# IWRAP Mk2

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# Introduction

The objective of the IWRAP Mk2 application is to provide the user with a tool that assist in the quantification of the risks involved with vessel traffic in specified geographical areas. On the basis of a specified traffic intensity and composition the tool allows the user to rationally evaluate and estimate the annual number of collision and grounding in a specified navigational area.

IWRAP Mk2 has two different licenses. The first license is free for all IALA members. This free version does not have the possibility to use AIS data for creating risk models. It is possible to import data in the free version, so it is possible to verify that data can be imported, but the data can not be used for risk modeling.

The second license is a commercial license that enables the user to use imported AIS data for risk modeling. Both licenses use the same software application, the only difference is the license key.

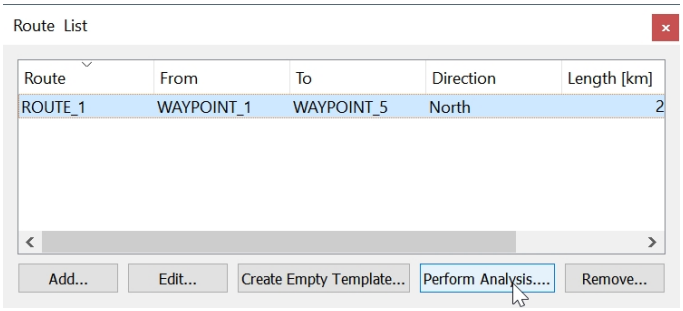
A commercial license is personal and has to be renewed each year.

If you want to know more about the commercial license or want to obtain a free license, please contact iwrap@gatehouse.dk.

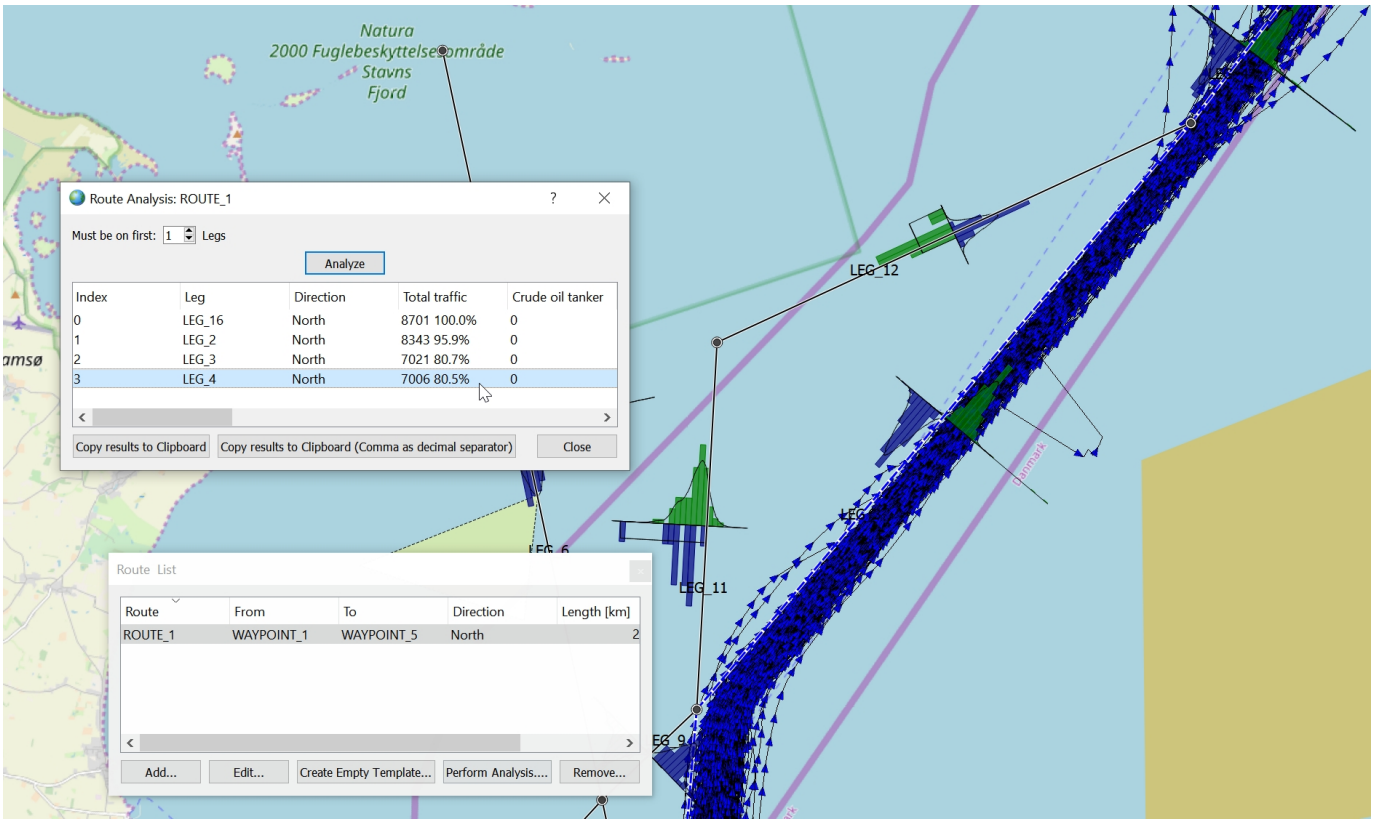
## Release notes

### *Version 6.3.0*

*1. Added route analysis, can only be used if AIS data is available and there are not too many gaps in the data.*




The following example shows that 80.5 percent that were on LEG_16 i.e. the start of the route continued to LEG_4 the i.e. end of the route.




*2. Added track view, first version, can be used to permanently display some ships tracks and/or trips on the map. The above example shows a list of tracks that follow a specific route. More features will follow...*
*3. Added possibility to set grounding safety margin*
*4. Minor fixes*

### *Version 6.2.0*

*1. Replay, color by direction*
*2. Set Causation Factors at start job*
*3. Clone project: Set Working Dir*
*4. "Import from other Model": copy polygon meta data*

### *Version 6.1.9*

*1. Minor changes*

### *Version 6.1.8*

*1. Minor changes*

### *Version 6.1.5*

*1. Fixed 64bit problem i track generation*
*2. Created new result export dialog, with possibility to discard some result types.*
*3. Added new grounding/allision per leg result output*
*4. Added job progress bar*
*5. Added inspect convert to year menu item, Settings/Inspect to Year Factor...*
*6. Now causation factors are stored in the project model. Adjust them using Settings/Model*

*Causation Factors...*
*7. Added Model and Result KML output. Data/Data Management/Export Model/Result KML..*
*8. Route traffic add/subtract now also adjusts waypoints*
*9. Added Grounding Safety Margin, Settings/Grounding Safety Margin...*

***Version 6.1.3***

*1. Fixed download ship type bug*

***Version 6.1.2***

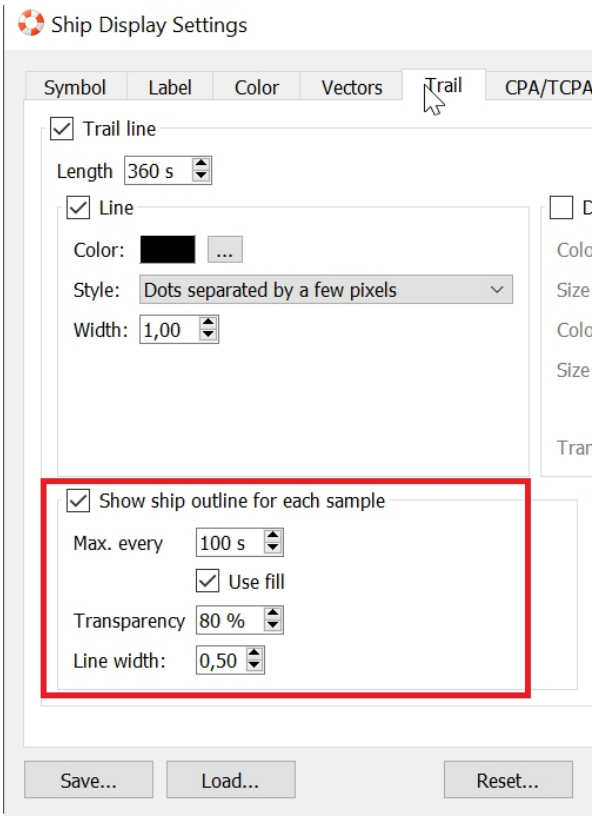
*1. Fixed bug in relation to legs with no traffic/distribution*

***Version 6.1.1***

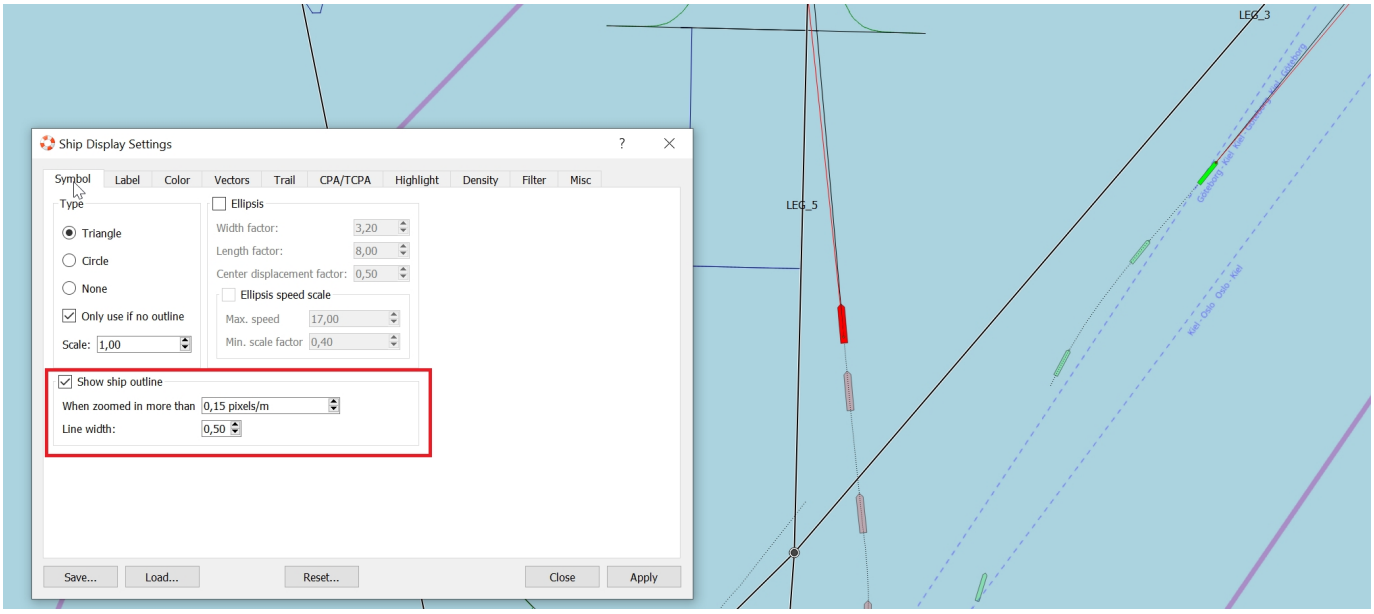
*1. Fixed integer column sorting in various lists*
2. Added possibility to store and load map view settings in separate files

***Version 6.1.0***

1. *Fixed small bug in replay interpolation, occurred at the end of a track*
2. Storing a leg.csv file with leg meta data when storing HTML/CSV output
3. Added historical outline to replay




Also added more control over when ship outline should be displayed.




