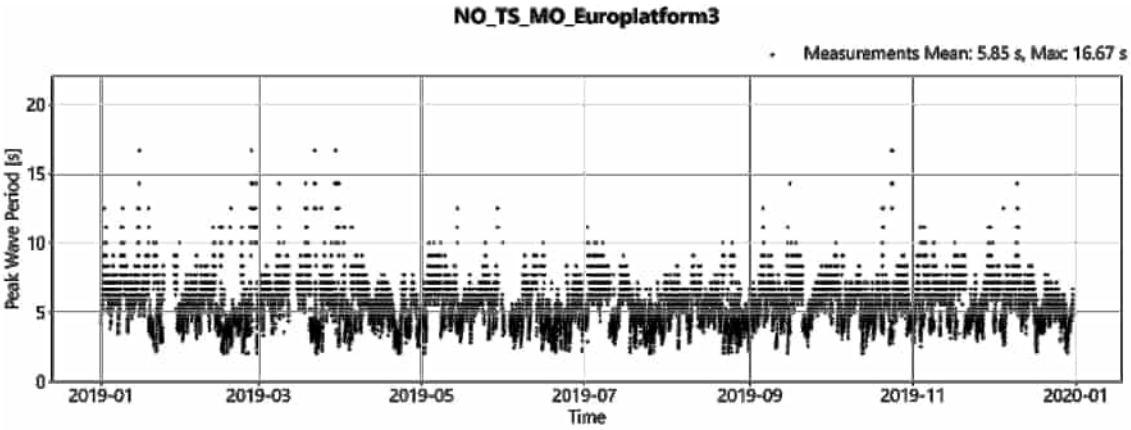

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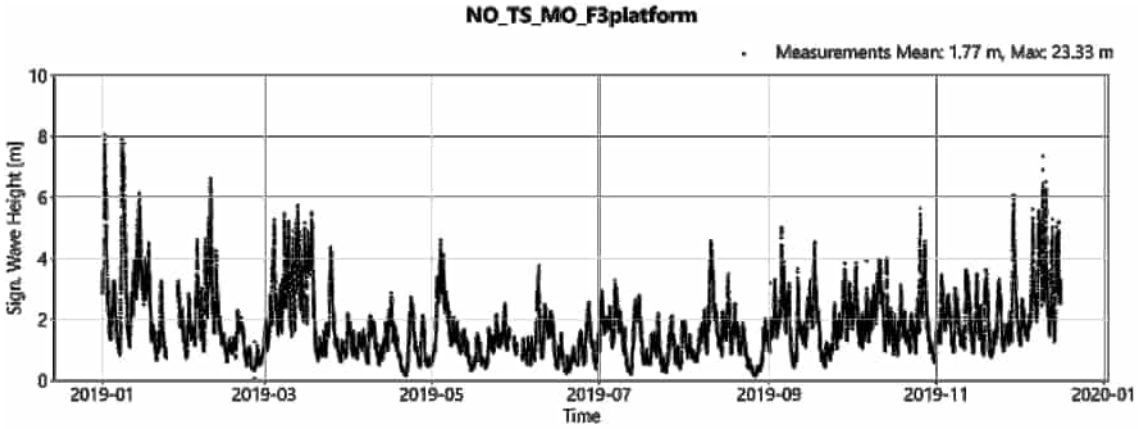

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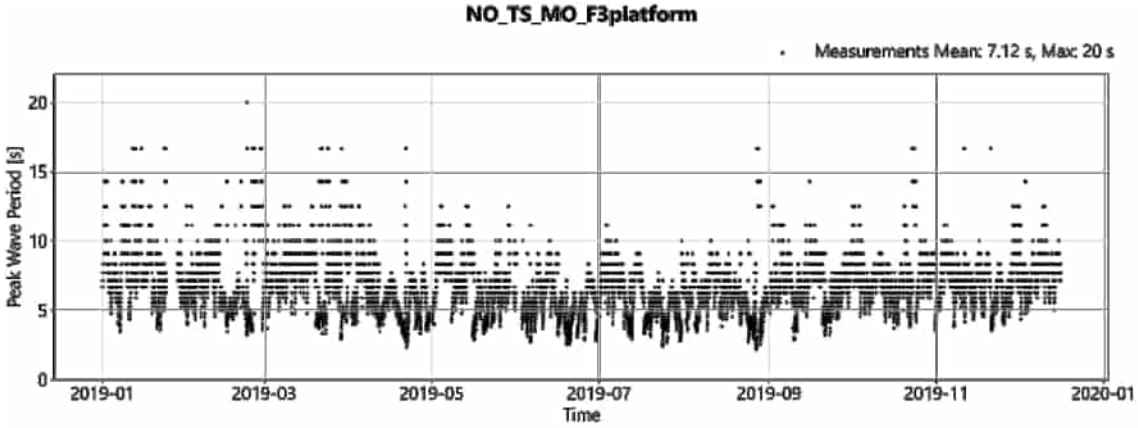

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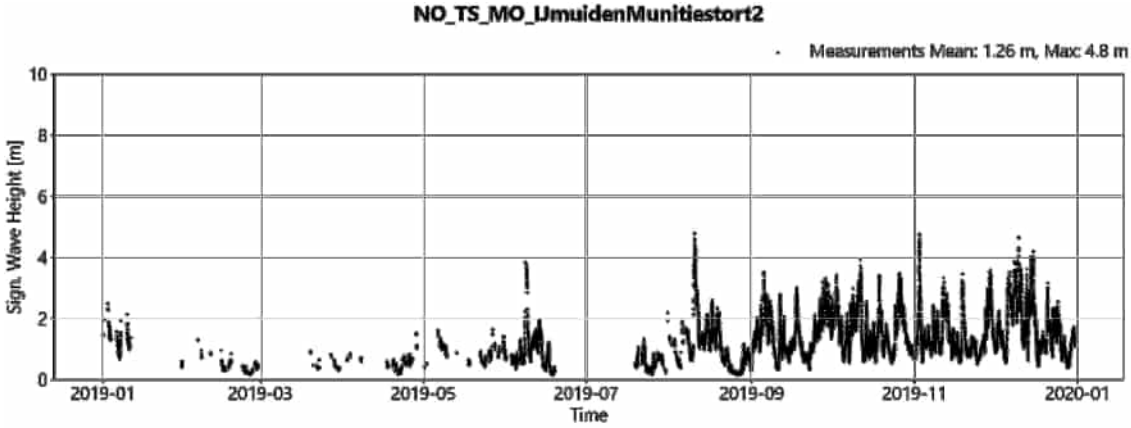

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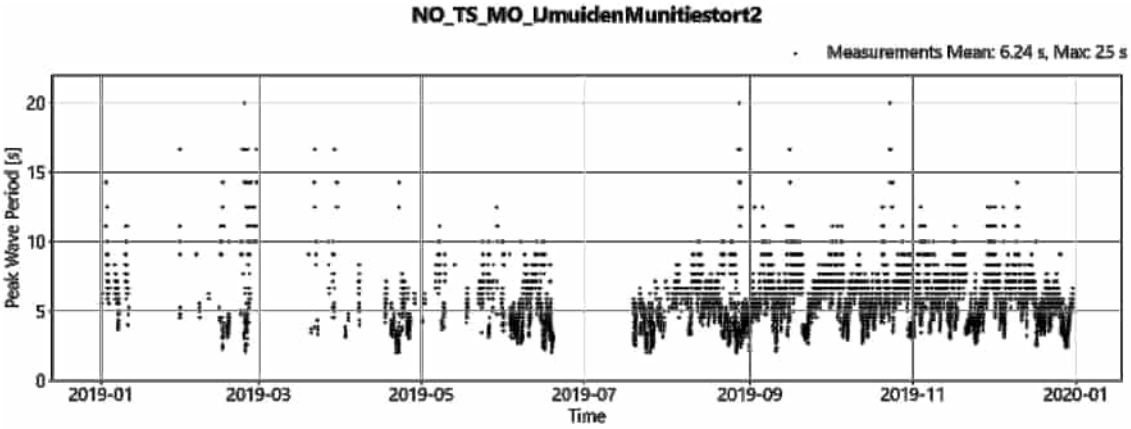

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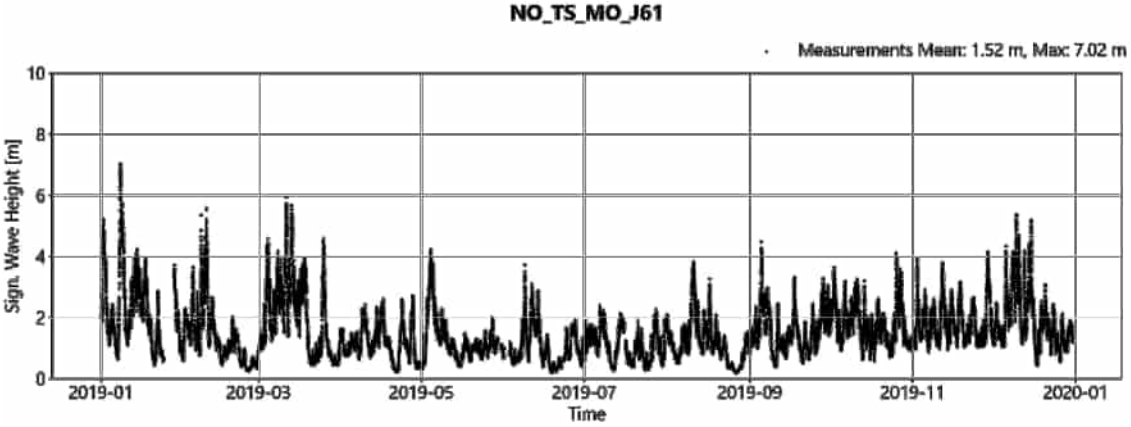

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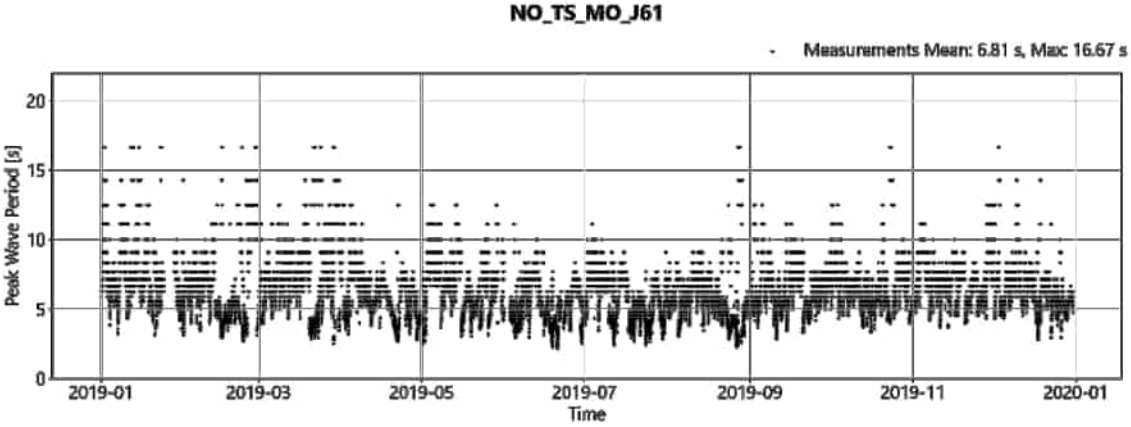

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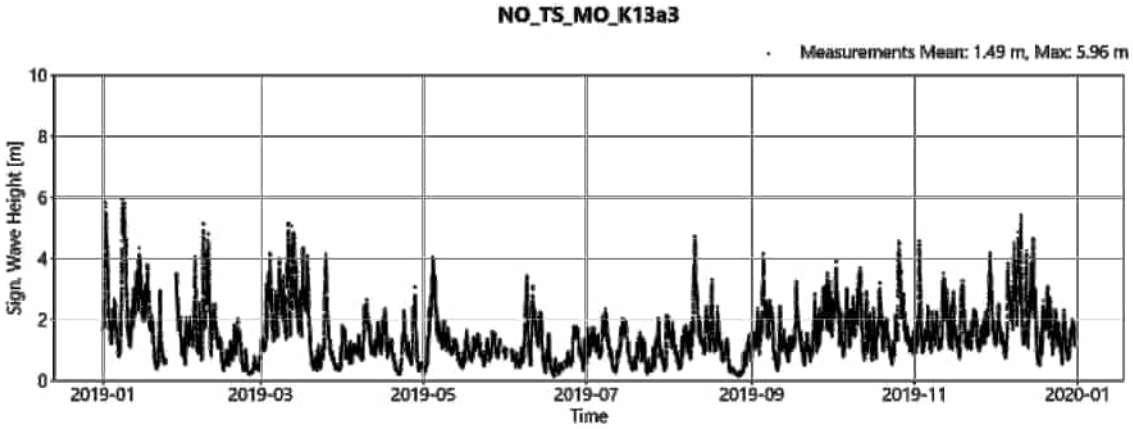

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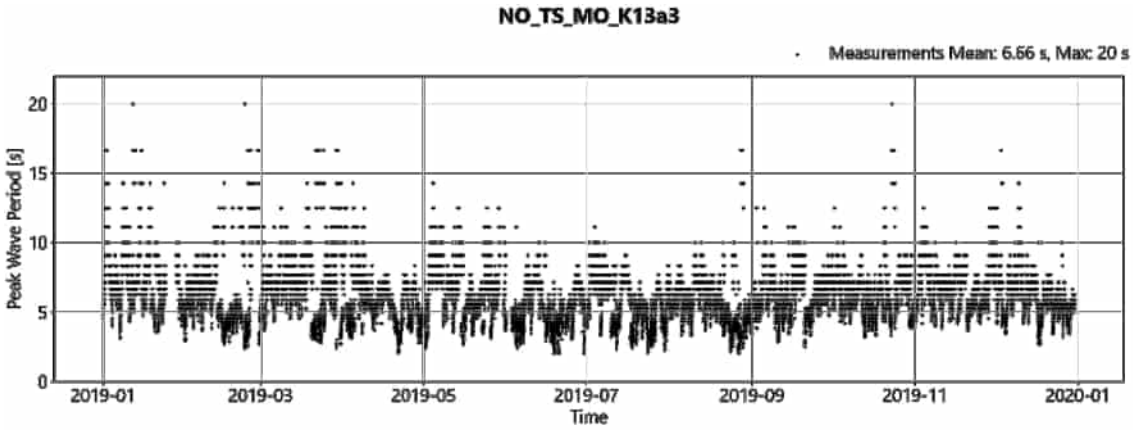

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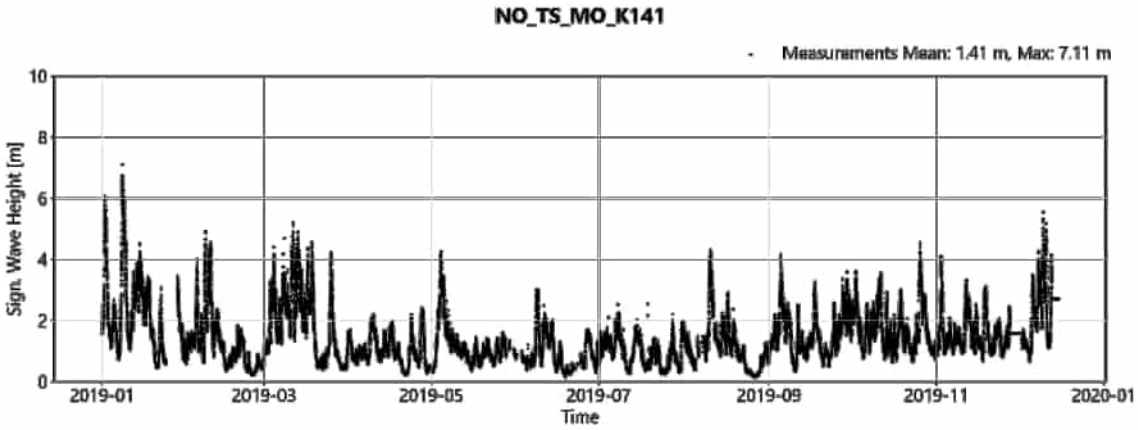

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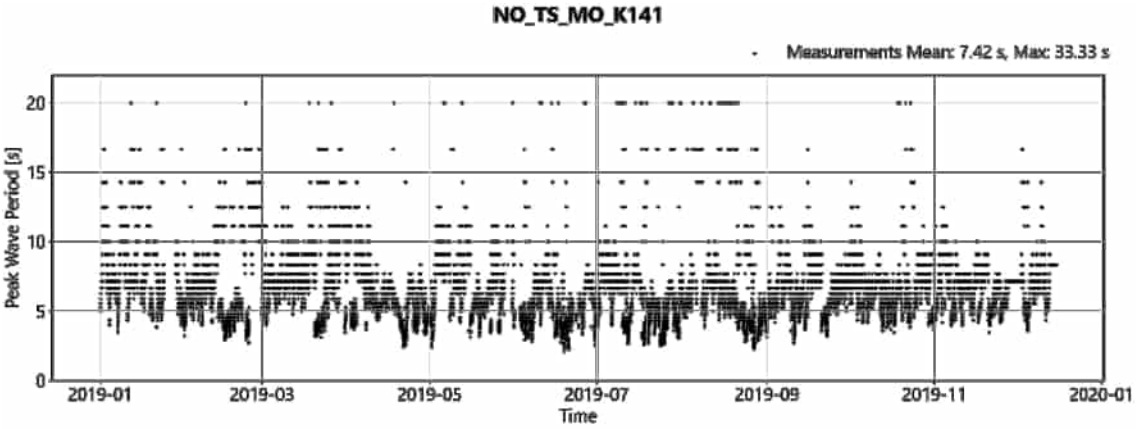

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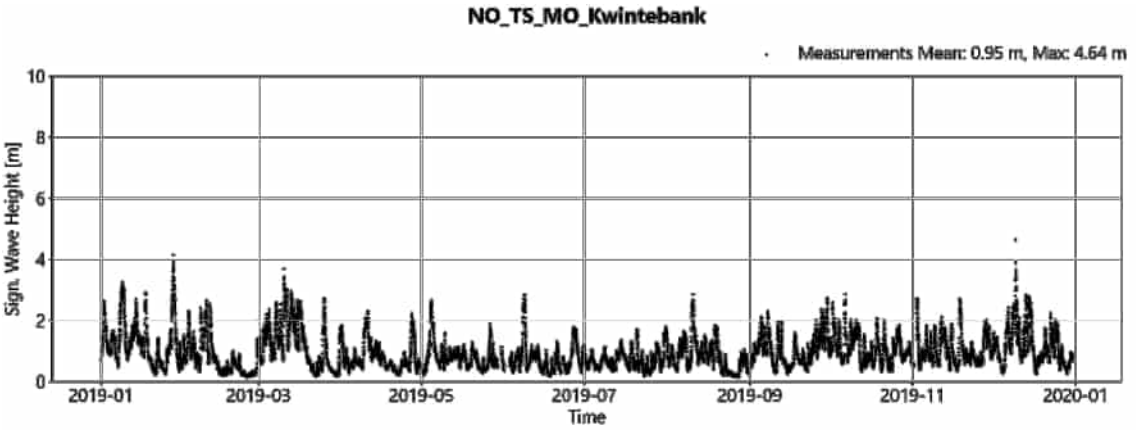

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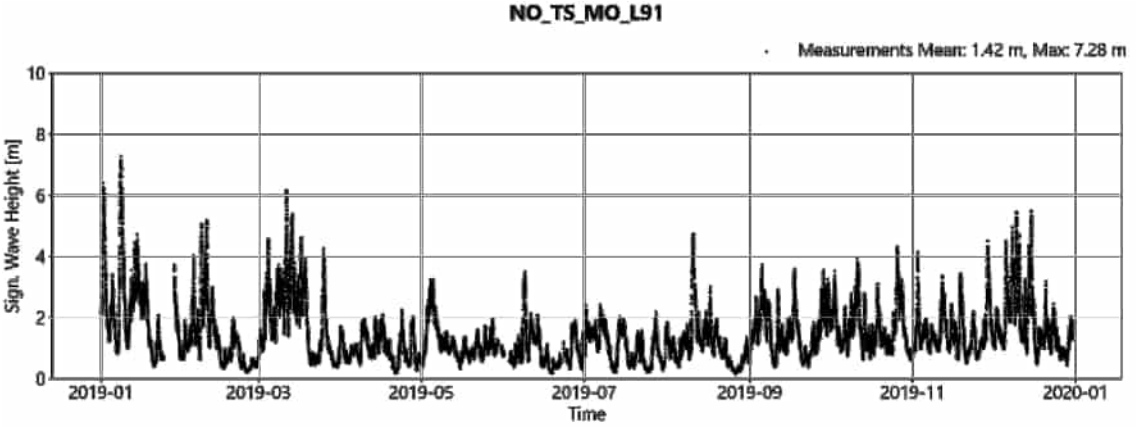

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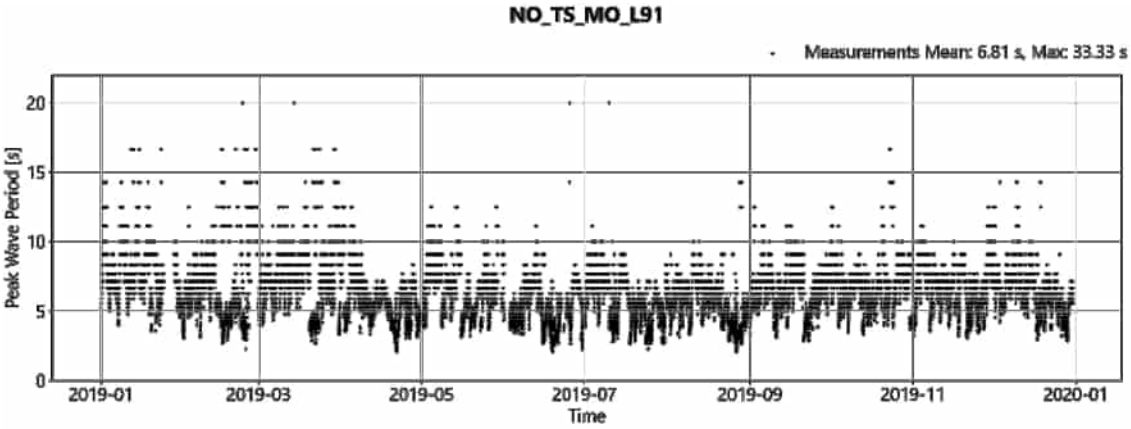

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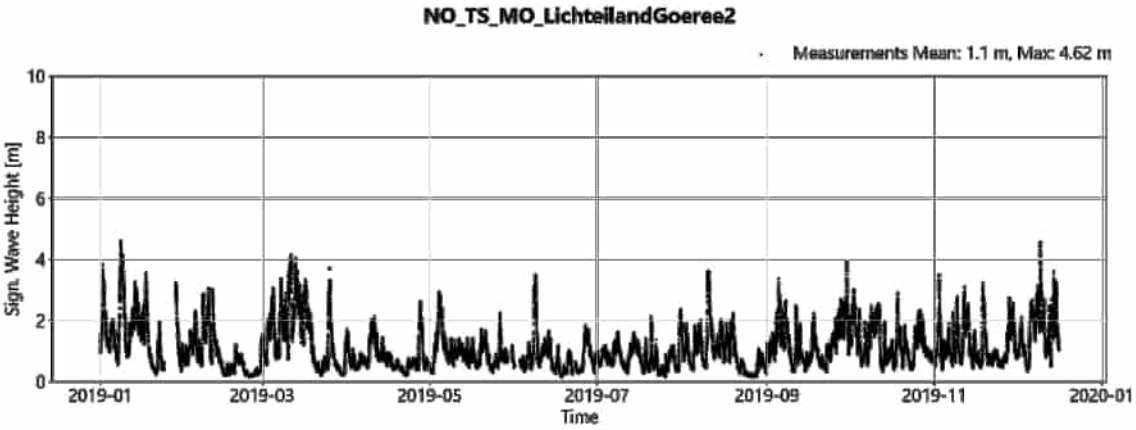

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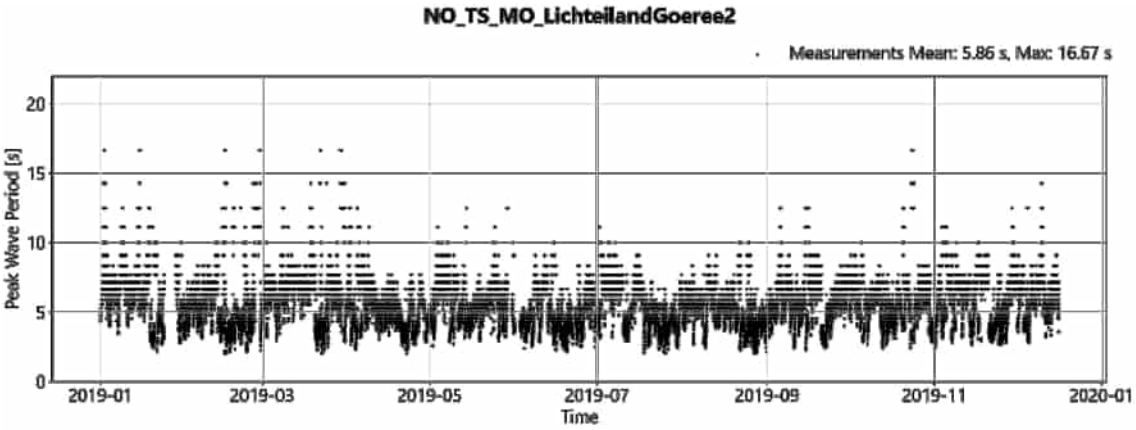

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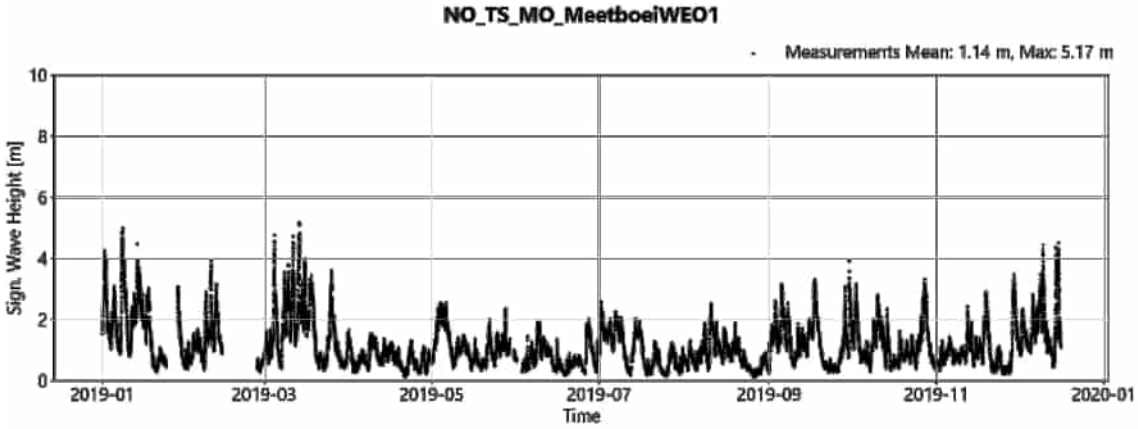

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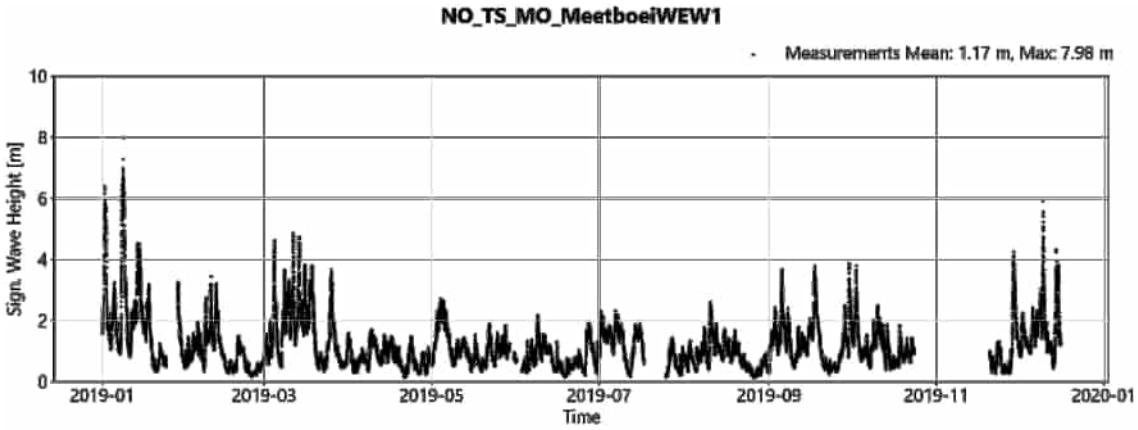

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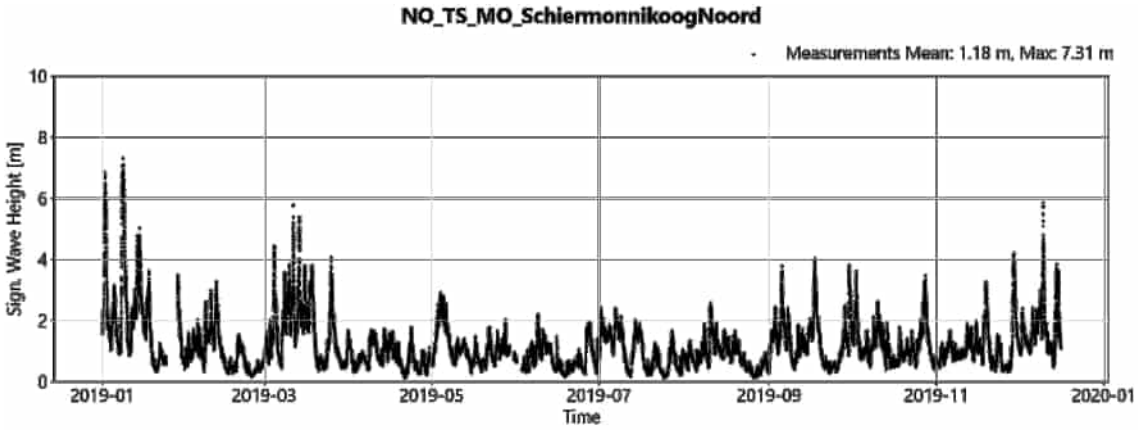
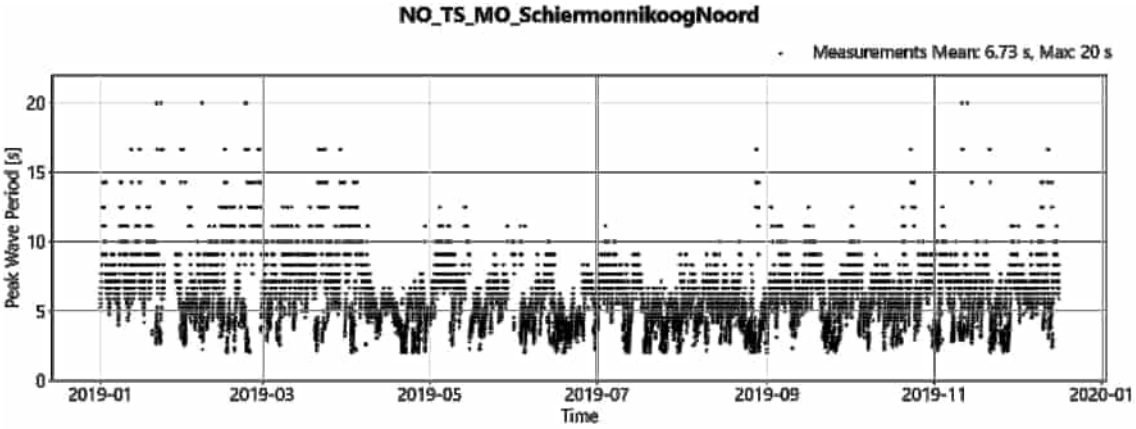


NO_TS_MO_SchiermonnikoogNoord_Hs: TS_plot_NO_TS_MO_SchiermonnikoogNoord_NO_TS_MO_SchiermonnikoogNoord



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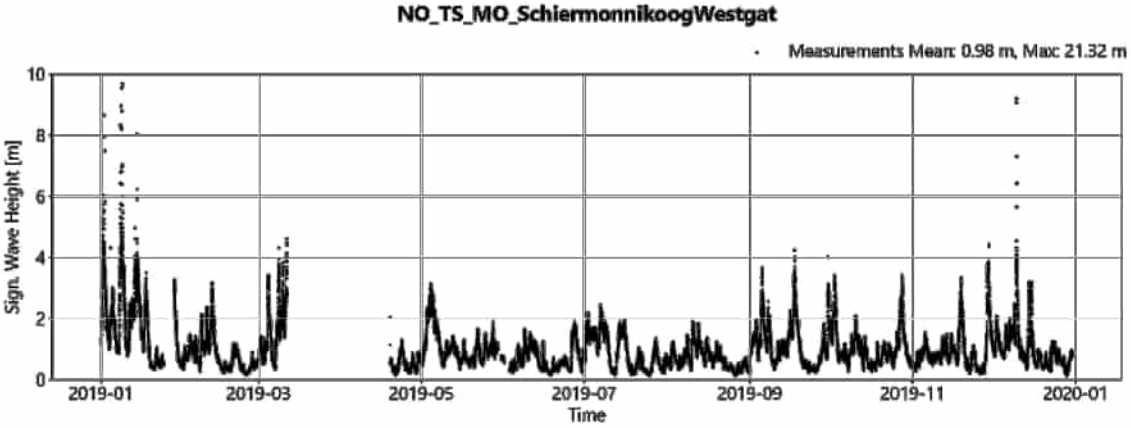
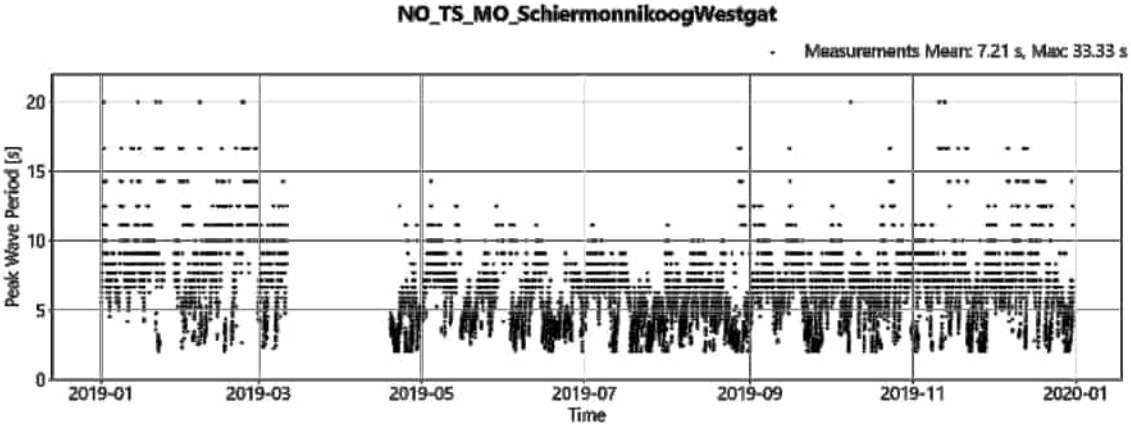


NO_TS_MO_SchiermonnikoogWestgat_Hs: TS_plot_NO_TS_MO_SchiermonnikoogWestgat_NO_TS_MO_SchiermonnikoogWestgat



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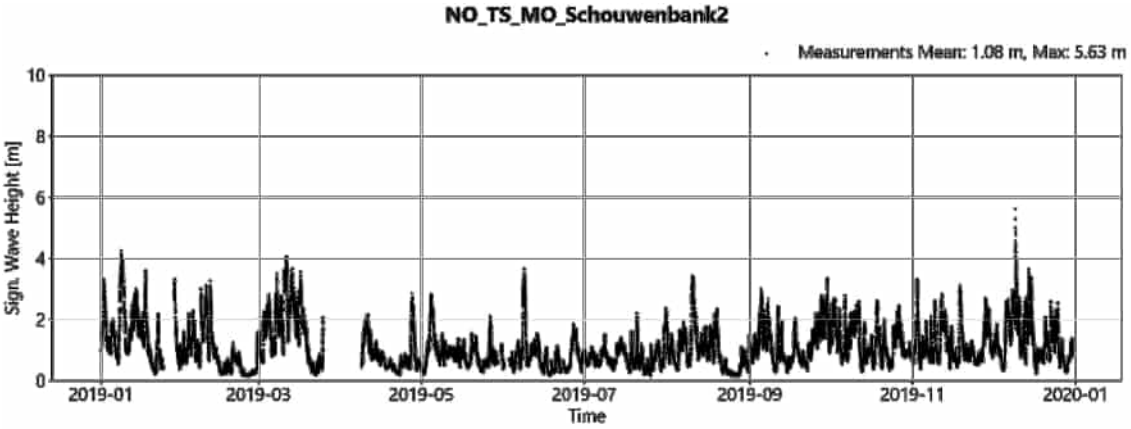
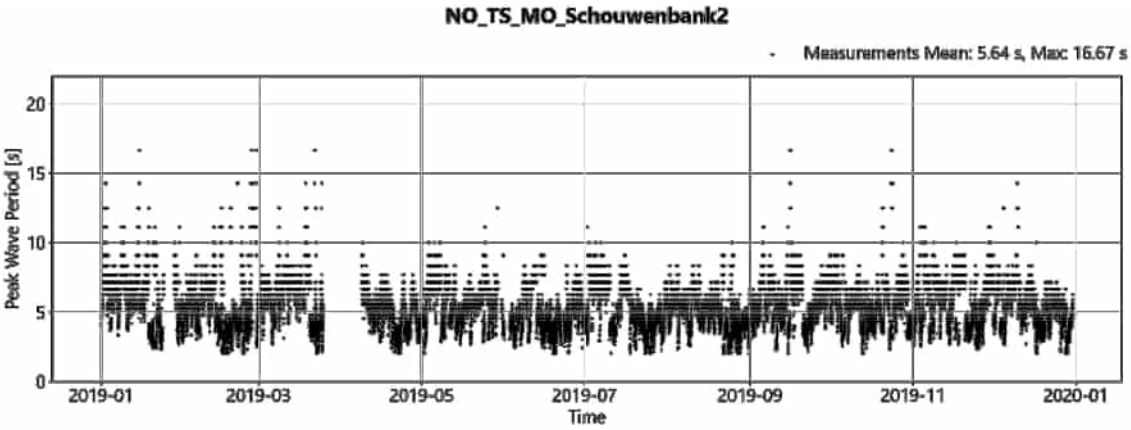
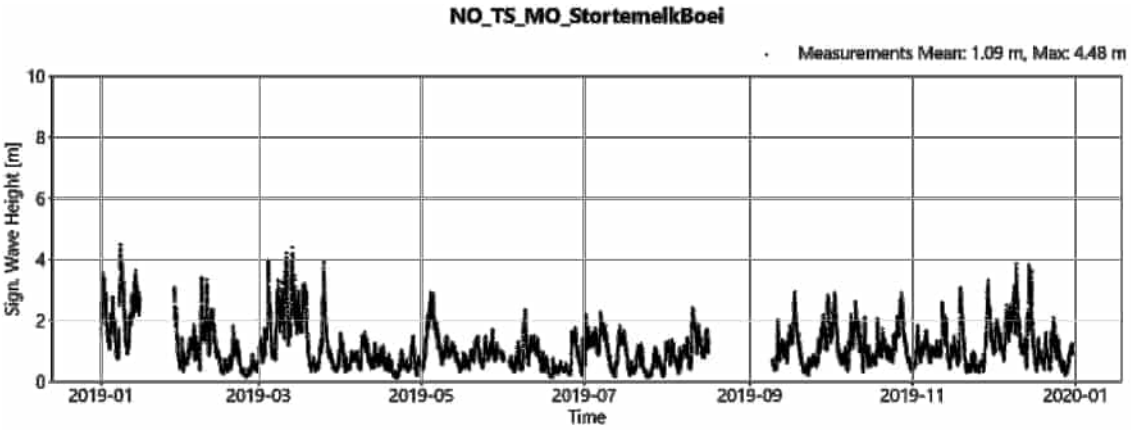


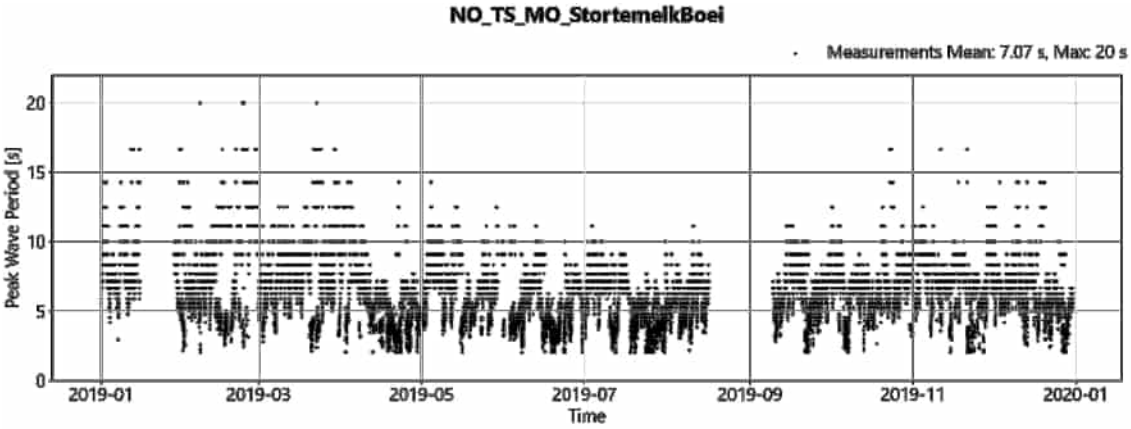
NO_TS_MO_Schouwenbank2_Hs: TS_plot_NO_TS_MO_Schouwenbank2_NO_TS_MO_Schouwenbank2



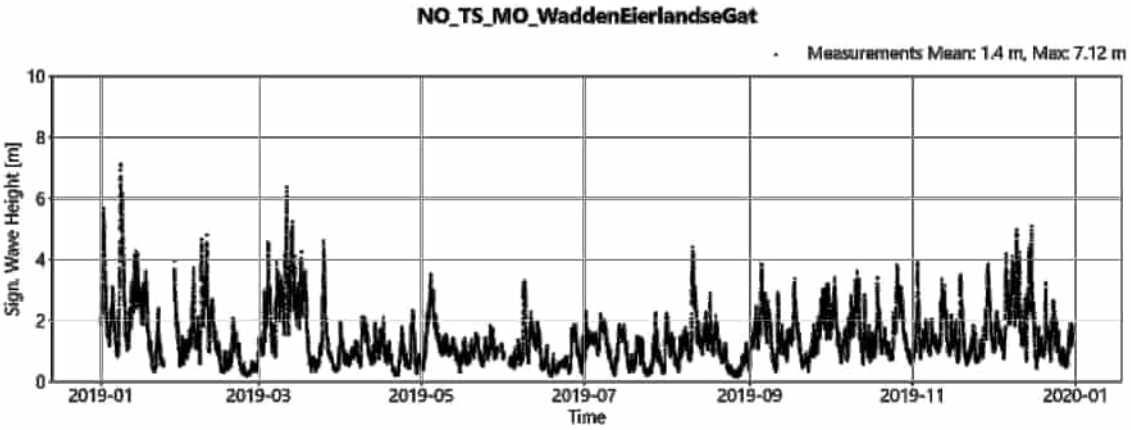
NO_TS_MO_Schouwenbank2_Tp: TS_plot_NO_TS_MO_Schouwenbank2_NO_TS_MO_Schouwenbank2



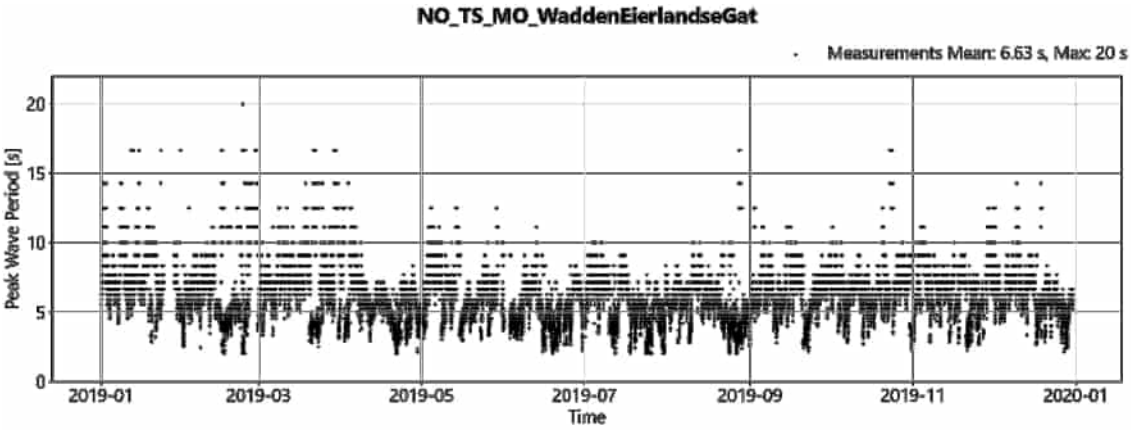
NO_TS_MO_StortemelkBoei_Hs: TS_plot_NO_TS_MO_StortemelkBoei_NO_TS_MO_StortemelkBoei



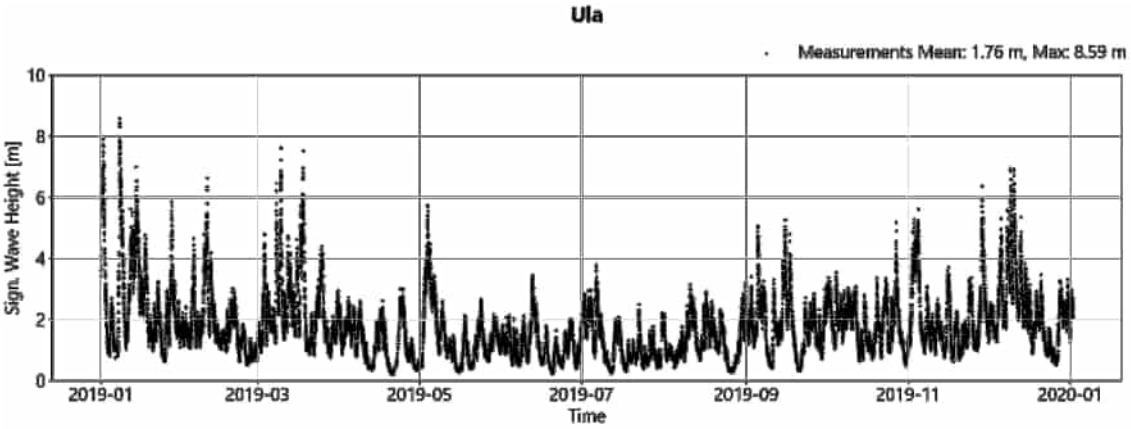
NO_TS_MO_StortemelkBoei_Tp: TS_plot_NO_TS_MO_StortemelkBoei_NO_TS_MO_StortemelkBoei



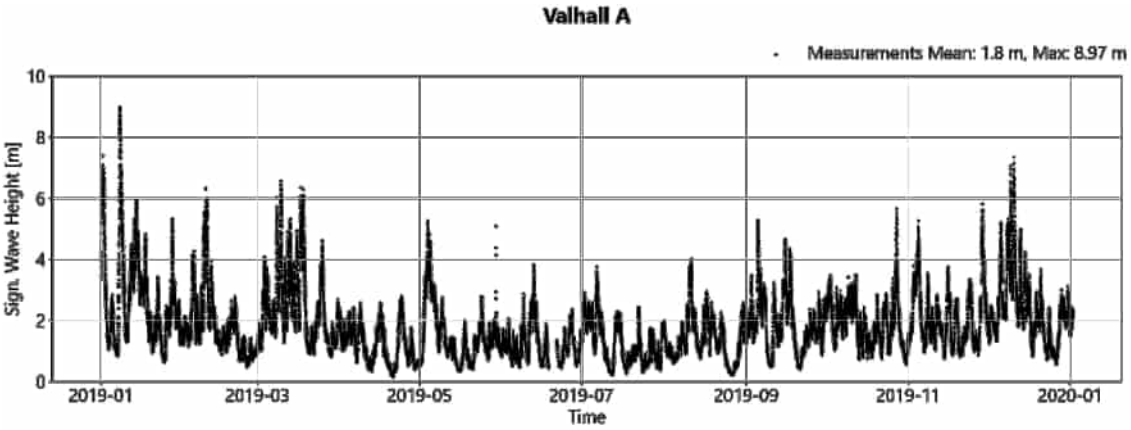
NO_TS_MO_WaddenEierlandseGat_Hs: TS_plot_NO_TS_MO_WaddenEierlandseGat_NO_TS_MO_WaddenEierlandseGat



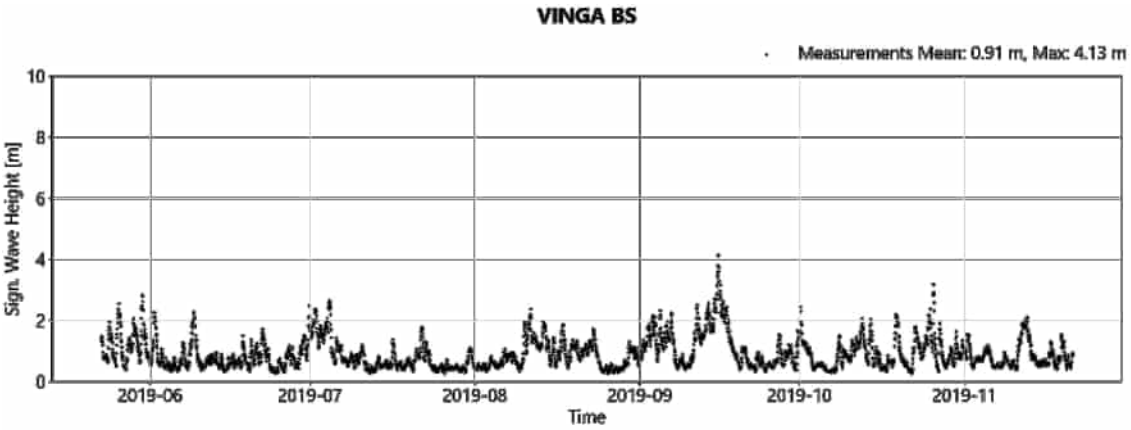
NO_TS_MO_WaddenEierlandseGat_Tp: TS_plot_NO_TS_MO_WaddenEierlandseGat_NO_TS_MO_WaddenEierlandseGat



