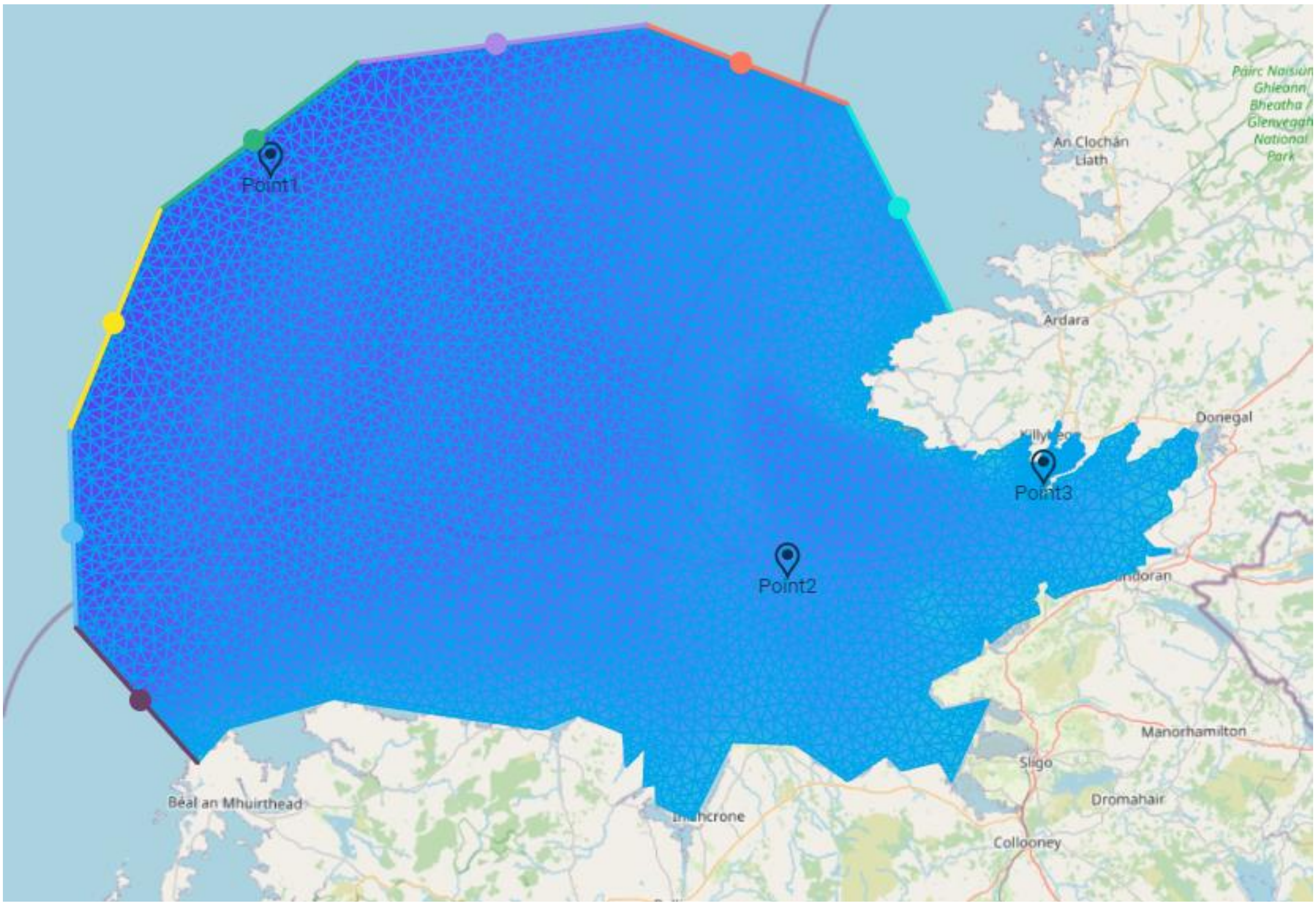
METOCEAN SIMULATOR


Point1
Point2
Point3
An Clochán Liath
Ardara
Donegal
Manorhamilton
Sligo
Dromahair
Collooney
Béal an Mhuirthead

Contents

1 Introduction

MIKE MS is built on the MIKE Cloud Platform and leverages the power of MIKE MeshBuilder and MIKE DataLink in a simple web-based user interface. The MIKE MS web interface provides pre-defined templates and default settings for a quick setup. MIKE MS assists in high-resolution meshing of the model domain, provides long term boundary conditions for the created mesh, simulates selected events in the cloud and reconstructs a long term timeseries from the selected events. The resulting timeseries can be downloaded or published to DHI's MetOcean On Demand platform for further analysis.

MIKE MS is based in the MIKE Cloud Platform (Microsoft Azure based) and can be used online using browsers like Google Chrome and Microsoft Edge. It is developed using Agile processes, meaning that updates can take place when required, and consequently, we urge MIKE MS users to communicate questions, remarks and wishes to DHI, as we are improving our products based on your feedback.

2 Getting started

It only takes a few steps to get started with the MIKE MS application. The basic workflow processes are as listed below:

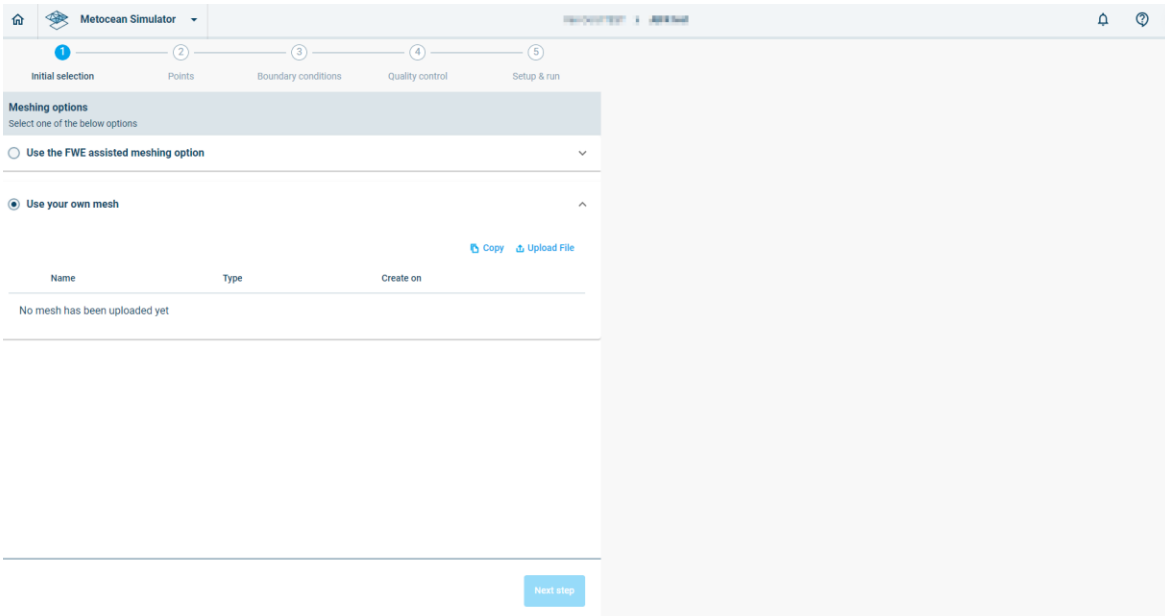
1. Go to the MIKE MS home page: https://metoceansimulator.mike-cloud.com/
2. Log in to MIKE Cloud via the MIKE MS home page
3. Select an existing project by clicking on it or create a new project

4. Enter the selected or created project by clicking on the name
   NOTE: MIKE Metocean Simulator will not start from the root of MIKE Cloud. It is required to enter a project folder or subfolder.
5. Start the Metocean Simulator

This will lead you to the initial starting screen:



We will now describe the layout of the MIKE MS interface in general in chapter 3.

3 MetOcean Simulator User Interface

The user interface consists of the following main user interface components:

- Top bar
- Stepper
- Inputs panel
- Maps area
- Layer manager

The MIKE MS layout is presented in Figure 3.1 below, and the UI components are further described in the following sub sections.

If you want to get started immediately on using MIKE MS, refer to Section 4.

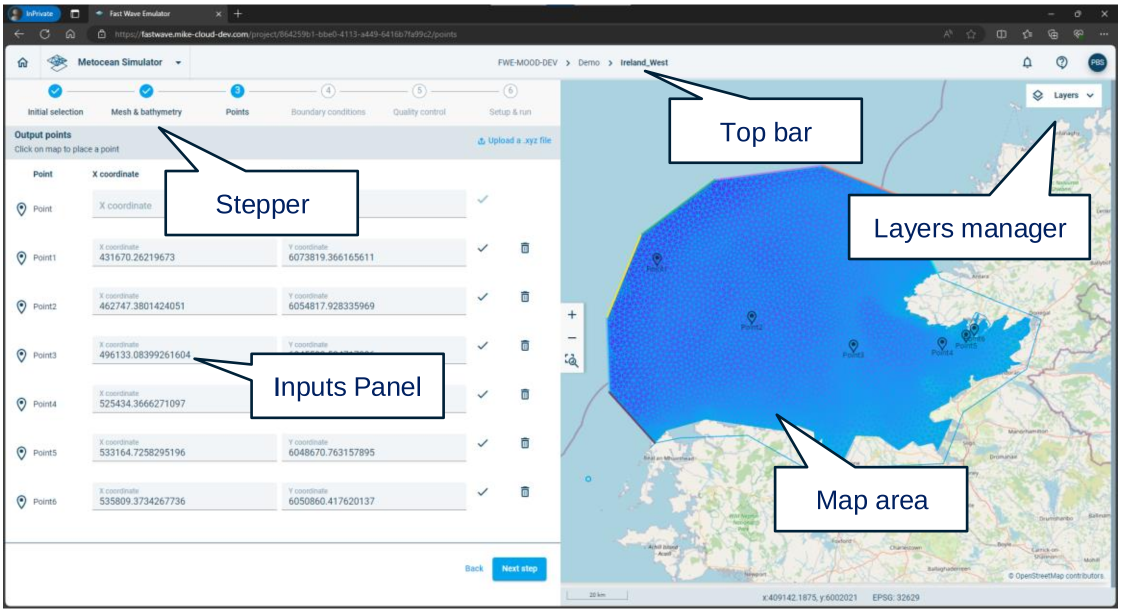


Figure 3.1 MIKE MS workspace with indication of main user interface components. The figure includes an example of a model mesh (blue polygon area) and output points.

3.1 Top bar

The application top bar includes generic functionality for DHI cloud applications including navigation between the Cloud applications as well as icons for help and user details.

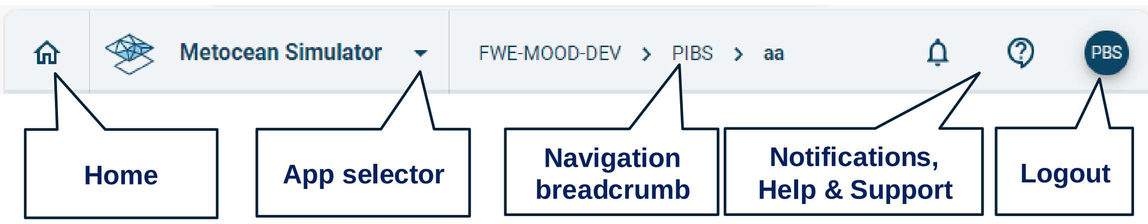


Figure 3.2 Metocean Simulator top bar

The top bar has the following features:

- Home: Direct link to the DHI cloud admin home page. By clicking here, you leave the current (MIKE MS) application.