### *Version 6.0.9*

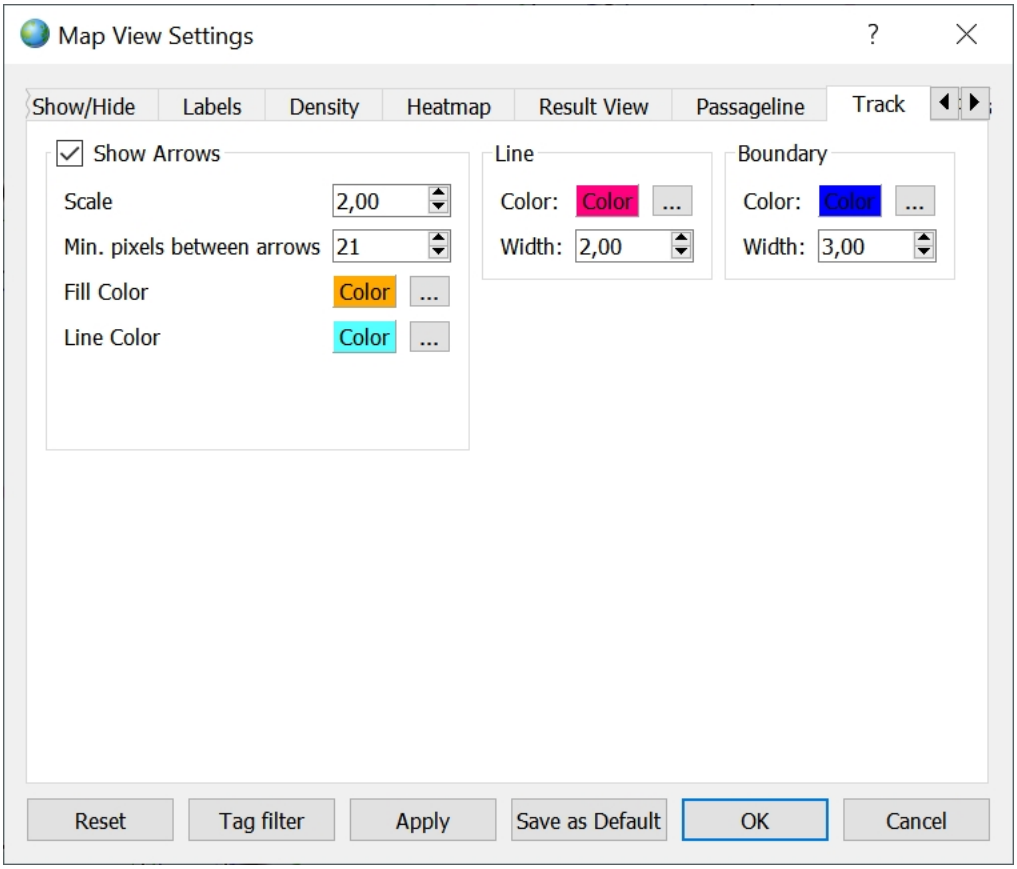
1. *Removed IMO UNIQUE requirement in static ship type DB*
2. Added new label display option for bathymetry and structures

### *Version 6.0.8*

*1. Fixed file sort problem, only occurs in special cases*

### *Version 6.0.7*

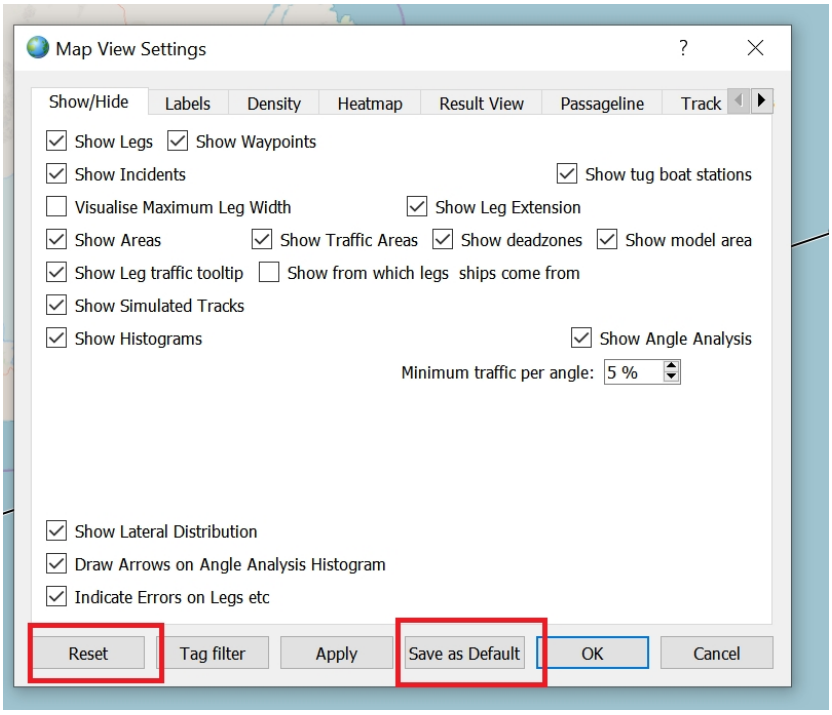
*1. Fixed 32/64 bit conversion bug when saving/loading custom ship types*
2. Added more Track map view settings




***Version 6.0.6***

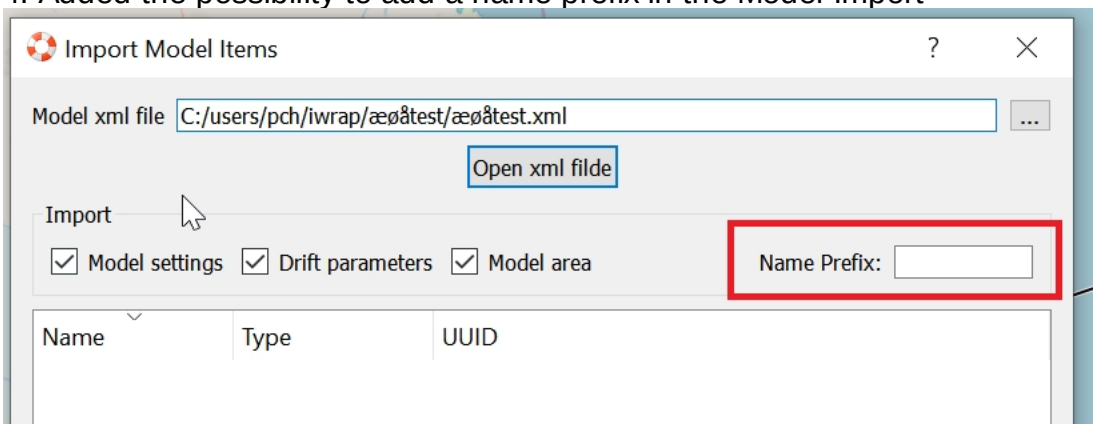
*1. Fixed UTF8 bug when saving/loading XML (default class A/B)*

2. Possibility to Save Map Settings as default




3. Control track display features (ship trip list)

4. Added the possibility to add a name prefix in the Model Import




5. Fixed bug when sorting on Trips in Ship/Trip list

***Version 6.0.5***

*1. Improved WMS handling*

***Version 6.0.4***

*1. Fixed bug when running jobs*

***Version 6.0.3***

*1. Fixed bug when deleting legs*

***Version 6.0.2***

1. *Warn if more than 5% samples are outside model area*

2. Made waypoint and legs more visible on density plots by adding a white background

3. Several minor fixes

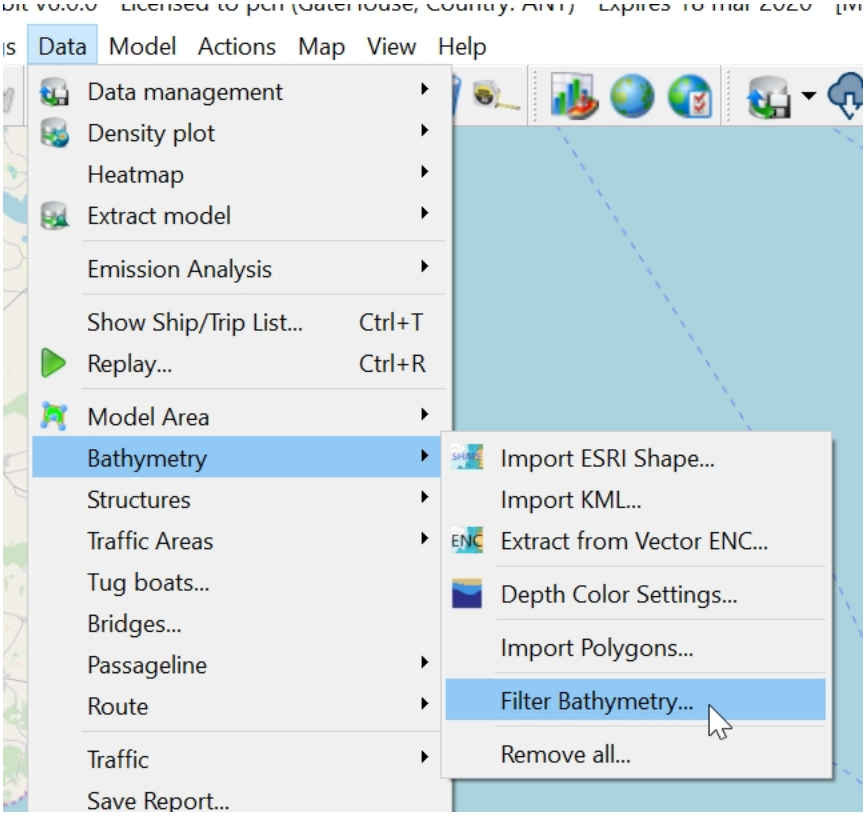
***Version 6.0.1***

*1. Added Web Map background, still experimental, more on this later*

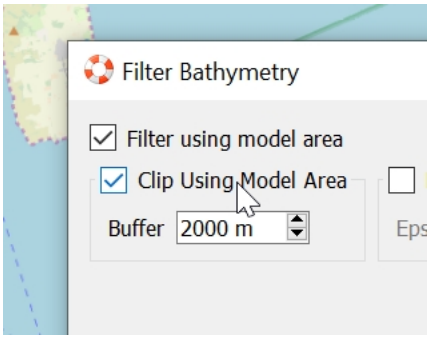
2. Fixed a bug in traffic editor when editing floating point numbers

***Version 6.0.0***

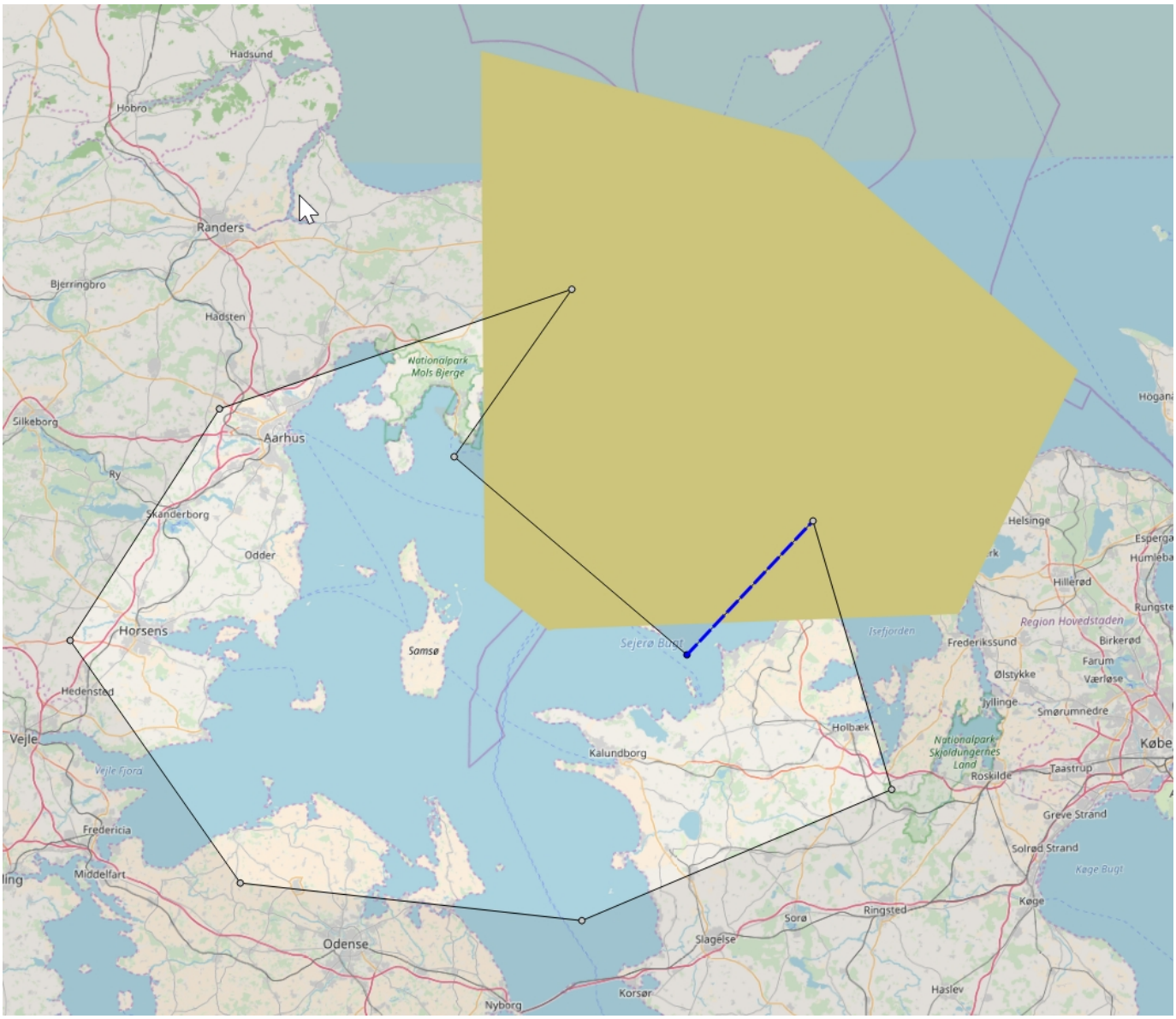
*1. Made it possible to clip bathymetry polygons.*