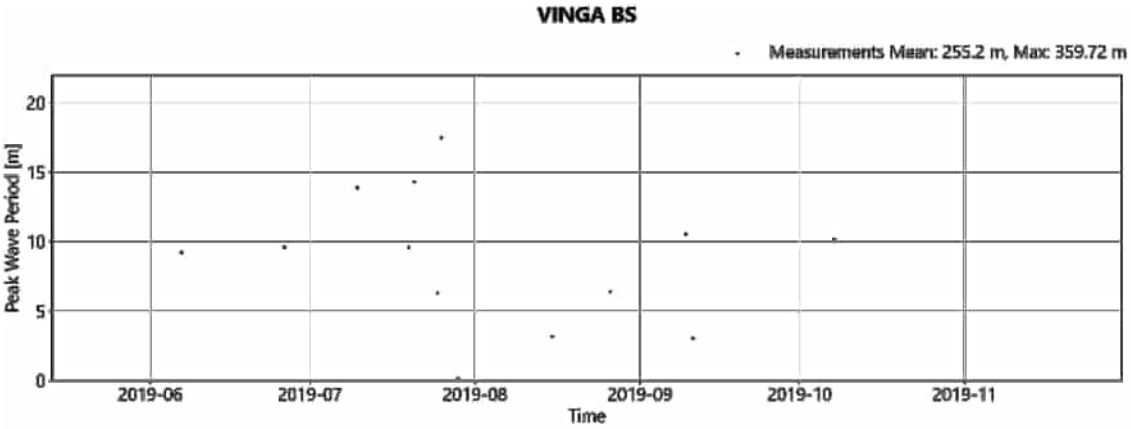
Ula_Hs: TS_plot_Ula_Ula



Valhall A_Hs: TS_plot_Valhall A_Valhall A



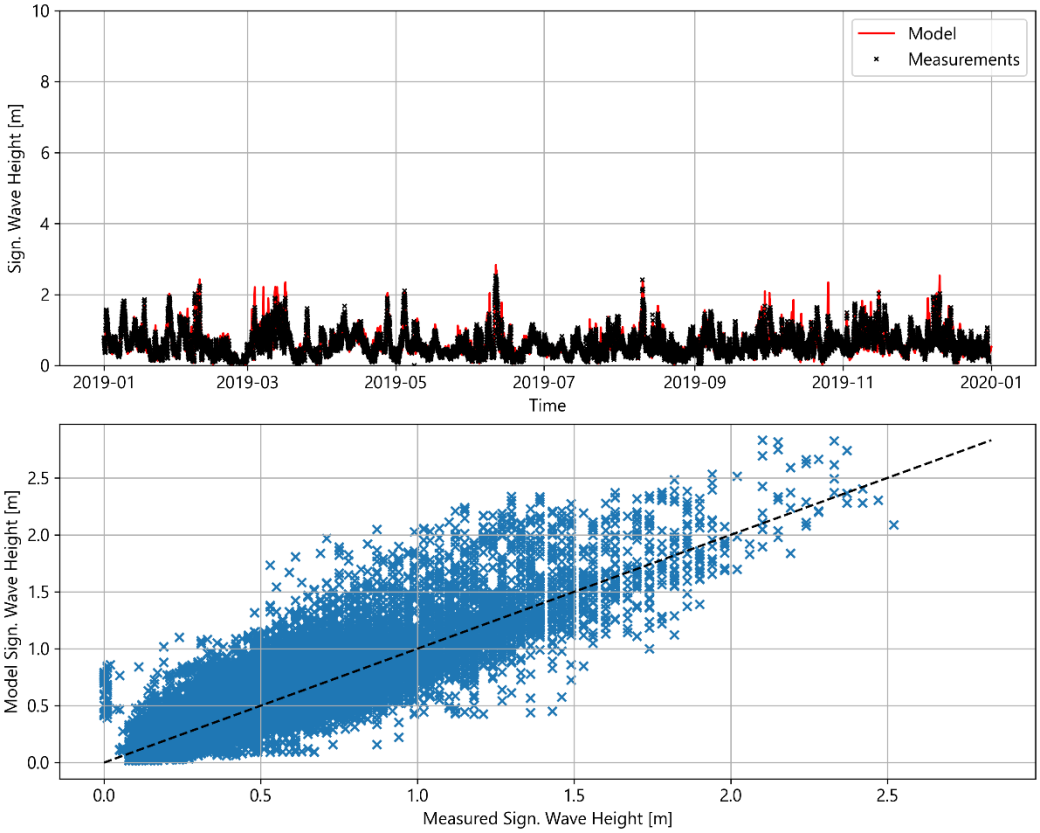
VINGA BS_Hs: TS_plot_VINGA BS_VINGA BS



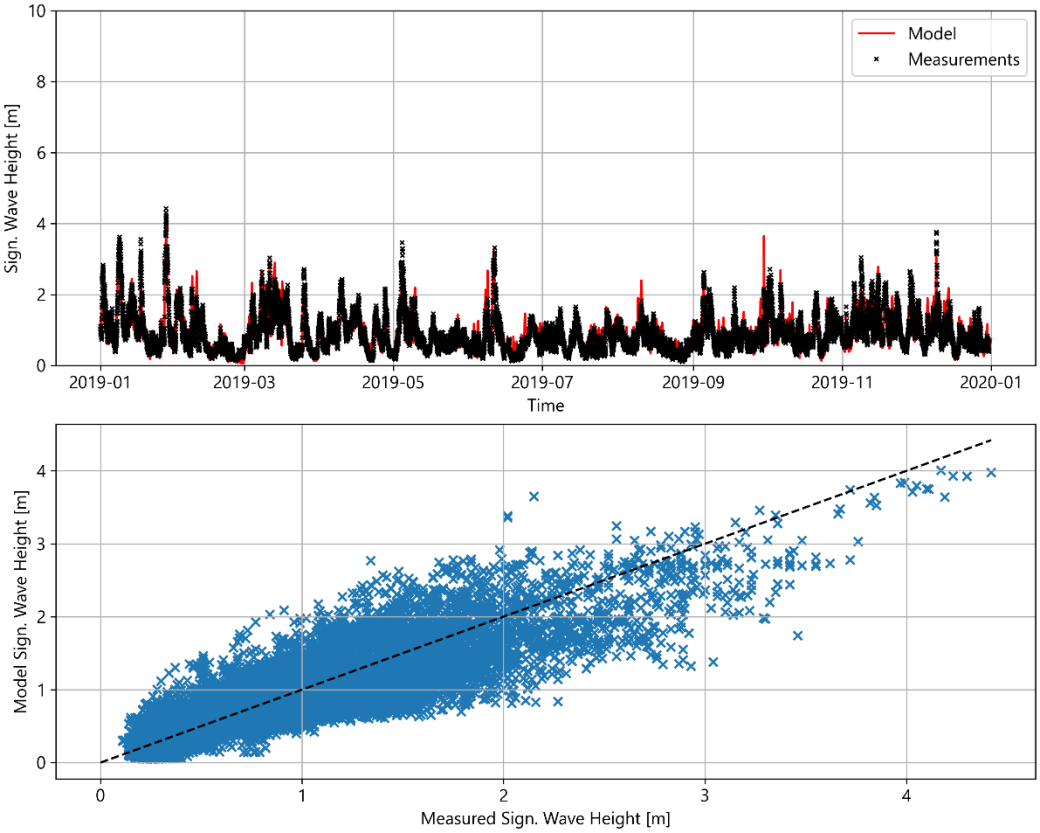
VINGA BS_Tp: TS_plot_VINGA BS_VINGA BS

Appendix C: Calibration of significant wave height

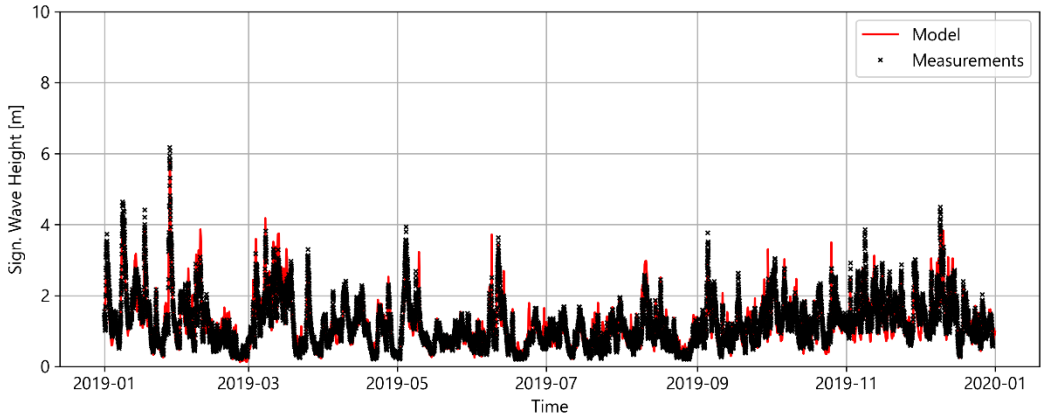
NO_TS_MO_6200041

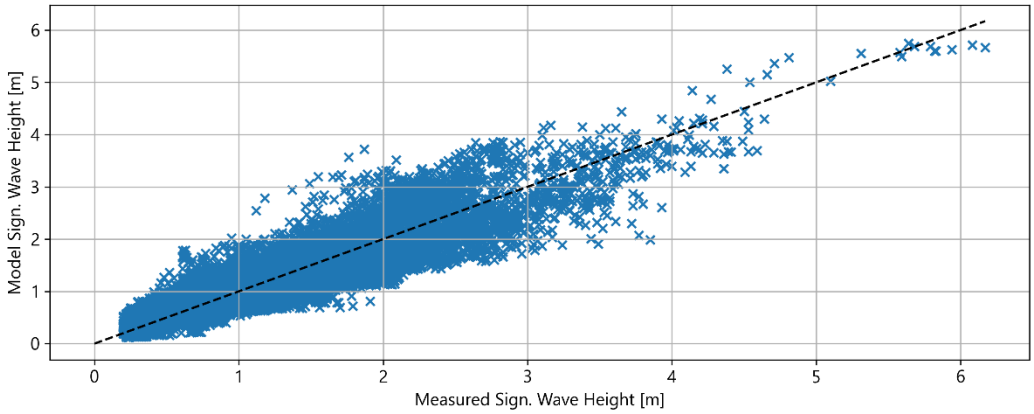


NO_TS_MO_6200041

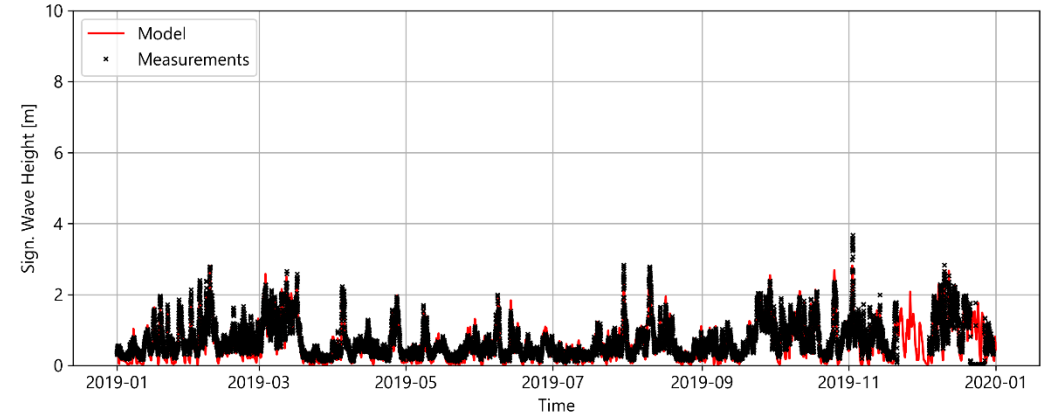


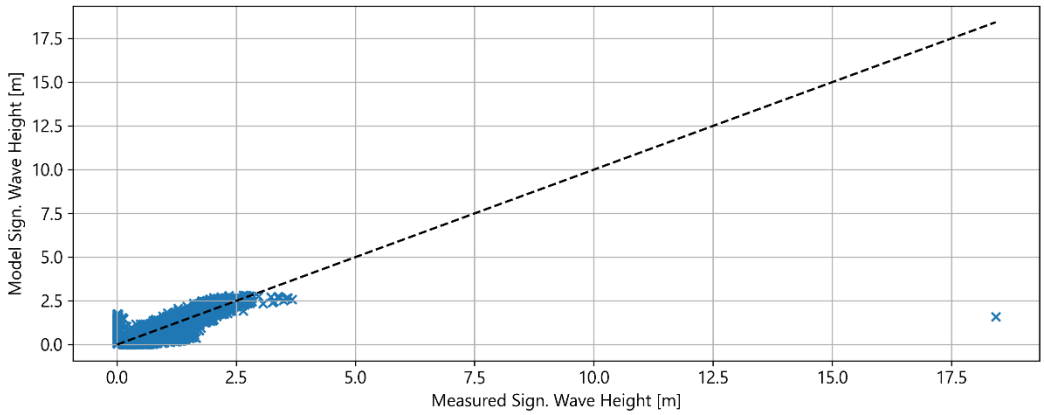
NO_TS_MO_6200289



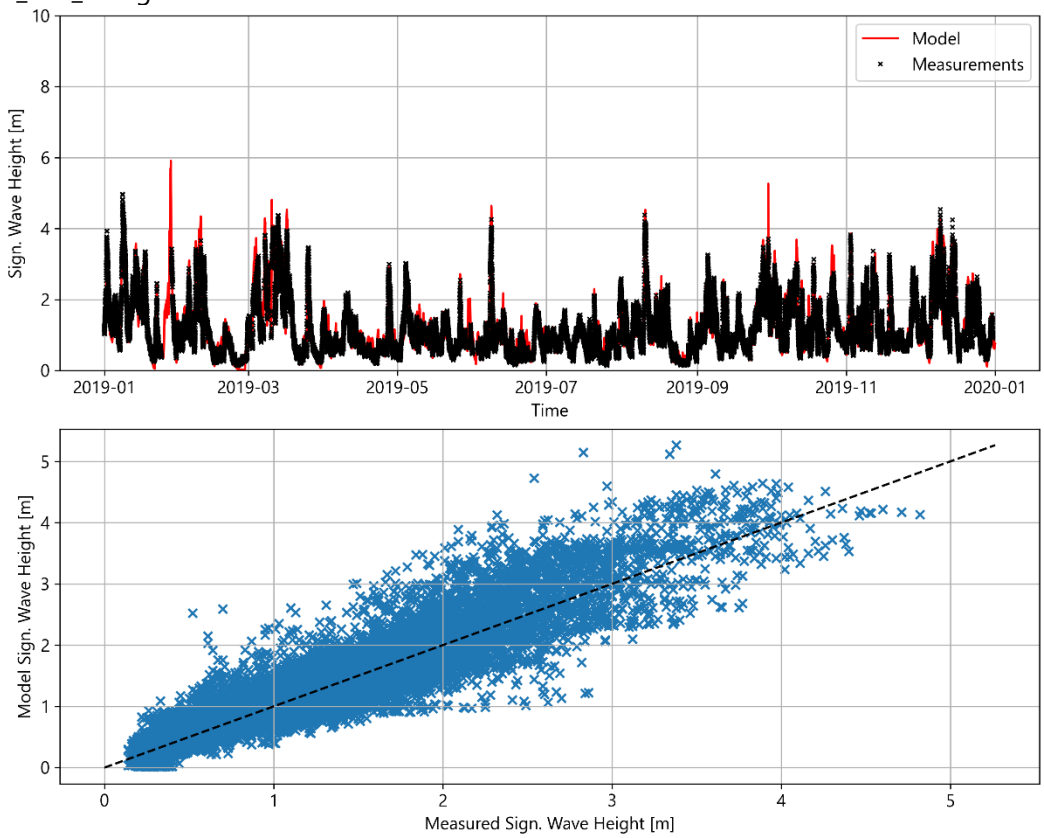


NO_TS_MO_6201011

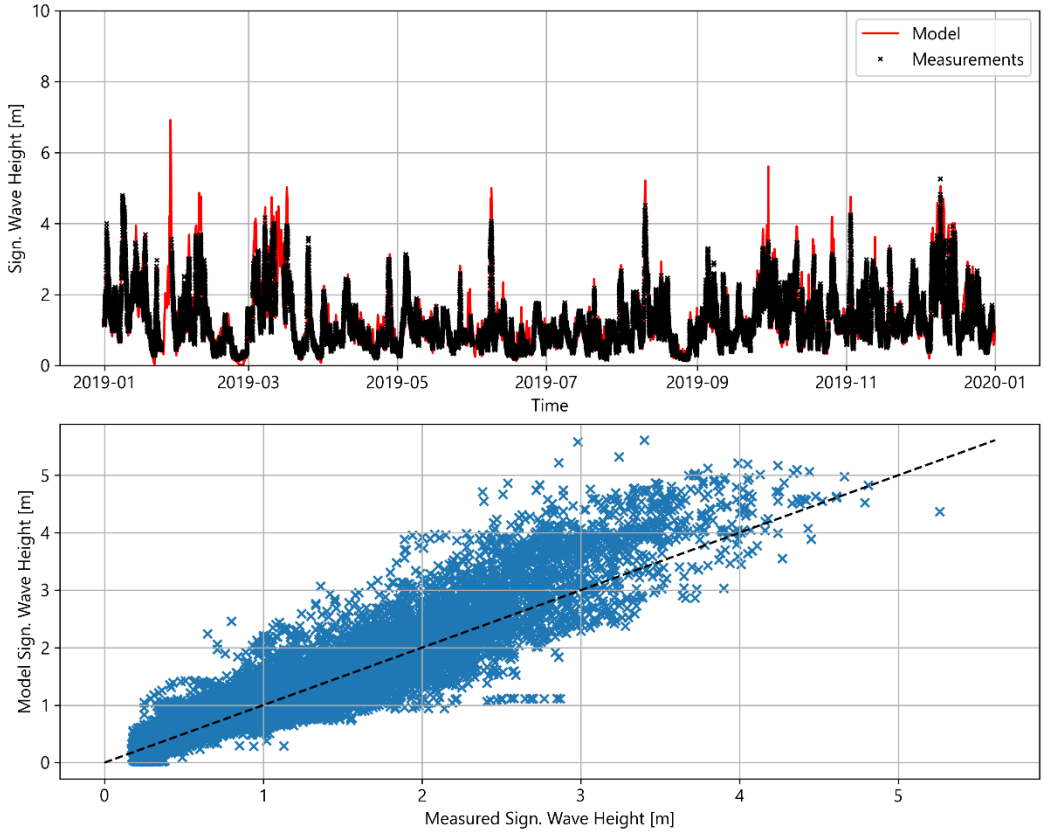




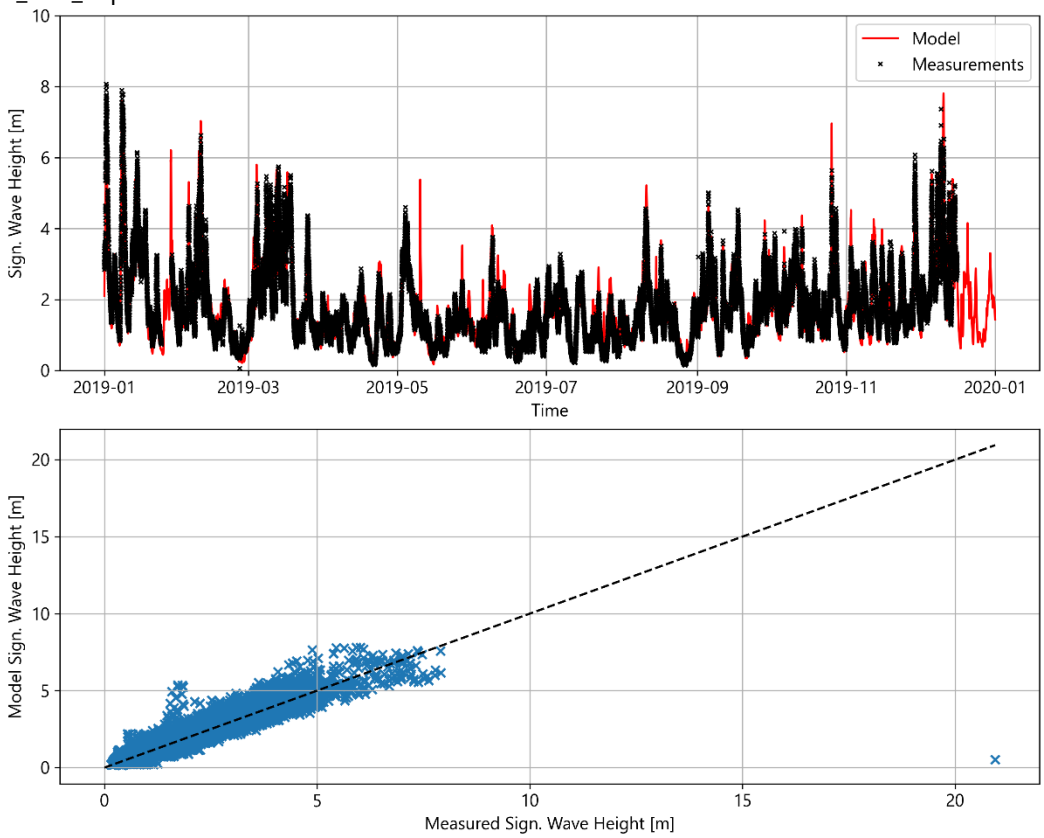
NO_TS_MO_EurogeulE13



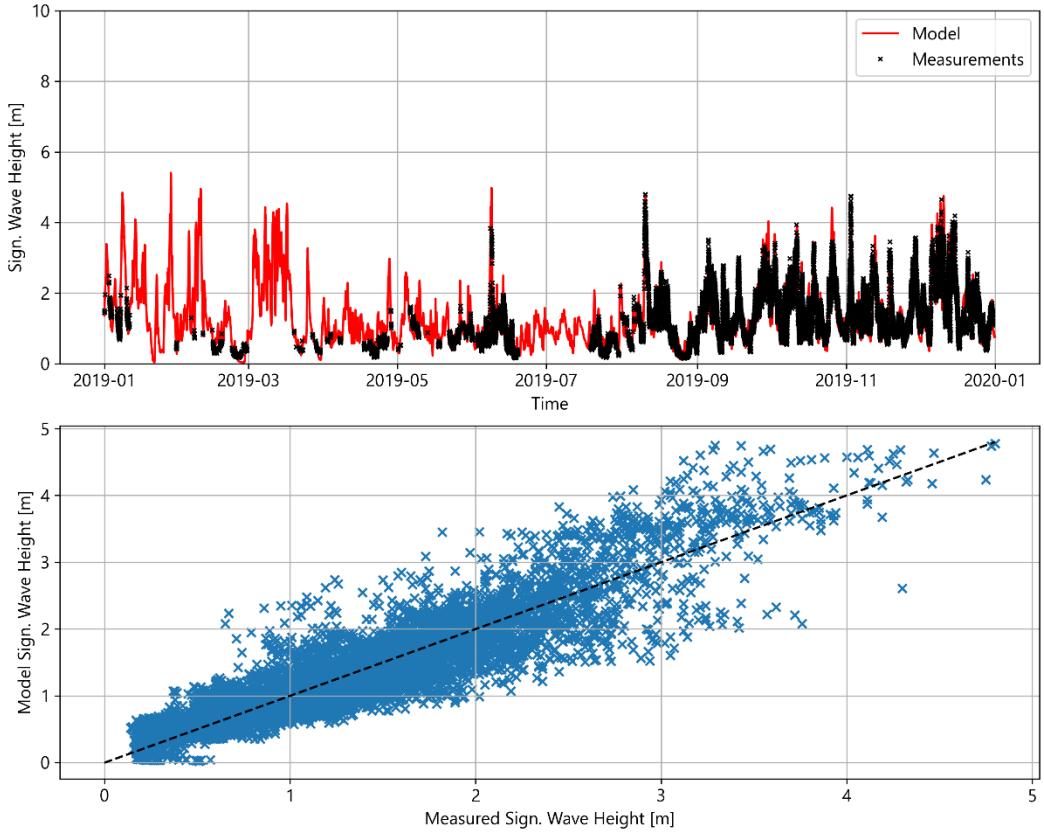
NO_TS_MO_Europlatform3



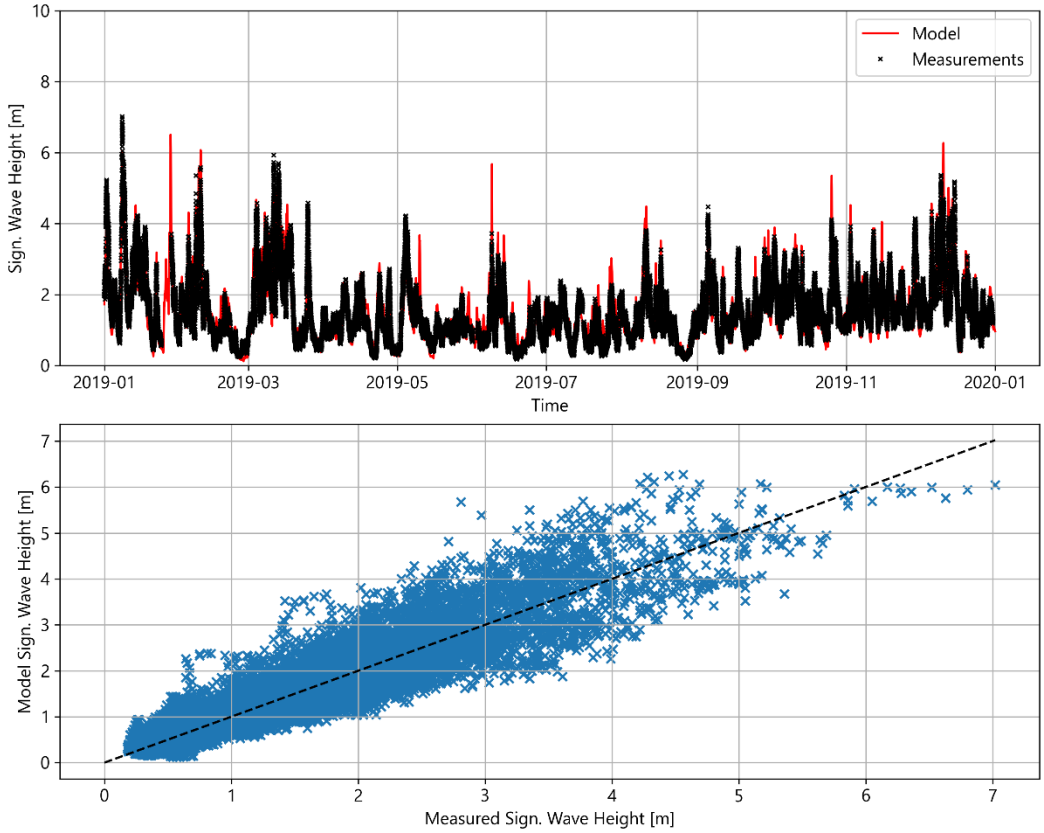
NO_TS_MO_F3platform



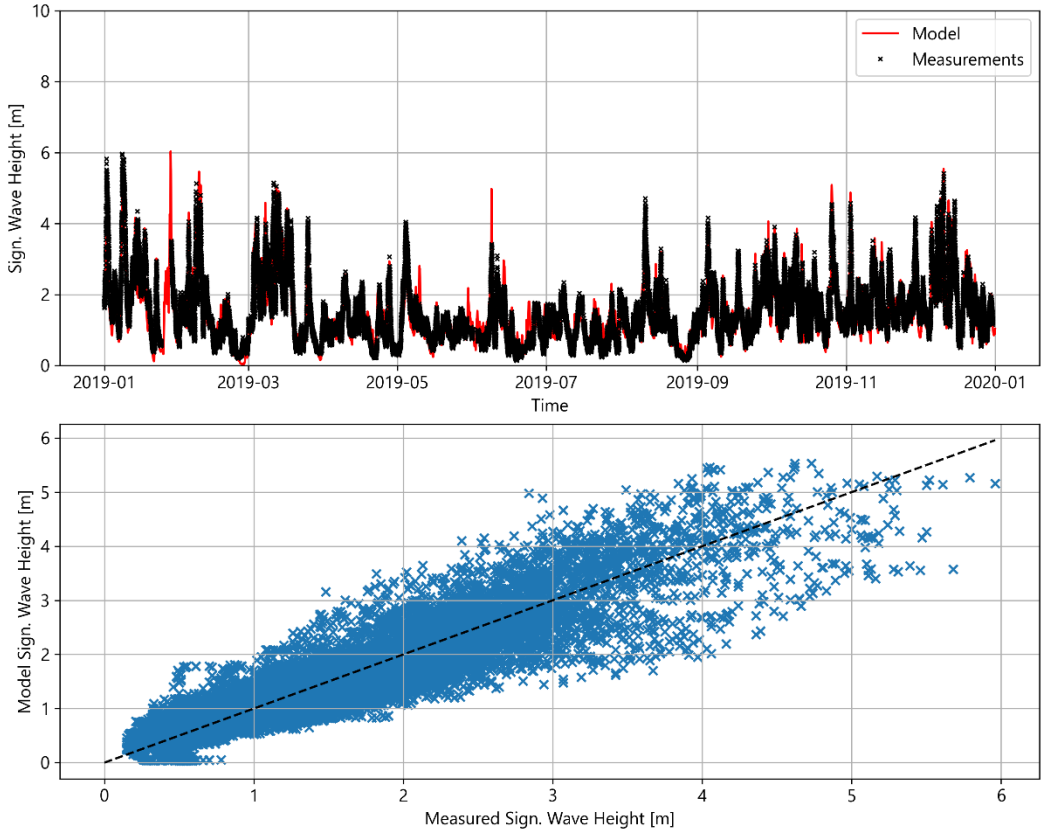
NO_TS_MO_IJmuidenMunitiestort2



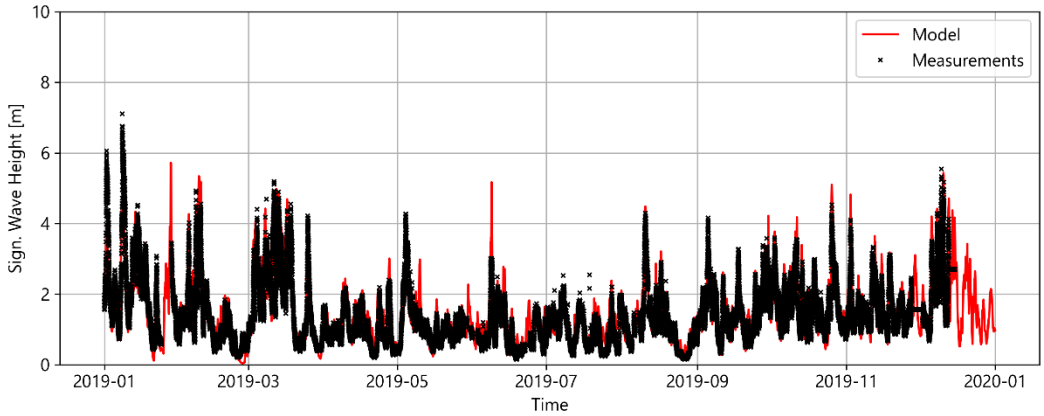
NO_TS_MO_J61

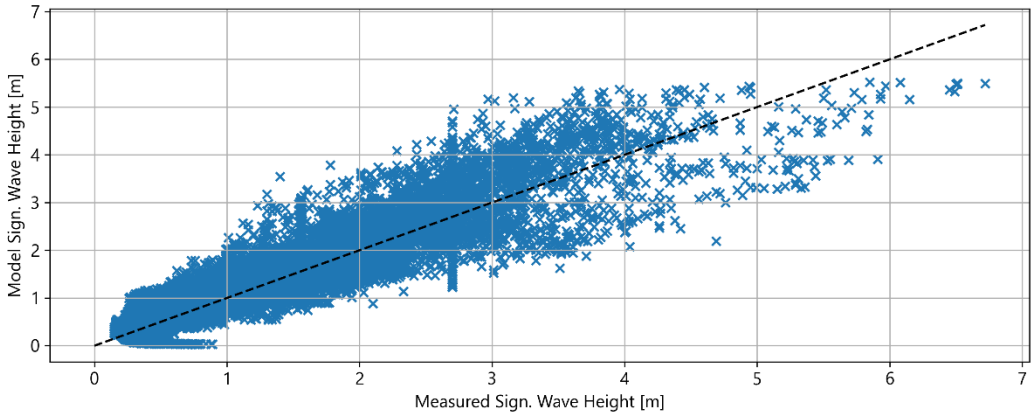


NO_TS_MO_K13a3

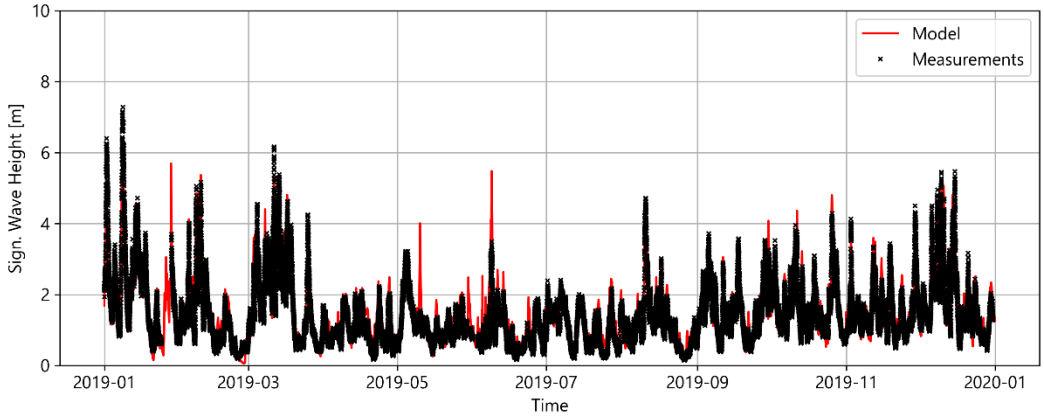


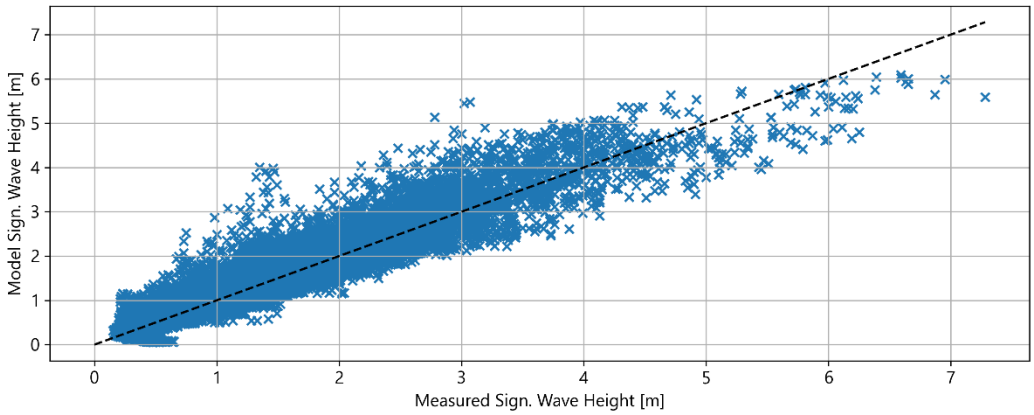
NO_TS_MO_K141



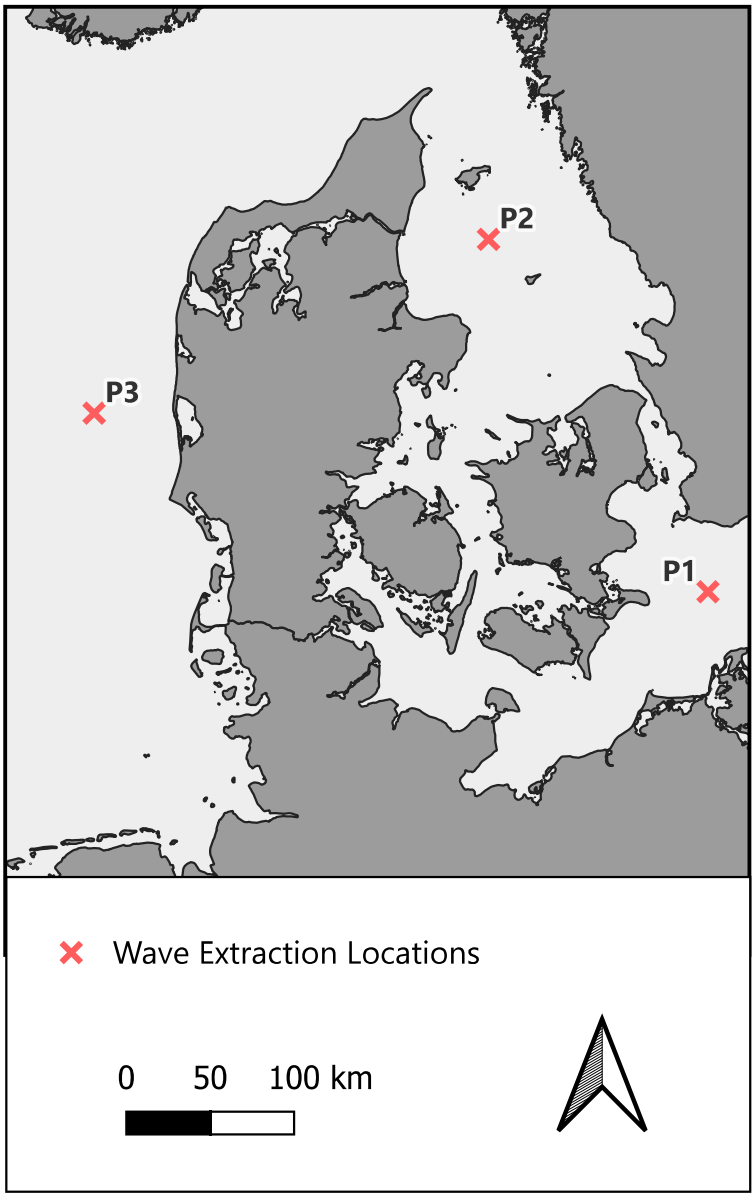


NO_TS_MO_L91

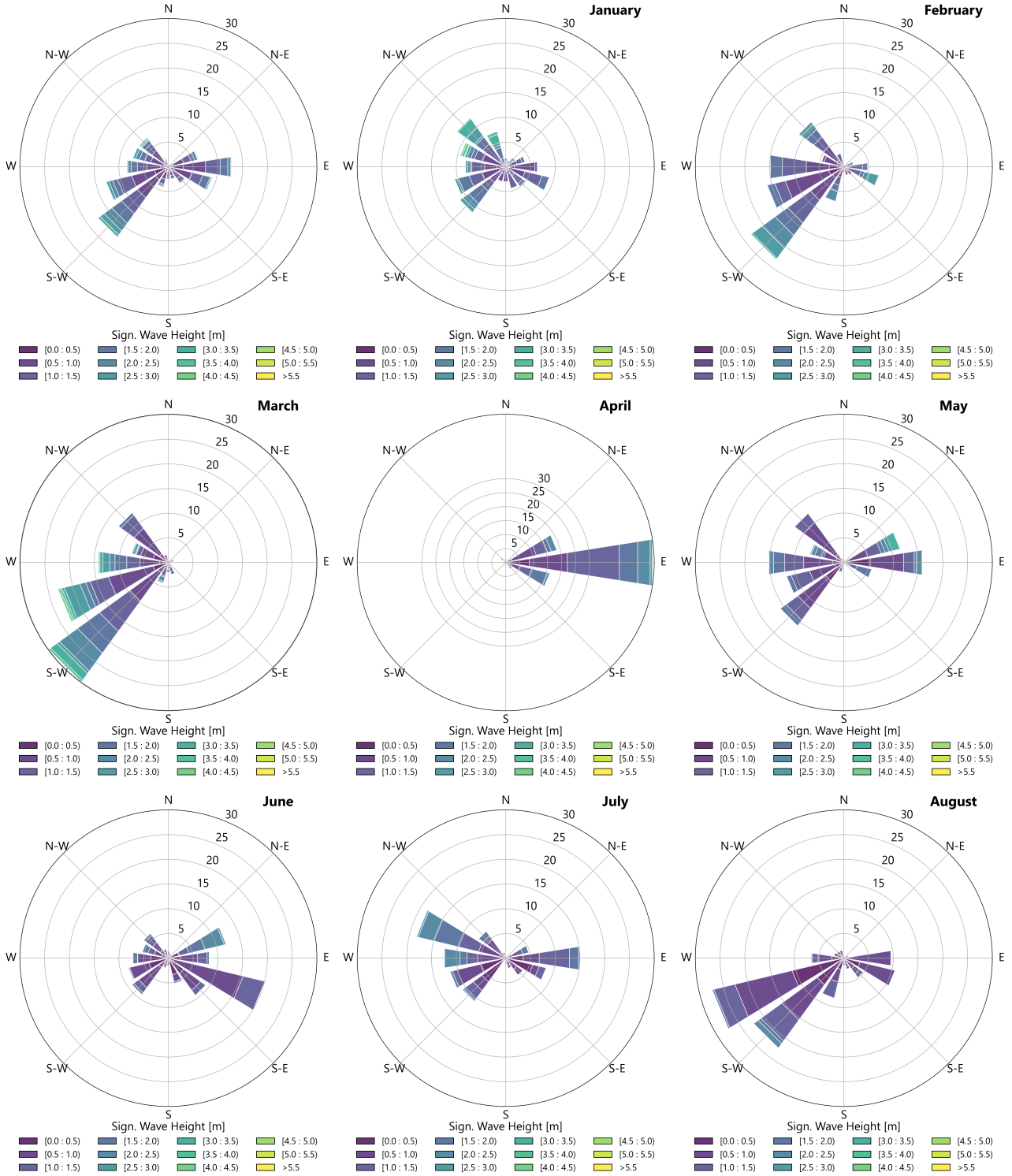


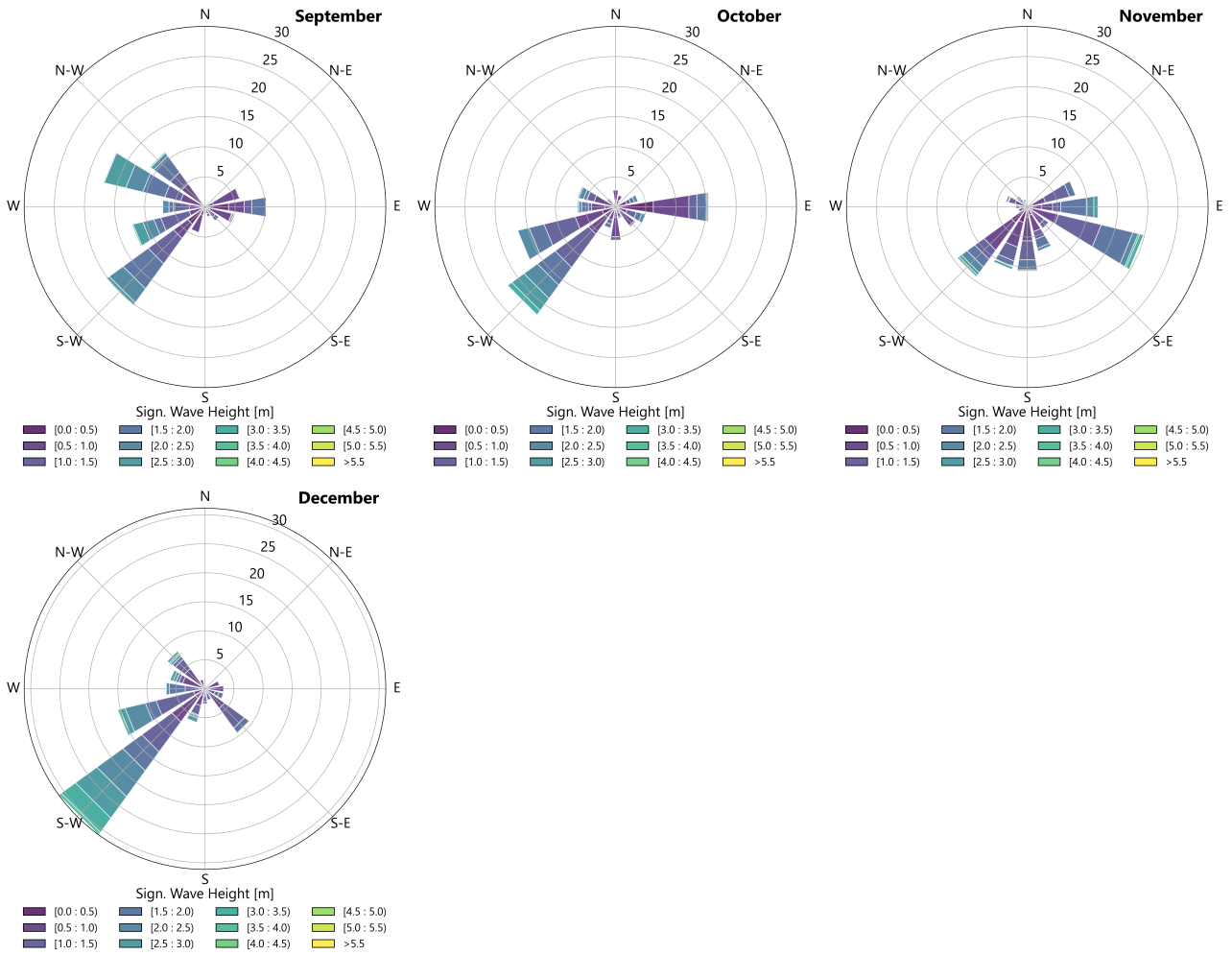


Appendix D: Wave Roses at Selected Locations

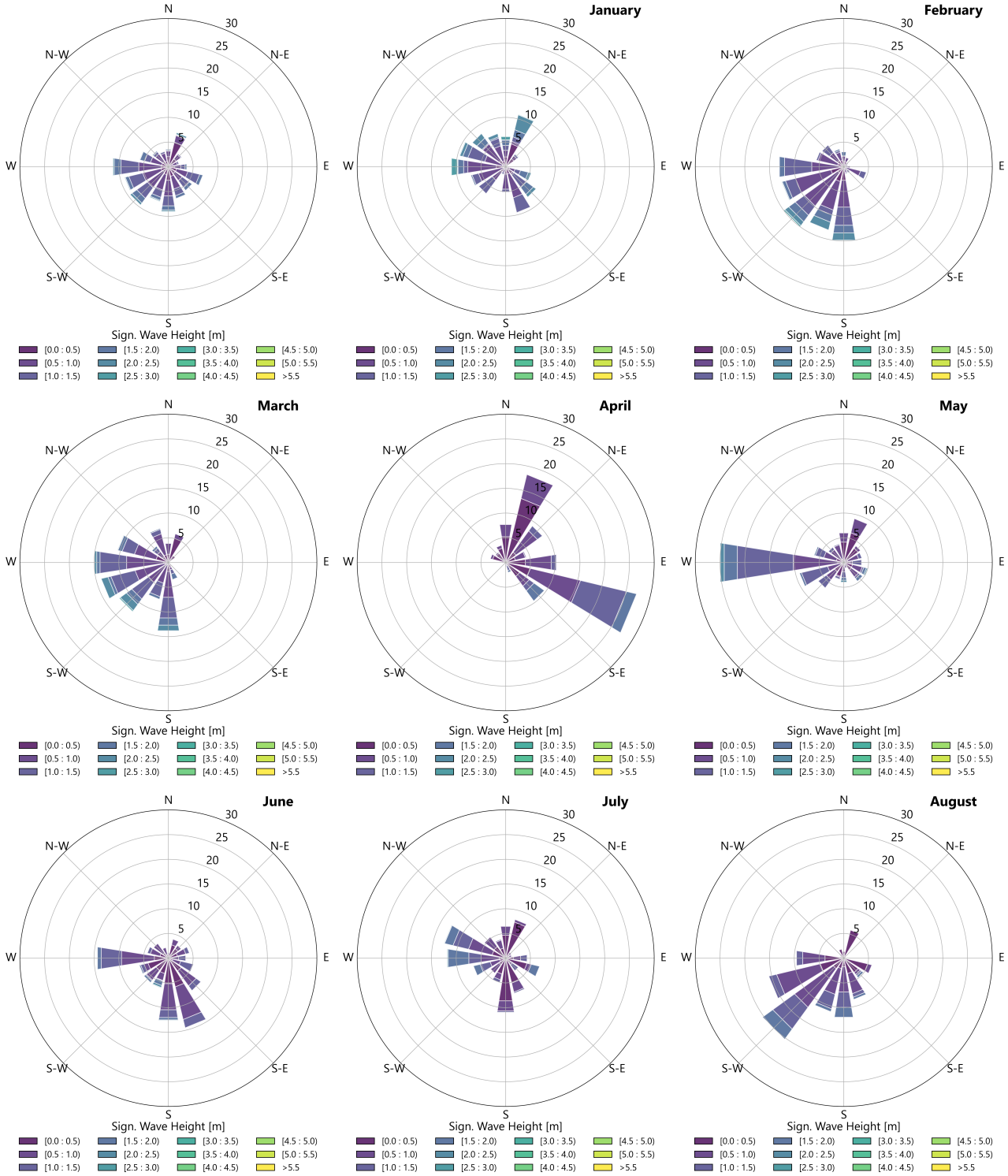

P2
P3
P1
Wave Extraction Locations
0 50 100 km

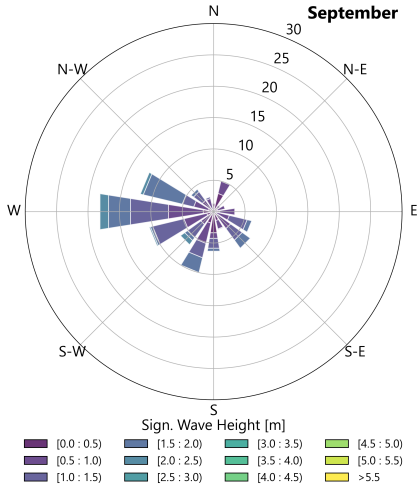
Point 1 - Baltic Sea

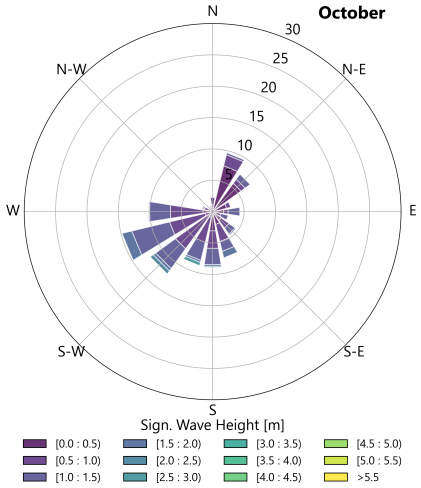


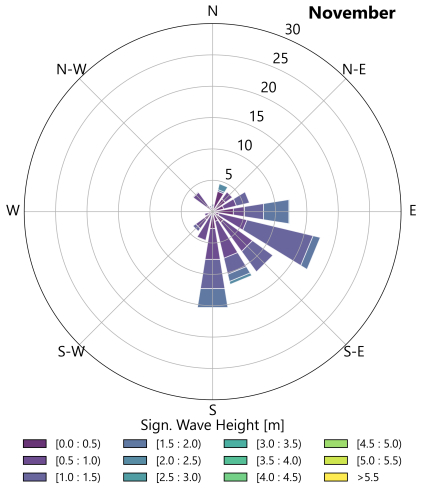

September
October
November
December
N
N-E
E
S-E
S
S-W
W
N-W
30
25
20
15
10
5
Sign. Wave Height [m]
[0.0 : 0.5)
[0.5 : 1.0)
[1.0 : 1.5)
[1.5 : 2.0)
[2.0 : 2.5)
[2.5 : 3.0)
[3.0 : 3.5)
[3.5 : 4.0)
[4.0 : 4.5)
[4.5 : 5.0)
[5.0 : 5.5)
>5.5

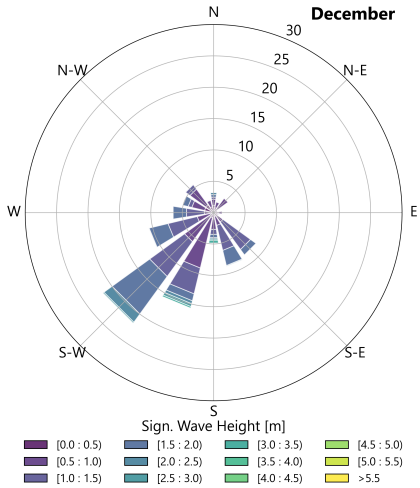
Point 2 - Kattegat



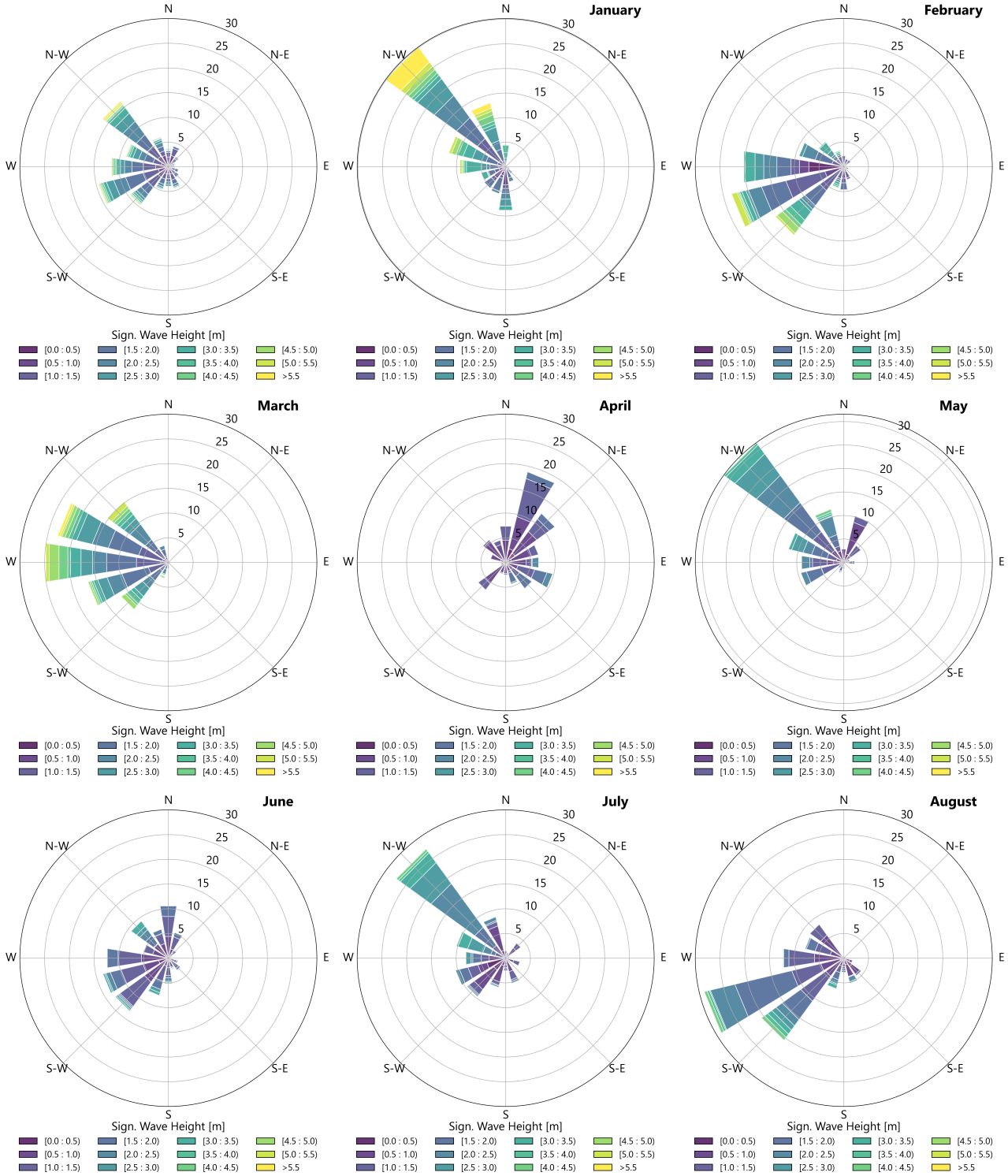

September
N
N-E
E
S-E
S
S-W
W
N-W
30
25
20
15
10
5
Sign. Wave Height [m]
[0.0 : 0.5)
[0.5 : 1.0)
[1.0 : 1.5)
[1.5 : 2.0)
[2.0 : 2.5)
[2.5 : 3.0)
[3.0 : 3.5)
[3.5 : 4.0)
[4.0 : 4.5)
[4.5 : 5.0)
[5.0 : 5.5)
>5.5


October
N
N-E
E
S-E
S
S-W
W
N-W
30
25
20
15
10
5
Sign. Wave Height [m]
[0.0 : 0.5)
[0.5 : 1.0)
[1.0 : 1.5)
[1.5 : 2.0)
[2.0 : 2.5)
[2.5 : 3.0)
[3.0 : 3.5)
[3.5 : 4.0)
[4.0 : 4.5)
[4.5 : 5.0)
[5.0 : 5.5)
>5.5


November
N
N-E
E
S-E
S
S-W
W
N-W
30
25
20
15
10
5
Sign. Wave Height [m]
[0.0 : 0.5)
[0.5 : 1.0)
[1.0 : 1.5)
[1.5 : 2.0)
[2.0 : 2.5)
[2.5 : 3.0)
[3.0 : 3.5)
[3.5 : 4.0)
[4.0 : 4.5)
[4.5 : 5.0)
[5.0 : 5.5)
>5.5


December
N
N-E
E
S-E
S
S-W
W
N-W
30
25
20
15
10
5
Sign. Wave Height [m]
[0.0 : 0.5)
[0.5 : 1.0)
[1.0 : 1.5)
[1.5 : 2.0)
[2.0 : 2.5)
[2.5 : 3.0)
[3.0 : 3.5)
[3.5 : 4.0)
[4.0 : 4.5)
[4.5 : 5.0)
[5.0 : 5.5)
>5.5

Point 3 - North Sea



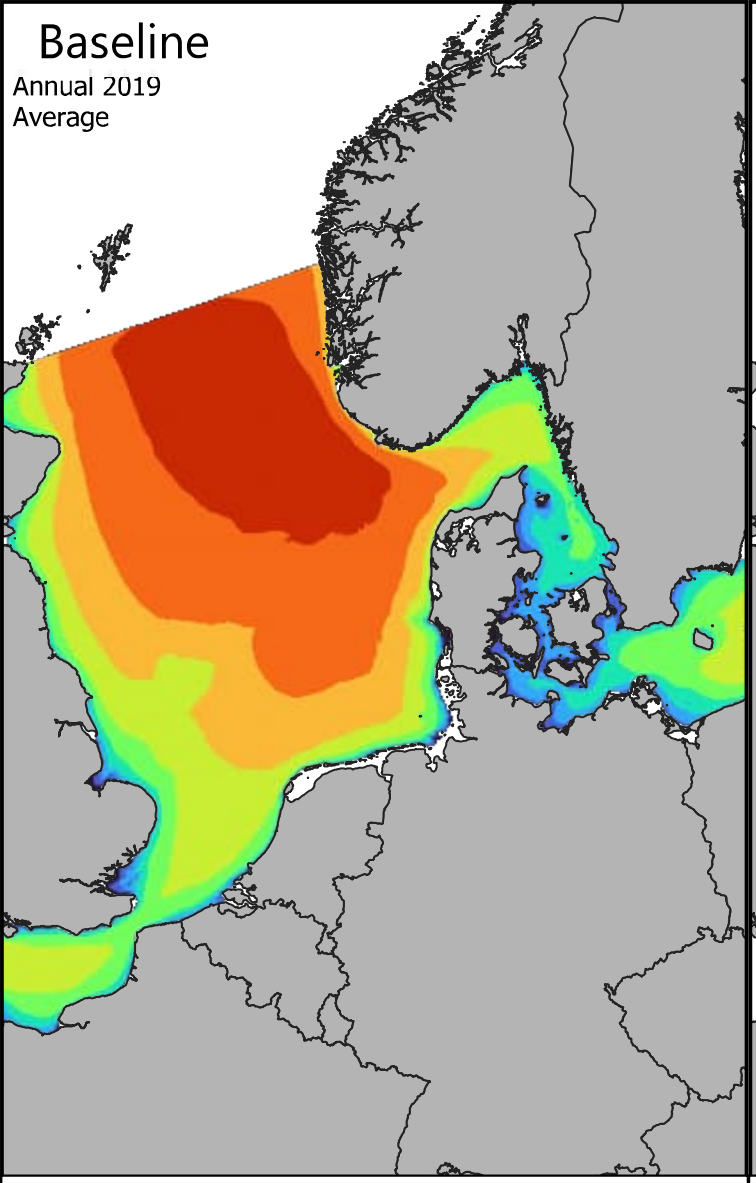
Appendix E: Wind Farms Spatial Impact on Significant Wave **H**eights

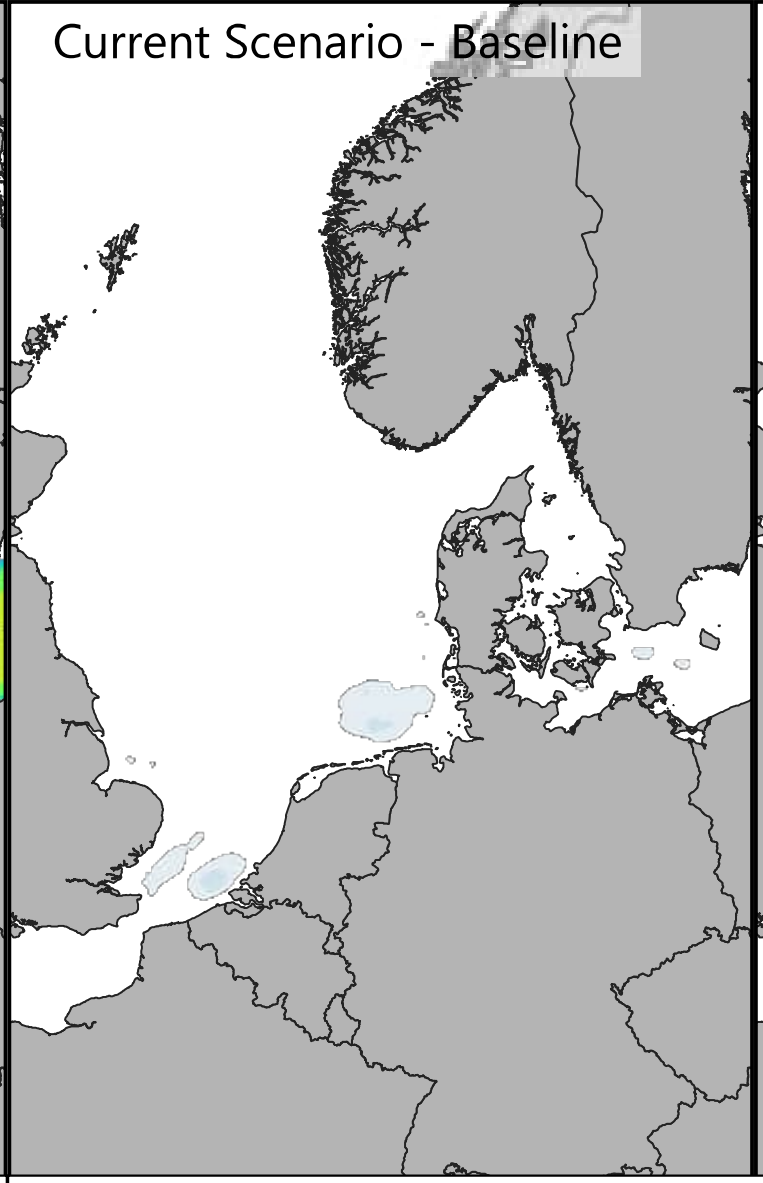
All the figures in Appendix present:

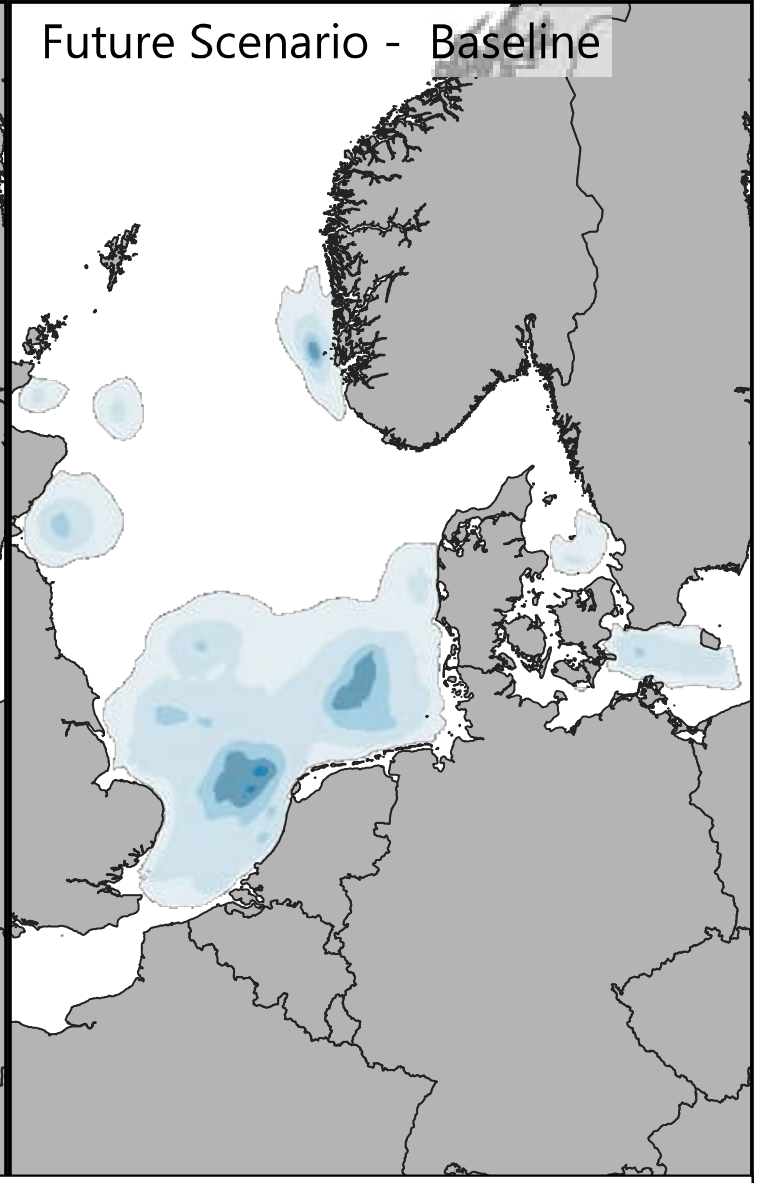
- Left: Baseline - averaged (monthly or yearly) significant wave height, Hm0, simulated without wind farms within the domain,

- Mid: Difference between the averaged Hm0 simulated with the Current scenario and the Baseline scenario,

- Right: Difference between the averaged Hm0 simulated with the Future scenario and the Baseline scenario.







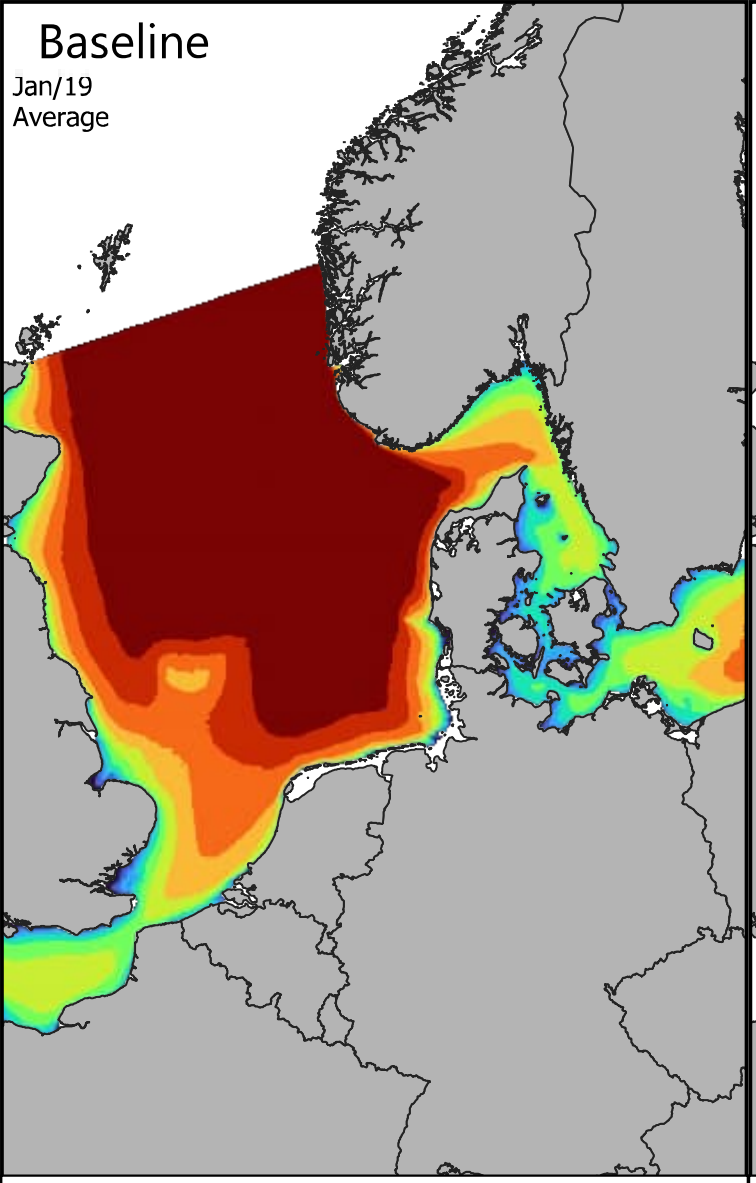
Signignificant Wave Height [m]

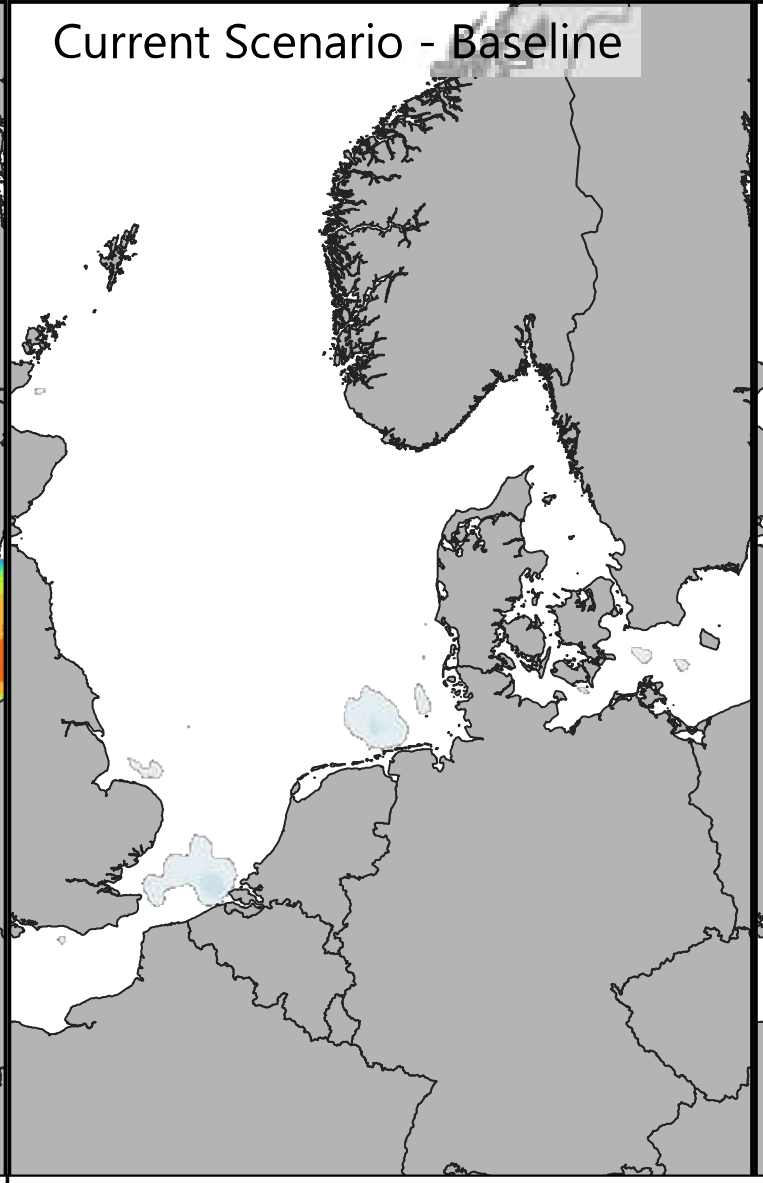
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

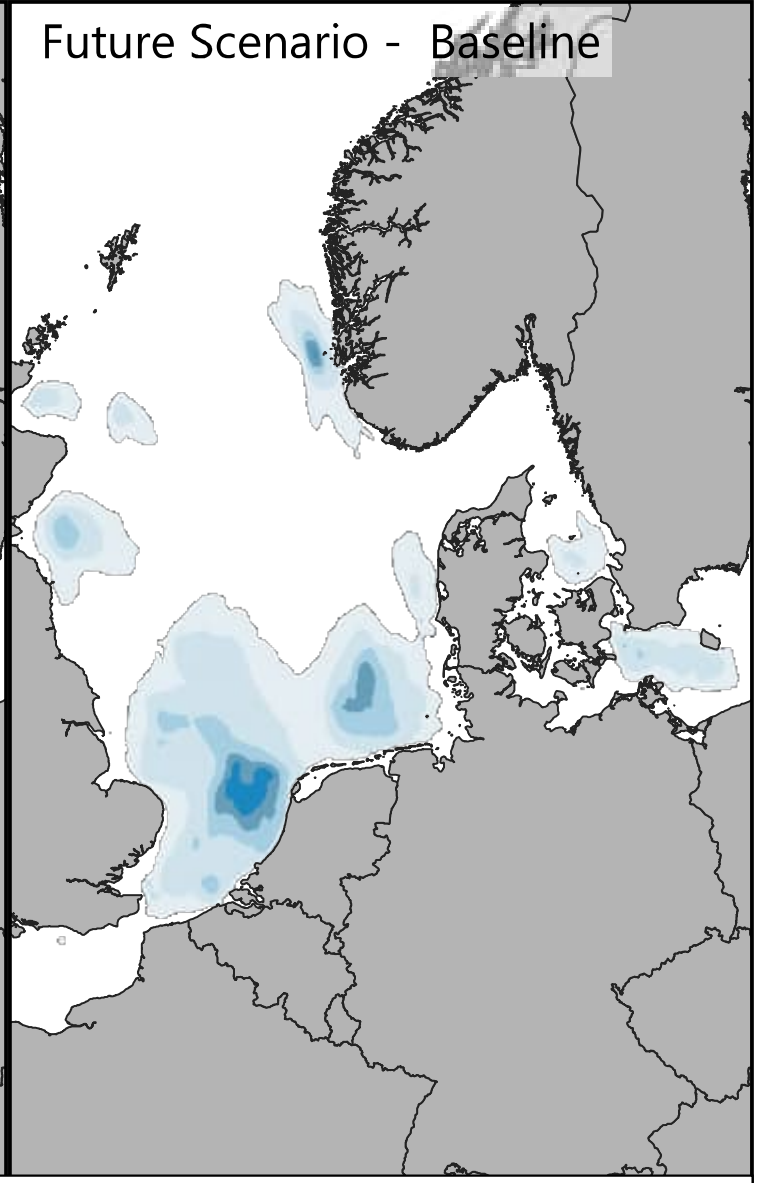
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







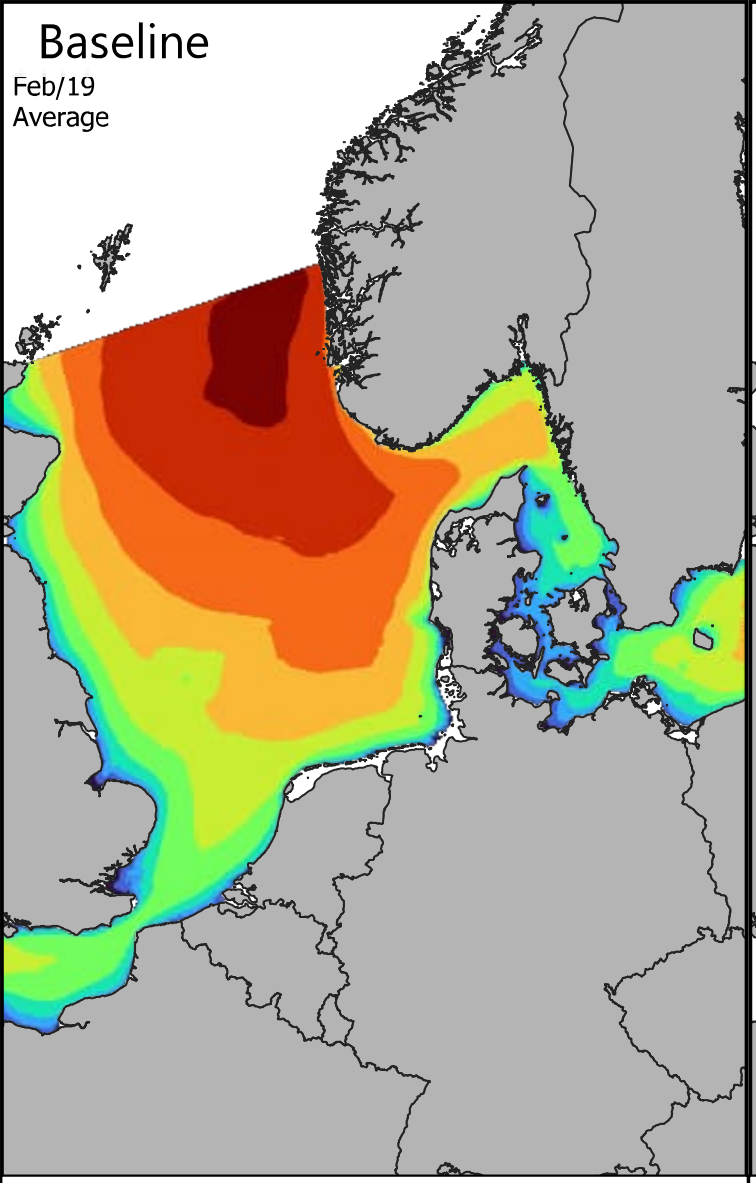
Signignificant Wave Height [m]

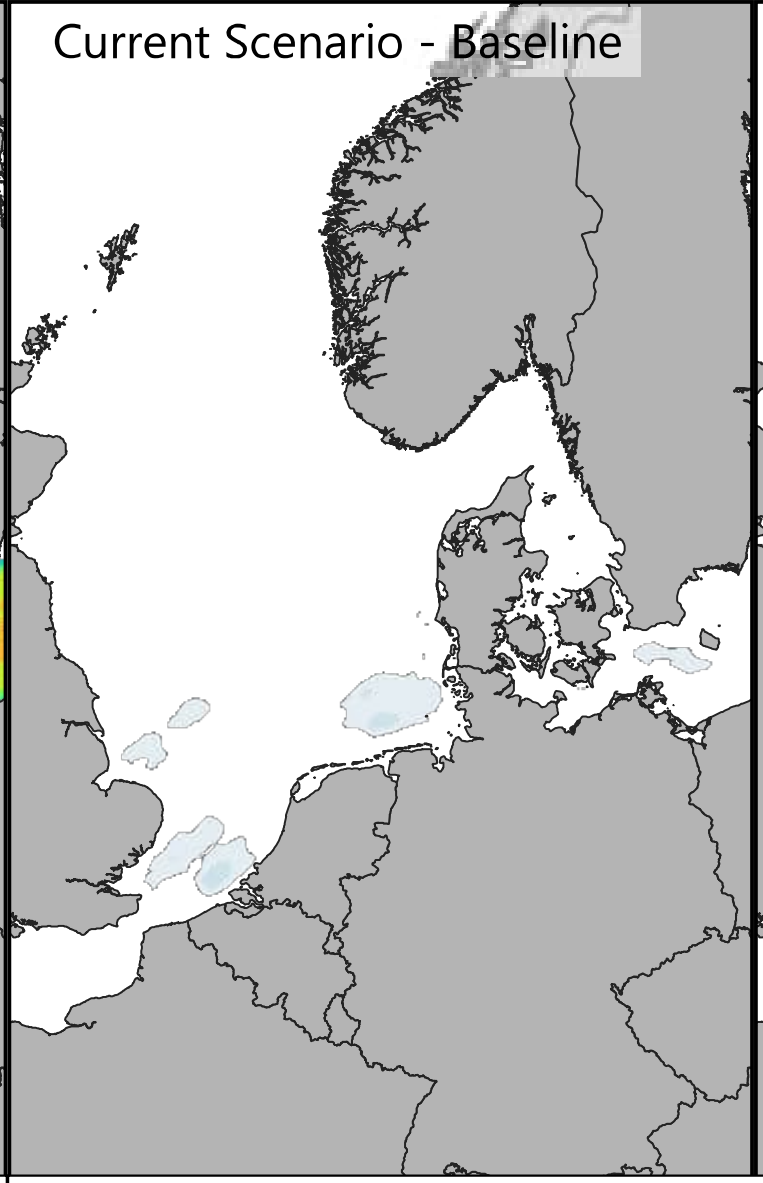
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

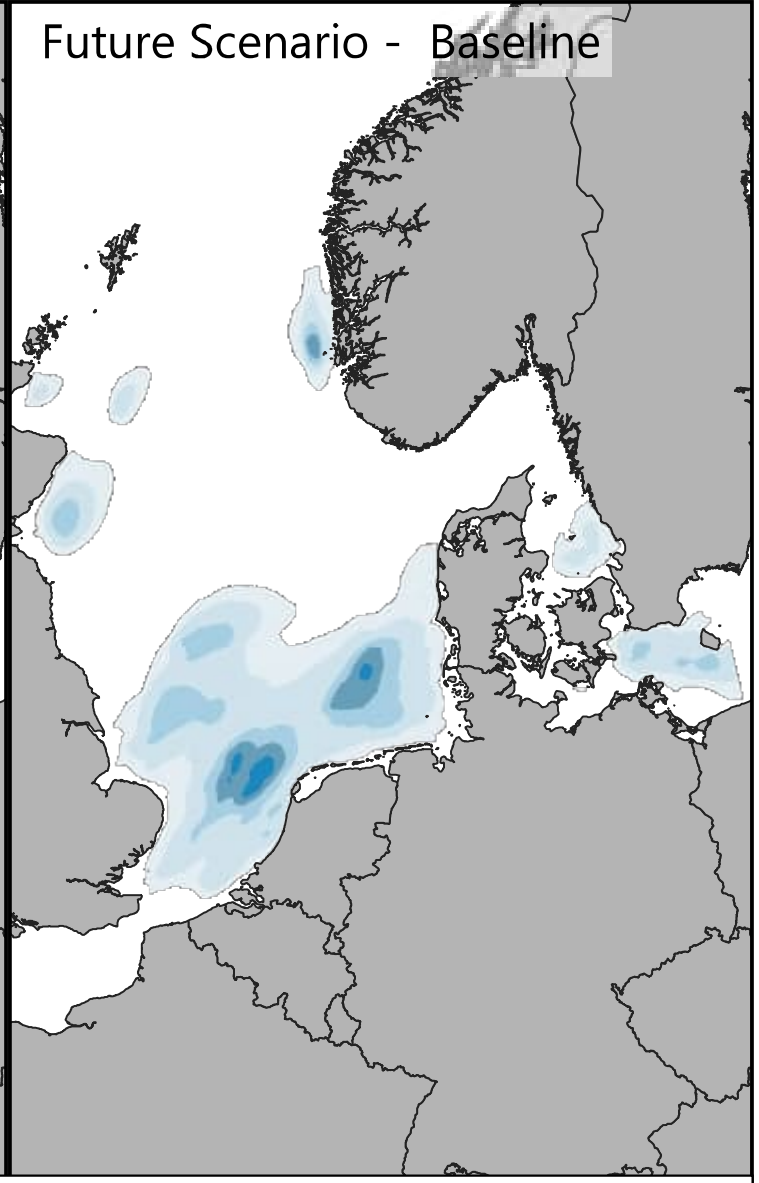
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







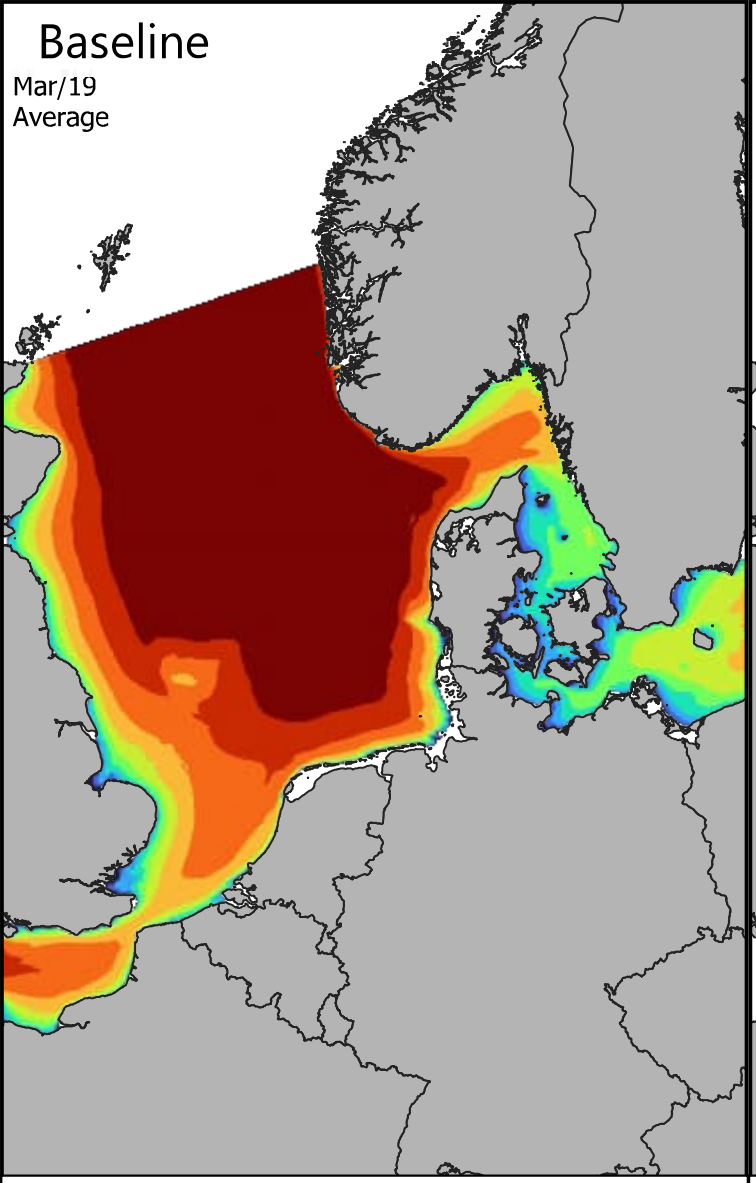
Signignificant Wave Height [m]

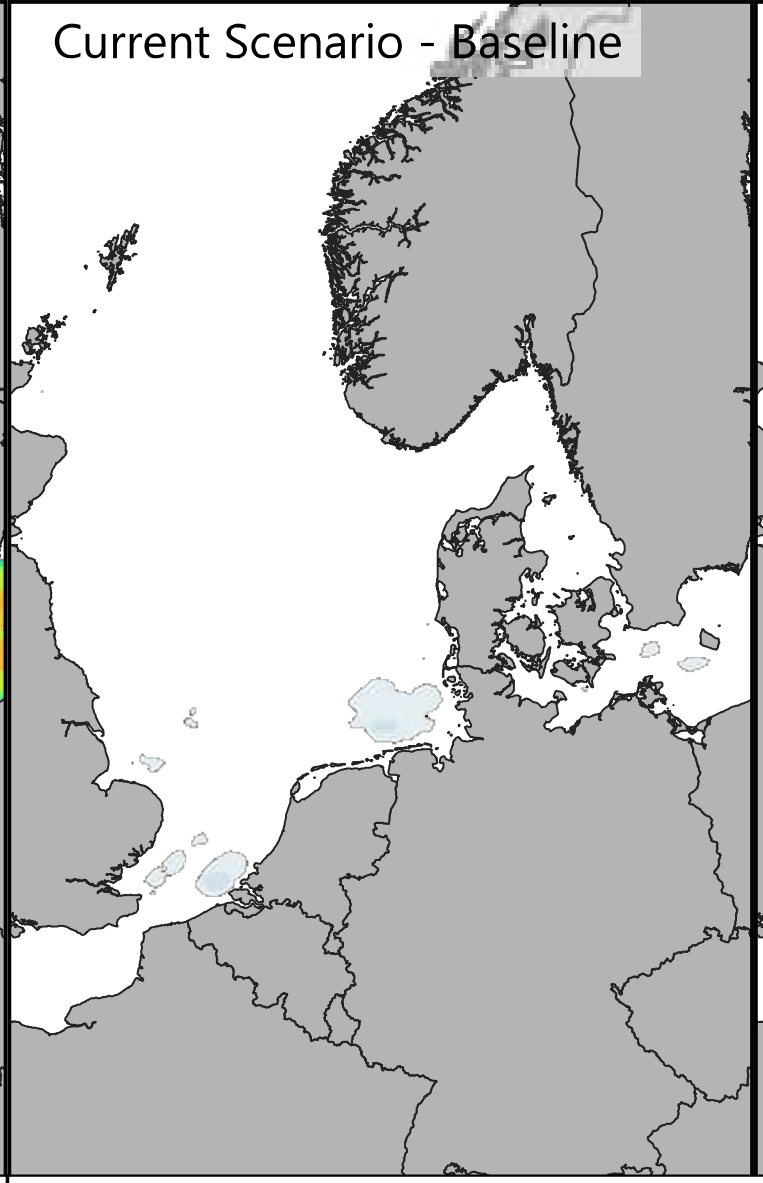
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

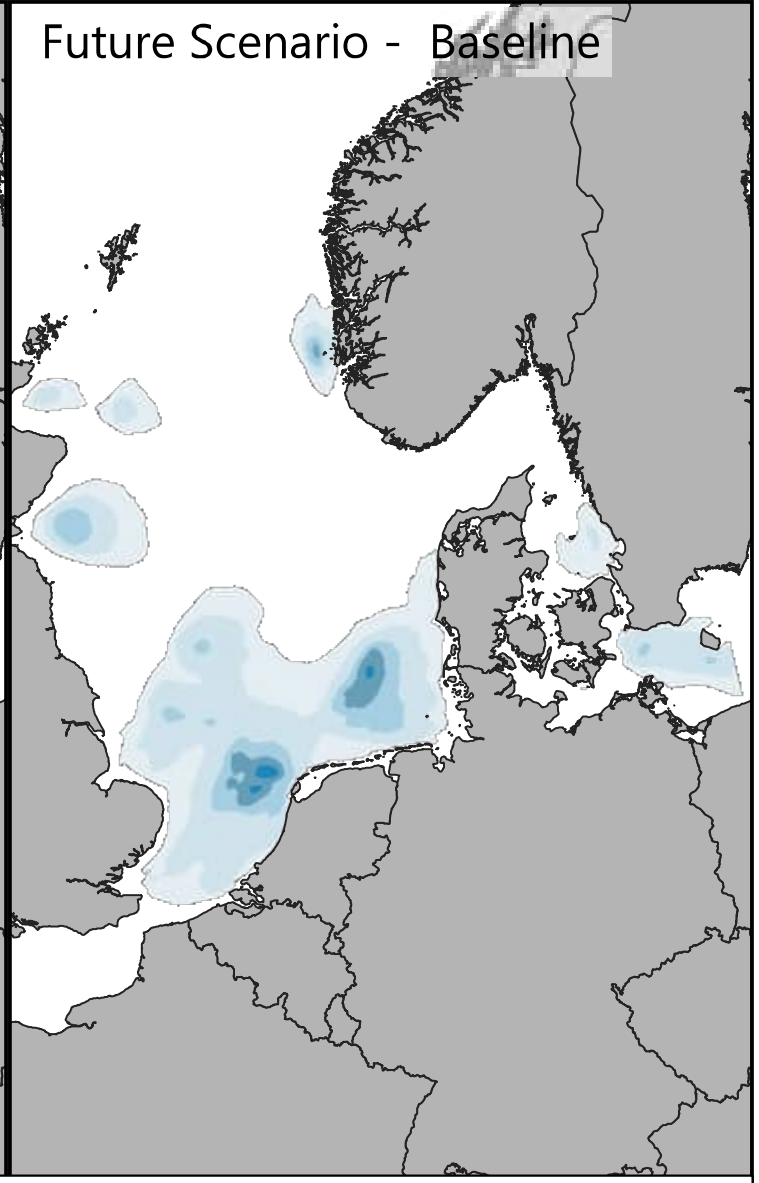
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







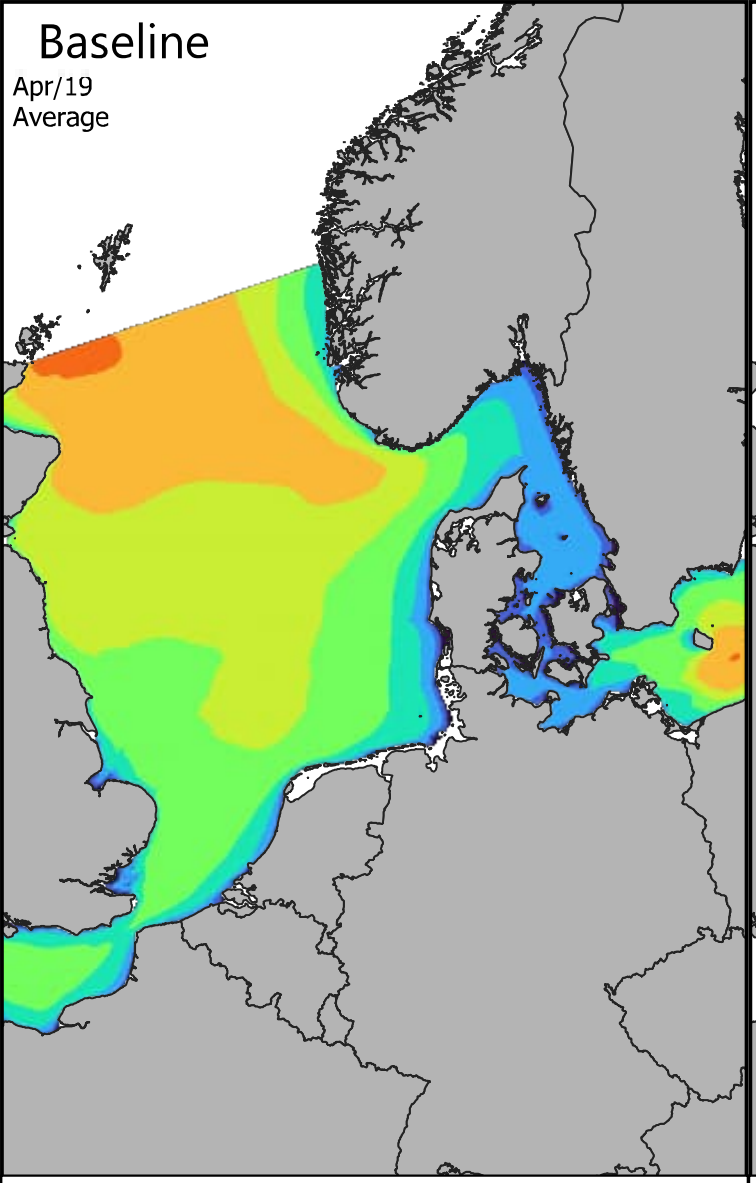
Signignificant Wave Height [m]

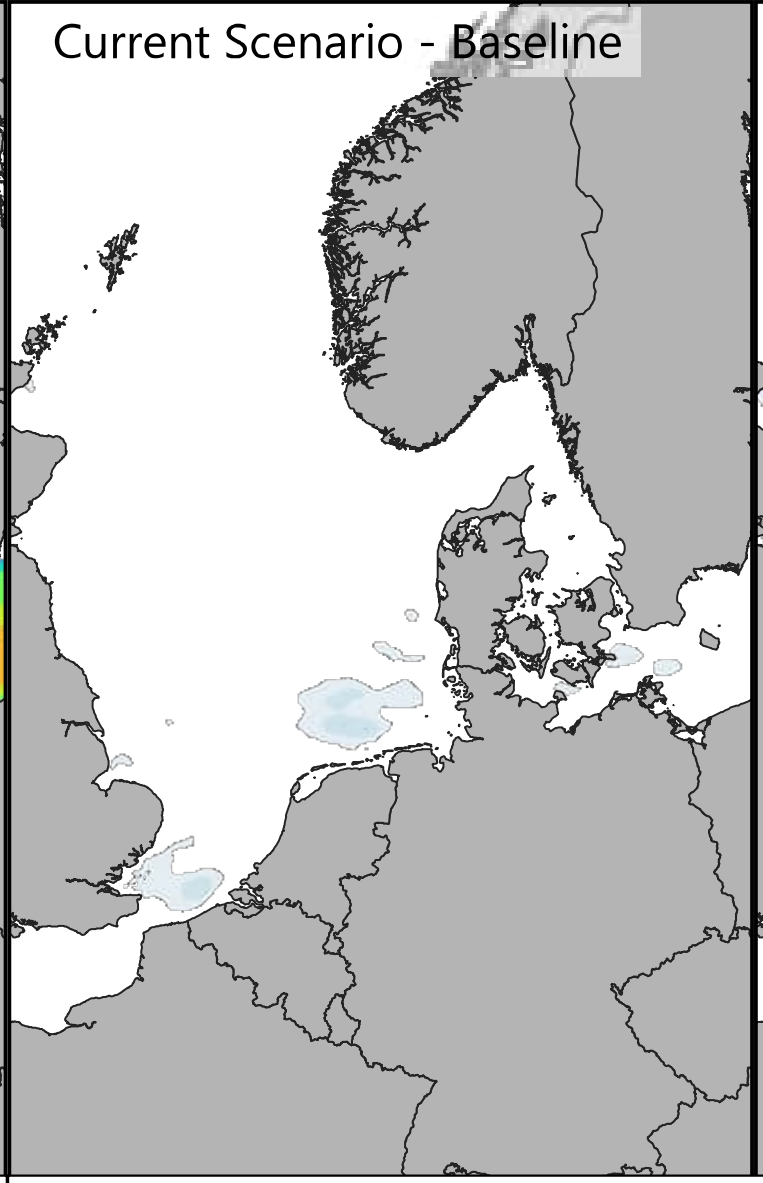
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

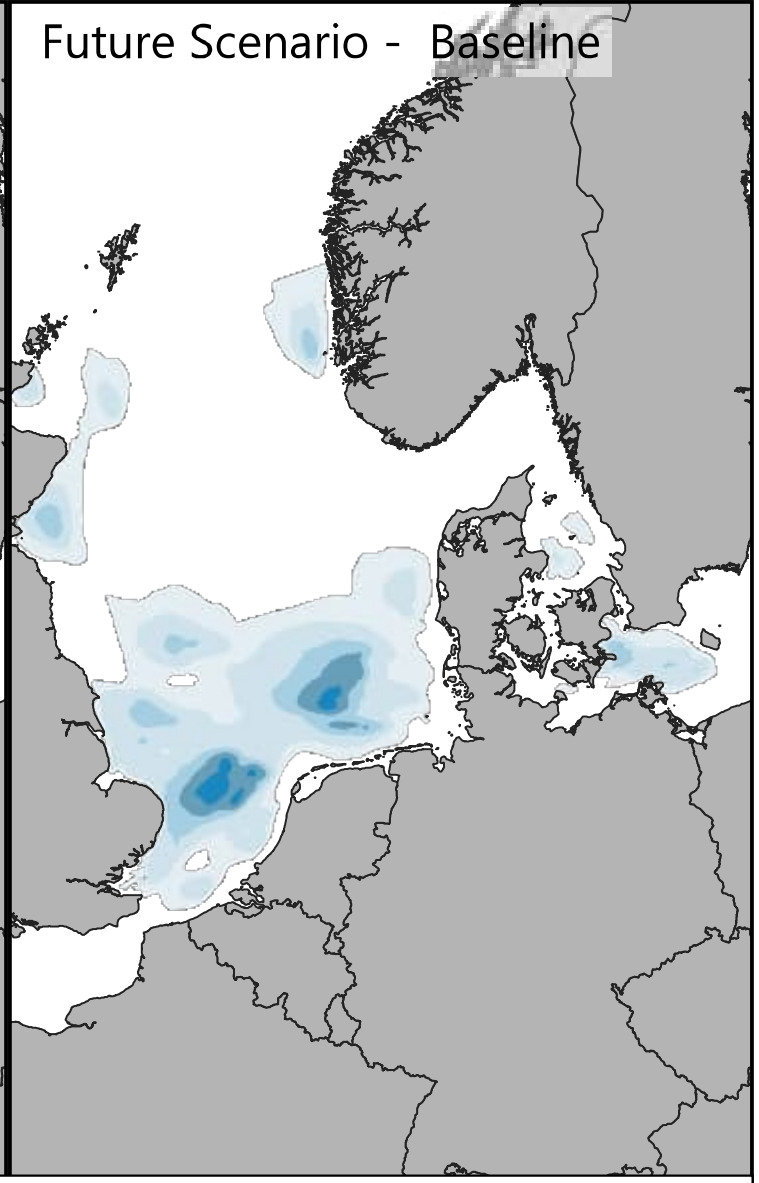
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







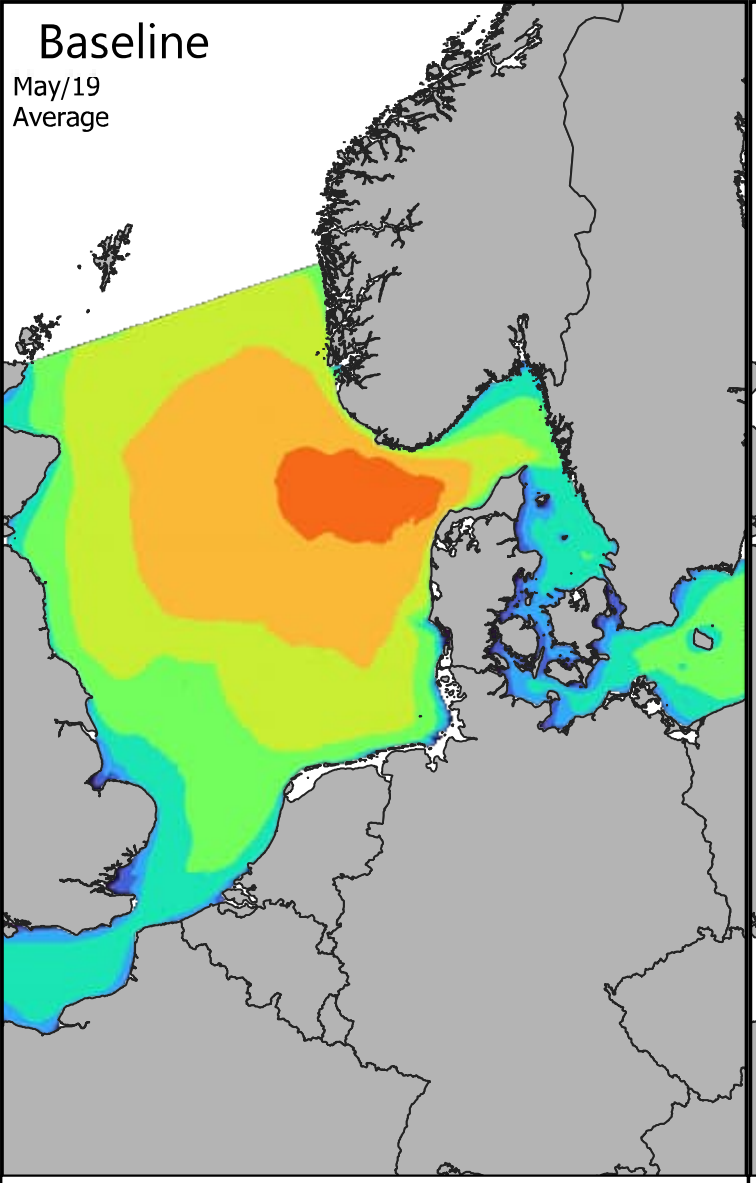
Signignificant Wave Height [m]

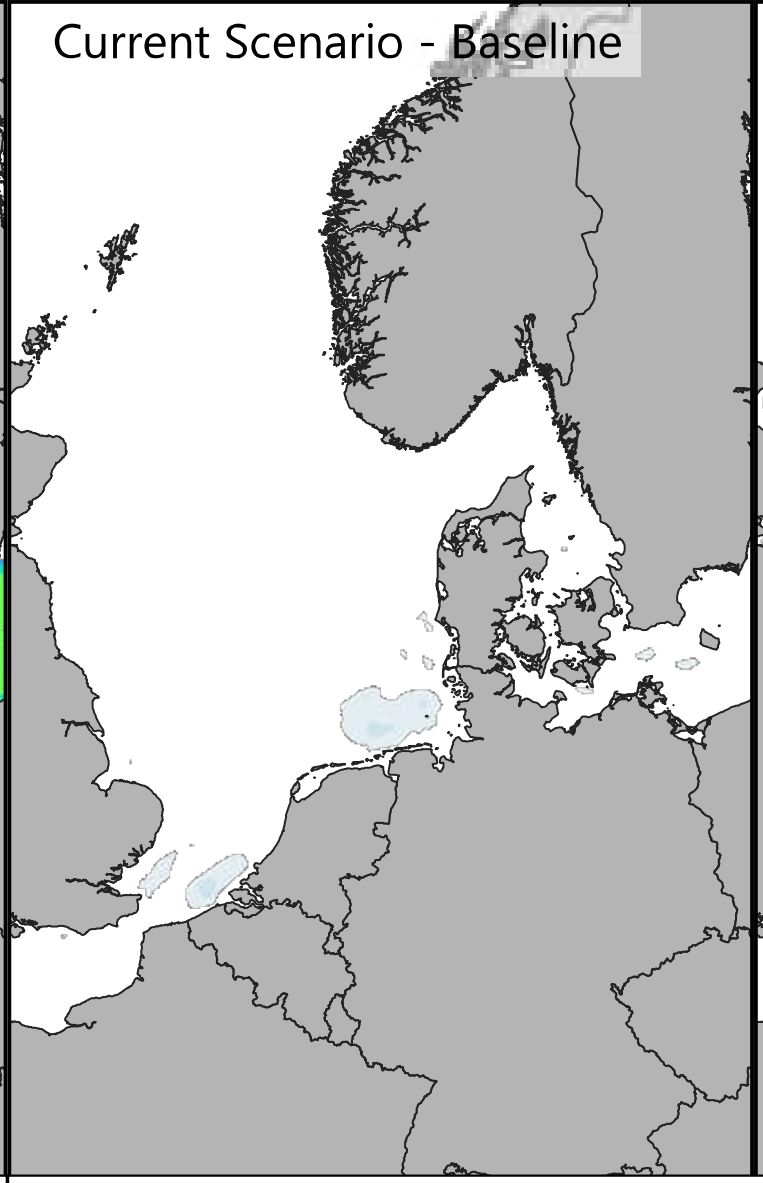
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

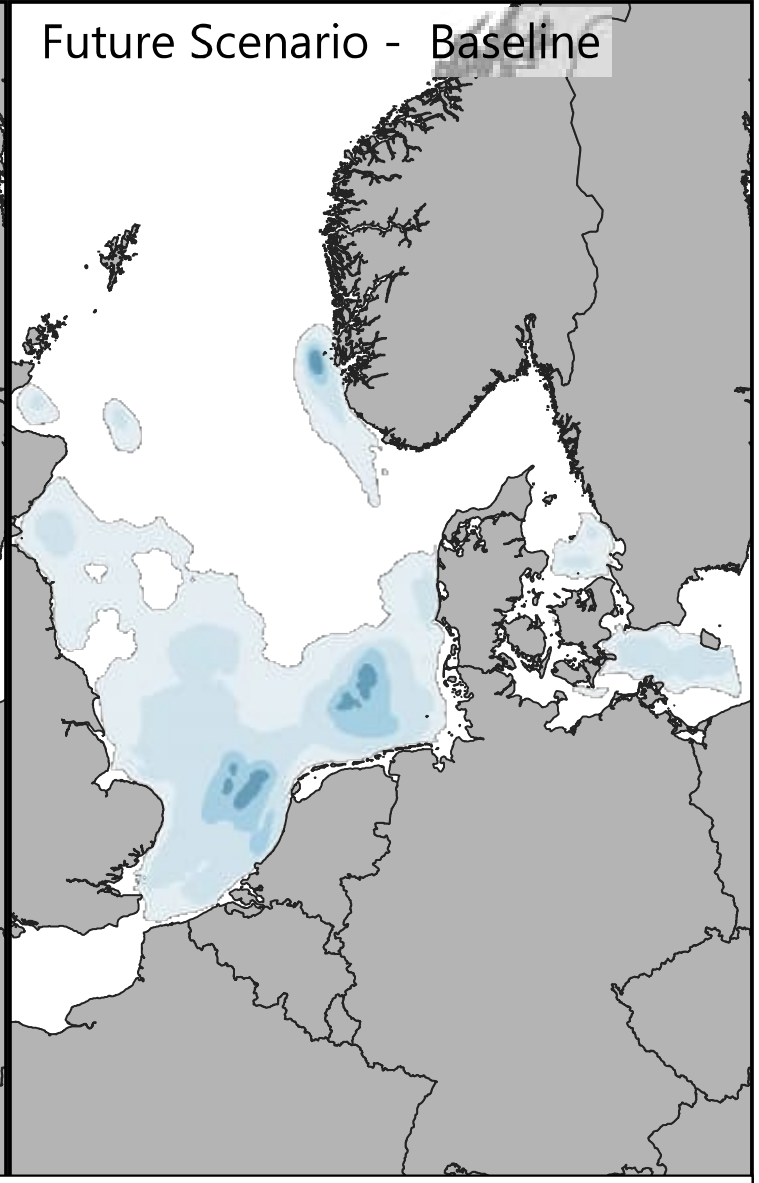
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







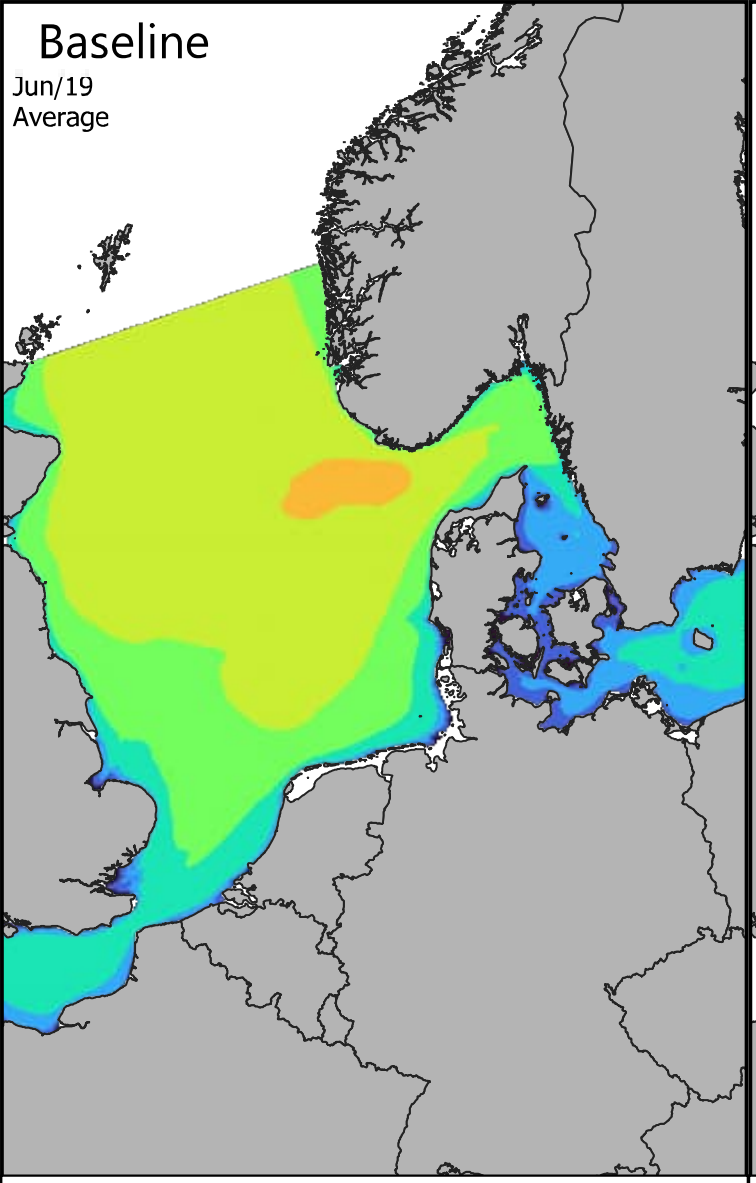
Signignificant Wave Height [m]

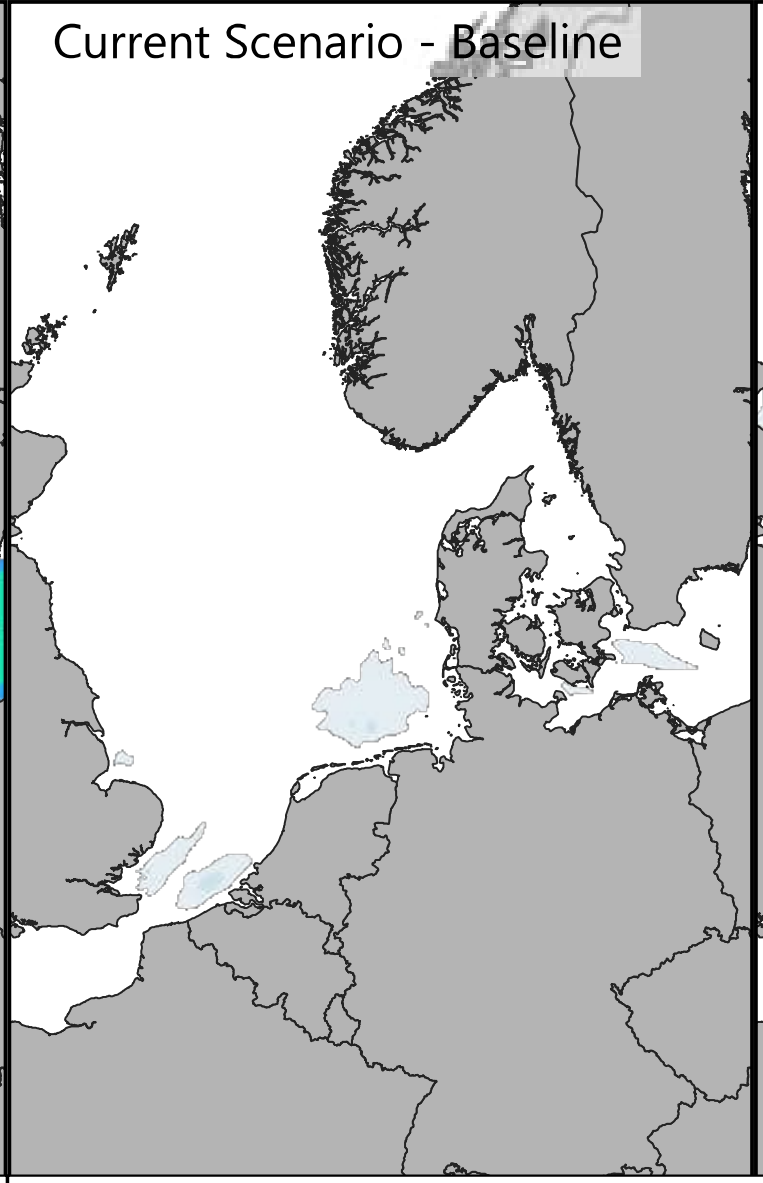
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

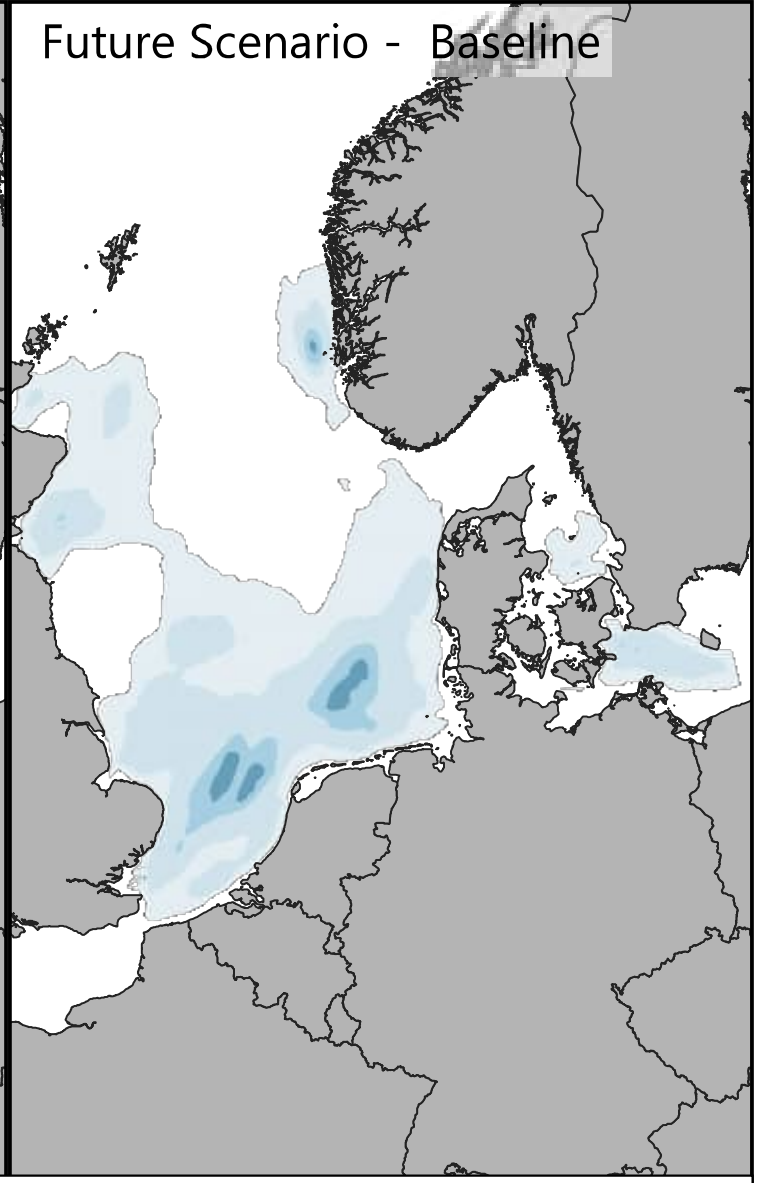
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







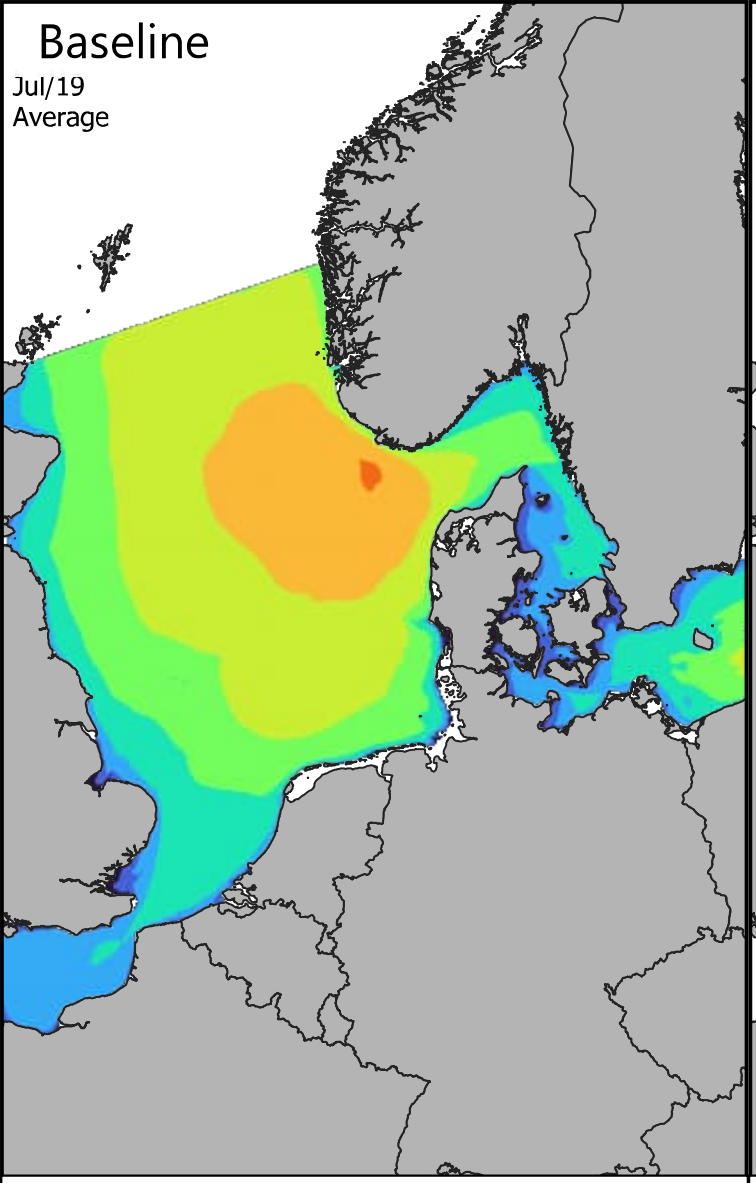
Signignificant Wave Height [m]