- App selector: A drop down list with the available Cloud applications are shown. If you click a new application, it opens the selected application in a new tab using the same project context.
- Navigation Breadcrumb: Click on a link to navigate between folders inside MIKE MS.
- Right side Icons for Notifications, Help & support and for logging out.

3.2 Stepper

The stepper highlights which step in the MIKE MS process flow is currently active.

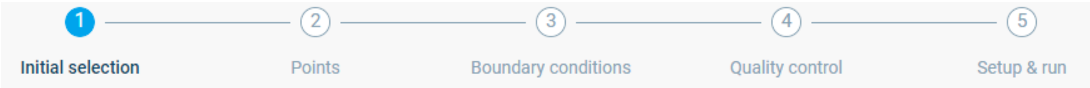


Figure 3.3 Metocean Simulator process stepper

3.3 Inputs panel

The inputs panel provides inputs fields and figures depending on the step in the MIKE MS setup. More details of the specific input panels are shown later in Section 4.

3.4 Map area

The map area shows the following:

- A generic base map showing borders and labels for orientation of the user.
- Model domains, shorelines and areas of interest.
- Bathymetry data.
- Model meshes.
- Output points.

3.5 Layers manager

The Layers manager, shown in Figure 3.4, enables different visualisations on the map. These will only be visible once a mesh is generated by the assisted meshing option.

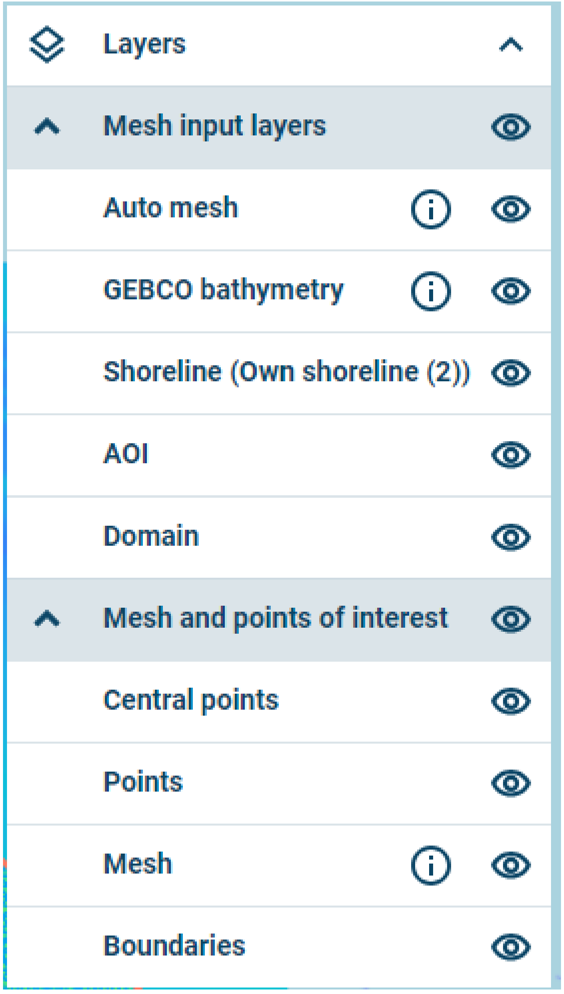


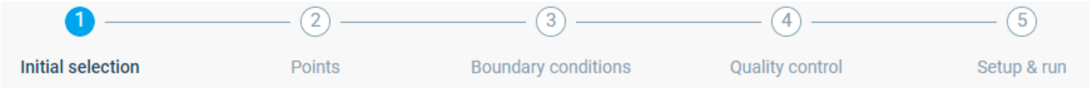
Figure 3.4 Layers manager

The following are examples of layers that can be turned on or off:

- Auto mesh: The mesh file generated by the assisted meshing option
- User defined bathymetry files (In this case reduce_IRL.xyz)
- GEBCO Bathymetry: As extracted automatically for the generated mesh
- Shoreline: As drawn or uploaded by the user
- Area of interest: As drawn or uploaded by the user
- Domain: As drawn or uploaded by the user
- Central points: Centres of boundary sections
- Points of interest: As specified by the user
- Mesh: As generated or uploaded
- Boundaries: Lines along the boundaries.

4 Step-by-step setup guide

This step-by-step setup guide will take the user through pre-defined steps. Each step in the process, as shown in the stepper, is broken down into subtasks which a user should be able to follow to set up an example in MIKE MS.



The step-by-step guide shows the user how to proceed through the whole workflow for an example mesh on the north-west coast of Ireland.

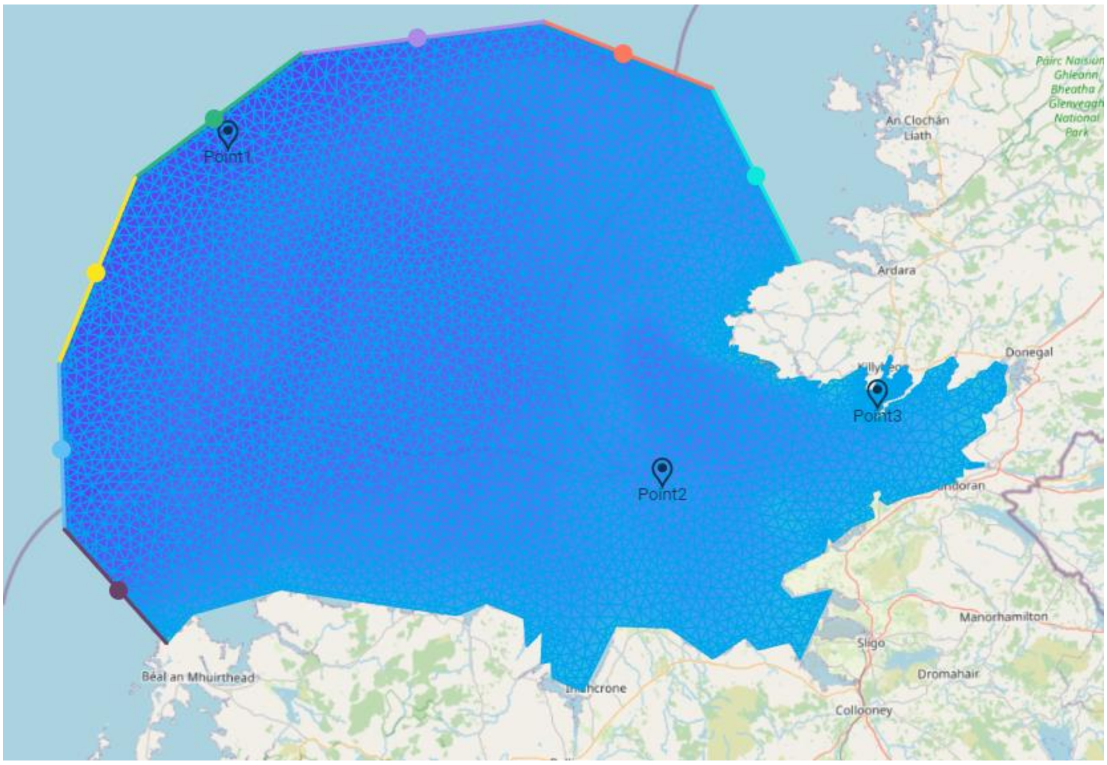


Figure 4.1 Example mesh to be set up in the step-by-step guide. The location is off the north-west coast of Ireland.

4.1 Initial selection

The user interface for Step 1 (Initial Selection) is shown in Figure 4.2 below.

The initial selection provides the user with the choice of the following meshing options:

1. Use of the **assisted meshing option** for generating either Coastal or Offshore meshes.
2. Use your **own mesh.**

In this example we select the assisted meshing option to generate a coastal mesh.

Click **Next step** to continue.

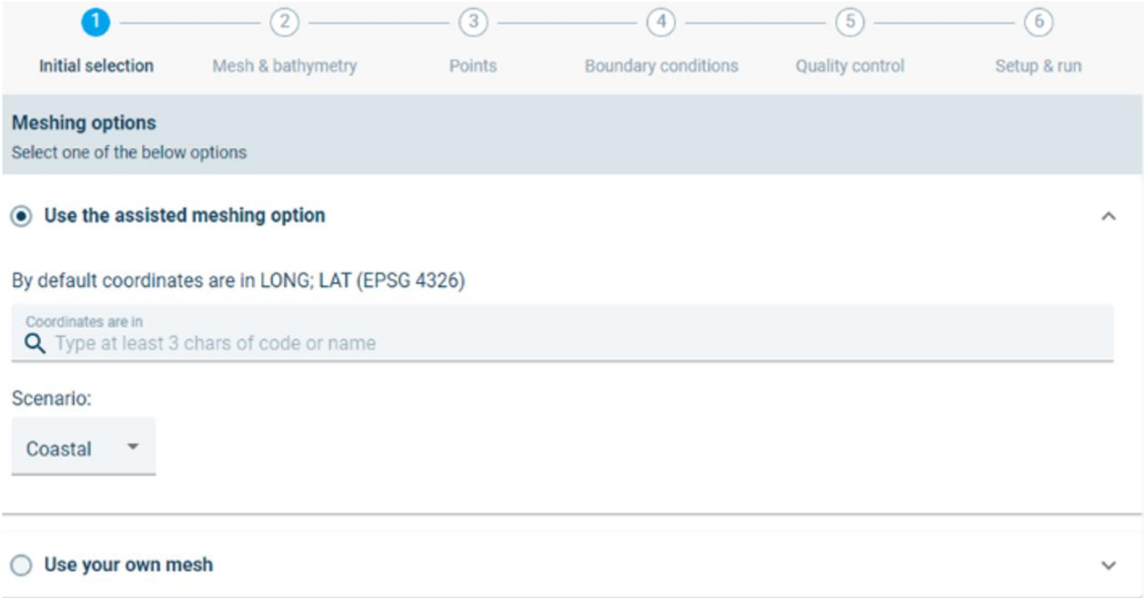


Figure 4.2 Step 1: Initial selection

4.1.1 Assisted meshing

Computational meshes can be generated directly by MIKE MS. The meshing uses pre-defined meshing parameters and is therefore called assisted meshing. The user is still required to provide the domain, the shoreline and an area of interest. These can be defined by drawing on the map or by uploading the shapes into the project. The user also has the option to change some of the pre-defined meshing parameters.

For assisted meshing the user has the option to select the map projection system or to leave it default (Long; Lat EPSG 4326). In this example setup the default projection system is used.

Next the user must select between the **Coastal** and **Offshore** assisted meshing scenarios. In this example the Coastal scenario is used. The Offshore scenario is similar to the Coastal scenario, with the only difference being that a shoreline is not required for the Offshore scenario.

NOTE: Switching between meshing options will reset your workspace and all previous settings will be removed.

NOTE: The assisted meshing is intended for an assisted setup of a high-resolution mesh. There may be cases where the assisted meshing does not fulfil the needs of the user. For such cases the user must generate their own mesh, as described in the next section.

NOTE: The assisted meshing does not identify islands as areas excluded from the mesh, instead it will generate triangular mesh over any islands. These triangular mesh cells will eventually be interpolated to a level which is higher than the water level and will thus be treated by the simulator as dry land.

4.1.2 Use your own mesh

In cases where the assisted mesh does not provide a suitable mesh, the user can choose to generate their own mesh. This can be done using MIKE Mesh Builder, MIKE Mesh Generator or by reusing a mesh from a previous project.

The generated mesh can be copied from the MIKE Cloud Platform, or be uploaded from your computer.

NOTE: Switching between meshing options will reset your workspace and all previous settings will be removed.

By using your own mesh, the stepper omits the Mesh & bathymetry step and skips directly to the Points step (Section 4.3).

4.2 Mesh and Bathymetry

The Mesh & bathymetry step is used for uploading user inputs towards the generation of an assisted mesh.