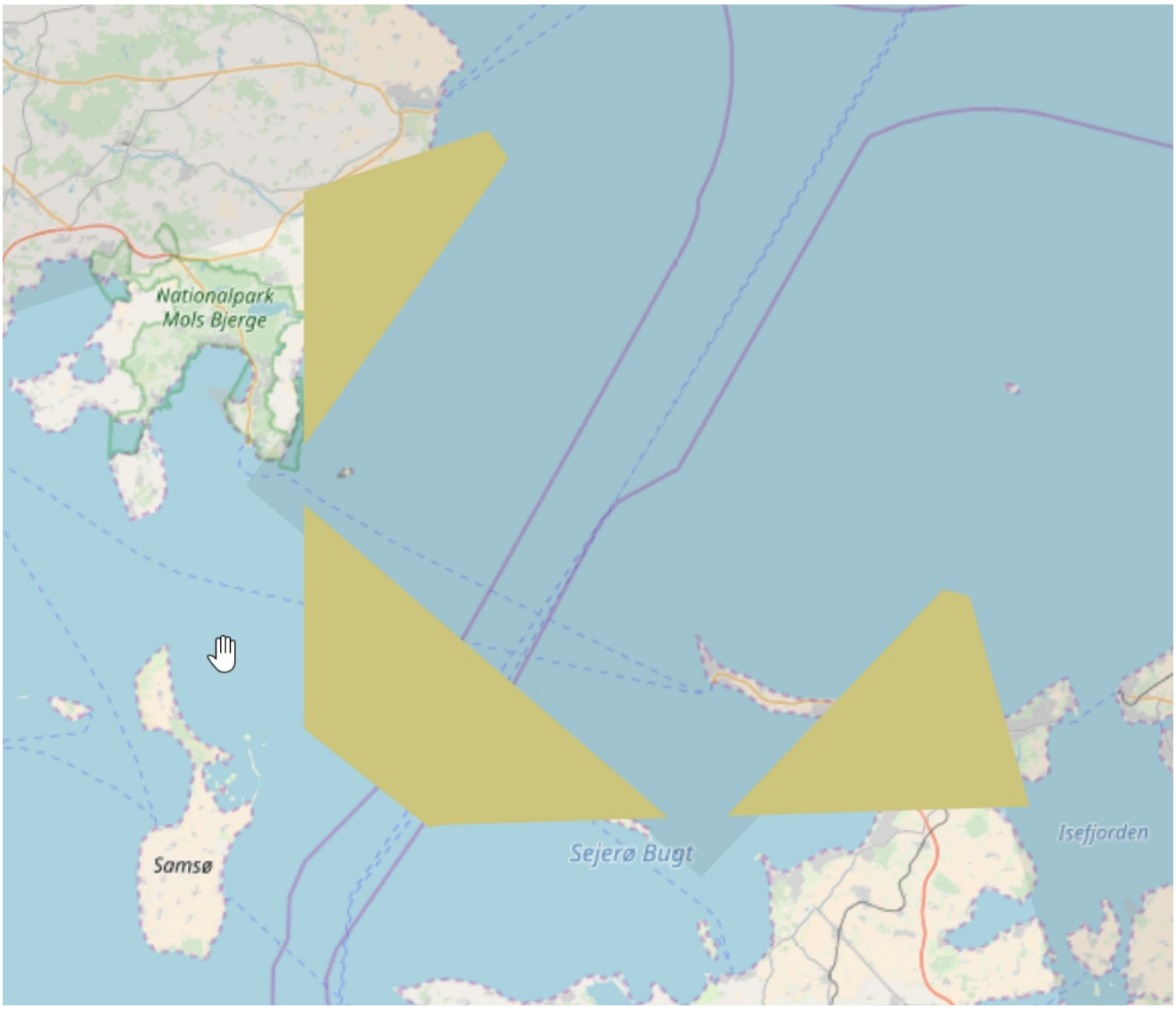

Select "Filter using mode area" and "Clip using Model Area". The Buffer distance enlarges the model area, so clipping can extend the model area, this is useful so that drifting grounding can occur outside the model area.




Here is an example, as you can see part of the land area is outside the Model Area,




Here is the result after doing the clip, with 2000 meters buffer.

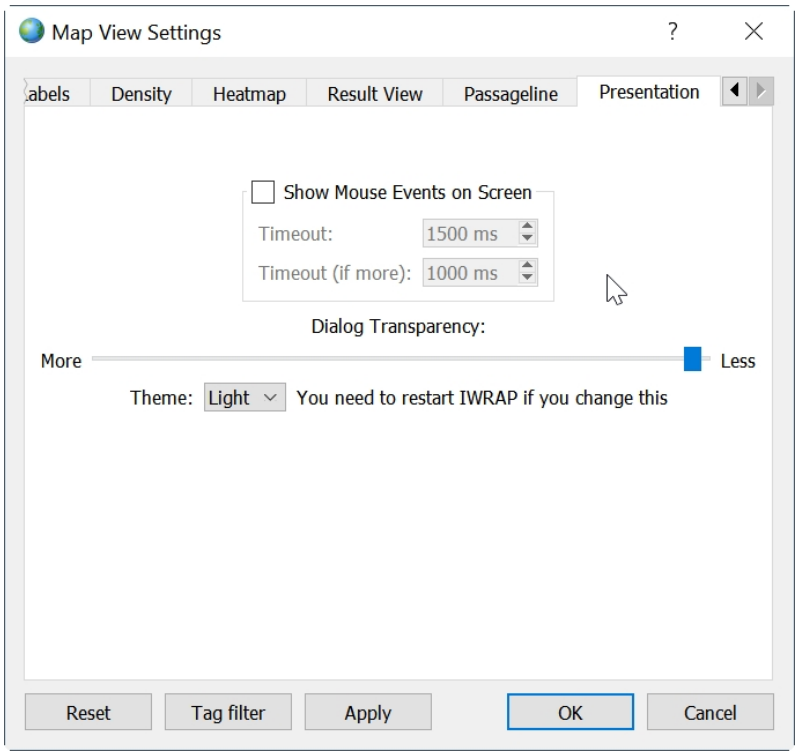



***Version 5.9.4***

1. Possibility to use S-57, S-63 and directENC
2. Added support for polylines
3. Possibility to specify that a polygon edge should be excluded from grounding calculations.
4. 64bit version
5. Compiler/toolset upgrade
6. Several performance enhancements and bug fixes
7. Added training guide
8. Added video player
9. Presentation settings:

   Control dialog transparency.

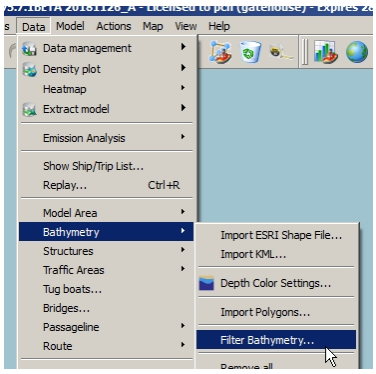
   Added dark theme, if you switch you must restart IWRAP, default is Light theme.



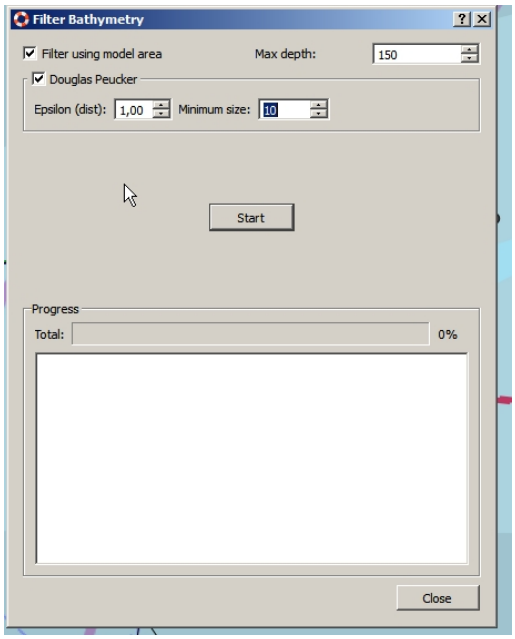

Show "Mouse Events on Screen"

## *Version 5.7.1*

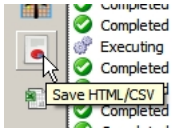
1. A new Filter Bathymetry function has been added



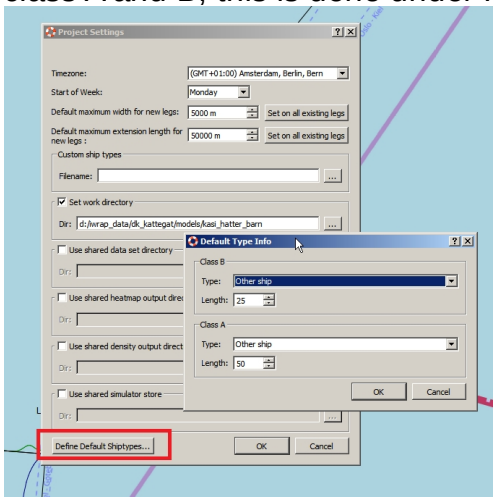

This enables you to filter the bathymetry polygons. You can use the model area as a filter i.e. remove all polygons completely outside the model area. You can also remove all polygons that are deeper than a certain Max Depth and you can downsample the polygon edges using the Douglas Peucker alogorithm.



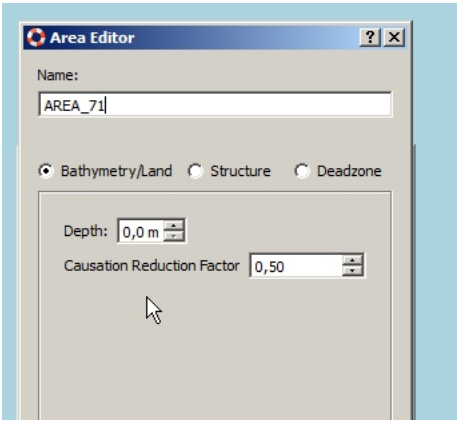

2. The same filters as mentioned above are now available when importing shape files.
3. Fixed a bug regarding & in file paths
4. The save HTML feature in the job list now also saves detailed collision results, i.e. were results are specified per depth category.



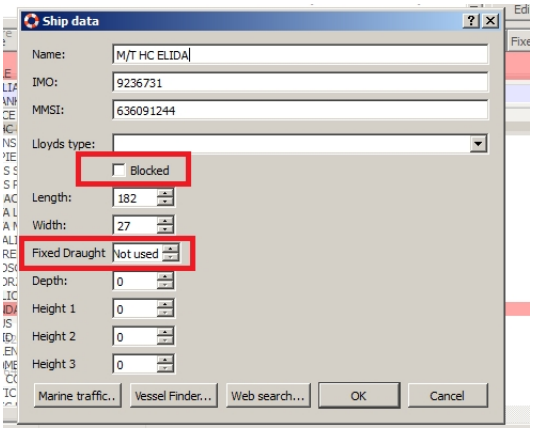

5. Class B support
6. Added new error message if model xml can not be parsed correctly
7. Zoom in on model area if model is empty
8. It is now possible to configure the ship type and length that is used if these are unknown for class A and B, this is done under Project Settings.



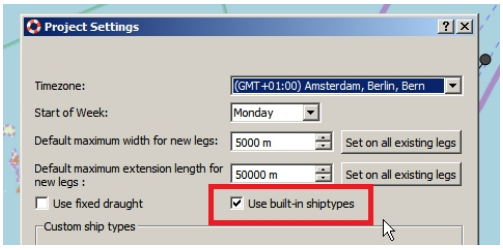

9. New passageline extraction feature, see Passagelines.
10. Added causation reduction factors to Bathymery and Structures



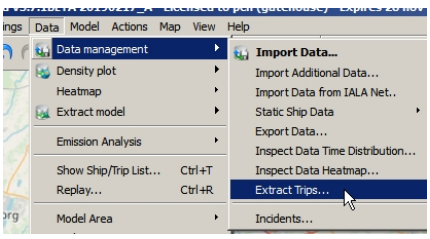

11. Fixed bug in bridge collision detection
12. Changed collision_type_vs_ship_type.html to collision_type_vs_ship_type_striking.html. Added collision_type_vs_ship_type_struck.html.
13. It is now possible to block certain mmsi numbers. Find the mmsi in the Ship/trip list and edit it




14. Instead of using the draught from the data stream it is now possible to set a fixed static draught, see the above screenshot.
15. An extract of the modified static ship data together with the model when you start a job. A copy of global settings is also stored.
16. IWRAP contains a database of ship types and length information, which has been used if no type/length has been available in the imported dataset. It is now possible to control the use of this database, under project settings. The database is used by default:




17. FIxed problem long duration trips. This means that if you have an existing dataset, you will have to extract trip data again, you can do this here:

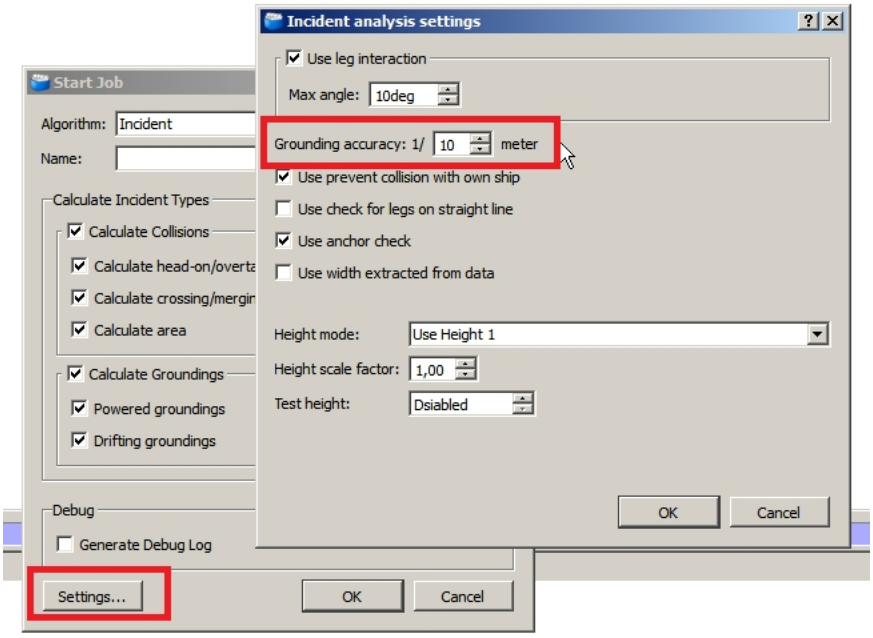



### *Version 5.7.0*

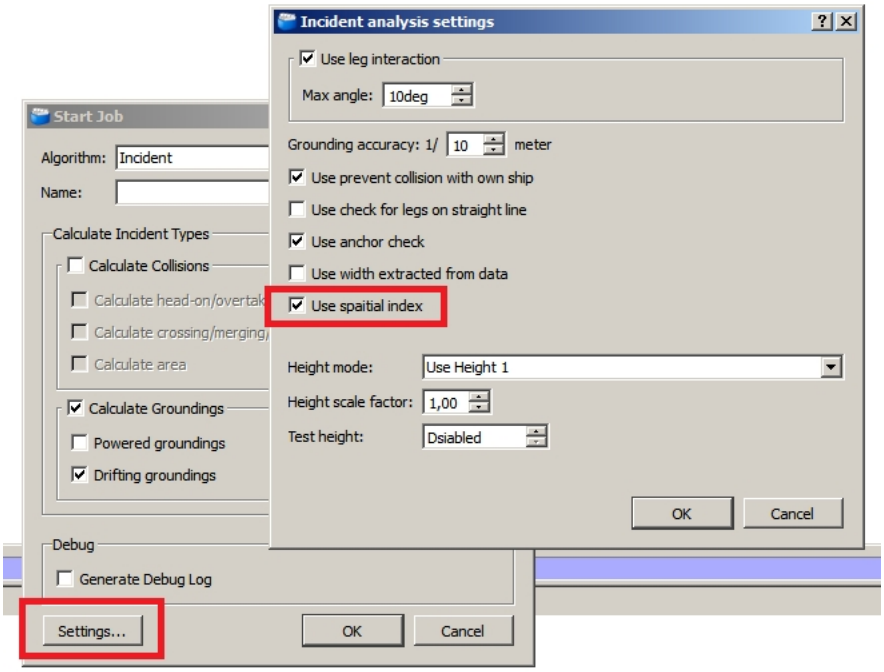
1. When a new job is started it is automatically selected in the job list.