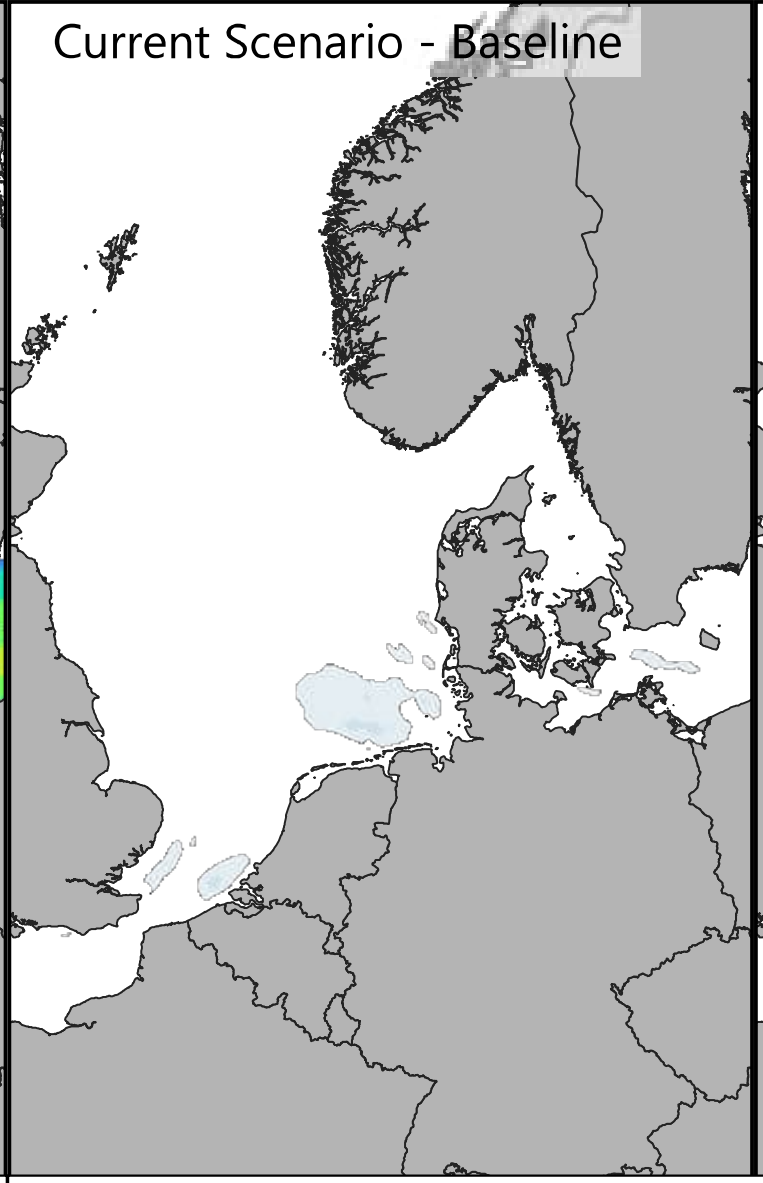
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

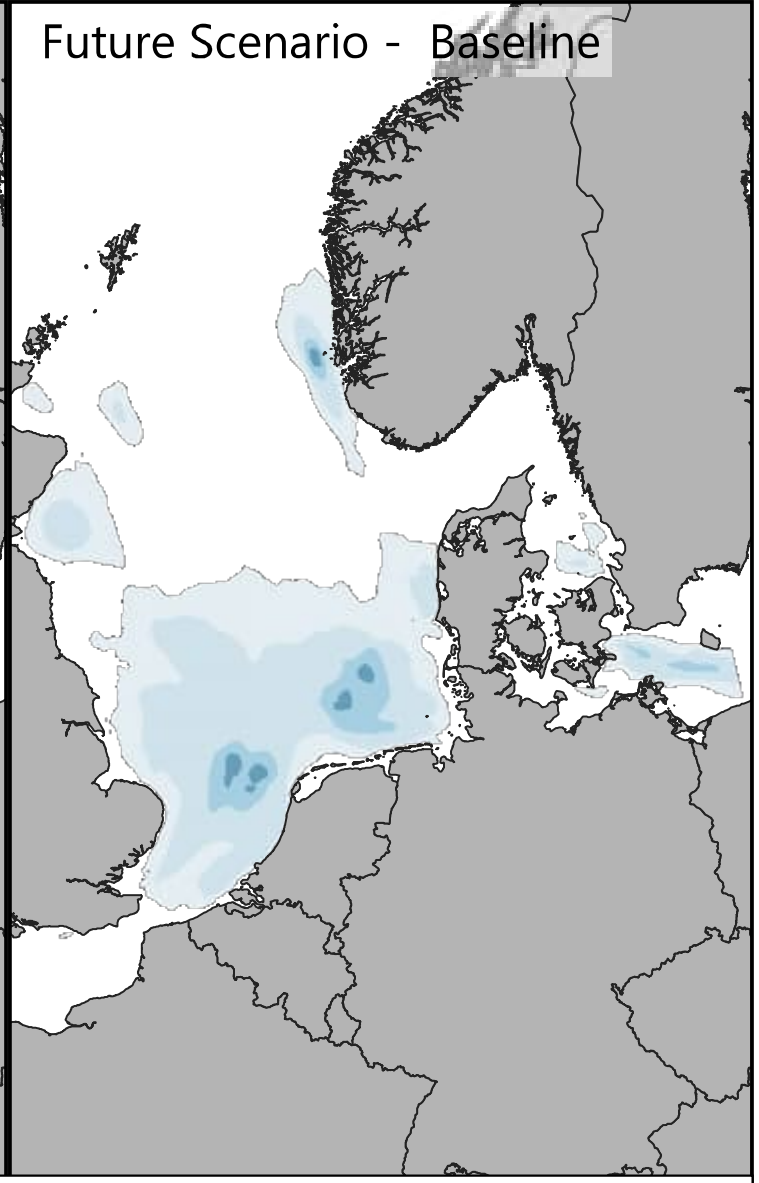
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







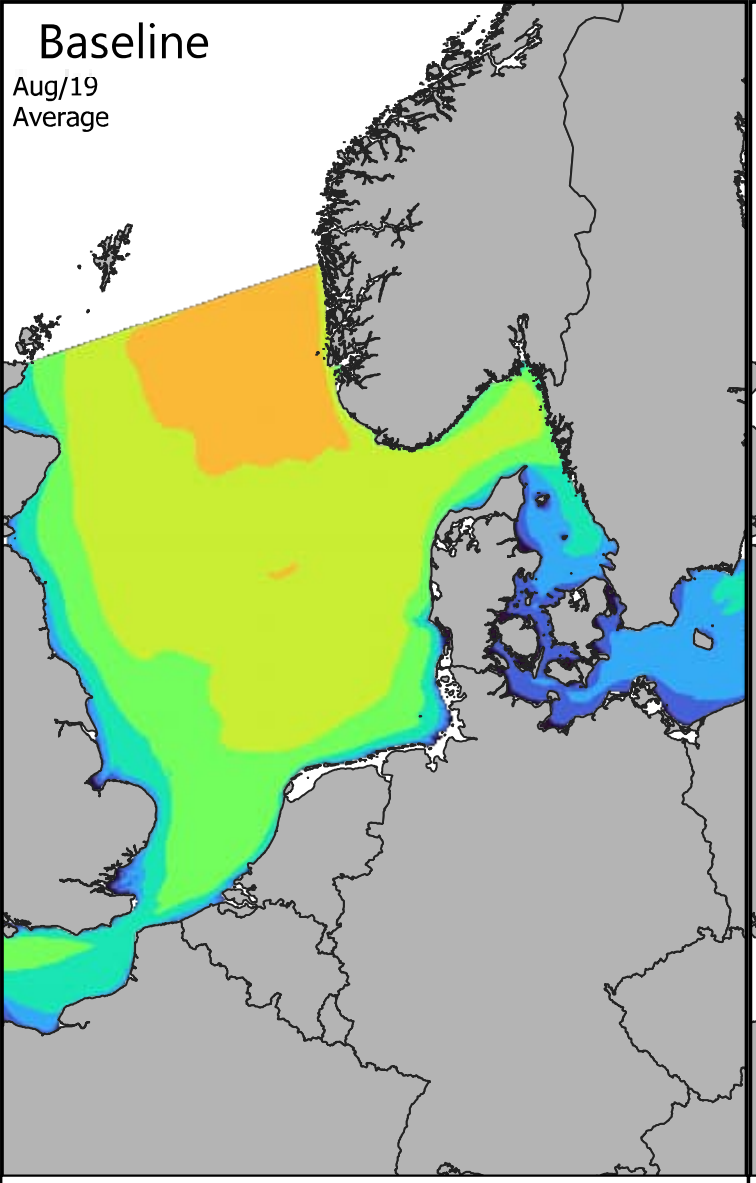
Signignificant Wave Height [m]

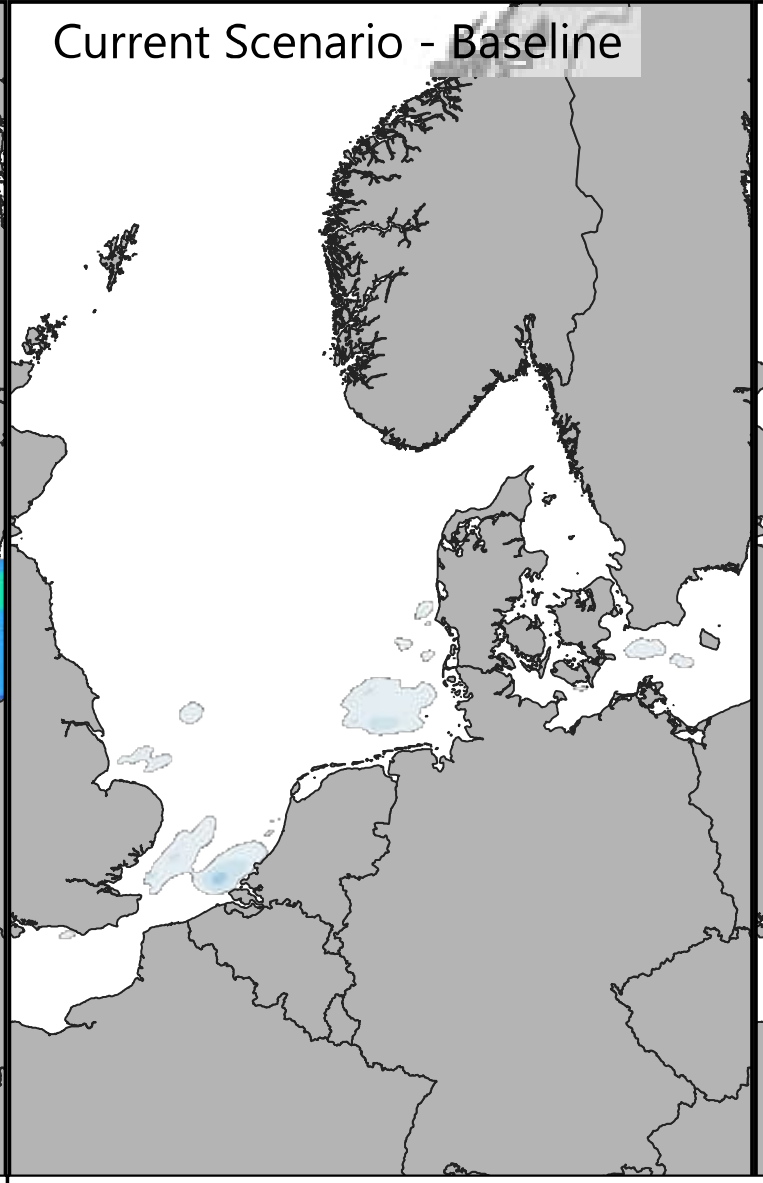
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

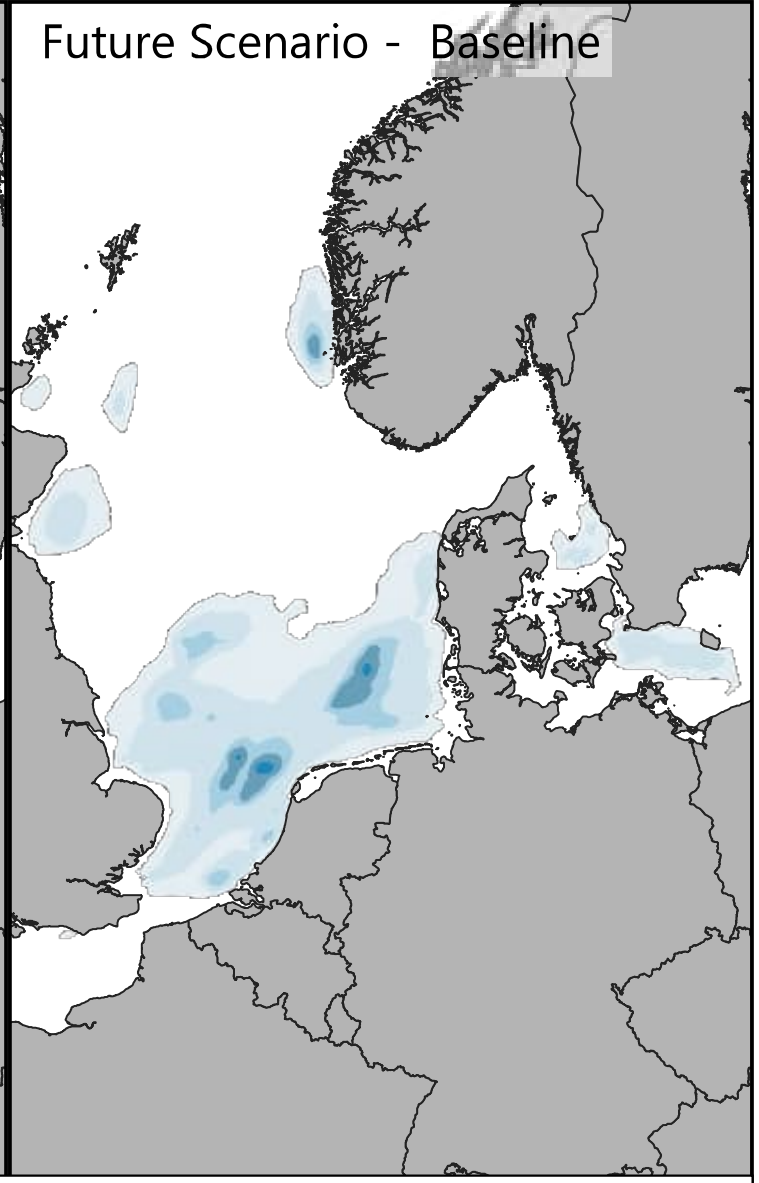
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







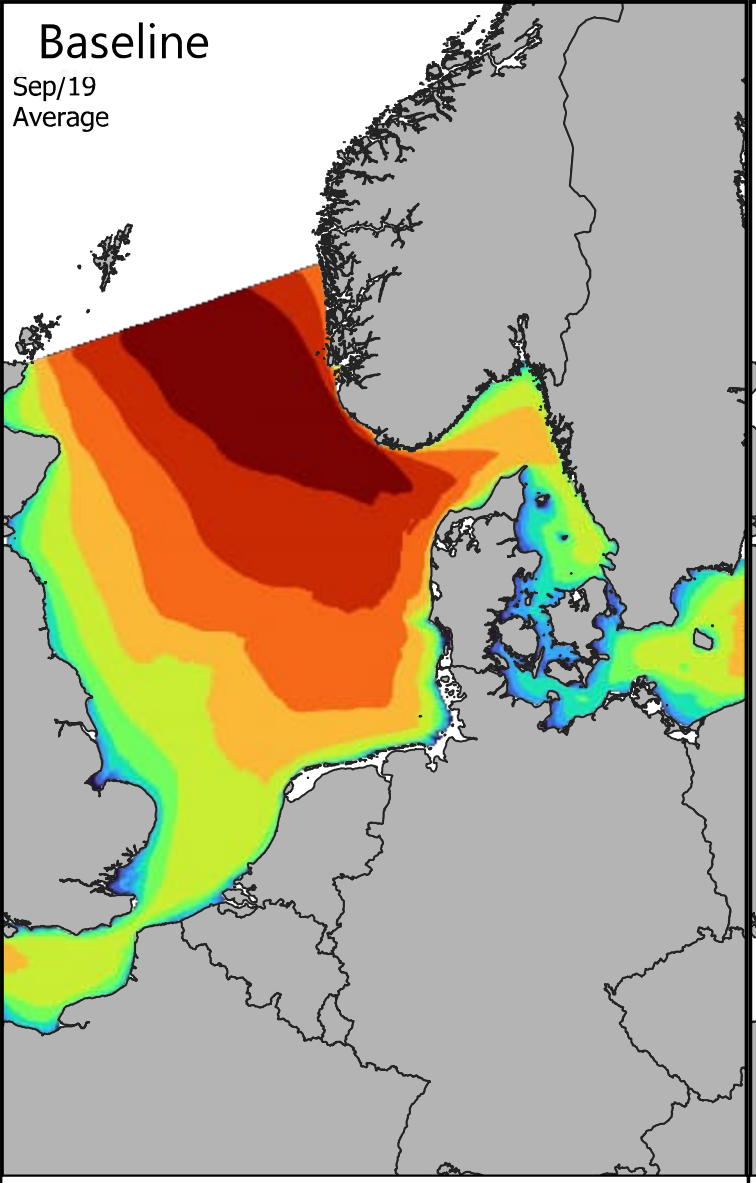
Signignificant Wave Height [m]

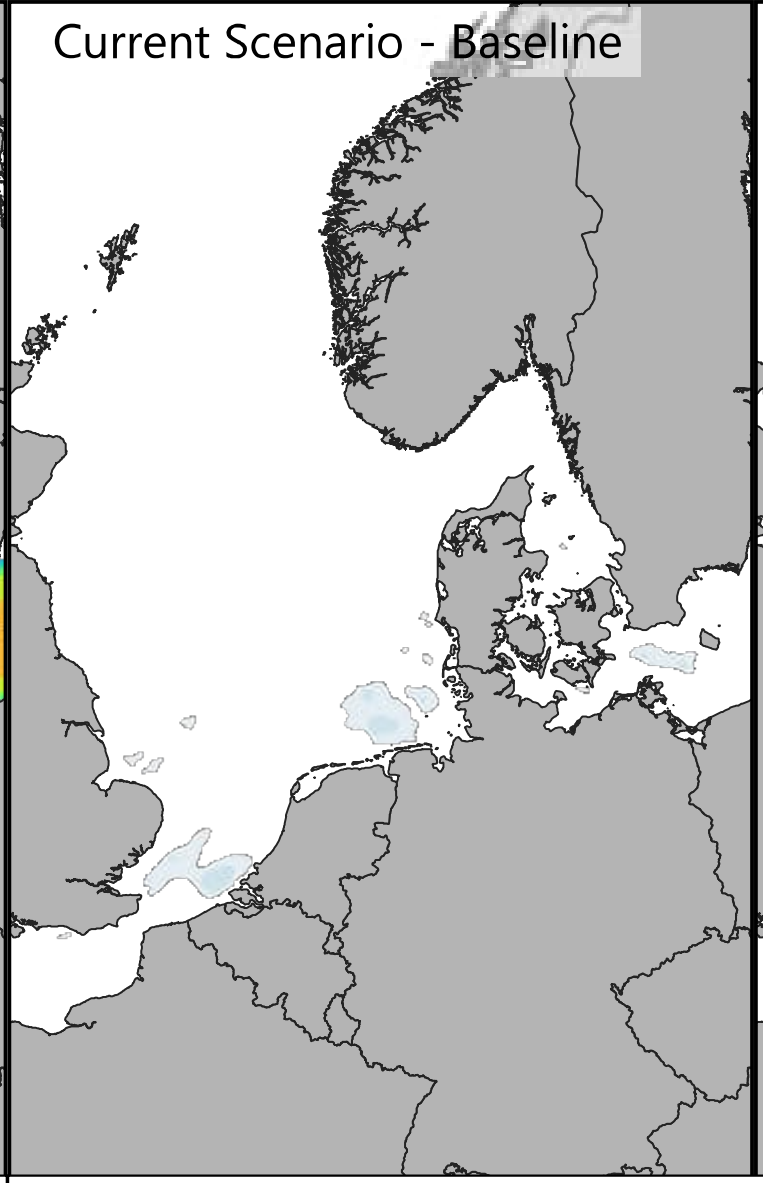
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

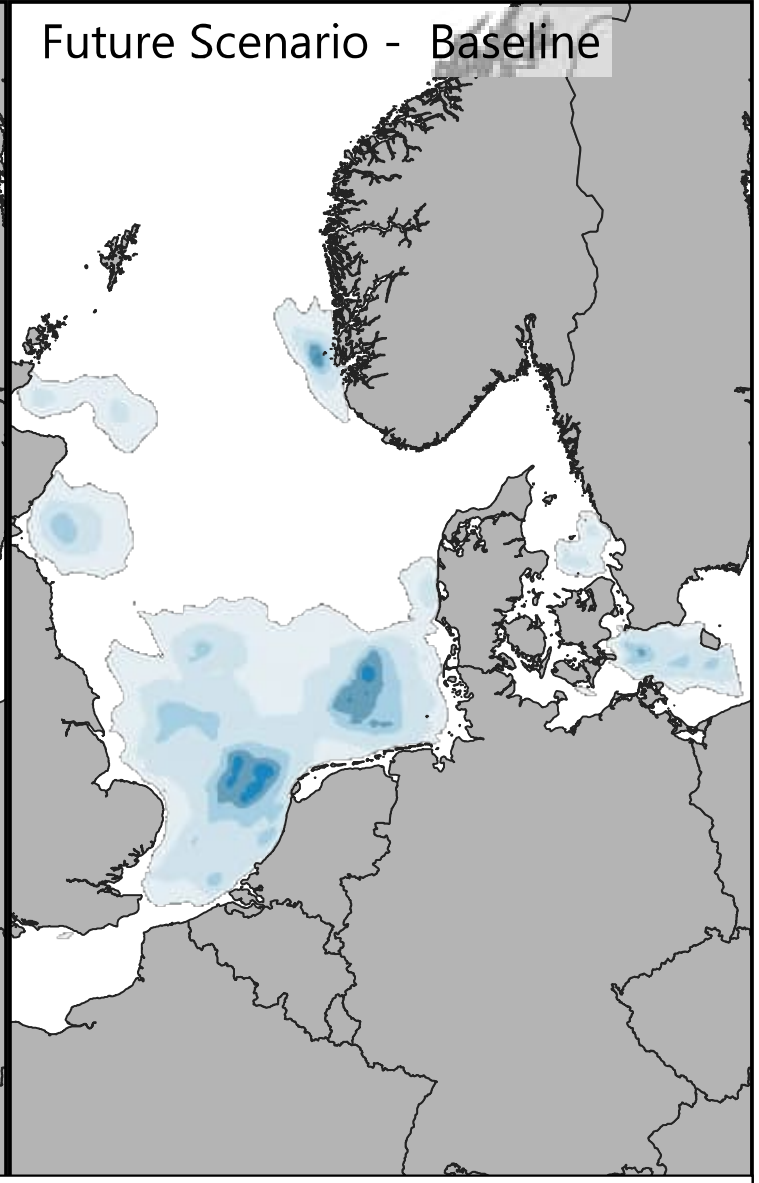
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







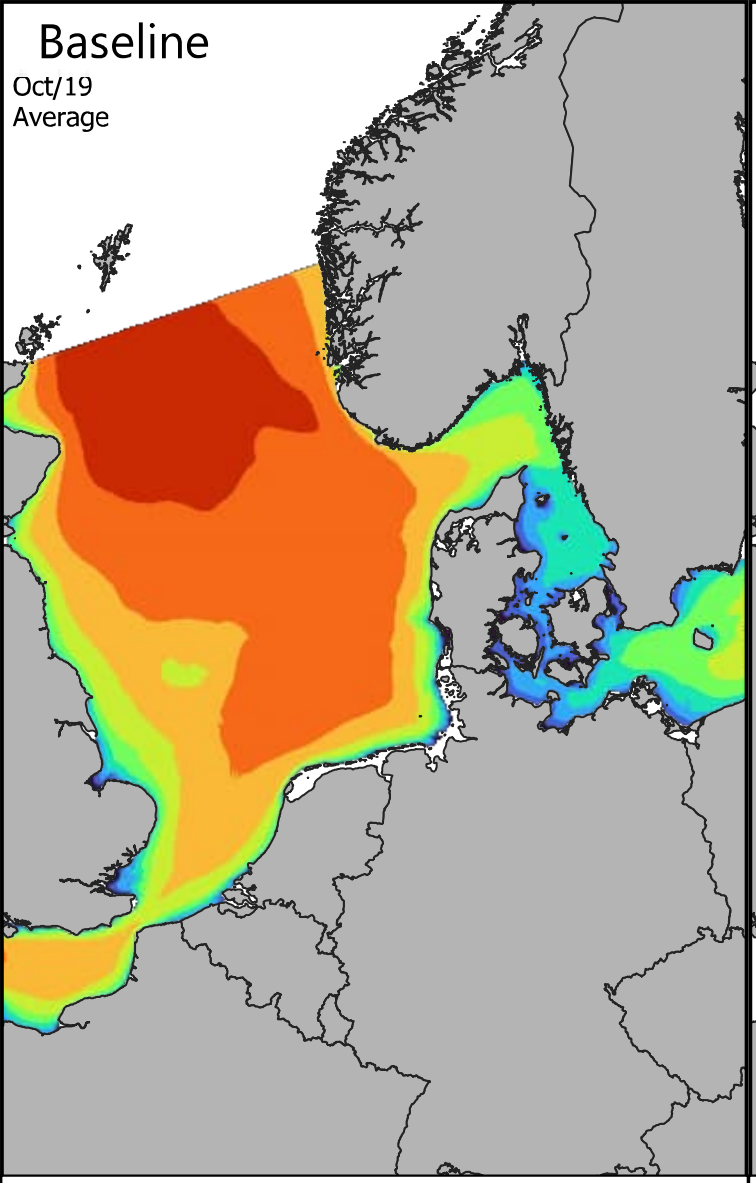
Signignificant Wave Height [m]

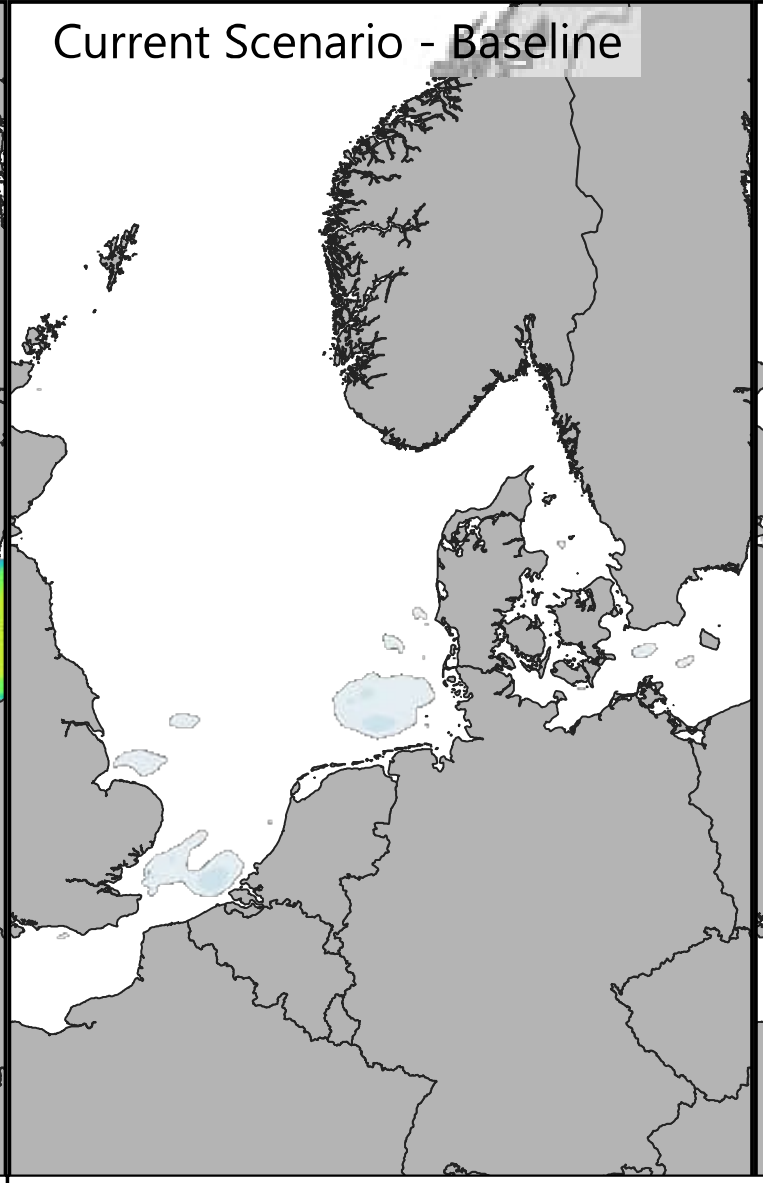
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

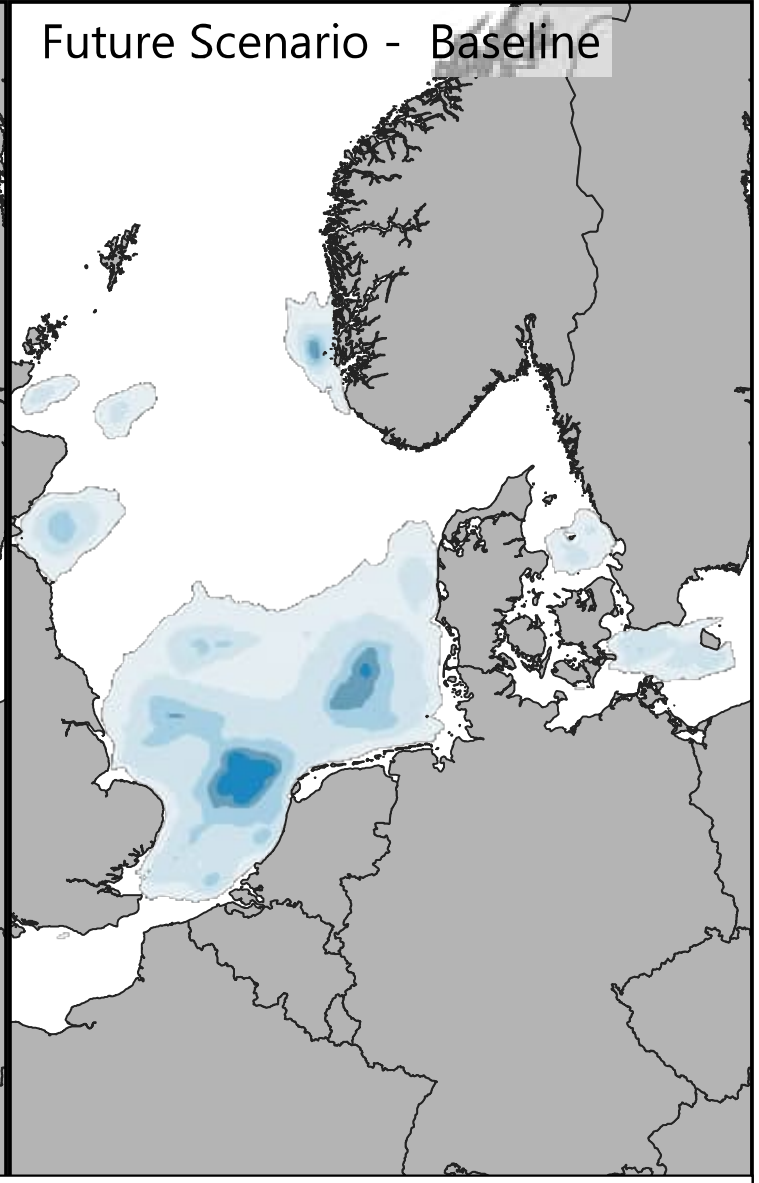
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







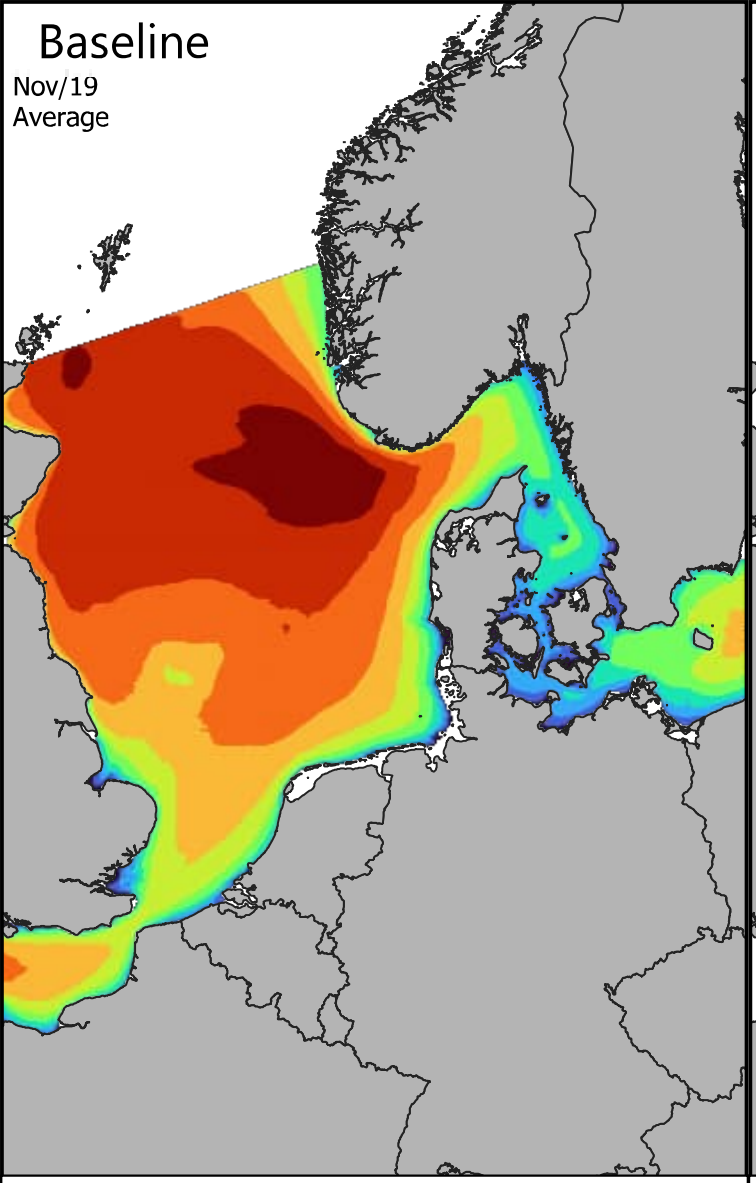
Signignificant Wave Height [m]

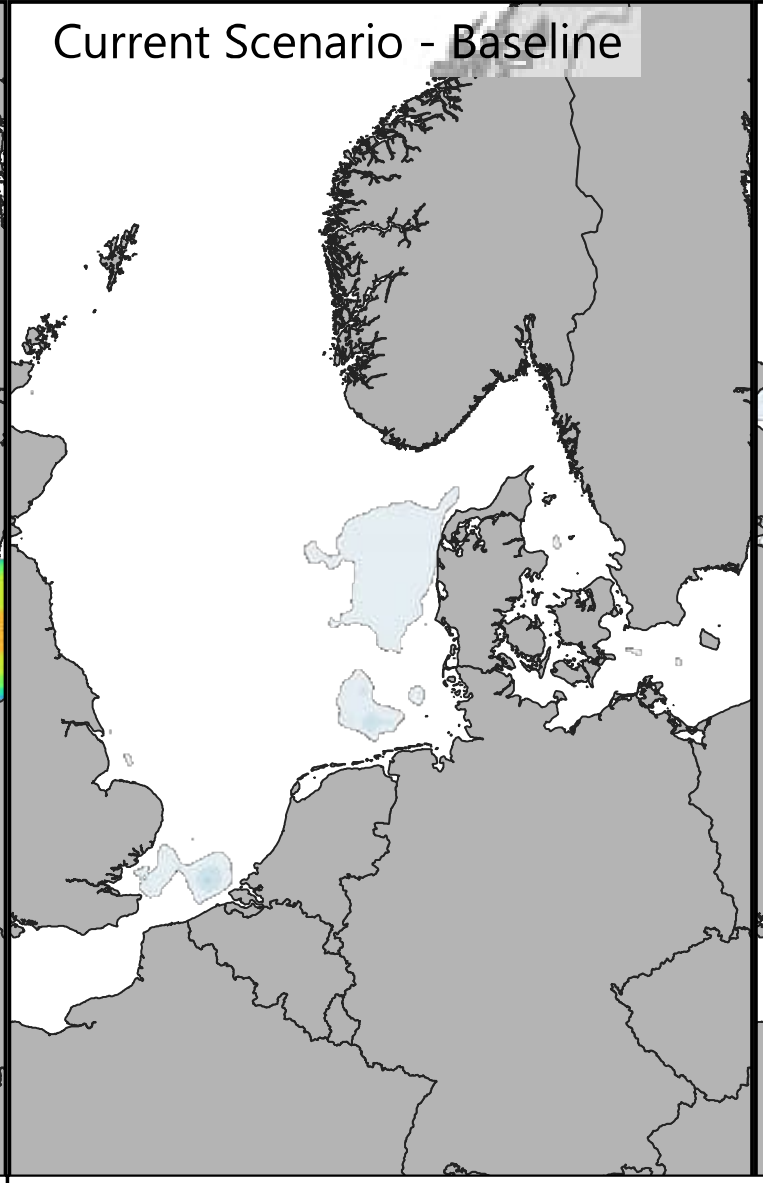
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

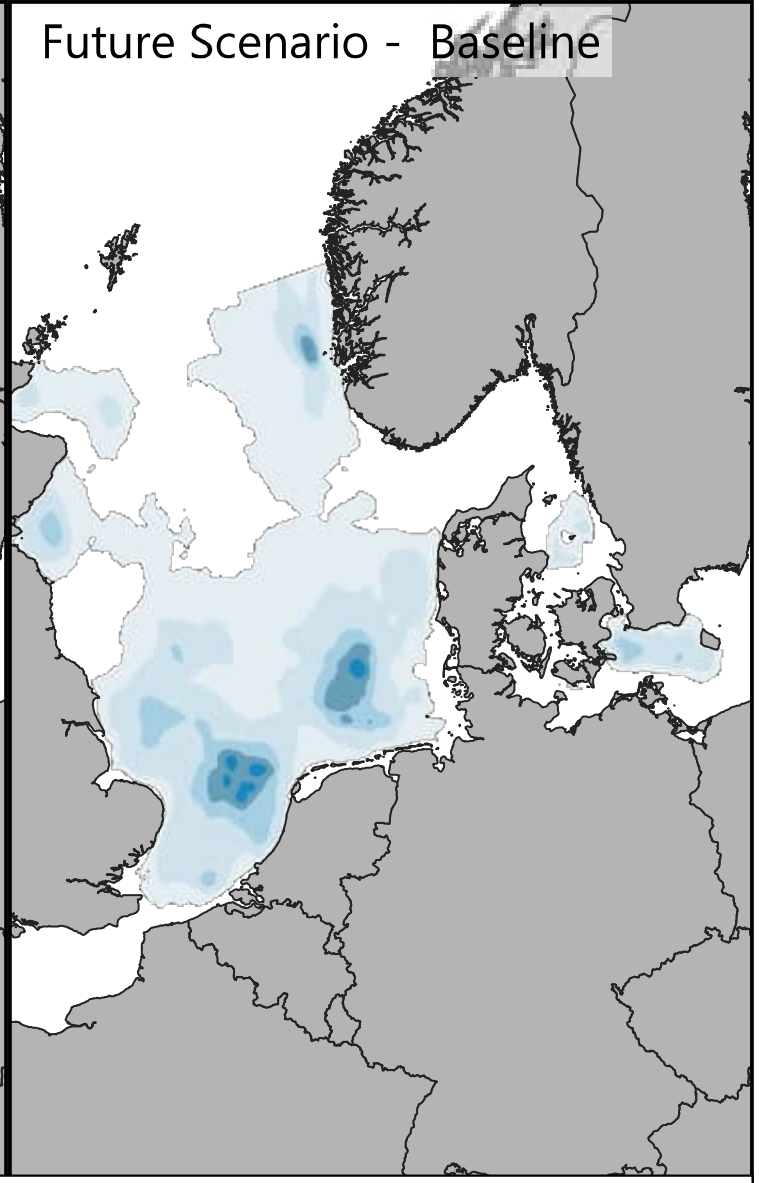
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







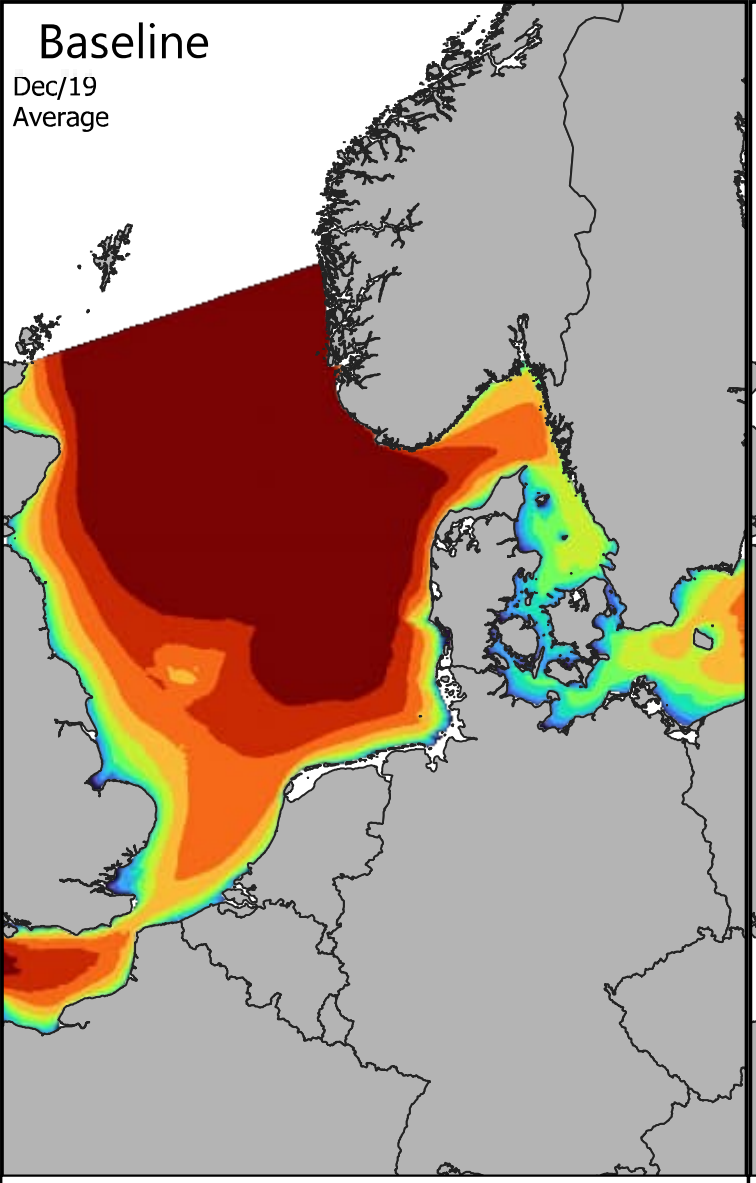
Signignificant Wave Height [m]

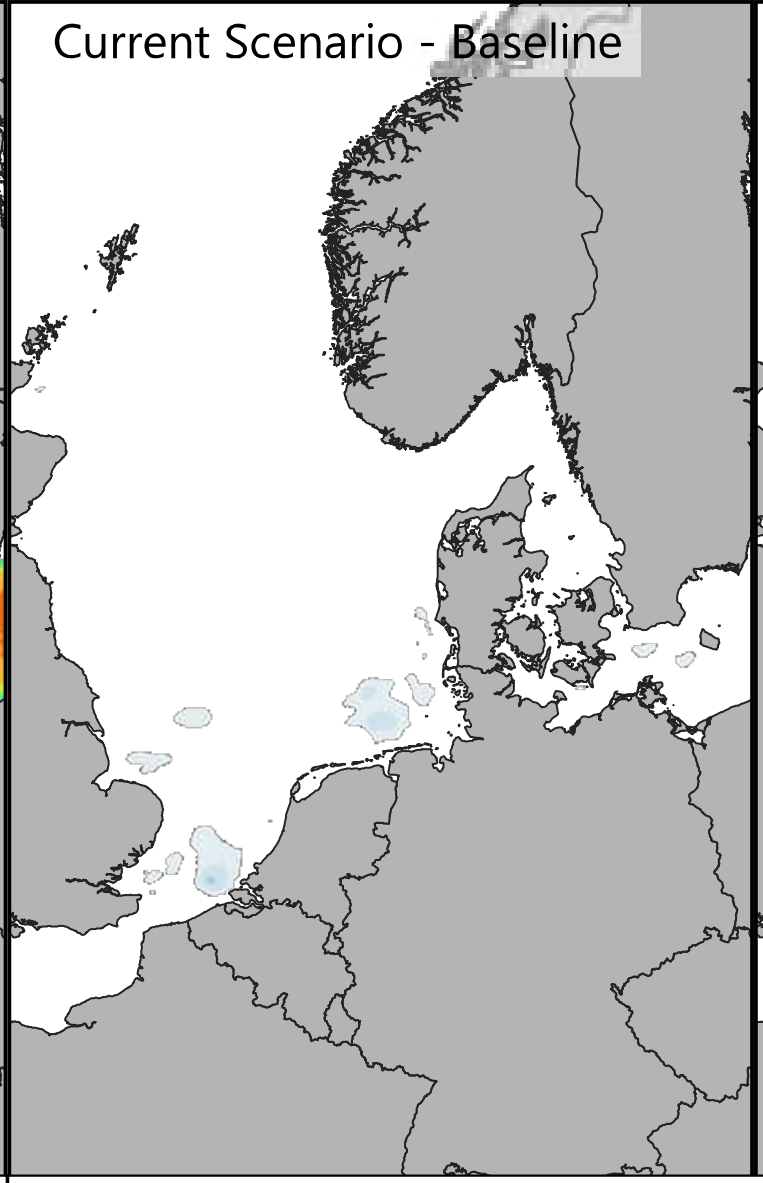
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

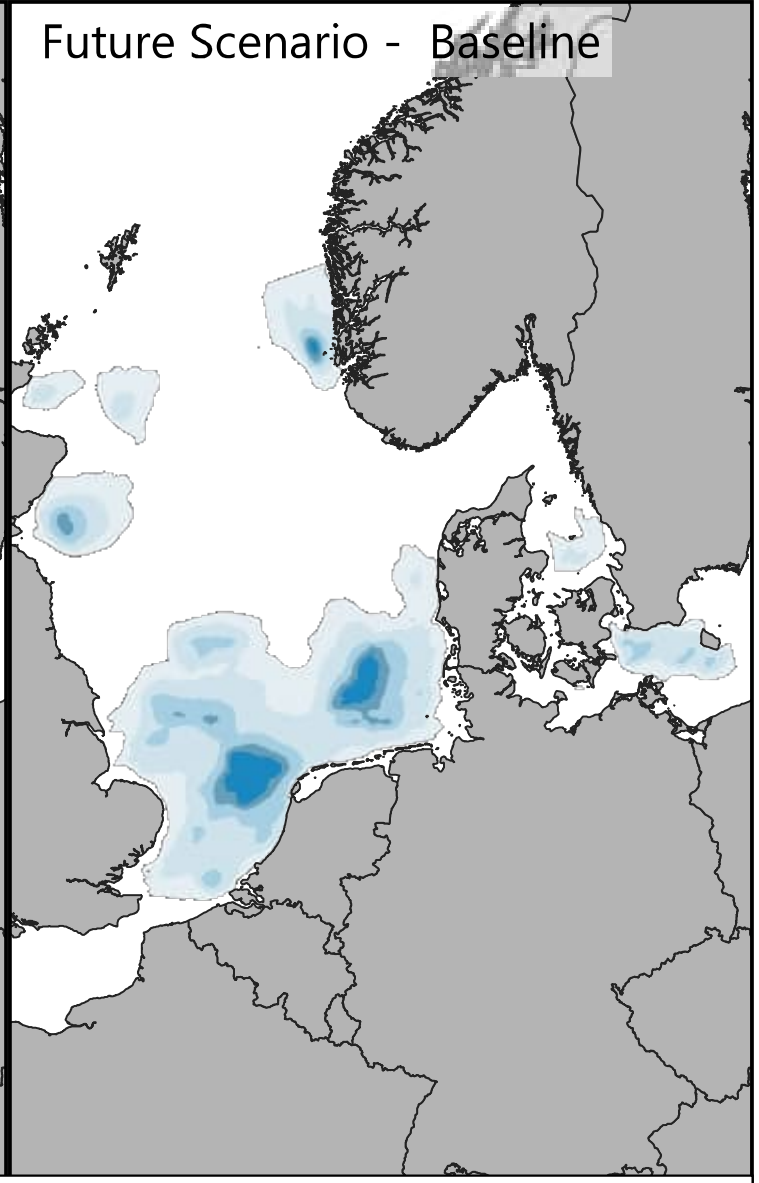
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







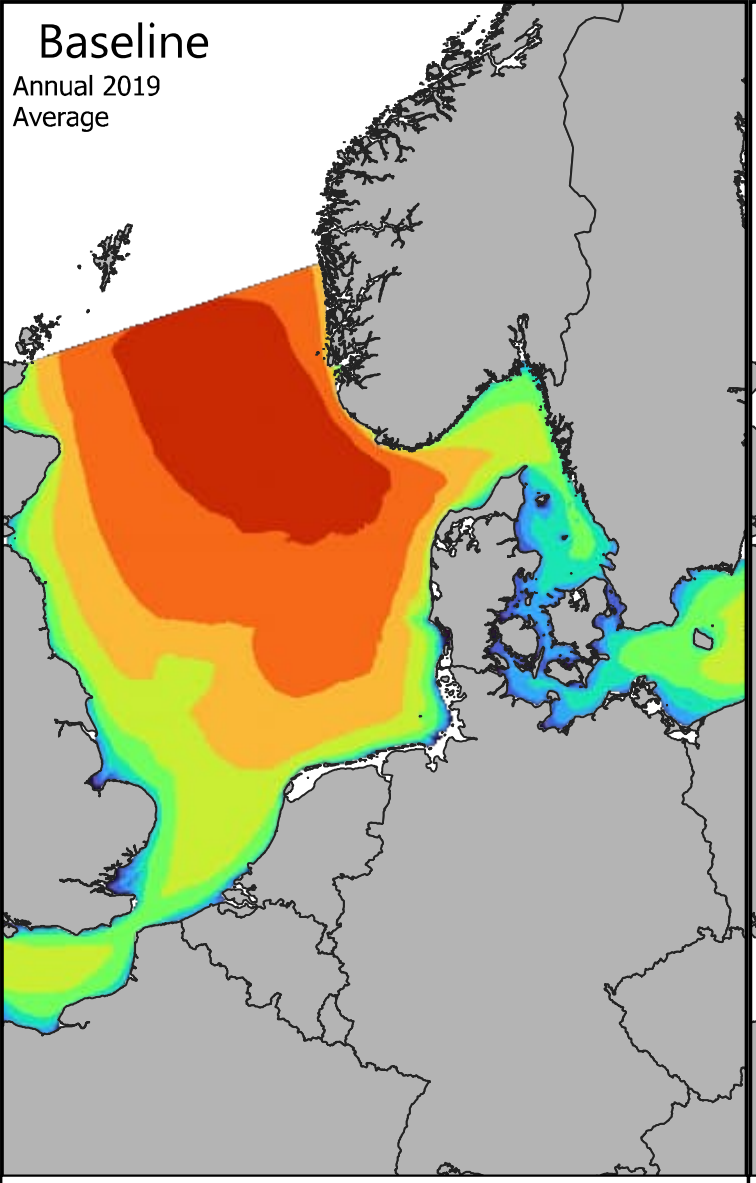
Signignificant Wave Height [m]

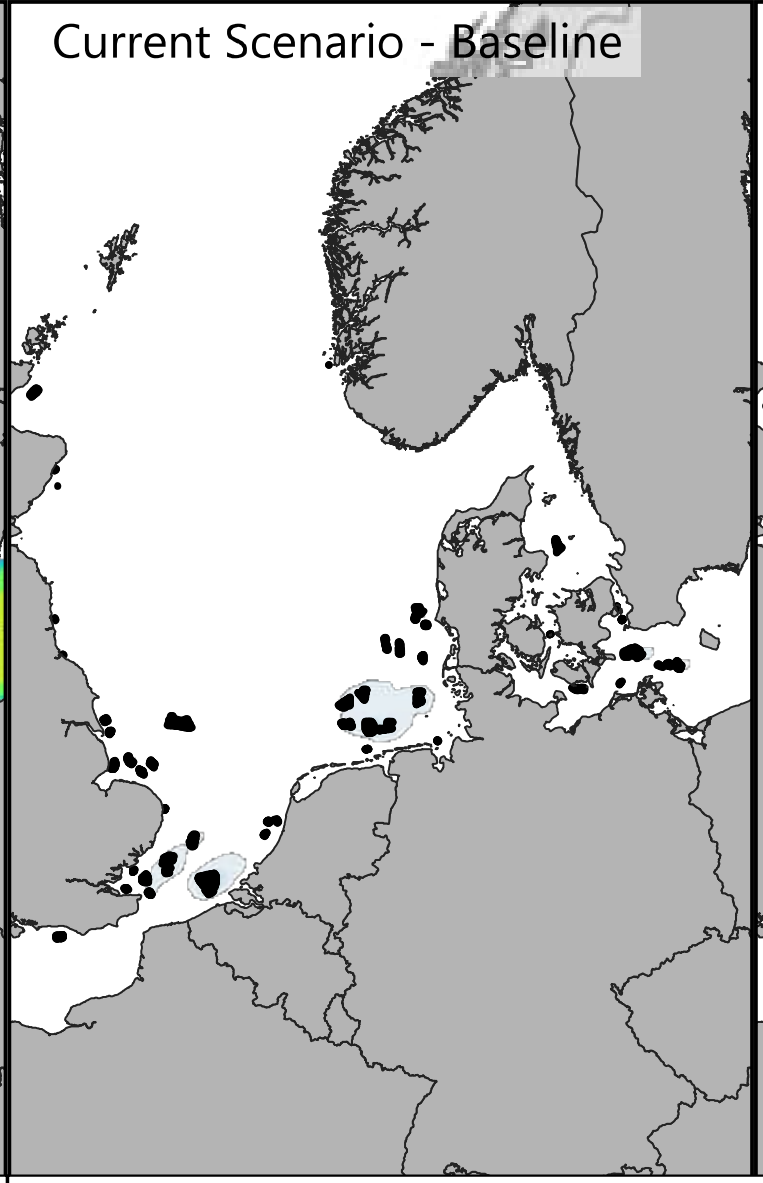
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

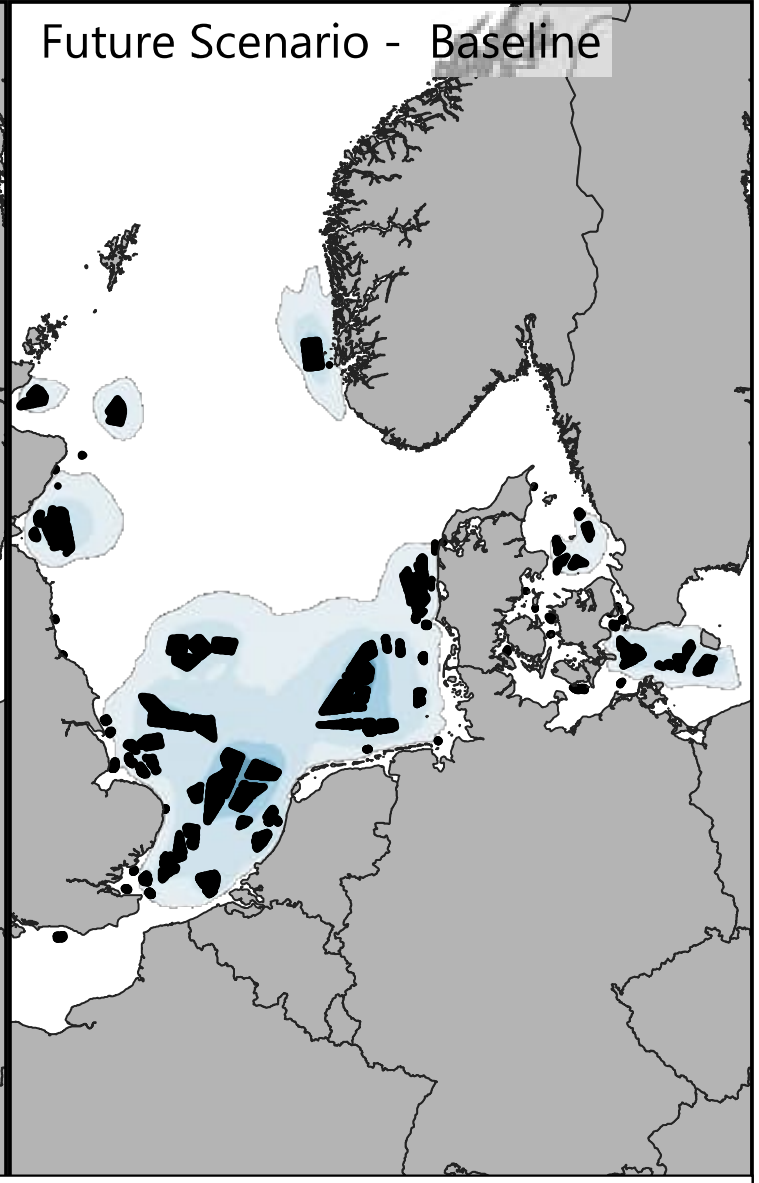
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







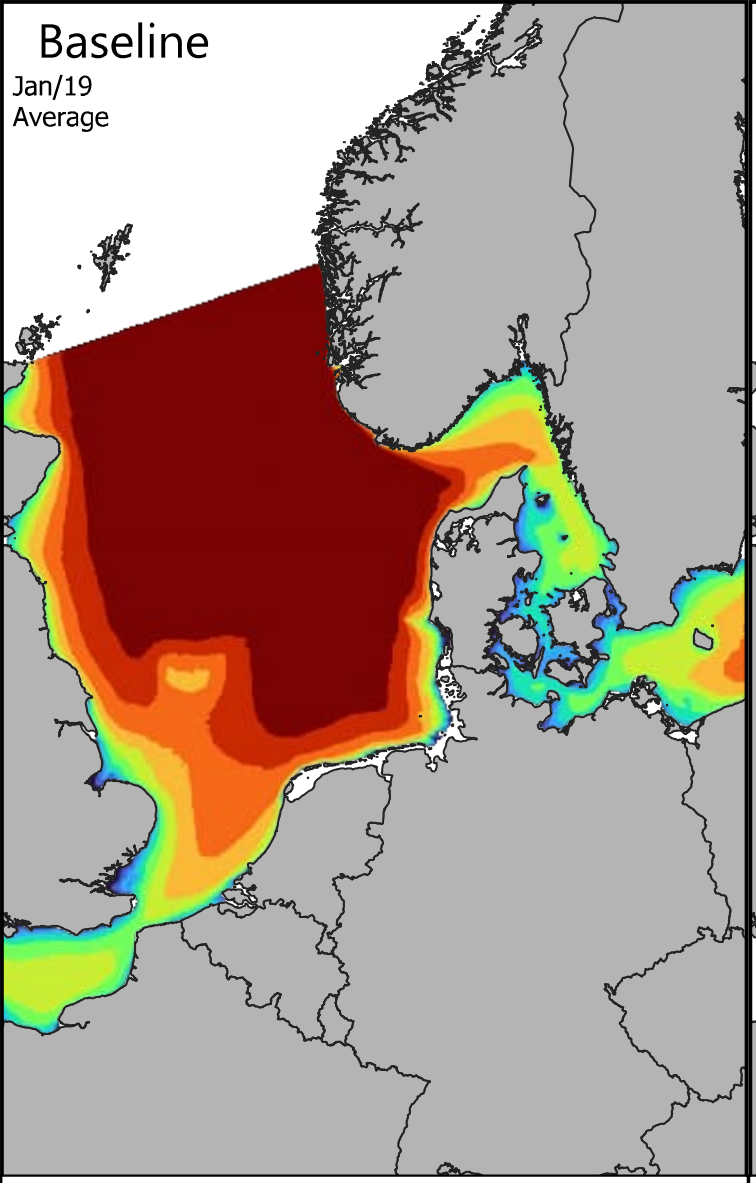
Signignificant Wave Height [m]

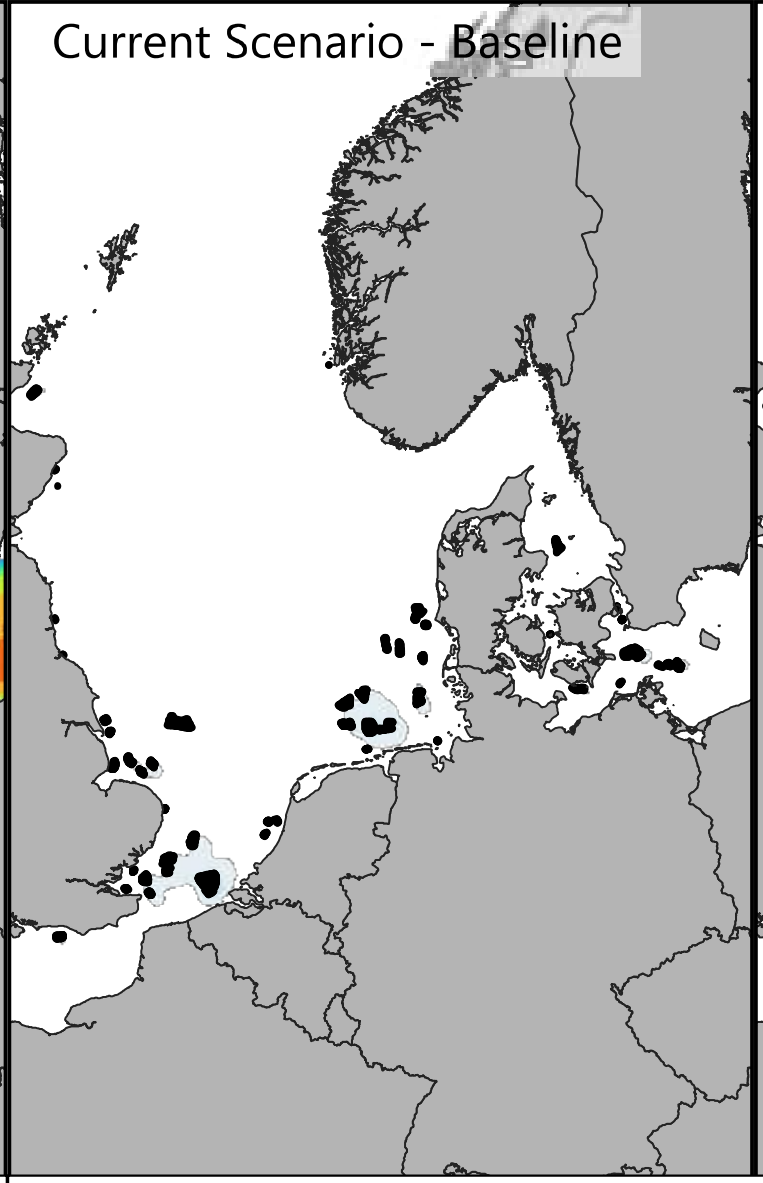
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

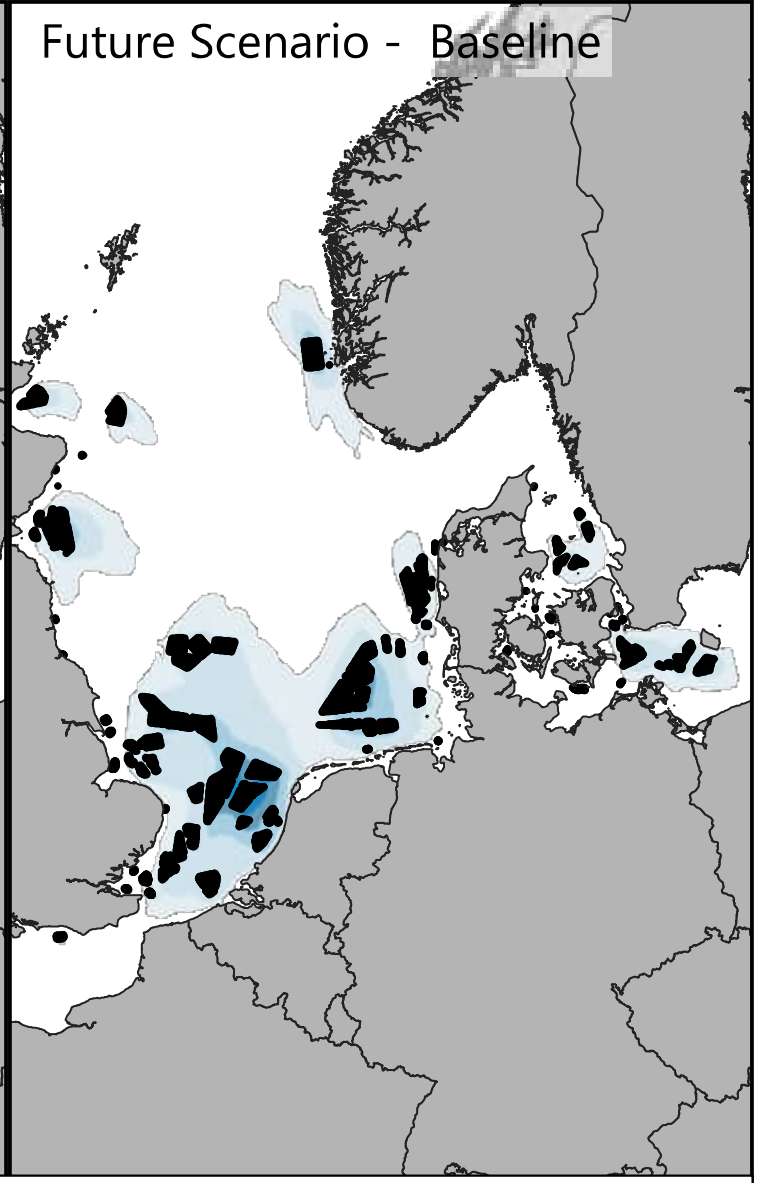
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







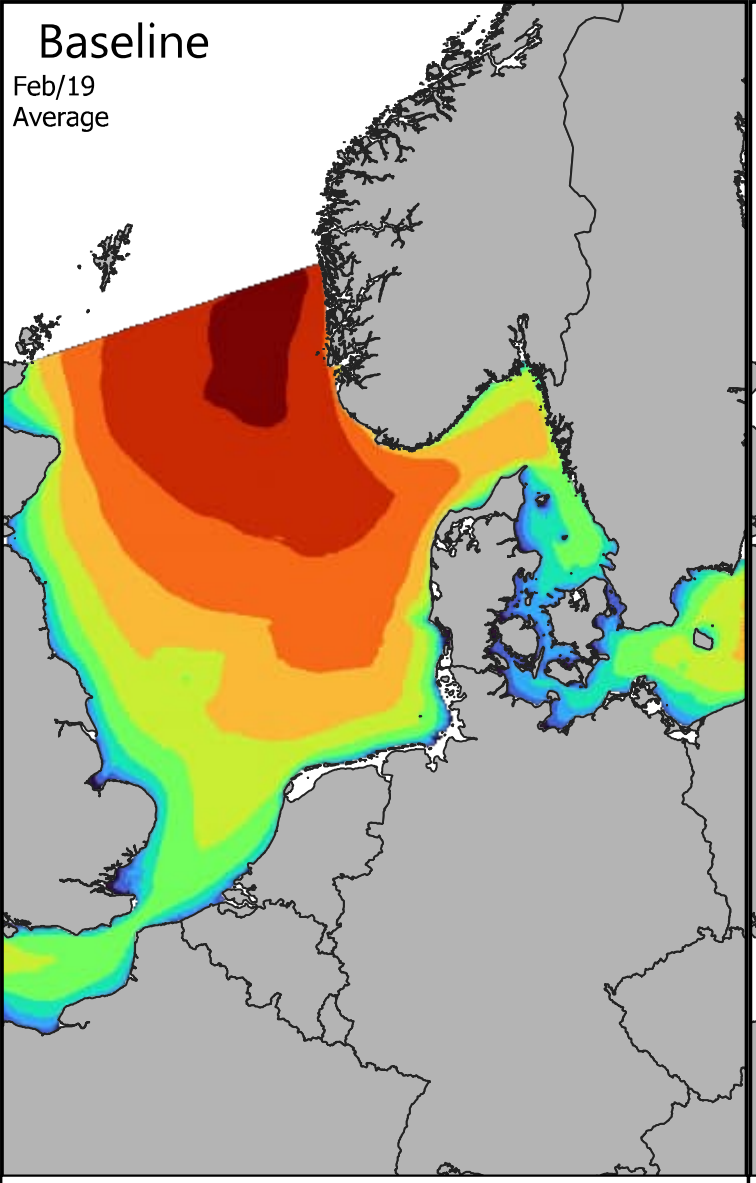
Signignificant Wave Height [m]

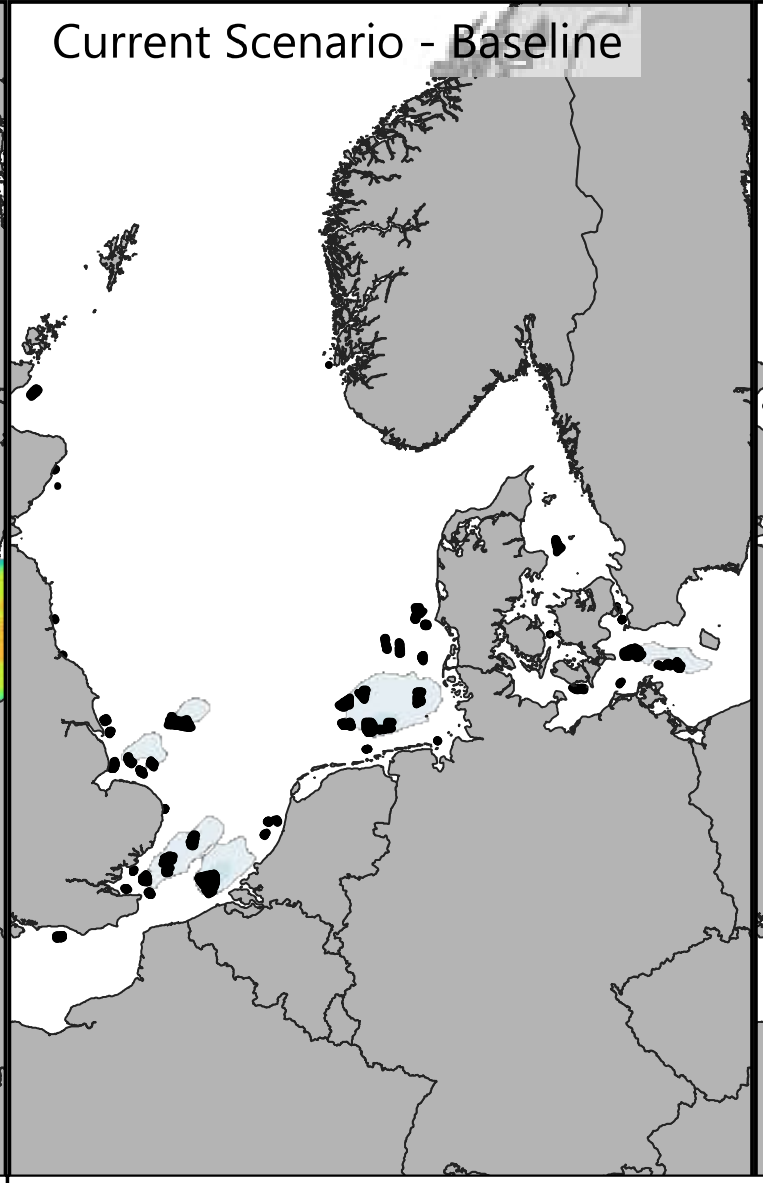
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

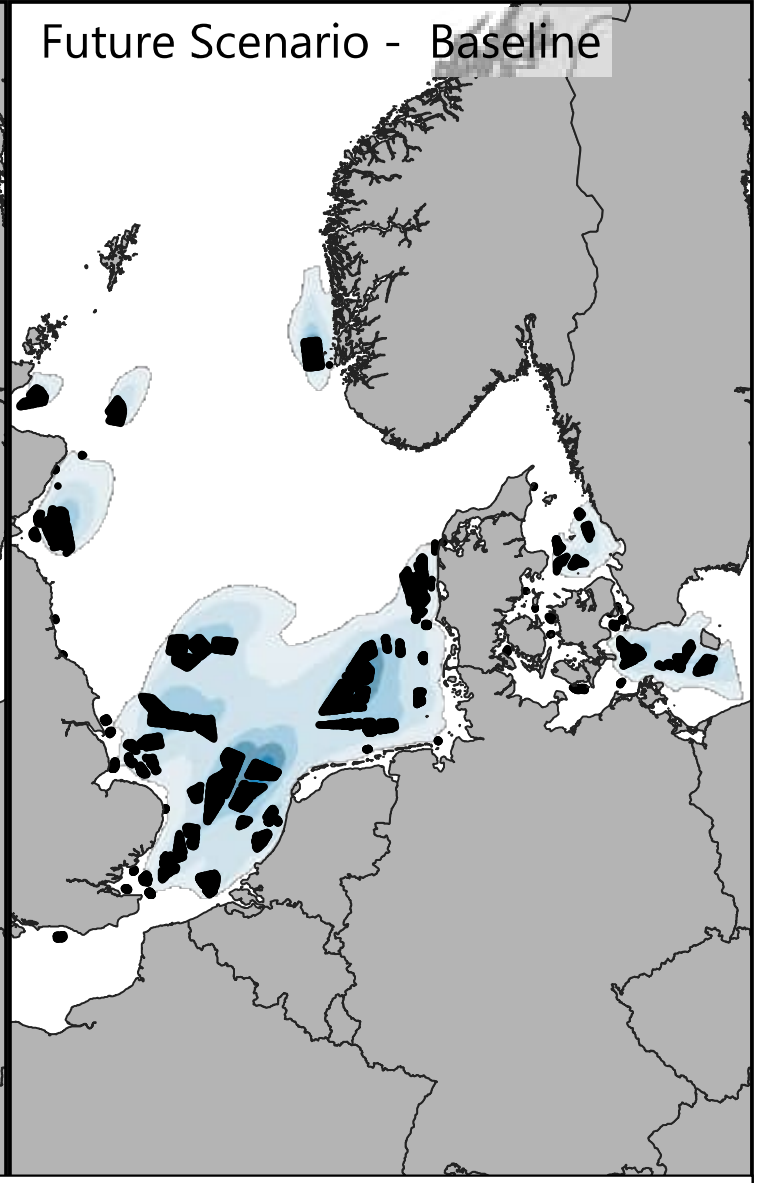
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







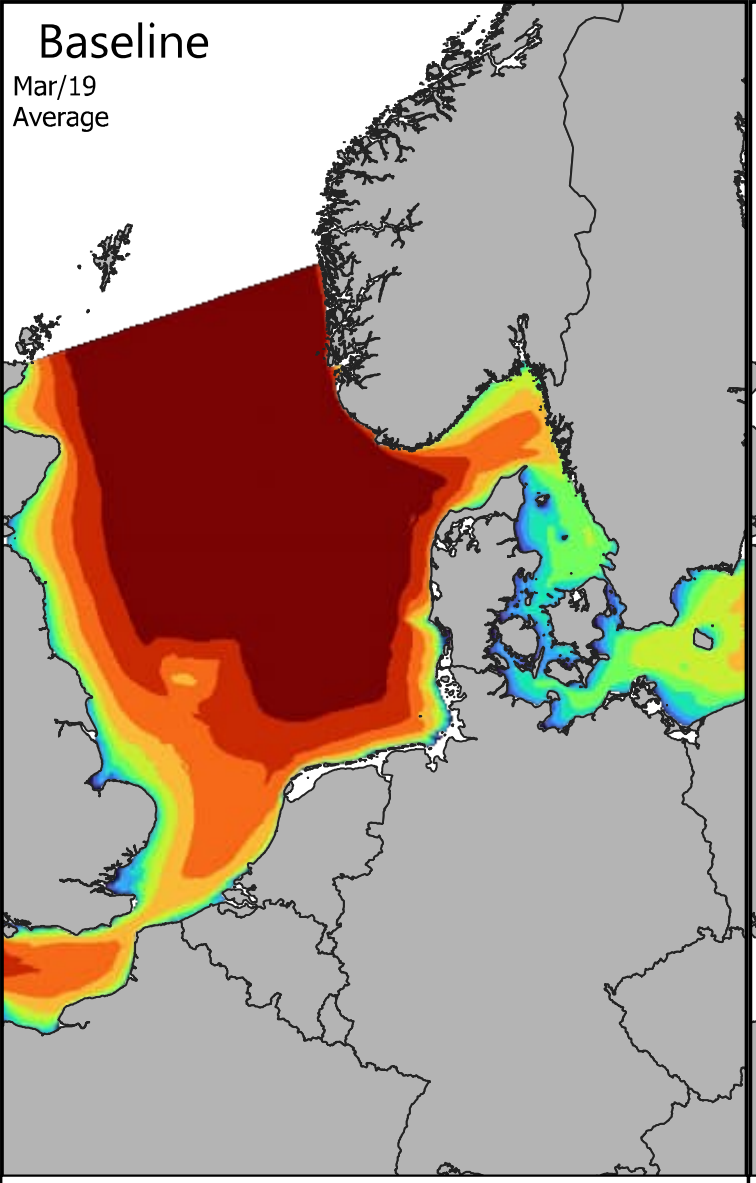
Signignificant Wave Height [m]

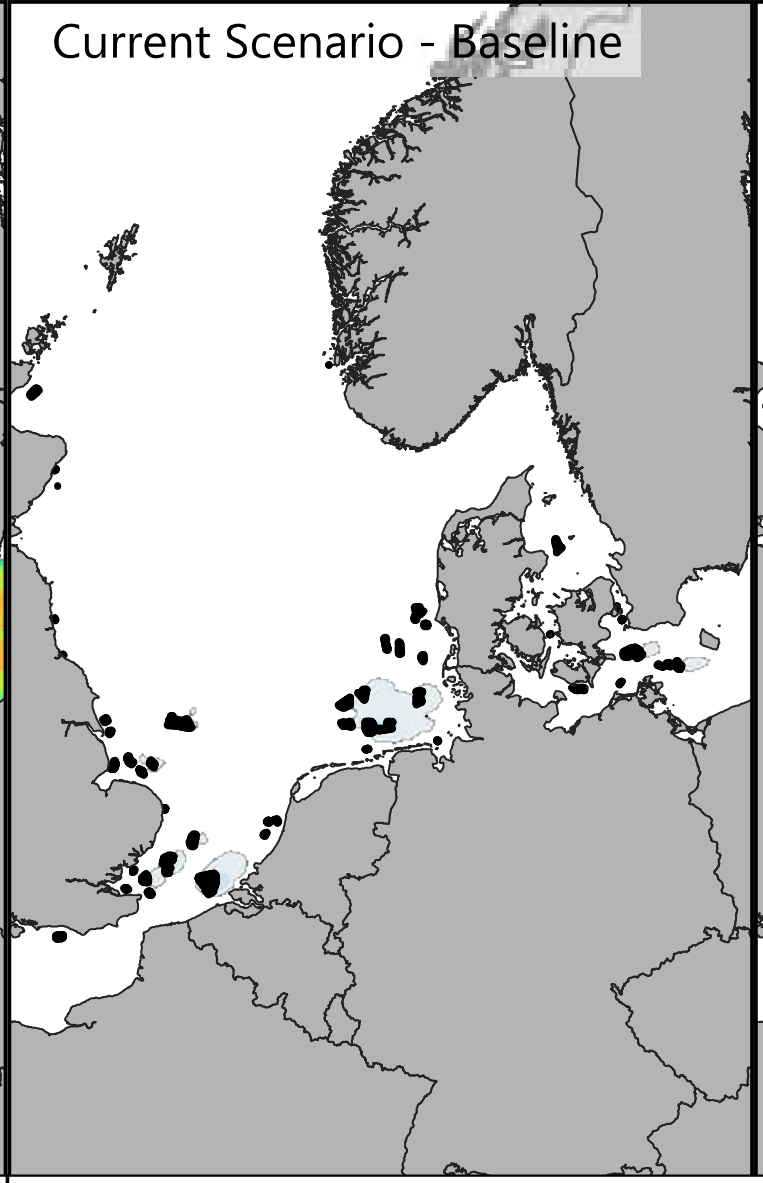
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

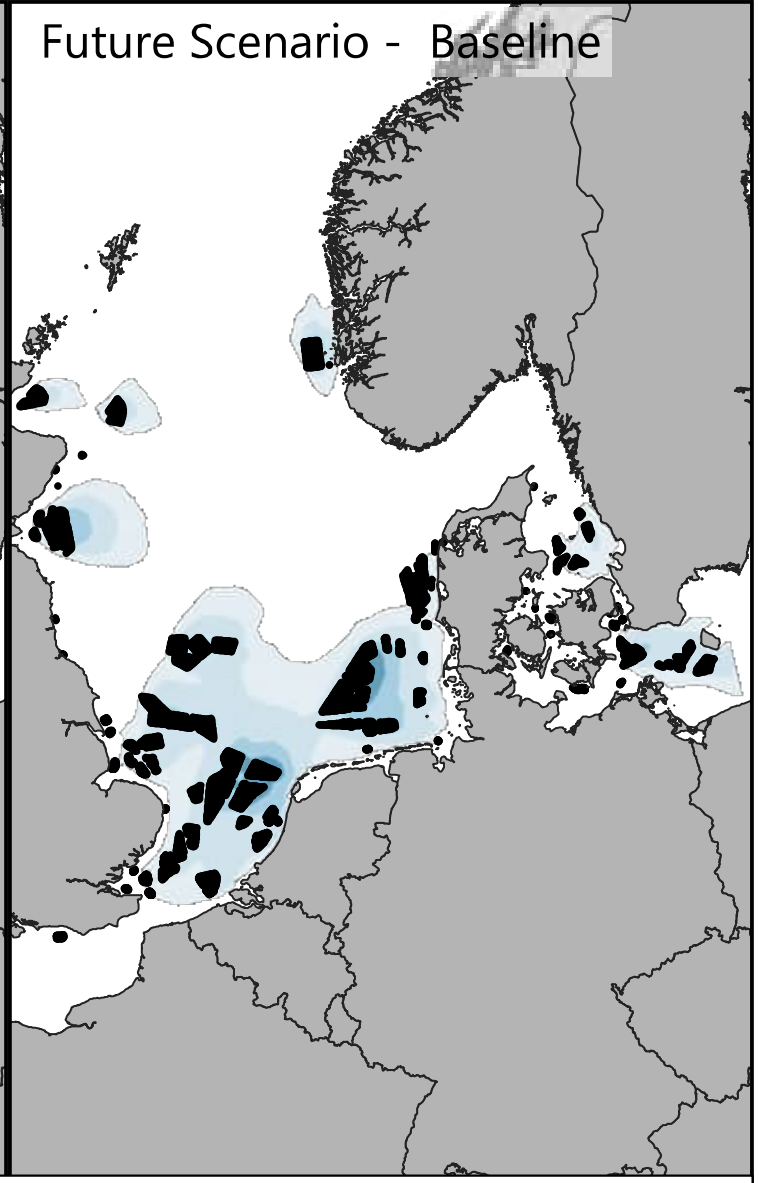
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







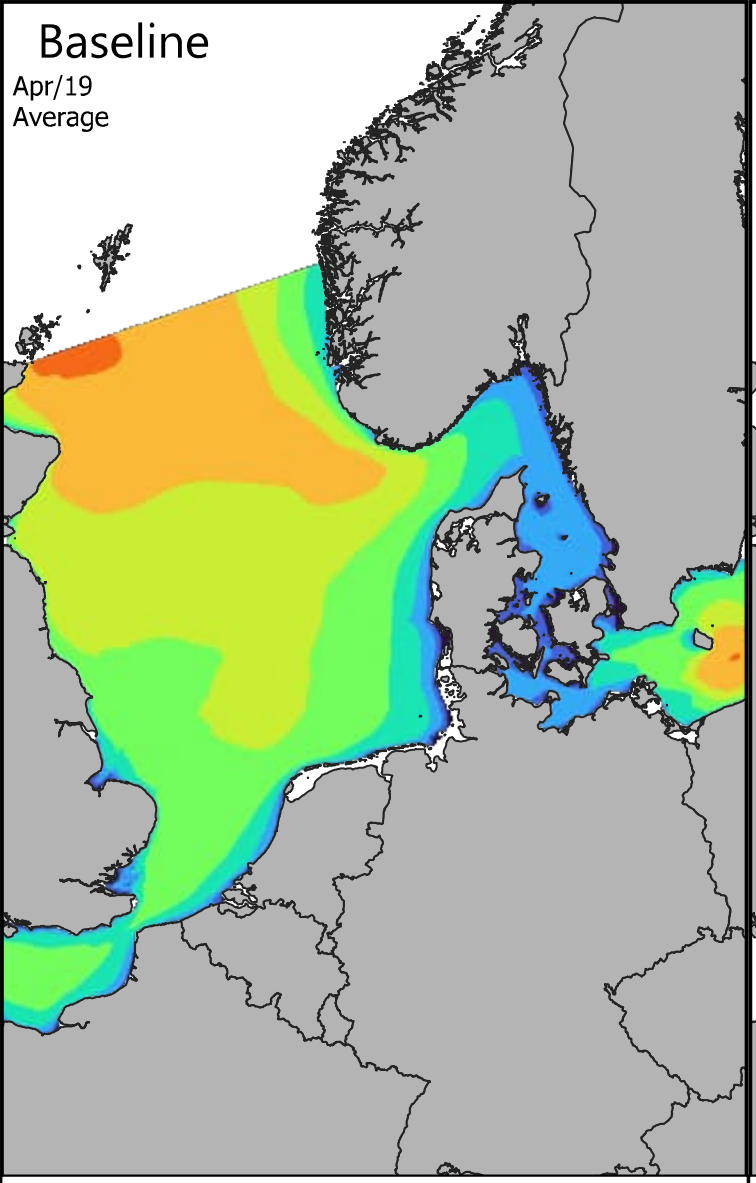
Signignificant Wave Height [m]

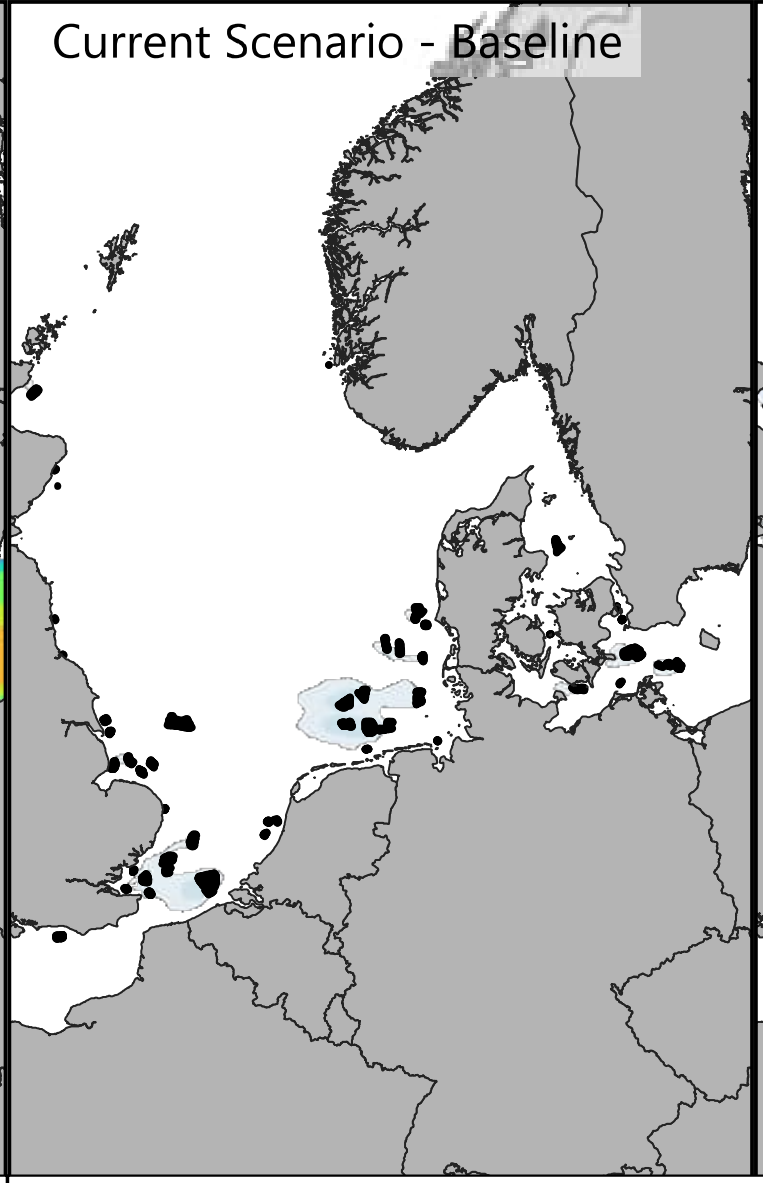
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