The inputs panel for the Mesh & bathymetry step is shown in Figure 4.3. The inputs panel show the required inputs from top to bottom.

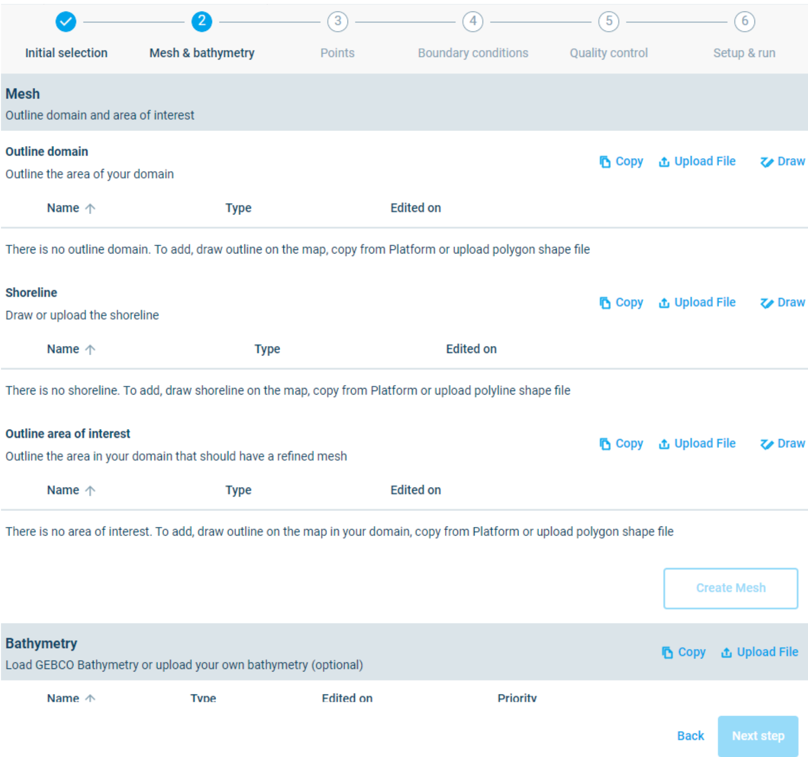


Figure 4.3 Inputs panel for the Mesh & bathymetry step.

The Mesh and bathymetry step consists of the following tasks, which are described in more detail in the sub sections below:

- Outline domain
- Define shoreline

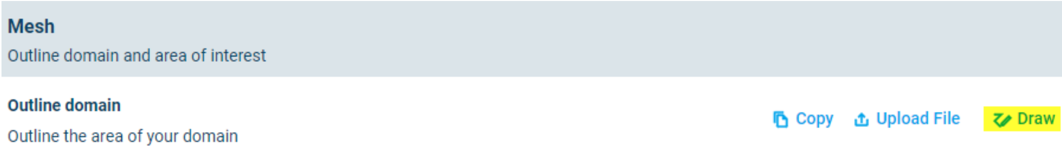
- Define area of interest
- Create mesh
- Upload bathymetry
- Interpolate mesh to bathymetry

4.2.1 Outline domain

The domain can be created by several options, including copying from the MIKE Cloud Platform, uploading from the desktop or by drawing in the map.

In this example a domain will be hand drawn on the map by taking the following steps:

1. Under the Mesh header on the left, go to the *Outline domain* section and click on the Draw button:



2. Click the offshore boundary of the model, passing onto land to enclose the full marine area as well as the land behind the shoreline to be modelled.

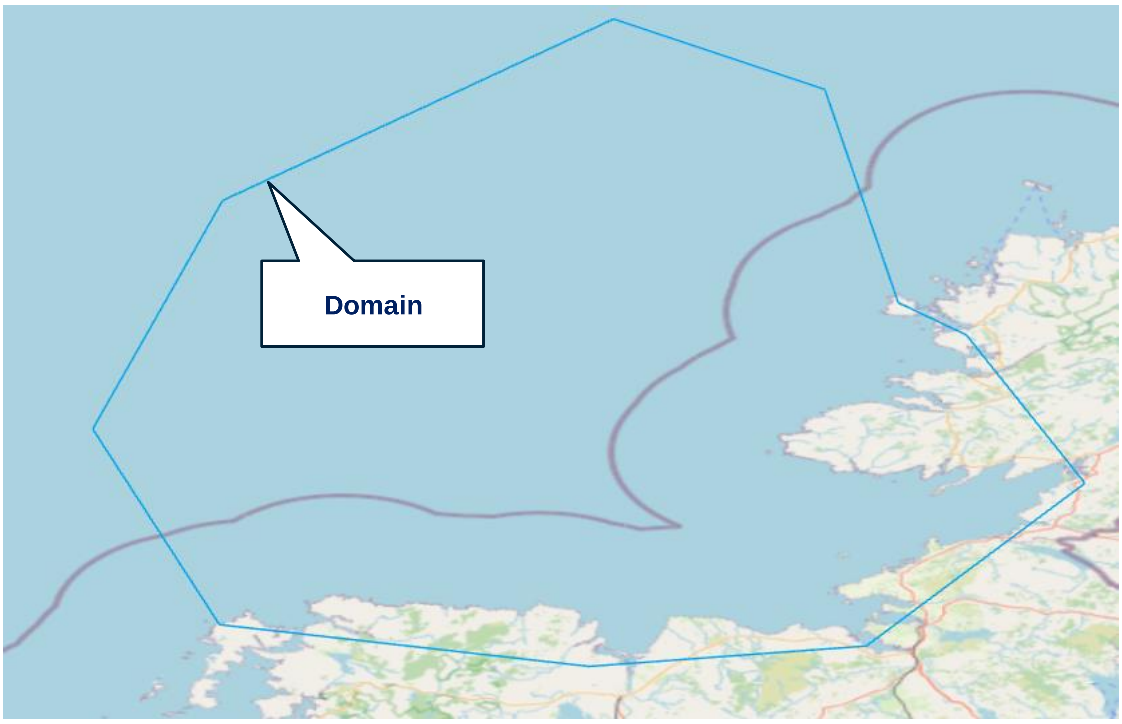
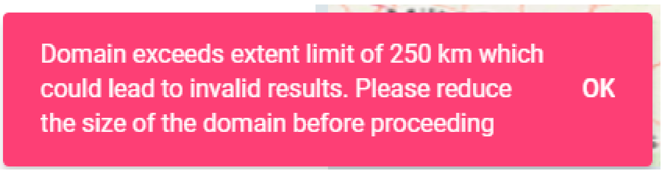


Figure 4.4 Definition of the model domain by hand drawing on the map. The domain outline defines the offshore boundary and encloses the land behind the shoreline to be modelled.

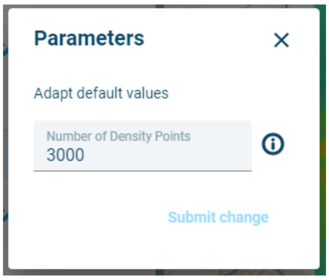
WARNING: MIKE MS will provide a pop-up warning message if the **horizontal or vertical dimensions exceed 250km**. The user will be requested to reduce the domain size before the mesh can be created.



WARNING: MIKE MS will provide a pop-up message if the **offshore boundary is too close to land**, and thereby not being able to extract boundary conditions from the DHI data providers. The user can still select to proceed if they choose to provide their own boundary conditions.

3. If required, the domain can be replaced by several options.

4. The density of the mesh in the domain can be set by specifying a number of density points in the domain. Click on and adjust the default number of density points from 3000 to 6000 and submit the change. More information about the density points can be found under the info button.



NOTE: As soon as the domain is created, MIKE MS will start to extract GEBCO bathymetry data which covers the full domain.

4.2.2 Define shoreline

The shoreline can be created using similar steps as for creating the domain.

In this example a shoreline will be hand drawn on the map by taking the following steps

1. Go to the *Shoreline* section on the left and click on the Draw button
2. **Start** by clicking **outside of the domain**
3. Keep clicking shoreline points along the shoreline
4. **End** the shoreline **outside of the domain** by double clicking

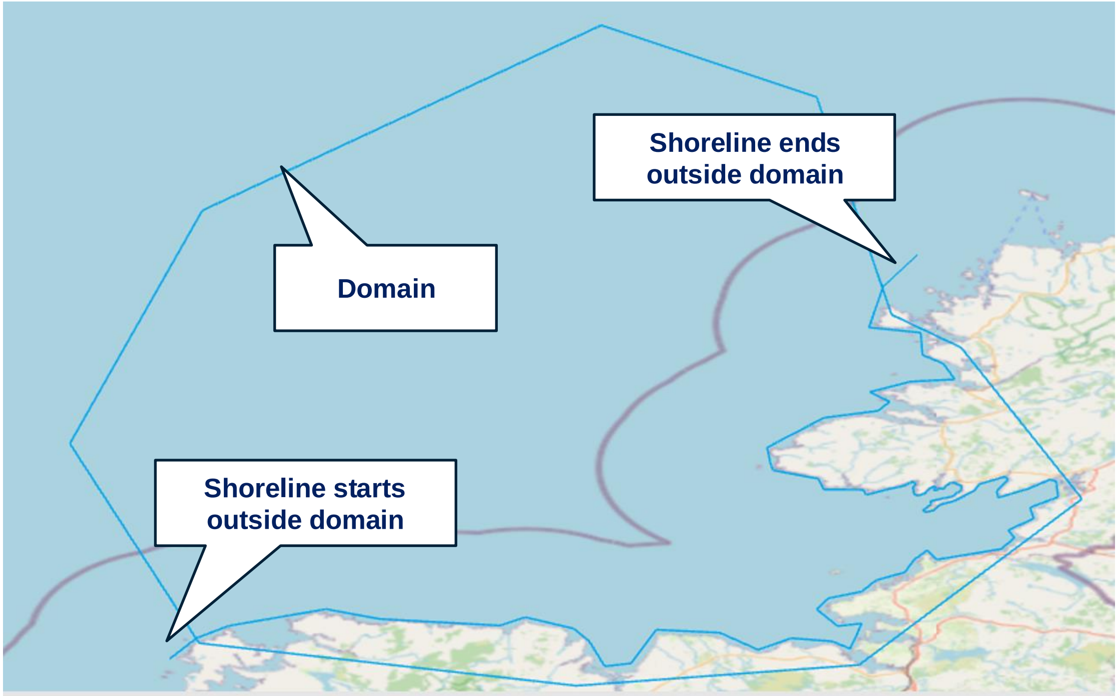
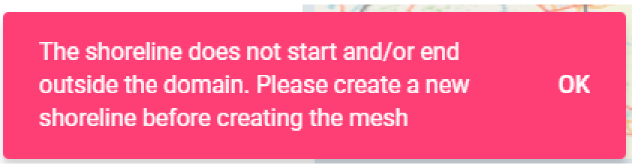


Figure 4.5 Definition of the model shoreline by hand drawing on the map. The shoreline must start and end outside the domain.

WARNING: MIKE MS will provide a pop-up warning message if the shoreline **starts or ends inside the domain**. The user will be requested to redo the shoreline before the mesh can be created.



5. The shoreline can be replaced by several options.

4.2.3 Define area of interest

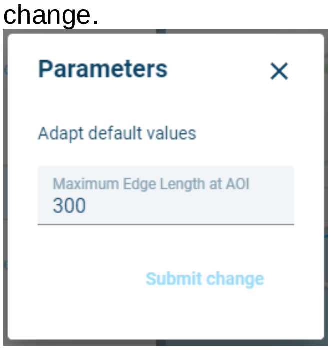
The area of interest is an area of higher resolution. It can be created by several options, similar to the domain and the shoreline:

In this example an area of interest will be drawn on the map by taking the following steps:

1. Go to the Area of Interest section and click on the Draw button
2. Click a polygon.
3. End the Area of Interest by double clicking. The area of interest is allowed to overlap with the shoreline and/or the edge of the domain.