2. Fixed bug in "Traffic/Load and Mulltiply"

3. Now the accuracy of the grounding calculations can be controlled, default is tenth of a meter. If you have models with very detailed bathymetry it is recommended that you e.g. use ½ meter accuracy to speed up calculations. You can set the accuracy when you start a new job. The accuracy is stored in the model.

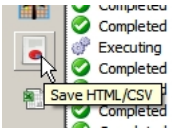



4. Added a spatial indexing scheme to the grounding calculations. Tests indicate that the performance is increased by a factor around 3-4 for the grounding calculations. The index is enabled by default, it is possible to enable/disable it here:




5. Fixed problem with movie generator, movie width and height must be even numbers. An error will be displayed if this is not the case.

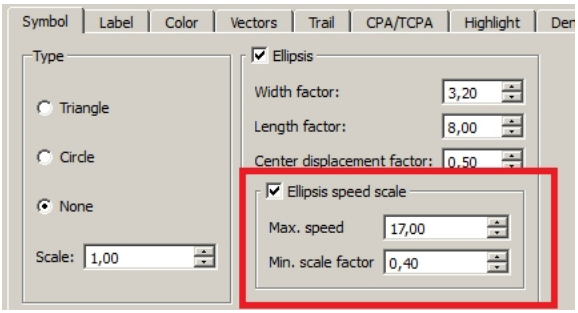
6. The save HTML feature in  the job list now also saves files as CSV




### *Version 5.6.0*

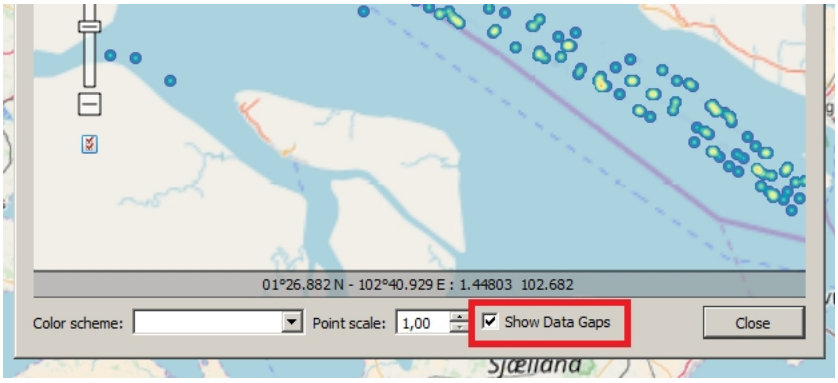
1. The grounding calculation calculation accuracy has been increased. Earlier versions the accuracy was meters now it is tenth of a meter. So you will observer difference i grounding results when upgrading to this version.
2. Now it is mandatory to create model area before starting the import of data. Use to create the model area and click on the map to add model area vertices. If you need to clear the model area and start from scratch you can clear it using the "Data/Model Area/Clear Model Area.." menu item.

3. When replaying it is now possible to scale the ship ellipse by speed. This is disabled by default. Using the below settings the ship will be shown with the full vector size when is moving more than 17knots, under this value it will be linearly scaled down. The Minimum scale factor ensure that it will not be zero.

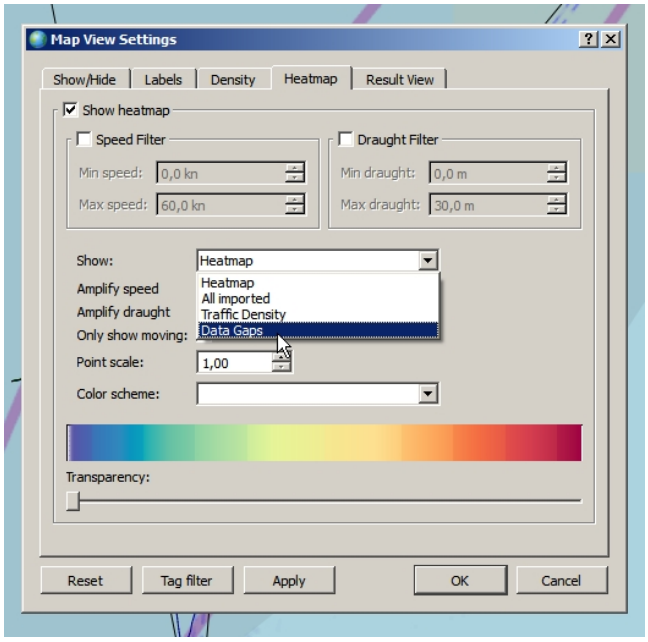



4. Added draught as a possibility to replay label

5. Added a new heatmap for lost signal, this can be used to analyze geographical gaps in data coverage. After importing data, in the heatmap view try selecting "Show Data Gaps"




It is also available for display on the model map view, you can select it here.




6. In the fitting result overview changed "Error" to "Gap", i.e. short for fitting gap, the gap indicates the fitting result quality. The fit wth the highest gap value has the poorest fit to the histogram. The term "Error" was causing confusion.

7. The data import directory is now stored in the model.

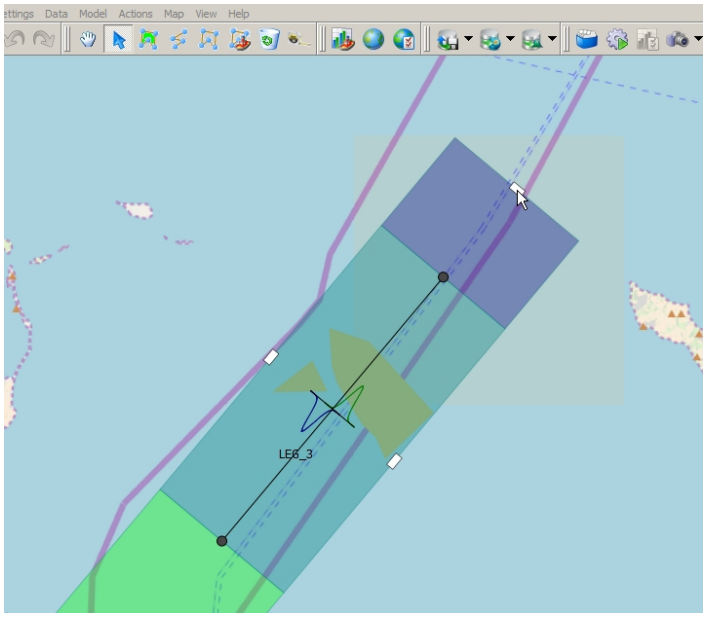
8. Movie generator can now include raster maps

### *Version 5.5.1*

1. Minor bug-fixes

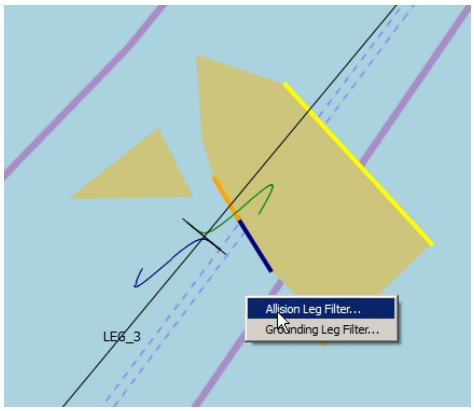
### *Version 5.5.0*

1. Modify leg extensions using the mouse. Select the pointer tool and start dragging the white indicators at the sides and the end of leg.

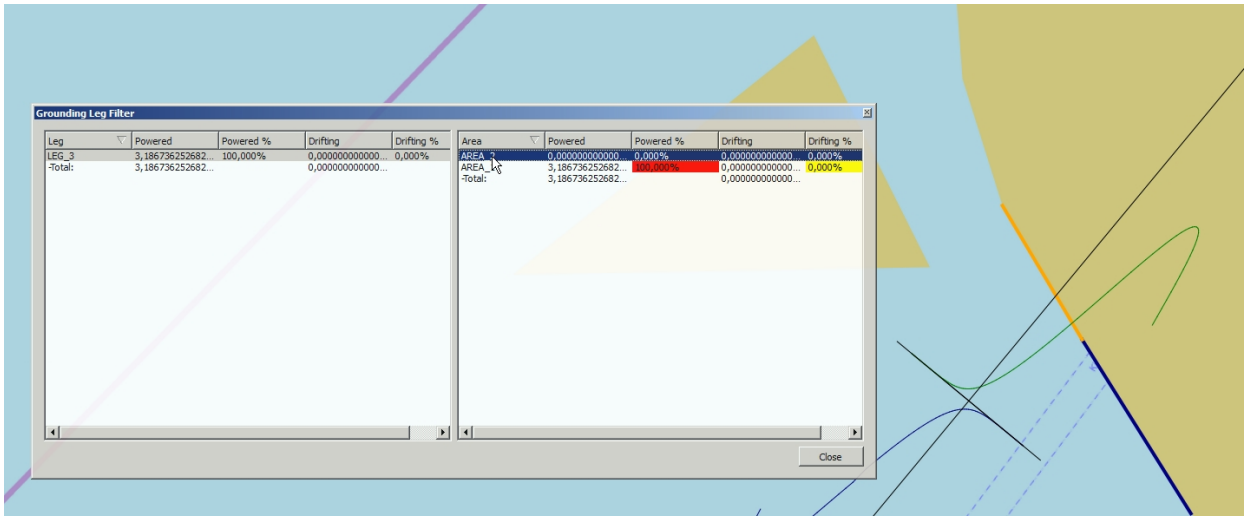



2. Fixed a crash during heatmap view

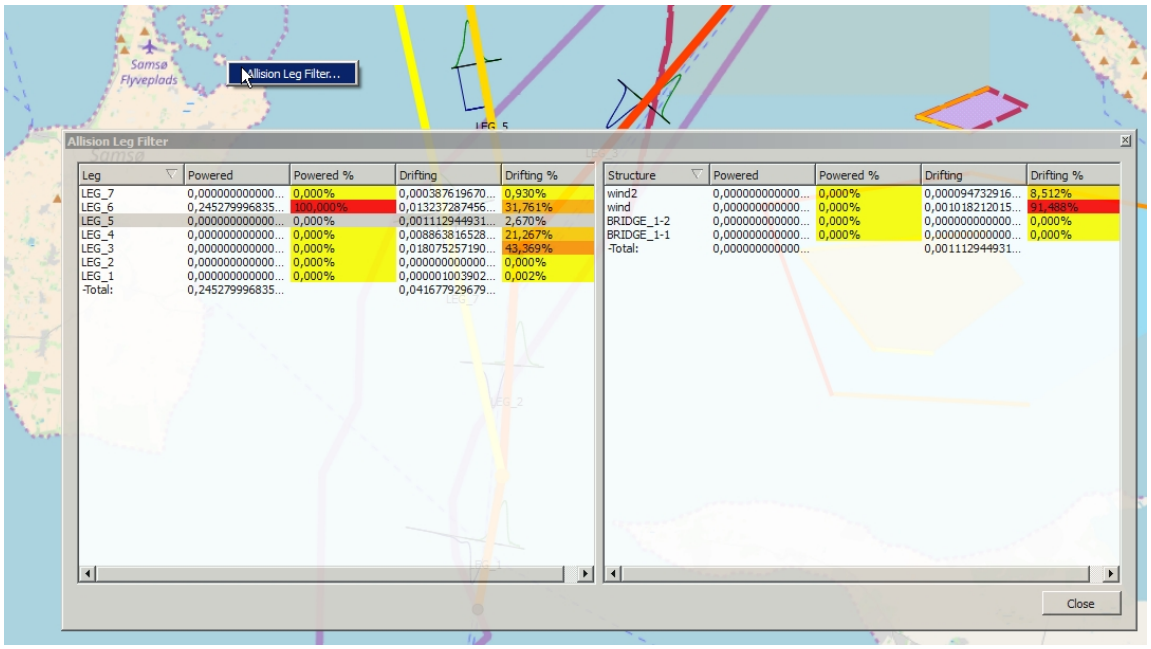
3. Allision and grounding result filters. These filters can be used to analyze allision and grounding results, open the result view and right-click on the map



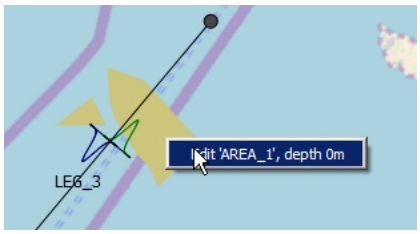

Now it is possible to select each leg and analyze which grounds the powered and drifting groundings will interact with. You can double-click on the area to zoom in on it on the map.