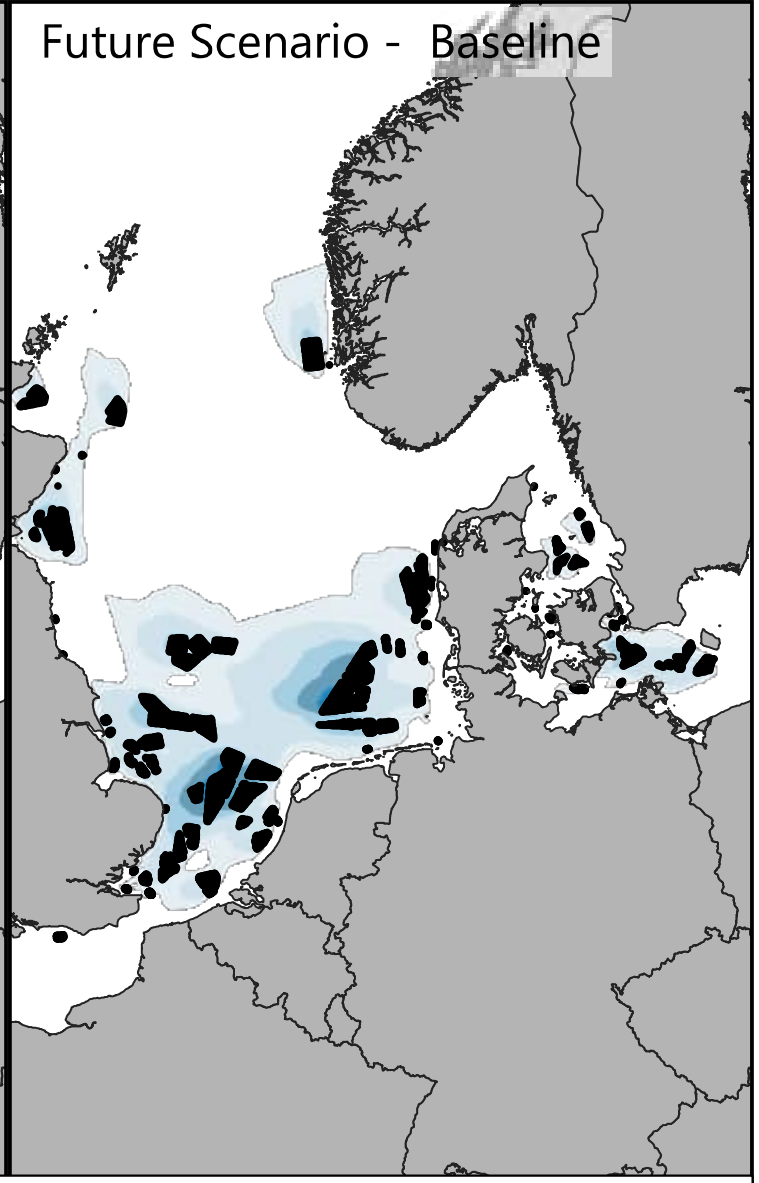
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







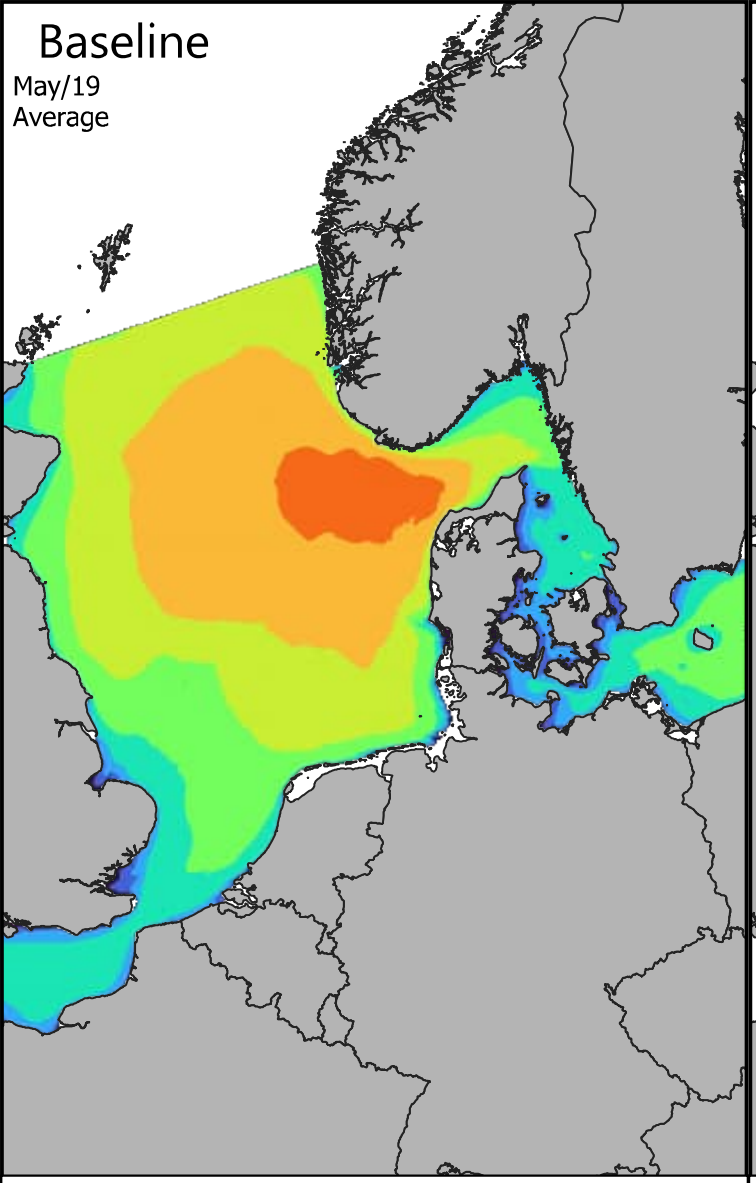
Signignificant Wave Height [m]

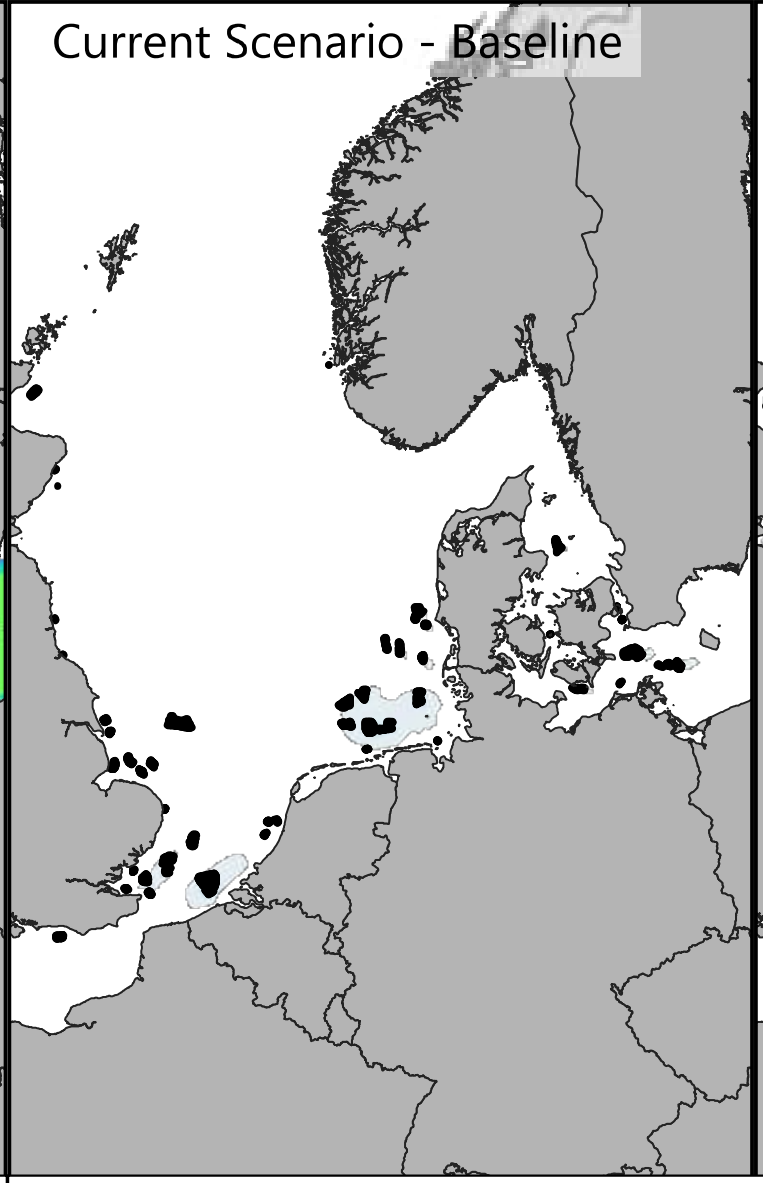
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

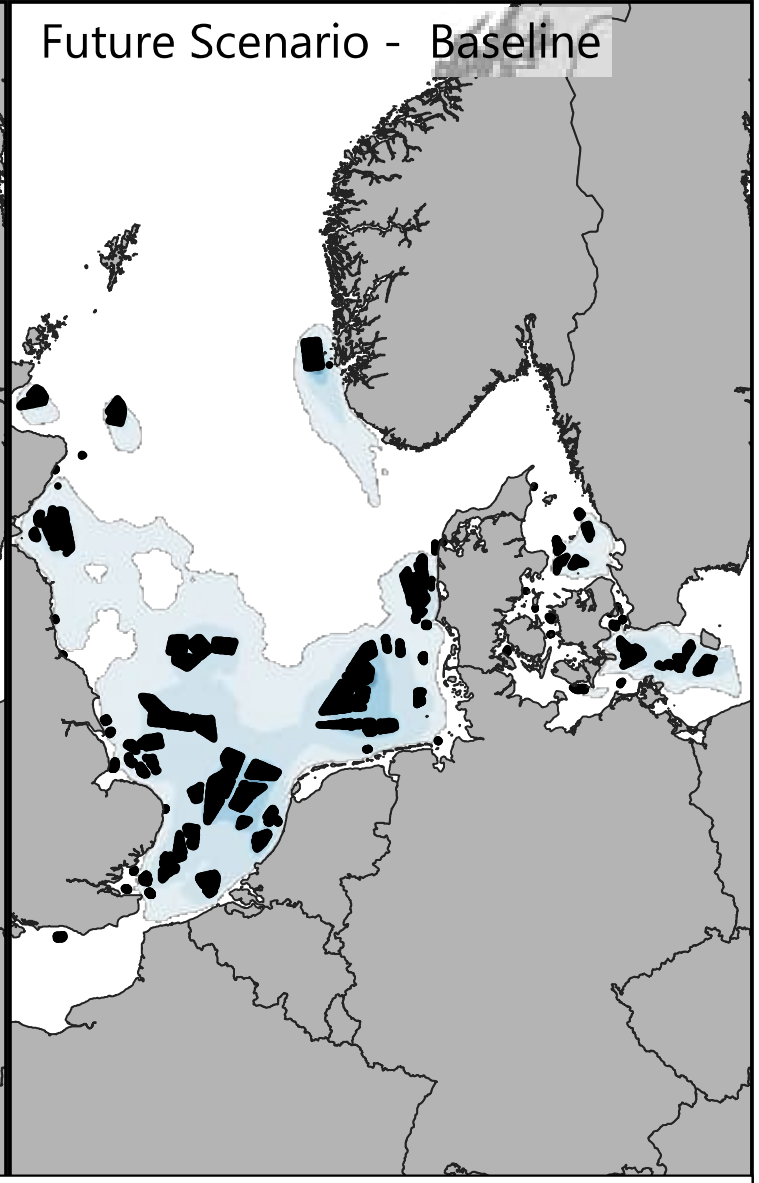
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







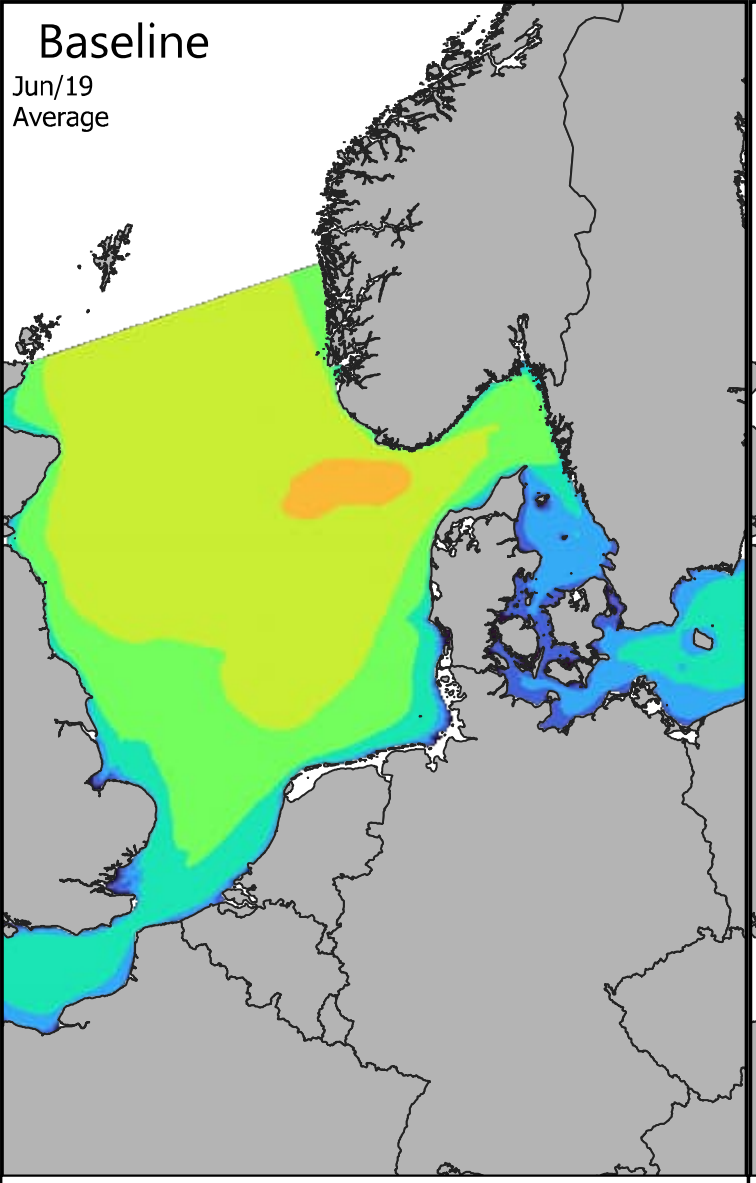
Signignificant Wave Height [m]

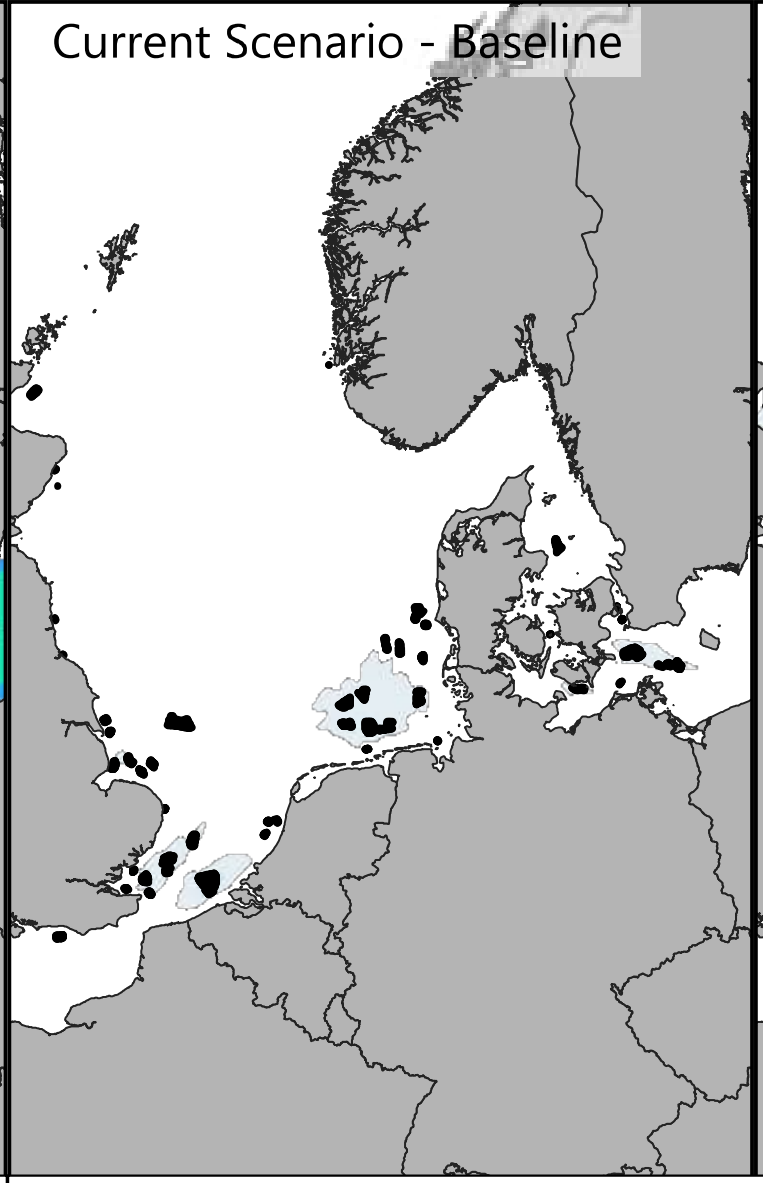
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

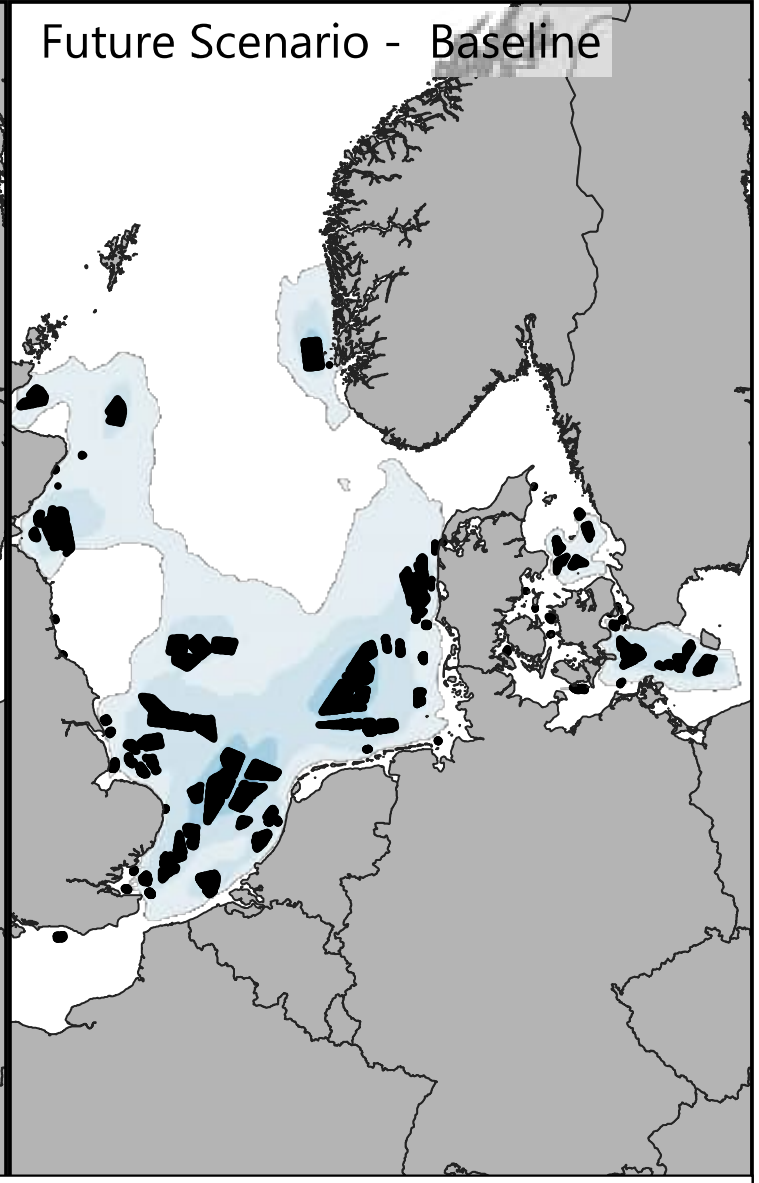
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







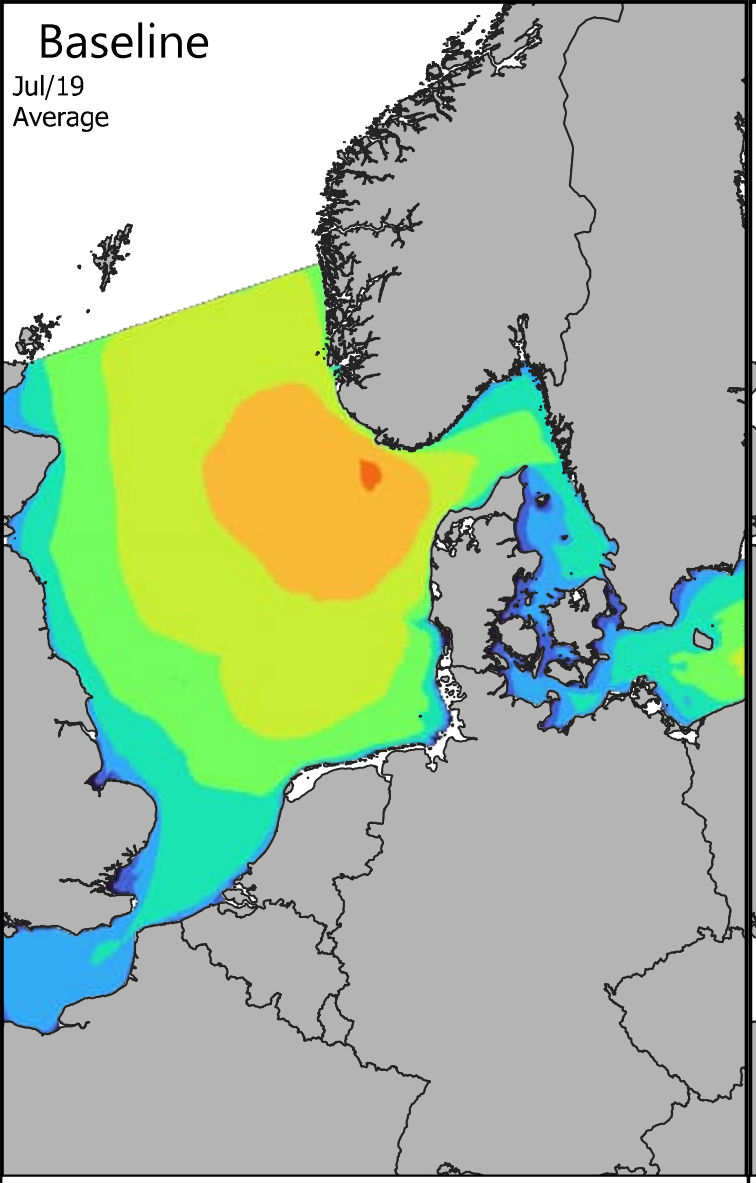
Signignificant Wave Height [m]

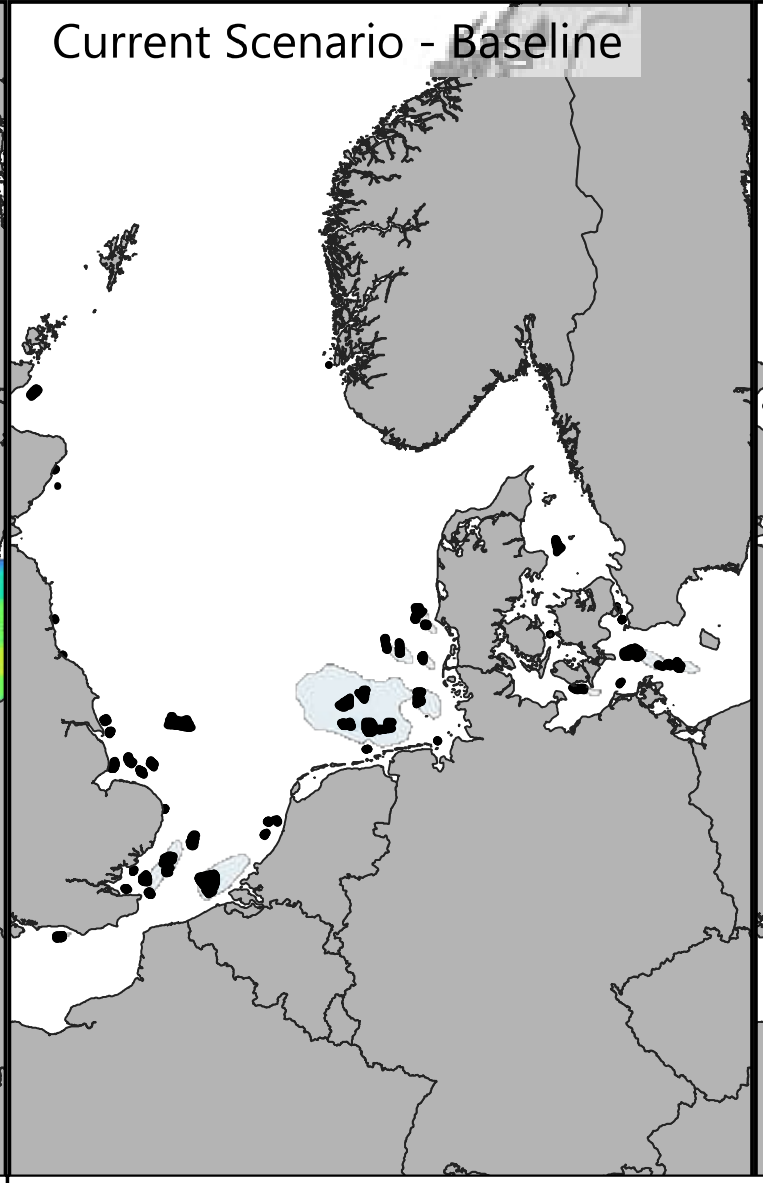
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

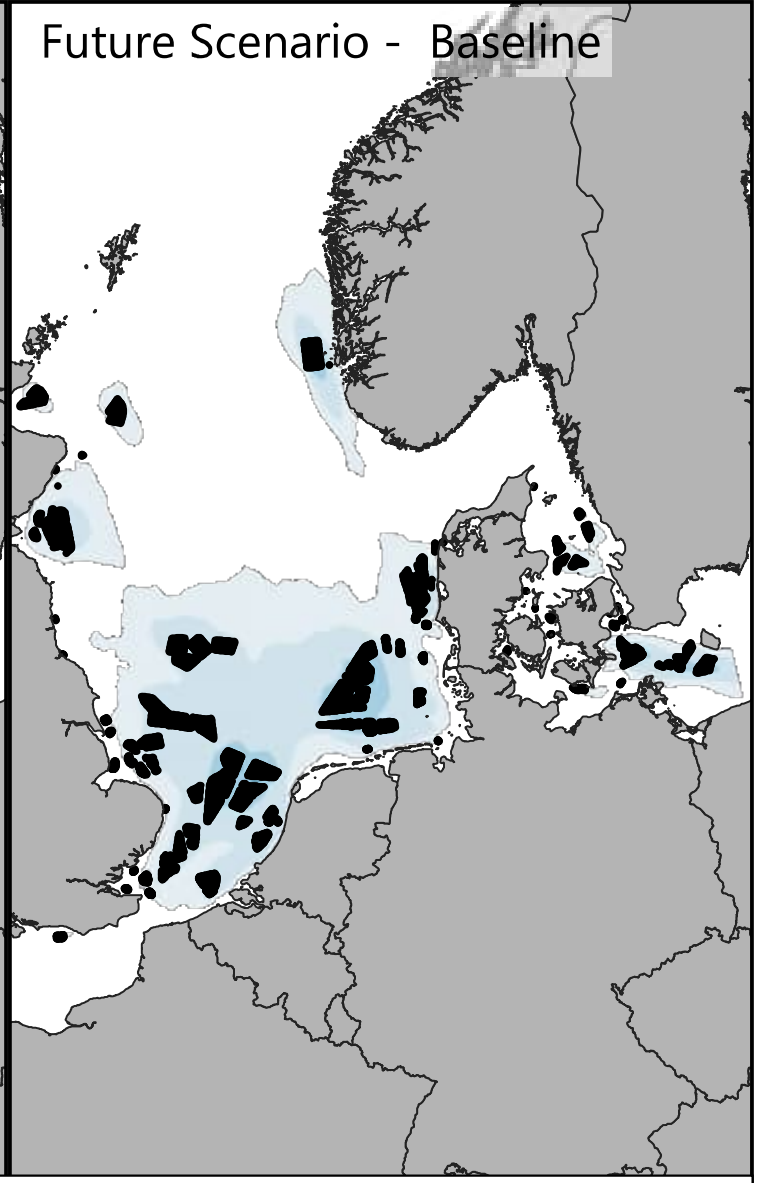
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







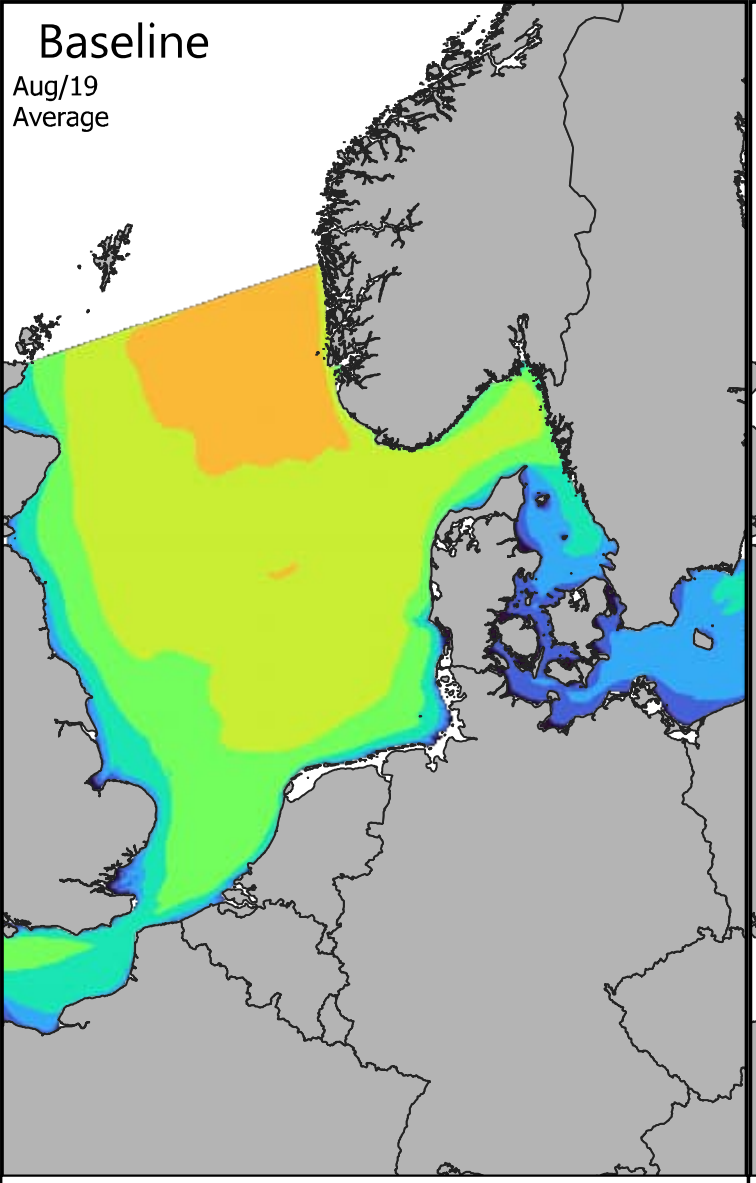
Signignificant Wave Height [m]

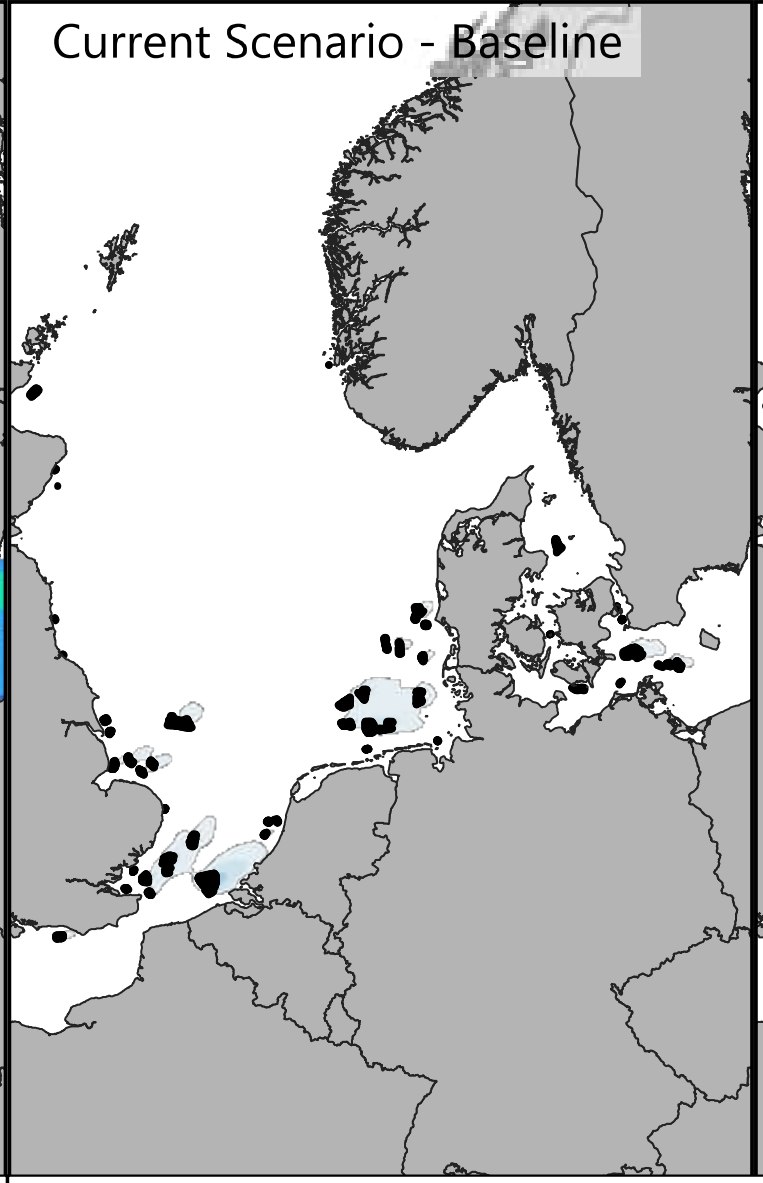
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

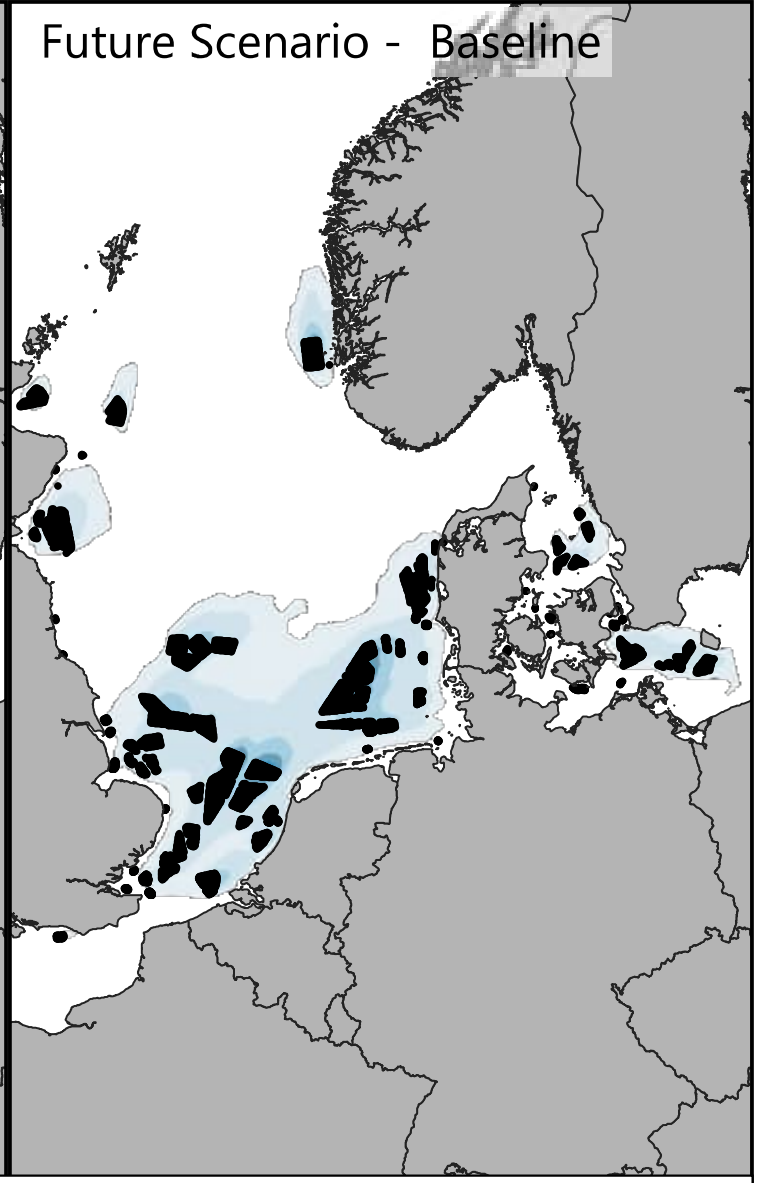
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







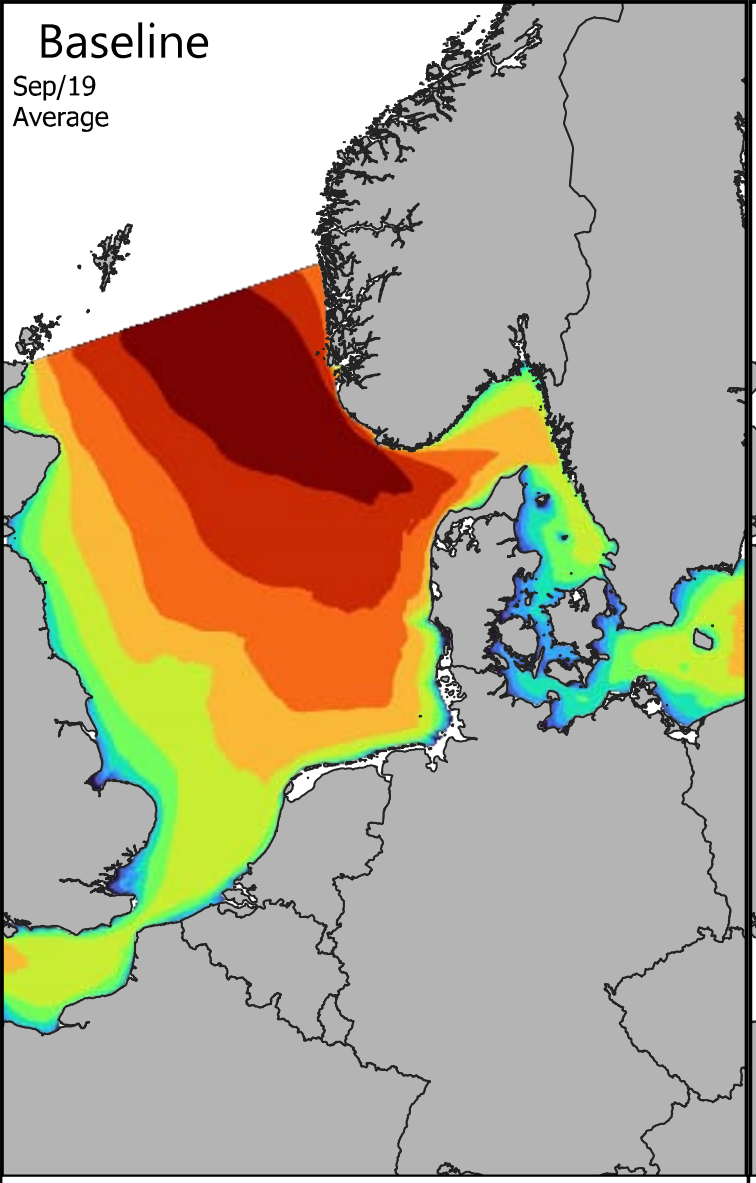
Signignificant Wave Height [m]

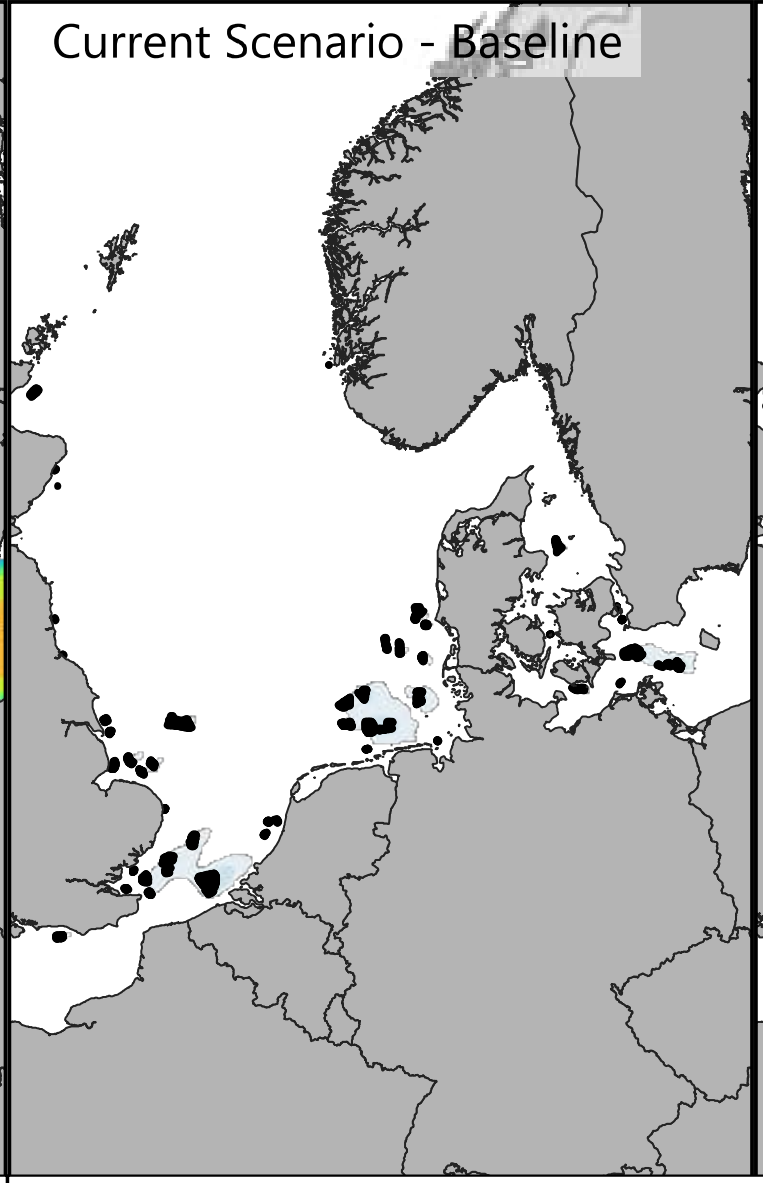
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

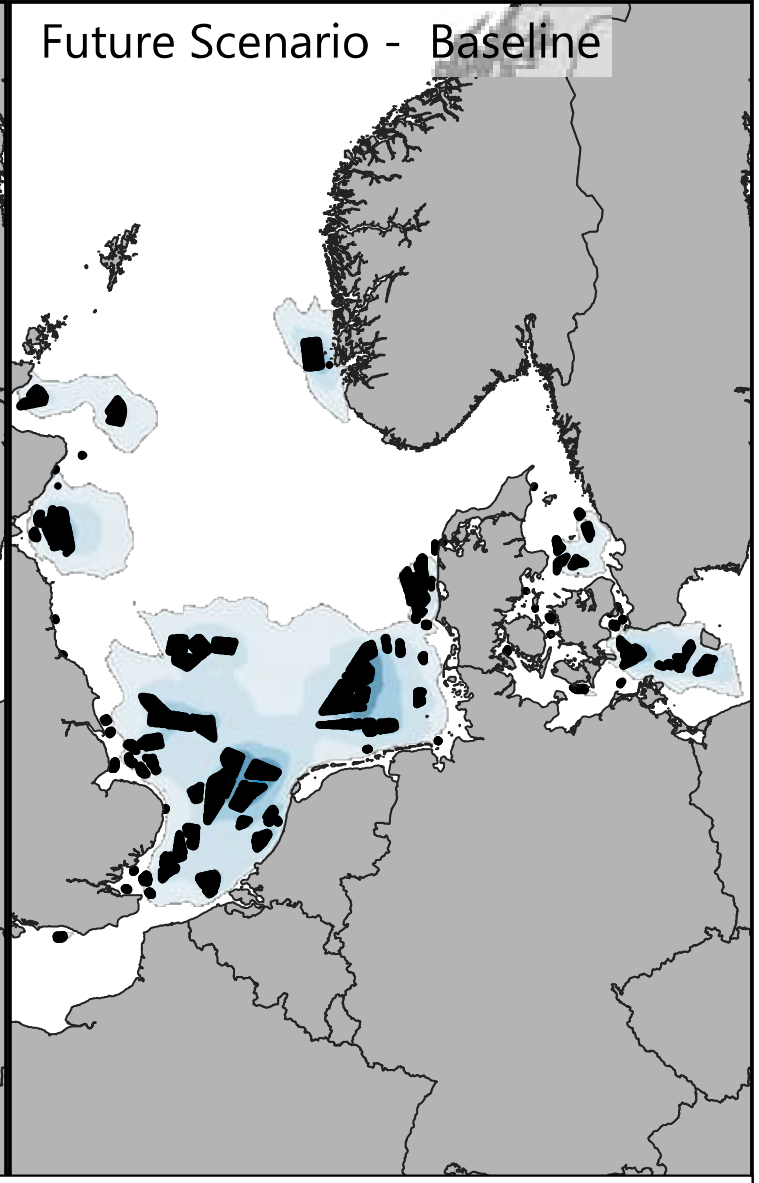
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







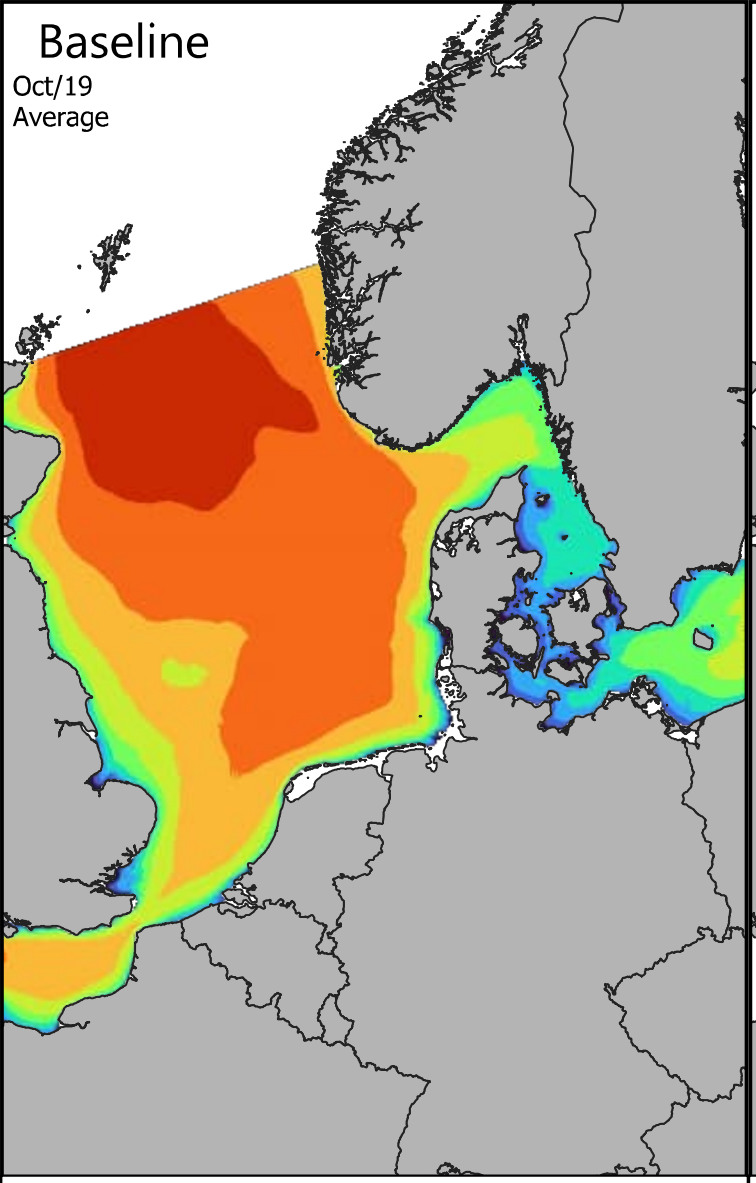
Signignificant Wave Height [m]

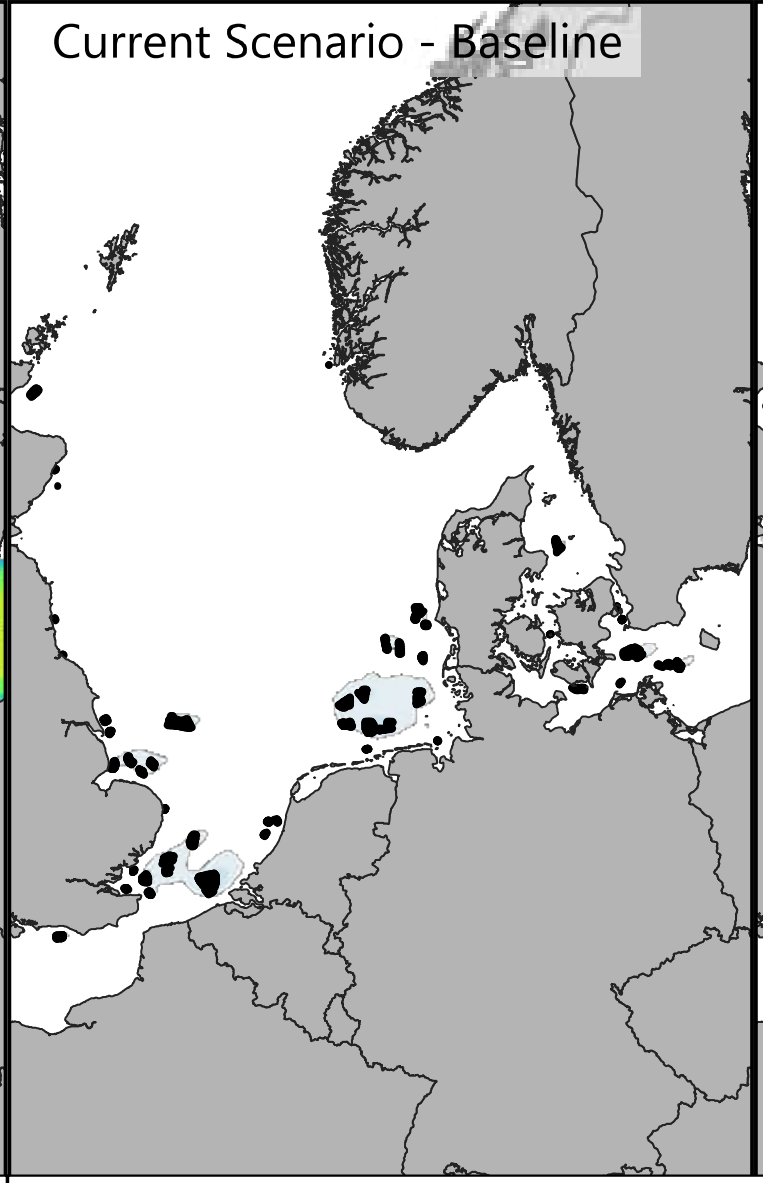
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

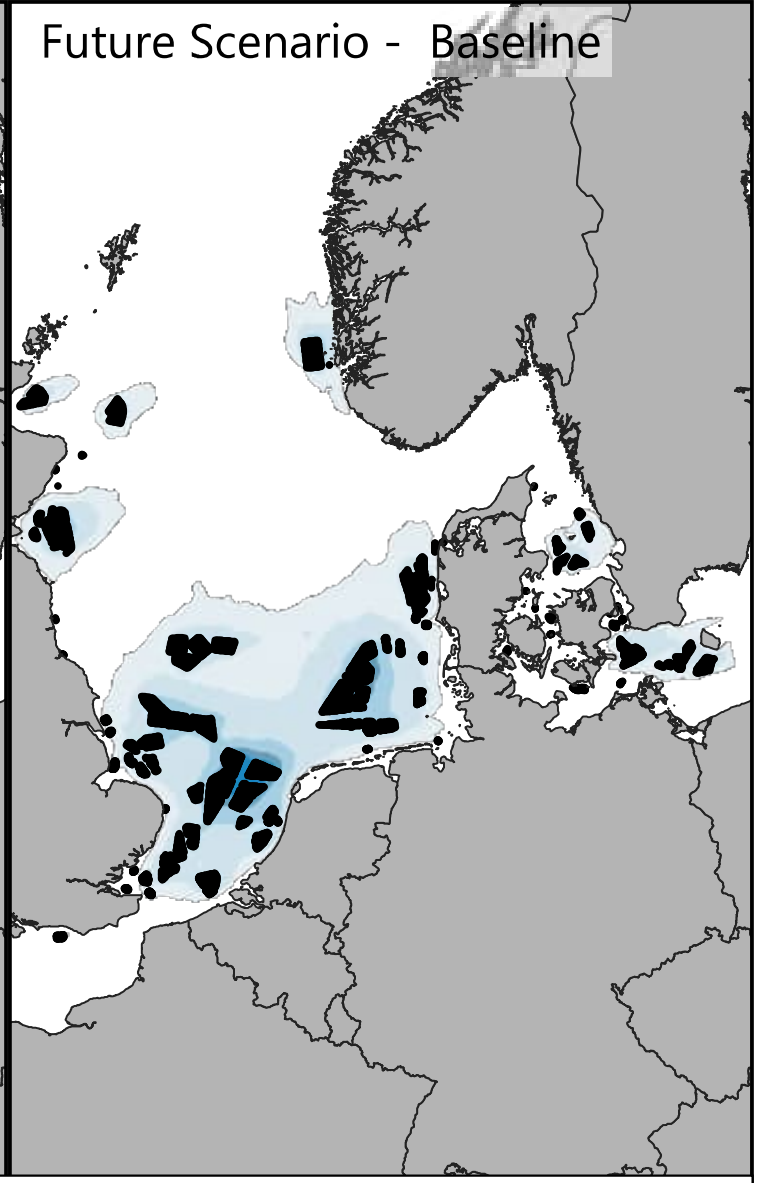
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







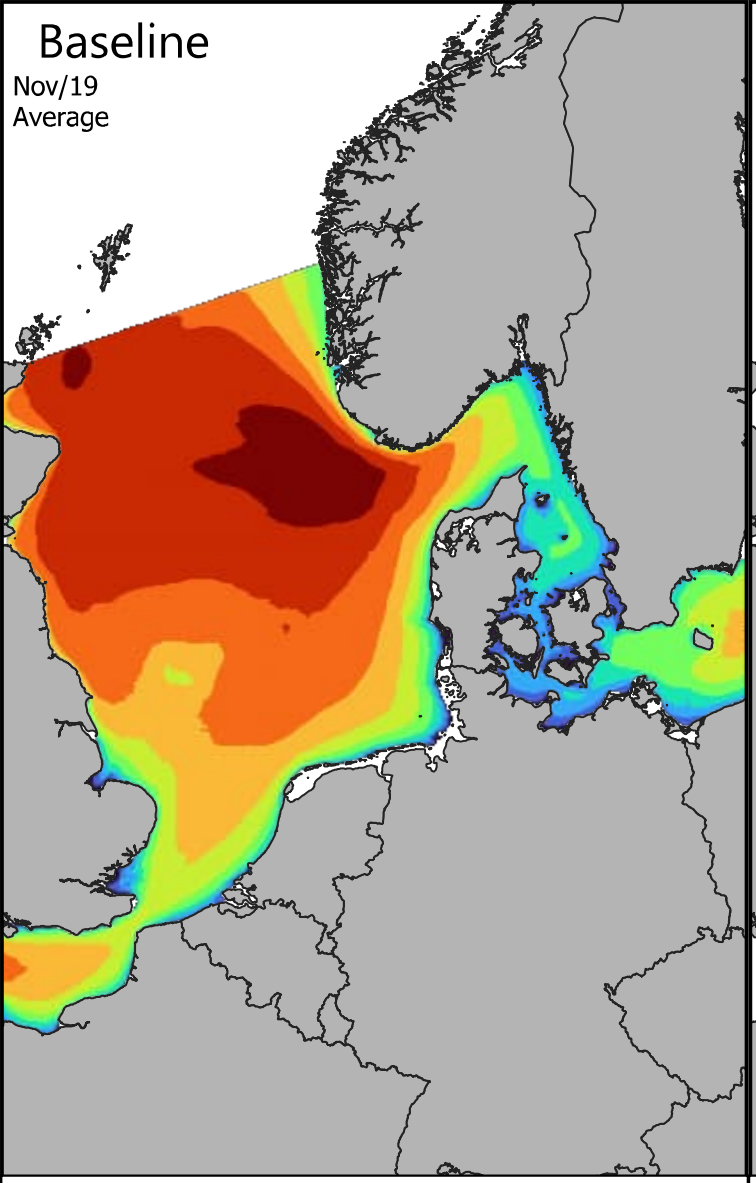
Signignificant Wave Height [m]

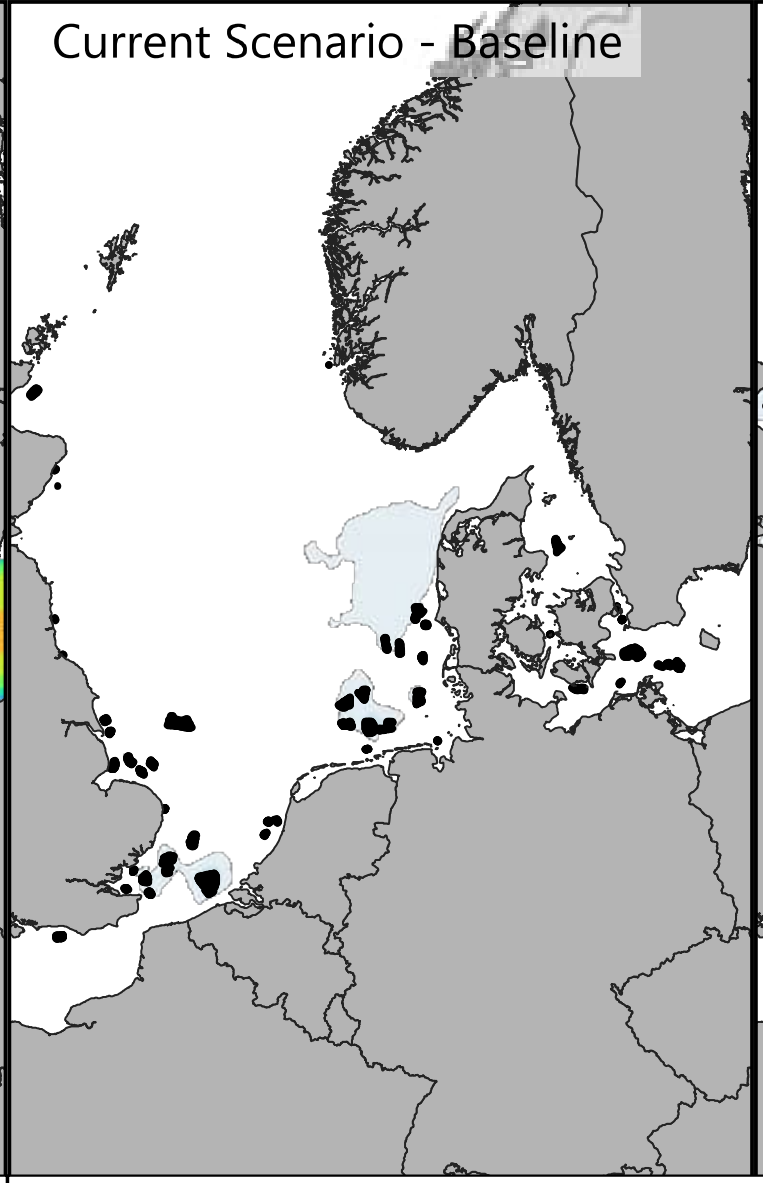
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

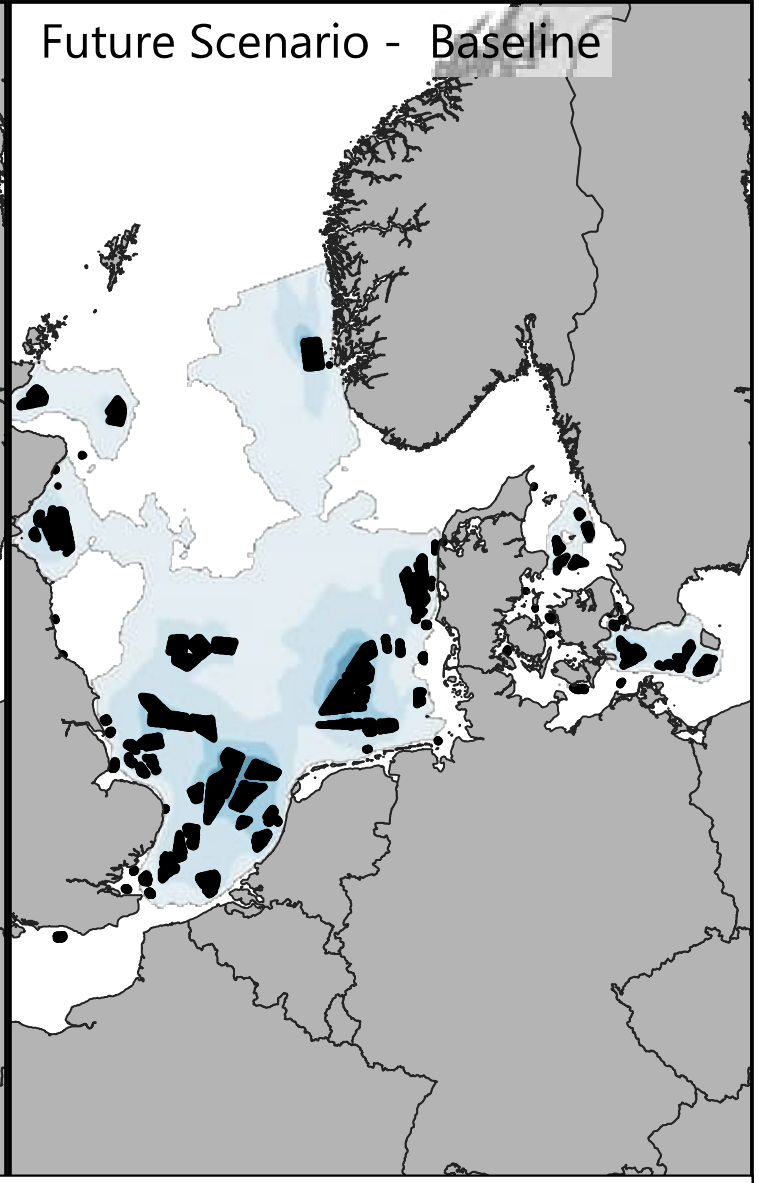
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







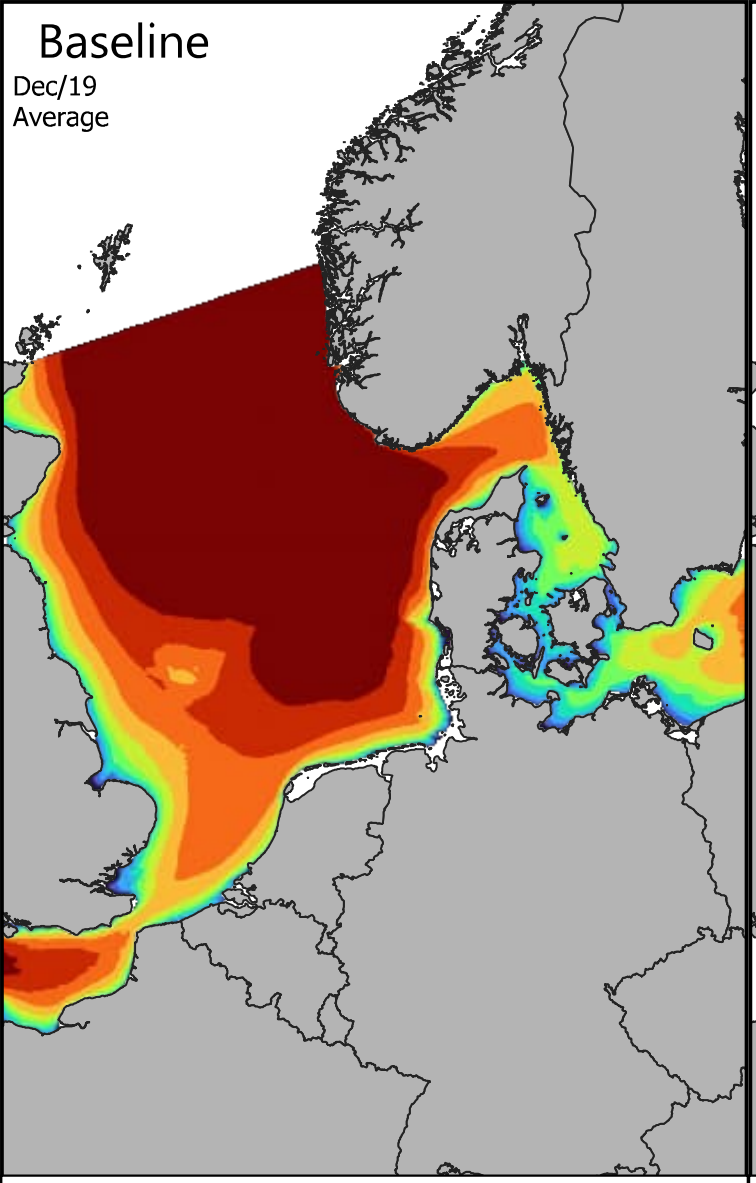
Signignificant Wave Height [m]

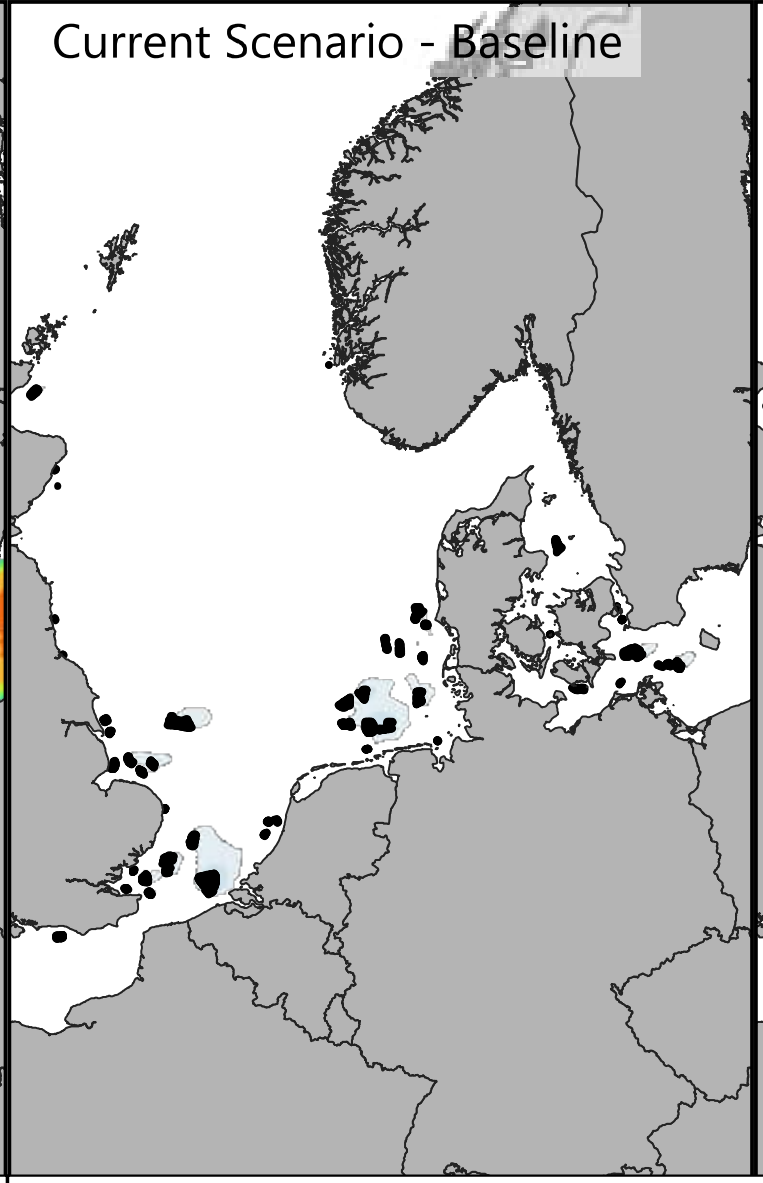
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

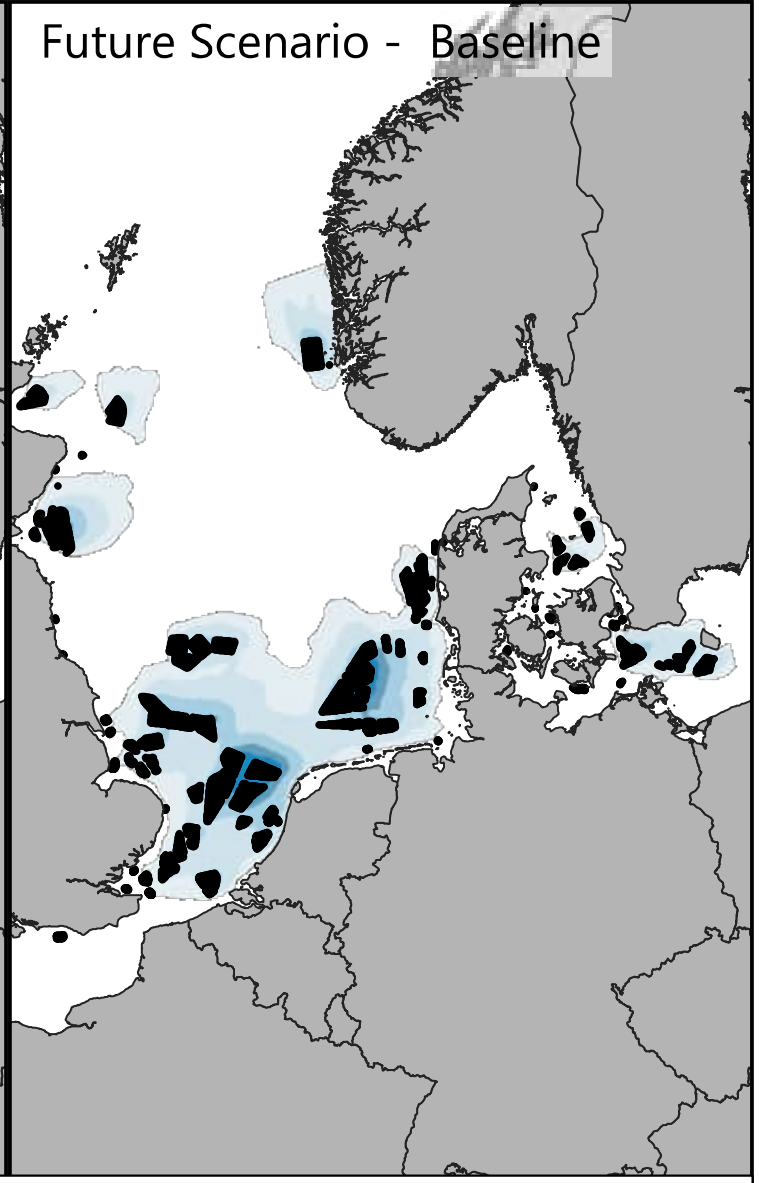
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







Signignificant Wave Height [m]

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km

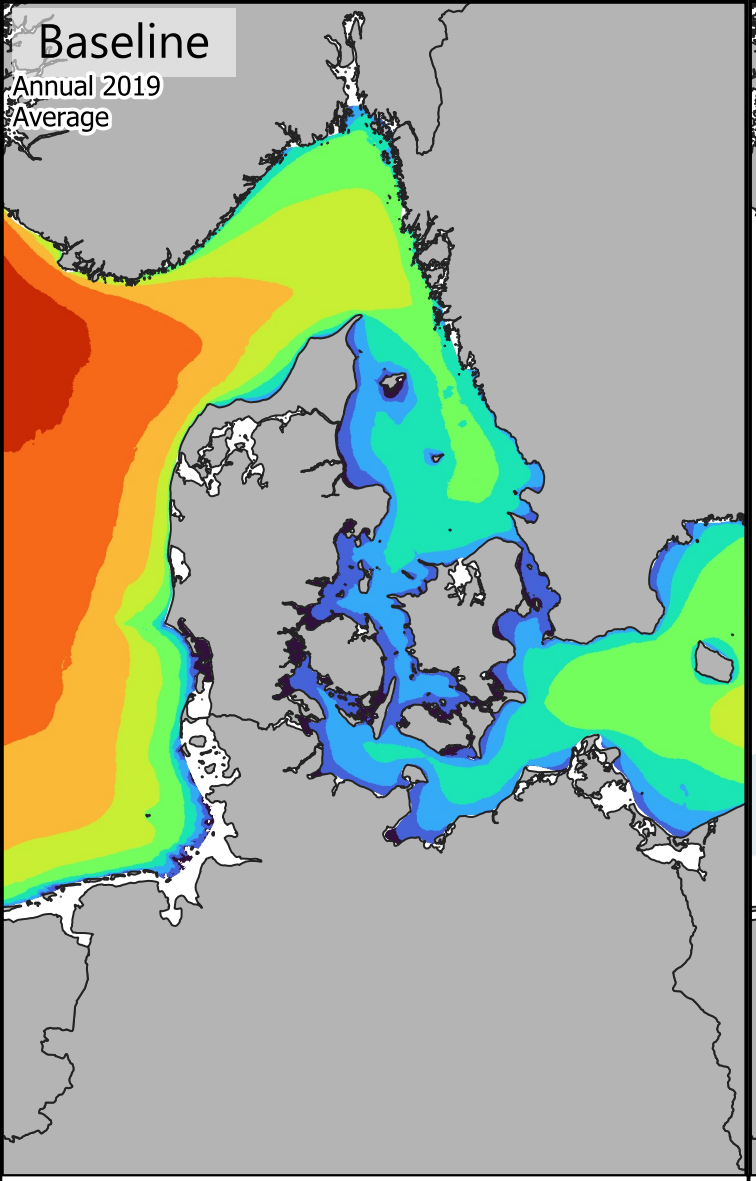
Appendix F: Wind Farms Impact on Significant Wave **H**eights, Danish waters

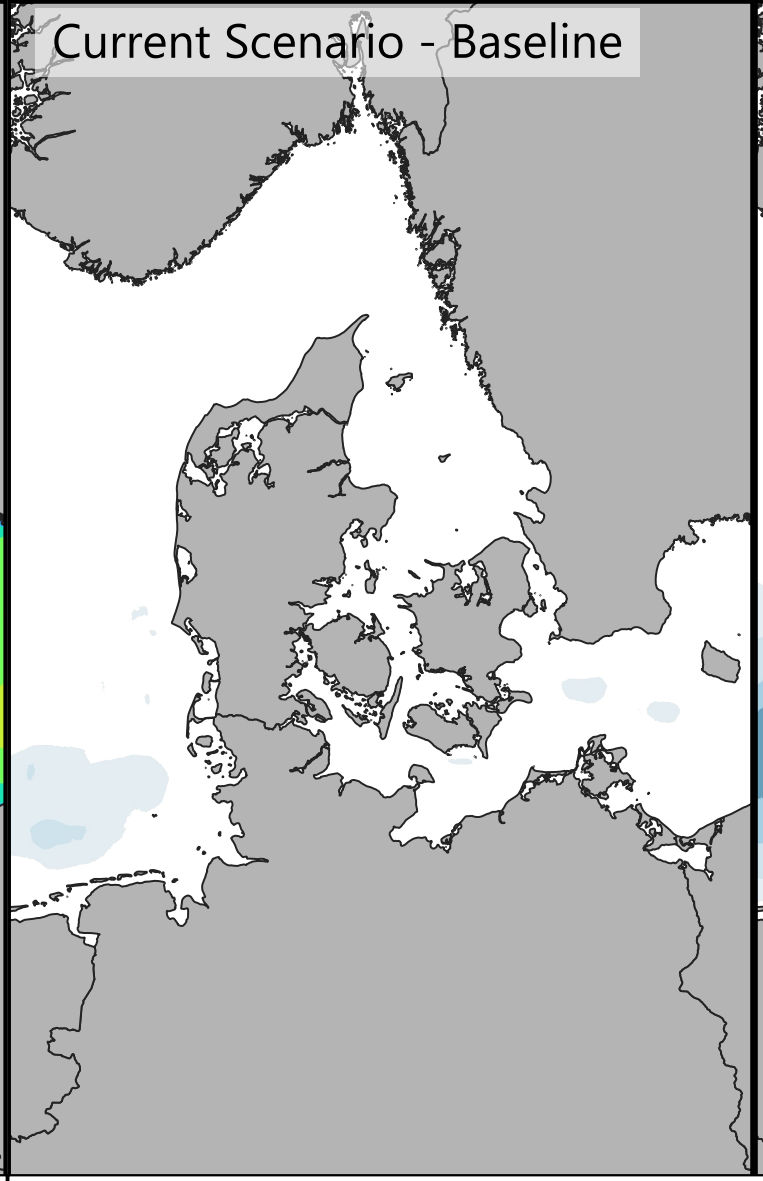
All the figures in Appendix present:

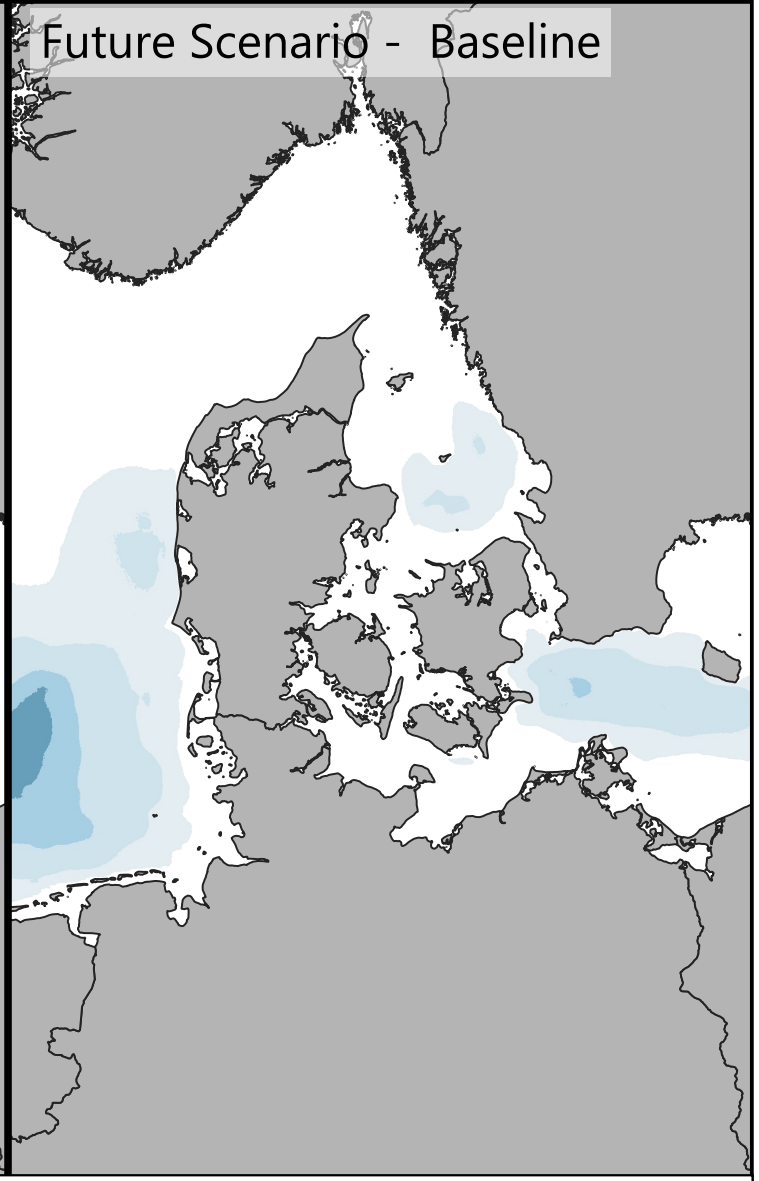
- Left: Baseline - averaged (monthly or yearly) significant wave height, Hm0, simulated without wind farms within the domain,

- Mid: Difference between the averaged Hm0 simulated with the Current scenario and the Baseline scenario,

- Right: Difference between the averaged Hm0 simulated with the Future scenario and the Baseline scenario.