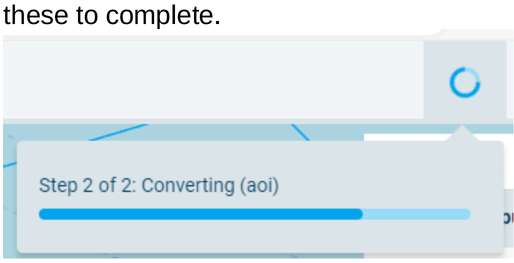
Figure 4.6 Definition of the area of interest by hand drawing on the map.

4. The area of interest can be replaced by several options.
   Replace Replace by upload Replace by drawing
5. The maximum edge length of the mesh in the area of interest can adjusted from the default. Click on and adjust the maximum edge length from 300 to 500 and submit the change.



4.2.4 Create mesh

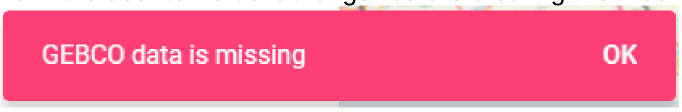
The Create Mesh button will become active after the domain, shoreline and the area of interest has been uploaded and converted. Pay attention to the processes in the Top bar and wait for these to complete.



Click create mesh:

WARNING: If the shoreline is longer than the offshore boundary, then the mesh will be created on land. To fix this problem, either place the offshore boundary further offshore, to extend the length of the offshore boundary or click the toggle button to invert the mesh.
The mesh is generated using a density function based on the seabed level from the GEBCO data. The density function placed higher resolution mesh in shallower water.

If the mesh is created before the GEBCO bathymetry is available, then a pop-up message will warn the user to wait a bit longer before creating the mesh.



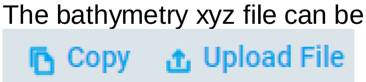
4.2.5 Upload bathymetry

By default, GEBCO bathymetry is provided by MIKE MS via MIKE DataLink. The user has the option to upload additional bathymetry in the form of a space separated .xyz file.

An example format for the bathymetry data is provided below. This text can be copied to a text file and saved as fake_bathymetry_data.xyz:

```
-8.705221 54.344768 -33.703766
-8.705221 54.351018 -35.303764
-8.705221 54.357268 -37.293251
```

The bathymetry xyz file can be uploaded from the desktop:



The uploaded bathymetry will be prioritised by default, but it can be move up and down the priority list by the user. The highest priority data will be used for interpolation of the mesh while any other lower priority data will be ignored where it is overlapped by the higher priority data.

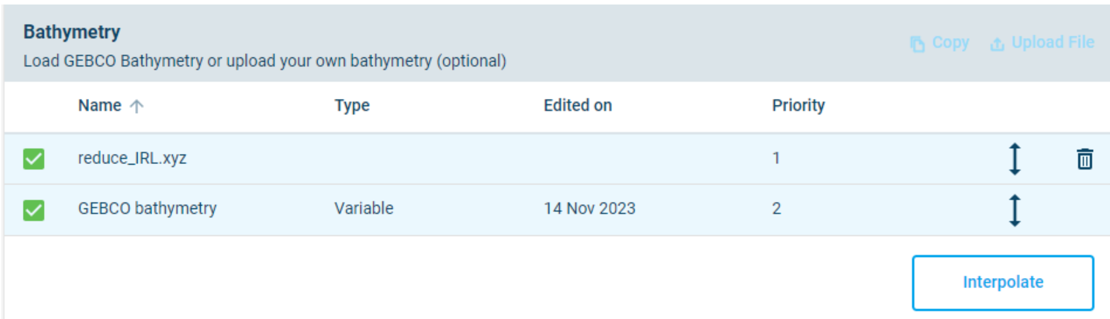


Figure 4.7 Prioritisation of bathymetry data.

4.2.6 Interpolate mesh to bathymetry

The mesh is interpolated to the bathymetry files when clicking *Interpolate*.

The user will see the interpolated mesh in the map as shown in Figure 4.8.

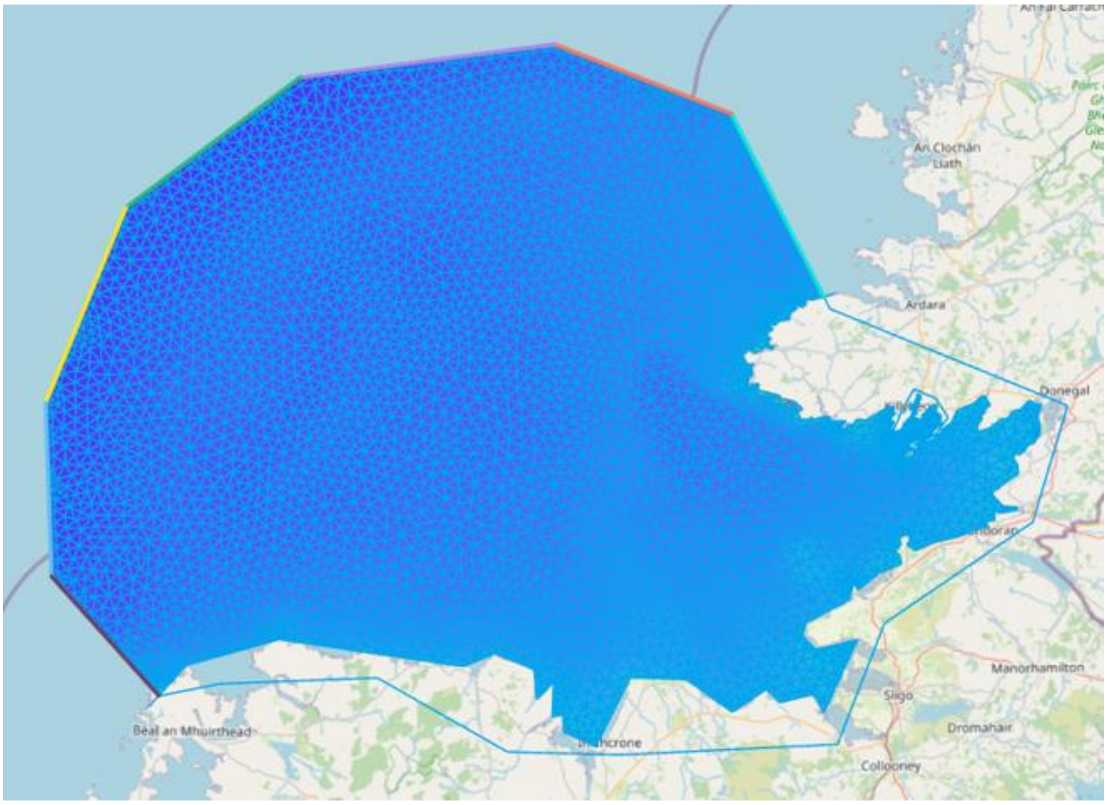


Figure 4.8 Mesh file interpolated to the bathymetry files

Click **Next step** to continue.

4.3 Points

In this step the user selects the output points from where the output will be derived.

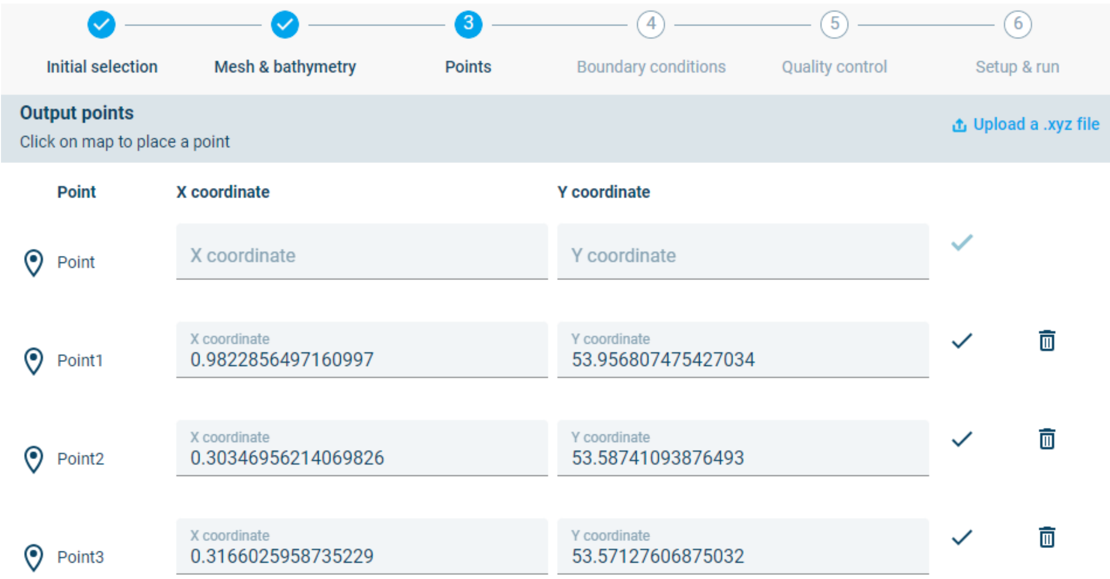


Figure 4.9 Step 3: Definition of output points

The user can upload a .xyz file with coordinates, click points in the interface or enter coordinates into the input fields.

In this example the user can choose to click some points on the map:

- One point in the centre of the offshore boundary (Useful for later validation)
- Points in the area of interest

The user can also select to create a space delimited xyz file (as defined in Section 4.2.5) and upload it into the interface. The following coordinates can be copied into the xyz file:

0.982 53.956 0.000
0.303 53.587 0.000
0.316 53.571 0.000

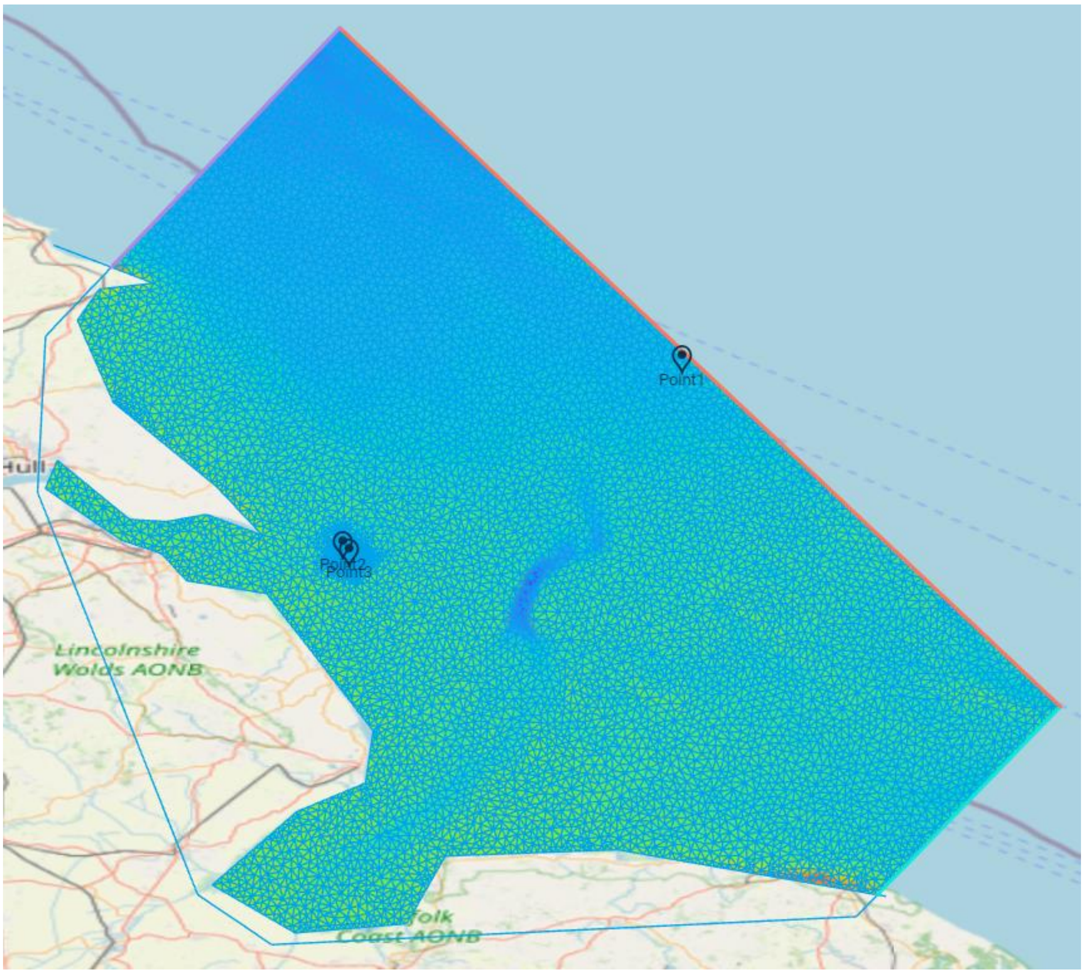


Figure 4.10 Model mesh with output points selected in the domain. One point is selected on the offshore boundary while two more are selected in the area of interest.