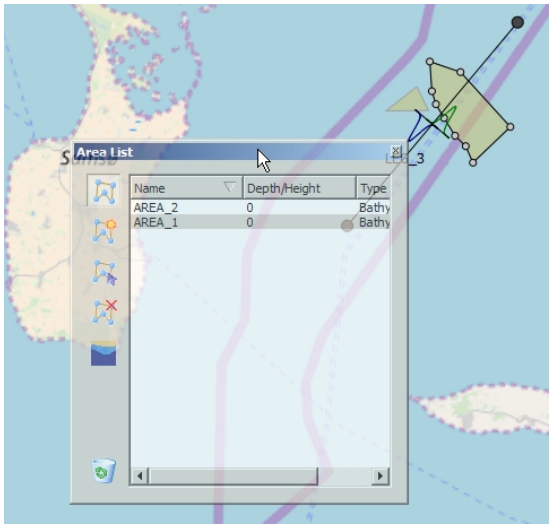

Here is a similar example for Allisions.



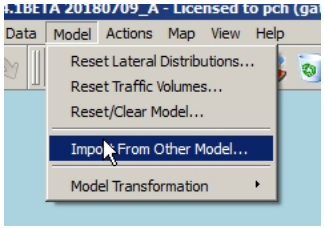

4. Right-click on an area on the map to edit it:



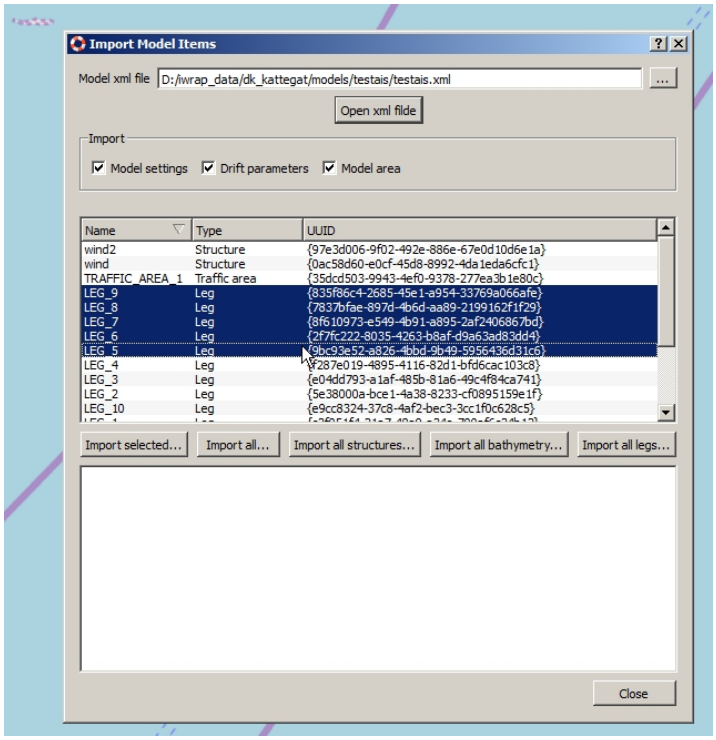

This will open the editor and select the area:




5. Import from other model. It is no possible to easily import legs etc. from another model




Simply open a model XML file and select the items you want to import.

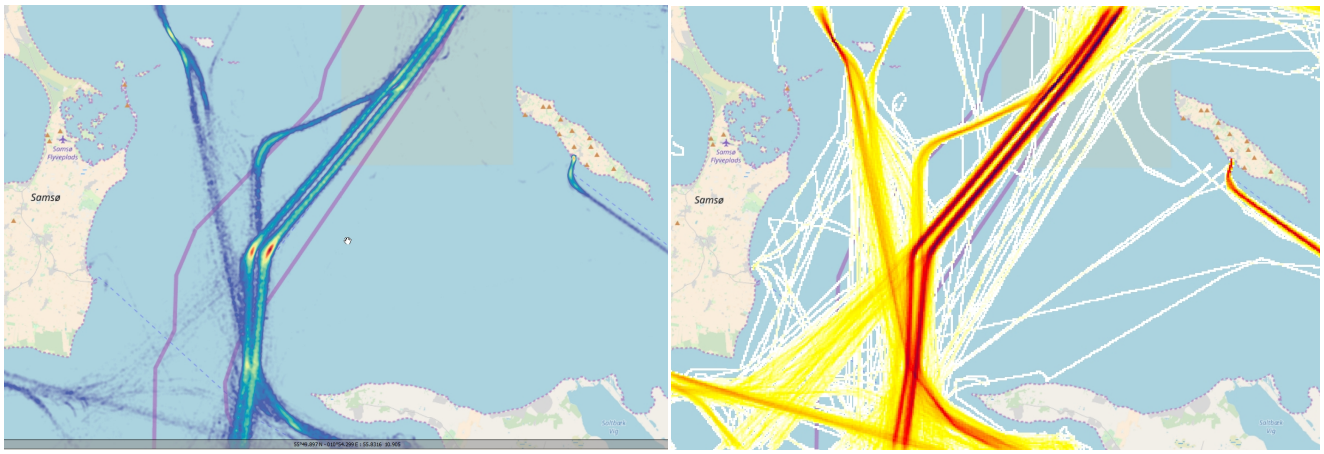



6. Several minor bug-fixes.

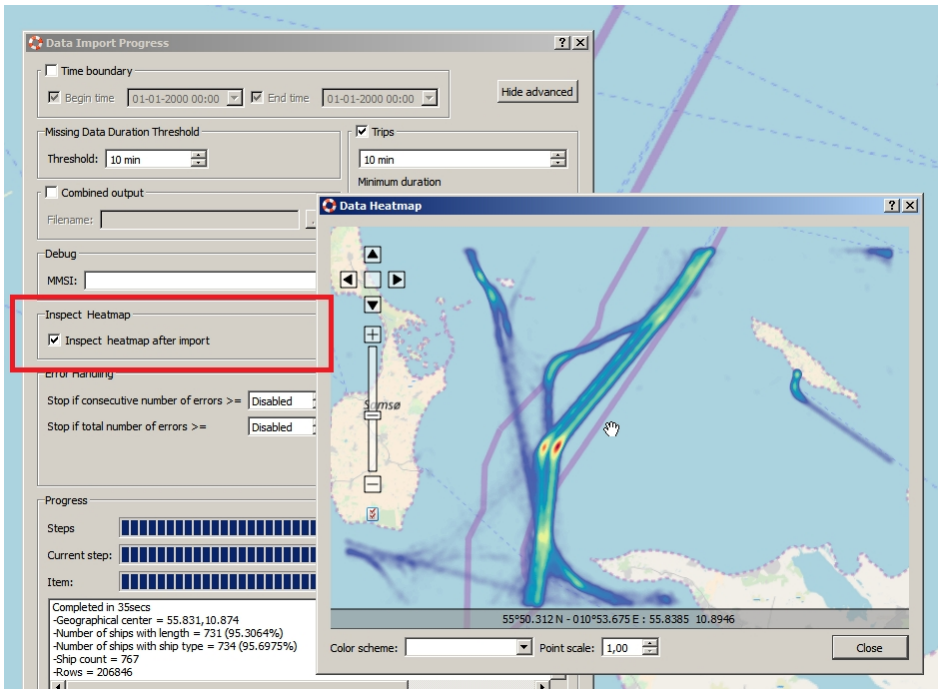
### *Version 5.4.0*

1. A new heatmap feature has been added. The difference between heatmap and density plot is that heatmaps don't use interpolation.

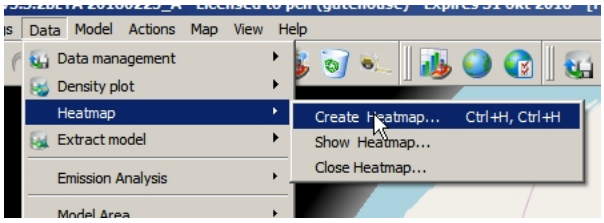
   The screenshots below show the difference, on the left hand side the new heatmap plot is shown and on the right hand side (or below depending on you screen) the density plot is shown for comparison.




   The nice thing about heatmaps is that they are fast to generate. When you import a new dataset a heatmap s automatically generated and displayed if the "Inspect heatmap after import" option is enabled. This can be used to inspect the spatial quality of the imported data.

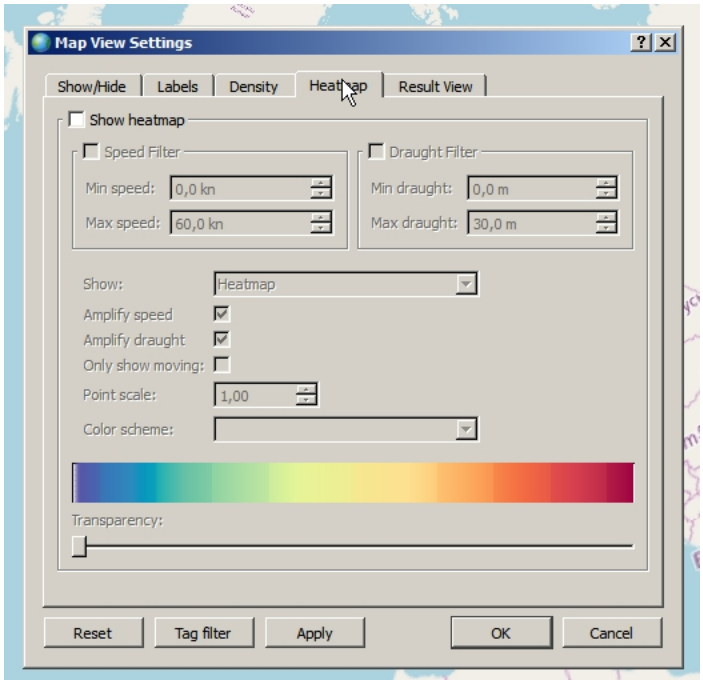



If you have already imported a dataset you can go to:



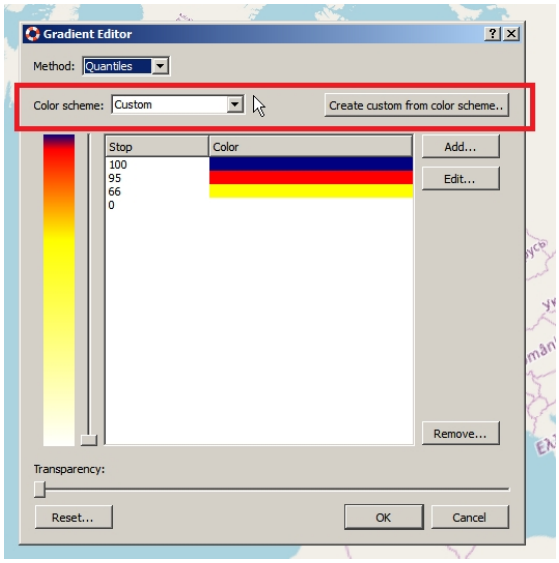

And create a new heatmap.

When you have created the heatmap, you can open the map view settings and control different visual aspects.

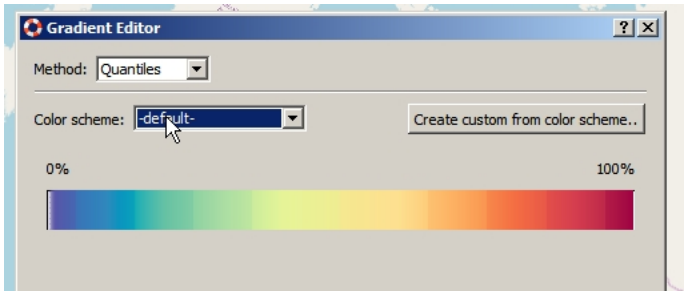



See Creating heatmaps for more information on creating heatmaps.

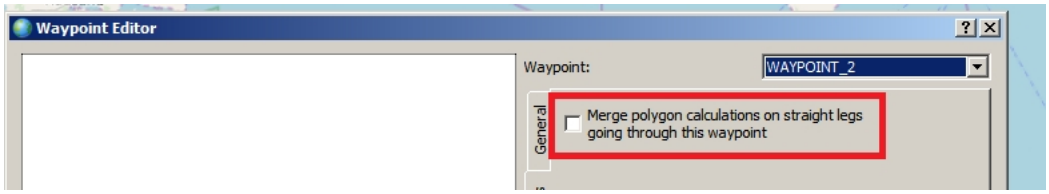
2. The gradient color dialog has been modified.




The color scheme that has normally been used is now called "Custom". Besides this custom color scheme you can now also select from a list of predefined colors.