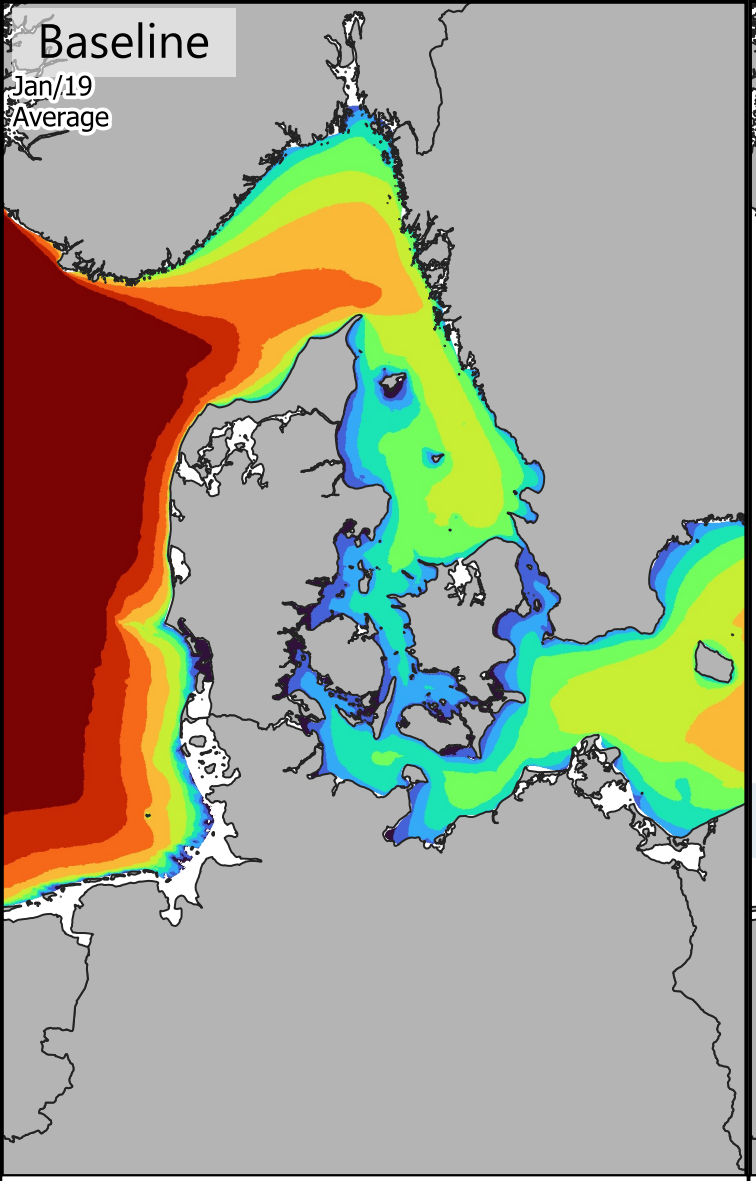
Signignificant Wave Height [m]

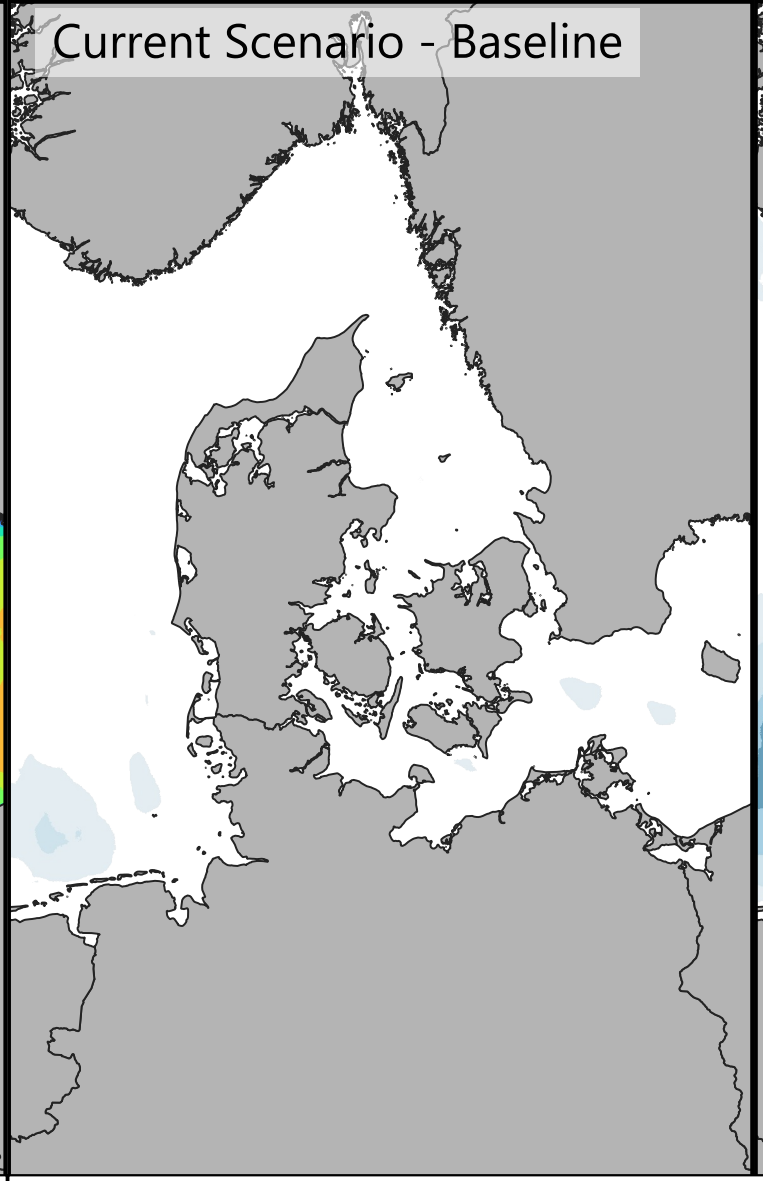
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

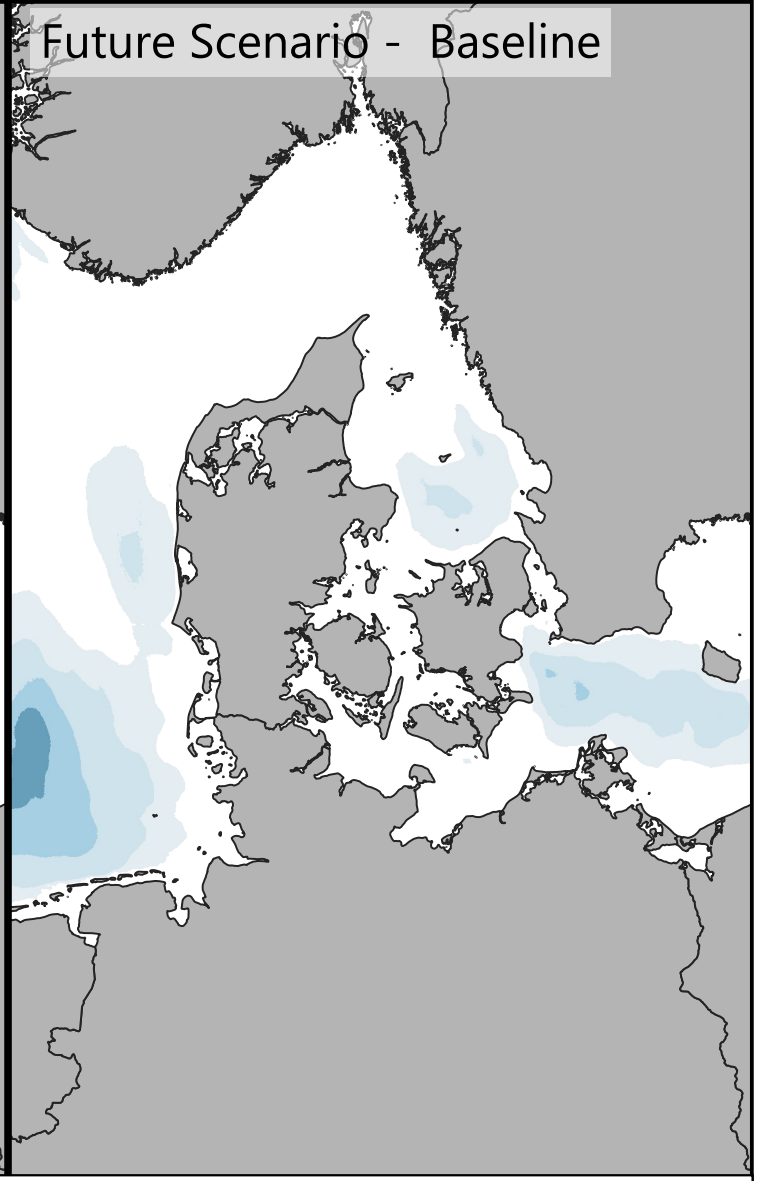
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







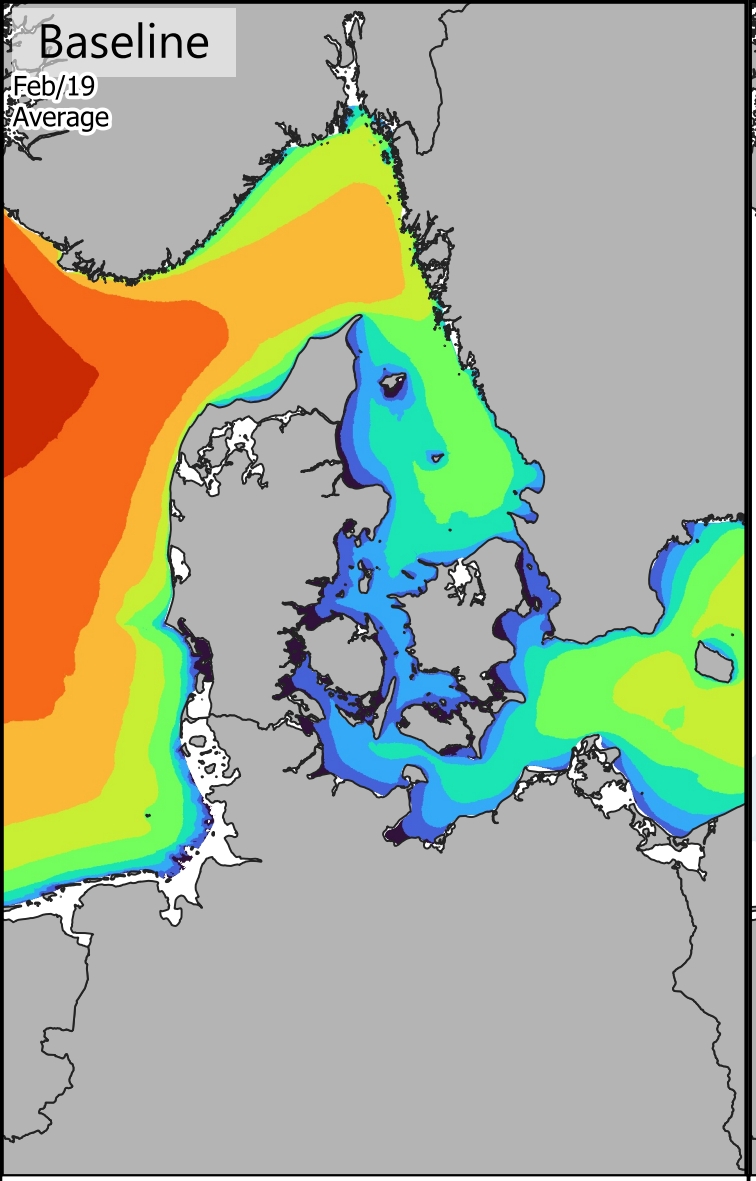
Signignificant Wave Height [m]

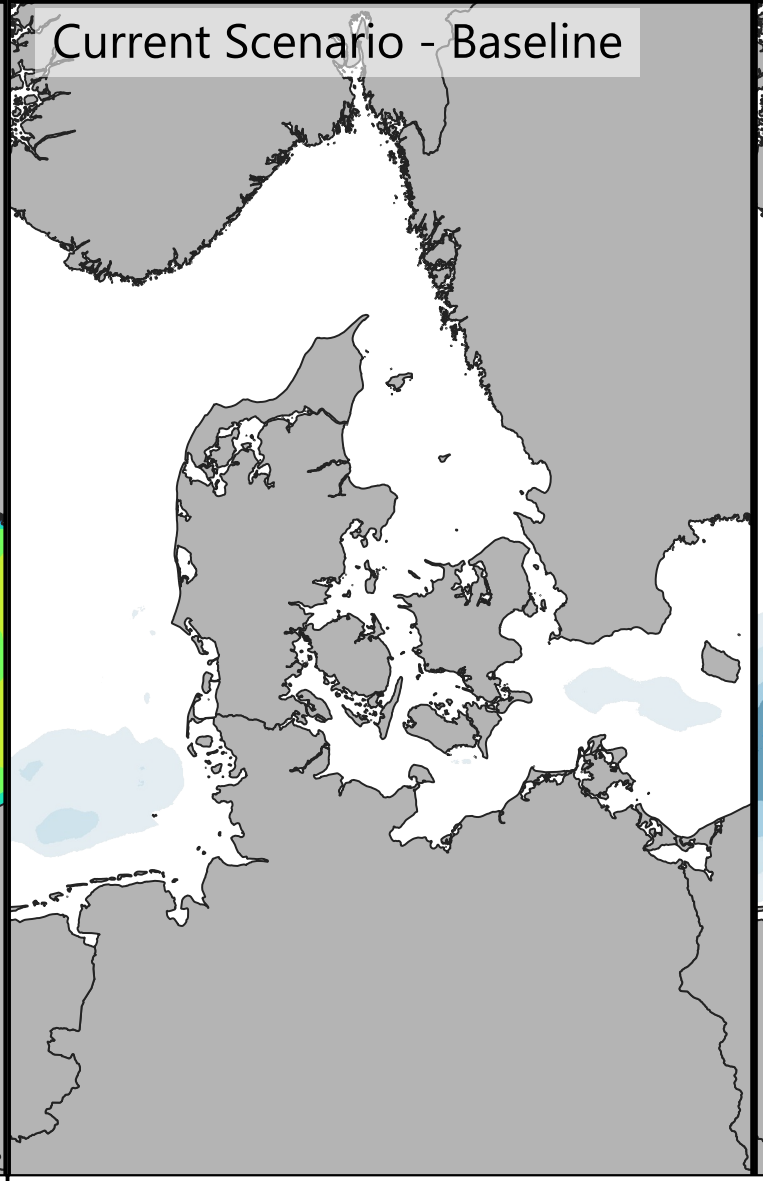
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

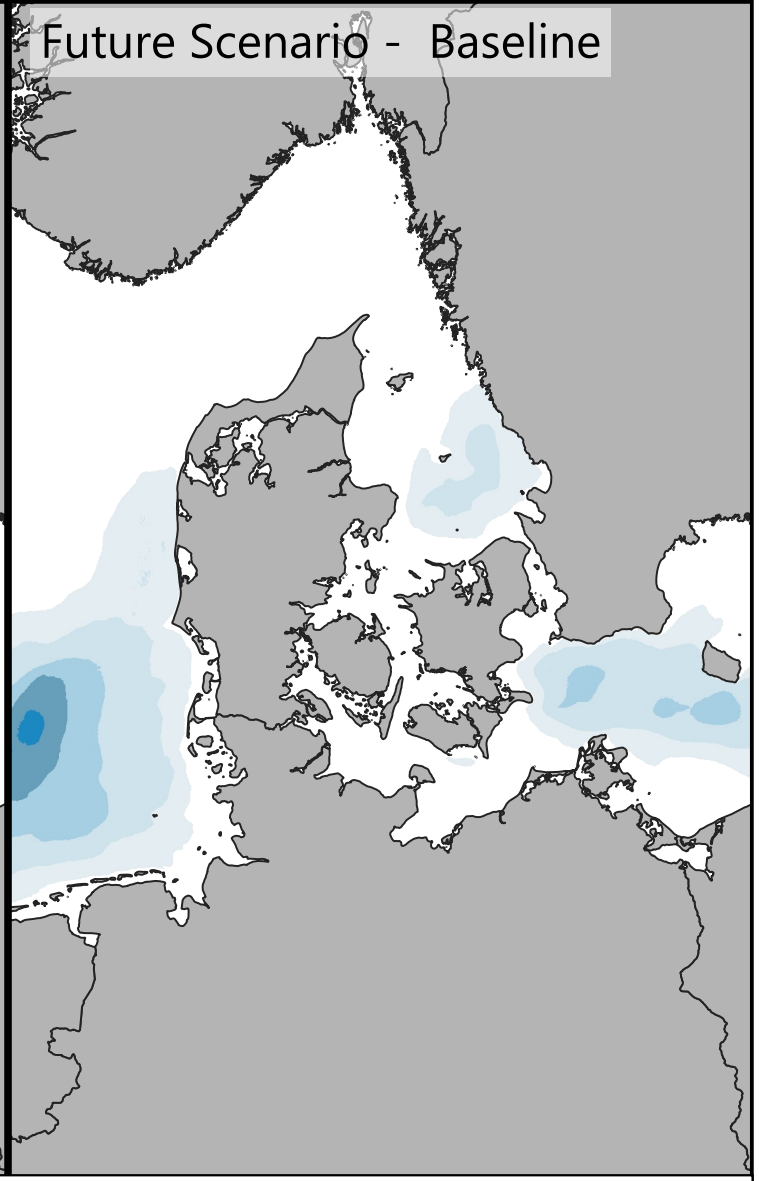
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







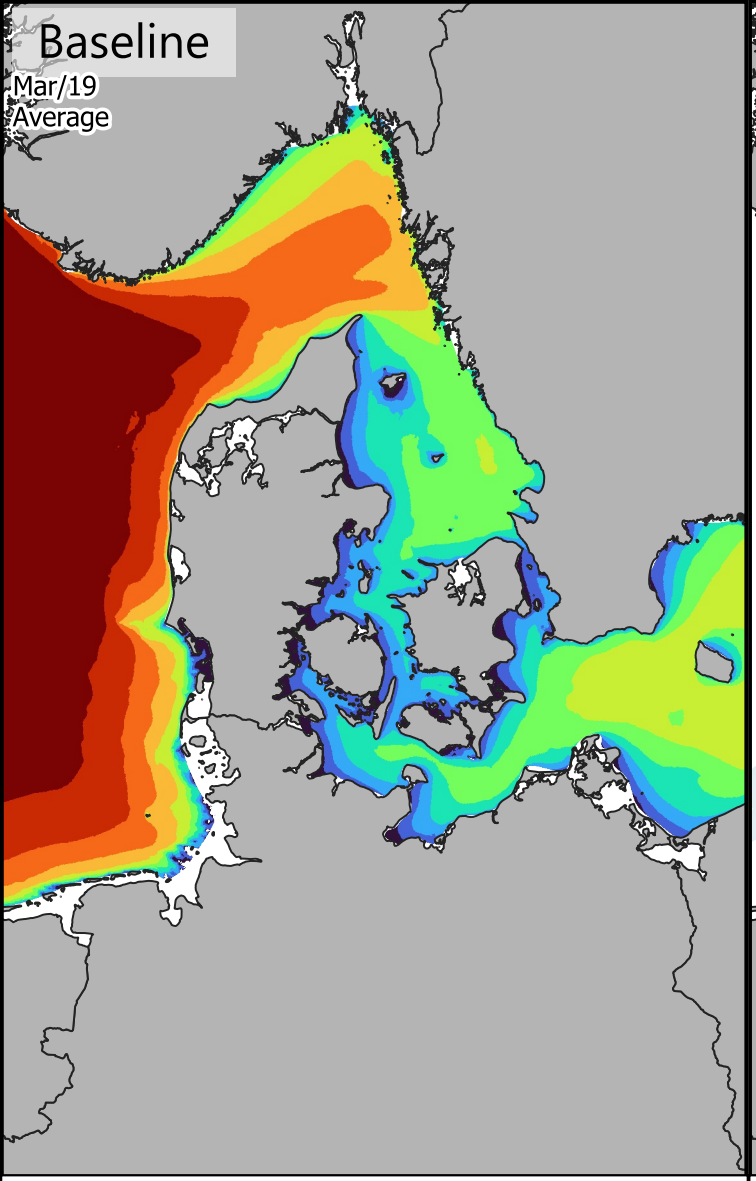
Signignificant Wave Height [m]

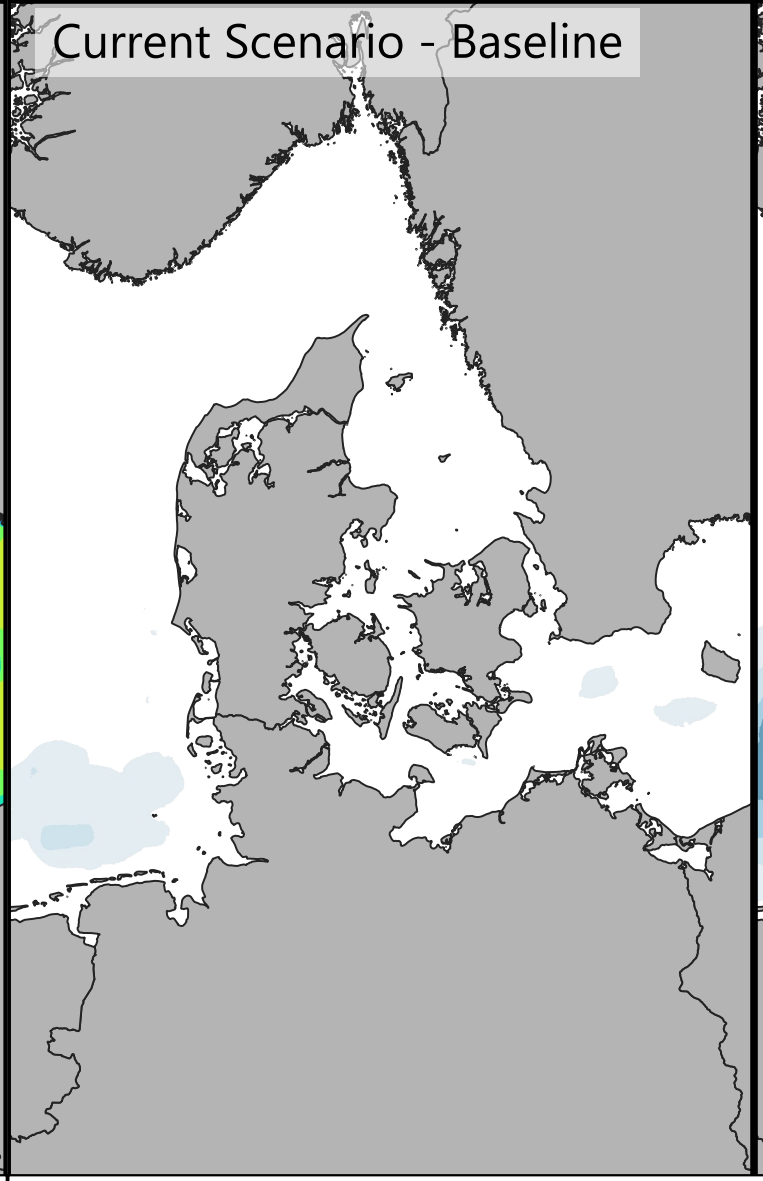
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

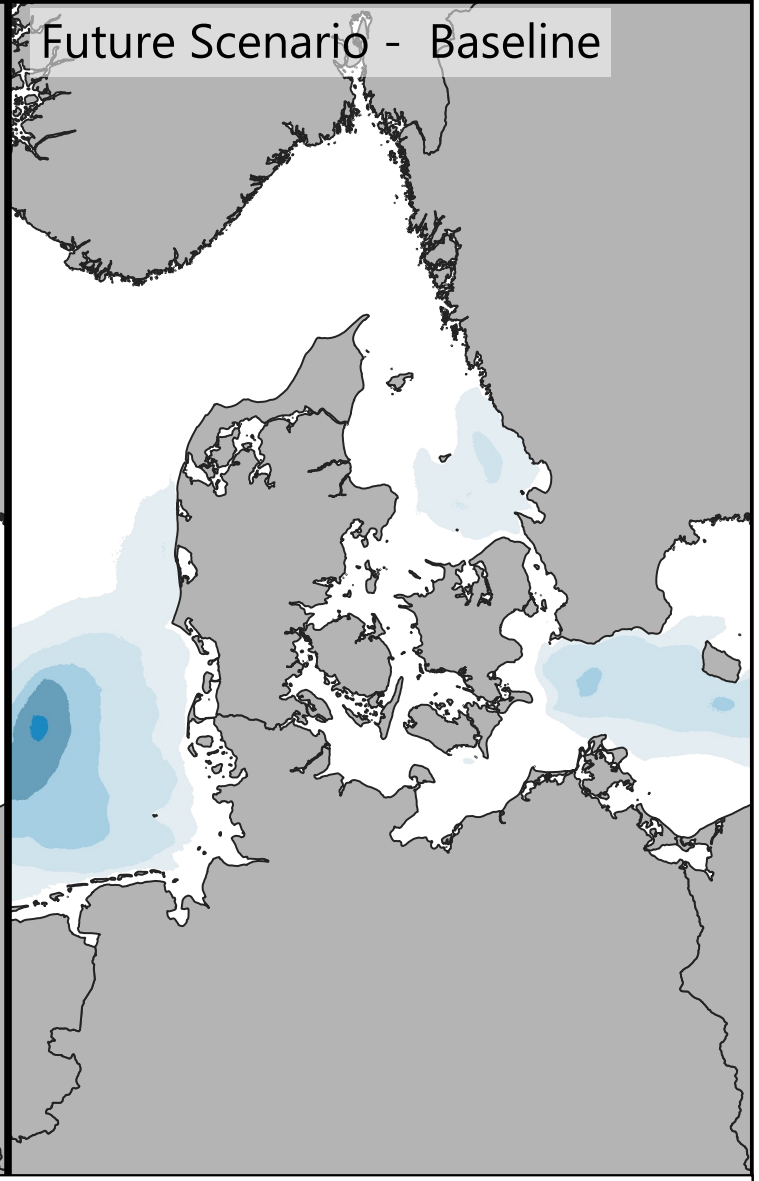
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







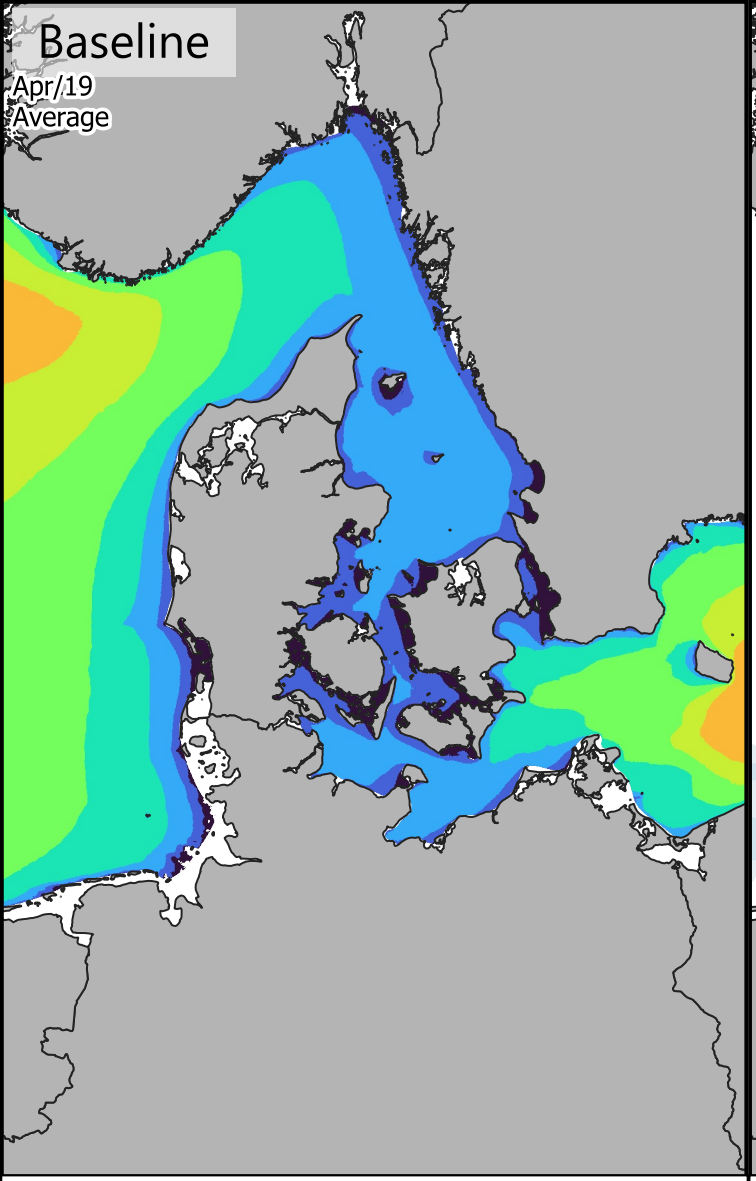
Signignificant Wave Height [m]

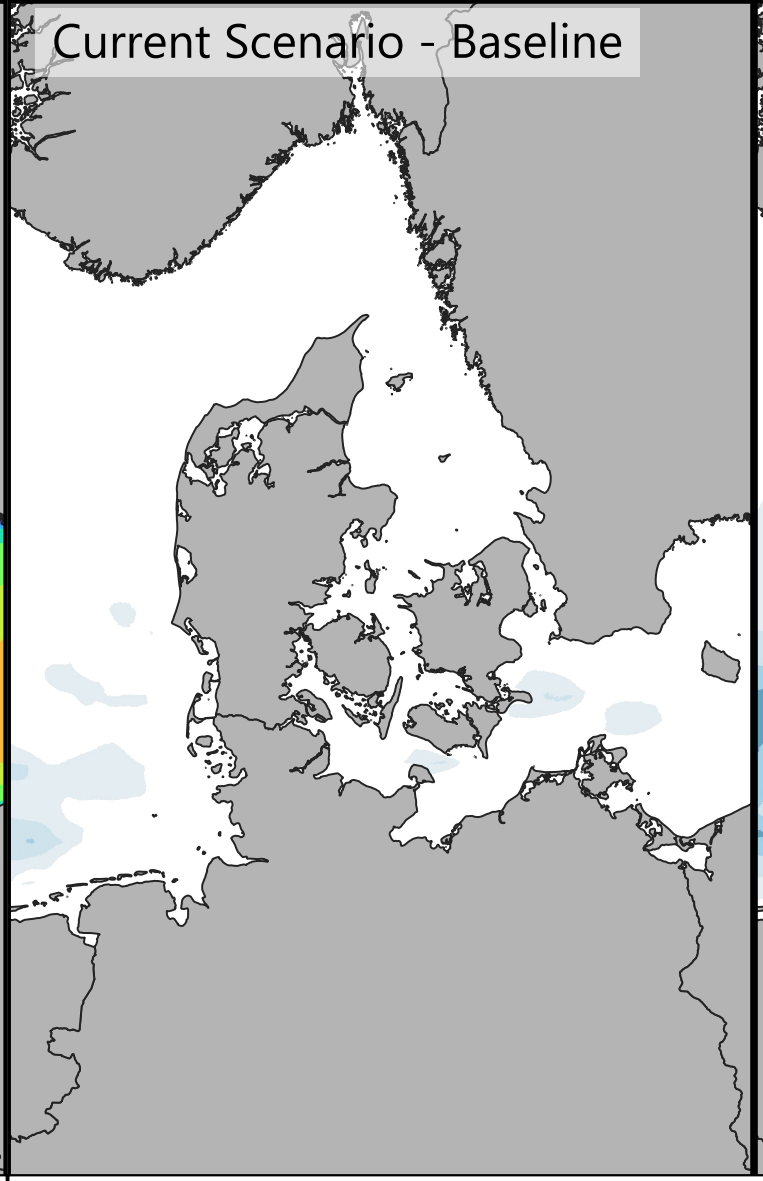
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

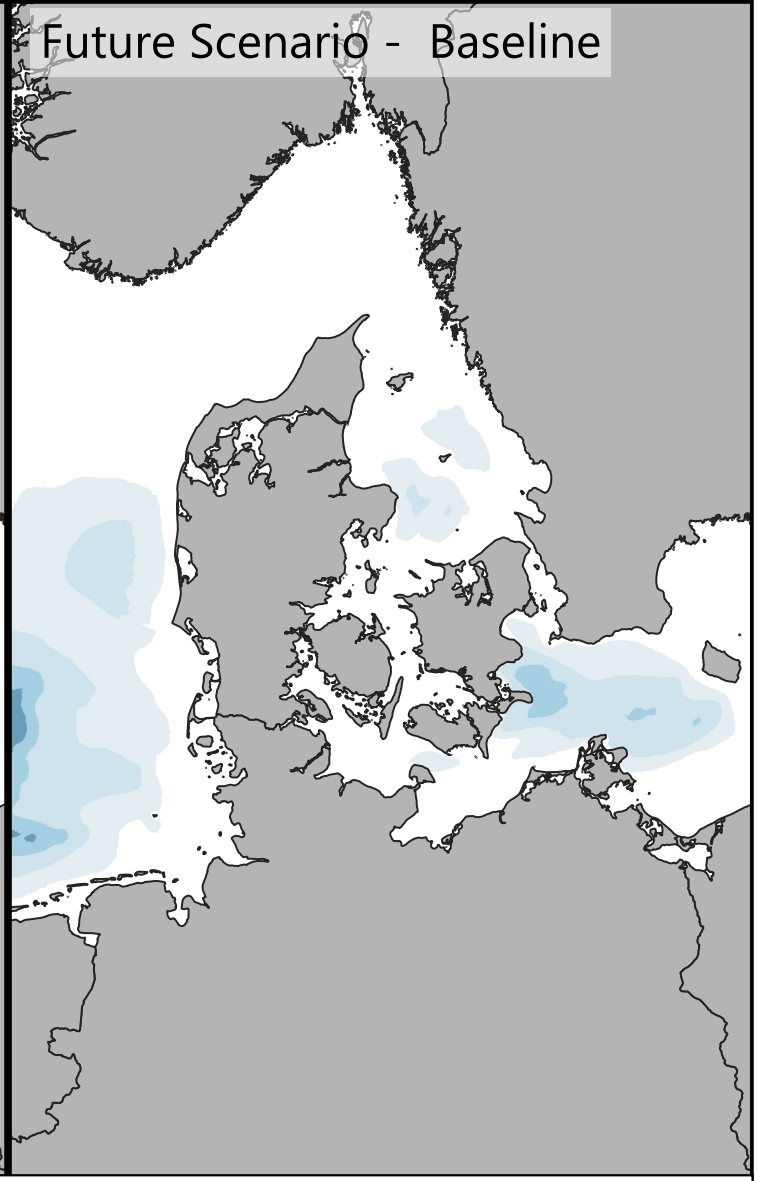
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







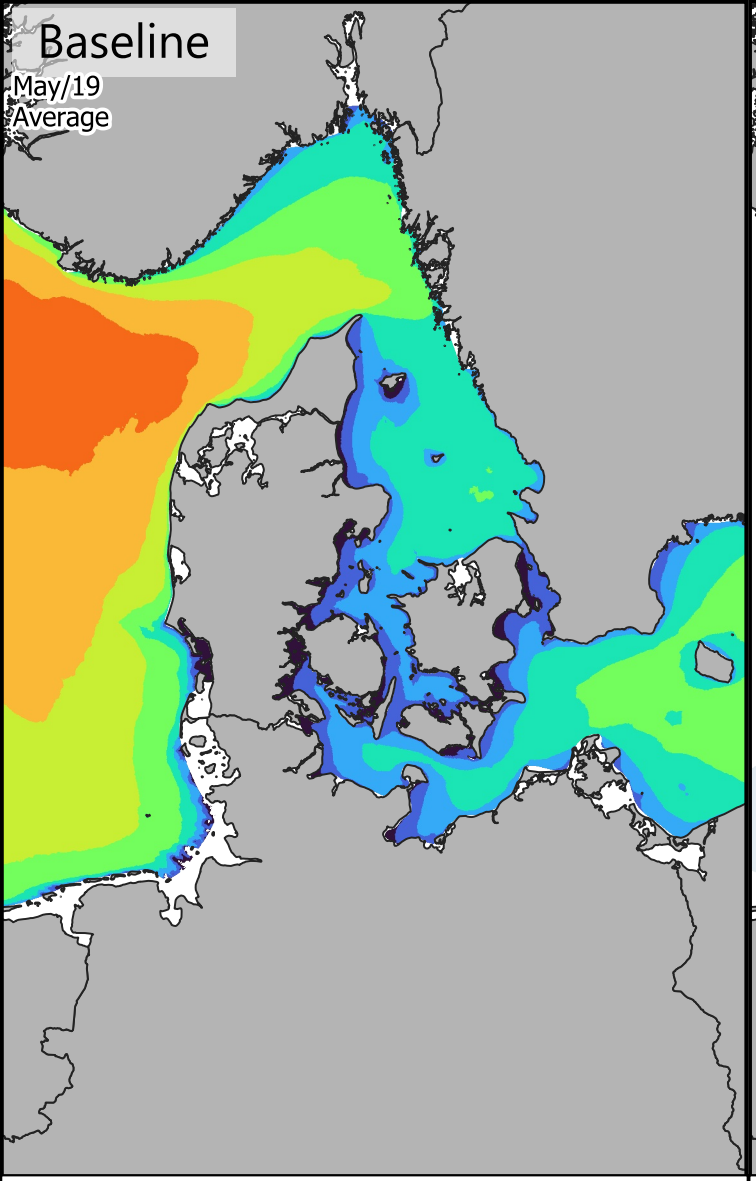
Signignificant Wave Height [m]

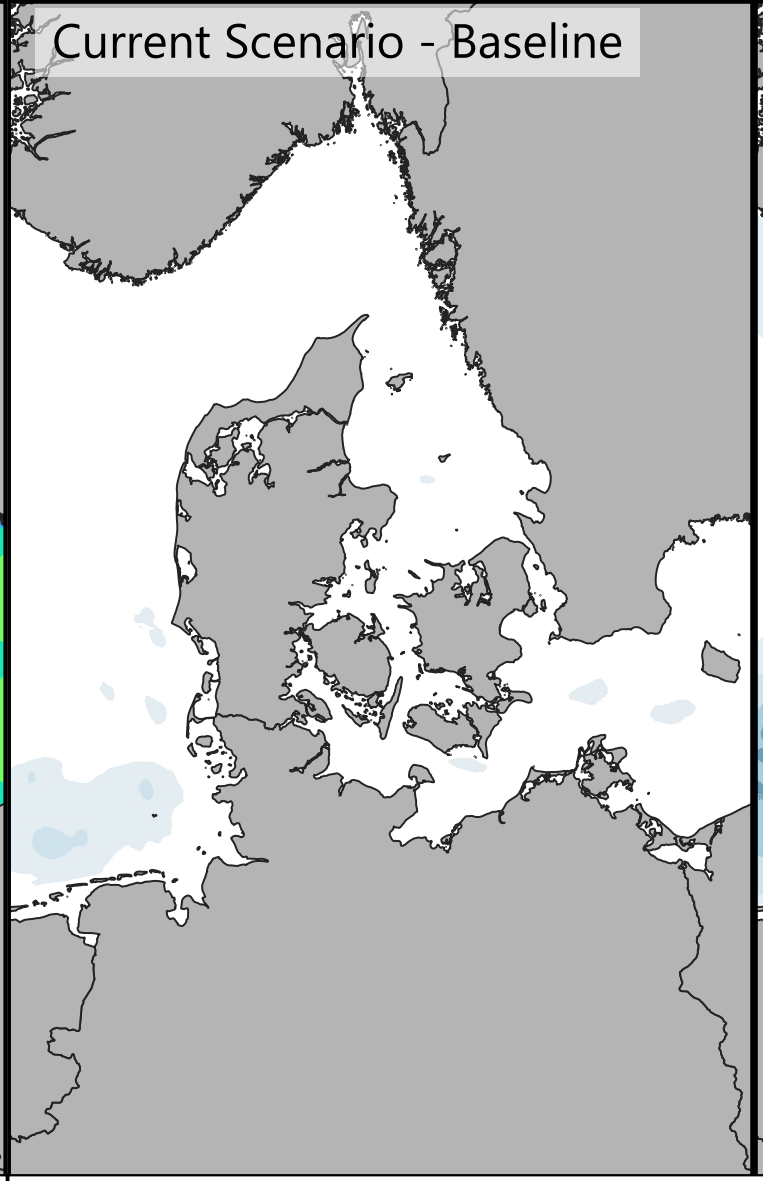
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

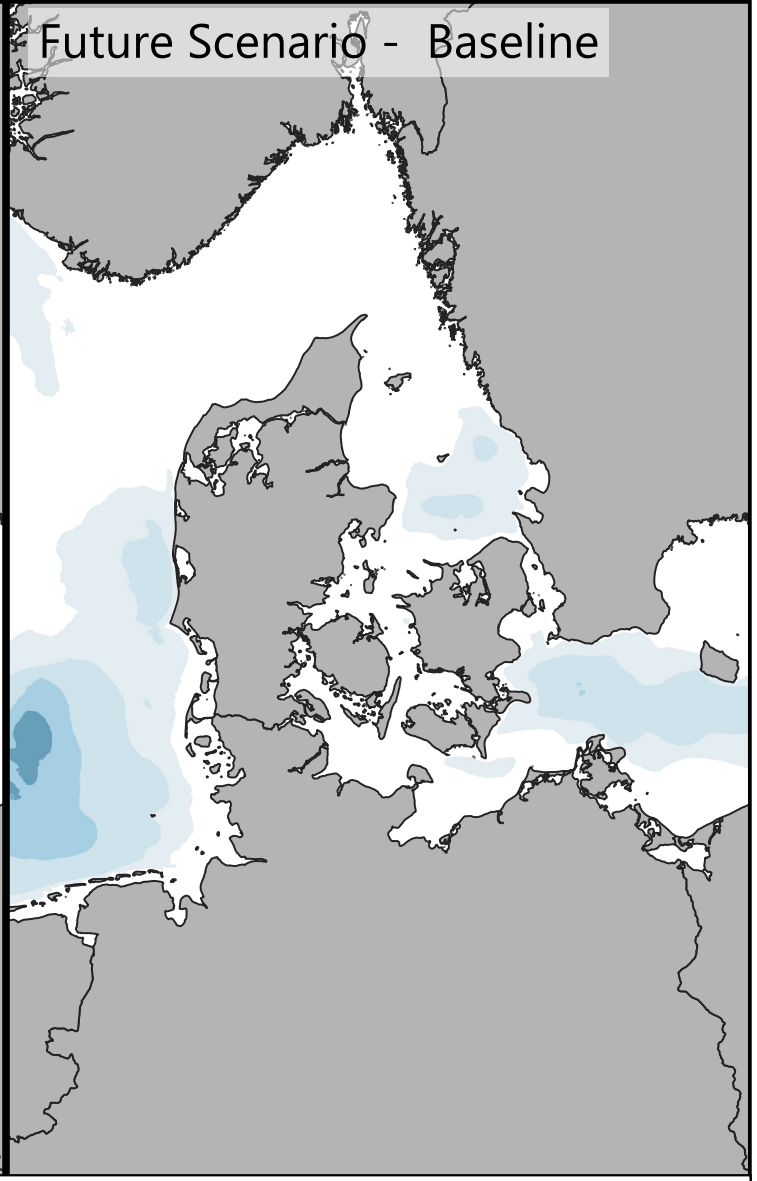
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







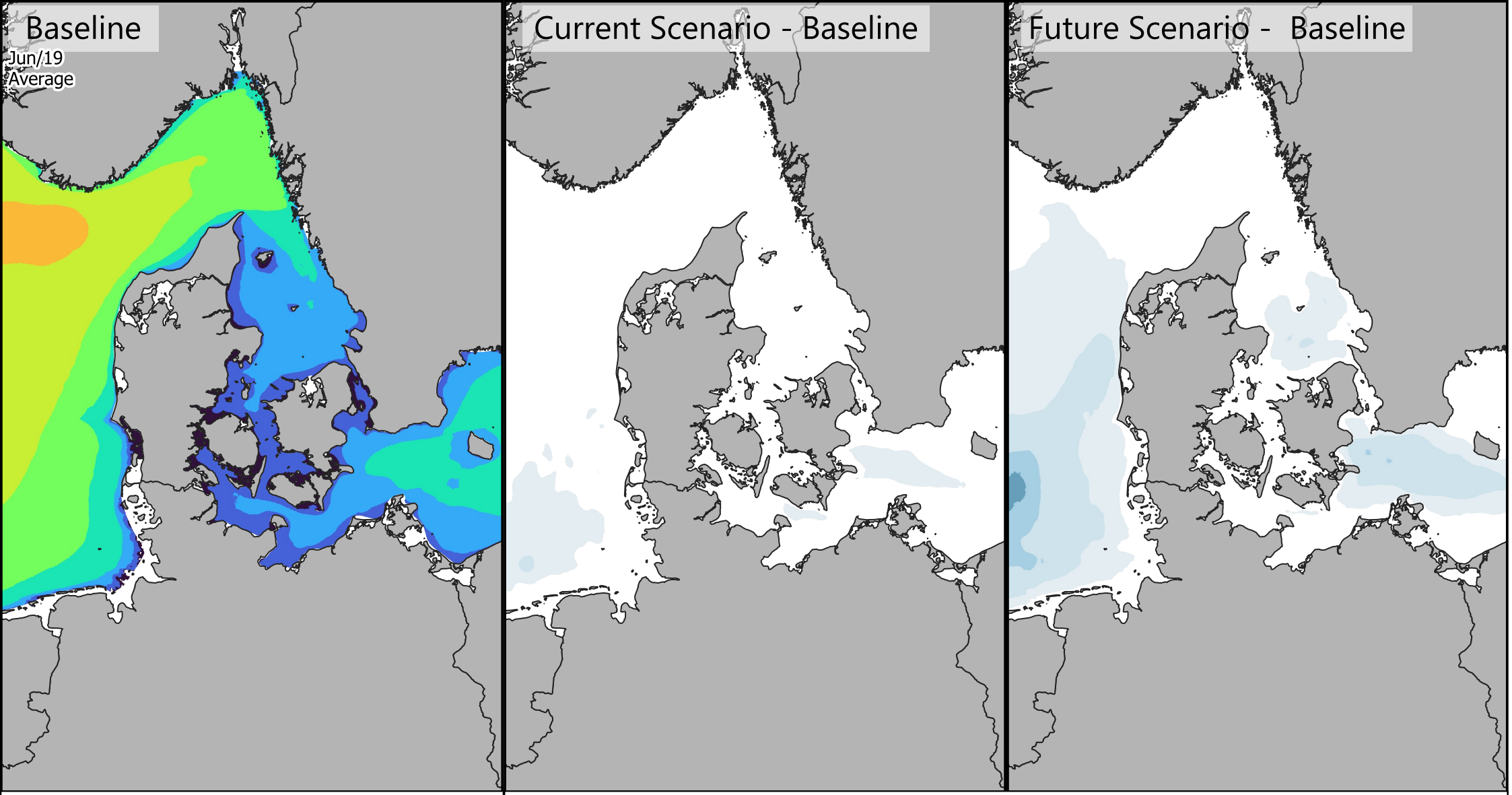
Signignificant Wave Height [m]

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km



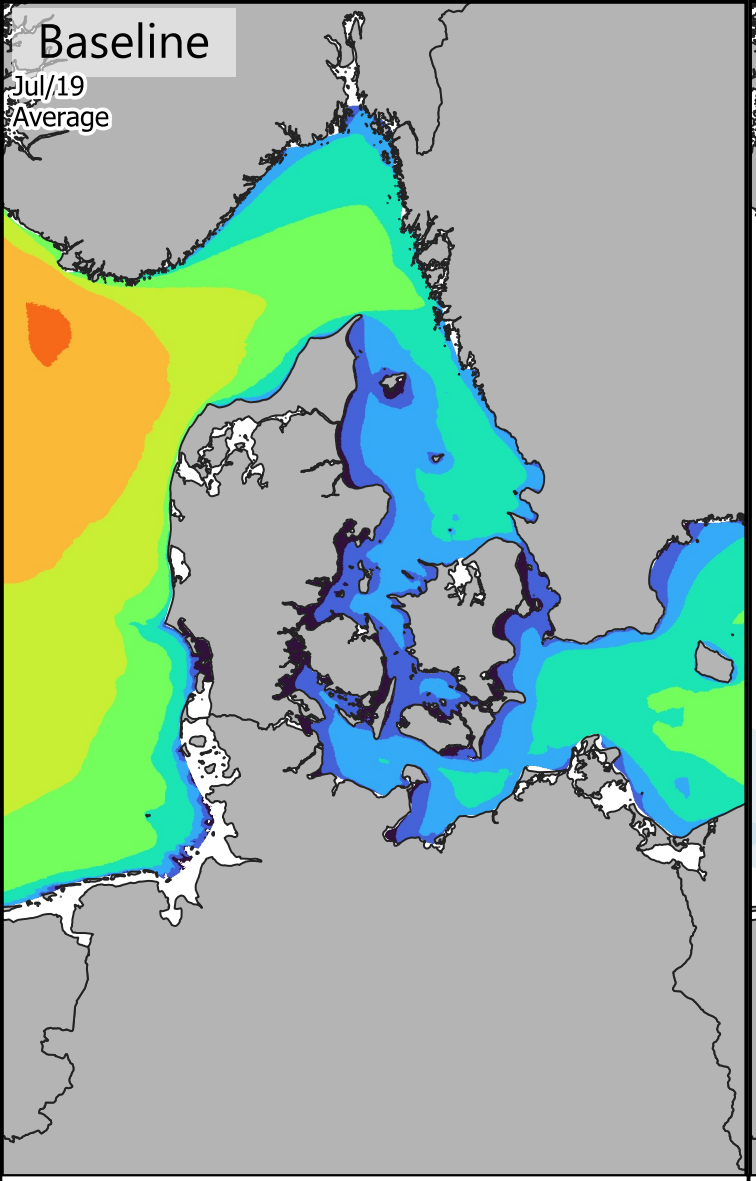
Signignificant Wave Height [m]

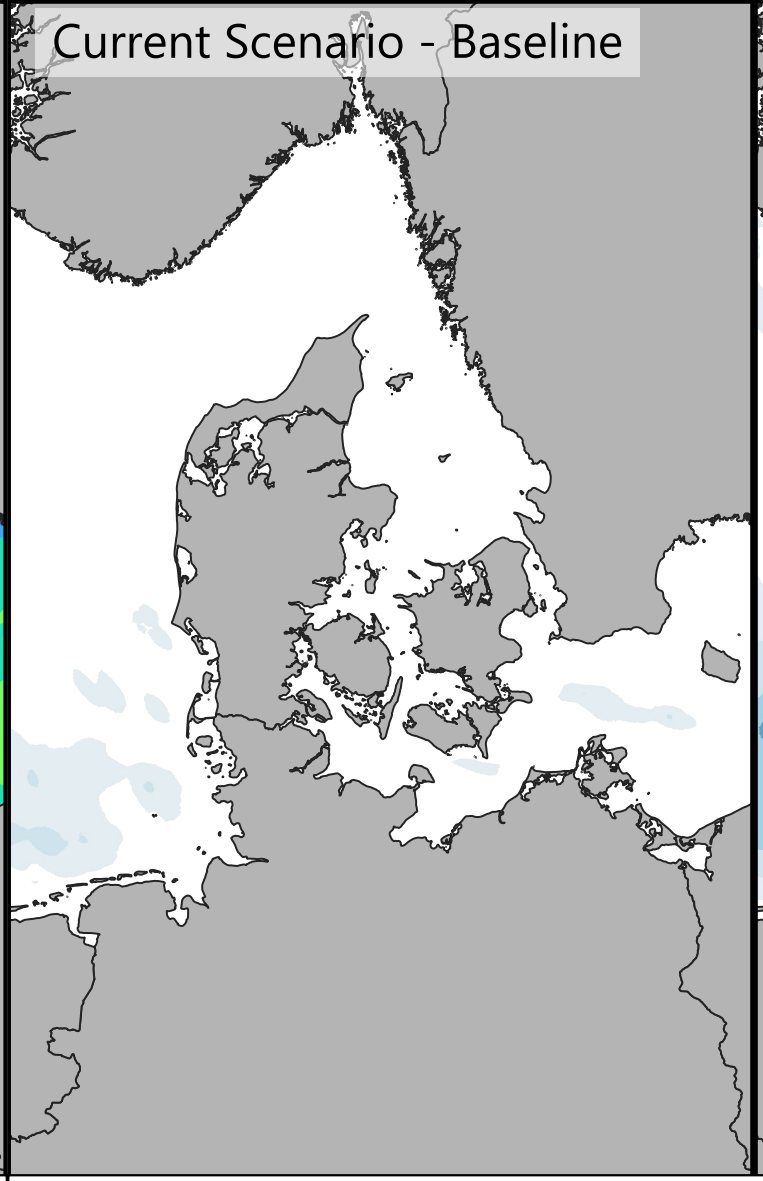
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

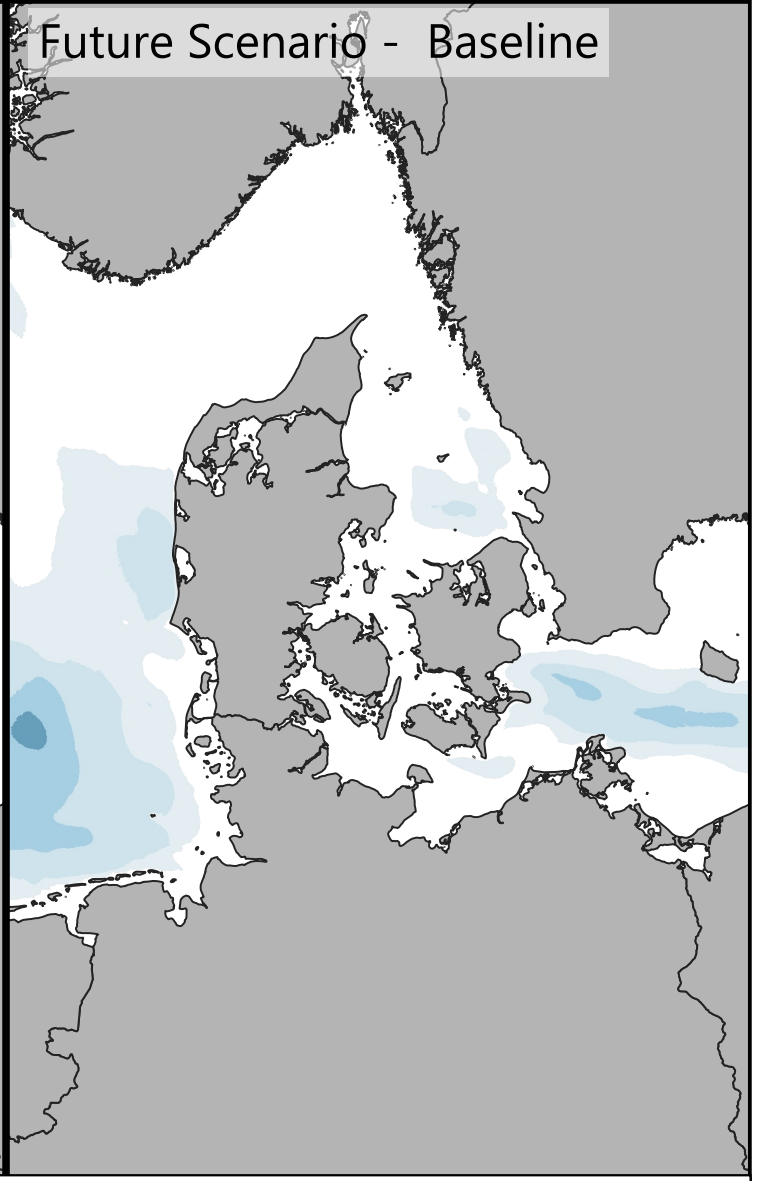
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







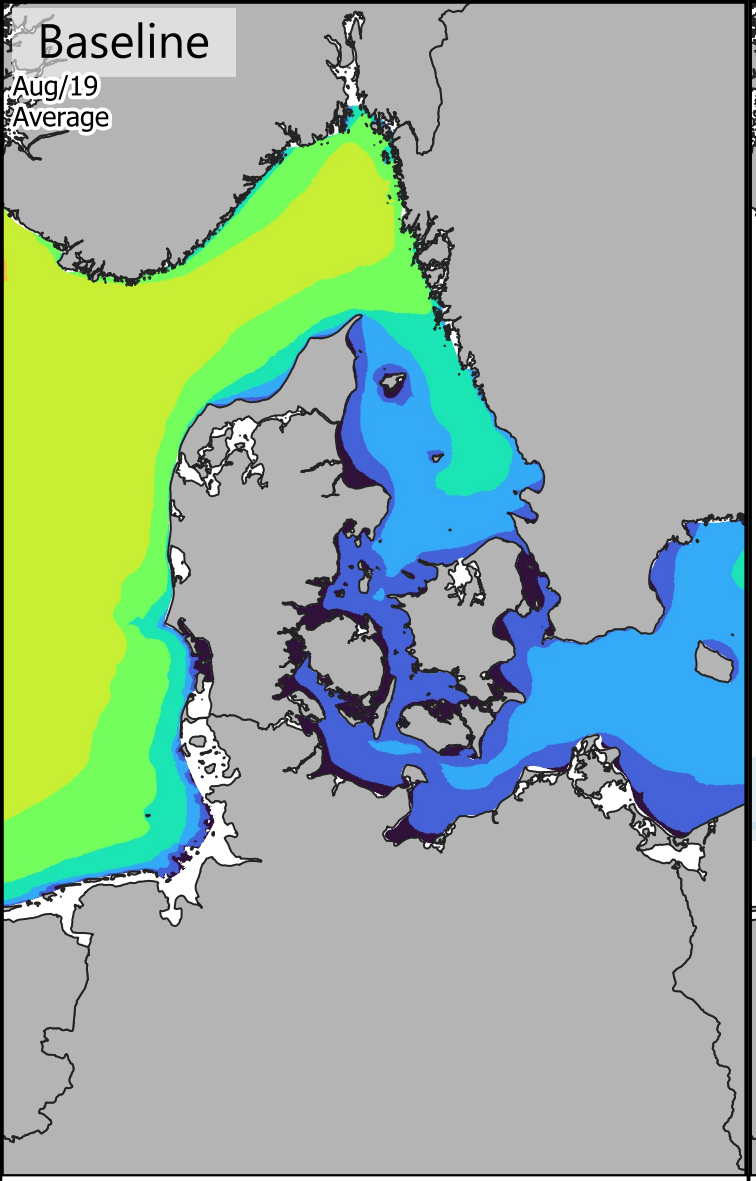
Signignificant Wave Height [m]

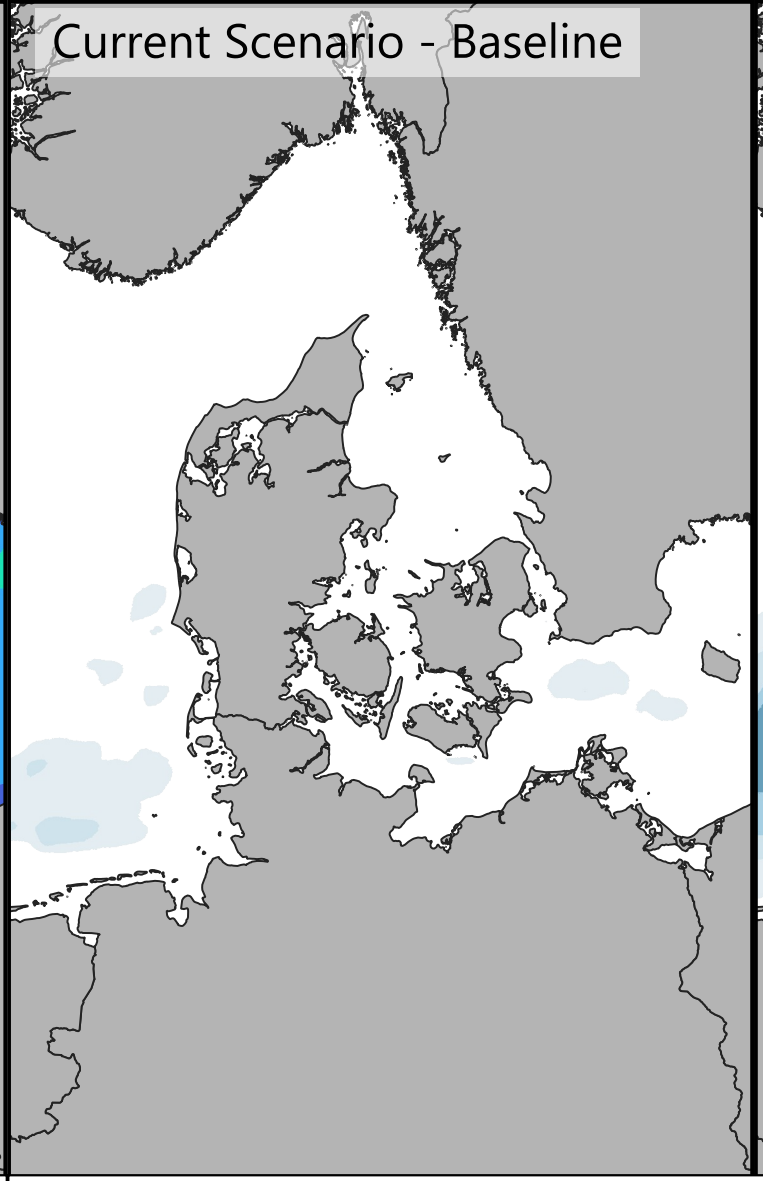
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

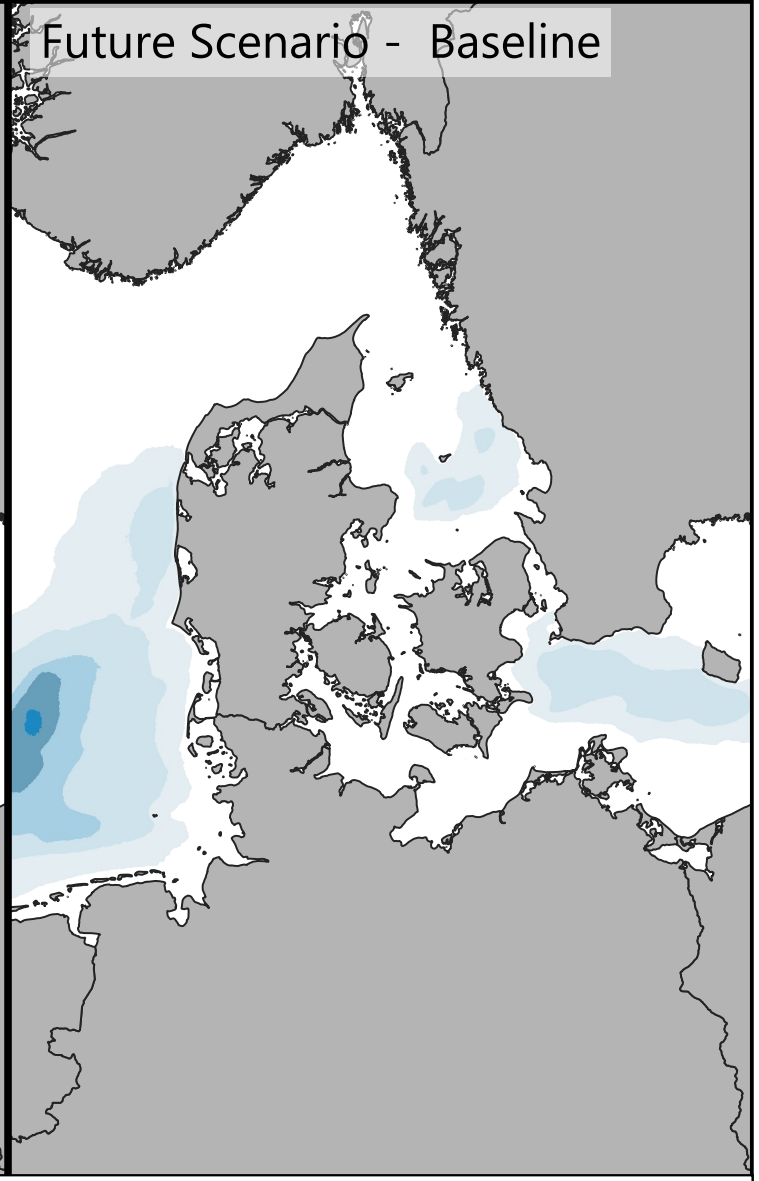
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







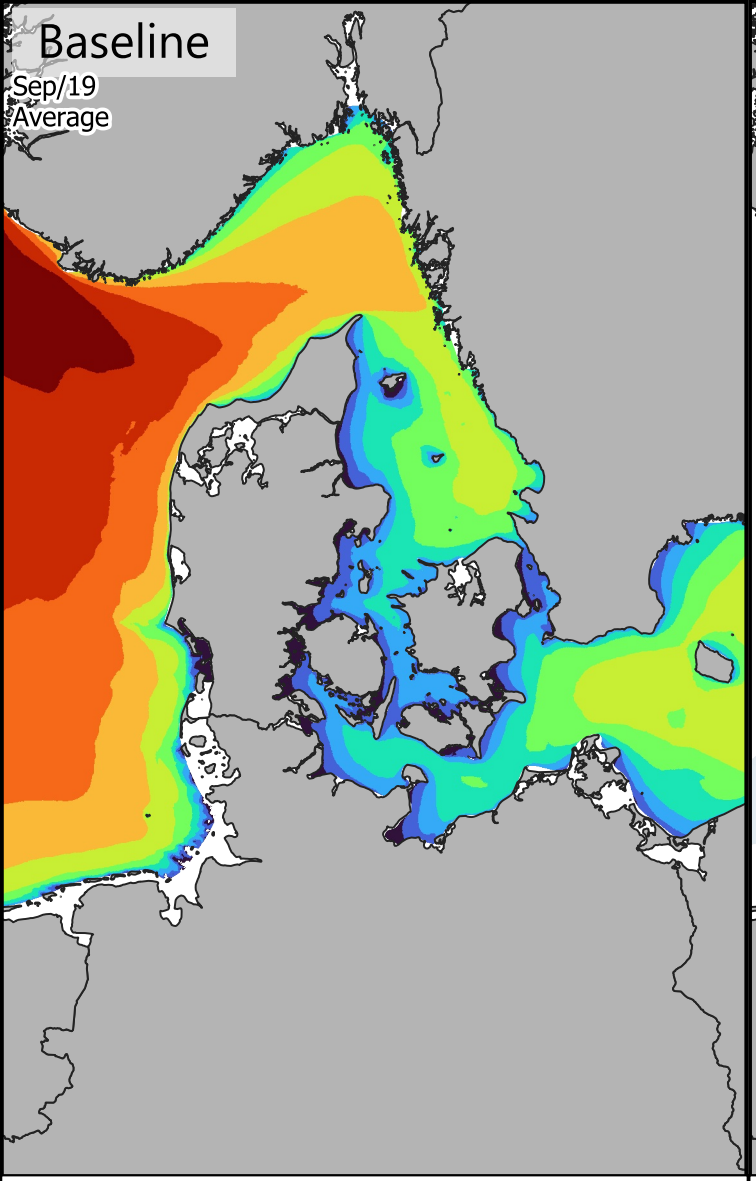
Signignificant Wave Height [m]

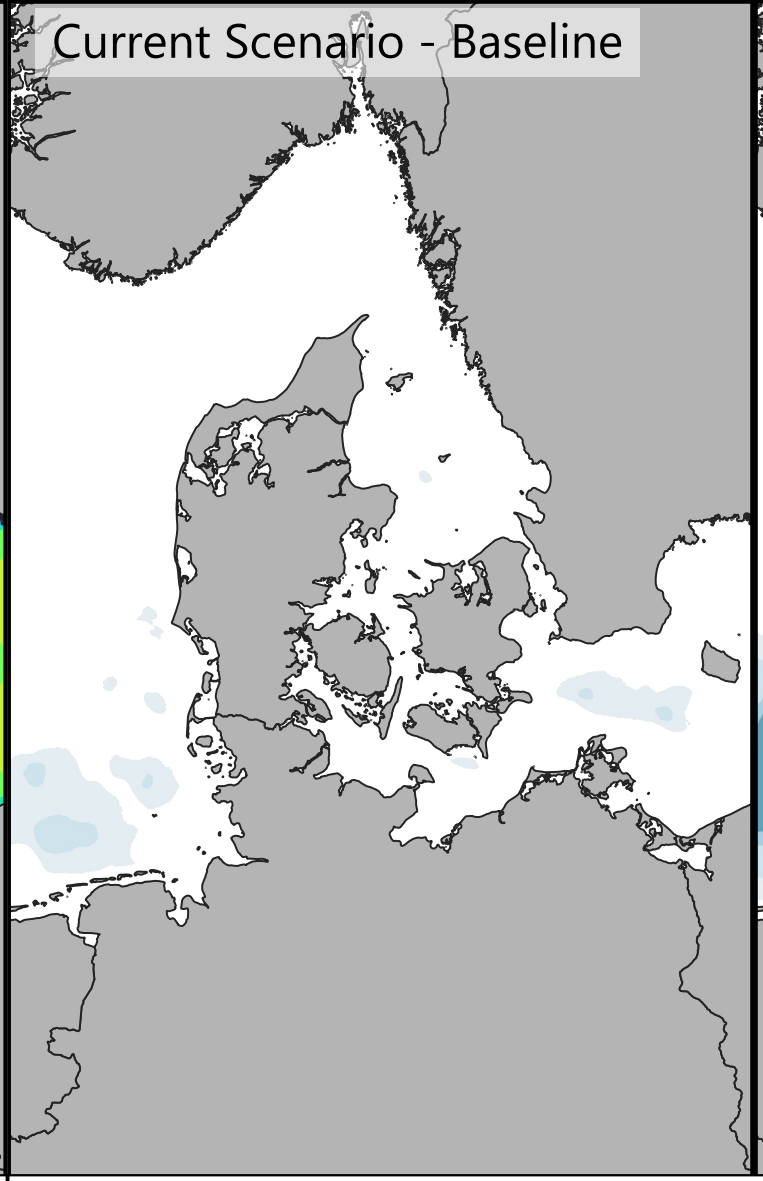
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

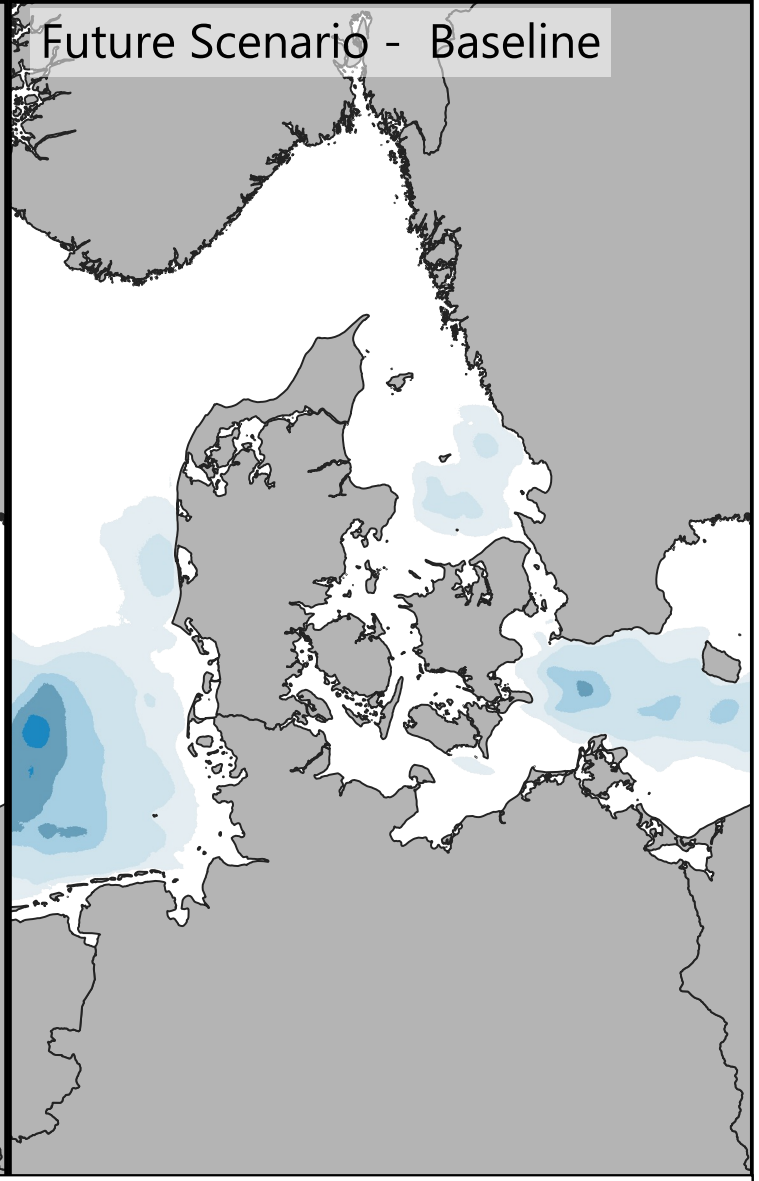
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







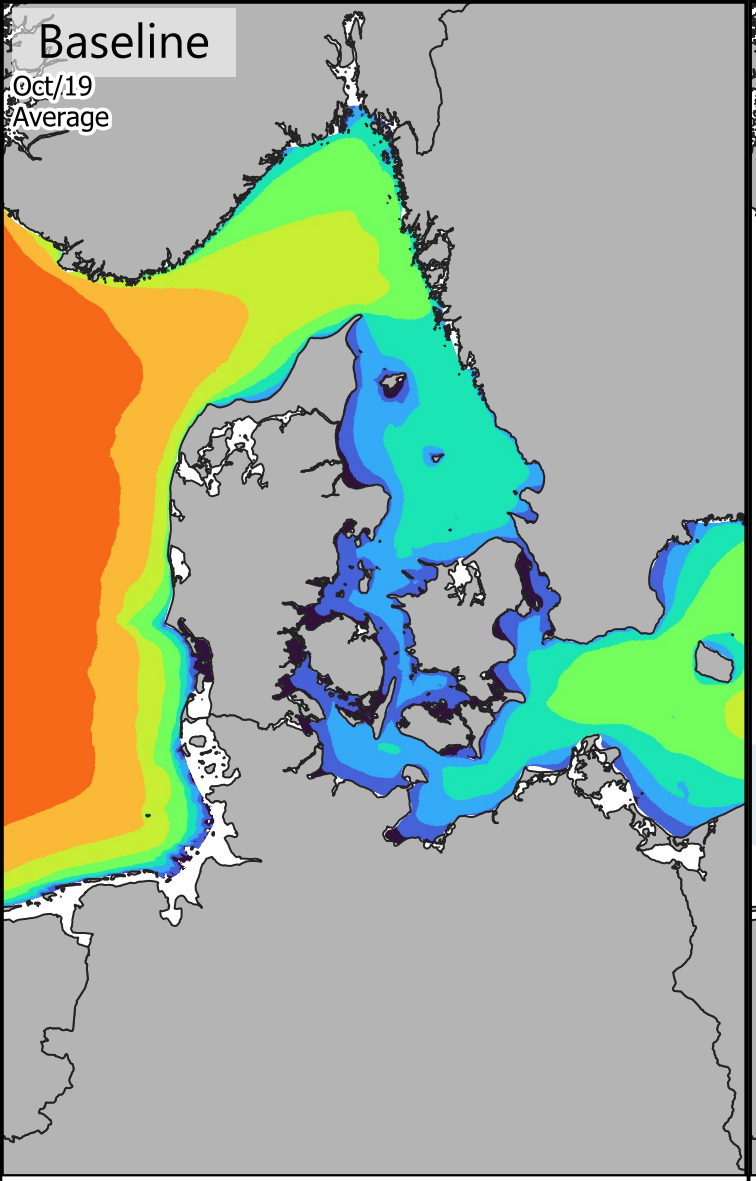
Signignificant Wave Height [m]

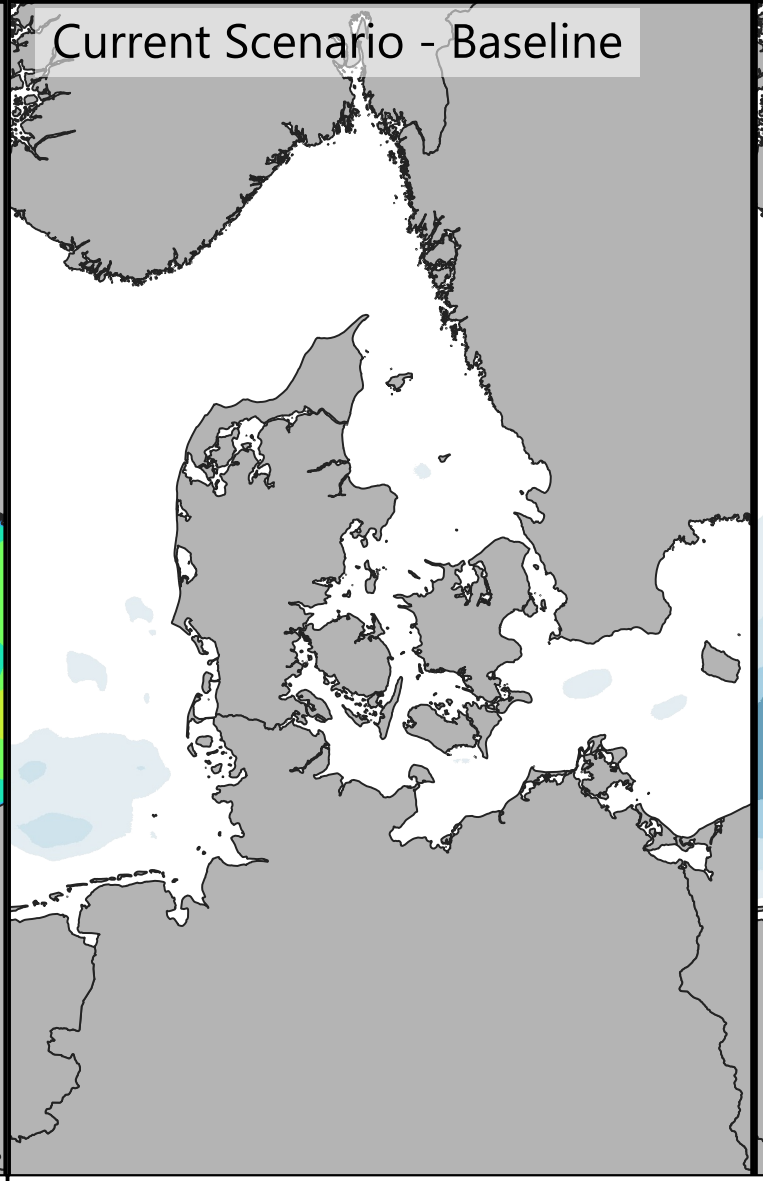
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

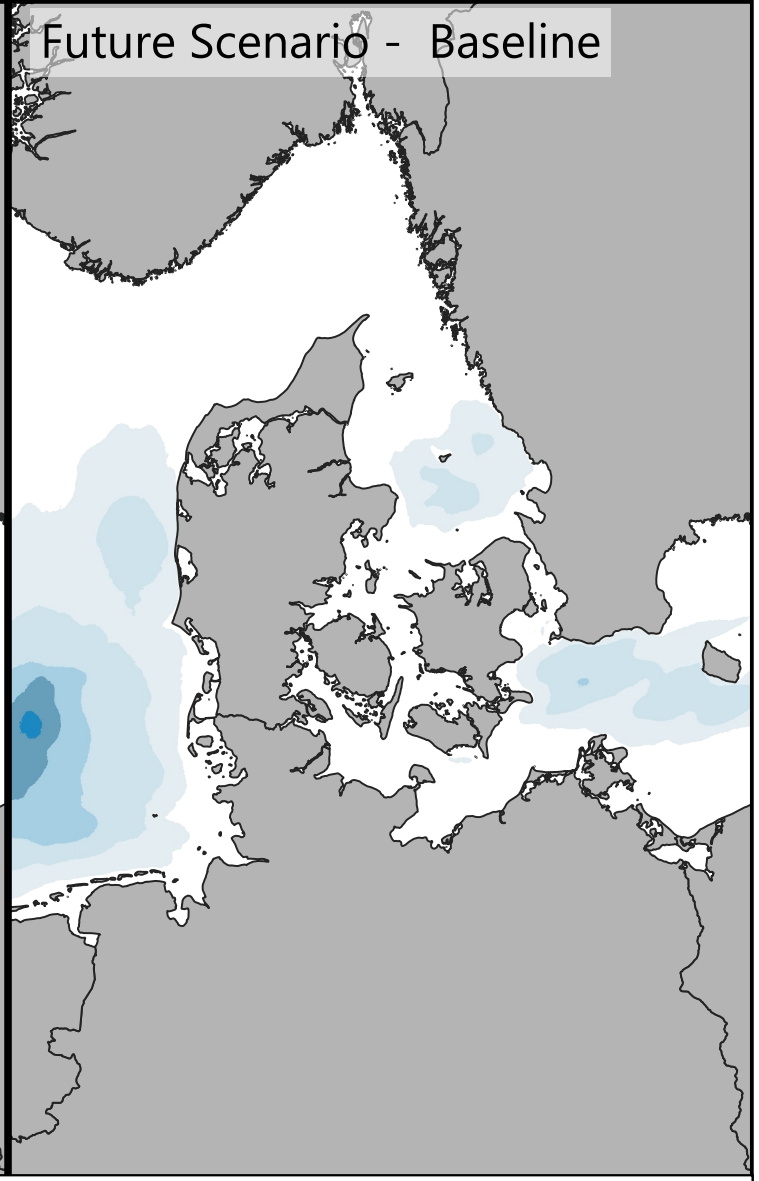
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







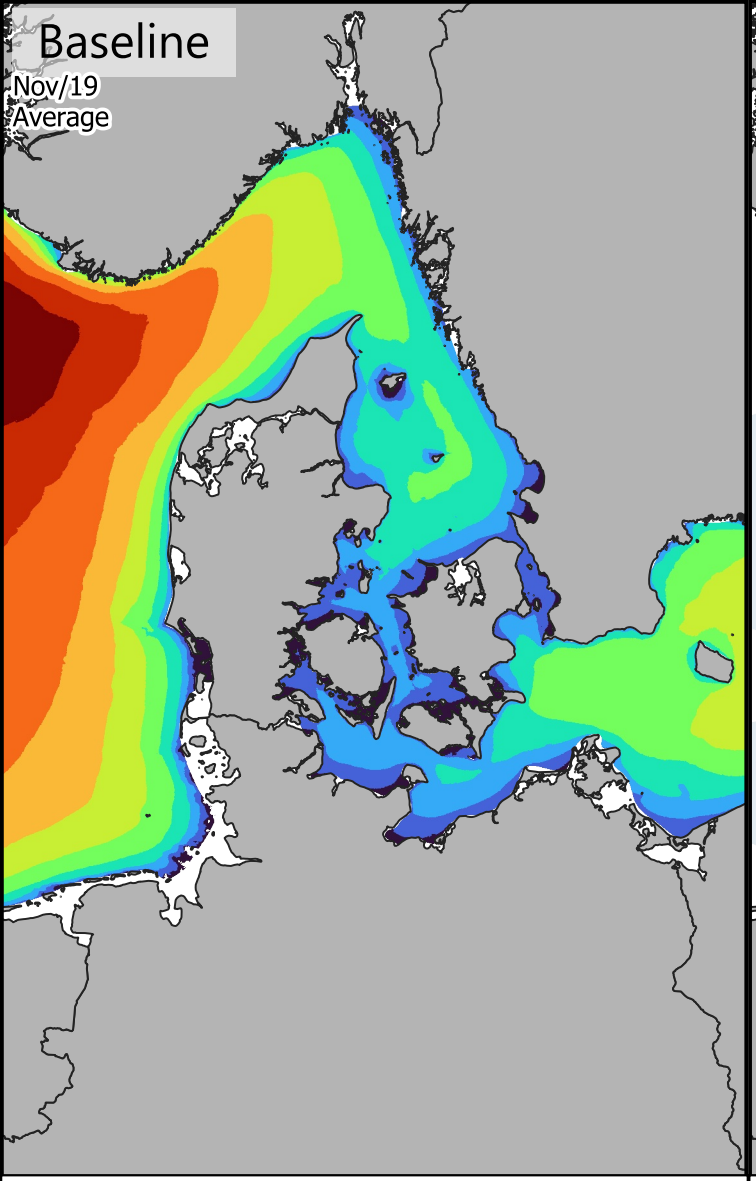
Signignificant Wave Height [m]

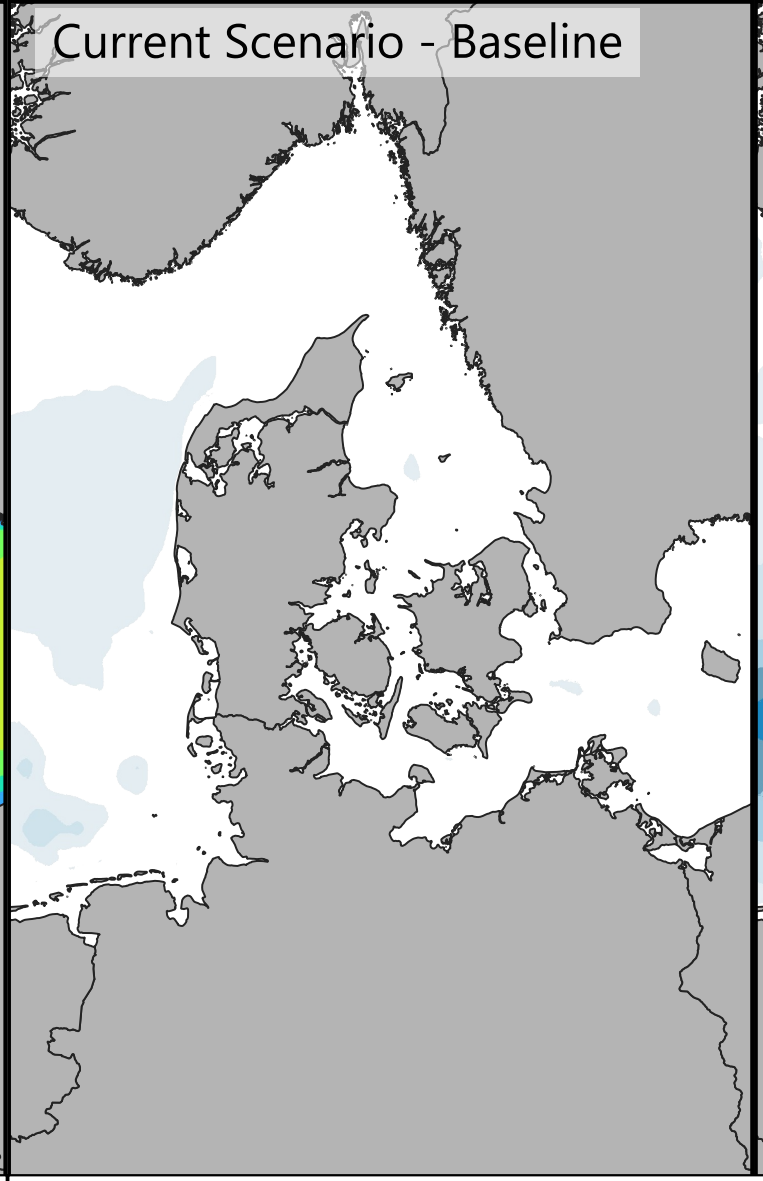
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

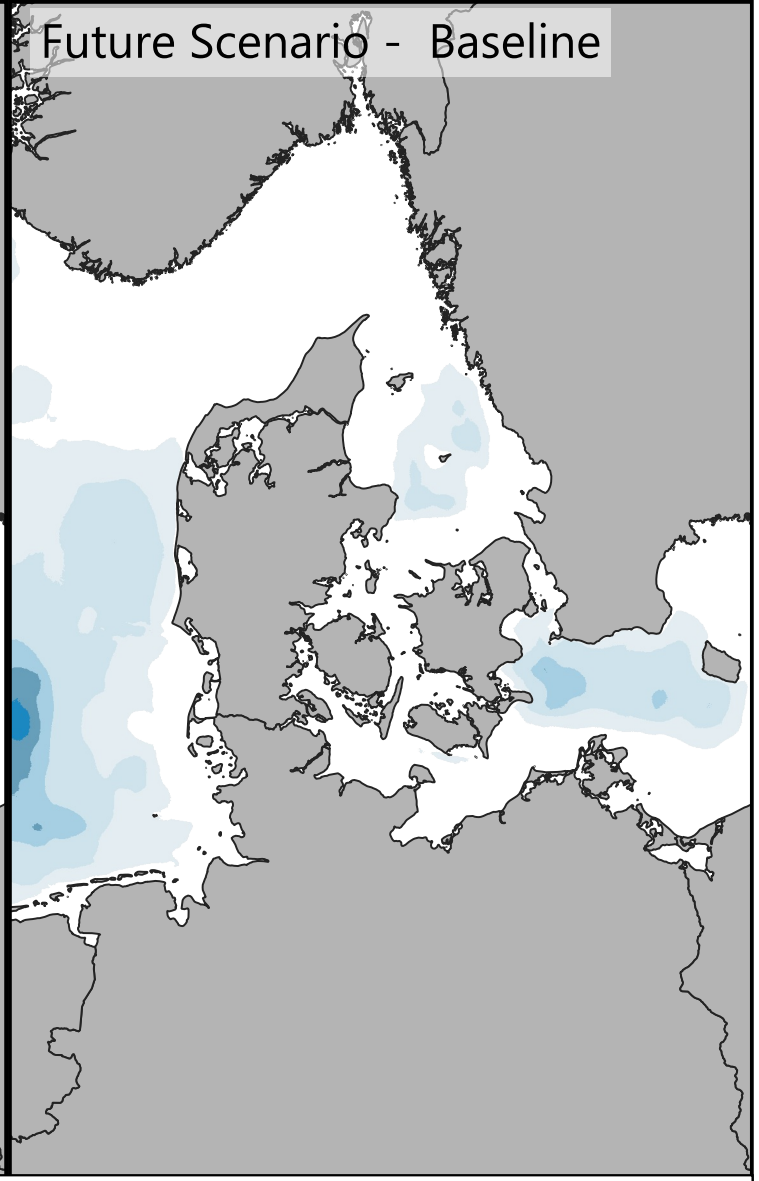
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