4.4 Boundary conditions

Boundary conditions can either be extracted from the DHI data providers or the user can provide their own boundary conditions by uploading. The options are shown in Figure 4.11 below.

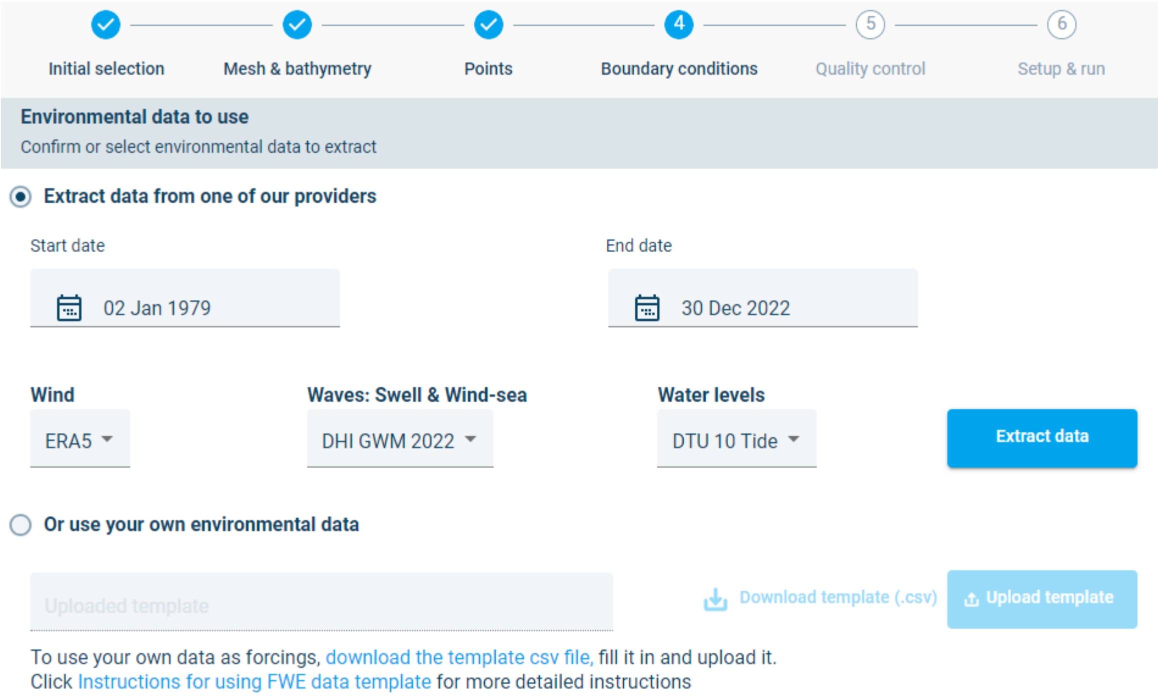


Figure 4.11 Step 4: Boundary conditions options

NOTE: The extraction from one of DHIs providers provide spatially varying boundary conditions, while when the user uploads their own environmental data the inputs are defined to not be spatially varying.

Both options will be described below in sub sections.

4.4.1 Extract data from one of our providers

The spatially varying boundary conditions has the following discretisation:

- Wave conditions along the offshore boundaries has three extraction points along each straight boundary section.
- Wind conditions over the domain are extracted in a 0.25 degree grid.
- Predicted tides over the domain are extracted in a 0.25 degree grid.

In this option the user can specify the start date and end date for which to extract data. By default, the full period is selected. It should take about 15 minutes to extract the entire period for the mesh shown here.

For a faster demonstration, the user can select one year of data by setting the start date to 1 Jan 2021 and the end date to 31 Dec 2021. The extraction of one year of data should take about 1 minute.

There is currently one wind (ERA5), one Waves (DHI GWM 2022) and one water levels (DTU10) source which is provided with MIKE MS.

Click extract data to start the extraction.

4.4.2 Use your own environmental data

If the user selects to upload their own data, it is important that the data is provided in the right format to MIKE MS.

Start by downloading the template file Download template (.csv)

The data in the template file can be edited and the number of rows can be extended, but the user must not change the headers or add additional columns to the file. Examples of the template file as seen in a Spreadsheet or in notepad++ is shown in Figure 4.12 and Figure 4.13 respectively.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Year (yyyy	Month (M	Day (dd)	Hour (HH)	Wind Spe	Wind Dire	Sign Wave	Peak Wav	Mean Wav	Directiona	Sign Wave	Peak Wav	Mean Wav	Directiona	Water level [m]	
2	1990	1	1	2	10	0	1	5	0	40	2	12	270	30	1	
3	1990	1	1	3	10	45	1	5	45	40	2	12	270	30	1	
4	1990	1	1	4	10	90	1	5	90	40	2	12	270	30	1	
5	1990	1	1	5	10	135	1	5	135	40	2	12	270	30	1	
6	1990	1	1	6	10	180	1	5	180	40	2	12	270	30	1	
7	1990	1	1	7	10	225	1	5	225	40	2	12	270	30	1	
8	1990	1	1	8	10	270	1	5	270	40	2	12	270	30	1	
9	1990	1	1	9	10	315	1	5	315	40	2	12	270	30	1	
10	1990	1	1	10	10	0	2	5	0	40	2	12	270	30	1	
11	1990	1	1	11	10	45	2	5	45	40	2	12	270	30	1	
12	1990	1	1	12	10	90	2	5	90	40	2	12	270	30	1	
13	1990	1	1	13	10	135	2	5	135	40	2	12	270	30	1	
14	1990	1	1	14	10	180	2	5	180	40	2	12	270	30	1	
15	1990	1	1	15	10	225	2	5	225	40	2	12	270	30	1	
16	1990	1	1	16	10	270	2	5	270	40	2	12	270	30	1	
17	1990	1	1	17	10	315	2	5	315	40	2	12	270	30	1	
18																

Figure 4.12 Example of the template file when viewed in as a spreadsheet. Be careful when editing the template in a spreadsheet, as the spreadsheet can add data in column P, change the number of decimals or change the delimiters.

Template_FWE_userdata.csv

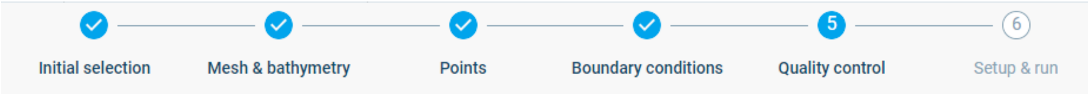
```
Year (yyyy),Month (MM),Day (dd),Hour (HH),Wind Speed at 10m (WS),Wind Direct
1990,1,1,2,10,0,1,5,0,40,2,12,270,30,1CRLF
1990,1,1,3,10,45,1,5,45,40,2,12,270,30,1CRLF
1990,1,1,4,10,90,1,5,90,40,2,12,270,30,1CRLF
1990,1,1,5,10,135,1,5,135,40,2,12,270,30,1CRLF
1990,1,1,6,10,180,1,5,180,40,2,12,270,30,1CRLF
1990,1,1,7,10,225,1,5,225,40,2,12,270,30,1CRLF
1990,1,1,8,10,270,1,5,270,40,2,12,270,30,1CRLF
1990,1,1,9,10,315,1,5,315,40,2,12,270,30,1CRLF
1990,1,1,10,10,0,2,5,0,40,2,12,270,30,1CRLF
1990,1,1,11,10,45,2,5,45,40,2,12,270,30,1CRLF
1990,1,1,12,10,90,2,5,90,40,2,12,270,30,1CRLF
1990,1,1,13,10,135,2,5,135,40,2,12,270,30,1CRLF
1990,1,1,14,10,180,2,5,180,40,2,12,270,30,1CRLF
1990,1,1,15,10,225,2,5,225,40,2,12,270,30,1CRLF
1990,1,1,16,10,270,2,5,270,40,2,12,270,30,1CRLF
1990,1,1,17,10,315,2,5,315,40,2,12,270,30,1CRLF
```

Figure 4.13 Example of the template file when viewed in notepad++

WARNING: When editing the file the data must maintain equidistant timesteps at constant 1h intervals

Some warning messages has been built into MIKE MS to warn the user of unexpected inputs.

4.5 Quality control



The quality control tab is used to select the events (defined here as nodes) which will be simulated and from which the long term timeseries will be reconstructed. It is also used to plot the selected events against the full timeseries.

The selection of events is done by reducing the dimensionality of the data and then selecting the maximum dissimilar events. This procedure is described in more detail in Section 5. By default, 10 dimensions and 100 nodes is selected. This selection will remain unchanged in this setup.

Under the quality control tab, the user can make plots of the boundary conditions data by changing the input fields. Thes plots show the selected nodes against the full timeseries. An example plot showing the Significant wave height for Boundary 3 is shown in Figure 4.14.

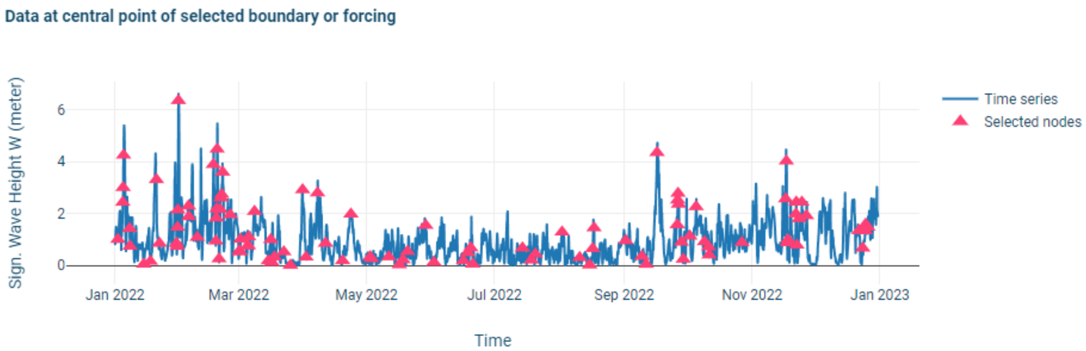


Figure 4.14 Selected nodes (red) from the timeseries data (blue) for the centre of Boundary 3.