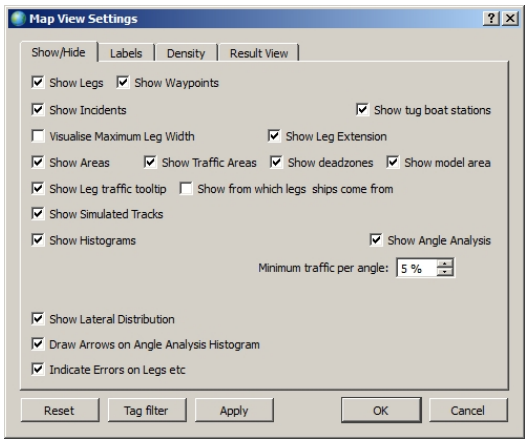

3. On the waypoints the "Merge polygon calculations on straight legs..." have now been disabled by default. It is recommended that you disable this on all waypoints.



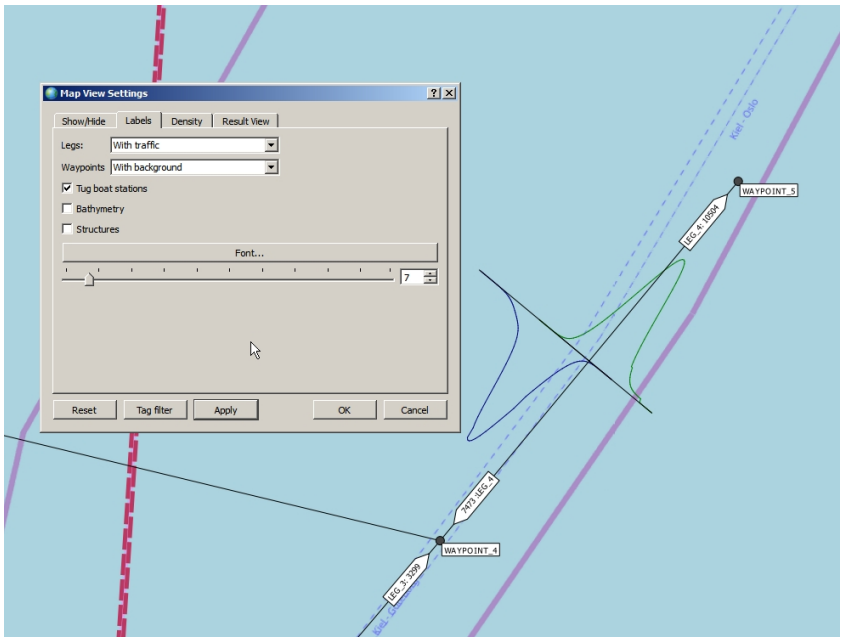

4. A new version of the XVid codec has been added. You can always get thew newest here https://www.xvid.com/download/.
5. Default leg width is changed from 10000m to 5000m

### *Version 5.3.0*

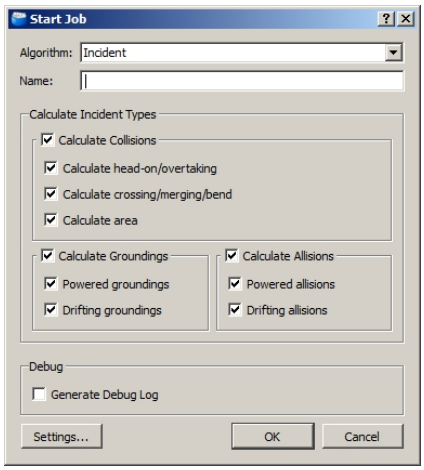
1. The Map View settings have been divided in to tabs:



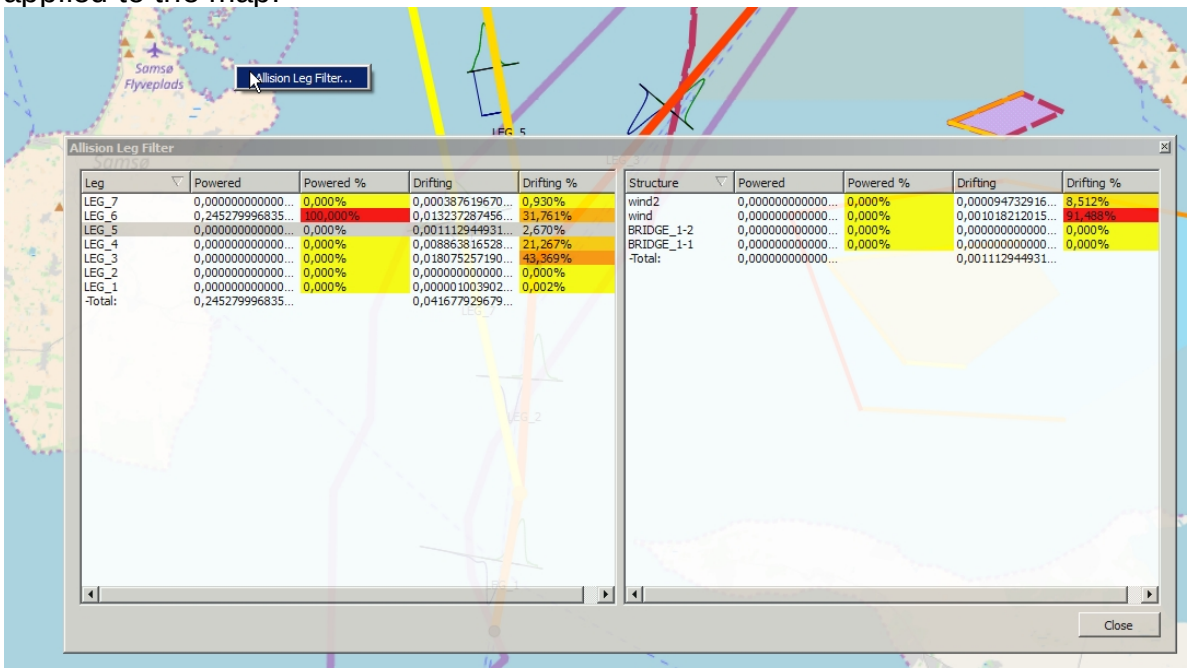

2. Labels on legs and waypoints now have more options, e.g. showing the traffic amount as part of the label:



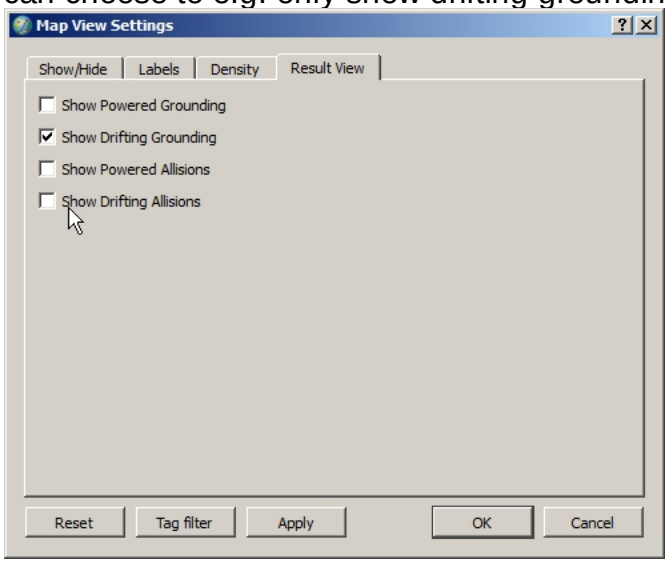

3. In the "Start job" dialog it is now possible to disable some of calculations, by default all are enabled. This is useful if you e.g. have a detailed bathymetry model, but are working on adjusting collisions, then you can temporarily disable grounding calculations to speed up your work. Remember to always perform your final analysis with all calculations checked!



4. If your model has allisions you can right click on the result view map and choose "Allision Leg Filter...", here you can select a leg on the left side and and see the resulting frequencies for each structure on the right side. Note that the map is also affected i.e. the filter is also applied to the map.

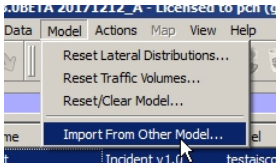



5. In the map view settings, it is also possible to filter which results to view on the map, so you can choose to e.g. only show drifting groundings

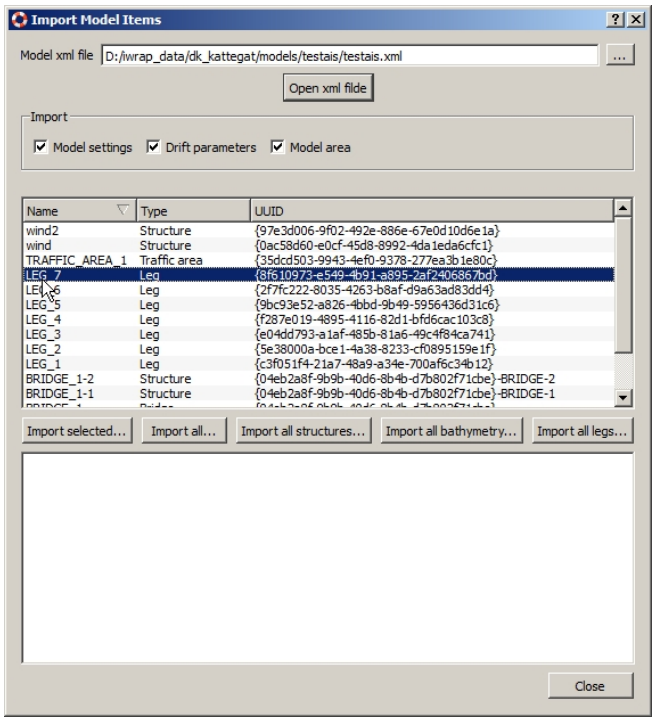



6. On the job view a "Save html" option has been added that will save all results to a number of html files. These files can easily be imported in to e.g. Word.

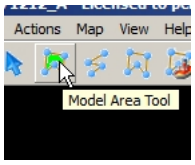
7. It is now possible to import parts of another model in to your current model, this feature can be accessed here:




Simply open a model xml file and select which elements you want to import.




8. The "Model area", i.e. the area of interest, can now be specified as a polygon using this tool:

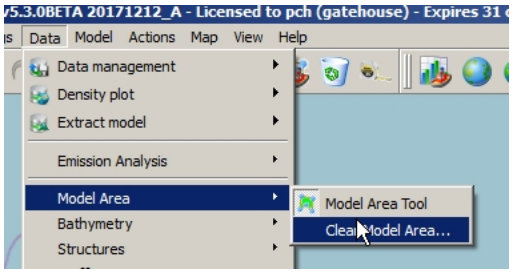



Simply select the tool and start drawing the area on the map by clicking on the map.

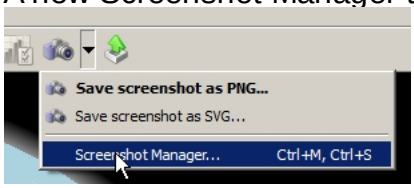
You  will see a slight difference in color inside/outside of the area.

The "Model area" will be used as a filter when you import AIS data.