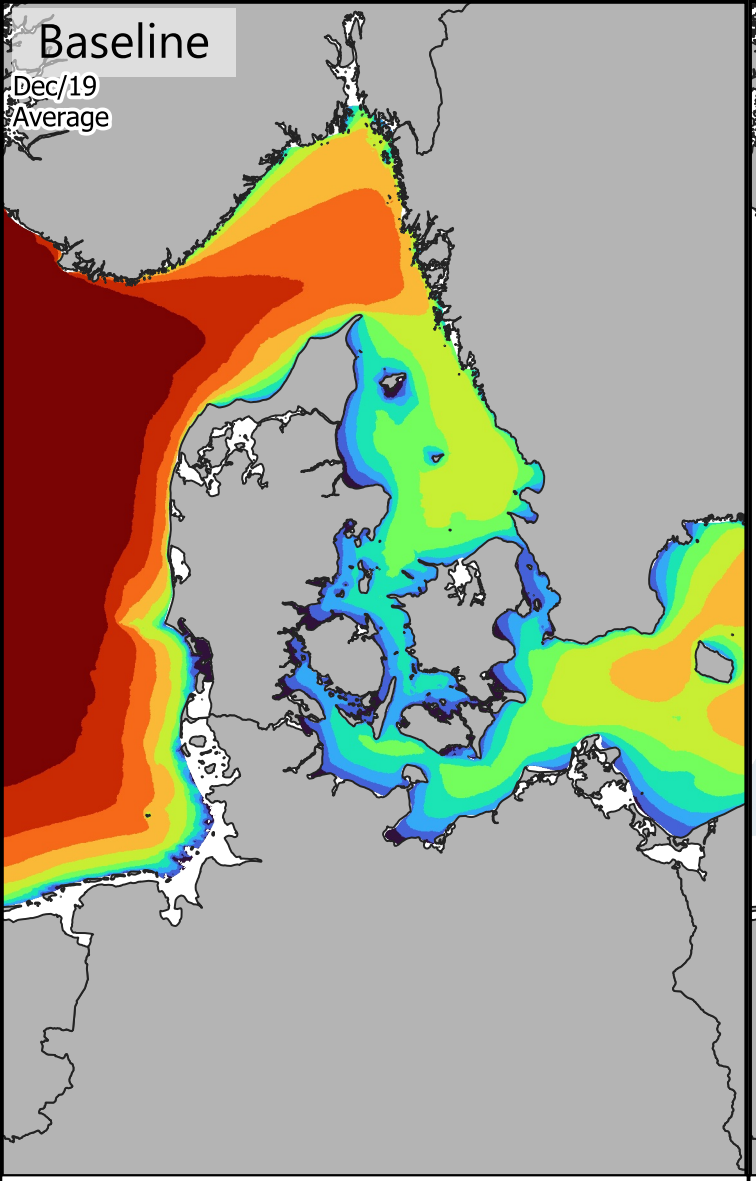
Signignificant Wave Height [m]

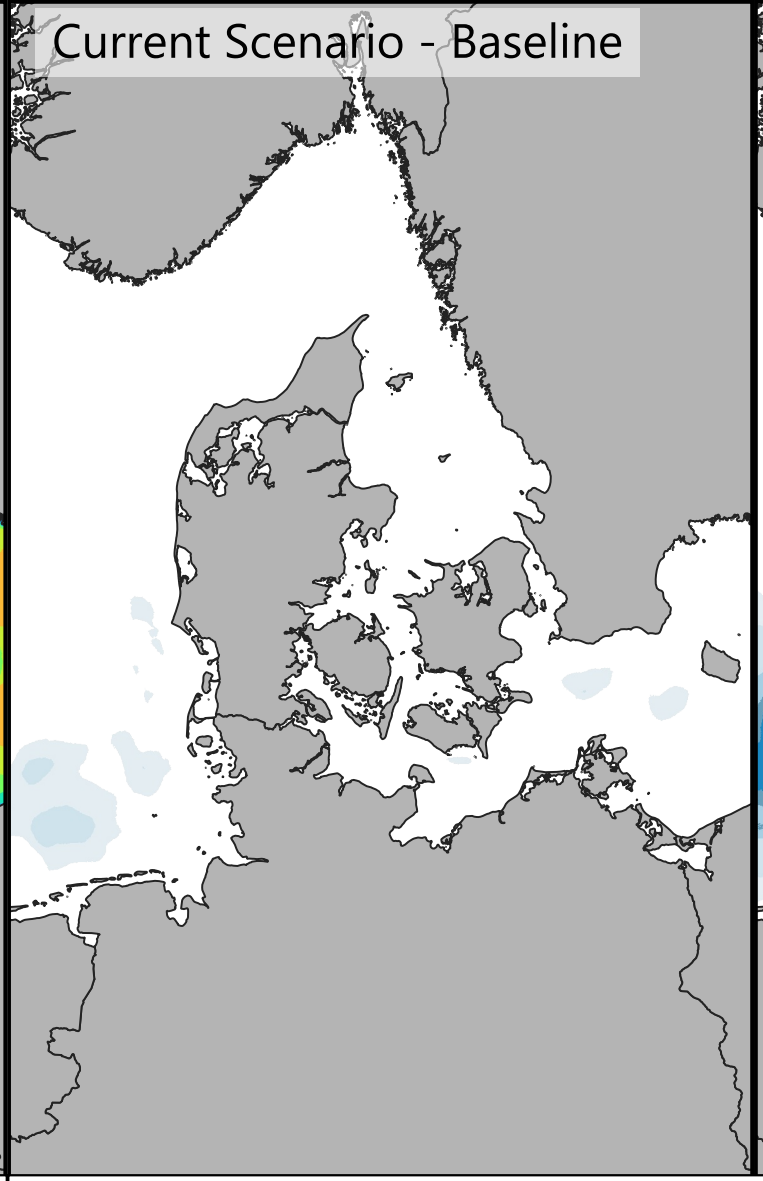
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

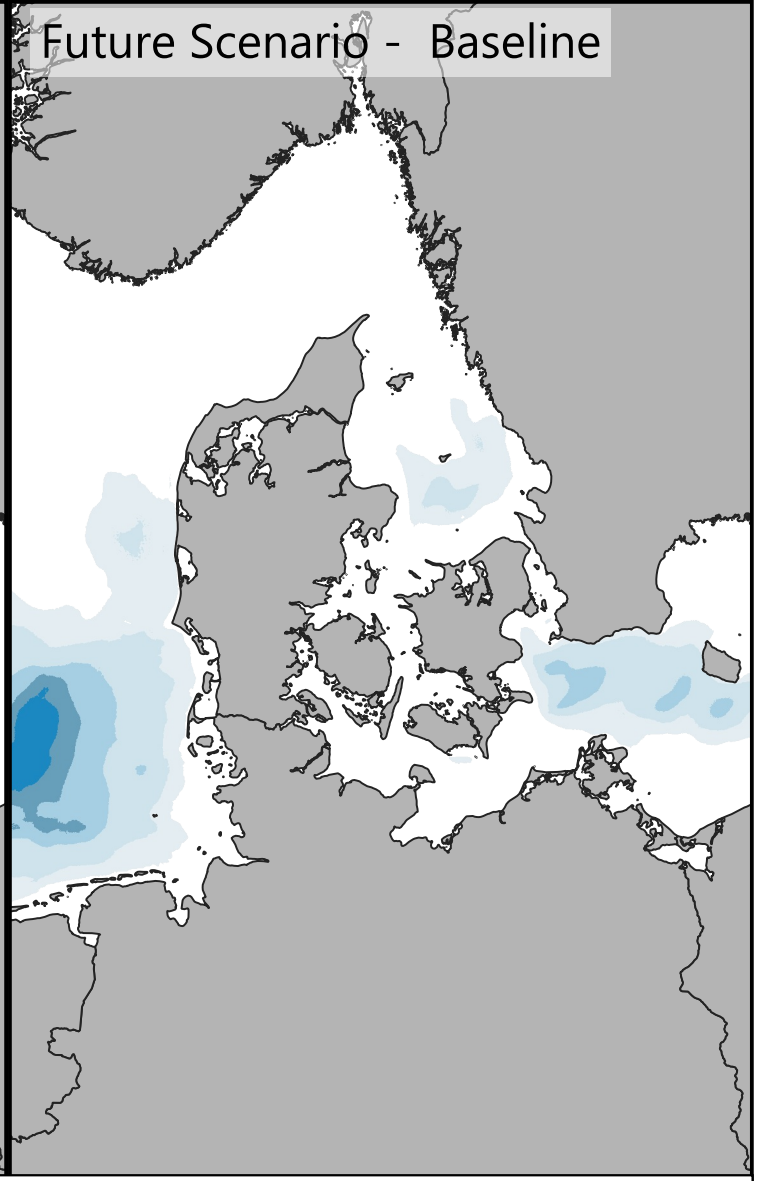
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







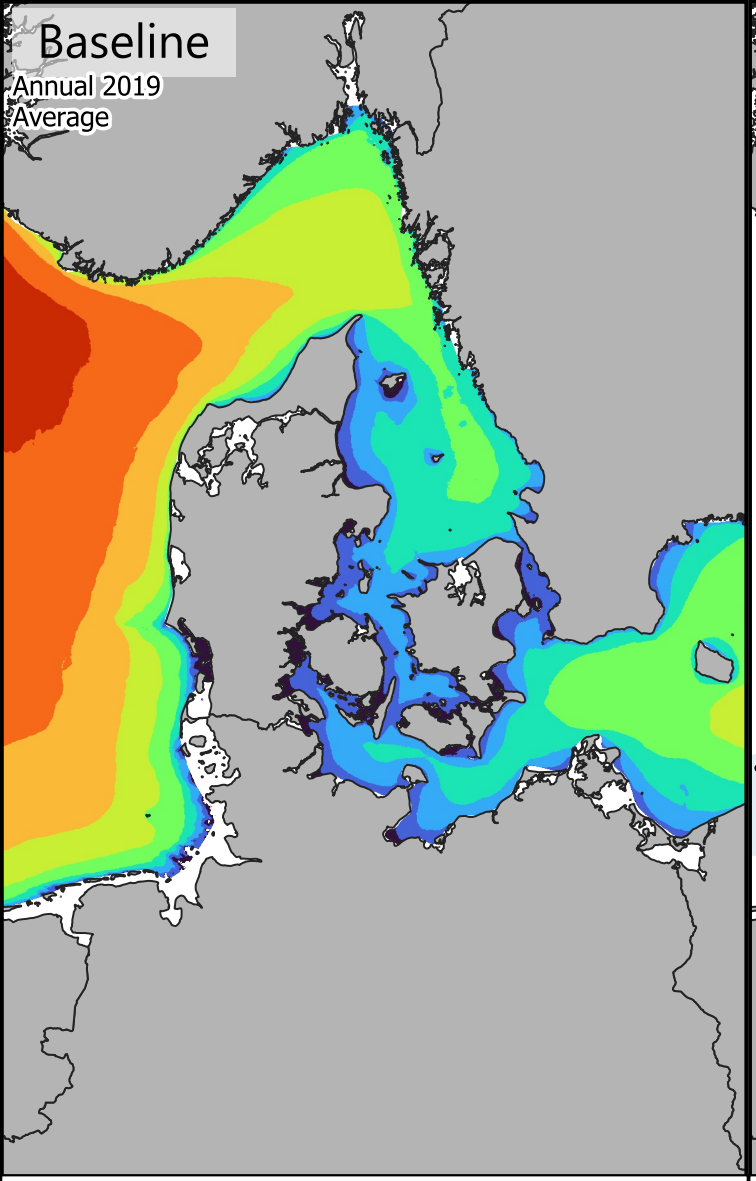
Signignificant Wave Height [m]

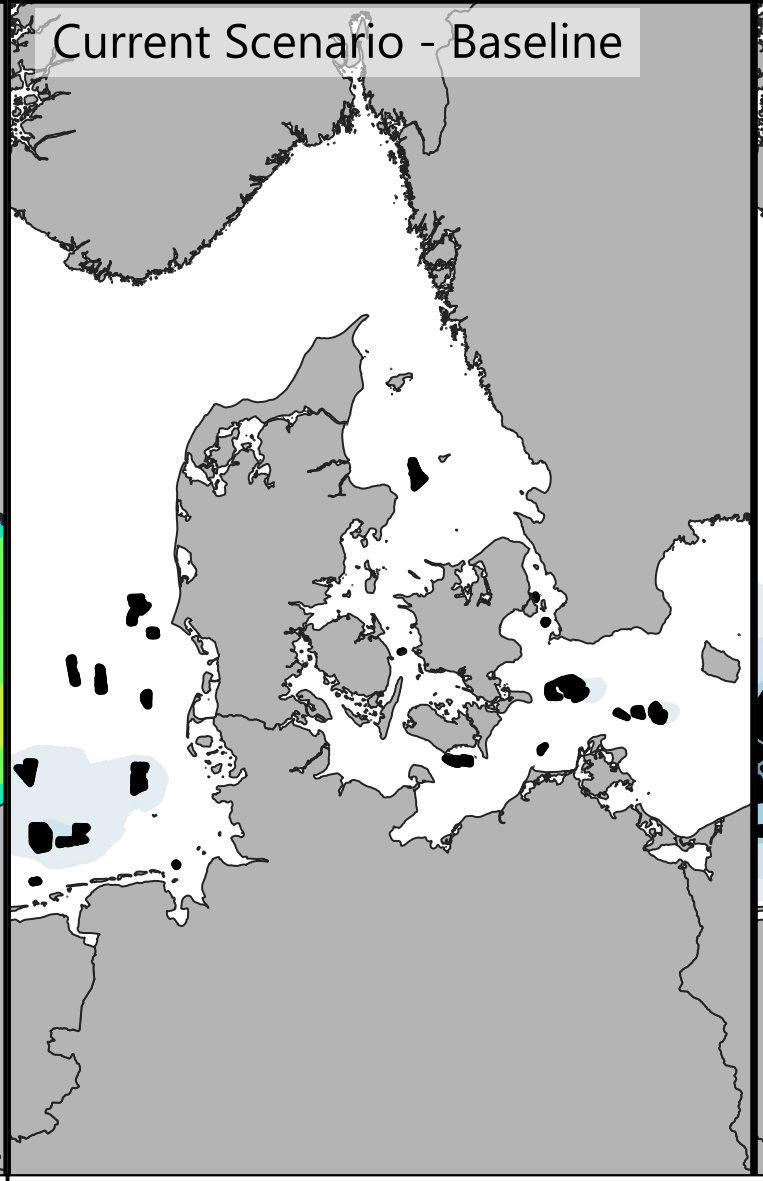
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

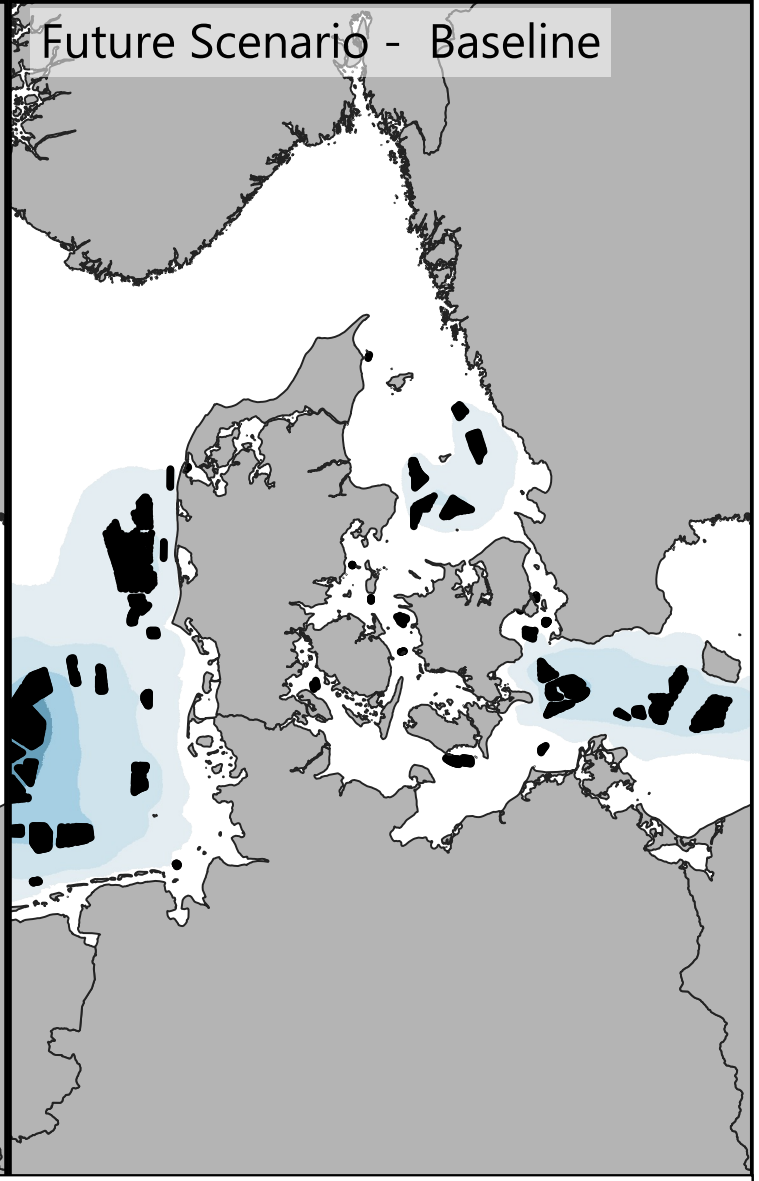
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







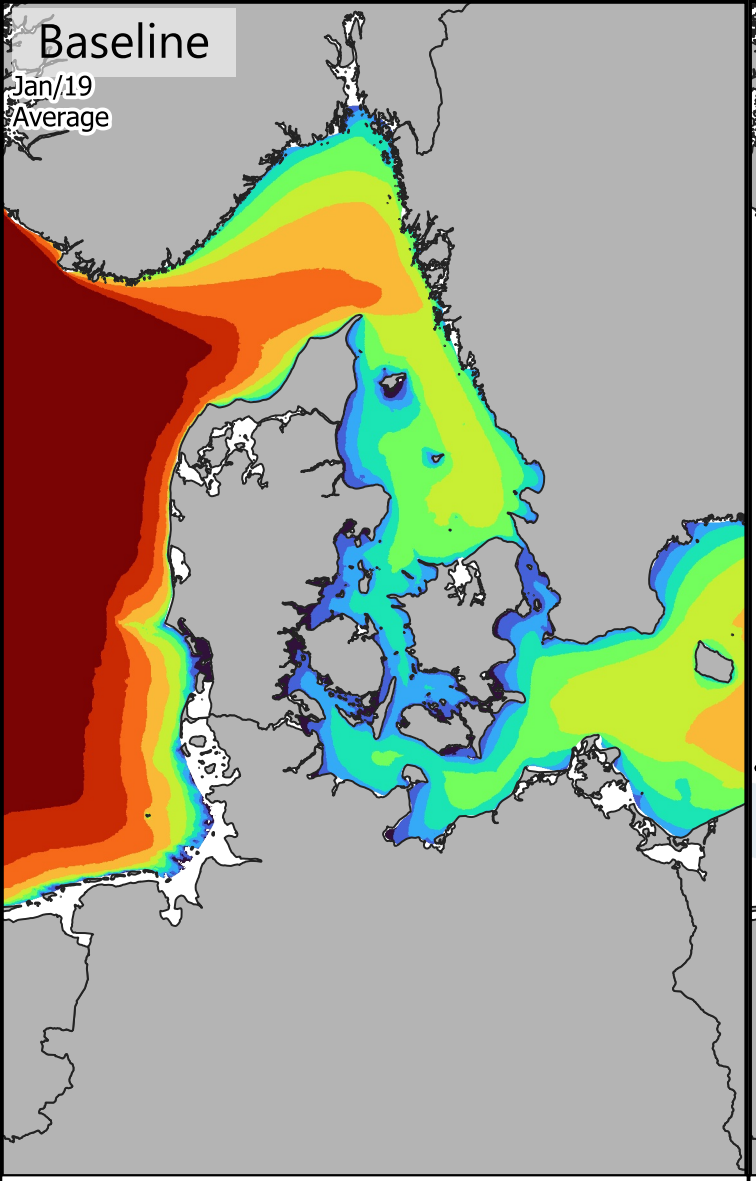
Signignificant Wave Height [m]

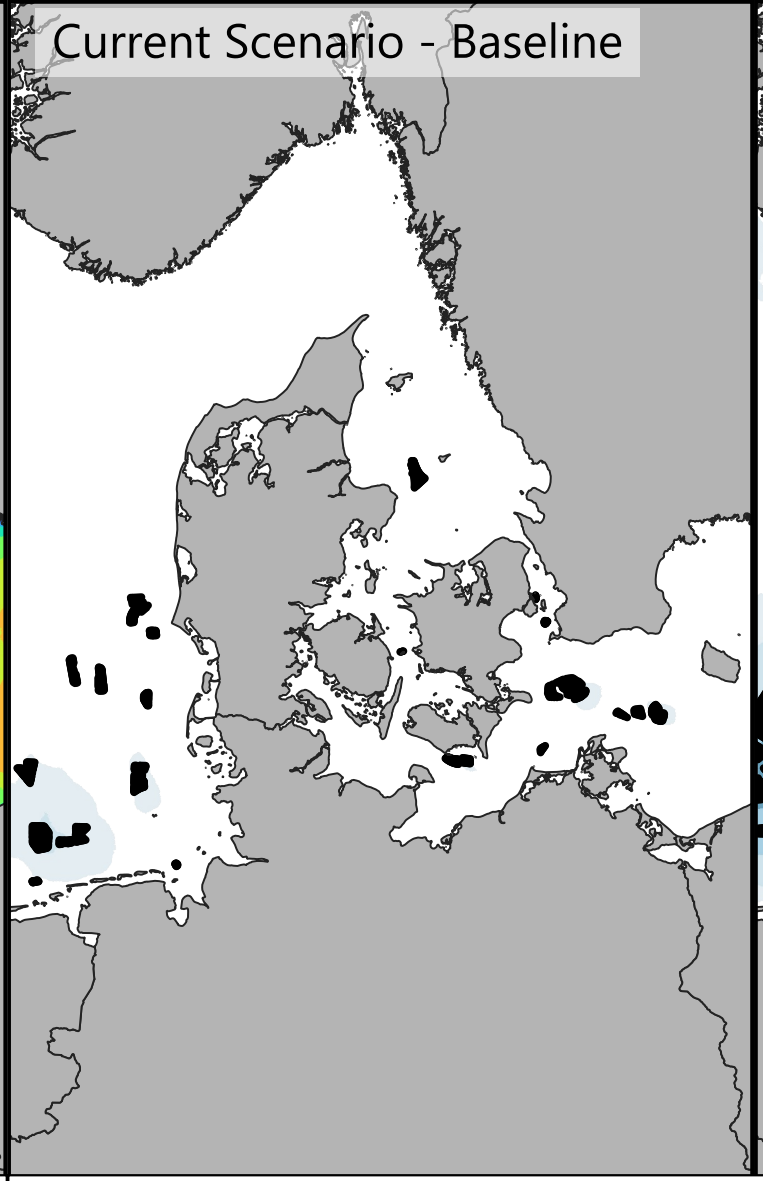
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

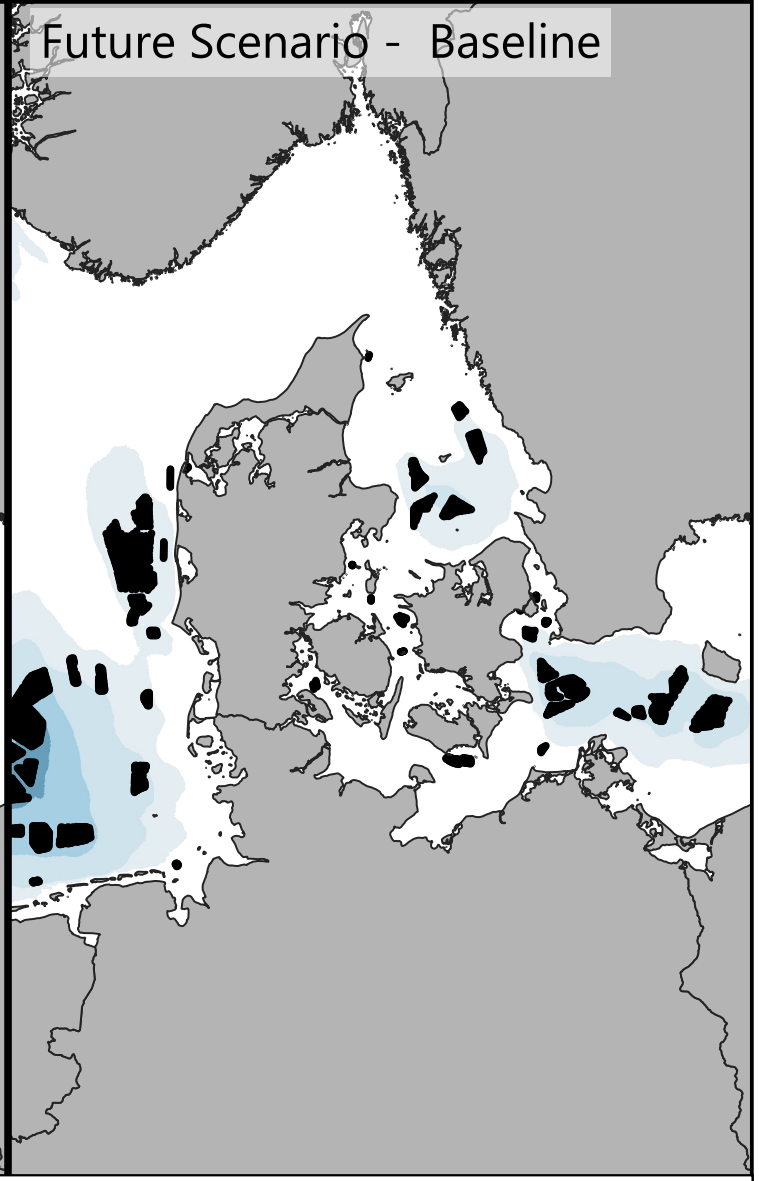
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







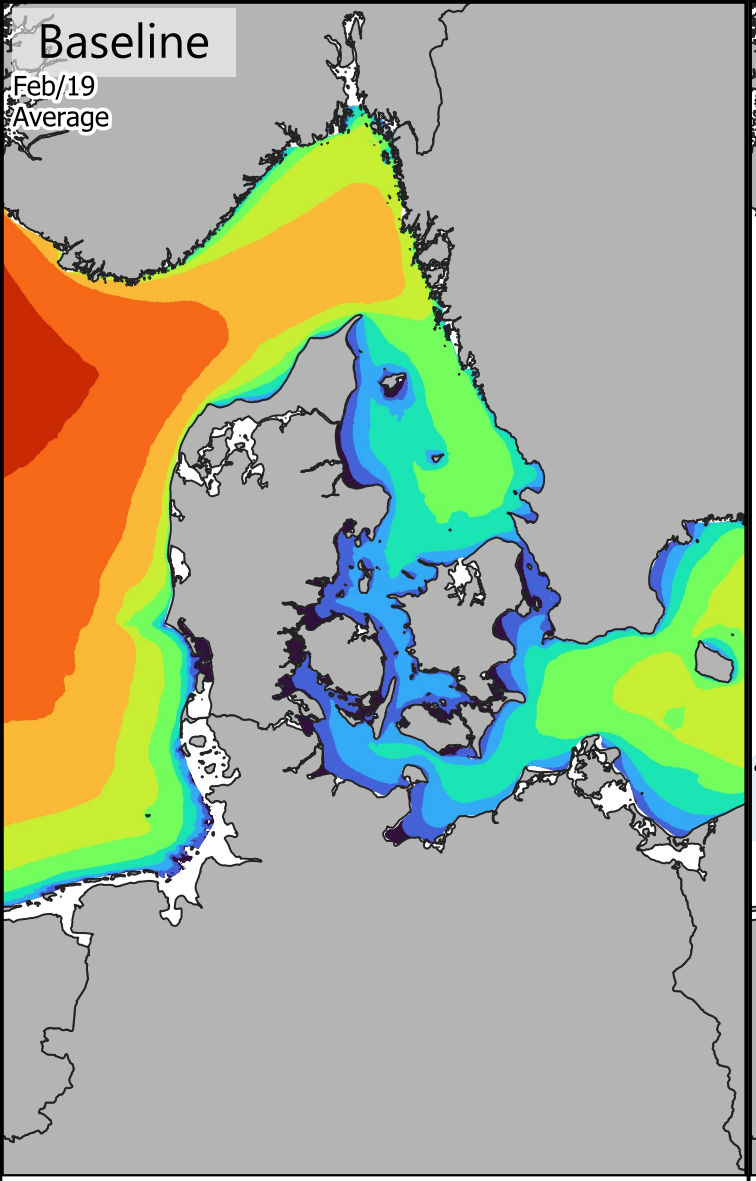
Signignificant Wave Height [m]

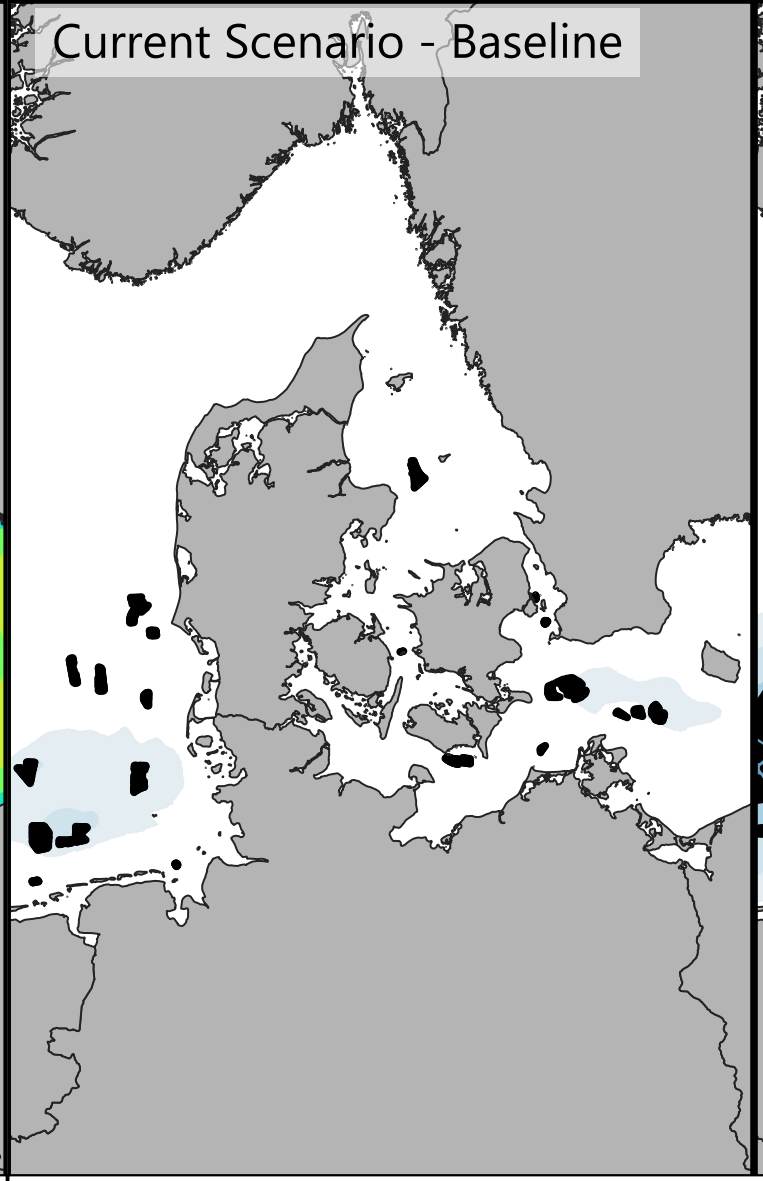
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

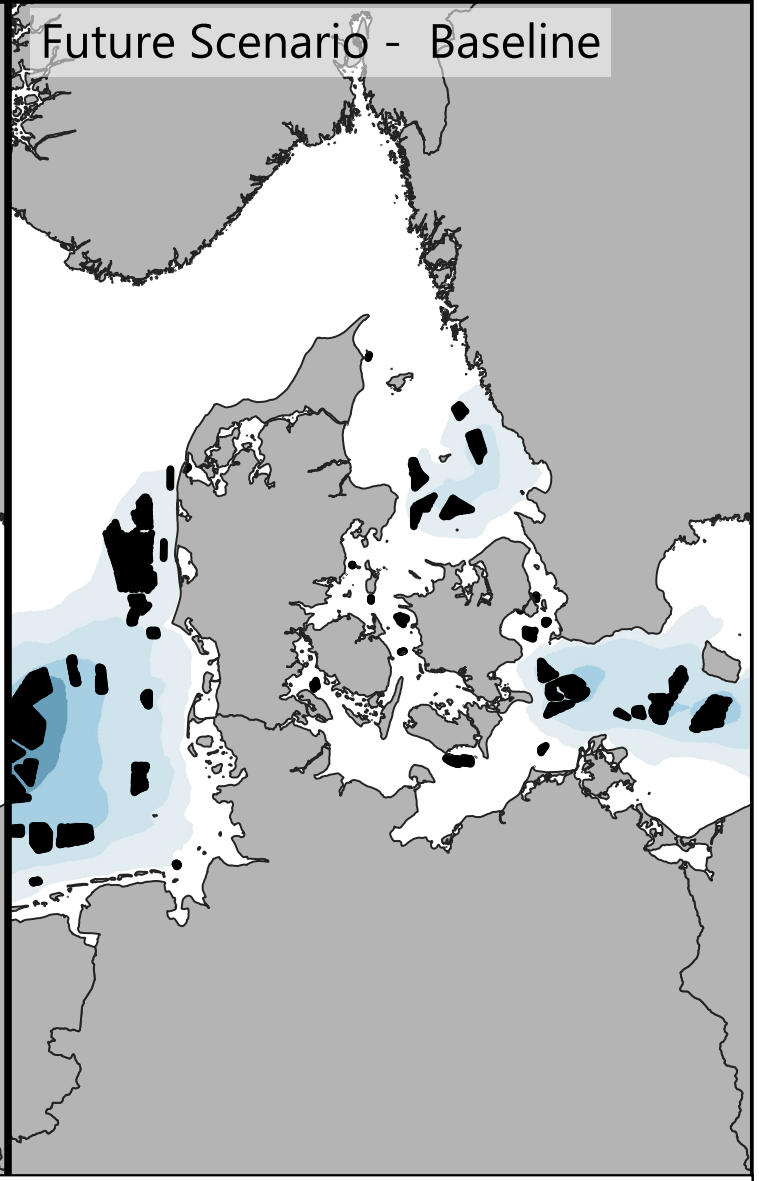
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







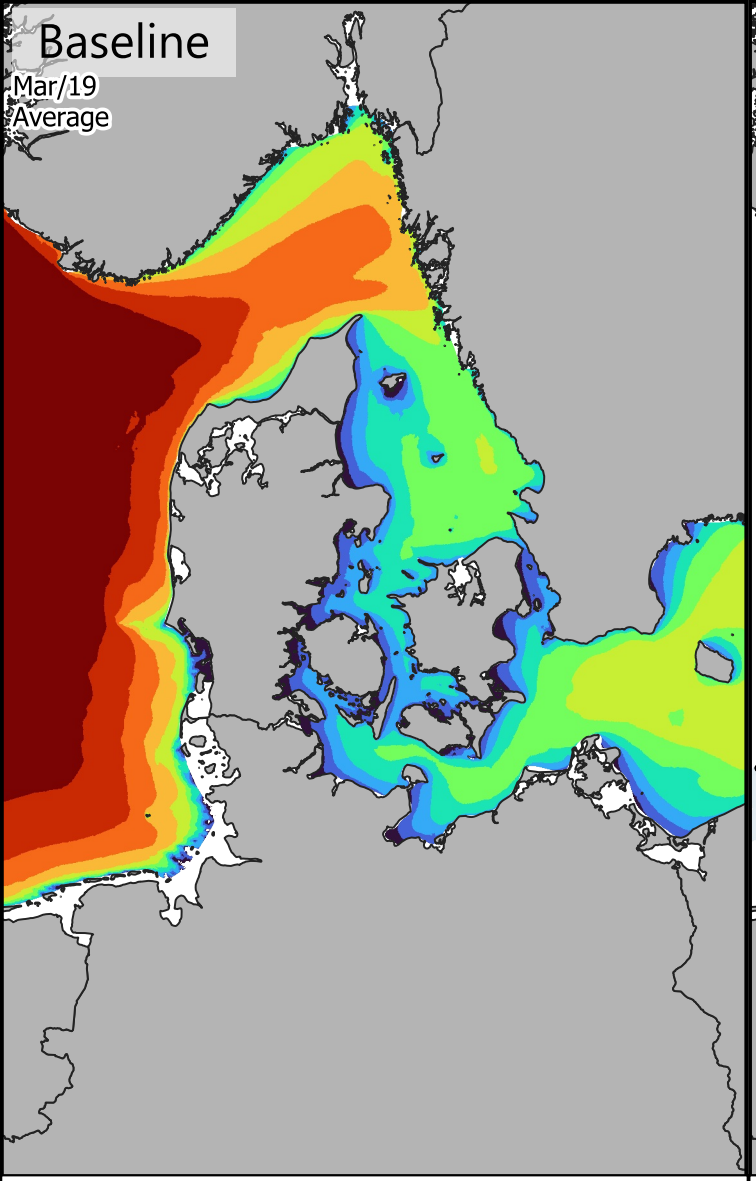
Signignificant Wave Height [m]

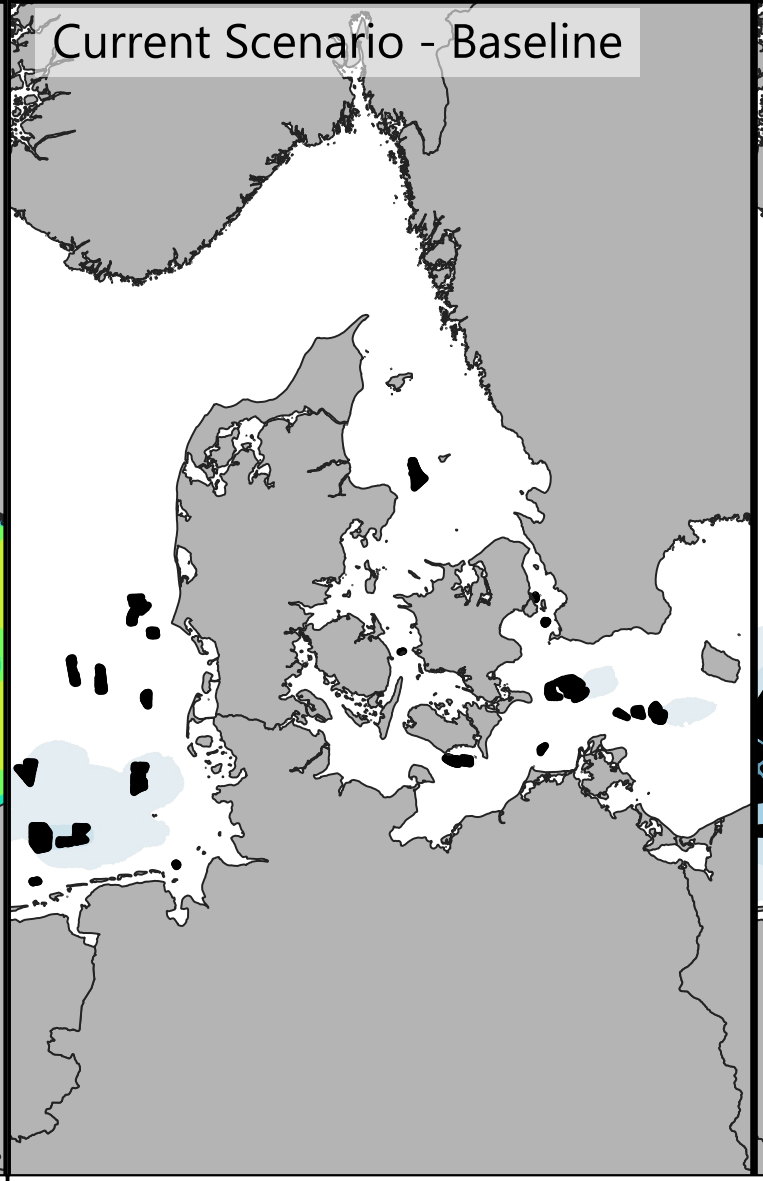
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

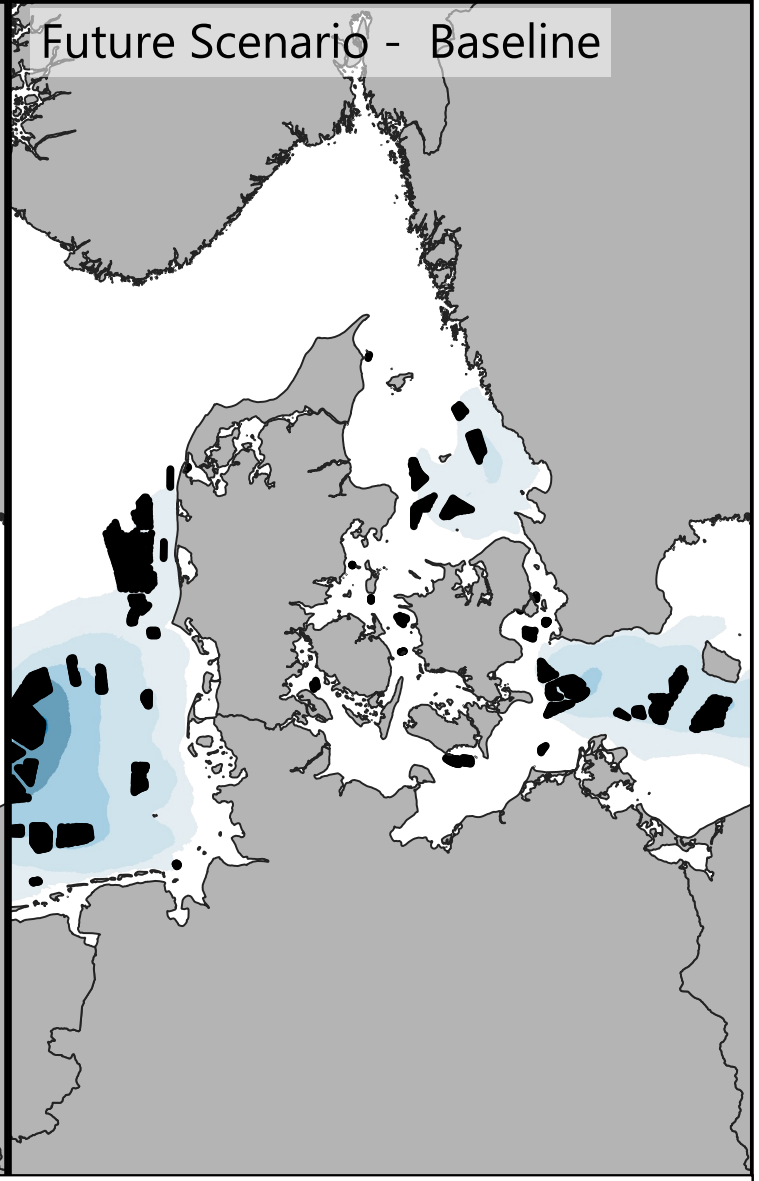
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







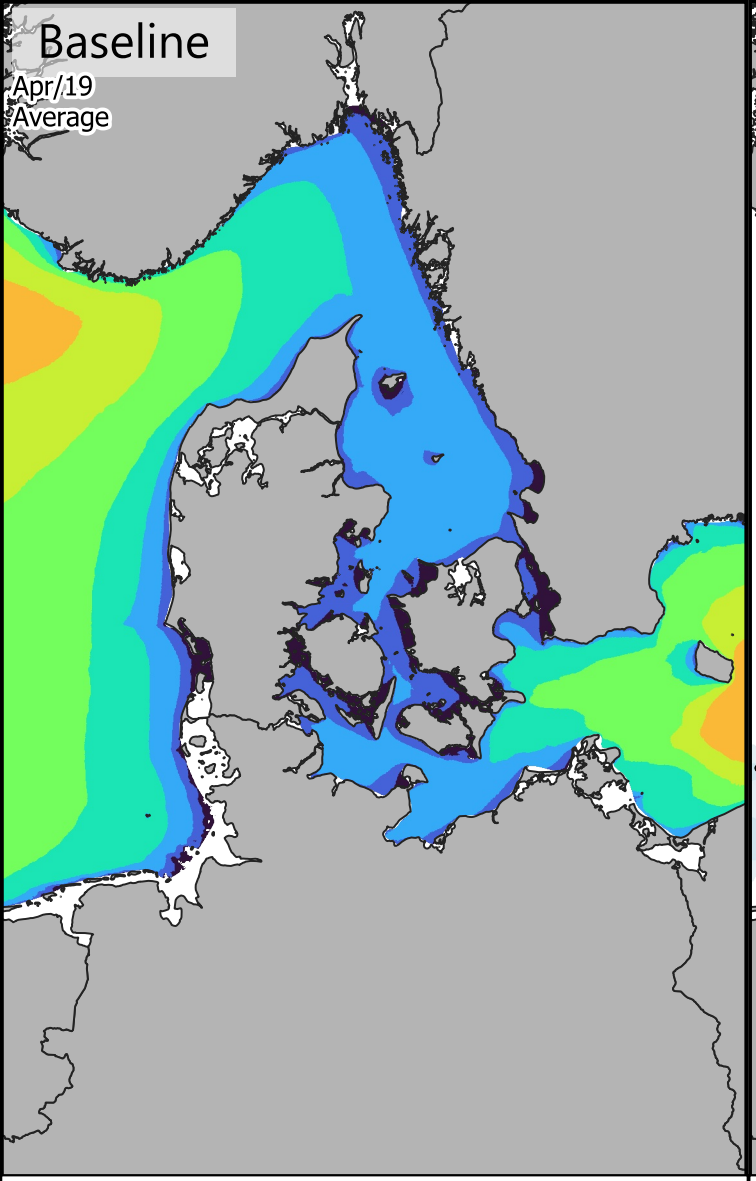
Signignificant Wave Height [m]

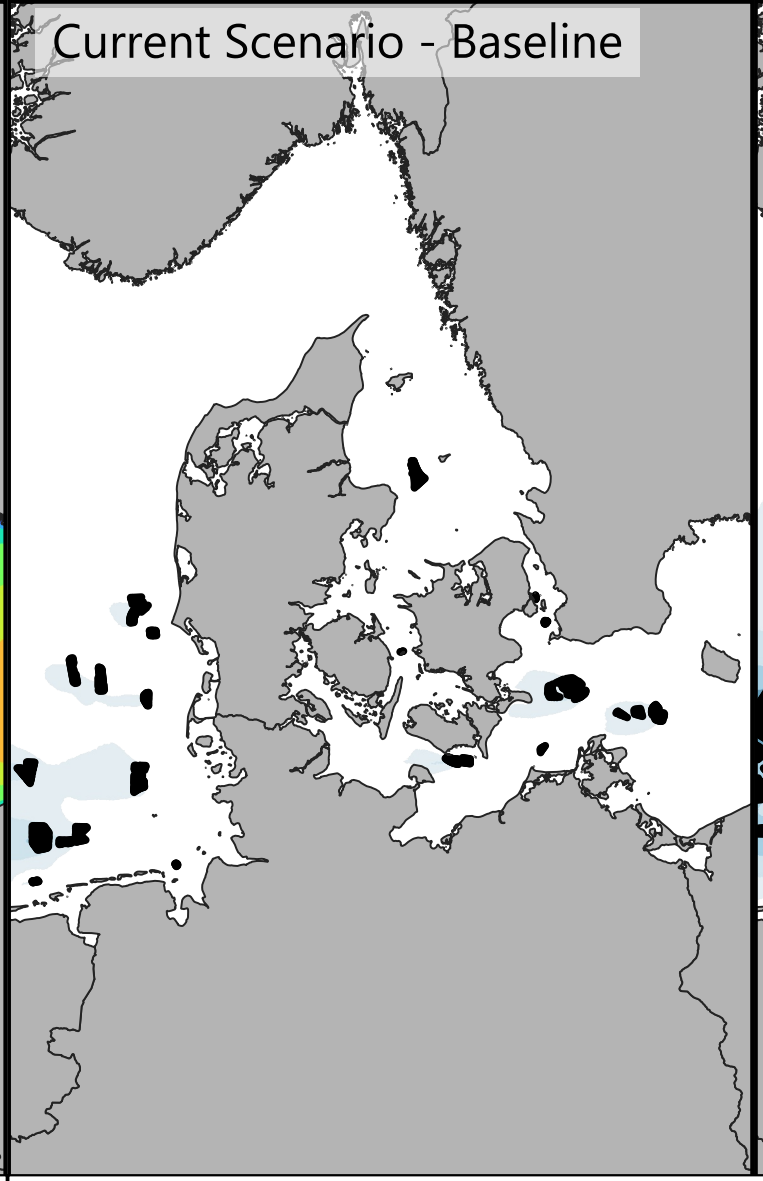
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

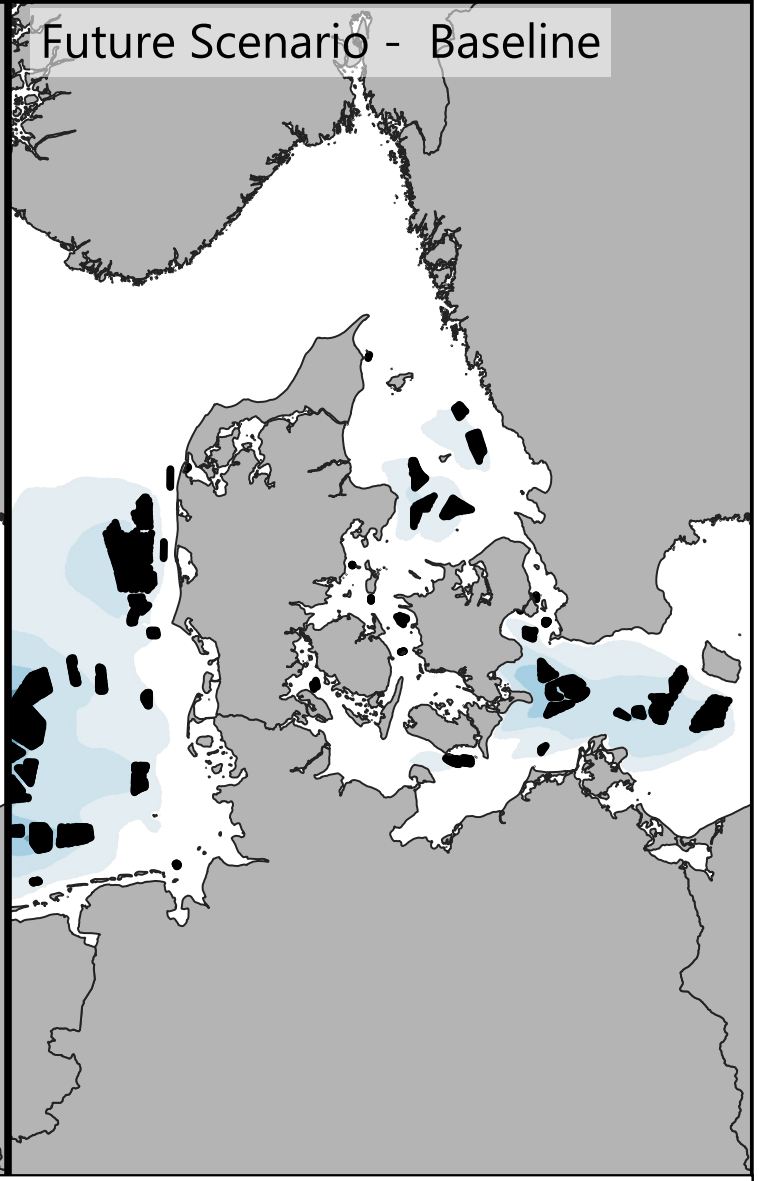
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







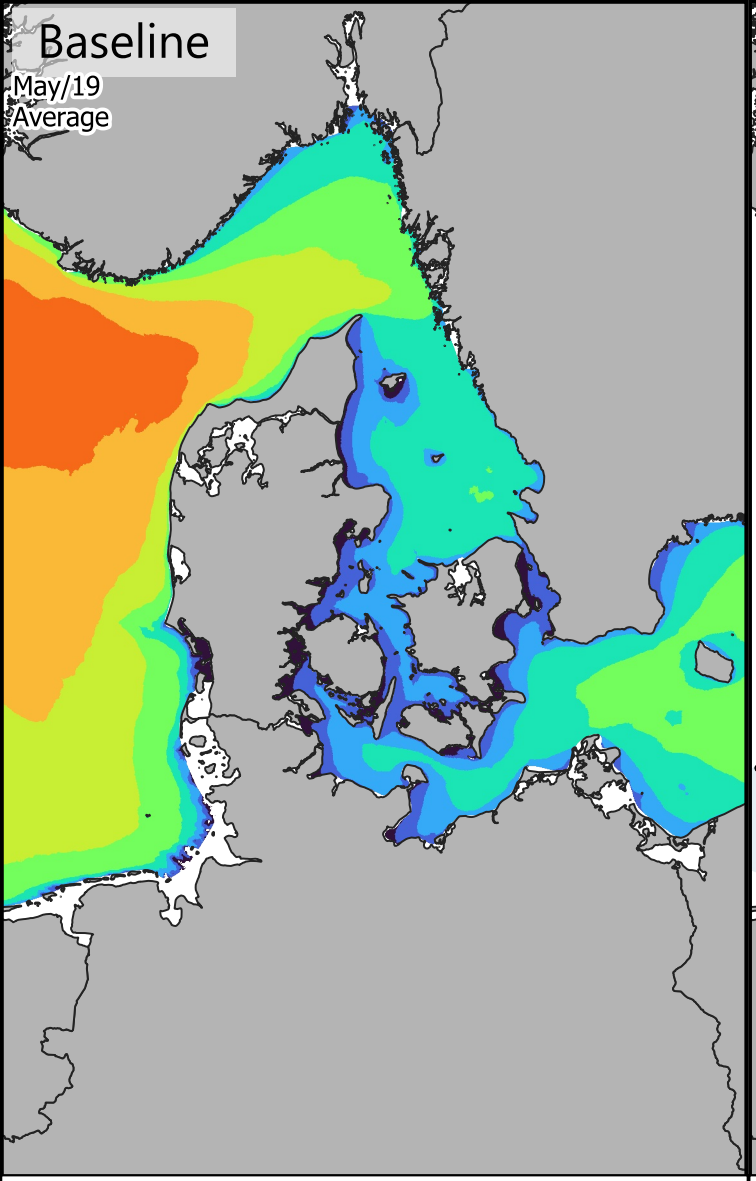
Signignificant Wave Height [m]

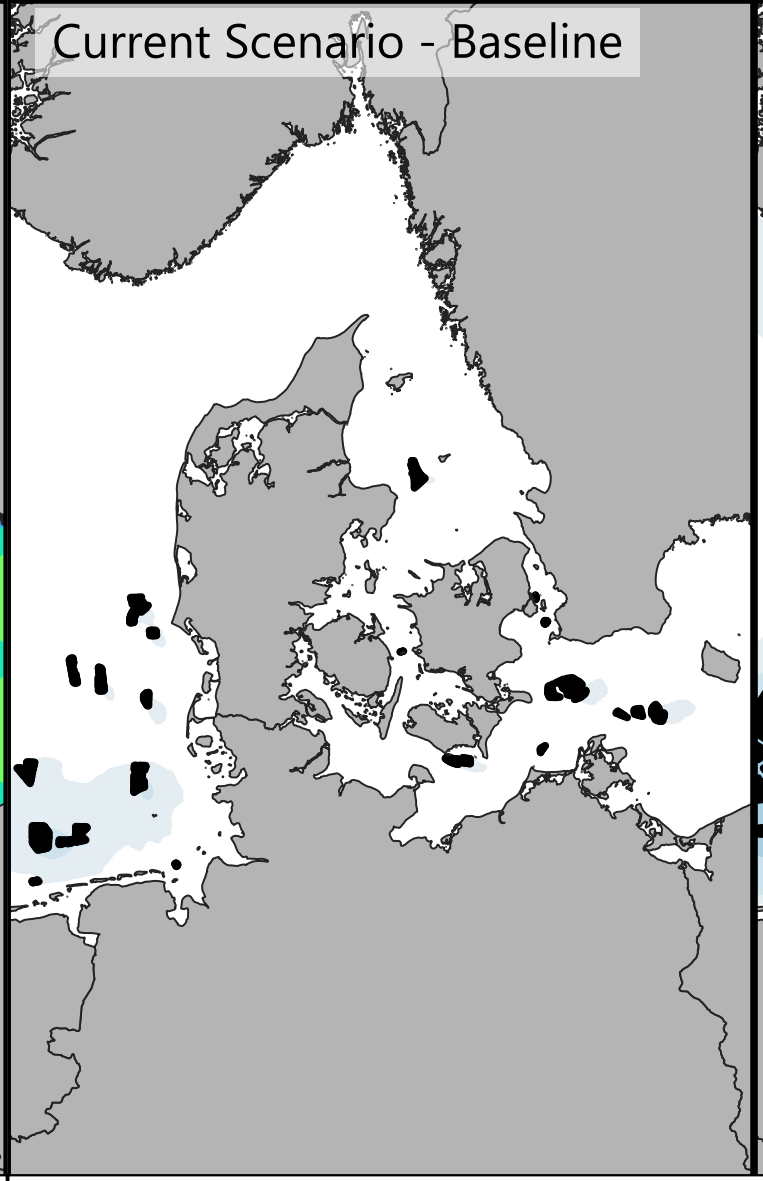
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

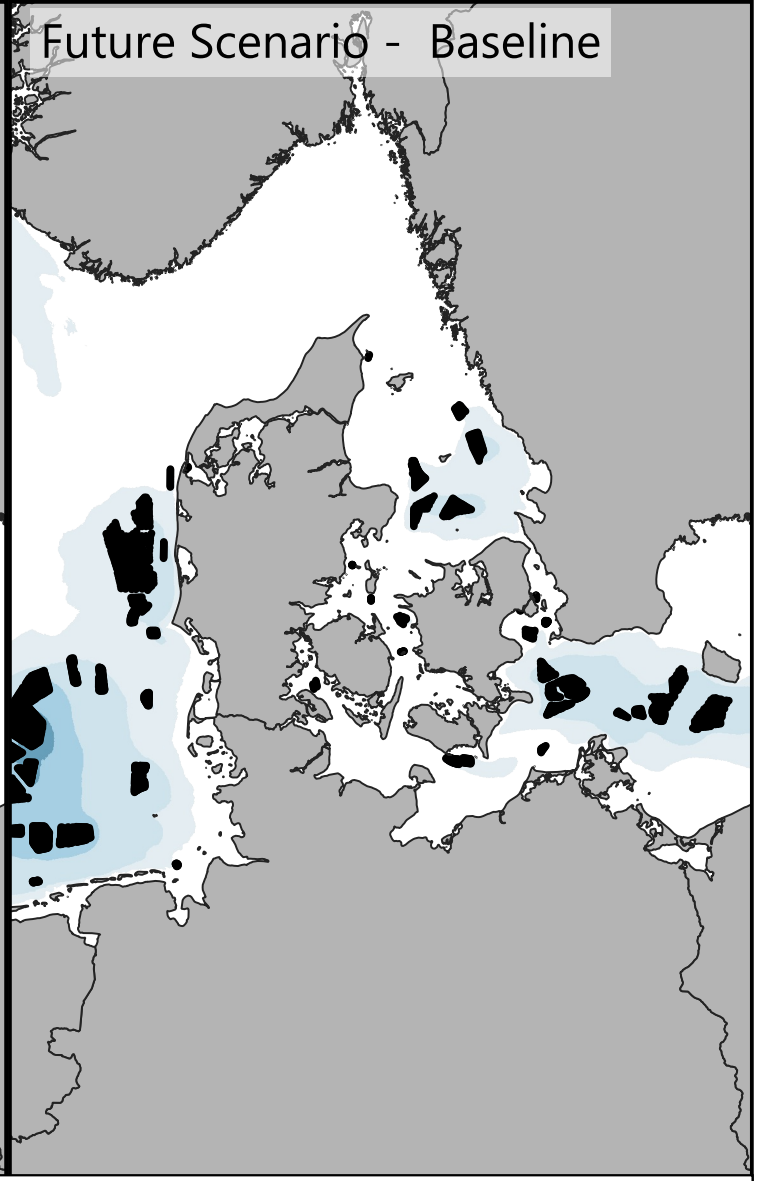
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







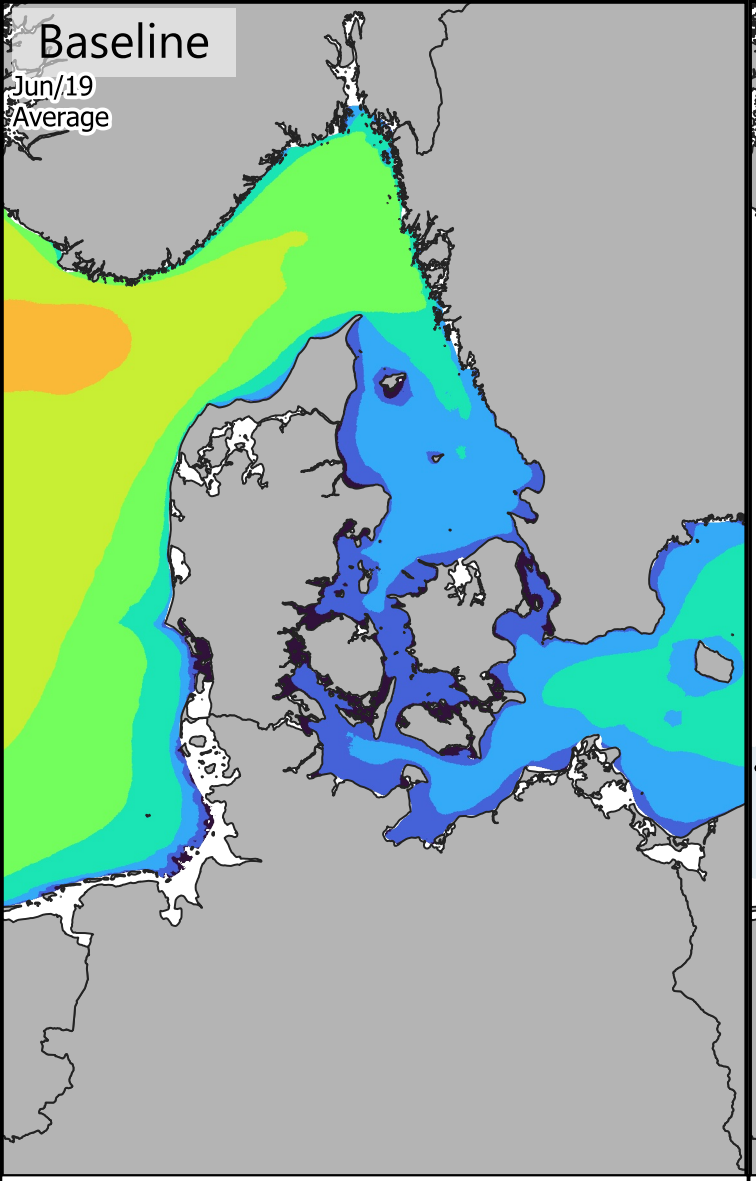
Signignificant Wave Height [m]

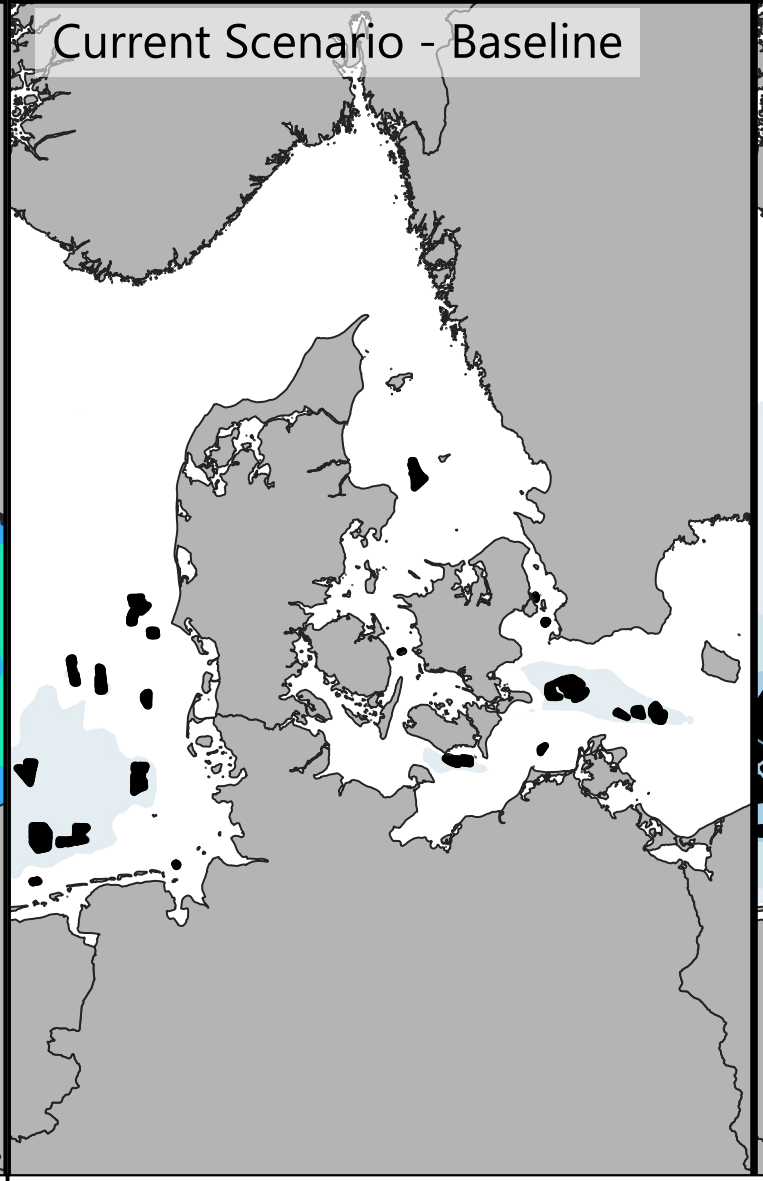
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

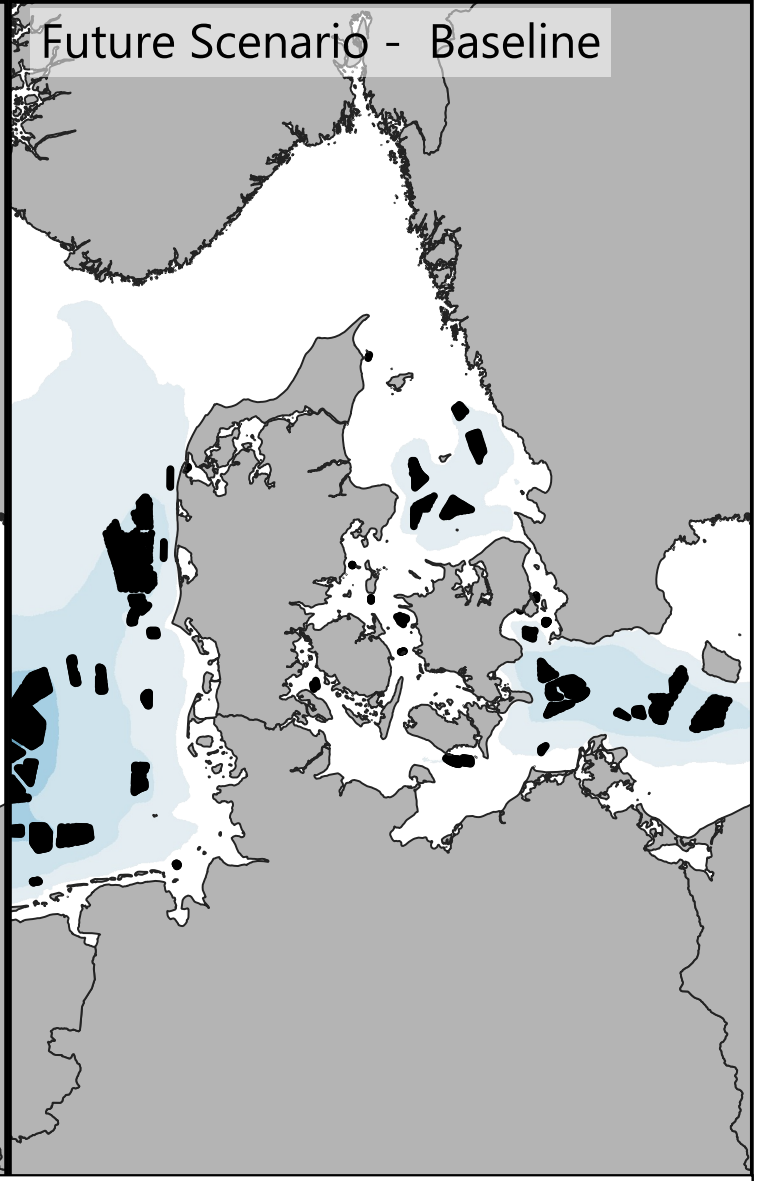
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







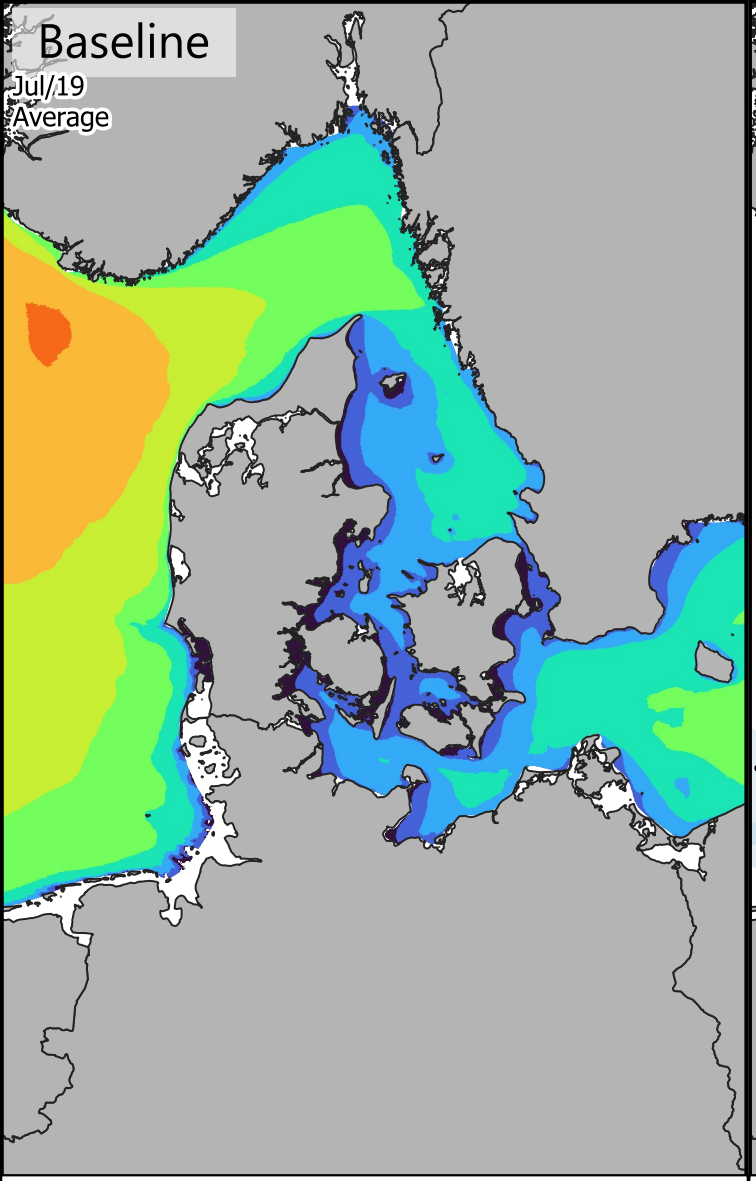
Signignificant Wave Height [m]

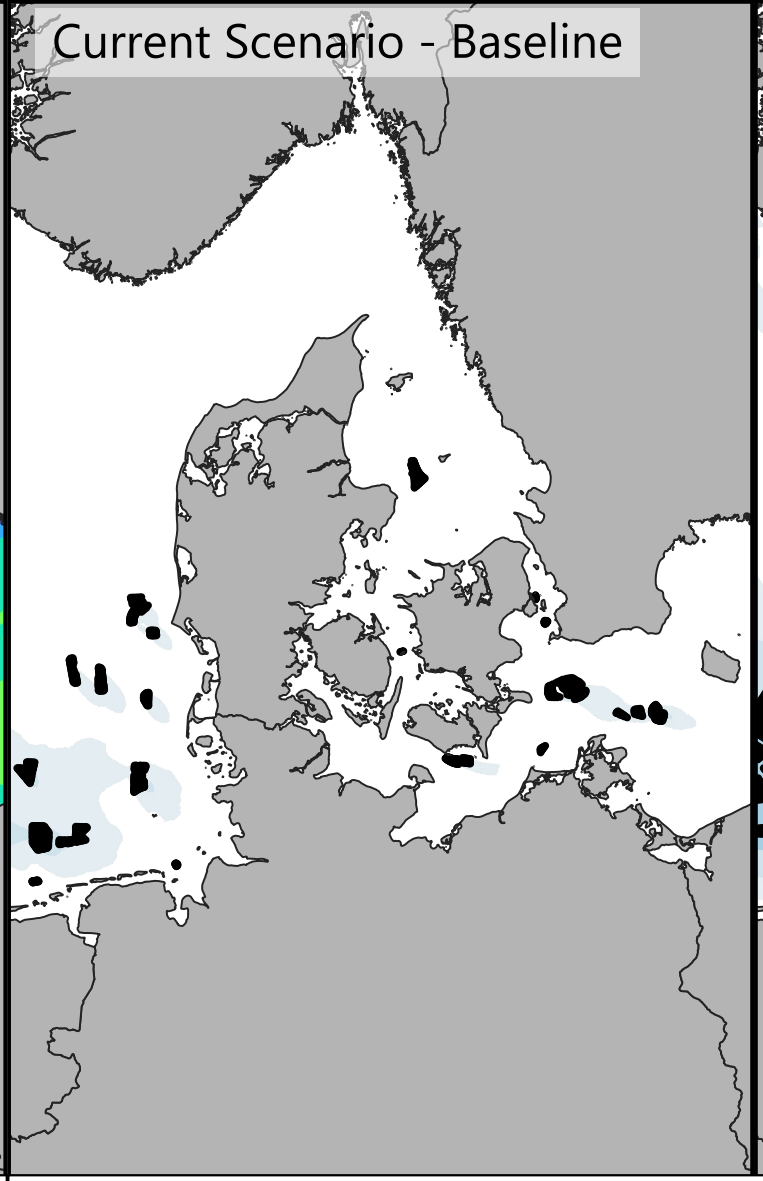
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

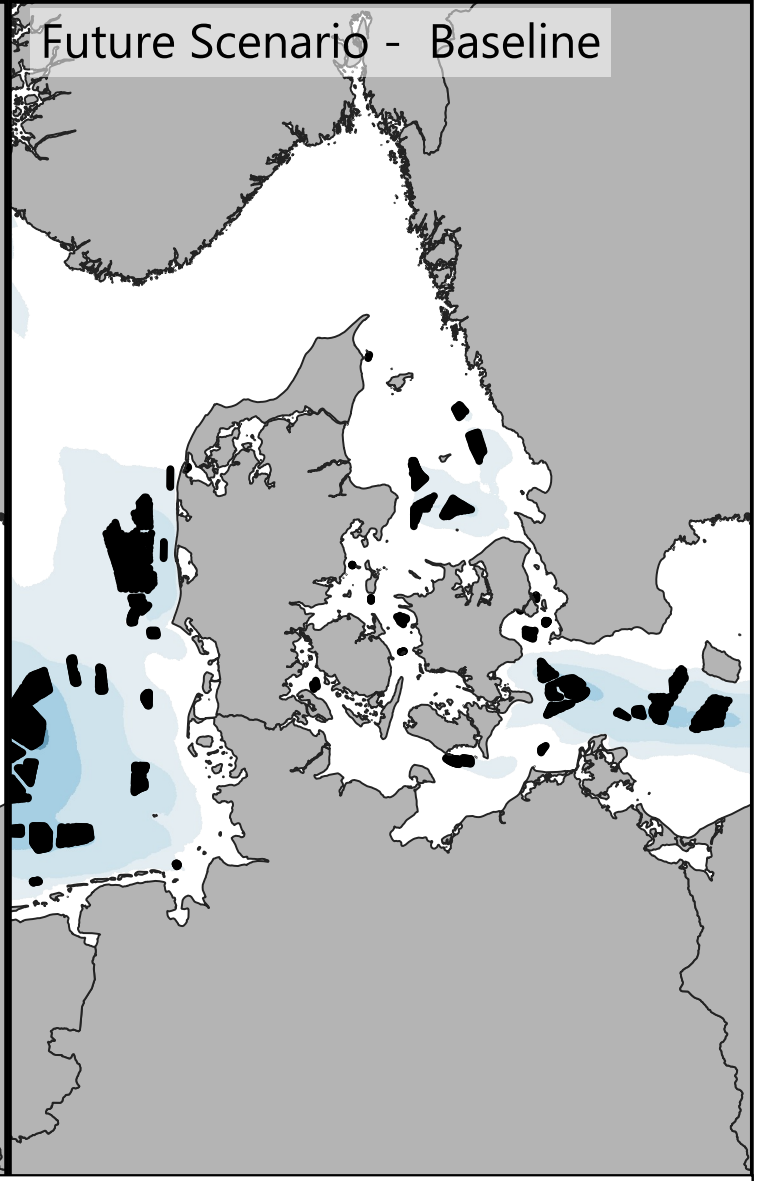
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







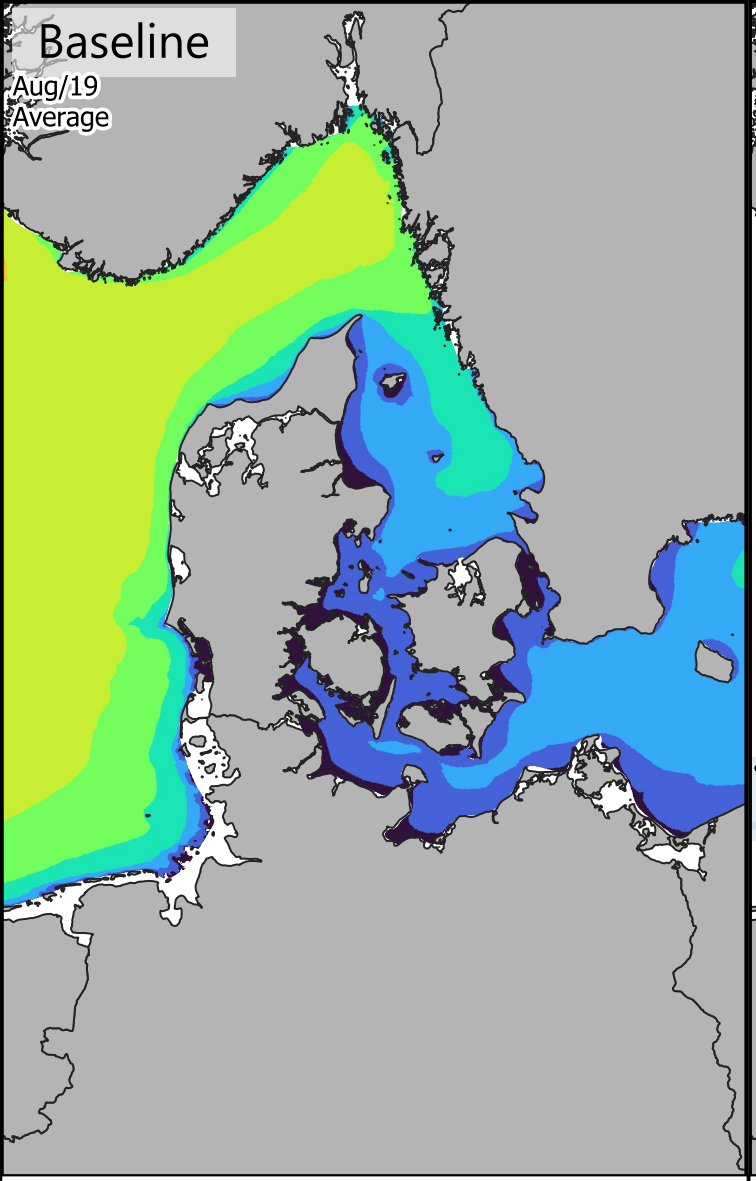
Signignificant Wave Height [m]

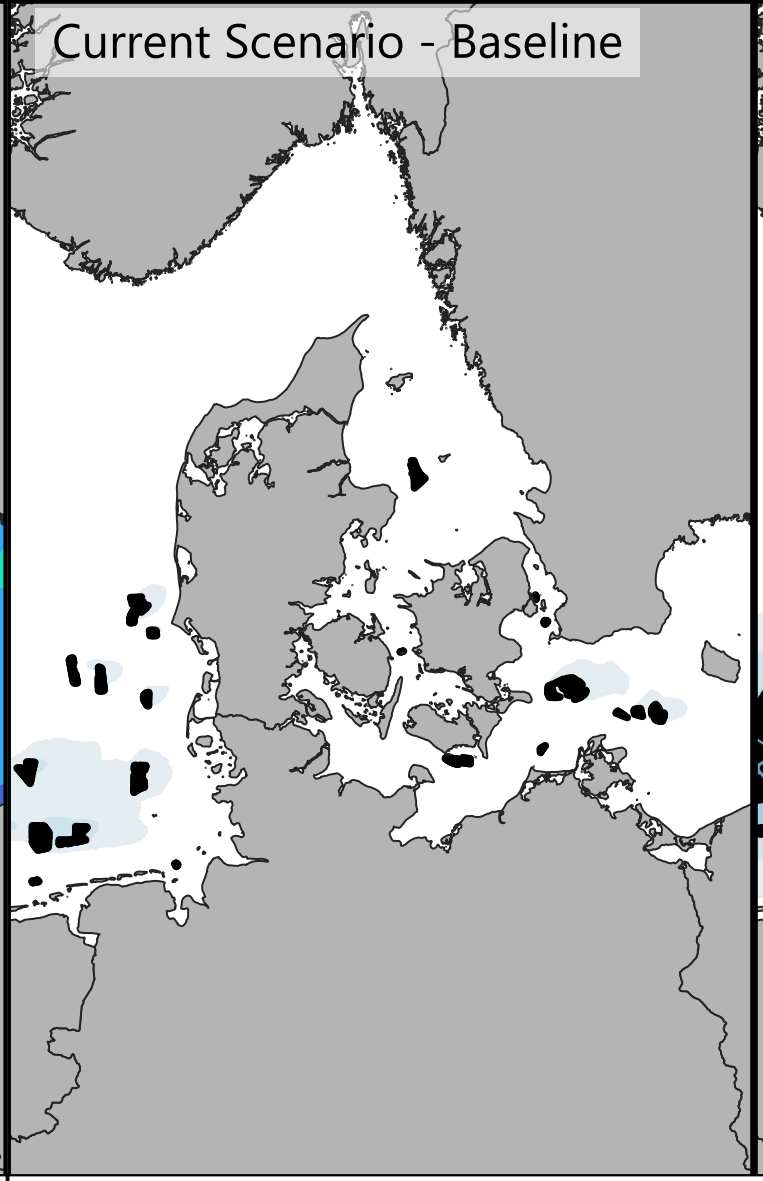
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

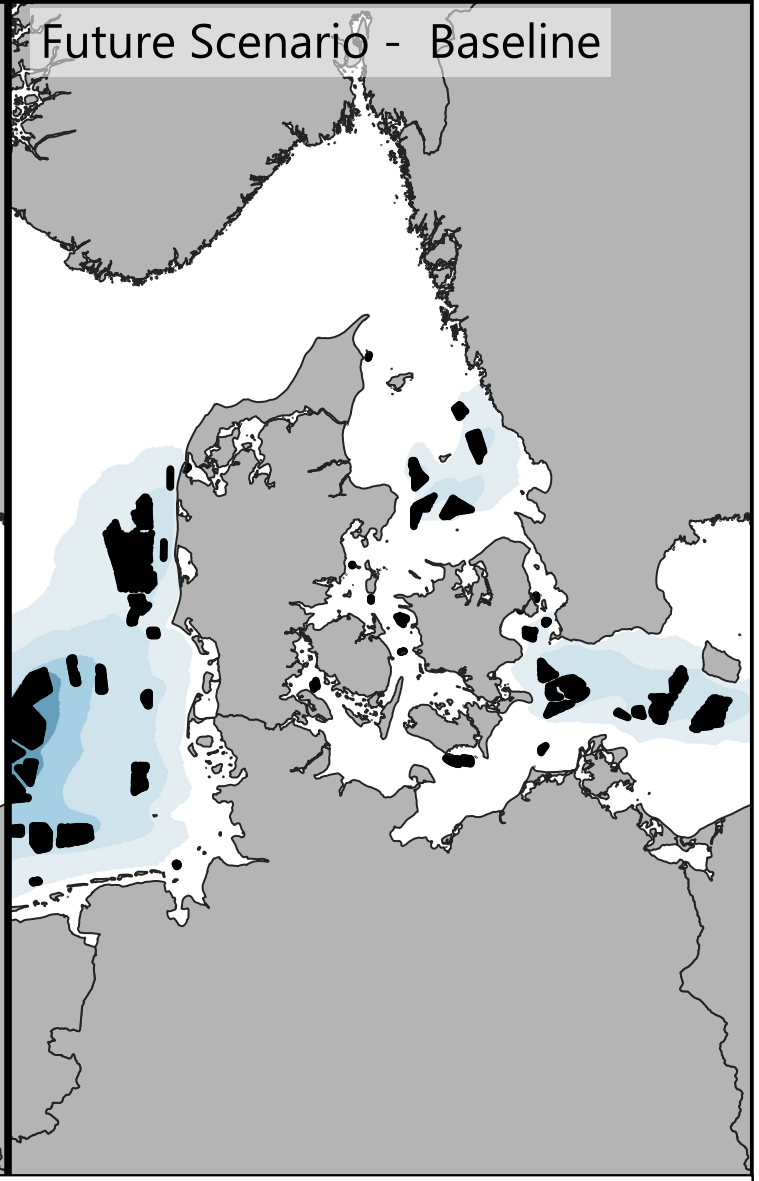
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