Additional nodes can by manually added by clicking on the plot. Here it was decided to select any peaks where the significant wave height on boundary 3 is above 4m, as shown in Figure 4.15

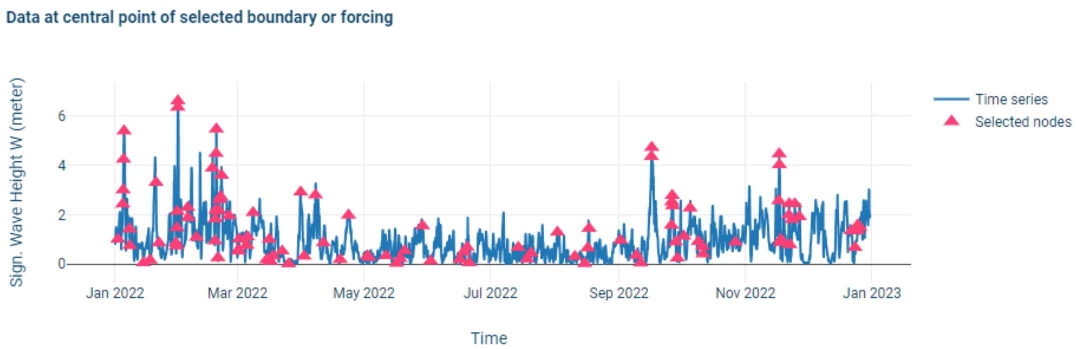


Figure 4.15 Additional nodes selected by clicking on the chart. Peaks above 4m was selected.

Peaks can also be selected for Boundary 2, Boundary 4, for the wind and for the predicted water level if required.

Example scatter plots of Significant wave height against peak wave period and mean wave direction is shown in Figure 4.16 and Figure 4.17 respectively. These plots can be used to identify any additional events that the user would like to add to the set of selected nodes.

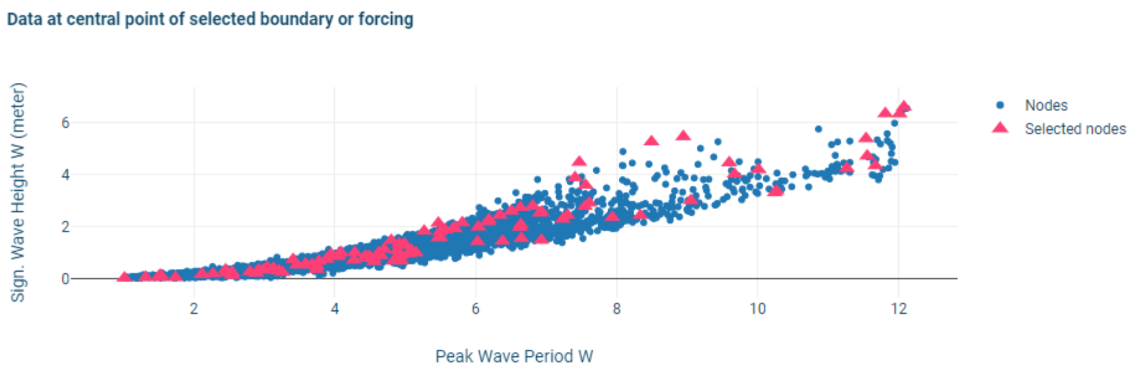


Figure 4.16 Scatter plot of Significant wave against peak wave period.

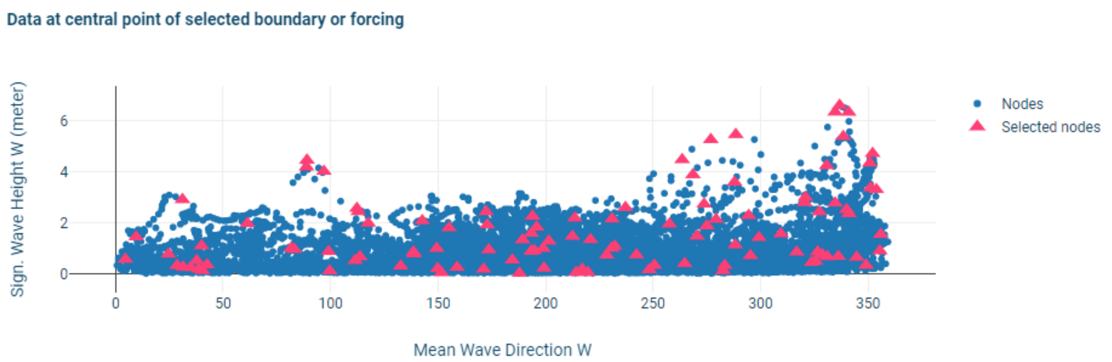
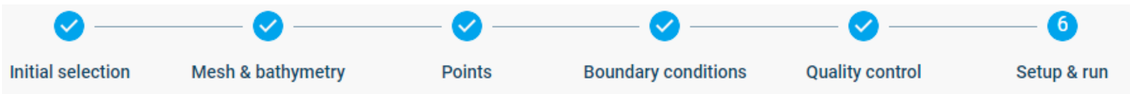


Figure 4.17 Scatter plot of Significant wave against mean wave direction.

4.6 Setup & run



The user can select a default template based on the seabed roughness, as shown in Figure 4.18

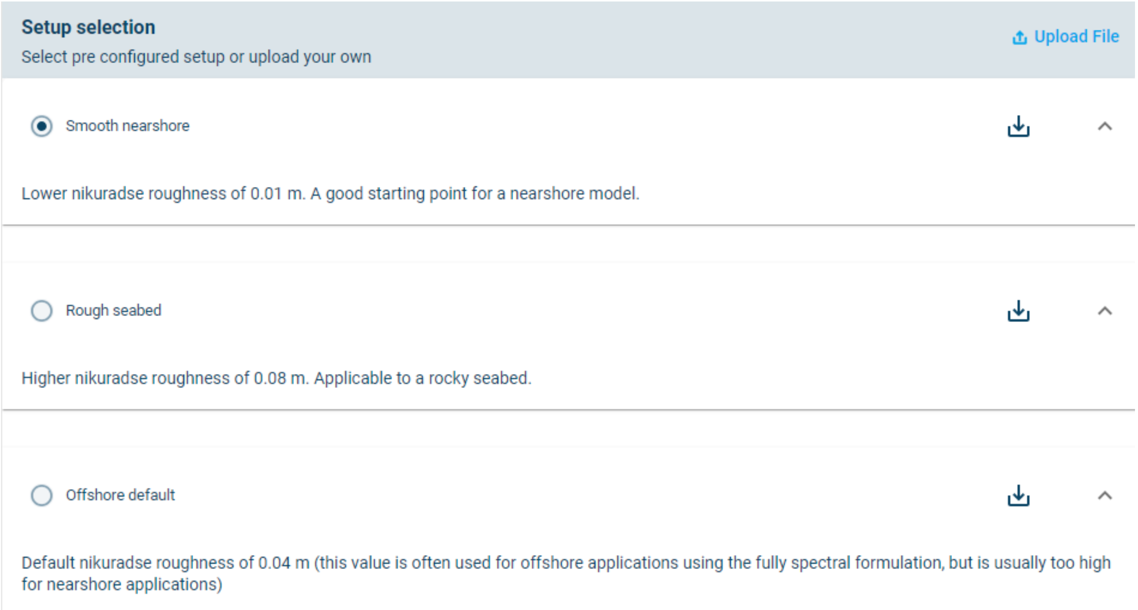


Figure 4.18 Pre-configured setup templates

NOTE: The user also has the option to download a template to make basic edits in the MIKE 21 SW desktop application and to re-upload **Upload File** the file as a new template. This can be done if the user wants to adjust the solution technique.

The selected nodes are shown again at the bottom of the inputs panel. In this step the user can select a timestep for conducting a test run by clicking on the chart:

Selected for test run

Select Boundary 3 (Offshore) and click the highest wave event on the boundary for running the test.

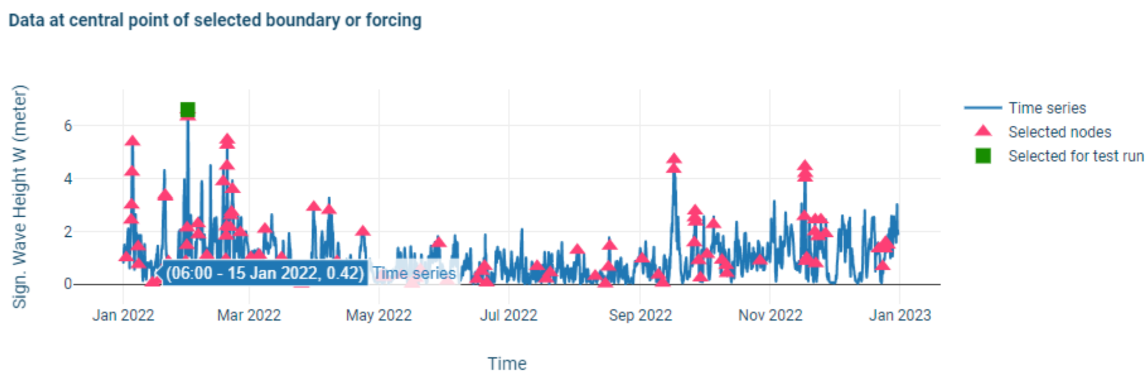


Figure 4.19 Selection of a test run

Click the button for running the test.

Run Test

NOTE: Pay attention to the progress in the Top bar. Running the test will be pending for a minute or two while the computer is prepared in the cloud. Once the computer is prepared, the next simulation will have a shorter pending time.

When completed, the test result will be shown in a panel on the right as a table.

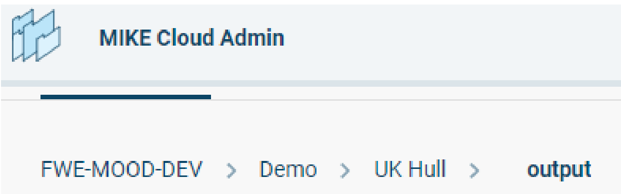
Result of test run

Points	Point1	Point2	Point3
Mean Wave Direction (degree)	333.631	10.005	358.559
Mean Wave Direction S (degree)	333.141	13.684	0.951
Mean Wave Direction W (degree)	337.613	354.431	349.328
Peak Wave Direction (radian)	5.76	0	6.021
Peak Wave Direction S (radian)	5.76	0	6.226
Peak Wave Direction W (radian)	5.76	6.021	6.021
Peak Wave Period (second)	12.089	10.879	10.958
Peak Wave Period S (second)	12.089	10.879	10.958
Peak Wave Period W (second)	6.929	6.915	6.896
Sign. Wave Height (meter)	7.083	4.962	4.463
Sign. Wave Height S (meter)	6.693	4.484	4.029
Sign. Wave Height W (meter)	2.32	2.123	1.92
Wave Period T02 (second)	9.564	8.486	8.41
Wave Period T02 S (second)	11.168	10.527	10.681
Wave Period T02 W (second)	5.332	5.304	5.145

Figure 4.20 Test run results

Compare the inputs at the boundary to the results for the point at the boundary. The results should be close to the input values.

Test results are also available from the Cloud Admin folder for outputs.



The test results in Cloud Admin includes a zip file which includes a spatial output in dfsu format.