You can clear the area model using this menu item,

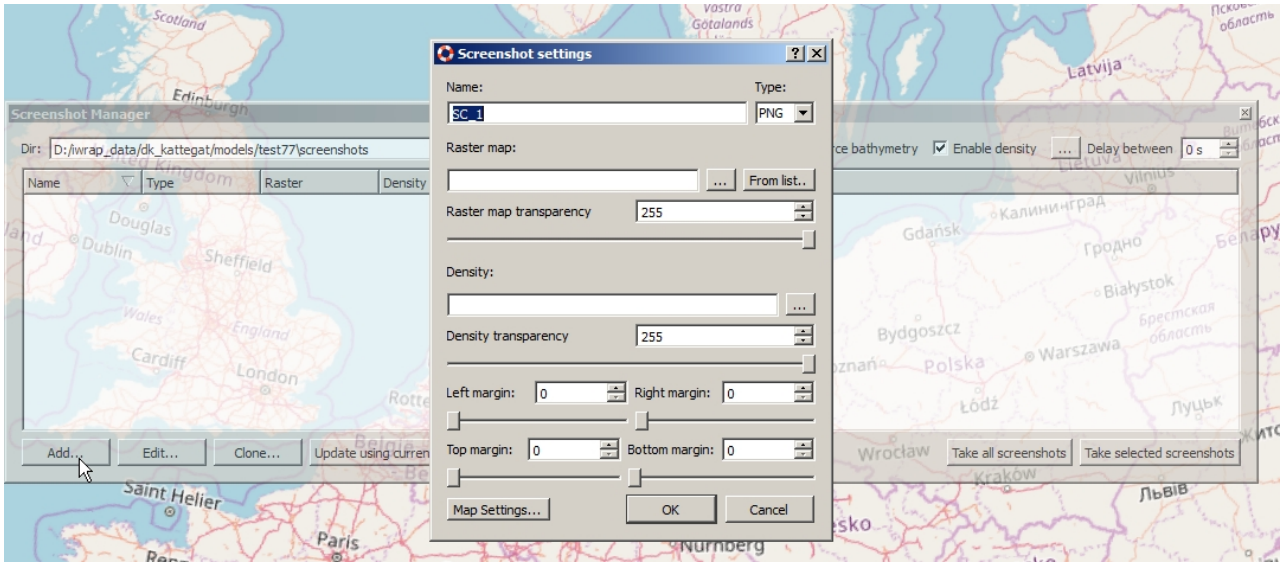



9. A new Screenshot Manager tool has been added

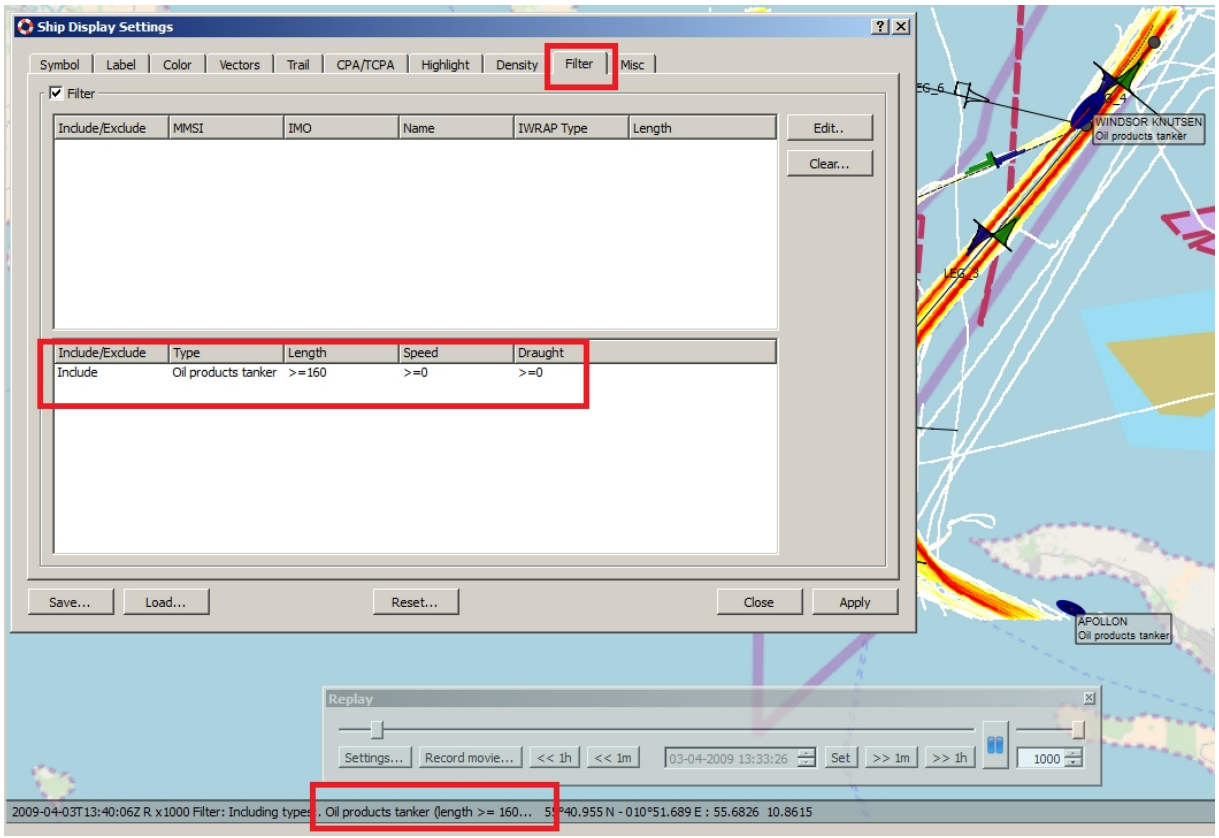



This enables to define some views that you want to use in your reports and quickly take screenshots for all the defined views.

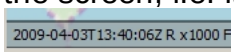
See Screenshot Manager for more info.



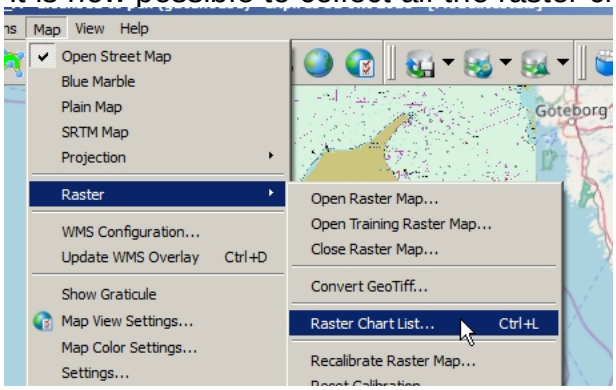

10. A ship filter has been added to the replay settings, when a filter is enabled it is indicated in the bottom of the screen.



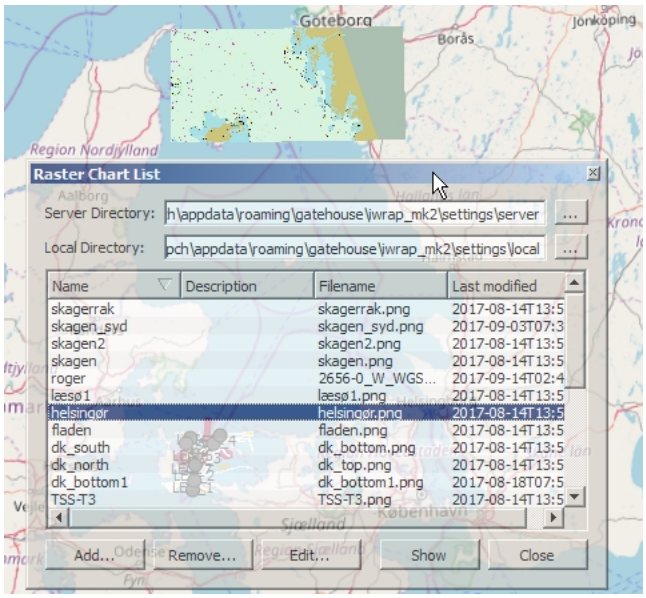

11. The replay speed can now be adjusted up to 1000, the speed is now shown in the bottom of the screen, i.e. it will also be visible on the video.



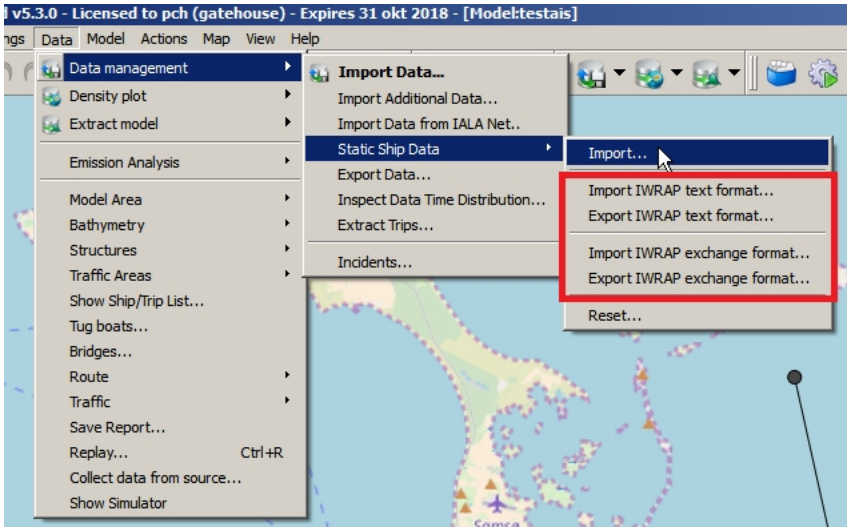

12. It is now possible to collect all the raster charts in a special Raster Chart List




The list makes it easy to access maps, furthermore you can specify a directory on a server and sync with the contents, so several users can easily share the same maps.




13. It is now possible to specify the maximum drift distance in each drift direction. Default is 50km.
14. If you have several PC or you want to share your database with other users you can use the different Import/Export features. use the "Import/Export IWRAP exchange format..." to exchange with other IWRAP users:




### *Version 5.2.0*

1. CPA/TCPA filter possibility when creating density plot, reorganized advanced settings.
2. CPA/TCPA visualization possibility when creating a replay/movie.
3. Control background colors of base map, e.g. make it gray or monochrome
4. New replay/movie trail feature for creating a faded colored trail, colors and other parameters can be controlled
5. Highlight one or more ships when replaying/creating a movie.
6. Sample interpolation when creating a replay/movie, can be turned on/off
7. Added a 1 hour and a 1 minute skip forward/back buttons on the replay control widget

### *Version 5.1.0*

1. NOTE! Fixed cache error in drifting allision/groundings algo. This change does have effect on the drifting allision/groundings results, by a couple of percentage points, magnitude

depends on your model...
2. Added Bridge editor, this Editor makes it easy to define a number of bridge polygons with a user specified height and width, see 'Data/Bridges...'.
3. Added support for Bridge allisions, i.e. it is now possible to define Bridge segments and specify their height. The height of the ship can be loaded as static or dynamic data. There are 3 different height values, and it is possible to choose one between these before running the incident algorithm.
4. A new CSV file is stored in the extraction directory, containing a row for each ship that is captured on a given leg.
5. There is one file for each direction. The filenames begin with captured and then the uuid/name of the leg and the 2 waypoints.

***Version 5.0.4***

1. Possibility to turn off interpolation when creating a traffic density plot.

***Version 5.0.3***

1. Fixed ship type problem in data import, when importing CSV.

***Version 5.0.2***

1. Integrated ship filter in model extraction setup.

***Version 5.0.1***

1. Minor bug fixes.

***Version 5.0.0***

1. Now, by default, IWRAP fits distributions in parallel, i.e. using a number of parallel running threads. This makes the fitting part of the lateral extraction process typically 3-4 times faster. If you have problems with this, it can be disabled by unchecing this box.

   file:///C:/user/gh/iwrap/impl/doc/images/fit_parallel.png

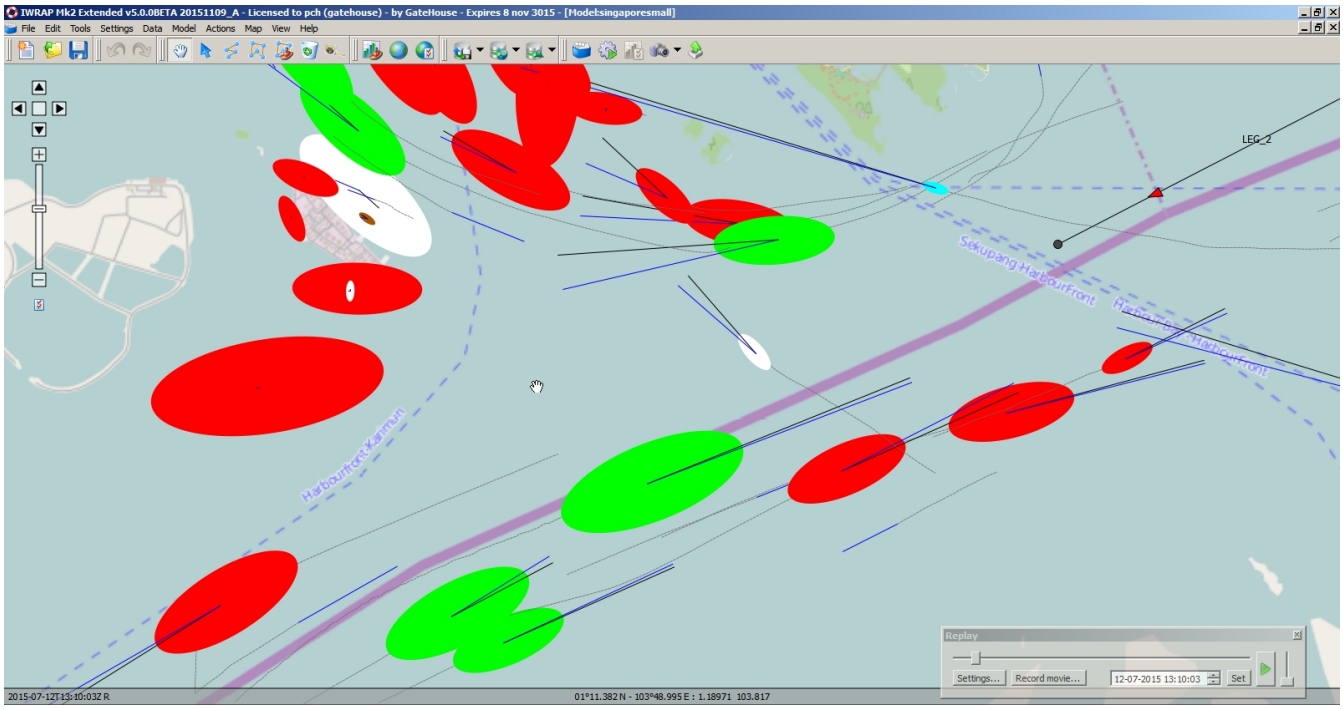
2. Custom Ship types. It is possible to define your own ship types. This option is mostly useful if you have access to Lloyds ship type information. Here you see an example of custom defined ship types:

   file:///C:/user/gh/iwrap/impl/doc/images/shiptypedef.png

   Each ship type is mapped to its corresponding Lloyds and/or AIS ship types, here you see an example of a RoRo type that has been mapped to a number of Lloyds ship types:

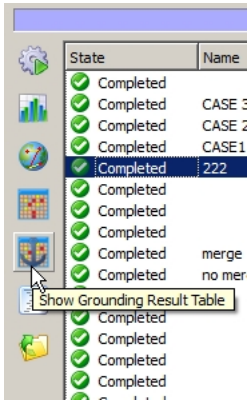
   file:///C:/user/gh/iwrap/impl/doc/images/shiptypedef_roro.png

- Replay and movie recording. Using the free basic version it is now possible to replay AIS data and create movies, see 'Data/Replay...'




- It is possible to draw the ships as circles, triangles or using their Safety Ellipsis as shown in example below.
- Ships can be drawn using a fixed color, or by ship type, or ship size.
- Labels can be added, e.g. name, MMSI, IMO, etc.
- It is possible to draw trails, using user defined length, color, line type etc
- Heading and/or COG/SOG vector can be added, using user defined length, color, line type etc.
- It is possible to record videos using a number of different encoders. You can easily define the length of the resulting video and e.g. specify how many frames per second the video should contain.