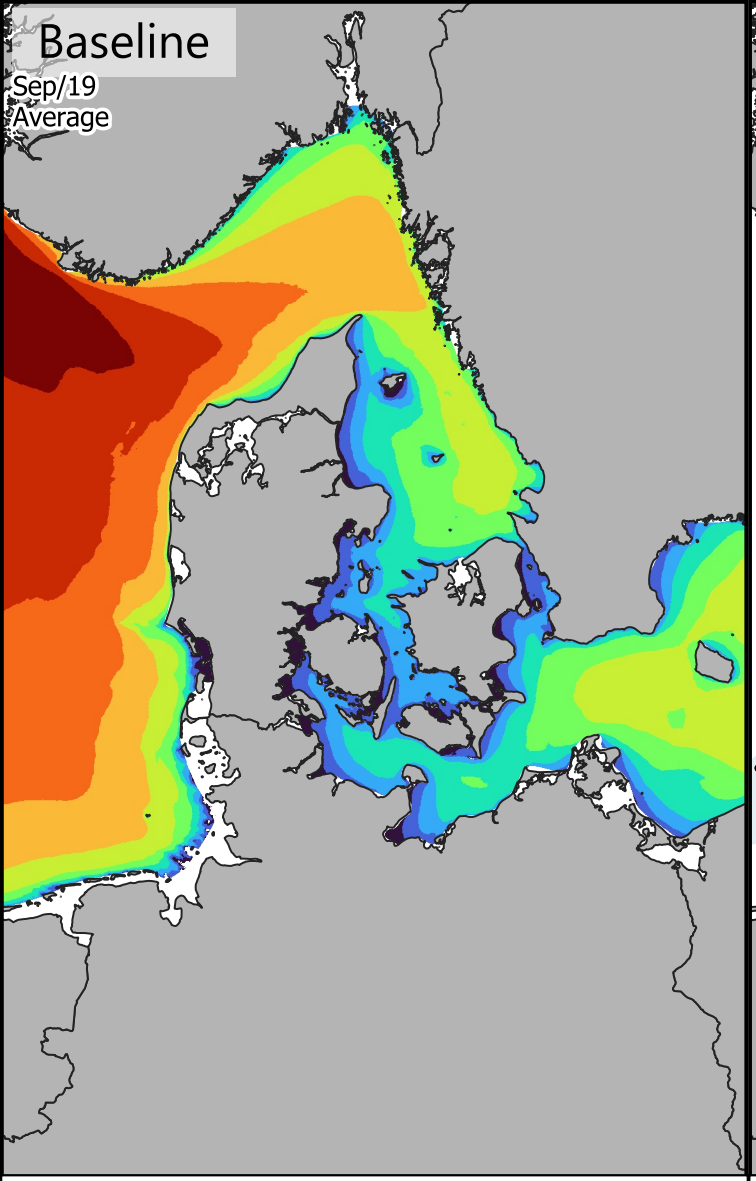
Signignificant Wave Height [m]

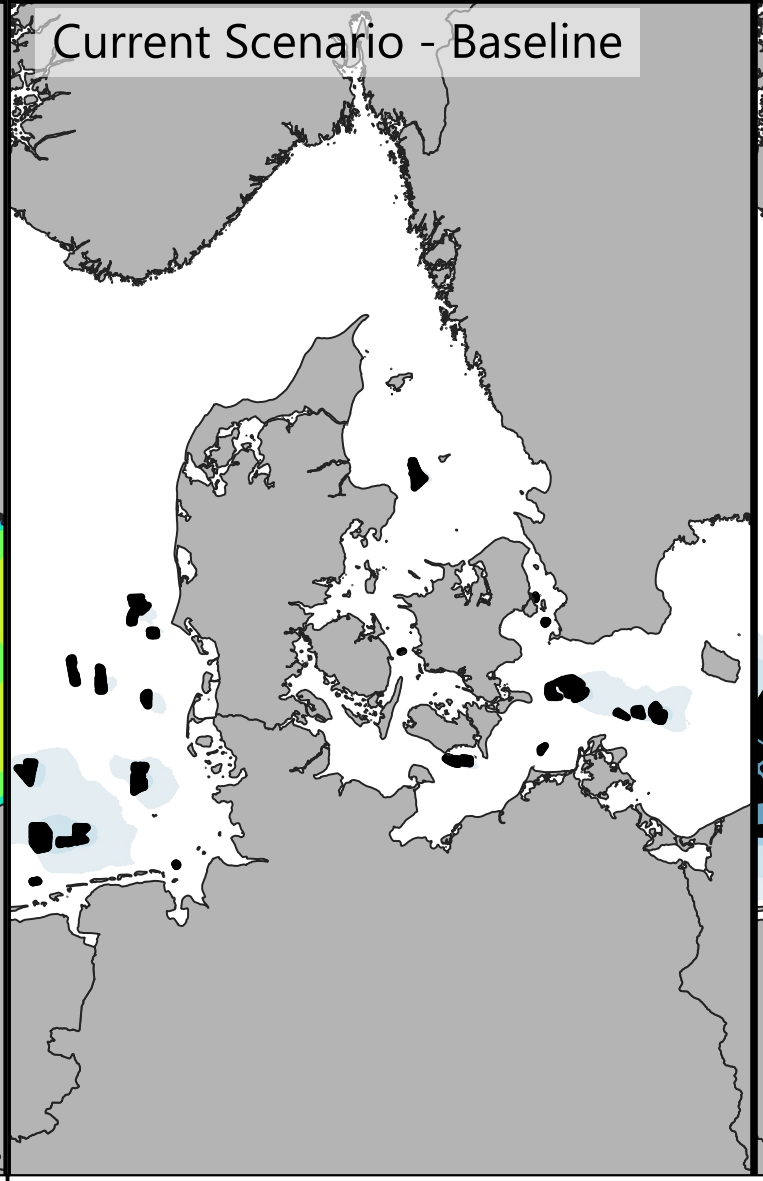
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

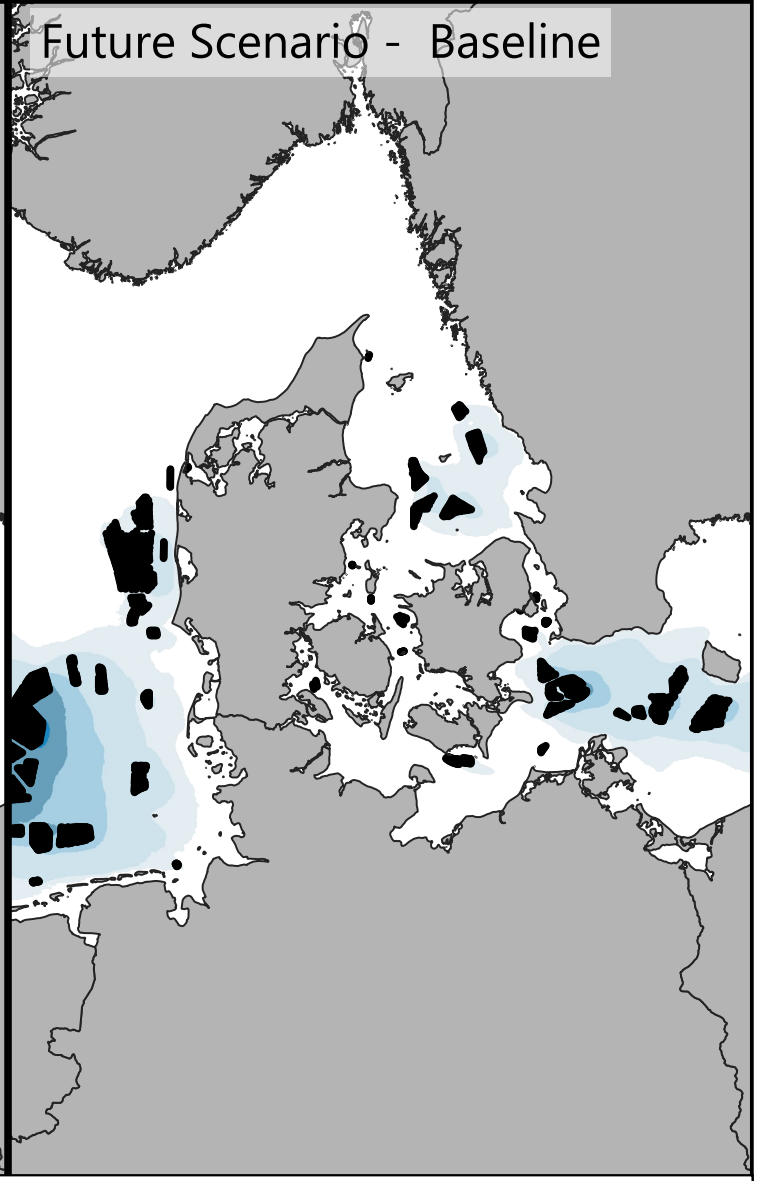
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







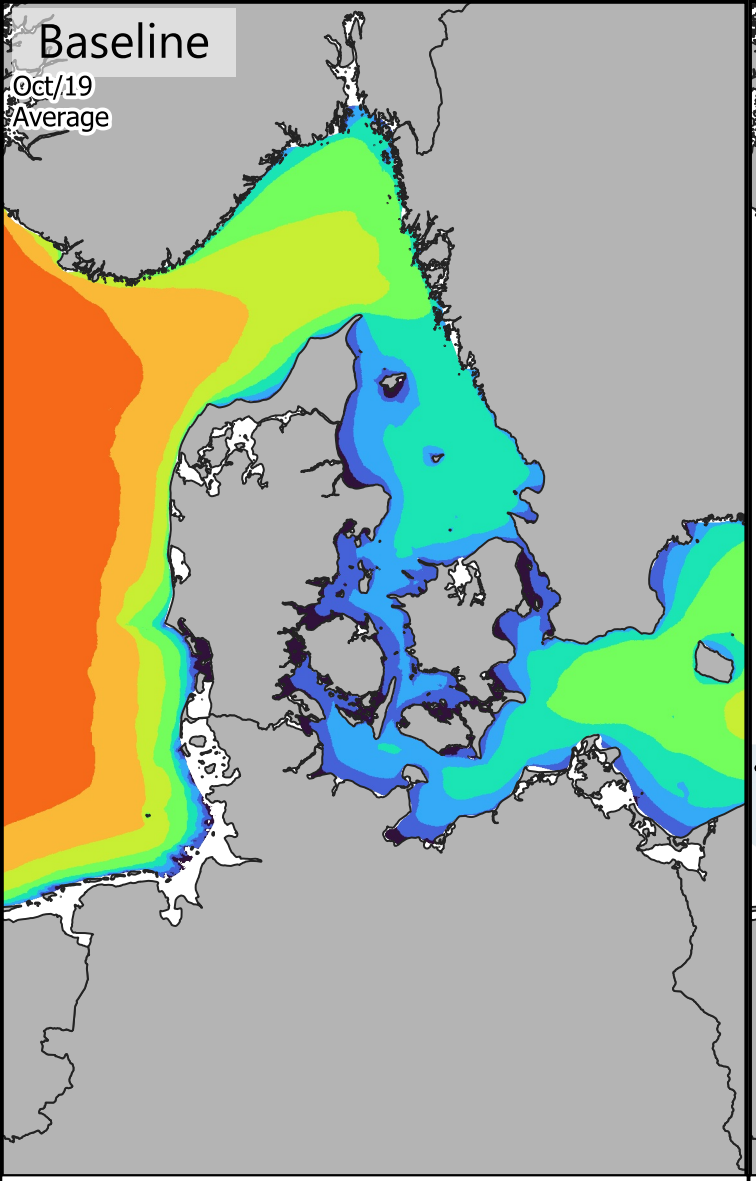
Signignificant Wave Height [m]

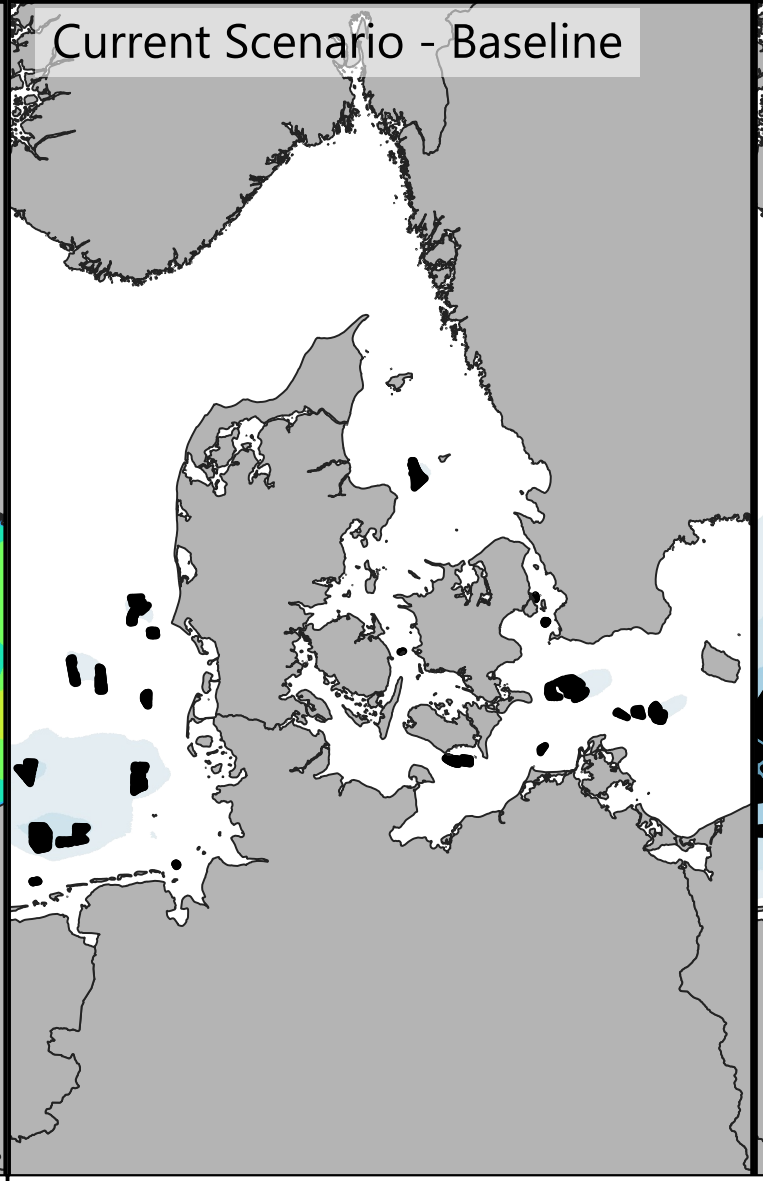
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

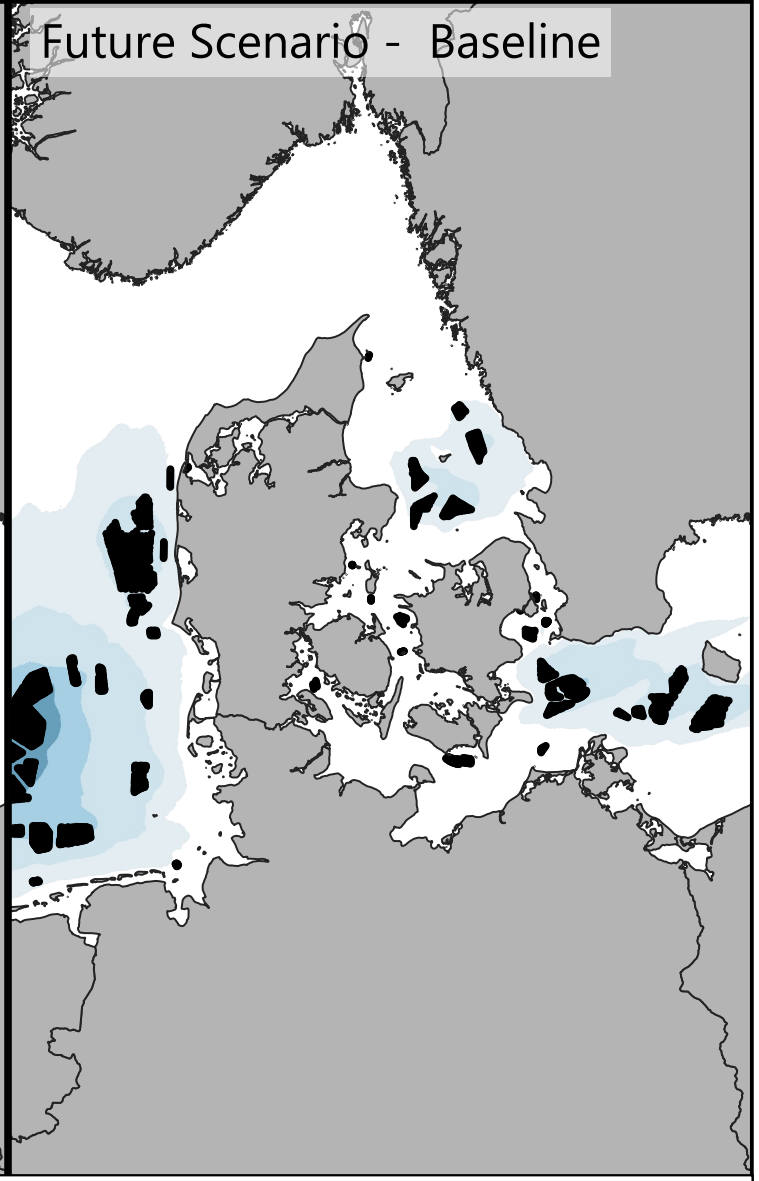
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







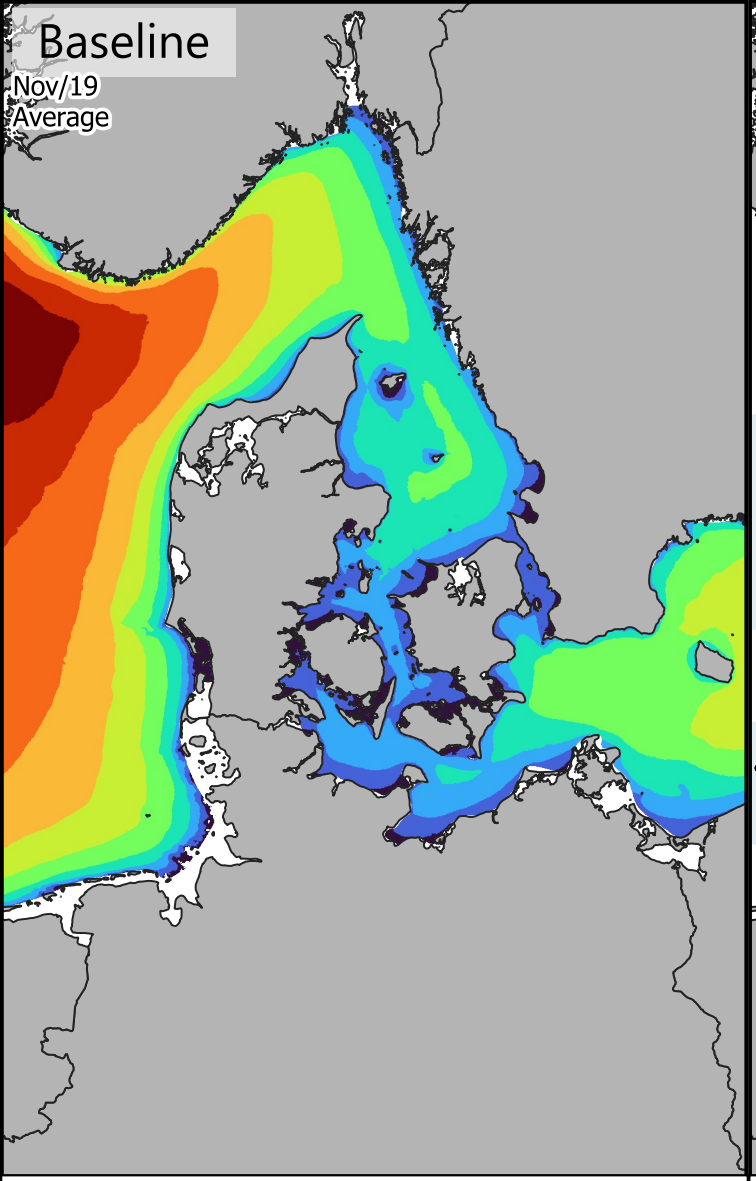
Signignificant Wave Height [m]

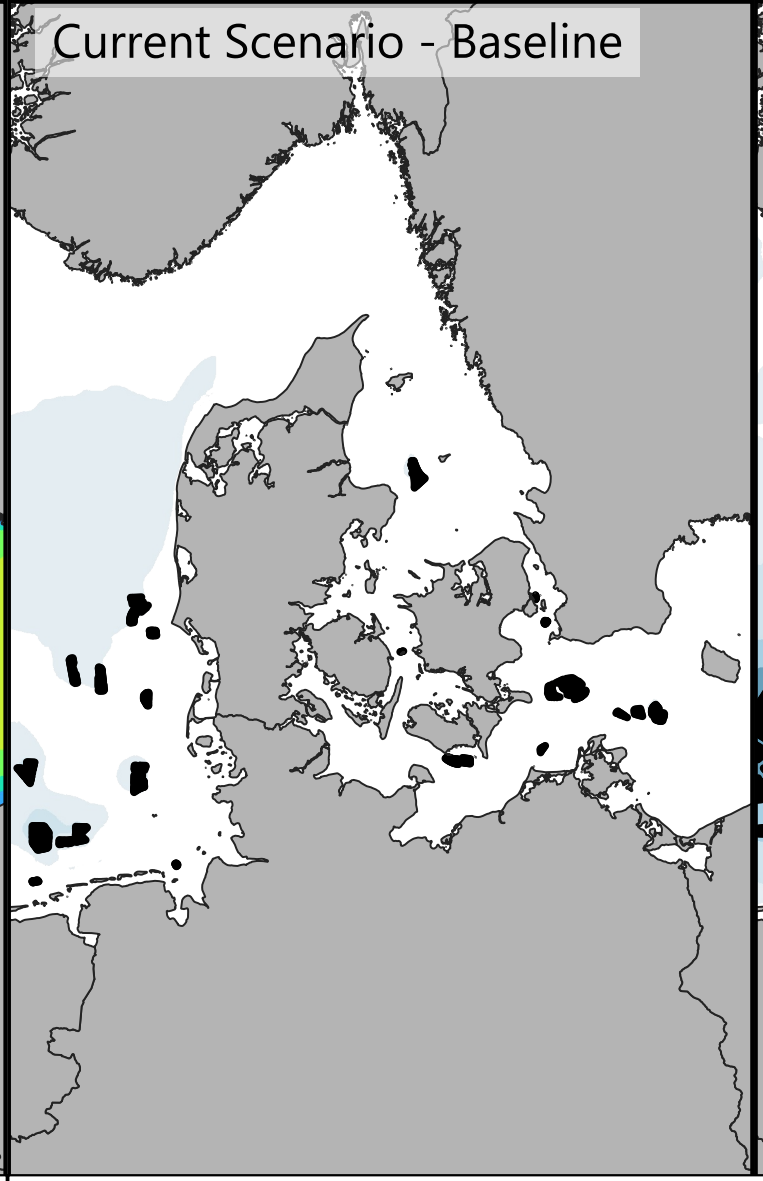
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

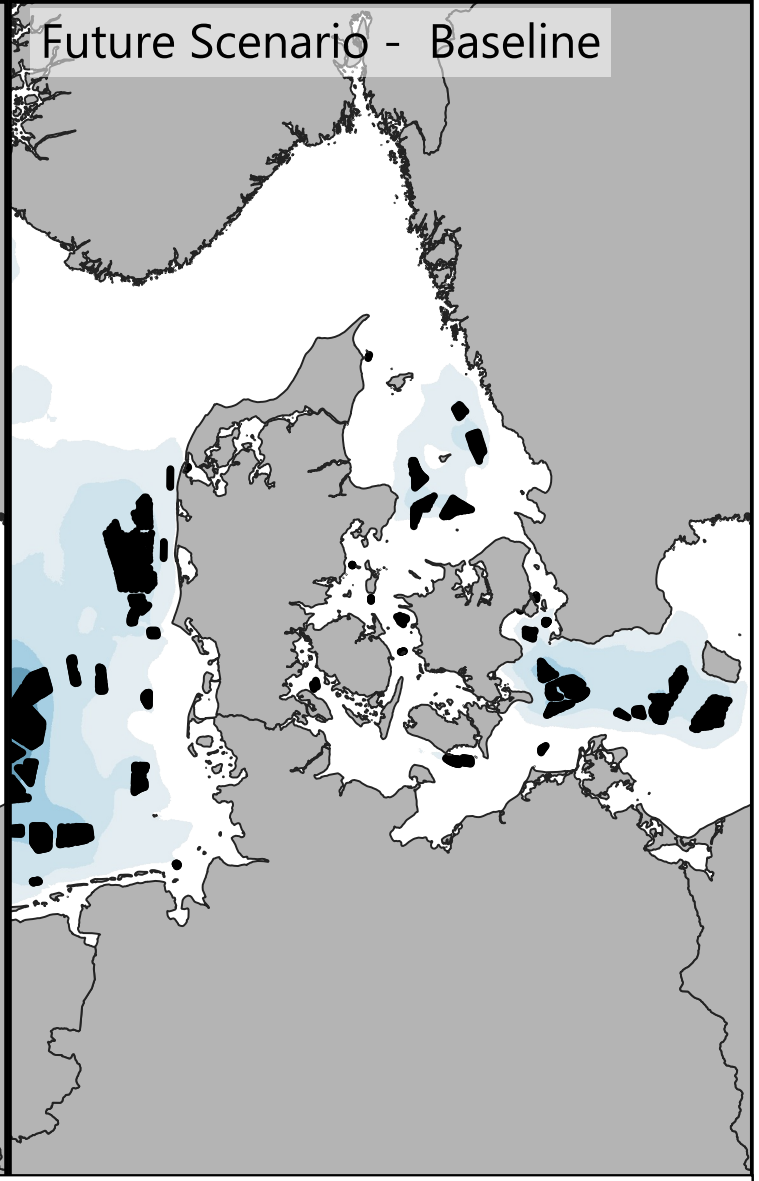
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







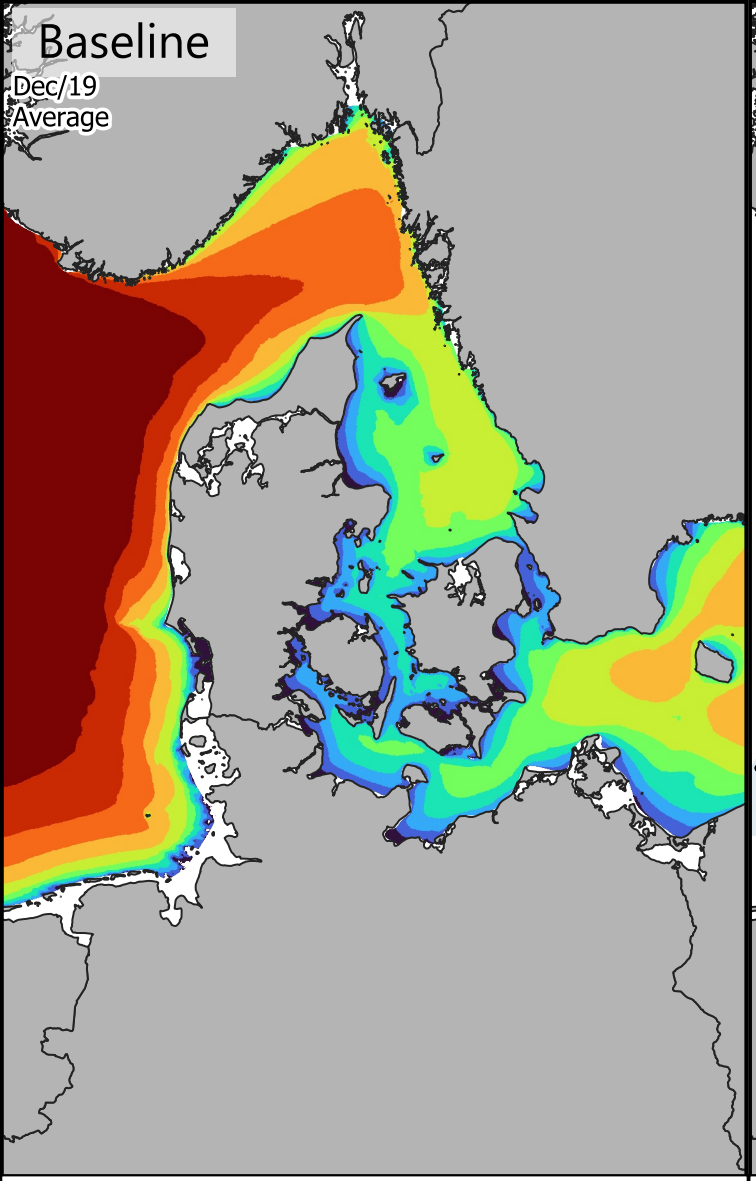
Signignificant Wave Height [m]

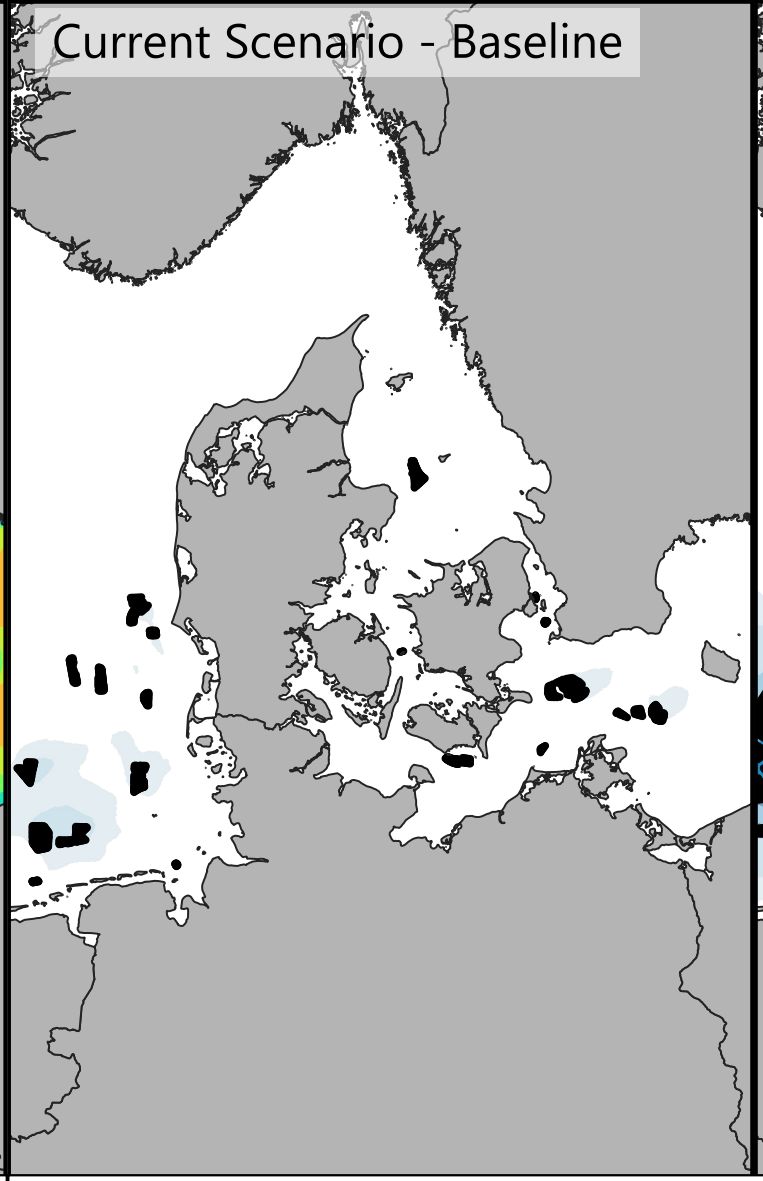
- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

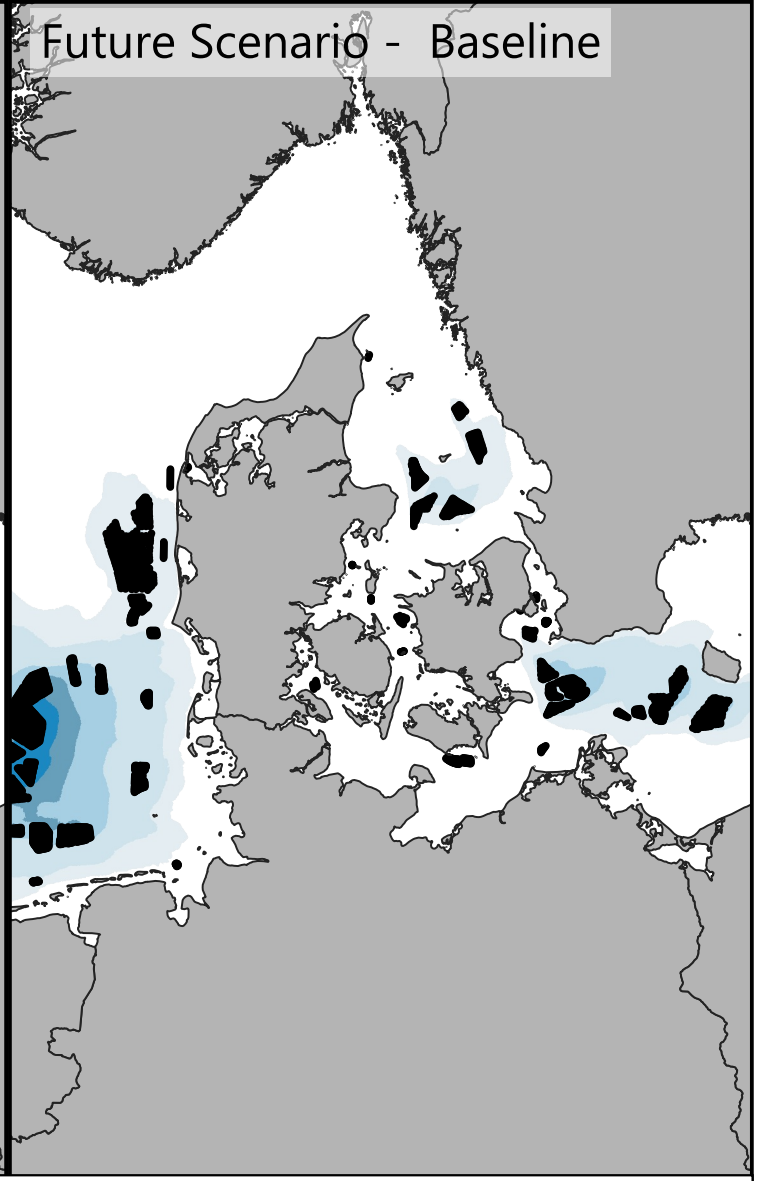
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km







Signignificant Wave Height [m]

- <= 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 1.75
- 1.75 - 2.00
- 2.00 - 2.25
- > 2.25

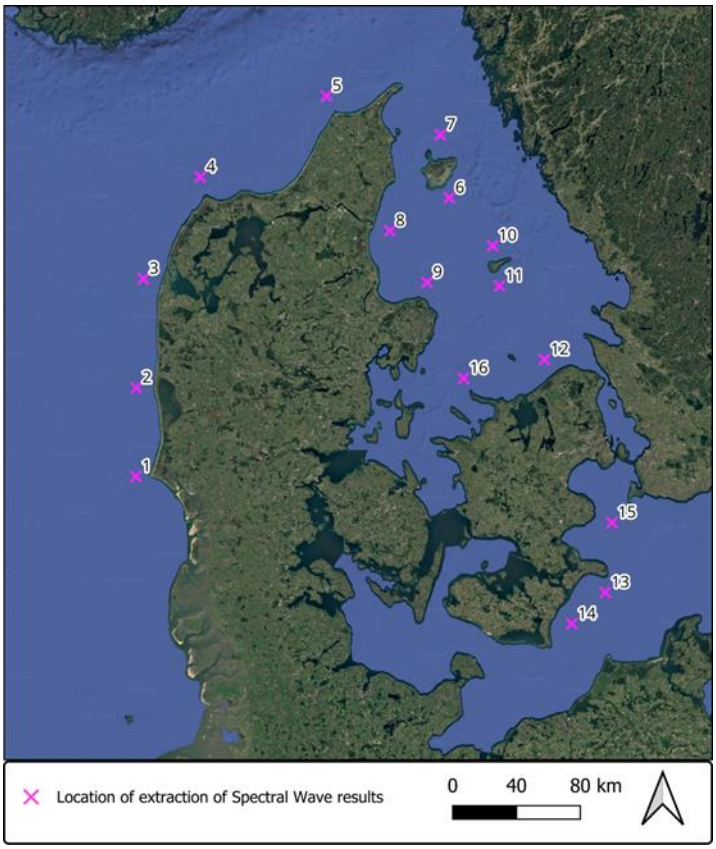
Difference: Year - Baseline [m]

- <= -0.20
- -0.20 - -0.15
- -0.15 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- > 0.15

0 100 200 km

Appendix G: Waves, Annual and Monthly variations at selected locations

Analysis of the annual and monthly wave climate based on the Atlantic- European North West Shelf- Wave Physics Reanalysis" wave model, AENWS.



Locations of extracted AENWS significant wave height (Hm0) and mean wave direction ()MWD.

Location of the extracted AENWS significant wave height (Hm0) and mean wave direction (MWD).

Location	Easterly coordinate [m]	Northerly coordinate [m]	Coordinate System
1	53878.5	6178532.8	UTM32
2	59055.8	6234090.4	UTM32
3	69412.3	6301994.4	UTM32
4	110637.5	6362581.3	UTM32
5	194011.0	6406269.6	UTM32
6	265128.3	6335758.0	UTM32
7	263095.0	6375780.9	UTM32
8	226193.4	6318429.9	UTM32
9	246624.0	6284199.1	UTM32
10	289605.8	6303538.8	UTM32
11	291627.6	6277955.9	UTM32
12	315748.9	6229539.8	UTM32
13	341136.4	6080754.1	UTM32
14	318478.2	6062920.4	UTM32
15	348974.3	6123958.3	UTM32
16	264207.7	6222170.6	UTM32

P1

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	*275.3 °*	*6.6 °*	*0.2 °*	*-0.7 °*	*1.22*	*0.08*	*-0.02*	*-0.03*
Jan	*267.5 °*	*30.3 °*	*0.4 °*	*-0.6 °*	*1.59*	*0.37*	*-0.01*	*-0.03*
Feb	*269.9 °*	*26.0 °*	*0.1 °*	*-0.3 °*	*1.49*	*0.38*	*-0.02*	*-0.03*
Mar	*274.3 °*	*32.2 °*	*-0.0 °*	*-0.6 °*	*1.28*	*0.30*	*-0.02*	*-0.03*
Apr	*293.6 °*	*29.2 °*	*-2.1 °*	*-0.8 °*	*1.00*	*0.21*	*-0.01*	*-0.02*
May	*294.3 °*	*30.4 °*	*0.2 °*	*-1.0 °*	*0.93*	*0.16*	*-0.02*	*-0.05*
Jun	*294.1 °*	*16.9 °*	*-0.5 °*	*-1.1 °*	*0.98*	*0.16*	*-0.02*	*-0.03*
Jul	*288.0 °*	*16.4 °*	*-0.1 °*	*-0.9 °*	*0.96*	*0.20*	*-0.02*	*-0.04*
Aug	*279.4 °*	*19.8 °*	*0.5 °*	*0.2 °*	*1.00*	*0.18*	*-0.02*	*-0.03*
Sep	*278.4 °*	*28.0 °*	*0.2 °*	*-0.5 °*	*1.17*	*0.24*	*-0.02*	*-0.03*
Oct	*262.3 °*	*24.4 °*	*1.2 °*	*-0.0 °*	*1.37*	*0.22*	*-0.02*	*-0.03*
Nov	*265.1 °*	*35.9 °*	*-3.3 °*	*-6.6 °*	*1.43*	*0.29*	*-0.01*	*-0.03*
Dec	*267.8 °*	*26.9 °*	*-0.1 °*	*-0.0 °*	*1.52*	*0.32*	*-0.02*	*-0.03*

P1

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	275	278	273	276	276	282	272	283	280	276	273	270	265	280	266	273	276	283	268	283	268	267	293	268	275	275	258	269	273	278	270	272	265	283	273	276	270
Jan	231	266	249	254	291	260	268	267	147	276	263	249	281	222	256	277	249	281	243	277	248	243	358	280	281	272	197	270	235	285	248	297	262	289	288	260	280
Feb	271	259	244	270	278	295	160	265	274	254	269	292	266	296	263	236	290	314	288	257	270	297	258	225	287	304	224	277	271	246	262	258	261	240	272	291	264
Mar	283	259	280	239	277	290	268	265	345	278	285	259	300	220	281	257	264	282	277	279	281	274	284	287	297	36	270	268	275	273	117	275	259	279	264	275	241
Apr	302	314	283	273	285	220	269	313	266	302	225	285	281	276	258	280	255	262	278	305	267	254	281	292	278	267	292	297	289	296	267	113	301	313	307	296	262
May	223	294	313	316	273	308	311	306	302	281	306	271	272	302	246	249	312	285	261	278	333	269	319	260	305	283	295	267	300	288	276	302	303	266	282	320	134
Jun	314	295	271	276	327	305	284	297	293	307	270	264	286	297	267	279	282	300	299	282	275	313	317	273	275	283	314	288	287	272	302	258	267	305	275	305	282
Jul	242	312	295	268	286	284	311	287	295	300	282	284	309	262	282	273	290	293	281	272	256	259	264	296	274	300	280	280	270	280	311	297	279	293	293	264	264
Aug	265	287	284	289	252	290	290	320	237	273	291	293	289	269	286	302	253	288	298	291	253	256	280	269	268	266	264	223	275	267	266	244	262	295	290	283	254
Sep	276	294	296	290	246	350	281	286	314	290	233	219	199	310	304	284	279	278	255	298	240	286	285	255	273	284	311	271	244	252	269	282	276	286	299	250	292
Oct	258	274	239	269	300	296	266	253	259	297	277	267	224	236	292	294	227	226	248	281	269	284	265	261	266	239	243	259	349	276	290	256	242	256	248	279	256
Nov	295	266	299	259	267	191	270	288	274	186	252	268	213	299	194	223	293	267	266	300	284	229	310	230	249	287	190	265	273	284	198	222	254	283	209	255	286
Dec	289	279	273	285	257	267	256	325	281	244	264	273	246	298	140	282	275	301	257	257	275	251	313	274	234	254	276	246	274	280	268	253	223	260	253	270	277

P1

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	1.31	1.3	1.38	1.24	1.26	1.22	1.26	1.27	1.05	1.17	1.3	1.26	1.32	1.15	1.09	1.08	1.24	1.27	1.17	1.33	1.28	1.15	1.09	1.28	1.27	1.17	1.17	1.34	1.15	1.27	1.11	1.24	1.29	1.16	1.25	1.23	1.2
Jan	1.38	1.69	1.92	1.62	1.63	2.29	1.87	1.87	0.91	0.94	1.43	1.54	1.97	1.07	1.6	1.54	1.33	2.29	1.13	2.36	1.89	1.3	1.03	1.39	1.81	1.17	1.49	1.96	1.43	1.43	1.38	1.74	1.79	1.26	1.91	1.63	1.74
Feb	1.88	1.95	2.16	1.11	1.5	1.45	0.88	1.99	1.28	1.98	1.77	1.77	1.88	1.36	2.01	0.82	1.48	1.44	1.08	1.21	1.69	1.06	0.87	1.43	1.36	0.98	1.63	1.47	1.57	1.26	1.2	1.3	2.13	1.07	2.18	1.55	1.54
Mar	1.37	1.51	1.96	0.87	1.59	1.24	1.83	1.87	0.88	1.38	1.54	1.13	1.58	0.88	1.34	0.96	1.17	1.16	1.06	1.37	1.76	1.17	1.19	1.16	1.26	0.93	1.2	1.24	1.04	1.18	0.87	1.75	1.35	1.27	0.82	1.41	1.03
Apr	0.95	0.94	1.12	1.14	1.05	0.81	1.08	1.32	0.58	1.48	0.81	1.16	0.85	1	0.74	0.94	0.82	0.89	1.14	1.06	0.79	0.6	0.99	1.01	1.02	0.99	0.94	1.25	1.14	1.33	0.83	0.6	1.06	1.35	1.04	0.82	1.17
May	0.73	0.97	0.75	1.17	0.89	0.85	0.81	0.79	0.98	0.91	0.94	0.89	0.87	0.87	0.84	0.87	1.05	1.13	1.06	1	0.55	1	1.05	1.04	1.04	0.93	0.83	1.33	0.88	0.78	0.65	1.17	1.09	0.9	1.03	1	0.63
Jun	0.99	0.73	0.81	1.09	0.8	1.06	1.27	1.01	1.12	0.84	1.02	0.92	1.27	1.05	1.02	0.9	1.09	1.08	0.91	0.69	1.13	1.02	0.9	0.9	1.19	1.16	1	1.17	0.82	1.08	1.12	0.85	0.72	0.73	0.8	0.73	1.14
Jul	1.03	1.14	1.31	0.78	0.91	1.17	0.55	0.78	1.05	0.67	1.34	0.87	1.06	0.77	0.96	0.8	0.85	0.89	0.58	1.17	0.89	1.02	0.87	1.15	0.98	0.79	0.65	1.13	1.02	0.93	0.77	1.04	1.2	0.88	1.23	1.19	0.97
Aug	1.13	1.28	1	1.05	1.27	1.15	1.04	1.03	0.74	0.55	1.33	0.9	0.91	0.97	0.56	1.05	0.85	1.15	0.87	1.16	1.12	1.04	1.05	1.03	0.89	0.97	1.23	0.72	1.1	1.03	1	0.98	0.81	1.08	0.75	0.98	1.05
Sep	1.5	1.04	1.42	1.38	1.15	0.93	1.23	1.22	0.97	1.48	0.89	0.89	1.02	1.19	1.03	1.06	1.62	1.06	1.04	1.75	0.92	1.43	1.25	1.32	1.54	1.08	0.88	1.19	0.88	0.92	1.52	1.44	1.13	0.96	1.15	1	0.95
Oct	1.25	1.63	1.34	1.38	1.11	1.07	1.31	1.31	1.43	1.57	1.94	1.49	1.46	1.51	1.19	1.2	1.34	1.09	1.27	1.03	1.76	1.38	1.38	1.54	1.42	1.35	1.33	0.92	1.02	1.81	1.53	1.27	1.36	1.59	1.38	1.54	1.23
Nov	1.56	1.34	1.13	1.67	1.8	0.9	1.41	1.25	1.62	1.14	1.07	1.51	1.56	1.84	0.94	1.18	1.6	1.55	2.04	1.86	1.72	1.61	1.28	1.14	1.41	1.61	1.07	1.81	1.35	1.77	1.08	1.06	1.58	1.54	1.42	1.29	1.38
Dec	1.95	1.39	1.66	1.64	1.37	1.75	1.81	0.88	1.08	1.18	1.55	2.06	1.38	1.3	0.96	1.56	1.69	1.54	1.82	1.34	1.16	1.14	1.17	2.25	1.3	2.01	1.8	1.95	1.57	1.78	1.42	1.6	1.26	1.24	1.37	1.6	1.62

P2

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	276.6 °	5.8 °	0.2 °	0.4 °	1.46	0.11	-0.01	-0.05
Jan	269.8 °	26.8 °	0.0 °	-0.1 °	1.95	0.50	0.00	-0.03
Feb	272.3 °	21.2 °	0.4 °	1.5 °	1.83	0.50	-0.01	-0.05
Mar	276.2 °	26.7 °	0.2 °	0.4 °	1.54	0.38	-0.01	-0.04
Apr	292.1 °	20.1 °	-1.0 °	9.0 °	1.18	0.27	-0.01	-0.03
May	292.1 °	19.3 °	0.0 °	-0.2 °	1.09	0.21	-0.01	-0.06
Jun	292.4 °	14.5 °	0.4 °	1.7 °	1.16	0.20	-0.02	-0.05
Jul	287.3 °	14.2 °	0.4 °	0.5 °	1.13	0.23	-0.01	-0.06
Aug	279.3 °	16.9 °	0.9 °	1.5 °	1.17	0.22	-0.02	-0.06
Sep	279.1 °	24.4 °	0.4 °	0.2 °	1.39	0.32	0.00	-0.06
Oct	265.5 °	22.7 °	0.7 °	0.6 °	1.61	0.27	-0.01	-0.05
Nov	268.1 °	30.0 °	-9.1 °	-6.9 °	1.71	0.37	-0.02	-0.05
Dec	270.1 °	24.1 °	0.0 °	0.3 °	1.83	0.45	-0.01	-0.04

P2

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	276	278	274	278	276	283	274	283	281	277	275	272	267	280	270	274	277	283	270	283	269	269	293	270	276	276	262	270	275	278	273	273	267	283	274	278	273
Jan	236	267	252	258	290	263	271	267	156	280	267	252	281	232	259	278	251	280	251	278	251	248	336	279	280	277	204	271	244	284	252	296	264	288	288	262	281
Feb	271	261	248	287	278	293	199	267	279	257	271	291	267	298	265	245	289	311	290	264	271	296	290	237	286	300	228	276	271	256	266	260	262	259	273	290	269
Mar	283	261	280	246	278	287	269	268	335	277	284	263	299	242	281	262	268	283	281	280	280	274	285	288	295	7	273	271	277	276	42	275	260	280	270	276	255
Apr	300	308	282	274	287	241	267	311	265	299	236	284	284	276	268	282	259	272	278	301	268	263	280	290	279	270	291	295	288	295	276	346	298	310	306	294	264
May	256	292	310	313	272	299	305	302	302	283	302	274	272	300	249	252	309	283	265	278	320	271	315	262	302	283	294	268	294	285	287	301	300	268	280	313	257
Jun	310	291	271	276	317	303	283	298	290	303	270	269	285	294	269	278	283	297	295	290	275	310	313	274	276	282	311	287	286	275	300	262	271	300	278	302	281
Jul	244	308	293	273	285	284	301	285	293	297	281	285	307	264	281	272	290	293	282	273	260	260	265	293	276	297	279	281	270	280	305	295	279	293	292	267	269
Aug	267	285	282	288	254	289	290	315	250	272	289	292	288	270	285	301	259	288	298	289	254	258	279	269	272	268	266	236	276	267	268	246	269	295	285	285	256
Sep	277	291	296	289	250	342	286	289	306	289	249	225	210	308	299	283	278	276	260	296	247	285	287	256	275	284	308	271	248	254	269	282	279	287	298	255	294
Oct	264	275	245	272	301	298	270	256	262	296	279	269	228	241	298	294	234	235	250	279	269	283	268	263	270	245	246	271	346	277	288	260	246	258	251	287	258
Nov	293	268	298	262	268	238	272	292	276	195	255	268	217	297	213	231	292	268	267	298	284	235	312	241	252	286	201	267	277	284	209	244	257	282	216	263	285
Dec	289	280	274	285	260	269	258	310	281	248	267	274	249	297	152	283	274	300	260	259	277	253	310	274	241	257	278	248	275	281	270	256	229	267	256	274	277

P2

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	1.52	1.54	1.64	1.46	1.48	1.43	1.47	1.49	1.21	1.37	1.52	1.47	1.54	1.31	1.25	1.25	1.44	1.49	1.36	1.58	1.49	1.32	1.25	1.51	1.48	1.37	1.36	1.59	1.35	1.49	1.3	1.44	1.52	1.34	1.46	1.43	1.4
Jan	1.57	2.09	2.37	1.95	1.99	2.88	2.26	2.21	0.93	1.13	1.69	1.84	2.43	1.23	1.91	1.8	1.51	2.82	1.33	2.89	2.26	1.54	1.12	1.65	2.15	1.36	1.69	2.44	1.64	1.72	1.61	2.07	2.16	1.46	2.31	1.92	2.08
Feb	2.21	2.38	2.66	1.28	1.8	1.73	0.98	2.39	1.46	2.4	2.16	2.15	2.27	1.59	2.38	0.93	1.71	1.66	1.21	1.37	2.09	1.18	0.92	1.64	1.62	1.11	1.95	1.75	1.86	1.45	1.4	1.54	2.59	1.22	2.58	1.89	1.8
Mar	1.53	1.79	2.4	1	1.85	1.48	2.18	2.17	0.97	1.66	1.78	1.33	1.85	0.94	1.59	1.12	1.35	1.29	1.17	1.6	2.03	1.37	1.39	1.39	1.51	0.99	1.47	1.44	1.23	1.41	0.94	2.06	1.6	1.51	0.94	1.61	1.17
Apr	1.1	1.08	1.34	1.35	1.25	0.88	1.24	1.54	0.69	1.72	0.86	1.33	0.94	1.13	0.84	1.03	0.93	1	1.34	1.26	0.89	0.65	1.14	1.2	1.17	1.2	1.08	1.49	1.29	1.57	0.93	0.61	1.24	1.56	1.19	0.92	1.34
May	0.78	1.14	0.88	1.38	1.01	0.94	0.91	0.91	1.14	1.05	1.07	1.01	0.99	0.99	0.95	1.02	1.23	1.33	1.17	1.19	0.6	1.16	1.23	1.23	1.24	1.09	0.94	1.57	1	0.86	0.71	1.37	1.3	0.97	1.2	1.16	0.67
Jun	1.17	0.86	0.95	1.25	0.93	1.26	1.52	1.16	1.32	0.96	1.19	1.05	1.47	1.23	1.15	1.04	1.25	1.27	1.07	0.78	1.32	1.16	1.07	1.04	1.39	1.32	1.14	1.4	0.92	1.26	1.34	1	0.79	0.87	0.94	0.84	1.37
Jul	1.2	1.33	1.53	0.89	1.07	1.37	0.64	0.92	1.24	0.76	1.57	1.01	1.21	0.87	1.09	0.91	0.99	1.03	0.7	1.36	0.97	1.15	1.02	1.28	1.12	0.97	0.72	1.3	1.19	1.09	0.92	1.2	1.47	1.01	1.48	1.36	1.13
Aug	1.35	1.54	1.18	1.25	1.46	1.33	1.2	1.22	0.82	0.65	1.56	1	1.11	1.12	0.63	1.25	0.94	1.36	0.96	1.33	1.25	1.21	1.22	1.18	1.02	1.12	1.47	0.83	1.3	1.2	1.17	1.14	0.91	1.23	0.87	1.14	1.27
Sep	1.77	1.23	1.68	1.64	1.32	1.07	1.41	1.41	1.07	1.83	0.99	0.99	1.13	1.33	1.2	1.26	1.93	1.27	1.19	2.07	1.03	1.7	1.43	1.58	1.82	1.24	0.99	1.36	1.05	1.03	1.87	1.7	1.36	1.09	1.29	1.2	1.08
Oct	1.47	1.9	1.52	1.58	1.24	1.21	1.49	1.6	1.71	1.82	2.29	1.69	1.71	1.77	1.35	1.4	1.54	1.23	1.43	1.2	2.12	1.59	1.59	1.82	1.65	1.52	1.56	1.05	1.16	2.13	1.84	1.46	1.54	1.88	1.63	1.83	1.43
Nov	1.84	1.57	1.29	2	2.17	0.99	1.66	1.44	1.9	1.24	1.22	1.8	1.75	2.15	1.04	1.32	1.89	1.83	2.45	2.23	2.02	1.9	1.53	1.35	1.65	1.93	1.19	2.14	1.59	2.1	1.2	1.14	1.88	1.82	1.62	1.44	1.64
Dec	2.35	1.64	1.98	1.99	1.65	2.02	2.16	0.96	1.27	1.31	1.82	2.46	1.59	1.47	1	1.85	2.05	1.8	2.24	1.6	1.36	1.25	1.29	2.76	1.46	2.54	2.15	2.36	1.94	2.1	1.64	1.89	1.44	1.41	1.56	1.9	1.92

P3

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	277.4 °	5.6 °	-0.1 °	1.0 °	1.46	0.11	-0.01	-0.02
Jan	272.0 °	26.6 °	-0.0 °	0.3 °	1.95	0.50	0.00	-0.02
Feb	275.3 °	25.2 °	-0.0 °	1.2 °	1.83	0.50	0.00	-0.03
Mar	278.3 °	22.9 °	-0.1 °	0.4 °	1.54	0.38	0.00	-0.02
Apr	292.2 °	18.4 °	-0.9 °	0.9 °	1.18	0.27	-0.01	-0.02
May	290.1 °	19.2 °	-0.1 °	-0.0 °	1.09	0.21	-0.01	-0.02
Jun	288.3 °	13.2 °	-1.0 °	1.6 °	1.16	0.20	-0.01	-0.04
Jul	283.8 °	12.5 °	0.6 °	0.9 °	1.13	0.23	0.00	-0.02
Aug	277.1 °	15.2 °	0.2 °	2.2 °	1.17	0.22	-0.01	-0.04
Sep	279.3 °	23.5 °	0.3 °	0.5 °	1.39	0.32	0.00	-0.02
Oct	267.6 °	23.5 °	0.1 °	1.6 °	1.61	0.27	-0.01	-0.03
Nov	271.0 °	28.0 °	-1.9 °	1.0 °	1.71	0.37	-0.03	-0.04
Dec	272.3 °	25.1 °	0.0 °	0.7 °	1.83	0.45	-0.01	-0.02

P3

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	277	277	273	278	277	284	275	283	282	277	276	272	268	280	275	275	277	282	271	283	270	269	295	270	278	277	265	271	276	279	276	275	268	284	275	281	275
Jan	240	268	254	258	289	265	272	266	58	279	269	253	280	236	260	278	254	281	259	278	254	252	351	277	281	283	209	272	250	282	257	294	265	292	288	262	284
Feb	272	263	249	306	278	291	14	267	281	261	271	290	267	302	265	255	288	313	298	285	272	296	347	247	285	304	230	277	271	268	274	260	264	271	273	289	275
Mar	283	262	280	251	278	285	270	269	336	276	281	265	297	250	281	264	271	284	293	282	278	275	283	288	292	357	275	274	276	279	8	273	260	278	273	278	268
Apr	300	309	280	273	287	265	265	310	268	297	260	282	288	277	276	290	265	277	275	297	266	266	278	288	282	271	293	291	287	293	280	3	293	308	307	298	268
May	274	287	307	310	270	299	301	297	306	284	299	284	270	295	250	251	306	279	266	277	314	269	311	261	299	281	292	266	291	286	294	299	295	272	276	306	346
Jun	305	284	267	272	312	299	280	298	284	300	268	268	280	289	268	275	280	291	287	296	272	305	308	272	274	280	306	283	284	275	295	263	271	296	278	296	277
Jul	244	302	288	274	282	281	289	281	289	293	278	280	302	263	278	271	288	290	277	271	261	259	262	288	273	291	280	281	266	280	297	291	277	292	287	266	269
Aug	265	280	278	284	255	287	290	308	258	269	286	289	284	267	286	297	263	284	301	286	253	257	278	268	273	267	264	244	275	265	265	245	273	294	279	285	255
Sep	276	286	296	284	250	351	297	295	303	286	279	232	215	311	296	280	276	272	263	294	254	282	292	255	275	280	308	269	250	258	268	282	282	290	302	257	293
Oct	270	275	247	276	307	299	270	255	261	293	282	271	231	243	312	293	238	240	251	277	268	284	267	263	273	250	247	278	353	276	288	260	250	258	251	300	259
Nov	291	268	299	262	268	290	273	298	278	203	260	269	220	294	288	238	289	268	267	296	283	238	323	247	254	283	208	267	283	284	218	307	258	282	219	281	284
Dec	288	280	276	284	262	272	257	310	281	252	268	275	252	298	121	283	274	301	261	259	279	257	313	274	256	257	279	250	276	281	272	256	234	275	262	280	279

P3

Hm0, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	1.54	1.59	1.68	1.5	1.52	1.49	1.5	1.52	1.24	1.4	1.54	1.48	1.55	1.33	1.28	1.28	1.46	1.54	1.38	1.61	1.52	1.34	1.29	1.55	1.52	1.41	1.39	1.63	1.39	1.54	1.34	1.46	1.57	1.38	1.49	1.47	1.45
Jan	1.57	2.27	2.44	1.96	2.13	3.02	2.3	2.21	0.93	1.24	1.74	1.87	2.52	1.24	1.95	1.86	1.51	2.93	1.41	2.92	2.31	1.6	1.2	1.69	2.17	1.43	1.69	2.55	1.62	1.8	1.65	2.09	2.28	1.5	2.4	1.93	2.15
Feb	2.21	2.5	2.67	1.37	1.9	1.84	1.05	2.45	1.52	2.5	2.26	2.19	2.33	1.68	2.37	0.98	1.73	1.75	1.25	1.42	2.23	1.15	0.95	1.68	1.72	1.17	1.98	1.84	1.89	1.5	1.47	1.59	2.6	1.32	2.62	2.02	1.86
Mar	1.47	1.81	2.55	1.03	1.86	1.59	2.24	2.16	1.03	1.77	1.8	1.43	1.91	0.95	1.68	1.17	1.36	1.29	1.2	1.67	2	1.43	1.41	1.49	1.6	1.07	1.6	1.52	1.27	1.52	1.01	2.05	1.66	1.57	0.98	1.57	1.24
Apr	1.14	1.14	1.43	1.4	1.3	0.91	1.27	1.62	0.77	1.74	0.86	1.33	0.95	1.15	0.88	1.05	0.95	1.05	1.36	1.34	0.9	0.67	1.18	1.26	1.19	1.3	1.12	1.55	1.3	1.65	0.98	0.66	1.31	1.6	1.2	0.96	1.36
May	0.78	1.2	0.91	1.42	1.03	0.95	0.9	0.92	1.22	1.09	1.07	1.04	1	1.01	0.97	1.05	1.28	1.35	1.17	1.23	0.62	1.18	1.25	1.27	1.3	1.14	0.95	1.58	1.03	0.88	0.75	1.42	1.35	0.95	1.21	1.22	0.7
Jun	1.18	0.9	0.96	1.22	0.99	1.31	1.56	1.16	1.34	0.98	1.22	1.04	1.48	1.24	1.15	1.04	1.24	1.29	1.11	0.8	1.35	1.17	1.14	1.07	1.39	1.32	1.12	1.44	0.91	1.29	1.37	1.05	0.79	0.96	0.99	0.84	1.42
Jul	1.22	1.34	1.52	0.92	1.1	1.37	0.67	0.95	1.29	0.76	1.55	1.01	1.21	0.87	1.09	0.92	1.02	1.05	0.75	1.37	0.95	1.14	1.06	1.22	1.13	1.03	0.73	1.31	1.18	1.12	1	1.23	1.55	1.03	1.53	1.35	1.15
Aug	1.37	1.57	1.2	1.26	1.43	1.32	1.17	1.24	0.84	0.66	1.55	0.95	1.19	1.12	0.65	1.27	0.93	1.4	0.95	1.35	1.19	1.24	1.25	1.17	1.04	1.14	1.49	0.87	1.34	1.21	1.17	1.16	0.91	1.25	0.89	1.18	1.32
Sep	1.79	1.28	1.67	1.67	1.3	1.16	1.45	1.44	1.06	1.91	1	0.98	1.13	1.32	1.18	1.32	1.93	1.34	1.21	2.12	1.05	1.72	1.47	1.59	1.87	1.23	1	1.31	1.1	1.04	1.95	1.75	1.46	1.11	1.29	1.24	1.06
Oct	1.51	1.88	1.51	1.56	1.25	1.24	1.49	1.69	1.74	1.79	2.28	1.67	1.69	1.77	1.42	1.44	1.53	1.23	1.37	1.24	2.2	1.55	1.59	1.87	1.65	1.49	1.6	1.1	1.29	2.13	1.91	1.44	1.53	1.9	1.65	1.92	1.46
Nov	1.87	1.59	1.33	2.06	2.18	1.04	1.7	1.46	1.91	1.22	1.25	1.85	1.68	2.19	1.11	1.32	1.91	1.88	2.49	2.24	2.03	1.91	1.64	1.39	1.7	2	1.22	2.12	1.69	2.18	1.21	1.17	1.95	1.89	1.62	1.47	1.69
Dec	2.42	1.66	2.05	2.1	1.75	2.05	2.16	0.97	1.3	1.28	1.88	2.46	1.59	1.46	1.01	1.89	2.17	1.87	2.33	1.61	1.42	1.25	1.3	2.83	1.46	2.62	2.22	2.41	2.04	2.15	1.63	1.91	1.46	1.43	1.56	1.93	1.98

P4

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	280.4 °	5.8 °	-0.1 °	0.3 °	1.42	0.09	0.00	-0.01
Jan	277.5 °	33.9 °	0.2 °	0.1 °	1.88	0.47	0.00	0.00
Feb	281.9 °	32.5 °	-0.0 °	0.6 °	1.80	0.44	0.00	-0.01
Mar	282.5 °	27.9 °	-0.1 °	-0.1 °	1.51	0.34	0.00	0.00
Apr	295.3 °	26.2 °	-0.5 °	-0.3 °	1.17	0.24	0.00	0.00
May	289.0 °	21.8 °	-0.1 °	0.0 °	1.07	0.20	0.00	-0.01
Jun	281.5 °	10.6 °	-2.1 °	-0.0 °	1.12	0.18	-0.01	-0.02
Jul	278.2 °	9.0 °	0.4 °	0.5 °	1.10	0.21	0.00	-0.01
Aug	275.7 °	14.0 °	-0.0 °	0.5 °	1.13	0.20	-0.01	-0.01
Sep	281.5 °	30.5 °	0.0 °	0.1 °	1.37	0.30	0.01	0.00
Oct	273.4 °	27.2 °	0.0 °	0.7 °	1.55	0.26	0.00	-0.01
Nov	278.1 °	46.3 °	0.2 °	0.0 °	1.65	0.31	-0.03	0.00
Dec	277.9 °	29.6 °	0.1 °	0.2 °	1.77	0.41	0.00	0.00

P4

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	279	276	275	279	279	287	279	283	290	279	278	276	270	284	284	279	277	281	274	282	273	273	303	272	280	279	273	274	282	279	282	279	272	286	277	285	279
Jan	251	271	262	263	283	269	275	269	96	278	275	263	278	248	265	281	257	280	272	277	262	260	35	272	282	298	142	276	274	281	272	295	269	306	285	267	288
Feb	279	267	257	343	281	287	39	268	323	268	273	285	270	309	269	277	284	327	318	345	273	297	33	272	283	319	238	280	273	282	301	265	270	311	274	288	280
Mar	293	266	277	270	281	286	273	271	7	276	278	273	292	284	281	272	279	284	325	288	278	277	280	286	287	31	280	282	276	279	37	273	268	278	276	282	295
Apr	296	326	282	279	289	320	272	304	280	292	45	278	299	285	290	320	279	281	276	288	268	279	278	287	286	271	296	284	287	289	295	35	288	300	310	311	284
May	310	282	297	303	271	306	309	295	310	278	293	297	274	288	259	256	298	271	267	276	317	272	301	267	290	284	291	267	302	291	305	291	286	286	274	295	35
Jun	295	277	264	268	305	286	277	294	275	303	267	269	274	281	269	275	274	281	281	299	270	294	293	270	269	274	294	276	285	275	284	269	276	285	278	289	274
Jul	250	290	279	271	277	276	283	279	281	288	273	275	292	266	276	274	282	284	274	268	267	259	264	281	269	282	288	278	265	278	287	283	274	287	279	266	272
Aug	265	276	276	279	261	285	291	294	310	271	280	285	276	269	313	288	276	278	303	280	260	258	279	271	271	268	262	256	273	266	266	250	277	293	280	282	260
Sep	275	284	296	277	256	22	314	313	314	280	317	245	136	328	294	278	274	271	268	290	283	279	302	259	277	280	310	274	262	277	271	282	285	295	312	265	291
Oct	276	277	255	283	336	307	272	261	264	290	282	278	242	252	335	292	242	252	257	278	267	297	268	268	276	260	257	312	22	279	289	268	259	261	258	315	262
Nov	288	272	314	267	271	5	275	315	284	178	276	274	223	290	34	247	284	269	269	293	284	244	359	261	267	281	116	271	292	281	227	21	265	283	224	341	280
Dec	285	280	279	283	268	279	263	335	290	278	276	279	263	304	59	285	274	310	265	265	291	354	332	274	341	262	280	257	276	279	272	260	245	287	272	290	283

P4

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	279	276	275	279	279	287	279	283	290	279	278	276	270	284	284	279	277	281	274	282	273	273	303	272	280	279	273	274	282	279	282	279	272	286	277	285	279
Jan	251	271	262	263	283	269	275	269	98	278	275	263	278	248	265	281	257	280	272	277	262	260	35	272	282	298	142	276	274	281	272	295	269	306	285	267	288
Feb	279	267	257	343	281	287	39	268	323	268	273	285	270	309	269	277	284	327	318	345	273	297	33	272	283	319	238	280	273	282	301	265	270	311	274	288	280
Mar	293	266	277	270	281	286	273	271	7	276	278	273	292	284	281	272	279	284	325	288	278	277	280	286	287	31	280	282	276	279	37	273	268	278	276	282	295
Apr	296	326	282	279	289	320	272	304	280	292	45	278	299	285	290	320	279	281	276	288	268	279	278	287	286	271	296	284	287	289	295	35	288	300	310	311	284
May	310	282	297	303	271	306	309	295	310	278	293	297	274	288	259	256	298	271	267	276	317	272	301	267	290	284	291	267	302	291	305	291	286	286	274	295	35
Jun	295	277	264	268	305	286	277	294	275	303	267	269	274	281	269	275	274	281	281	299	270	294	293	270	269	274	294	276	285	275	284	269	276	285	278	289	274
Jul	250	290	279	271	277	276	283	279	281	288	273	275	292	266	276	274	282	284	274	268	267	259	264	281	269	282	288	278	265	278	287	283	274	287	279	266	272
Aug	265	276	276	279	261	285	291	294	310	271	280	285	276	269	313	288	276	278	303	280	260	258	279	271	271	268	262	256	273	266	266	250	277	293	280	282	260
Sep	275	284	296	277	256	22	314	313	314	280	317	245	136	328	294	278	274	271	268	290	283	279	302	259	277	280	310	274	262	277	271	282	285	295	312	265	291
Oct	276	277	255	283	336	307	272	261	264	290	282	278	242	252	335	292	242	252	257	278	267	297	268	268	276	260	257	312	22	279	289	268	259	261	258	315	262
Nov	288	272	314	267	271	5	275	315	284	178	276	274	223	290	34	247	284	269	269	293	284	244	359	261	267	281	116	271	292	281	227	21	265	283	224	341	280
Dec	285	280	279	283	268	279	263	335	290	278	276	279	263	304	59	285	274	310	265	265	291	354	332	274	341	262	280	257	276	279	272	260	245	287	272	290	283

P5

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	272.3 °	5.5 °	0.0 °	0.2 °	1.08	0.08	0.00	0.00
Jan	272.4 °	34.7 °	0.1 °	0.0 °	1.41	0.41	0.00	0.00
Feb	275.0 °	35.8 °	0.0 °	0.2 °	1.35	0.40	0.00	0.00
Mar	272.0 °	31.5 °	0.1 °	-0.0 °	1.11	0.30	0.00	0.00
Apr	286.6 °	29.4 °	-0.3 °	0.1 °	0.86	0.20	0.00	0.00
May	276.7 °	21.3 °	0.1 °	-0.1 °	0.80	0.19	0.00	0.00
Jun	267.4 °	7.8 °	-0.5 °	0.6 °	0.87	0.18	0.00	0.00
Jul	264.6 °	5.6 °	0.3 °	0.0 °	0.88	0.20	0.00	0.00
Aug	265.3 °	9.2 °	-0.2 °	0.3 °	0.88	0.18	-0.01	-0.01
Sep	272.9 °	29.5 °	0.0 °	0.1 °	1.04	0.27	0.01	0.01
Oct	269.2 °	26.7 °	0.1 °	0.0 °	1.17	0.22	-0.01	0.00
Nov	275.4 °	48.2 °	0.4 °	-0.8 °	1.23	0.27	-0.01	0.00
Dec	274.1 °	33.5 °	0.4 °	0.5 °	1.33	0.34	0.01	0.02

P5

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	279	276	275	279	279	287	279	283	290	279	278	276	270	284	284	279	277	281	274	282	273	273	303	272	280	279	273	274	282	279	282	279	272	286	277	285	279
Jan	251	271	262	263	283	269	275	269	96	278	275	263	278	248	265	281	257	280	272	277	262	260	35	272	282	298	142	276	274	281	272	295	269	306	285	267	288
Feb	279	267	257	343	281	287	39	268	323	268	273	285	270	309	269	277	284	327	318	345	273	297	33	272	283	319	238	280	273	282	301	265	270	311	274	288	280
Mar	293	266	277	270	281	286	273	271	7	276	278	273	292	284	281	272	279	284	325	288	278	277	280	286	287	31	280	282	276	279	37	273	268	278	276	282	295
Apr	296	326	282	279	289	320	272	304	280	292	45	278	299	285	290	320	279	281	276	288	268	279	278	287	286	271	296	284	287	289	295	35	288	300	310	311	284
May	310	282	297	303	271	306	309	295	310	278	293	297	274	288	259	256	298	271	267	276	317	272	301	267	290	284	291	267	302	291	305	291	286	286	274	295	35
Jun	295	277	264	268	305	286	277	294	275	303	267	269	274	281	269	275	274	281	281	299	270	294	293	270	269	274	294	276	285	275	284	269	276	285	278	289	274
Jul	250	290	279	271	277	276	283	279	281	288	273	275	292	266	276	274	282	284	274	268	267	259	264	281	269	282	288	278	265	278	287	283	274	287	279	266	272
Aug	265	276	276	279	261	285	291	294	310	271	280	285	276	269	313	288	276	278	303	280	260	258	279	271	271	268	262	256	273	266	266	250	277	293	280	282	260
Sep	275	284	296	277	256	22	314	313	314	280	317	245	136	328	294	278	274	271	268	290	283	279	302	259	277	280	310	274	262	277	271	282	285	295	312	265	291
Oct	276	277	255	283	336	307	272	261	264	290	282	278	242	252	335	292	242	252	257	278	267	297	268	268	276	260	257	312	22	279	289	268	259	261	258	315	262
Nov	288	272	314	267	271	5	275	315	284	178	276	274	223	290	34	247	284	269	269	293	284	244	359	261	267	281	116	271	292	281	227	21	265	283	224	341	280
Dec	285	280	279	283	268	279	263	335	290	278	276	279	263	304	59	285	274	310	265	265	291	354	332	274	341	262	280	257	276	279	272	260	245	287	272	290	283

P5

Hm0, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	1.07	1.19	1.24	1.08	1.12	1.12	1.1	1.1	0.92	1	1.14	1.05	1.08	1	0.99	0.94	1.05	1.07	0.99	1.18	1.11	0.98	0.97	1.13	1.11	1.03	1	1.25	1.04	1.17	0.99	1.1	1.23	1.03	1.11	1.12	1.09
Jan	1.06	2.02	1.79	1.38	1.63	2.35	1.56	1.39	0.6	0.9	1.28	1.32	1.77	0.79	1.52	1.43	0.94	2.09	0.94	2.19	1.71	1.18	0.92	1.1	1.45	1.12	1.22	1.91	1.18	1.31	1.21	1.36	1.83	1.07	1.8	1.38	1.59
Feb	1.39	1.96	1.98	1.16	1.55	1.3	0.79	1.86	1.06	1.94	1.92	1.43	1.72	1.3	1.78	0.57	1.15	1.31	0.86	1	1.78	0.76	0.73	1.2	1.33	0.85	1.26	1.32	1.29	1.12	1.07	1.29	2.04	1.12	1.87	1.56	1.37
Mar	0.92	1.32	2.09	0.7	1.26	1.28	1.66	1.42	0.74	1.44	1.16	1.05	1.35	0.69	1.37	0.76	0.94	0.79	0.83	1.17	1.3	1.01	0.96	1.18	1.23	0.84	1.29	1.16	0.75	1.19	0.85	1.45	1.22	1.18	0.65	1.08	0.91
Apr	0.86	0.83	1.06	0.96	0.98	0.67	0.87	1.14	0.65	1.25	0.64	0.9	0.61	0.82	0.62	0.75	0.65	0.69	0.91	1.03	0.59	0.48	0.9	0.88	0.79	1.01	0.81	1.16	0.79	1.28	0.81	0.55	1.09	1.05	0.84	0.72	1.01
May	0.54	0.96	0.76	0.97	0.79	0.63	0.57	0.75	0.91	0.79	0.72	0.78	0.76	0.8	0.65	0.8	0.95	0.89	0.81	0.99	0.42	0.96	0.84	1.09	0.92	0.8	0.62	1.2	0.71	0.68	0.45	1.13	1.09	0.73	1	0.76	0.54
Jun	0.66	0.73	0.67	0.91	0.69	1	1.35	0.82	0.87	0.61	0.99	0.78	1.01	1	0.97	0.91	0.96	0.87	0.81	0.68	1.13	0.73	0.9	0.94	0.89	0.87	0.69	1.22	0.6	1.14	0.9	0.86	0.59	0.9	0.91	0.58	1.08
Jul	0.95	0.87	1.03	0.75	0.92	1.14	0.52	0.81	1.1	0.53	1.1	0.81	0.81	0.71	0.81	0.68	0.84	0.77	0.65	1.12	0.65	0.92	0.83	0.67	0.88	0.83	0.61	1.08	0.95	0.91	0.78	0.94	1.42	0.73	1.14	1.2	0.96
Aug	1	1.12	0.93	1	1.13	1	0.81	0.78	0.63	0.42	1.19	0.55	0.95	0.94	0.52	0.93	0.73	0.93	0.66	1.02	0.92	1.02	1.01	0.84	0.72	0.84	1.08	0.74	1.13	0.94	0.92	0.92	0.67	0.99	0.7	0.94	1.09
Sep	1.36	0.94	1.21	1.19	0.85	0.93	1.17	1.07	0.72	1.43	0.75	0.69	0.8	0.98	0.81	1.03	1.35	1.03	0.92	1.52	0.79	1.31	1.1	1.26	1.56	0.78	0.69	0.91	0.86	0.74	1.64	1.38	1.32	0.85	0.88	0.95	0.73
Oct	1.06	1.29	1.05	0.95	0.98	0.85	1.04	1.31	1.21	1.26	1.63	1.22	1.05	1.3	1.21	1.02	1.11	0.82	0.93	0.85	1.67	1.12	1.01	1.36	1.13	1.09	1.23	0.87	1.19	1.57	1.44	1.05	1.08	1.36	1.25	1.66	1.08
Nov	1.31	1.05	0.92	1.45	1.47	0.78	1.29	1.18	1.52	0.75	0.88	1.33	0.99	1.61	0.9	0.87	1.32	1.28	1.73	1.4	1.41	1.34	1.47	1.04	1.29	1.4	0.92	1.53	1.39	1.53	0.78	0.87	1.47	1.4	1.26	1.09	1.26
Dec	1.7	1.18	1.37	1.58	1.27	1.5	1.47	0.68	0.99	0.82	1.47	1.75	1.11	1.06	0.78	1.51	1.62	1.35	1.8	1.14	0.95	0.86	0.97	2.02	1.14	1.91	1.53	1.87	1.58	1.61	1.1	1.4	0.96	1.02	1.12	1.49	1.48

P6

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	198.7 °	15.0 °	-0.0 °	0.6 °	0.67	0.03	0.00	0.00
Jan	199.1 °	40.5 °	-0.8 °	2.1 °	0.85	0.15	0.00	0.00
Feb	194.8 °	59.6 °	-0.1 °	-0.6 °	0.81	0.16	0.00	0.00
Mar	191.2 °	45.8 °	0.1 °	0.1 °	0.68	0.12	0.00	0.00
Apr	190.5 °	59.4 °	-0.1 °	-1.3 °	0.55	0.07	0.00	-0.01
May	196.1 °	60.1 °	0.3 °	-0.3 °	0.50	0.08	0.00	0.00
Jun	217.1 °	31.9 °	-0.3 °	-0.5 °	0.50	0.10	0.00	0.00
Jul	220.6 °	23.6 °	-0.1 °	2.1 °	0.49	0.11	0.00	-0.01
Aug	209.2 °	35.9 °	-0.2 °	0.5 °	0.55	0.11	0.00	0.00
Sep	200.5 °	47.3 °	0.2 °	1.5 °	0.67	0.11	0.00	0.00
Oct	190.9 °	39.5 °	0.5 °	0.1 °	0.79	0.11	0.00	-0.01
Nov	185.8 °	55.7 °	-2.3 °	-0.7 °	0.82	0.11	0.00	-0.01
Dec	198.9 °	47.9 °	0.6 °	0.1 °	0.82	0.13	0.00	0.00

P6

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	204	224	220	212	220	210	205	215	166	221	216	201	200	202	189	209	211	210	199	229	217	191	157	213	216	203	174	212	203	220	189	210	215	207	211	208	197
Jan	159	241	218	211	257	227	218	181	126	230	209	200	241	157	229	222	159	243	157	245	192	186	100	203	200	174	140	220	160	232	185	283	225	127	256	202	201
Feb	181	221	209	110	246	255	108	232	112	220	242	258	225	274	224	172	245	71	128	133	236	158	111	171	252	30	176	209	219	160	141	219	225	119	229	259	202
Mar	146	207	250	160	214	258	220	200	96	234	228	170	269	135	244	181	188	180	126	218	209	171	222	237	252	84	222	193	168	216	102	229	209	232	170	208	146
Apr	249	117	228	177	209	155	170	304	139	293	131	242	152	179	164	94	140	189	211	272	144	159	219	251	188	205	193	268	201	259	165	108	253	298	313	151	179
May	162	253	288	327	227	186	147	261	188	191	255	174	205	283	145	201	268	218	198	232	64	240	321	211	228	155	109	224	100	162	159	254	275	174	233	181	121
Jun	330	231	193	228	241	265	254	235	233	156	235	190	242	253	231	240	239	263	234	250	241	303	263	241	225	219	290	247	189	240	250	192	174	223	239	234	227
Jul	196	275	252	239	246	253	203	247	255	307	243	250	250	225	228	241	253	240	242	240	228	223	212	170	233	267	186	239	236	235	256	254	246	236	254	226	226
Aug	226	239	226	254	210	247	214	303	138	168	250	147	240	219	159	274	211	235	170	226	229	214	218	212	223	226	209	147	240	220	229	209	196	291	243	252	207
Sep	238	225	270	233	193	85	197	128	93	259	149	161	135	85	214	210	232	207	196	247	185	239	183	216	236	191	172	175	219	145	232	236	236	155	139	196	188
Oct	182	225	166	186	105	154	196	213	200	290	216	205	177	195	98	237	161	173	205	228	224	145	169	214	214	182	165	139	80	230	223	211	173	208	212	178	189
Nov	251	183	23	201	210	116	217	90	205	145	124	198	171	265	119	170	250	198	214	277	234	165	63	193	188	232	137	220	205	231	149	126	214	215	150	111	234
Dec	256	208	196	252	200	195	210	112	189	152	213	218	184	88	118	238	231	100	221	198	204	127	39	226	124	214	220	208	242	230	191	206	156	133	183	204	207

P6

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.68	0.68	0.71	0.66	0.65	0.68	0.7	0.69	0.61	0.62	0.7	0.67	0.71	0.64	0.65	0.61	0.66	0.66	0.63	0.68	0.68	0.65	0.62	0.7	0.69	0.64	0.71	0.74	0.65	0.71	0.65	0.67	0.72	0.62	0.66	0.67	0.66
Jan	0.88	0.94	1.02	0.8	0.76	1.16	0.88	0.97	0.69	0.52	0.73	0.81	0.9	0.73	0.85	0.82	0.83	0.99	0.76	1.06	1.16	0.75	0.78	0.65	0.84	0.7	1.21	0.95	0.84	0.72	0.82	0.79	0.93	0.67	0.94	0.85	0.9
Feb	0.95	1.03	1.13	0.82	0.78	0.66	0.72	0.98	0.76	1.08	0.95	0.72	0.9	0.79	0.98	0.47	0.63	0.87	0.59	0.91	0.93	0.56	0.55	0.95	0.7	0.5	0.96	0.81	0.72	0.8	0.79	0.76	1	0.75	0.92	0.77	0.8
Mar	0.72	0.84	0.95	0.62	0.75	0.66	0.91	1	0.58	0.76	0.73	0.69	0.7	0.57	0.74	0.55	0.66	0.53	0.54	0.69	0.83	0.63	0.51	0.66	0.69	0.67	0.71	0.68	0.45	0.67	0.63	0.76	0.75	0.63	0.51	0.65	0.66
Apr	0.5	0.64	0.63	0.62	0.54	0.55	0.62	0.62	0.37	0.68	0.58	0.57	0.47	0.53	0.44	0.62	0.51	0.5	0.54	0.56	0.4	0.42	0.59	0.49	0.55	0.58	0.53	0.58	0.55	0.67	0.56	0.49	0.62	0.56	0.47	0.54	0.62
May	0.38	0.55	0.37	0.49	0.45	0.43	0.48	0.49	0.53	0.52	0.46	0.53	0.53	0.44	0.51	0.49	0.56	0.49	0.62	0.55	0.26	0.55	0.48	0.65	0.53	0.53	0.39	0.72	0.46	0.48	0.35	0.6	0.55	0.43	0.55	0.48	0.47
Jun	0.31	0.38	0.39	0.6	0.37	0.49	0.7	0.52	0.38	0.48	0.59	0.54	0.59	0.54	0.62	0.59	0.59	0.52	0.45	0.39	0.63	0.47	0.42	0.52	0.59	0.6	0.37	0.62	0.51	0.71	0.47	0.52	0.4	0.4	0.47	0.31	0.59
Jul	0.62	0.41	0.6	0.39	0.52	0.59	0.29	0.44	0.58	0.35	0.59	0.41	0.4	0.4	0.49	0.4	0.43	0.43	0.3	0.67	0.38	0.55	0.5	0.45	0.5	0.44	0.4	0.62	0.49	0.55	0.35	0.49	0.75	0.45	0.58	0.69	0.55
Aug	0.62	0.63	0.55	0.53	0.72	0.56	0.55	0.44	0.57	0.25	0.67	0.37	0.56	0.62	0.42	0.46	0.52	0.53	0.36	0.61	0.6	0.65	0.6	0.58	0.43	0.53	0.74	0.6	0.68	0.59	0.59	0.54	0.42	0.61	0.37	0.53	0.62
Sep	0.73	0.5	0.69	0.64	0.6	0.71	0.78	0.71	0.56	0.74	0.58	0.69	0.81	0.66	0.5	0.62	0.74	0.61	0.74	0.8	0.59	0.74	0.7	0.77	0.91	0.52	0.51	0.73	0.51	0.59	0.85	0.8	0.67	0.53	0.66	0.65	0.52
Oct	0.77	0.75	0.8	0.68	0.69	0.63	0.79	0.73	0.77	0.71	1.03	0.86	0.88	0.9	0.81	0.64	0.9	0.73	0.7	0.49	0.94	0.78	0.79	0.89	0.75	0.83	0.95	0.72	0.84	0.95	0.83	0.64	0.79	0.84	0.73	0.95	0.74
Nov	0.71	0.76	0.58	0.93	0.88	0.73	0.82	0.79	0.97	0.77	0.69	0.82	1.02	0.88	0.74	0.77	0.76	0.87	1	0.81	0.85	1.05	0.88	0.71	0.87	0.77	0.9	0.84	0.93	0.81	0.74	0.76	0.87	0.77	1.03	0.75	0.66
Dec	0.93	0.76	0.86	0.81	0.78	0.99	0.92	0.56	0.62	0.64	0.85	1	0.78	0.7	0.75	0.89	0.81	0.87	0.98	0.65	0.58	0.7	0.66	1.05	0.87	1.04	0.84	1.06	0.79	0.92	0.8	0.87	0.92	0.76	0.75	0.85	0.81