It is recommended that the user download and inspect this results file using the desktop MIKE Zero interface. An example of such an output, called Area.dfsu is shown in Figure 4.21

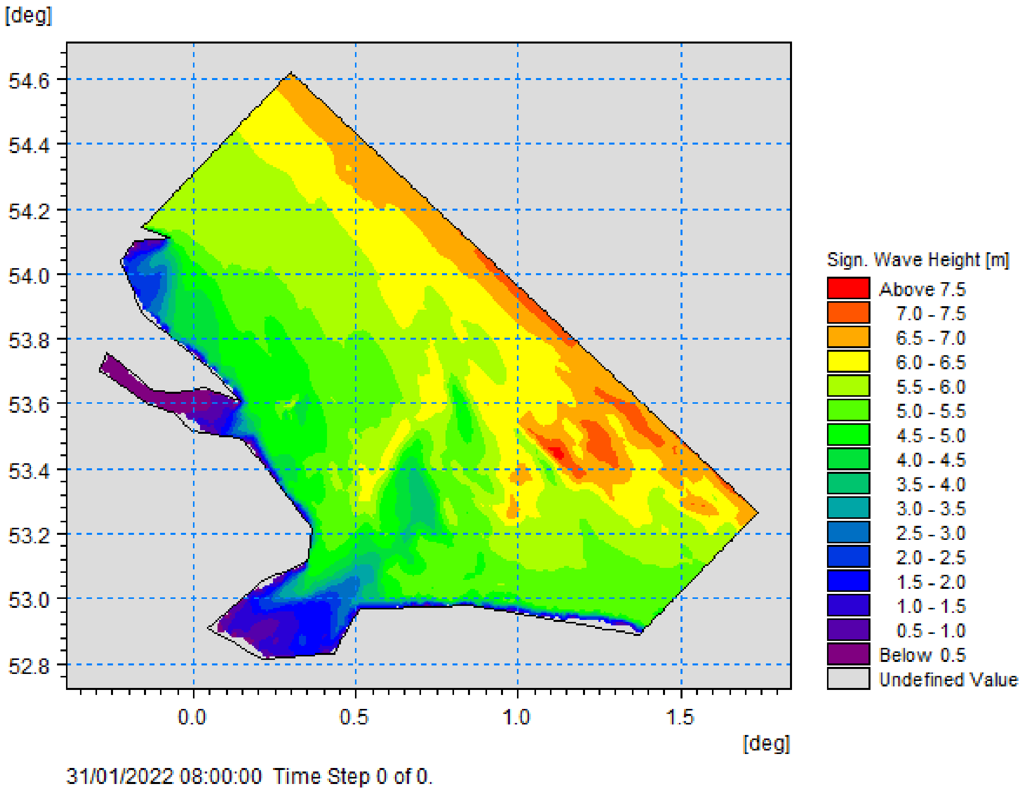
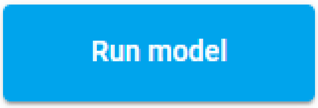


Figure 4.21 Test run area output

Press Run model to run the full set of simulations.



The model runs will take some time to complete. The duration can be estimated by taking the time elapsed to complete the test run and multiplying it by the number of selected nodes.

On completion a notification pops up indicating that the model results is ready for download or for publishing to MOOD.

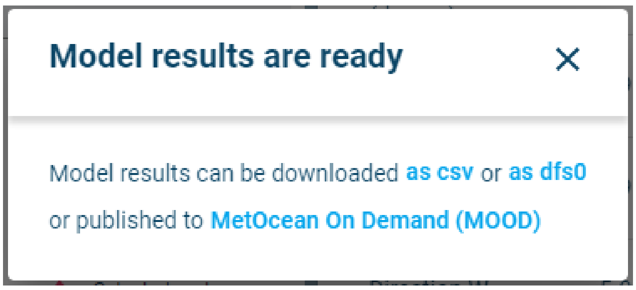


Figure 4.22 Pop up notification indicating that the model results are ready. The pop us includes options to download data or to publish the results to MOOD.

When the simulation has completed, results can also be downloaded directly from the Setup & run tab. The data is available in .csv and .dfs0 formats. The results are also available from project folder in Cloud Admin in the outputs folder

The results can be published to MetOcean On Demand (MOOD) by clicking the provided button. The MIKE MS results will be called a Local Model in MOOD

4.7 View and interact with the results in MOOD

Go to the MOOD site: https://www.metocean-on-demand.com/

DHI Metocean Data Portal

If you have logged off since running and publishing MIKE MS, sign in using the same login details as you used for setting up the MIKE MS model.

In the layers panel on the left, you need to activate the local model area and the local model points, as shown in Figure 4.23

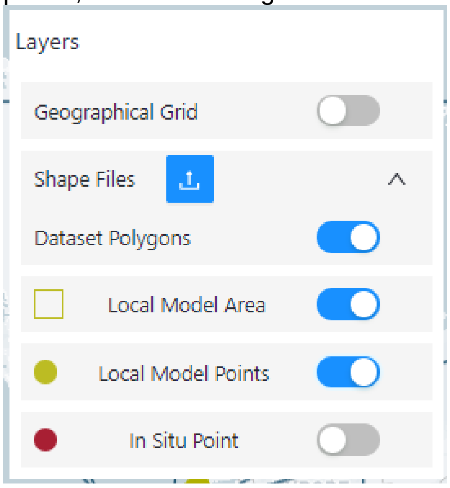


Figure 4.23 Layers panel in MOOD showing the toggle switches for displaying the local model area and points

You should see your model domain and points in the map, as shown in Figure 4.24

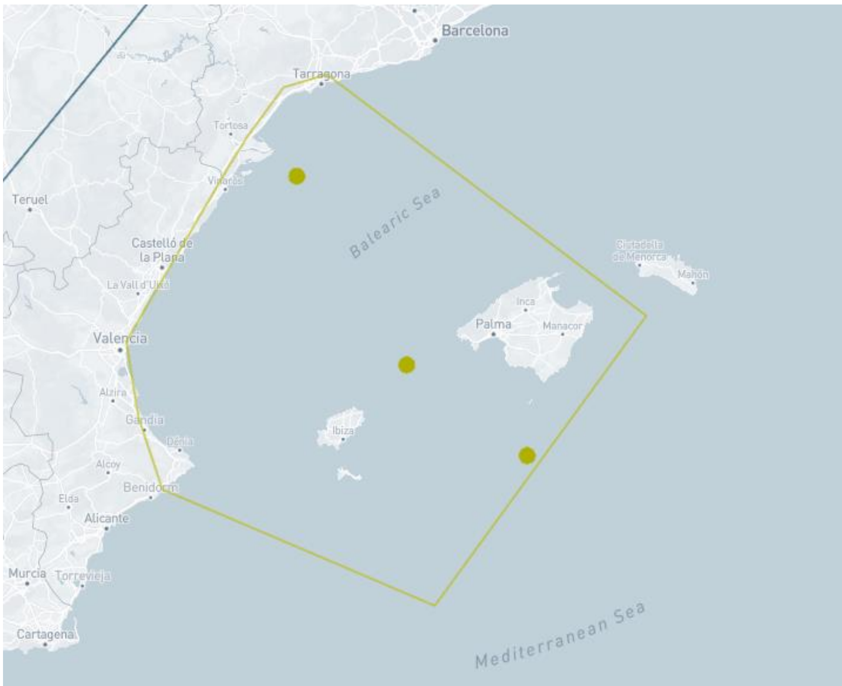


Figure 4.24 Local model domain and points as indicated on the map in MOOD

Double click one of the points and make a new point in the location, as shown in Figure 4.25

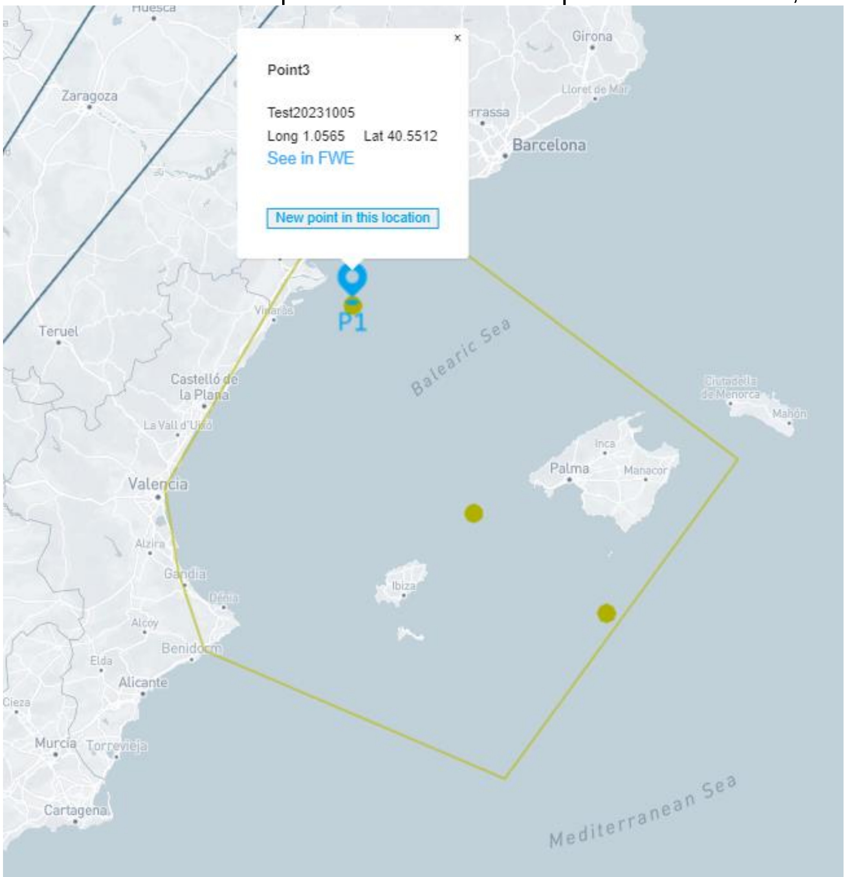


Figure 4.25 Layers panel in MOOD showing the toggle switches for displaying the local model area and points

In the points panel on the right, as shown in Figure 4.26, you can select a subset of the data. In this case the full timeseries (1 year) is selected.

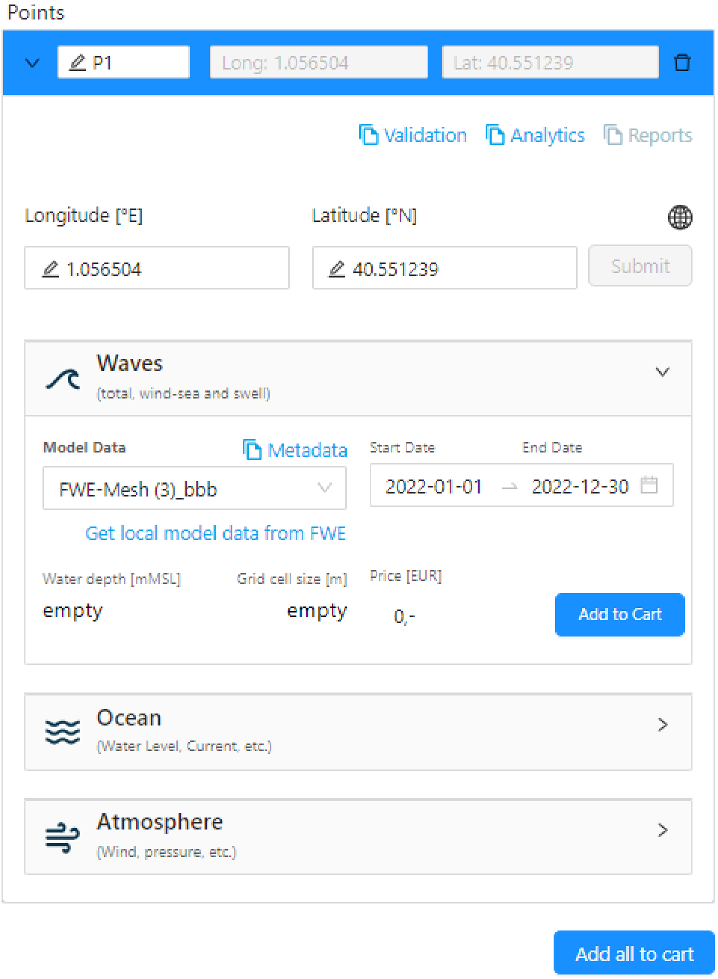


Figure 4.26 Points panel in MOOD. Here a subset of the data can be selected.

Click on the analytics button to make plots of the data Analytics

The analytics modal will pop up, from which several analytics can be generated. The timeseries, rose and scatter plots can be created without a MOOD subscription. Examples of these are shown below in Figure 4.27, Figure 4.28 and Figure 4.29 respectively.

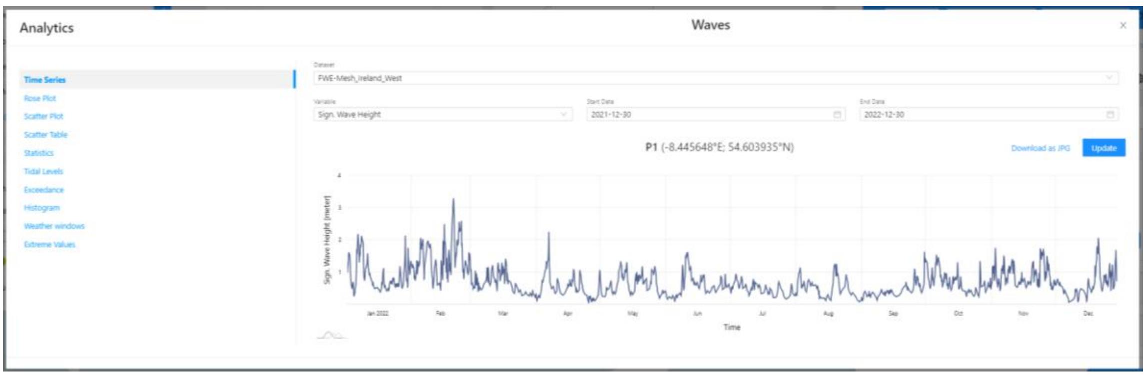


Figure 4.27 Timeseries plot in MOOD

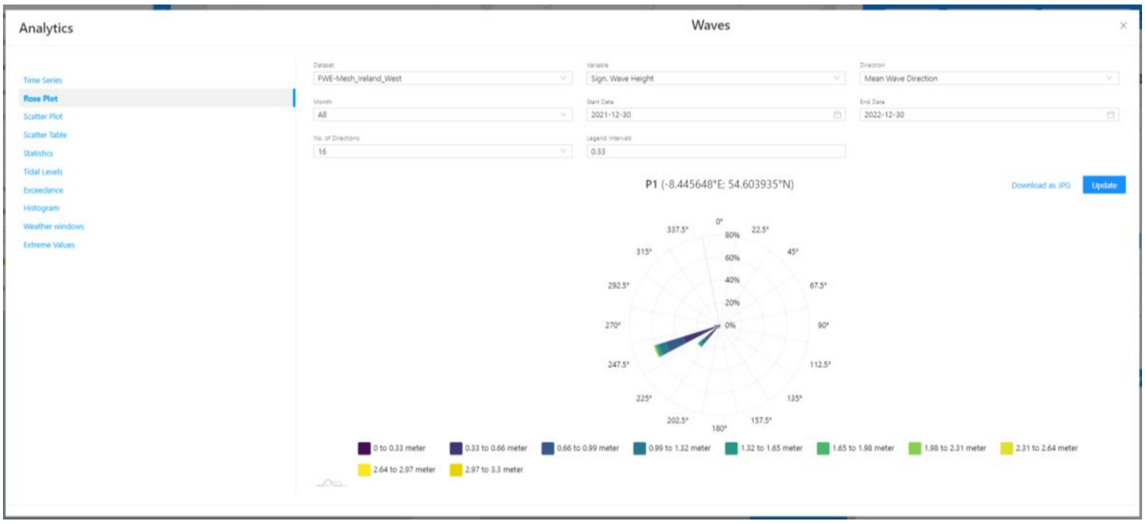


Figure 4.28 Rose plot in MOOD

Figure 4.29 Scatter plot in MOOD

Users subscribed to MOOD analytics can make additional analytics for the full datasets, including Scatter tables, Statistics plots, Exceedance plots, Histograms, Weather windows and Extreme values. Users who are not subscribed to MOOD analytics can only use the last year of data using the additional analytics.

5 Scientific description

MIKE MS is a MIKE Cloud[1] application for modelling high-resolution nearshore and offshore wave conditions. MIKE MS applies statistical methods to get radically faster results than traditional modeling. It applies high-quality data from MIKE DataLink[2], removing effort modelers. MIKE MS leverages cloud infrastructure to remove hardware investment, increasing cost-effectiveness. It is powered by recognized MIKE software (MIKE 21 SW[3] – quasi stationary formulation).

MIKE MS follows the scientific basis defined by Camus et al (2013)[4],, and is implemented by DHI as shown in Figure 5.1. The diagram shows the sequence of obtaining boundary conditions and selecting a subset of the events by using principal component analysis (PCA) and maximum dissimilarity analysis (MDA). At completion of the modelling of the selected events the full timeseries is reconstructed using a radial basis function (RBF).

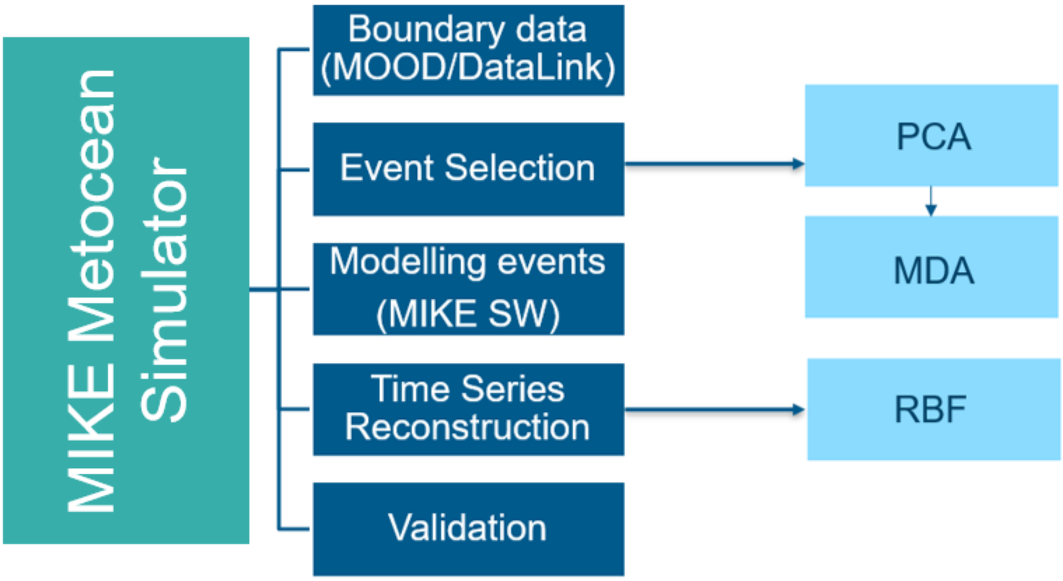


Figure 5.1 MIKE MS simulation process

Data extracted along the boundaries of the model include significant wave height, peak wave period, mean wave direction and directional standard deviation for both wind sea and swell wave components. Data extracted over the domain include directional wind vector components as well as predicted tides.

The event selection (PCA and MDA) makes use of all the extracted parameters along all boundaries and over the domain.

An example of a comparison between a MIKE MS model run using 100 events and a model run simulating all timesteps and using an instationary formulation is shown in Figure 5.2, for a location off the US west coast.

[1] https://www.mikepoweredbydhi.com/products/mike-cloud

[2] https://www.mikepoweredbydhi.com/products/mike-cloud/mike-data-link

[3] https://manuals.mikepoweredbydhi.help/latest/Coast_and_Sea/M21SW_Scientific_Doc.pdf

[4] Camus, P., Mendez, F. J., Medina, R., Tomas, A., & Izaguirre, C. (IH Cantabria 2013). High resolution downscaled ocean waves (DOW) reanalysis in coastal areas. Coastal Engineering, Volume 72, Pages 56-68.

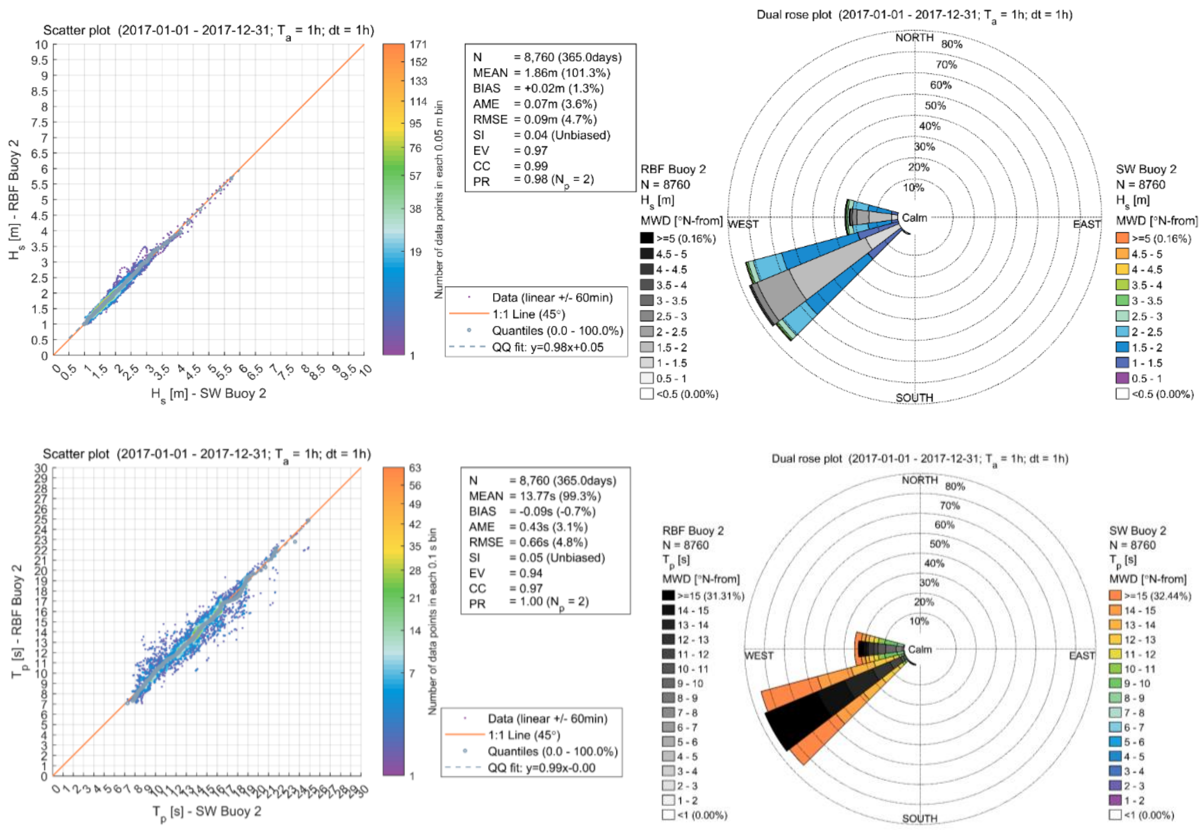


Figure 5.2 Comparison of a MIKE MS run using 100 events against a detailed model run simulating all timesteps and using an instationary formulation. Comparison plots show significant wave height [m] (top) and peak wave period [s] (bottom) for a location off US west coast. Note this is a model to model comparison.