P7

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	236.4 °	25.2 °	0.3 °	0.3 °	0.70	0.03	0.00	0.00
Jan	232.6 °	57.5 °	0.3 °	0.0 °	0.91	0.17	0.00	-0.01
Feb	235.2 °	82.4 °	-0.1 °	0.3 °	0.86	0.17	0.00	0.00
Mar	225.0 °	68.0 °	0.1 °	0.1 °	0.73	0.15	0.00	0.00
Apr	314.5 °	89.6 °	0.6 °	-0.0 °	0.58	0.10	0.00	0.00
May	267.6 °	73.5 °	-0.4 °	-0.7 °	0.52	0.09	0.00	-0.01
Jun	254.5 °	35.9 °	1.9 °	-2.2 °	0.52	0.11	0.00	0.00
Jul	250.8 °	26.7 °	-0.8 °	-1.5 °	0.50	0.11	0.00	-0.01
Aug	237.0 °	45.6 °	-1.6 °	0.8 °	0.55	0.11	0.00	0.00
Sep	239.9 °	72.2 °	0.3 °	1.1 °	0.70	0.13	0.00	-0.01
Oct	213.3 °	64.2 °	-0.0 °	0.8 °	0.82	0.12	0.00	-0.01
Nov	215.6 °	83.4 °	-0.4 °	0.0 °	0.88	0.12	-0.01	-0.01
Dec	237.6 °	68.7 °	1.7 °	3.5 °	0.88	0.15	0.01	0.00

P7

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	237	253	250	247	253	261	238	273	207	267	253	232	223	270	236	249	245	246	224	267	245	217	358	236	251	240	181	237	249	256	220	253	243	289	249	261	227
Jan	157	258	233	223	277	248	241	194	119	253	276	211	267	153	250	259	156	266	157	272	204	193	72	222	252	299	133	240	158	266	190	333	244	356	286	214	248
Feb	193	241	220	68	272	279	92	250	61	239	257	284	244	337	248	177	279	15	86	121	257	242	65	173	279	0	178	246	240	157	102	246	248	69	255	290	234
Mar	120	224	268	157	254	284	236	218	50	264	278	173	303	112	274	194	220	252	77	261	273	175	268	261	281	62	254	221	162	244	78	254	236	260	173	285	135
Apr	301	93	256	263	293	152	179	329	338	312	115	271	98	280	156	24	138	202	228	296	130	159	264	281	211	224	316	291	227	290	346	81	291	320	344	47	222
May	182	276	312	333	245	279	38	311	355	237	295	192	230	301	127	215	309	236	240	260	0	261	335	230	255	136	54	239	14	259	158	276	297	143	260	241	99
Jun	330	247	214	251	299	277	270	299	260	140	255	200	270	269	256	263	256	296	266	282	257	329	282	256	244	236	325	261	201	263	268	237	191	256	261	277	236
Jul	207	293	281	251	269	266	259	272	272	324	257	264	267	245	244	290	275	253	262	250	248	237	241	144	250	287	222	257	250	263	272	291	259	272	274	241	240
Aug	233	262	251	269	226	276	272	317	131	174	268	120	251	249	203	294	235	250	52	265	252	228	242	236	237	243	220	152	264	234	246	222	228	319	274	275	223
Sep	264	263	323	252	206	57	291	27	7	279	146	160	130	31	284	231	254	223	225	287	210	262	293	233	257	205	322	184	238	137	250	268	271	19	71	213	230
Oct	195	260	168	183	18	139	221	233	214	317	248	240	178	212	62	285	158	170	222	261	240	335	167	237	246	193	166	138	49	284	275	238	180	229	229	342	199
Nov	297	241	353	215	226	107	248	347	250	135	104	228	167	298	85	166	288	213	238	316	281	163	22	213	201	262	130	244	302	259	142	97	232	269	146	57	268
Dec	284	251	217	276	215	233	224	68	286	133	258	259	204	3	106	282	251	14	238	212	252	98	8	248	83	231	241	222	263	260	251	222	151	91	204	293	246

P7

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.71	0.73	0.76	0.69	0.7	0.72	0.73	0.74	0.63	0.67	0.74	0.7	0.73	0.7	0.67	0.64	0.69	0.7	0.65	0.74	0.72	0.67	0.67	0.72	0.73	0.67	0.72	0.78	0.68	0.75	0.67	0.71	0.77	0.68	0.71	0.72	0.69
Jan	0.85	1.06	1.06	0.8	0.88	1.27	0.9	1.09	0.64	0.55	0.81	0.82	1.01	0.7	0.89	0.88	0.82	1.12	0.76	1.21	1.2	0.8	0.82	0.69	0.92	0.75	1.18	1.04	0.85	0.82	0.85	0.95	0.99	0.73	1.12	0.88	0.97
Feb	1	1.1	1.11	0.87	0.89	0.75	0.71	1.04	0.81	1.15	1.03	0.83	0.93	0.92	1.03	0.45	0.68	1.01	0.66	0.93	1.01	0.53	0.58	0.95	0.78	0.56	0.91	0.88	0.73	0.79	0.84	0.81	1.1	0.8	1	0.92	0.84
Mar	0.77	0.85	1.11	0.57	0.8	0.76	0.95	1.06	0.58	0.88	0.82	0.71	0.83	0.56	0.82	0.56	0.64	0.52	0.58	0.71	0.92	0.64	0.55	0.71	0.78	0.71	0.77	0.68	0.46	0.71	0.65	0.82	0.78	0.7	0.52	0.74	0.64
Apr	0.57	0.65	0.65	0.67	0.59	0.52	0.64	0.73	0.39	0.84	0.56	0.6	0.46	0.55	0.44	0.64	0.5	0.48	0.52	0.66	0.41	0.38	0.6	0.54	0.55	0.59	0.57	0.68	0.54	0.76	0.59	0.5	0.75	0.71	0.55	0.56	0.64
May	0.34	0.6	0.44	0.6	0.48	0.42	0.48	0.52	0.58	0.52	0.48	0.52	0.55	0.49	0.49	0.49	0.62	0.5	0.6	0.59	0.27	0.58	0.52	0.64	0.55	0.53	0.42	0.73	0.51	0.49	0.33	0.66	0.64	0.47	0.61	0.49	0.45
Jun	0.34	0.41	0.38	0.6	0.41	0.52	0.78	0.55	0.38	0.44	0.62	0.52	0.64	0.58	0.61	0.63	0.59	0.54	0.48	0.44	0.66	0.47	0.47	0.53	0.55	0.59	0.42	0.66	0.48	0.73	0.49	0.52	0.4	0.45	0.49	0.31	0.59
Jul	0.59	0.44	0.66	0.36	0.56	0.6	0.29	0.46	0.63	0.36	0.58	0.43	0.45	0.4	0.48	0.41	0.44	0.42	0.32	0.67	0.36	0.54	0.5	0.45	0.49	0.49	0.42	0.63	0.49	0.55	0.37	0.54	0.81	0.46	0.62	0.7	0.55
Aug	0.59	0.65	0.56	0.56	0.71	0.6	0.57	0.48	0.53	0.25	0.72	0.39	0.56	0.64	0.38	0.54	0.52	0.52	0.38	0.64	0.62	0.64	0.62	0.54	0.44	0.53	0.71	0.55	0.73	0.59	0.57	0.52	0.44	0.67	0.4	0.55	0.64
Sep	0.81	0.55	0.81	0.68	0.58	0.74	0.85	0.75	0.59	0.84	0.54	0.63	0.77	0.72	0.53	0.67	0.79	0.64	0.72	0.91	0.59	0.8	0.75	0.79	1	0.5	0.52	0.74	0.52	0.59	0.93	0.87	0.78	0.57	0.69	0.66	0.51
Oct	0.77	0.8	0.81	0.68	0.81	0.64	0.79	0.79	0.78	0.87	1.05	0.92	0.85	0.91	0.89	0.67	0.92	0.75	0.68	0.53	0.97	0.85	0.79	0.94	0.79	0.82	0.94	0.7	0.94	1.11	0.91	0.66	0.76	0.89	0.76	1.07	0.75
Nov	0.83	0.83	0.63	0.95	0.9	0.72	0.87	0.9	1.04	0.75	0.72	0.86	0.95	1.08	0.77	0.73	0.89	0.9	1.07	0.95	0.95	1.03	1.06	0.69	0.93	0.86	0.87	0.9	1.05	0.9	0.7	0.78	0.92	0.85	1.05	0.83	0.75
Dec	1.04	0.81	0.91	0.93	0.79	1.07	0.93	0.57	0.69	0.61	0.95	1.13	0.8	0.83	0.75	1.03	0.9	1	1.03	0.65	0.64	0.74	0.74	1.14	0.95	1.12	0.87	1.12	0.88	1	0.83	0.88	0.9	0.83	0.78	0.94	0.91

P8

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	167.9 °	25.0 °	-0.1 °	-0.2 °	0.55	0.02	0.00	-0.01
Jan	171.0 °	54.8 °	0.2 °	-1.4 °	0.70	0.13	0.00	-0.01
Feb	158.2 °	79.2 °	-0.3 °	-0.9 °	0.68	0.12	0.00	-0.01
Mar	158.1 °	55.5 °	-0.6 °	-0.3 °	0.58	0.09	0.00	0.00
Apr	104.3 °	78.9 °	-0.9 °	-1.2 °	0.48	0.07	0.00	-0.01
May	146.9 °	87.9 °	0.5 °	2.4 °	0.42	0.06	0.00	0.00
Jun	201.3 °	69.7 °	0.6 °	-0.2 °	0.39	0.07	0.00	0.00
Jul	208.3 °	56.0 °	3.2 °	4.4 °	0.37	0.07	0.00	-0.01
Aug	188.2 °	62.0 °	-0.1 °	0.6 °	0.42	0.08	-0.01	-0.01
Sep	166.7 °	63.8 °	2.3 °	3.3 °	0.55	0.10	0.00	-0.01
Oct	161.9 °	43.1 °	0.8 °	-0.2 °	0.66	0.11	0.00	-0.01
Nov	151.5 °	64.7 °	-0.4 °	-0.7 °	0.70	0.10	-0.01	-0.01
Dec	168.4 °	58.4 °	0.8 °	0.9 °	0.67	0.09	-0.01	-0.01

P8

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	156	196	189	161	182	138	158	135	109	167	169	159	163	120	124	150	164	151	156	194	184	139	89	181	171	141	140	178	136	175	131	155	186	104	161	142	152
Jan	151	238	205	197	262	217	192	143	116	226	127	176	244	141	222	198	135	242	137	248	167	157	88	173	143	106	127	212	132	199	158	39	213	65	266	181	140
Feb	136	207	198	90	252	281	99	225	88	210	240	288	213	51	209	152	296	57	97	119	232	106	91	145	266	44	161	152	198	127	102	188	214	90	218	296	165
Mar	113	186	252	133	179	287	205	171	87	213	153	131	332	106	244	147	121	123	96	157	156	128	155	223	254	80	192	142	140	175	94	217	179	219	139	163	121
Apr	340	96	186	104	90	122	111	10	58	326	117	247	113	110	115	73	122	146	190	299	107	129	152	280	122	174	87	286	152	278	97	95	255	341	17	90	124
May	127	264	342	359	203	107	108	20	76	122	335	129	168	316	111	164	351	188	144	223	77	225	29	169	203	112	82	205	59	102	111	269	297	135	206	129	107
Jun	26	221	134	230	101	274	258	92	240	121	224	163	239	298	180	230	233	293	239	223	233	4	272	221	203	197	354	243	148	237	259	141	121	149	201	102	207
Jul	165	309	244	227	254	261	136	252	263	25	244	245	255	205	226	75	260	212	232	231	188	199	174	108	233	297	105	240	226	192	100	241	243	202	268	213	204
Aug	212	257	199	254	186	270	126	346	116	134	257	109	222	193	115	292	177	209	97	148	214	185	165	174	208	191	192	121	236	194	209	186	148	0	75	265	181
Sep	236	147	46	209	154	79	106	89	70	267	125	131	117	72	83	168	220	177	147	308	134	227	106	193	223	157	76	135	188	124	220	217	241	98	105	171	129
Oct	146	209	134	132	72	106	157	195	157	346	172	158	158	169	83	84	135	149	175	192	205	73	140	186	183	146	145	116	74	167	129	157	132	185	189	99	156
Nov	327	125	45	177	183	104	182	56	152	129	101	156	154	303	101	143	268	174	195	5	230	144	59	166	156	225	123	203	103	215	127	106	197	144	132	90	220
Dec	265	150	160	266	177	149	194	93	90	119	188	198	151	54	108	251	221	78	206	182	141	103	45	217	102	200	198	191	241	224	129	183	137	98	143	122	164

P8

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.56	0.53	0.56	0.54	0.52	0.58	0.59	0.57	0.56	0.52	0.58	0.54	0.58	0.55	0.57	0.5	0.54	0.55	0.51	0.55	0.54	0.56	0.57	0.54	0.56	0.54	0.61	0.59	0.54	0.56	0.55	0.55	0.56	0.53	0.54	0.56	0.55
Jan	0.73	0.63	0.73	0.6	0.57	0.84	0.69	0.82	0.74	0.39	0.61	0.66	0.68	0.63	0.61	0.67	0.73	0.75	0.68	0.79	0.93	0.63	0.83	0.52	0.72	0.64	1.17	0.68	0.77	0.57	0.67	0.7	0.66	0.62	0.72	0.66	0.76
Feb	0.82	0.74	0.82	0.83	0.58	0.51	0.78	0.69	0.78	0.81	0.67	0.55	0.67	0.71	0.72	0.41	0.49	0.85	0.57	0.88	0.68	0.53	0.57	0.86	0.57	0.52	0.77	0.68	0.55	0.73	0.73	0.58	0.74	0.72	0.67	0.61	0.66
Mar	0.67	0.63	0.68	0.55	0.61	0.54	0.7	0.82	0.65	0.6	0.59	0.59	0.57	0.56	0.59	0.46	0.59	0.5	0.54	0.59	0.69	0.56	0.42	0.52	0.56	0.74	0.58	0.57	0.4	0.52	0.69	0.57	0.61	0.5	0.45	0.52	0.62
Apr	0.43	0.63	0.5	0.58	0.46	0.52	0.55	0.52	0.32	0.59	0.59	0.46	0.44	0.47	0.42	0.62	0.5	0.43	0.4	0.45	0.36	0.38	0.5	0.4	0.48	0.48	0.5	0.43	0.47	0.52	0.49	0.53	0.49	0.49	0.44	0.53	0.57
May	0.38	0.41	0.29	0.45	0.35	0.41	0.48	0.41	0.49	0.47	0.41	0.47	0.41	0.36	0.48	0.36	0.5	0.36	0.52	0.4	0.26	0.44	0.44	0.51	0.43	0.48	0.35	0.51	0.46	0.44	0.33	0.48	0.43	0.38	0.42	0.44	0.49
Jun	0.27	0.28	0.32	0.44	0.35	0.37	0.5	0.45	0.28	0.45	0.45	0.4	0.44	0.42	0.48	0.45	0.44	0.42	0.36	0.32	0.45	0.41	0.33	0.38	0.45	0.46	0.31	0.44	0.44	0.54	0.36	0.43	0.36	0.32	0.34	0.27	0.43
Jul	0.48	0.34	0.46	0.3	0.4	0.41	0.26	0.34	0.43	0.32	0.43	0.28	0.33	0.29	0.37	0.33	0.32	0.34	0.22	0.47	0.3	0.38	0.38	0.39	0.35	0.33	0.35	0.46	0.32	0.44	0.29	0.4	0.5	0.38	0.43	0.45	0.4
Aug	0.44	0.47	0.41	0.38	0.53	0.43	0.47	0.37	0.55	0.22	0.5	0.33	0.41	0.48	0.42	0.34	0.42	0.38	0.32	0.5	0.45	0.49	0.46	0.46	0.31	0.39	0.54	0.54	0.48	0.42	0.42	0.38	0.34	0.52	0.3	0.39	0.44
Sep	0.55	0.39	0.6	0.46	0.49	0.78	0.66	0.67	0.56	0.52	0.54	0.58	0.81	0.65	0.44	0.49	0.53	0.46	0.58	0.65	0.51	0.54	0.63	0.53	0.65	0.44	0.48	0.62	0.38	0.53	0.61	0.6	0.52	0.46	0.62	0.49	0.45
Oct	0.67	0.58	0.7	0.62	0.66	0.55	0.64	0.52	0.58	0.61	0.84	0.71	0.71	0.71	0.78	0.54	0.8	0.59	0.51	0.39	0.63	0.72	0.69	0.68	0.6	0.68	0.78	0.69	0.89	0.75	0.67	0.5	0.67	0.63	0.52	0.83	0.6
Nov	0.59	0.66	0.53	0.72	0.68	0.75	0.66	0.75	0.82	0.76	0.67	0.67	0.84	0.7	0.74	0.65	0.61	0.66	0.77	0.7	0.71	0.9	0.88	0.58	0.7	0.57	0.87	0.61	0.78	0.59	0.68	0.73	0.63	0.63	0.95	0.73	0.49
Dec	0.74	0.63	0.71	0.6	0.6	0.82	0.67	0.54	0.54	0.6	0.7	0.78	0.65	0.65	0.8	0.72	0.56	0.82	0.66	0.49	0.5	0.71	0.66	0.73	0.86	0.75	0.6	0.79	0.57	0.68	0.68	0.66	0.8	0.68	0.64	0.75	0.64

P9

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	167.9 °	25.0 °	-0.1 °	-0.2 °	0.59	0.02	-0.01	-0.02
Jan	171.0 °	54.8 °	0.2 °	-1.4 °	0.74	0.13	-0.01	-0.02
Feb	158.2 °	79.2 °	-0.3 °	-0.9 °	0.72	0.11	-0.01	-0.01
Mar	158.1 °	55.5 °	-0.6 °	-0.3 °	0.62	0.10	0.00	-0.01
Apr	104.3 °	78.9 °	-0.9 °	-1.2 °	0.52	0.08	-0.01	-0.03
May	146.9 °	87.9 °	0.5 °	2.4 °	0.46	0.07	-0.01	-0.01
Jun	201.3 °	69.7 °	0.6 °	-0.2 °	0.45	0.08	-0.01	-0.02
Jul	208.3 °	56.0 °	3.2 °	4.4 °	0.42	0.08	0.00	-0.01
Aug	188.2 °	62.0 °	-0.1 °	0.6 °	0.47	0.08	0.00	-0.01
Sep	166.7 °	63.8 °	2.3 °	3.3 °	0.59	0.10	0.00	-0.01
Oct	161.9 °	43.1 °	0.8 °	-0.2 °	0.69	0.11	-0.01	-0.02
Nov	151.5 °	64.7 °	-0.4 °	-0.7 °	0.73	0.09	-0.01	-0.02
Dec	168.4 °	58.4 °	0.8 °	0.9 °	0.72	0.10	0.00	-0.01

P9																																										
	Direction, average [°N]																																									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	211	260	247	243	248	238	209	305	92	277	251	200	195	24	120	233	234	237	189	278	234	149	58	221	249	173	143	223	188	259	135	230	230	9	226	225	175
Jan	155	260	227	220	284	240	240	160	112	261	296	202	271	140	249	263	134	268	135	271	183	169	86	202	218	86	124	237	130	285	158	351	239	46	288	204	183
Feb	157	233	214	81	283	301	96	249	76	234	263	296	239	0	242	154	297	46	88	112	258	74	89	145	295	32	165	261	239	123	99	237	240	82	251	302	206
Mar	102	211	274	131	256	306	237	208	79	258	299	133	312	100	287	149	99	89	90	253	262	115	294	269	296	75	240	150	141	237	90	254	209	273	135	241	120
Apr	319	85	270	82	329	119	92	344	34	319	114	283	93	75	112	54	114	154	231	305	95	122	293	296	114	198	62	297	221	294	90	90	298	328	342	69	121
May	119	292	325	342	239	75	91	341	13	110	322	127	197	314	101	196	322	231	164	289	67	270	355	204	267	93	63	241	40	69	108	297	306	148	268	115	105
Jun	1	279	142	275	38	295	280	322	284	104	261	183	276	301	255	274	269	307	290	294	263	332	296	269	260	252	324	274	167	281	286	140	109	249	276	320	248
Jul	175	311	291	267	290	279	80	283	291	353	270	277	286	239	270	323	287	280	288	267	236	240	246	45	261	303	117	269	260	291	315	297	271	305	290	240	246
Aug	253	293	265	291	215	292	304	332	109	121	283	98	274	256	104	301	216	267	66	292	258	224	261	216	252	237	219	118	270	240	258	199	171	337	340	284	207
Sep	270	286	340	261	166	77	29	74	56	285	122	129	111	62	32	226	253	219	160	302	134	270	66	224	261	173	53	140	227	125	249	263	280	73	93	192	111
Oct	153	268	135	130	52	98	187	222	188	325	214	194	162	182	75	328	137	151	207	287	232	32	141	224	234	160	146	107	71	292	309	224	133	213	220	74	166
Nov	312	112	21	199	220	100	234	30	200	125	87	180	156	306	99	145	302	192	232	328	291	148	51	175	171	272	119	235	348	256	124	109	221	267	132	83	260
Dec	293	199	179	287	190	179	217	81	70	114	260	235	168	26	103	291	248	50	231	200	155	99	31	240	96	222	228	212	266	258	122	209	138	81	157	172	210

P9																																					
	H_{m0}, average [m]																																				
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.6	0.58	0.61	0.59	0.57	0.62	0.64	0.62	0.58	0.57	0.63	0.58	0.61	0.59	0.61	0.54	0.59	0.59	0.54	0.61	0.58	0.59	0.6	0.59	0.61	0.58	0.63	0.64	0.58	0.62	0.58	0.59	0.6	0.56	0.58	0.6	0.58
Jan	0.71	0.71	0.78	0.65	0.68	0.93	0.76	0.85	0.72	0.42	0.63	0.68	0.78	0.63	0.68	0.71	0.71	0.85	0.68	0.92	0.96	0.63	0.8	0.55	0.79	0.68	1.16	0.75	0.78	0.61	0.68	0.78	0.71	0.65	0.83	0.68	0.83
Feb	0.84	0.81	0.86	0.83	0.66	0.58	0.77	0.79	0.78	0.86	0.77	0.63	0.74	0.76	0.8	0.4	0.56	0.87	0.58	0.9	0.77	0.58	0.58	0.89	0.66	0.54	0.73	0.72	0.61	0.76	0.72	0.63	0.81	0.72	0.76	0.7	0.71
Mar	0.69	0.67	0.8	0.56	0.67	0.59	0.77	0.87	0.67	0.67	0.66	0.59	0.66	0.56	0.65	0.48	0.63	0.54	0.52	0.63	0.76	0.59	0.48	0.58	0.66	0.76	0.61	0.6	0.4	0.57	0.69	0.64	0.63	0.54	0.46	0.56	0.61
Apr	0.49	0.66	0.55	0.57	0.5	0.52	0.56	0.61	0.33	0.7	0.57	0.51	0.45	0.49	0.43	0.64	0.51	0.43	0.44	0.53	0.35	0.39	0.55	0.46	0.52	0.51	0.53	0.53	0.51	0.62	0.52	0.54	0.55	0.57	0.47	0.56	0.57
May	0.39	0.47	0.35	0.51	0.37	0.44	0.51	0.48	0.52	0.49	0.47	0.5	0.43	0.45	0.48	0.38	0.58	0.4	0.57	0.44	0.28	0.48	0.53	0.53	0.48	0.48	0.38	0.58	0.47	0.48	0.34	0.56	0.53	0.39	0.46	0.49	0.5
Jun	0.3	0.32	0.35	0.49	0.41	0.47	0.6	0.49	0.33	0.49	0.5	0.43	0.51	0.47	0.56	0.52	0.53	0.5	0.39	0.36	0.52	0.5	0.39	0.43	0.51	0.52	0.37	0.53	0.46	0.64	0.43	0.45	0.38	0.34	0.38	0.3	0.47
Jul	0.47	0.43	0.55	0.35	0.45	0.49	0.28	0.39	0.5	0.37	0.5	0.33	0.38	0.32	0.44	0.37	0.38	0.39	0.24	0.55	0.33	0.42	0.4	0.44	0.39	0.4	0.36	0.53	0.37	0.5	0.35	0.46	0.59	0.42	0.52	0.5	0.44
Aug	0.49	0.55	0.47	0.47	0.56	0.49	0.52	0.43	0.56	0.22	0.59	0.37	0.48	0.53	0.43	0.42	0.44	0.44	0.35	0.56	0.5	0.53	0.49	0.5	0.35	0.43	0.58	0.55	0.55	0.48	0.49	0.38	0.34	0.58	0.32	0.44	0.47
Sep	0.6	0.43	0.67	0.54	0.5	0.79	0.69	0.7	0.6	0.63	0.54	0.57	0.8	0.66	0.49	0.53	0.61	0.49	0.63	0.73	0.52	0.62	0.67	0.58	0.73	0.47	0.52	0.65	0.41	0.53	0.66	0.68	0.55	0.48	0.65	0.51	0.47
Oct	0.71	0.65	0.7	0.64	0.67	0.57	0.71	0.53	0.6	0.7	0.94	0.77	0.68	0.72	0.8	0.6	0.8	0.59	0.54	0.43	0.69	0.78	0.7	0.74	0.65	0.69	0.76	0.71	0.9	0.83	0.74	0.53	0.67	0.66	0.55	0.9	0.62
Nov	0.67	0.68	0.58	0.75	0.75	0.74	0.74	0.78	0.86	0.73	0.67	0.68	0.79	0.81	0.74	0.65	0.7	0.69	0.82	0.79	0.8	0.87	0.89	0.59	0.71	0.62	0.85	0.67	0.82	0.66	0.66	0.71	0.67	0.67	0.91	0.75	0.55
Dec	0.88	0.68	0.74	0.7	0.62	0.86	0.72	0.57	0.55	0.6	0.72	0.85	0.64	0.7	0.8	0.79	0.62	0.87	0.75	0.52	0.53	0.7	0.7	0.81	0.85	0.79	0.66	0.82	0.65	0.77	0.74	0.7	0.77	0.71	0.63	0.8	0.67

P10

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	231.5 °	13.6 °	1.2 °	1.9 °	0.74	0.04	-0.01	-0.02
Jan	227.3 °	45.2 °	-0.1 °	-0.4 °	0.95	0.19	0.00	-0.01
Feb	227.1 °	68.5 °	1.2 °	1.9 °	0.90	0.20	-0.01	-0.03
Mar	222.5 °	54.1 °	0.5 °	1.3 °	0.75	0.16	-0.01	-0.02
Apr	264.1 °	64.3 °	0.2 °	0.1 °	0.60	0.11	0.00	-0.03
May	248.0 °	59.0 °	0.1 °	0.3 °	0.55	0.10	0.00	-0.02
Jun	256.2 °	26.8 °	2.2 °	3.8 °	0.57	0.13	-0.01	-0.02
Jul	254.8 °	19.5 °	-0.1 °	-0.7 °	0.55	0.13	0.00	-0.01
Aug	240.7 °	36.5 °	-0.7 °	0.2 °	0.60	0.13	-0.01	-0.02
Sep	235.7 °	53.1 °	0.4 °	-0.3 °	0.73	0.14	0.00	-0.01
Oct	216.9 °	51.2 °	1.2 °	1.9 °	0.86	0.13	-0.01	-0.03
Nov	215.9 °	68.5 °	-2.3 °	-0.9 °	0.90	0.12	-0.01	-0.04
Dec	228.7 °	56.7 °	1.3 °	1.5 °	0.92	0.17	-0.01	-0.01

P10

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	237	250	246	244	247	247	237	259	220	258	247	231	227	253	230	244	243	245	228	259	241	226	273	236	246	238	194	236	242	251	226	246	240	262	245	245	227
Jan	181	252	231	227	272	241	241	210	119	253	250	220	260	164	246	247	168	257	163	260	211	203	90	228	244	235	139	236	170	258	201	309	241	292	278	220	238
Feb	216	236	222	97	266	274	103	246	73	235	254	279	241	306	240	185	266	12	126	126	251	222	109	182	273	346	187	245	241	182	150	244	240	99	248	278	231
Mar	174	227	263	166	246	275	237	227	71	256	269	190	289	136	266	200	232	240	134	245	252	207	266	258	279	69	244	222	184	241	92	251	234	255	176	249	151
Apr	286	102	252	229	252	168	207	311	312	301	129	264	168	232	187	11	136	209	234	291	137	161	262	274	234	221	259	283	232	277	196	93	283	306	303	234	215
May	168	274	305	317	242	249	145	300	278	234	282	199	226	294	146	221	291	238	240	257	351	263	319	230	250	162	358	242	360	220	162	275	290	212	260	249	114
Jun	311	257	222	251	291	281	268	284	262	181	256	213	265	275	253	261	258	287	263	271	256	307	281	262	252	249	304	263	220	261	270	225	209	255	262	287	247
Jul	212	290	279	255	270	267	272	268	275	316	257	265	270	243	250	274	268	263	272	257	243	240	248	252	247	288	219	255	252	263	291	285	261	264	274	240	245
Aug	244	263	256	274	228	267	263	312	134	180	269	163	261	248	194	290	235	256	259	264	250	235	246	238	245	247	230	146	260	243	250	225	228	300	285	268	229
Sep	255	260	298	255	224	73	240	206	354	276	161	165	127	48	279	235	251	231	226	272	213	258	246	235	253	223	301	207	242	159	247	259	262	271	148	217	236
Oct	205	253	184	191	358	172	226	233	222	303	238	235	188	213	73	277	178	182	227	261	238	304	183	236	242	202	173	136	62	268	262	236	199	230	232	265	210
Nov	280	243	331	219	234	112	248	331	236	145	109	224	179	287	113	181	281	216	237	299	262	175	21	209	210	255	136	238	262	252	151	127	232	254	156	98	259
Dec	276	243	218	269	216	224	228	83	255	169	245	242	205	329	112	266	246	352	236	218	245	123	355	240	124	232	236	221	259	250	242	225	163	111	209	255	233

P10

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.75	0.76	0.8	0.73	0.73	0.75	0.78	0.77	0.65	0.7	0.78	0.73	0.77	0.71	0.71	0.67	0.74	0.72	0.68	0.78	0.76	0.71	0.68	0.77	0.77	0.71	0.75	0.83	0.71	0.8	0.7	0.75	0.81	0.69	0.74	0.75	0.72
Jan	0.88	1.09	1.15	0.9	0.92	1.35	0.99	1.07	0.63	0.57	0.8	0.88	1.08	0.73	0.98	0.91	0.83	1.19	0.76	1.3	1.26	0.79	0.78	0.72	0.96	0.77	1.23	1.1	0.88	0.81	0.86	0.95	1.07	0.75	1.16	0.92	1.04
Feb	1.02	1.16	1.25	0.85	0.91	0.78	0.69	1.16	0.79	1.22	1.11	0.86	1.02	0.89	1.14	0.45	0.73	0.95	0.61	0.95	1.07	0.6	0.57	1	0.82	0.54	0.93	0.89	0.82	0.84	0.8	0.85	1.18	0.77	1.09	0.92	0.9
Mar	0.77	0.9	1.13	0.62	0.84	0.74	1.03	1.1	0.59	0.87	0.84	0.7	0.84	0.56	0.85	0.58	0.72	0.57	0.54	0.75	0.97	0.67	0.6	0.76	0.81	0.71	0.77	0.72	0.46	0.75	0.62	0.91	0.82	0.72	0.52	0.76	0.66
Apr	0.61	0.67	0.68	0.63	0.62	0.53	0.63	0.76	0.38	0.86	0.55	0.66	0.49	0.56	0.44	0.67	0.51	0.5	0.57	0.67	0.39	0.4	0.65	0.56	0.6	0.64	0.57	0.72	0.62	0.81	0.61	0.5	0.74	0.73	0.56	0.57	0.64
May	0.38	0.61	0.44	0.6	0.48	0.45	0.5	0.58	0.58	0.55	0.52	0.56	0.57	0.54	0.51	0.51	0.66	0.52	0.66	0.59	0.28	0.61	0.59	0.67	0.59	0.53	0.43	0.8	0.47	0.52	0.35	0.72	0.7	0.48	0.63	0.54	0.46
Jun	0.34	0.43	0.41	0.67	0.42	0.6	0.82	0.59	0.44	0.51	0.66	0.56	0.69	0.6	0.7	0.67	0.68	0.62	0.49	0.43	0.72	0.59	0.49	0.57	0.67	0.68	0.47	0.73	0.53	0.83	0.57	0.55	0.44	0.42	0.51	0.35	0.66
Jul	0.61	0.52	0.73	0.44	0.58	0.7	0.3	0.5	0.67	0.4	0.67	0.46	0.48	0.44	0.56	0.43	0.5	0.48	0.32	0.76	0.41	0.6	0.52	0.51	0.56	0.52	0.4	0.71	0.56	0.62	0.41	0.59	0.88	0.51	0.71	0.78	0.62
Aug	0.68	0.72	0.61	0.62	0.78	0.65	0.61	0.52	0.56	0.24	0.81	0.4	0.63	0.69	0.41	0.56	0.54	0.61	0.39	0.68	0.7	0.7	0.64	0.64	0.47	0.58	0.82	0.6	0.79	0.67	0.67	0.57	0.43	0.73	0.39	0.6	0.66
Sep	0.83	0.54	0.81	0.73	0.62	0.73	0.87	0.76	0.6	0.91	0.58	0.68	0.78	0.69	0.55	0.69	0.87	0.64	0.78	0.95	0.61	0.86	0.78	0.85	1.06	0.56	0.57	0.78	0.54	0.61	0.97	0.94	0.75	0.57	0.71	0.69	0.55
Oct	0.84	0.87	0.82	0.73	0.75	0.67	0.9	0.78	0.82	0.88	1.2	0.96	0.86	0.94	0.86	0.72	0.93	0.74	0.76	0.55	1.07	0.88	0.82	0.99	0.85	0.87	0.96	0.73	0.89	1.12	0.95	0.72	0.83	0.94	0.81	1.09	0.78
Nov	0.85	0.82	0.67	1.01	1	0.72	0.94	0.88	1.08	0.74	0.71	0.86	0.98	1.08	0.75	0.78	0.93	0.93	1.12	0.98	1.02	1.06	0.97	0.73	0.94	0.89	0.88	0.96	1.05	0.95	0.71	0.77	0.97	0.86	1.03	0.82	0.77
Dec	1.13	0.85	0.94	0.97	0.84	1.11	1.04	0.59	0.68	0.66	0.94	1.17	0.81	0.81	0.73	1.05	0.94	0.96	1.13	0.73	0.63	0.71	0.75	1.23	0.92	1.17	0.94	1.17	0.94	1.09	0.88	0.98	0.9	0.82	0.8	0.97	0.89

P11

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	218.0 °	11.4 °	-1.3 °	0.4 °	0.76	0.05	-0.01	-0.04
Jan	216.7 °	38.6 °	0.3 °	3.2 °	0.99	0.21	-0.01	-0.04
Feb	214.1 °	60.6 °	-0.8 °	0.6 °	0.93	0.22	-0.02	-0.05
Mar	210.1 °	47.4 °	-1.1 °	0.4 °	0.77	0.16	-0.01	-0.05
Apr	222.7 °	60.3 °	0.4 °	0.9 °	0.60	0.10	-0.01	-0.02
May	221.6 °	60.9 °	-1.4 °	0.2 °	0.54	0.10	-0.02	-0.04
Jun	240.7 °	26.9 °	-3.2 °	-5.5 °	0.58	0.14	-0.01	-0.04
Jul	243.0 °	20.3 °	0.4 °	2.7 °	0.56	0.14	-0.01	-0.03
Aug	229.2 °	36.5 °	-1.6 °	-1.1 °	0.62	0.14	0.00	-0.05
Sep	221.8 °	49.1 °	-0.5 °	0.4 °	0.75	0.15	-0.01	-0.03
Oct	209.4 °	41.3 °	-0.9 °	-0.1 °	0.89	0.14	-0.01	-0.05
Nov	206.5 °	59.2 °	-1.4 °	-2.6 °	0.92	0.13	-0.01	-0.03
Dec	217.0 °	48.3 °	-0.2 °	0.7 °	0.95	0.19	0.00	-0.04

P11

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	227	241	235	233	237	232	227	242	196	243	235	222	220	232	215	230	232	231	219	246	232	216	222	228	236	225	191	228	228	240	214	234	231	240	233	231	218
Jan	183	245	226	222	262	234	235	205	119	244	233	216	251	166	239	233	171	248	163	249	208	201	104	222	230	213	141	232	172	247	198	290	233	227	267	216	227
Feb	210	229	219	118	255	264	109	239	101	229	246	267	233	282	232	185	252	46	139	129	243	177	127	181	262	360	190	234	235	180	159	235	232	122	240	266	226
Mar	176	222	254	166	235	264	232	219	87	246	250	189	274	142	253	194	218	205	154	229	237	198	253	248	268	81	235	209	186	231	97	241	226	243	172	235	152
Apr	268	111	241	210	235	166	194	298	309	291	133	252	164	211	181	91	135	200	228	281	136	154	248	263	223	214	221	274	224	268	181	100	269	294	274	181	201
May	153	267	296	307	233	223	141	289	259	215	267	187	217	287	152	216	282	233	225	246	47	254	315	224	242	162	155	237	39	178	157	268	283	207	249	204	114
Jun	295	247	209	244	283	275	262	265	255	169	249	210	256	270	244	254	251	274	251	262	250	298	276	256	246	242	289	259	211	254	264	210	194	246	257	278	241
Jul	207	285	267	250	261	261	244	260	268	312	251	257	268	236	246	259	259	258	268	253	236	237	240	230	242	282	203	250	247	257	287	276	256	250	269	233	240
Aug	241	259	250	269	223	259	248	309	132	173	262	174	259	238	152	279	227	250	239	252	241	228	237	230	242	241	224	143	253	236	244	221	214	286	274	262	224
Sep	247	243	278	249	219	85	225	174	60	269	157	164	127	79	265	229	243	225	218	259	202	249	223	229	245	216	267	202	233	167	240	251	248	220	165	213	211
Oct	201	243	182	189	175	165	218	228	218	289	229	226	190	207	99	262	179	182	221	251	232	277	183	229	235	199	174	132	76	255	247	227	196	226	227	234	207
Nov	266	221	320	215	229	113	237	330	223	148	127	215	183	274	121	182	269	212	231	281	247	178	49	203	206	244	137	231	239	242	153	136	227	242	159	132	247
Dec	265	230	210	260	212	216	224	103	228	170	231	232	203	281	114	250	239	346	230	215	231	134	5	233	143	227	228	216	250	241	228	219	167	147	204	232	223

P11

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.77	0.78	0.82	0.75	0.75	0.78	0.81	0.78	0.66	0.71	0.81	0.75	0.79	0.71	0.73	0.68	0.76	0.74	0.7	0.79	0.79	0.73	0.68	0.8	0.79	0.72	0.78	0.86	0.73	0.82	0.72	0.77	0.82	0.69	0.74	0.77	0.74
Jan	0.94	1.12	1.24	0.97	0.94	1.45	1.05	1.09	0.67	0.58	0.81	0.93	1.12	0.77	1.03	0.94	0.87	1.25	0.79	1.38	1.34	0.82	0.77	0.73	1	0.8	1.32	1.17	0.95	0.81	0.91	0.93	1.11	0.77	1.14	0.97	1.09
Feb	1.08	1.24	1.37	0.87	0.92	0.77	0.73	1.24	0.81	1.3	1.16	0.85	1.08	0.87	1.23	0.48	0.74	0.94	0.6	0.98	1.13	0.63	0.59	1.07	0.84	0.52	0.99	0.9	0.86	0.91	0.82	0.87	1.25	0.78	1.15	0.91	0.94
Mar	0.78	0.94	1.16	0.64	0.87	0.73	1.09	1.15	0.6	0.87	0.83	0.7	0.83	0.58	0.87	0.59	0.76	0.6	0.54	0.78	0.99	0.68	0.61	0.77	0.8	0.73	0.78	0.75	0.46	0.76	0.64	0.94	0.85	0.71	0.51	0.76	0.69
Apr	0.6	0.68	0.7	0.63	0.63	0.55	0.64	0.74	0.36	0.84	0.58	0.68	0.49	0.56	0.45	0.67	0.52	0.52	0.59	0.65	0.37	0.42	0.65	0.56	0.6	0.65	0.57	0.7	0.65	0.8	0.62	0.5	0.7	0.68	0.53	0.56	0.64
May	0.41	0.59	0.42	0.55	0.49	0.46	0.51	0.57	0.56	0.56	0.53	0.58	0.58	0.52	0.52	0.52	0.65	0.53	0.69	0.58	0.27	0.61	0.58	0.68	0.59	0.53	0.42	0.82	0.46	0.53	0.35	0.71	0.66	0.48	0.61	0.54	0.48
Jun	0.33	0.42	0.41	0.69	0.42	0.6	0.84	0.59	0.45	0.52	0.67	0.59	0.7	0.58	0.73	0.68	0.71	0.62	0.48	0.43	0.74	0.59	0.46	0.57	0.7	0.69	0.45	0.74	0.54	0.86	0.57	0.55	0.45	0.41	0.48	0.35	0.68
Jul	0.64	0.53	0.73	0.46	0.57	0.72	0.3	0.5	0.67	0.39	0.71	0.46	0.45	0.45	0.59	0.43	0.51	0.49	0.3	0.78	0.45	0.62	0.51	0.53	0.58	0.49	0.4	0.73	0.58	0.63	0.4	0.59	0.89	0.5	0.71	0.82	0.63
Aug	0.71	0.73	0.61	0.62	0.82	0.65	0.62	0.5	0.59	0.24	0.82	0.41	0.64	0.71	0.44	0.54	0.56	0.62	0.4	0.68	0.74	0.73	0.65	0.69	0.48	0.59	0.87	0.64	0.78	0.69	0.69	0.59	0.42	0.72	0.36	0.61	0.67
Sep	0.86	0.53	0.8	0.74	0.64	0.75	0.89	0.78	0.61	0.92	0.61	0.71	0.81	0.69	0.55	0.69	0.91	0.64	0.8	0.97	0.65	0.88	0.8	0.89	1.09	0.58	0.59	0.81	0.54	0.63	1	0.96	0.73	0.56	0.72	0.7	0.57
Oct	0.9	0.9	0.85	0.77	0.74	0.68	0.94	0.79	0.84	0.85	1.3	0.99	0.92	0.98	0.88	0.73	0.96	0.76	0.82	0.55	1.13	0.9	0.85	1.02	0.89	0.93	0.99	0.75	0.9	1.12	0.98	0.74	0.87	0.97	0.83	1.12	0.79
Nov	0.84	0.81	0.67	1.08	1.06	0.76	0.97	0.88	1.13	0.77	0.71	0.89	1.04	1.04	0.77	0.82	0.92	0.96	1.17	0.97	1.05	1.14	0.95	0.78	0.96	0.89	0.93	1.02	1.05	0.98	0.74	0.78	1.01	0.87	1.07	0.84	0.77
Dec	1.15	0.87	0.97	0.97	0.89	1.16	1.11	0.6	0.68	0.7	0.95	1.24	0.84	0.79	0.77	1.07	0.97	0.95	1.21	0.78	0.64	0.73	0.74	1.32	0.94	1.24	1.01	1.27	0.96	1.15	0.91	1.03	0.93	0.82	0.82	1	0.92

P12

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	292.4 °	9.3 °	-0.3 °	-1.5 °	0.65	0.05	0.00	-0.02
Jan	277.5 °	42.0 °	0.1 °	-0.1 °	0.83	0.23	0.00	-0.03
Feb	286.9 °	47.9 °	-0.3 °	-1.0 °	0.80	0.21	0.00	-0.03
Mar	291.0 °	38.7 °	-0.4 °	-1.8 °	0.66	0.18	-0.01	-0.03
Apr	325.7 °	48.0 °	1.0 °	1.6 °	0.54	0.14	-0.01	-0.01
May	318.2 °	30.3 °	-0.3 °	-1.4 °	0.50	0.11	0.00	-0.03
Jun	302.9 °	13.4 °	0.9 °	-1.3 °	0.54	0.13	-0.01	-0.03
Jul	299.5 °	16.2 °	-0.9 °	-2.5 °	0.53	0.14	0.00	-0.03
Aug	294.2 °	30.6 °	0.2 °	-0.7 °	0.55	0.14	0.00	-0.02
Sep	296.9 °	35.1 °	-0.4 °	-1.8 °	0.64	0.16	0.00	-0.03
Oct	281.1 °	33.4 °	-0.7 °	-2.4 °	0.72	0.15	0.00	-0.01
Nov	288.5 °	62.0 °	-1.2 °	0.1 °	0.74	0.16	0.00	-0.01
Dec	279.4 °	40.4 °	0.4 °	-0.4 °	0.80	0.19	0.01	-0.01

P12

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	281	282	277	281	279	286	278	295	310	290	282	275	275	295	286	285	280	286	274	287	274	285	312	271	283	284	267	273	286	283	290	283	274	298	281	284	276
Jan	220	268	254	257	284	262	271	279	84	273	286	256	282	220	268	273	224	275	197	276	252	255	40	265	290	297	118	264	240	284	247	314	263	317	294	254	284
Feb	272	261	247	344	287	293	68	266	17	260	267	293	263	315	264	219	285	351	340	65	270	322	1	249	295	335	223	286	266	276	326	275	262	14	270	293	274
Mar	307	261	278	229	280	286	264	270	16	281	296	269	300	61	285	276	280	301	334	277	288	301	292	282	299	39	276	266	236	276	51	272	274	278	269	282	295
Apr	306	20	287	297	288	276	293	318	339	305	86	282	326	291	261	336	73	260	263	303	38	109	297	293	296	261	297	295	277	291	313	60	302	309	292	328	271
May	324	293	311	315	265	307	322	313	299	298	300	290	263	304	356	258	306	268	283	281	340	285	323	260	278	316	325	269	338	331	295	292	302	276	282	319	79
Jun	319	294	276	277	323	294	284	304	285	315	281	261	289	298	283	285	279	300	288	294	275	312	294	283	280	283	307	283	275	286	289	283	293	295	287	306	274
Jul	251	303	294	274	289	283	311	289	294	324	274	282	290	271	279	299	281	287	302	279	269	265	294	322	270	306	281	276	273	292	311	298	280	293	292	260	274
Aug	273	292	287	293	260	287	290	320	63	287	287	303	288	283	303	297	267	277	311	292	277	270	280	271	277	275	262	100	283	273	278	250	281	305	307	284	268
Sep	277	293	305	285	276	38	279	316	337	292	241	194	46	349	317	277	271	272	286	295	269	281	292	263	276	278	314	286	270	250	271	284	286	297	314	260	287
Oct	272	282	260	276	320	331	282	269	266	307	269	281	228	255	341	300	264	247	259	290	263	314	250	274	279	248	219	12	27	292	299	267	271	270	266	300	276
Nov	299	310	325	253	267	68	281	328	281	92	350	267	208	299	26	244	301	253	273	308	289	227	347	253	254	281	93	265	301	275	122	51	261	285	185	342	277
Dec	293	282	262	287	253	268	259	22	297	289	280	268	252	319	72	290	269	330	260	252	294	13	340	263	329	263	260	251	276	272	300	260	195	338	254	285	271

P12

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.77	0.78	0.82	0.75	0.75	0.78	0.81	0.78	0.66	0.71	0.81	0.75	0.79	0.71	0.73	0.68	0.76	0.74	0.7	0.79	0.79	0.73	0.68	0.8	0.79	0.72	0.78	0.86	0.73	0.82	0.72	0.77	0.82	0.69	0.74	0.77	0.74
Jan	0.94	1.12	1.24	0.97	0.94	1.45	1.05	1.09	0.67	0.58	0.81	0.93	1.12	0.77	1.03	0.94	0.87	1.25	0.79	1.38	1.34	0.82	0.77	0.73	1	0.8	1.32	1.17	0.95	0.81	0.91	0.93	1.11	0.77	1.14	0.97	1.09
Feb	1.08	1.24	1.37	0.87	0.92	0.77	0.73	1.24	0.81	1.3	1.16	0.85	1.08	0.87	1.23	0.48	0.74	0.94	0.6	0.98	1.13	0.63	0.59	1.07	0.84	0.52	0.99	0.9	0.86	0.91	0.82	0.87	1.25	0.78	1.15	0.91	0.94
Mar	0.78	0.94	1.16	0.64	0.87	0.73	1.09	1.15	0.6	0.87	0.83	0.7	0.83	0.58	0.87	0.59	0.76	0.6	0.54	0.78	0.99	0.68	0.61	0.77	0.8	0.73	0.78	0.75	0.46	0.76	0.64	0.94	0.85	0.71	0.51	0.76	0.69
Apr	0.6	0.68	0.7	0.63	0.63	0.55	0.64	0.74	0.36	0.84	0.58	0.68	0.49	0.56	0.45	0.67	0.52	0.52	0.59	0.65	0.37	0.42	0.65	0.56	0.6	0.65	0.57	0.7	0.65	0.8	0.62	0.5	0.7	0.68	0.53	0.56	0.64
May	0.41	0.59	0.42	0.55	0.49	0.46	0.51	0.57	0.56	0.56	0.53	0.58	0.58	0.52	0.52	0.52	0.65	0.53	0.69	0.58	0.27	0.61	0.58	0.68	0.59	0.53	0.42	0.82	0.46	0.53	0.35	0.71	0.66	0.48	0.61	0.54	0.48
Jun	0.33	0.42	0.41	0.69	0.42	0.6	0.84	0.59	0.45	0.52	0.67	0.59	0.7	0.58	0.73	0.68	0.71	0.62	0.48	0.43	0.74	0.59	0.46	0.57	0.7	0.69	0.45	0.74	0.54	0.86	0.57	0.55	0.45	0.41	0.48	0.35	0.68
Jul	0.64	0.53	0.73	0.46	0.57	0.72	0.3	0.5	0.67	0.39	0.71	0.46	0.45	0.45	0.59	0.43	0.51	0.49	0.3	0.78	0.45	0.62	0.51	0.53	0.58	0.49	0.4	0.73	0.58	0.63	0.4	0.59	0.89	0.5	0.71	0.82	0.63
Aug	0.71	0.73	0.61	0.62	0.82	0.65	0.62	0.5	0.59	0.24	0.82	0.41	0.64	0.71	0.44	0.54	0.56	0.62	0.4	0.68	0.74	0.73	0.65	0.69	0.48	0.59	0.87	0.64	0.78	0.69	0.69	0.59	0.42	0.72	0.36	0.61	0.67
Sep	0.86	0.53	0.8	0.74	0.64	0.75	0.89	0.78	0.61	0.92	0.61	0.71	0.81	0.69	0.55	0.69	0.91	0.64	0.8	0.97	0.65	0.88	0.8	0.89	1.09	0.58	0.59	0.81	0.54	0.63	1	0.96	0.73	0.56	0.72	0.7	0.57
Oct	0.9	0.9	0.85	0.77	0.74	0.68	0.94	0.79	0.84	0.85	1.3	0.99	0.92	0.98	0.88	0.73	0.96	0.76	0.82	0.55	1.13	0.9	0.85	1.02	0.89	0.93	0.99	0.75	0.9	1.12	0.98	0.74	0.87	0.97	0.83	1.12	0.79
Nov	0.84	0.81	0.67	1.08	1.06	0.76	0.97	0.88	1.13	0.77	0.71	0.89	1.04	1.04	0.77	0.82	0.92	0.96	1.17	0.97	1.05	1.14	0.95	0.78	0.96	0.89	0.93	1.02	1.05	0.98	0.74	0.78	1.01	0.87	1.07	0.84	0.77
Dec	1.15	0.87	0.97	0.97	0.89	1.16	1.11	0.6	0.68	0.7	0.95	1.24	0.84	0.79	0.77	1.07	0.97	0.95	1.21	0.78	0.64	0.73	0.74	1.32	0.94	1.24	1.01	1.27	0.96	1.15	0.91	1.03	0.93	0.82	0.82	1	0.92

P13

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	188.2 °	29.5 °	0.7 °	3.3 °	0.68	0.04	-0.01	-0.04
Jan	201.7 °	45.5 °	-0.6 °	-2.2 °	0.87	0.18	-0.01	-0.02
Feb	186.9 °	68.9 °	-0.0 °	-0.2 °	0.85	0.16	-0.01	-0.03
Mar	173.2 °	59.6 °	-0.1 °	-0.3 °	0.73	0.14	0.00	-0.01
Apr	112.7 °	73.5 °	0.5 °	0.7 °	0.62	0.09	-0.03	-0.10
May	116.9 °	74.6 °	0.3 °	5.3 °	0.55	0.09	-0.01	-0.04
Jun	206.9 °	72.4 °	0.8 °	4.4 °	0.49	0.12	-0.02	-0.05
Jul	214.2 °	58.6 °	1.4 °	2.2 °	0.50	0.09	-0.01	-0.03
Aug	202.0 °	55.7 °	1.5 °	3.6 °	0.52	0.09	-0.02	-0.02
Sep	187.4 °	64.3 °	0.6 °	0.7 °	0.67	0.11	-0.01	-0.03
Oct	189.2 °	49.3 °	-0.0 °	0.9 °	0.79	0.15	-0.01	-0.03
Nov	187.8 °	56.8 °	1.0 °	2.7 °	0.80	0.10	0.01	-0.04
Dec	203.0 °	47.4 °	0.1 °	0.0 °	0.85	0.12	0.00	-0.02

P13

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	202	217	219	209	208	166	198	203	105	203	210	202	200	182	135	186	204	187	192	224	202	155	111	205	212	149	148	206	179	222	134	205	212	195	208	196	188
Jan	180	238	223	219	241	227	226	197	95	211	222	210	247	155	233	211	153	241	114	241	199	185	90	215	217	108	121	230	154	218	180	259	227	142	248	211	209
Feb	201	225	218	95	248	262	96	232	92	226	239	252	230	175	226	135	242	74	109	107	235	80	114	134	244	72	187	202	223	149	104	224	229	89	234	250	213
Mar	165	218	244	120	222	237	225	213	85	222	225	144	242	96	229	134	149	114	110	142	228	128	240	214	245	81	223	151	144	225	86	231	194	231	118	227	103
Apr	218	88	100	90	208	96	116	5	68	272	100	232	103	164	93	82	97	95	218	268	85	94	149	109	109	148	84	257	208	259	96	86	234	264	158	84	168
May	87	204	275	281	142	84	86	70	72	93	77	92	141	258	86	208	56	192	157	231	83	164	61	179	117	90	116	221	79	84	89	234	262	210	216	94	85
Jun	76	208	125	239	81	261	251	250	255	101	234	202	257	265	203	223	231	257	210	111	220	57	280	235	245	249	273	245	102	238	248	112	92	91	215	74	235
Jul	200	258	248	223	193	253	92	98	250	68	244	201	257	218	180	209	233	237	95	247	151	230	153	229	235	284	82	235	247	157	39	261	245	194	253	227	230
Aug	241	275	231	252	225	243	217	359	99	99	251	162	245	213	82	265	169	236	244	219	230	204	225	207	228	166	224	96	239	226	233	207	125	241	75	237	214
Sep	234	108	250	236	178	83	214	132	79	257	111	118	103	105	70	153	234	134	153	242	93	235	139	225	235	171	76	171	118	185	238	241	235	142	135	187	115
Oct	160	239	170	163	136	104	191	228	207	268	203	205	180	193	102	249	166	156	213	106	225	80	159	215	224	176	161	96	76	250	221	214	172	221	224	164	181
Nov	250	164	169	209	223	95	207	54	204	120	89	197	177	254	104	154	256	199	234	264	217	174	84	167	199	238	115	229	218	233	117	130	223	230	146	164	233
Dec	244	187	178	248	192	204	224	87	123	125	227	225	204	193	99	231	233	120	226	216	177	119	59	227	149	226	221	212	240	230	214	217	152	167	194	213	216

P13

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.69	0.64	0.71	0.64	0.69	0.75	0.73	0.69	0.69	0.64	0.74	0.65	0.67	0.63	0.75	0.62	0.69	0.67	0.62	0.71	0.74	0.7	0.69	0.7	0.67	0.69	0.74	0.73	0.66	0.69	0.68	0.69	0.68	0.65	0.63	0.71	0.67
Jan	0.8	0.78	0.98	0.81	0.75	1.17	0.94	0.96	0.9	0.46	0.76	0.77	0.86	0.63	0.84	0.86	0.79	1.04	0.73	1.22	1.1	0.67	1.08	0.55	0.94	0.93	1.31	0.94	0.93	0.66	0.84	0.79	0.86	0.8	0.88	0.95	1.01
Feb	0.98	0.93	1.07	0.93	0.7	0.61	0.91	0.99	0.91	1.01	0.95	0.67	0.87	0.77	1.06	0.46	0.68	0.99	0.59	0.94	0.85	0.77	0.75	1.15	0.89	0.72	0.74	0.71	0.74	0.93	0.73	0.71	1.09	0.91	1.01	0.74	0.86
Mar	0.73	0.71	0.9	0.63	0.74	0.66	0.91	0.97	0.84	0.66	0.72	0.57	0.84	0.83	0.74	0.56	0.78	0.77	0.73	0.84	0.84	0.63	0.54	0.66	0.6	1.16	0.6	0.78	0.48	0.58	0.94	0.81	0.71	0.55	0.52	0.64	0.73
Apr	0.52	0.75	0.64	0.58	0.58	0.75	0.6	0.73	0.42	0.65	0.73	0.62	0.48	0.52	0.59	0.78	0.6	0.65	0.52	0.54	0.49	0.6	0.54	0.64	0.59	0.58	0.75	0.51	0.58	0.61	0.71	0.76	0.51	0.62	0.69	0.73	0.61
May	0.62	0.42	0.33	0.42	0.59	0.65	0.69	0.53	0.58	0.63	0.61	0.52	0.54	0.43	0.57	0.44	0.6	0.41	0.67	0.45	0.43	0.6	0.58	0.6	0.61	0.54	0.59	0.57	0.58	0.62	0.54	0.63	0.49	0.53	0.47	0.6	0.69
Jun	0.36	0.26	0.38	0.53	0.64	0.52	0.6	0.43	0.41	0.58	0.49	0.38	0.56	0.36	0.72	0.6	0.65	0.48	0.35	0.56	0.64	0.71	0.37	0.45	0.52	0.46	0.36	0.46	0.52	0.65	0.48	0.52	0.58	0.34	0.33	0.4	0.47
Jul	0.47	0.59	0.57	0.45	0.54	0.55	0.36	0.49	0.49	0.46	0.63	0.46	0.44	0.39	0.63	0.38	0.48	0.47	0.3	0.63	0.62	0.49	0.4	0.56	0.5	0.37	0.62	0.61	0.47	0.47	0.36	0.56	0.56	0.51	0.56	0.63	0.43
Aug	0.47	0.58	0.42	0.48	0.63	0.51	0.58	0.43	0.65	0.35	0.62	0.51	0.42	0.6	0.59	0.47	0.56	0.53	0.45	0.57	0.63	0.57	0.5	0.66	0.42	0.5	0.61	0.69	0.53	0.49	0.5	0.41	0.43	0.63	0.3	0.49	0.42
Sep	0.69	0.49	0.74	0.49	0.65	0.83	0.74	0.8	0.84	0.64	0.65	0.64	0.81	0.64	0.6	0.57	0.7	0.5	0.64	0.78	0.81	0.71	0.84	0.62	0.7	0.54	0.75	0.69	0.54	0.71	0.7	0.74	0.5	0.6	0.67	0.46	0.66
Oct	0.87	0.78	0.82	0.77	0.86	0.71	0.78	0.5	0.54	0.73	1.33	0.88	0.74	0.8	0.89	0.69	0.87	0.65	0.71	0.57	0.83	0.84	0.83	0.78	0.7	0.86	0.7	0.82	1.05	0.84	0.79	0.68	0.88	0.75	0.59	1	0.63
Nov	0.68	0.63	0.7	0.85	0.89	0.95	0.86	0.77	0.98	0.73	0.67	0.73	0.78	0.82	0.79	0.74	0.77	0.73	0.86	0.79	0.98	1.01	0.96	0.68	0.72	0.72	0.89	0.89	0.77	0.77	0.78	0.8	0.76	0.74	0.93	0.83	0.64
Dec	1.05	0.79	0.93	0.77	0.73	1.07	0.87	0.75	0.69	0.83	0.76	1.04	0.68	0.76	0.99	0.91	0.77	0.85	0.94	0.69	0.63	0.81	0.91	1.06	0.87	0.9	0.97	1.05	0.73	0.93	0.79	0.84	0.82	0.78	0.69	0.98	0.86

P14

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	184.5 °	37.6 °	-0.5 °	0.2 °	0.58	0.03	-0.01	-0.01
Jan	200.6 °	50.9 °	-2.6 °	1.8 °	0.73	0.15	-0.01	-0.01
Feb	182.7 °	81.6 °	-0.9 °	-0.7 °	0.72	0.13	-0.01	-0.01
Mar	163.6 °	73.2 °	-0.1 °	-0.2 °	0.62	0.13	-0.01	-0.01
Apr	73.1 °	79.1 °	0.0 °	0.7 °	0.54	0.09	-0.01	-0.02
May	76.4 °	78.1 °	-0.6 °	-0.5 °	0.48	0.08	-0.01	-0.02
Jun	219.3 °	86.7 °	-0.3 °	3.7 °	0.42	0.10	-0.02	-0.03
Jul	221.2 °	86.5 °	0.2 °	-1.1 °	0.43	0.08	-0.01	-0.02
Aug	202.4 °	64.6 °	-0.2 °	-1.2 °	0.44	0.08	-0.01	0.00
Sep	182.0 °	77.3 °	0.1 °	-0.0 °	0.56	0.09	0.00	-0.01
Oct	187.0 °	59.4 °	-0.3 °	-0.1 °	0.66	0.13	-0.01	-0.01
Nov	185.4 °	67.2 °	0.9 °	-0.1 °	0.67	0.09	0.01	-0.01
Dec	201.1 °	53.5 °	-0.5 °	-0.5 °	0.71	0.10	0.00	-0.01

P14

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	201	216	220	206	205	146	196	197	90	196	210	202	200	172	114	178	200	172	187	227	196	128	90	205	213	120	134	206	164	224	110	208	214	186	210	193	187
Jan	186	237	222	218	240	227	228	204	87	211	221	209	249	153	232	215	152	240	100	241	199	181	82	212	214	94	112	231	148	212	181	280	227	97	250	213	208
Feb	201	225	218	83	250	271	89	232	82	225	239	253	231	116	226	130	242	65	98	96	235	67	102	122	322	65	191	201	222	139	94	226	229	79	234	256	218
Mar	149	219	245	103	229	243	228	216	78	222	227	130	263	86	232	120	119	95	95	112	232	86	249	202	261	76	227	133	127	225	80	230	187	231	105	229	90
Apr	229	79	79	66	214	85	98	22	64	284	91	239	89	139	85	73	87	83	222	282	76	83	108	64	83	125	73	260	217	268	83	78	267	295	111	75	165
May	79	140	282	288	119	76	77	61	58	78	69	80	127	274	78	212	44	186	145	246	77	95	52	163	86	79	96	224	68	74	81	257	280	217	229	83	77
Jun	70	201	109	244	74	271	257	239	258	83	244	209	273	268	177	235	234	269	210	83	191	52	346	239	255	255	278	244	81	246	285	90	81	74	193	62	236
Jul	201	348	247	235	83	255	83	69	256	63	247	193	267	218	176	214	237	240	77	252	118	231	29	250	236	337	73	236	252	74	46	289	244	109	268	227	231
Aug	244	295	239	254	226	248	268	17	91	87	254	160	234	222	74	275	143	239	245	201	230	211	223	214	236	123	222	86	241	229	234	211	106	269	67	246	229
Sep	235	90	251	240	173	75	211	98	73	257	102	105	92	84	65	108	235	102	132	252	83	238	115	227	234	174	66	168	102	182	239	247	237	113	111	192	80
Oct	157	239	165	155	109	92	177	233	212	271	201	206	184	199	88	313	161	155	212	79	223	63	150	219	225	172	163	86	70	254	233	215	163	225	229	141	170
Nov	255	83	133	208	224	86	206	38	202	106	72	188	177	256	93	146	265	199	238	278	223	178	78	162	202	237	104	230	220	232	109	119	226	234	138	168	233
Dec	248	180	175	249	192	206	226	80	96	110	228	226	212	186	90	231	232	88	219	215	171	106	56	226	139	226	220	213	238	228	229	217	151	153	195	218	221

P14

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.58	0.54	0.59	0.54	0.58	0.64	0.62	0.59	0.59	0.55	0.63	0.55	0.56	0.53	0.64	0.53	0.58	0.57	0.53	0.61	0.62	0.59	0.59	0.59	0.56	0.59	0.63	0.6	0.56	0.57	0.58	0.59	0.58	0.56	0.55	0.61	0.57
Jan	0.66	0.63	0.81	0.68	0.63	0.97	0.78	0.79	0.77	0.37	0.66	0.65	0.73	0.5	0.7	0.73	0.66	0.88	0.61	1.04	0.91	0.55	0.94	0.45	0.79	0.81	1.08	0.78	0.78	0.54	0.7	0.69	0.72	0.72	0.75	0.81	0.88
Feb	0.85	0.76	0.89	0.8	0.59	0.51	0.79	0.82	0.79	0.84	0.78	0.56	0.73	0.66	0.89	0.38	0.58	0.87	0.51	0.78	0.7	0.66	0.65	0.98	0.76	0.65	0.6	0.59	0.63	0.78	0.63	0.6	0.94	0.82	0.87	0.63	0.74
Mar	0.62	0.59	0.74	0.52	0.63	0.57	0.76	0.81	0.74	0.56	0.61	0.47	0.73	0.73	0.61	0.48	0.67	0.68	0.65	0.73	0.71	0.54	0.46	0.56	0.5	1.04	0.5	0.67	0.41	0.48	0.83	0.69	0.62	0.47	0.45	0.53	0.64
Apr	0.45	0.66	0.56	0.5	0.48	0.67	0.53	0.63	0.37	0.56	0.63	0.52	0.41	0.45	0.53	0.7	0.52	0.58	0.44	0.46	0.43	0.53	0.47	0.56	0.51	0.49	0.66	0.42	0.48	0.52	0.61	0.7	0.44	0.56	0.63	0.67	0.53
May	0.57	0.36	0.28	0.37	0.52	0.59	0.61	0.46	0.5	0.54	0.54	0.46	0.47	0.37	0.5	0.36	0.51	0.35	0.58	0.38	0.39	0.53	0.51	0.51	0.53	0.47	0.53	0.47	0.52	0.55	0.49	0.55	0.42	0.46	0.4	0.53	0.64
Jun	0.32	0.23	0.31	0.45	0.59	0.44	0.49	0.37	0.34	0.51	0.41	0.32	0.47	0.31	0.62	0.49	0.54	0.41	0.29	0.49	0.54	0.63	0.31	0.38	0.43	0.4	0.31	0.37	0.44	0.54	0.41	0.45	0.53	0.3	0.29	0.36	0.4
Jul	0.38	0.53	0.48	0.39	0.46	0.45	0.32	0.42	0.4	0.42	0.53	0.4	0.38	0.33	0.54	0.33	0.4	0.4	0.26	0.52	0.55	0.4	0.32	0.5	0.42	0.31	0.57	0.51	0.39	0.4	0.32	0.49	0.46	0.46	0.47	0.53	0.36
Aug	0.38	0.49	0.35	0.4	0.52	0.43	0.48	0.37	0.56	0.3	0.51	0.44	0.33	0.5	0.51	0.39	0.48	0.44	0.4	0.48	0.52	0.47	0.41	0.55	0.35	0.41	0.5	0.59	0.42	0.4	0.4	0.34	0.39	0.56	0.28	0.41	0.34
Sep	0.58	0.42	0.63	0.41	0.54	0.72	0.62	0.68	0.75	0.53	0.55	0.54	0.67	0.54	0.53	0.47	0.58	0.41	0.53	0.66	0.7	0.59	0.72	0.49	0.56	0.46	0.65	0.57	0.45	0.6	0.57	0.62	0.43	0.52	0.58	0.38	0.56
Oct	0.74	0.65	0.69	0.66	0.75	0.61	0.63	0.39	0.44	0.63	1.12	0.74	0.61	0.66	0.76	0.59	0.72	0.53	0.59	0.48	0.68	0.73	0.68	0.64	0.58	0.72	0.57	0.67	0.9	0.69	0.65	0.59	0.76	0.63	0.49	0.86	0.52
Nov	0.57	0.53	0.6	0.69	0.73	0.81	0.7	0.67	0.82	0.61	0.55	0.62	0.63	0.69	0.67	0.61	0.64	0.59	0.71	0.67	0.83	0.82	0.83	0.55	0.58	0.6	0.73	0.74	0.64	0.64	0.65	0.68	0.63	0.62	0.79	0.73	0.54
Dec	0.88	0.65	0.78	0.64	0.59	0.9	0.72	0.64	0.58	0.73	0.64	0.87	0.57	0.65	0.85	0.76	0.64	0.72	0.77	0.58	0.52	0.68	0.8	0.88	0.73	0.75	0.81	0.86	0.59	0.76	0.66	0.71	0.66	0.67	0.58	0.84	0.72

P15

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	177.7 °	18.8 °	1.2 °	6.8 °	0.59	0.03	-0.01	-0.05
Jan	187.1 °	39.8 °	-1.4 °	1.4 °	0.77	0.17	-0.01	-0.06
Feb	177.0 °	54.8 °	-0.3 °	-0.8 °	0.73	0.15	-0.01	-0.04
Mar	169.5 °	46.3 °	-0.0 °	-0.5 °	0.63	0.12	0.00	-0.03
Apr	145.8 °	58.4 °	-0.6 °	-2.1 °	0.53	0.08	-0.02	-0.08
May	149.0 °	58.0 °	2.7 °	9.2 °	0.47	0.08	-0.01	-0.04
Jun	189.1 °	63.5 °	-1.9 °	-0.7 °	0.42	0.10	-0.02	-0.07
Jul	196.8 °	55.4 °	5.2 °	11.7 °	0.41	0.07	-0.01	-0.04
Aug	186.6 °	48.9 °	1.5 °	7.1 °	0.44	0.09	-0.02	-0.05
Sep	176.4 °	47.8 °	1.7 °	4.5 °	0.58	0.09	0.00	-0.03
Oct	176.8 °	34.6 °	-0.6 °	1.9 °	0.70	0.13	-0.01	-0.04
Nov	175.4 °	41.0 °	0.2 °	-1.3 °	0.72	0.11	-0.01	-0.09
Dec	187.6 °	38.7 °	0.7 °	2.6 °	0.74	0.11	-0.01	-0.06

P15

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	180	198	203	187	188	160	179	180	124	186	187	184	177	164	145	171	184	171	173	199	185	154	130	187	189	153	148	185	166	199	142	184	196	176	186	177	166
Jan	157	239	215	208	239	221	214	178	111	210	207	198	244	150	227	201	152	237	129	240	183	173	109	196	190	132	129	218	151	195	156	249	218	152	249	196	179
Feb	179	215	207	114	246	259	112	226	110	218	239	254	221	160	217	149	233	101	131	120	231	115	127	143	221	93	170	177	210	146	128	205	222	104	228	254	193
Mar	154	205	248	131	207	238	214	198	105	208	198	145	211	113	222	145	159	137	125	148	201	131	230	198	248	98	213	151	143	206	102	224	185	219	131	208	121
Apr	182	107	125	123	172	116	134	52	84	274	114	230	122	165	115	105	112	119	197	281	107	111	146	141	134	158	106	263	188	264	114	104	237	256	182	105	159
May	106	215	294	290	156	102	108	90	104	116	107	113	150	259	105	185	90	161	151	201	101	182	80	175	134	110	125	205	98	105	109	215	267	187	195	111	101
Jun	98	192	131	225	99	264	256	231	262	115	222	173	251	267	177	204	221	257	176	132	209	99	292	211	242	241	280	234	124	224	233	128	114	122	149	95	216
Jul	179	205	242	189	158	257	109	124	250	82	237	201	250	196	170	151	220	210	118	242	159	210	141	166	227	312	104	225	244	145	93	268	245	172	248	215	206
Aug	230	272	205	239	209	232	154	337	115	125	245	154	177	183	103	269	166	222	201	169	220	183	202	179	220	161	211	112	232	207	206	187	142	245	113	236	186
Sep	228	133	234	214	167	103	196	134	105	260	126	129	117	117	88	158	225	150	145	213	120	217	153	214	224	165	99	157	141	161	226	230	224	143	139	171	149
Oct	156	226	164	163	149	121	172	211	178	263	183	185	168	180	117	190	159	157	195	145	211	138	152	194	201	166	155	113	92	238	184	202	161	203	207	149	159
Nov	234	175	149	192	209	113	188	141	188	132	115	183	163	247	121	152	235	182	217	245	192	164	109	165	179	220	126	220	196	221	129	135	211	219	145	152	215
Dec	241	170	170	246	176	186	209	104	141	139	212	211	186	167	115	212	223	133	208	200	163	132	82	214	147	211	207	200	237	217	182	203	150	149	180	201	200

P15

H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.6	0.56	0.61	0.55	0.59	0.64	0.65	0.61	0.59	0.55	0.63	0.56	0.59	0.55	0.64	0.54	0.59	0.57	0.54	0.6	0.64	0.61	0.58	0.61	0.59	0.59	0.67	0.65	0.57	0.59	0.6	0.6	0.6	0.54	0.56	0.61	0.59
Jan	0.79	0.66	0.87	0.71	0.63	1.03	0.8	0.88	0.85	0.38	0.6	0.66	0.72	0.63	0.71	0.73	0.75	0.85	0.7	1	1.06	0.61	0.93	0.49	0.8	0.76	1.31	0.84	0.86	0.54	0.79	0.66	0.73	0.64	0.75	0.83	0.88
Feb	0.86	0.84	0.98	0.81	0.57	0.5	0.83	0.87	0.8	0.9	0.77	0.54	0.75	0.66	0.9	0.43	0.54	0.81	0.48	0.92	0.74	0.65	0.66	1.04	0.71	0.51	0.76	0.67	0.63	0.84	0.62	0.62	0.92	0.77	0.85	0.61	0.75
Mar	0.63	0.65	0.75	0.59	0.63	0.52	0.81	0.89	0.73	0.59	0.63	0.54	0.68	0.73	0.63	0.5	0.65	0.59	0.58	0.7	0.75	0.57	0.44	0.58	0.54	0.96	0.55	0.67	0.42	0.51	0.84	0.69	0.63	0.47	0.48	0.56	0.67
Apr	0.45	0.68	0.54	0.49	0.52	0.64	0.53	0.6	0.33	0.55	0.66	0.52	0.44	0.45	0.47	0.65	0.55	0.54	0.45	0.45	0.42	0.53	0.47	0.53	0.52	0.52	0.63	0.43	0.52	0.51	0.63	0.64	0.47	0.49	0.52	0.58	0.53
May	0.52	0.36	0.26	0.33	0.48	0.54	0.57	0.45	0.46	0.54	0.49	0.47	0.47	0.35	0.49	0.42	0.52	0.36	0.55	0.39	0.34	0.49	0.45	0.52	0.53	0.47	0.47	0.52	0.49	0.53	0.44	0.53	0.41	0.46	0.42	0.54	0.6
Jun	0.26	0.24	0.34	0.45	0.52	0.41	0.52	0.38	0.32	0.5	0.43	0.37	0.47	0.29	0.61	0.52	0.55	0.4	0.3	0.44	0.53	0.56	0.3	0.39	0.45	0.41	0.29	0.41	0.46	0.57	0.4	0.48	0.48	0.3	0.29	0.33	0.42
Jul	0.44	0.48	0.48	0.35	0.47	0.45	0.3	0.41	0.42	0.35	0.51	0.37	0.32	0.33	0.52	0.31	0.39	0.38	0.26	0.51	0.48	0.43	0.37	0.47	0.41	0.31	0.49	0.51	0.37	0.4	0.27	0.46	0.5	0.41	0.48	0.54	0.39
Aug	0.4	0.48	0.37	0.39	0.53	0.41	0.49	0.34	0.61	0.31	0.51	0.42	0.36	0.54	0.51	0.37	0.47	0.42	0.35	0.49	0.56	0.51	0.43	0.57	0.36	0.43	0.53	0.64	0.45	0.44	0.46	0.38	0.36	0.49	0.24	0.41	0.4
Sep	0.59	0.4	0.59	0.42	0.55	0.75	0.65	0.69	0.67	0.55	0.59	0.6	0.78	0.56	0.48	0.5	0.58	0.45	0.59	0.67	0.65	0.6	0.68	0.55	0.64	0.47	0.62	0.63	0.47	0.6	0.62	0.64	0.43	0.49	0.62	0.45	0.57
Oct	0.79	0.64	0.75	0.68	0.7	0.64	0.74	0.47	0.51	0.56	1.15	0.76	0.73	0.74	0.75	0.53	0.79	0.63	0.62	0.46	0.72	0.7	0.79	0.69	0.63	0.8	0.71	0.78	0.88	0.71	0.71	0.58	0.77	0.69	0.55	0.88	0.62
Nov	0.57	0.56	0.56	0.79	0.79	0.89	0.78	0.65	0.86	0.71	0.6	0.6	0.82	0.66	0.73	0.72	0.64	0.68	0.76	0.65	0.86	0.99	0.77	0.65	0.68	0.6	0.89	0.76	0.69	0.65	0.75	0.77	0.68	0.62	0.9	0.74	0.54
Dec	0.88	0.69	0.83	0.63	0.7	0.95	0.77	0.65	0.57	0.7	0.66	0.9	0.61	0.62	0.9	0.79	0.63	0.71	0.83	0.61	0.56	0.72	0.72	0.92	0.8	0.84	0.81	0.96	0.61	0.82	0.69	0.75	0.87	0.69	0.62	0.84	0.73

P16

	AENWS		*NIRAS Model*		AENWS		*NIRAS Model*	
	Mean MWD	**St.Dev.**	**Impact on Direction**		**Mean Hm0**	**St. Dev.**	**Impact on Hm0**	
	[°N]	[°]	Current Scenario - Baseline	Future Scenario - Baseline	[m]	[m]	Current Scenario - Baseline	Future Scenario - Baseline
Annual	243.2 °	28.0 °	-0.2 °	-0.6 °	0.66	0.03	0.00	-0.01
Jan	234.5 °	55.2 °	-0.5 °	-0.8 °	0.84	0.16	0.00	-0.02
Feb	239.5 °	85.3 °	-0.2 °	-0.8 °	0.81	0.16	0.00	-0.02
Mar	232.4 °	67.5 °	-0.4 °	-0.4 °	0.68	0.13	0.00	-0.01
Apr	332.5 °	88.6 °	0.8 °	1.4 °	0.55	0.10	-0.01	-0.02
May	303.2 °	90.2 °	-0.5 °	-1.0 °	0.49	0.08	0.00	-0.02
Jun	267.6 °	36.0 °	6.2 °	8.6 °	0.50	0.11	-0.01	-0.02
Jul	260.9 °	30.6 °	-0.4 °	-1.8 °	0.48	0.10	0.00	-0.01
Aug	248.3 °	50.1 °	-0.2 °	-0.7 °	0.52	0.11	0.00	-0.02
Sep	250.9 °	70.0 °	0.0 °	-0.4 °	0.64	0.12	0.00	-0.01
Oct	224.4 °	61.9 °	-0.6 °	-1.7 °	0.75	0.12	0.00	-0.01
Nov	227.0 °	83.5 °	-3.3 °	-1.7 °	0.79	0.10	0.00	0.00
Dec	236.4 °	66.3 °	0.3 °	-0.1 °	0.81	0.13	0.01	-0.01

P16

Direction, average [°N]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	250	256	250	254	252	262	245	277	42	270	255	240	235	276	248	255	252	257	236	268	244	244	355	239	257	251	199	242	254	258	239	255	243	281	250	253	236
Jan	190	246	231	230	272	239	245	231	91	251	262	229	263	163	244	250	171	257	143	256	217	210	72	233	267	329	121	241	149	266	203	322	239	350	277	227	255
Feb	234	235	226	57	269	284	79	244	60	235	249	281	240	329	240	197	271	28	64	94	249	15	72	173	283	16	199	267	243	164	115	246	240	64	248	281	240
Mar	290	231	260	145	255	282	239	236	56	253	273	186	291	93	270	182	262	6	79	247	260	273	277	258	288	60	247	222	192	245	72	247	240	253	146	252	121
Apr	308	61	269	291	268	125	334	333	11	307	104	263	50	264	108	29	96	197	238	298	72	107	281	285	284	225	0	283	251	281	72	67	288	315	293	33	214
May	99	281	314	329	238	21	59	328	314	85	309	140	227	301	87	225	312	244	239	265	53	265	344	228	263	65	358	241	23	31	104	281	294	226	252	26	85
Jun	349	275	225	261	26	284	264	297	267	72	255	232	266	287	256	264	257	290	275	278	253	319	287	260	260	255	306	263	239	267	279	235	238	270	259	315	248
Jul	212	302	278	253	276	265	9	274	279	348	257	261	274	242	262	295	261	268	297	259	236	241	264	338	249	297	235	256	252	277	302	286	259	279	278	236	244
Aug	249	279	263	278	232	272	277	330	92	111	269	334	271	259	70	287	239	255	321	278	252	238	254	240	251	248	234	109	261	246	254	226	238	312	322	271	232
Sep	256	272	309	260	227	59	253	13	31	279	121	141	93	36	345	250	249	238	246	285	192	259	289	236	250	235	5	236	236	167	248	263	266	306	48	225	270
Oct	217	258	182	201	5	80	237	237	227	306	238	239	197	214	45	301	173	186	230	270	236	347	184	240	252	203	176	84	56	275	279	238	205	237	235	297	221
Nov	290	283	356	225	238	82	251	355	239	119	52	228	189	291	80	178	291	223	245	310	274	182	34	207	215	259	111	242	279	251	132	100	235	261	147	66	256
Dec	279	253	224	271	216	230	233	63	291	132	253	243	217	345	84	273	244	12	236	225	271	89	11	241	78	236	236	223	256	249	272	229	165	46	214	259	239

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H_{m0}, average [m]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	0.67	0.66	0.71	0.66	0.65	0.69	0.7	0.69	0.62	0.63	0.71	0.64	0.66	0.63	0.66	0.59	0.66	0.65	0.6	0.7	0.67	0.64	0.64	0.67	0.68	0.65	0.66	0.72	0.64	0.7	0.63	0.65	0.67	0.61	0.62	0.65	0.62
Jan	0.72	0.87	0.97	0.79	0.81	1.17	0.89	0.92	0.64	0.5	0.72	0.8	0.96	0.61	0.85	0.83	0.72	1.07	0.66	1.19	1.07	0.66	0.78	0.61	0.89	0.76	1.09	0.93	0.83	0.7	0.73	0.85	0.89	0.75	0.96	0.8	0.95
Feb	0.97	0.98	1.09	0.87	0.79	0.7	0.72	1.01	0.82	1.05	0.99	0.75	0.91	0.8	1.04	0.4	0.68	0.95	0.56	0.84	0.93	0.63	0.58	0.91	0.77	0.58	0.75	0.79	0.73	0.81	0.75	0.71	1.03	0.73	0.96	0.79	0.78
Mar	0.73	0.73	0.96	0.55	0.77	0.65	0.9	0.97	0.66	0.72	0.74	0.57	0.74	0.56	0.75	0.51	0.72	0.61	0.55	0.72	0.86	0.62	0.56	0.65	0.7	0.79	0.65	0.66	0.39	0.64	0.67	0.79	0.72	0.61	0.4	0.65	0.59
Apr	0.54	0.65	0.62	0.59	0.56	0.5	0.6	0.67	0.34	0.81	0.53	0.61	0.43	0.53	0.43	0.69	0.47	0.46	0.5	0.58	0.33	0.37	0.57	0.51	0.55	0.57	0.56	0.61	0.57	0.68	0.57	0.49	0.57	0.65	0.51	0.54	0.57
May	0.4	0.49	0.37	0.54	0.43	0.46	0.51	0.52	0.54	0.52	0.53	0.51	0.47	0.5	0.48	0.42	0.61	0.45	0.62	0.51	0.27	0.55	0.59	0.58	0.51	0.49	0.4	0.67	0.46	0.51	0.35	0.63	0.57	0.43	0.5	0.47	0.46
Jun	0.33	0.35	0.38	0.61	0.42	0.55	0.69	0.54	0.42	0.48	0.54	0.47	0.59	0.5	0.66	0.58	0.62	0.57	0.42	0.4	0.62	0.6	0.41	0.47	0.6	0.6	0.43	0.59	0.49	0.72	0.51	0.45	0.41	0.34	0.37	0.32	0.55
Jul	0.51	0.52	0.64	0.42	0.48	0.61	0.28	0.43	0.57	0.39	0.62	0.39	0.4	0.37	0.52	0.38	0.45	0.42	0.25	0.64	0.43	0.5	0.42	0.5	0.49	0.42	0.39	0.61	0.5	0.53	0.36	0.52	0.68	0.45	0.59	0.63	0.49
Aug	0.57	0.65	0.51	0.54	0.66	0.57	0.55	0.48	0.53	0.21	0.69	0.4	0.51	0.58	0.4	0.49	0.48	0.52	0.38	0.6	0.65	0.57	0.54	0.58	0.4	0.51	0.71	0.54	0.63	0.57	0.55	0.46	0.33	0.66	0.32	0.46	0.5
Sep	0.71	0.46	0.76	0.62	0.53	0.78	0.75	0.72	0.68	0.75	0.54	0.57	0.72	0.68	0.54	0.56	0.75	0.5	0.64	0.87	0.58	0.73	0.73	0.68	0.86	0.51	0.58	0.7	0.44	0.55	0.82	0.76	0.59	0.48	0.63	0.52	0.51
Oct	0.78	0.8	0.71	0.69	0.73	0.6	0.77	0.61	0.65	0.83	1.12	0.83	0.7	0.78	0.83	0.67	0.82	0.57	0.66	0.5	0.87	0.86	0.71	0.83	0.73	0.78	0.74	0.67	0.93	0.93	0.85	0.63	0.73	0.76	0.64	0.96	0.62
Nov	0.77	0.71	0.67	0.87	0.87	0.73	0.8	0.84	0.96	0.66	0.67	0.76	0.79	0.92	0.7	0.65	0.81	0.77	0.97	0.91	0.94	0.92	0.97	0.63	0.77	0.74	0.79	0.86	0.89	0.79	0.62	0.66	0.78	0.72	0.87	0.78	0.64
Dec	1.04	0.75	0.83	0.83	0.69	0.98	0.89	0.61	0.62	0.66	0.83	1.02	0.7	0.75	0.74	0.93	0.76	0.9	0.94	0.63	0.56	0.7	0.8	1.05	0.9	0.98	0.83	1.01	0.81	0.95	0.79	0.83	0.7	0.71	0.71	0.9	0.78