3. IWRAP has a new grounding result table, it can be found below the ship-ship result table.

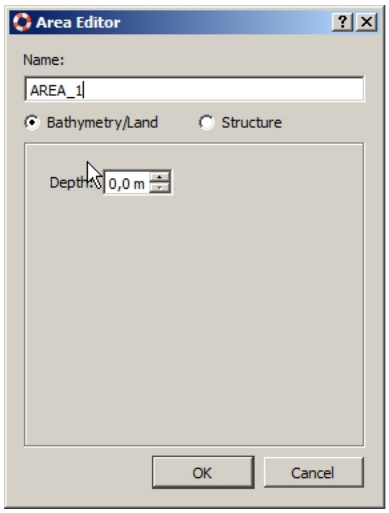


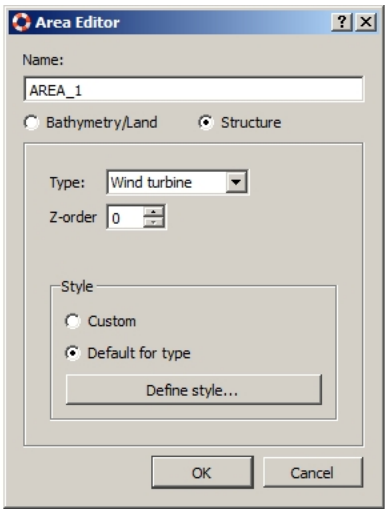

The table shows results for ship types and ship length categories, and can be filtered for each polygon.

4. IWRAP will now detect if two consecutive legs are on a straight line, i.e. there is no bend. In this case IWRAP will set
5. the leg extensions lengths to 0.
6. Many minor fixes...

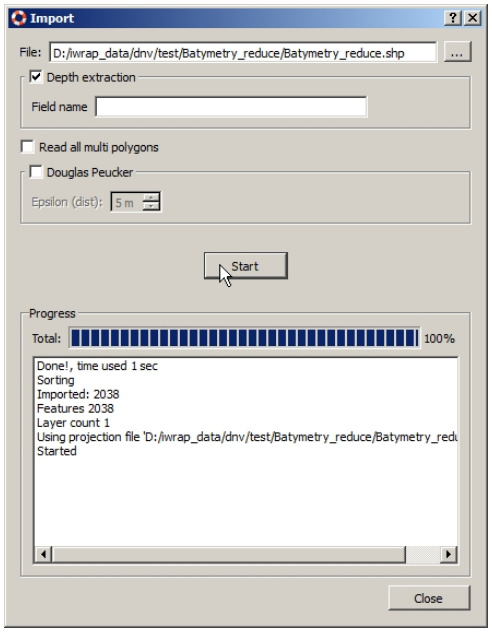
### *Version 4.7.0*

1. Allisions: In previous versions of IWRAP structures e.g. wind turbines have been modelled using grounds. Now it is possible to define structures directly. An allision is a collision between a moving vessel and a stationary object/structure. Allisions now have their own result category i.e. they are no longer mixed with groundings. This means that they are directly visible on the main result view.
2. Structures are defined like normal polygon areas, except that you have to tick off the 'Structure' button, see right hand side below.



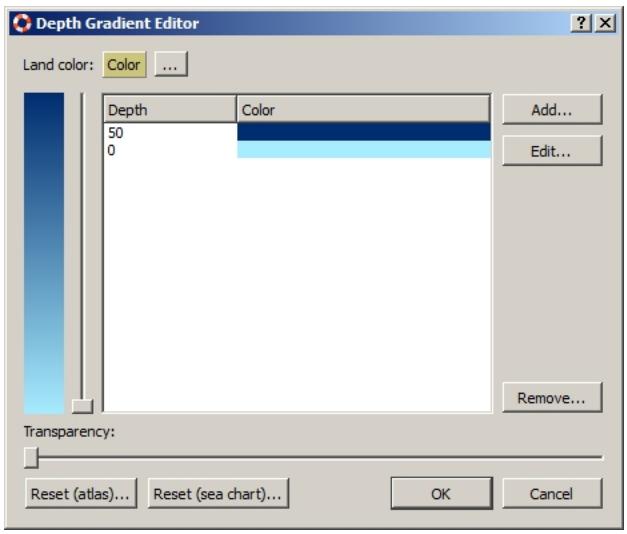




3. Allisions have been assigned their own causation factor.
4. Polygons for Bathymetry, Structures or Traffic Areas can be imported from the Data menu from ESRI shape or KML files. E.g. import Bathymetry shape file from 'Data/Bathymetry/Import ESRI shape file...'.

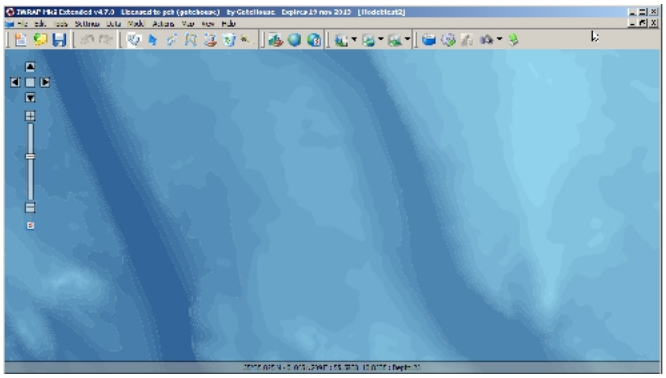


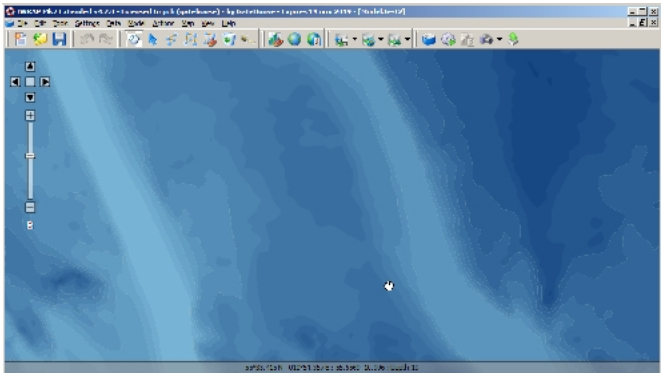

5. When importing Shape files it is possible to specify a field that contains the depth of the polygon. Furthermore it can be specified how multi polygons are to be handled, sometimes all of them should be included, but the default is to only include the first layer (i.e. the others may be interior rings).
6. For both Shape and KML files you can choose to simplify the polygons by using the Doglas-Peucker algorithm.
7. Note that when you import polygons from a file each polygon is tagged with the name of the

file. Each time you import
8. the file the polygons from that file will be deleted first.
9. New bathymetry coloring. IWRAP now uses a gradient for Bathymetry coloring, similar as used for e.g. Traffic Density.



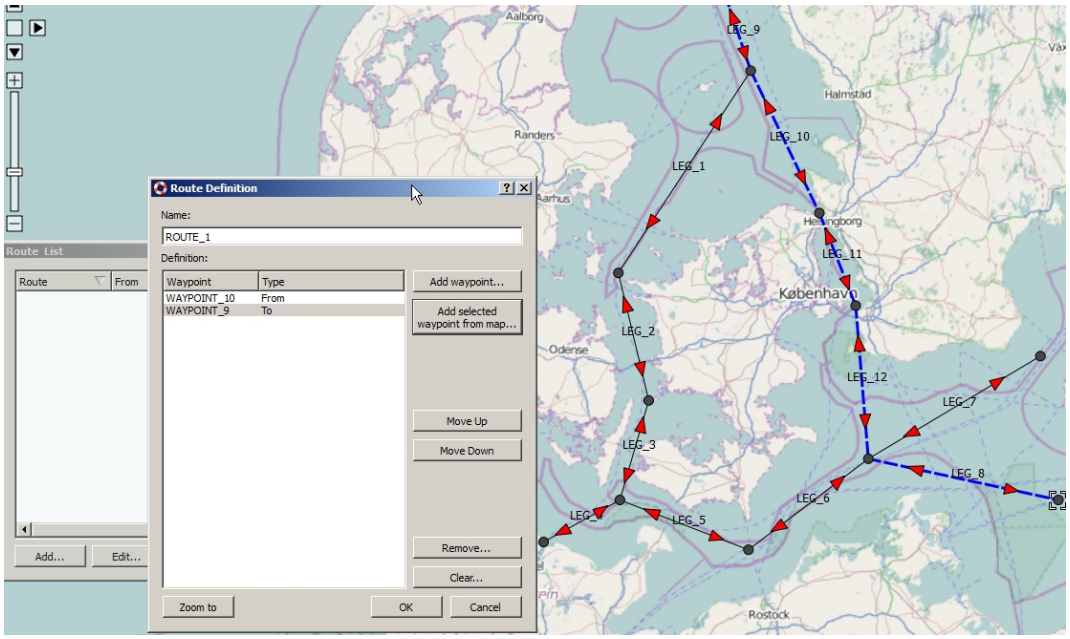

The 'Reset (atlas)' button makes deep area dark and shallow areas lighter, 'Reset (sea chart)' does the inverse. Here you see an example, atlas mode on the left hand side.



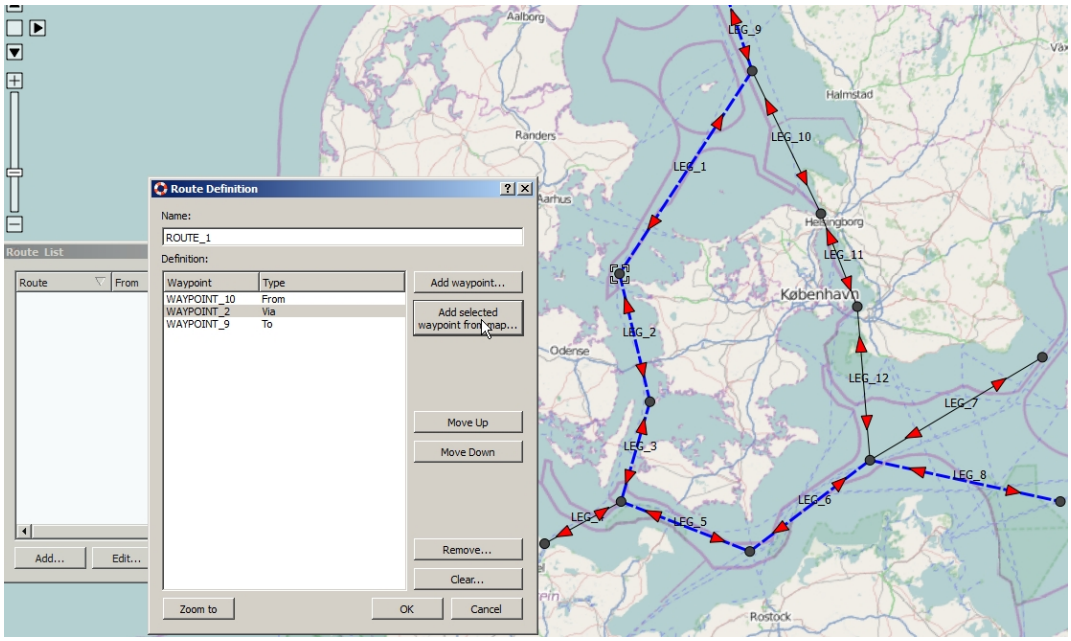


10. Bentley-Ottmann algorithm is now used to check if polygons are simple, this gives a huge performance improvement for large polygons.
11. The Traffic Area Composition dialog has been simplified, the style is now set by pressing the 'Style...' button.
12. Possible to pan when pointer tool is selected i.e. when no selectable object is clicked it is possible to pan the map.
13. Routes: This version contains the possibility to define routes. A route consists of a number of waypoints and legs. This can be used to e.g. move traffic from one route to another

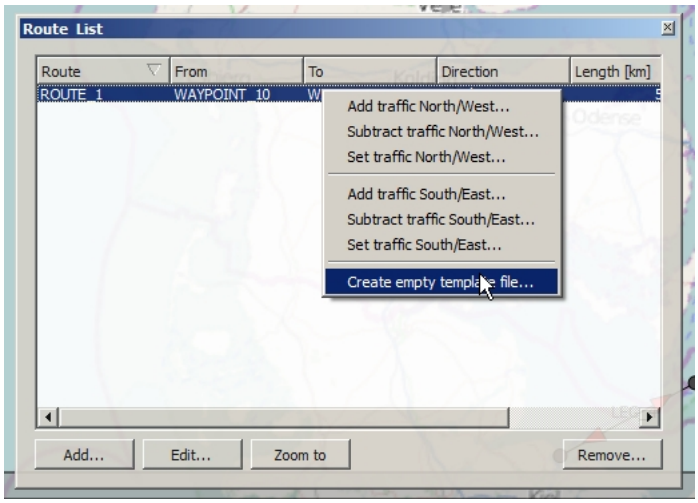
    Here is an example of a route between two waypoints. IWRAP automatically chooses the shortest route, indicated with blue dashed lines.



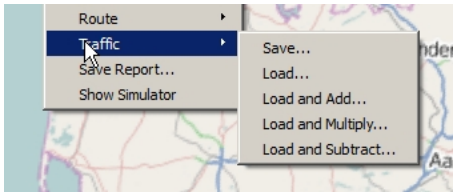

If you don't want the shortest route you can insert one or more via points.



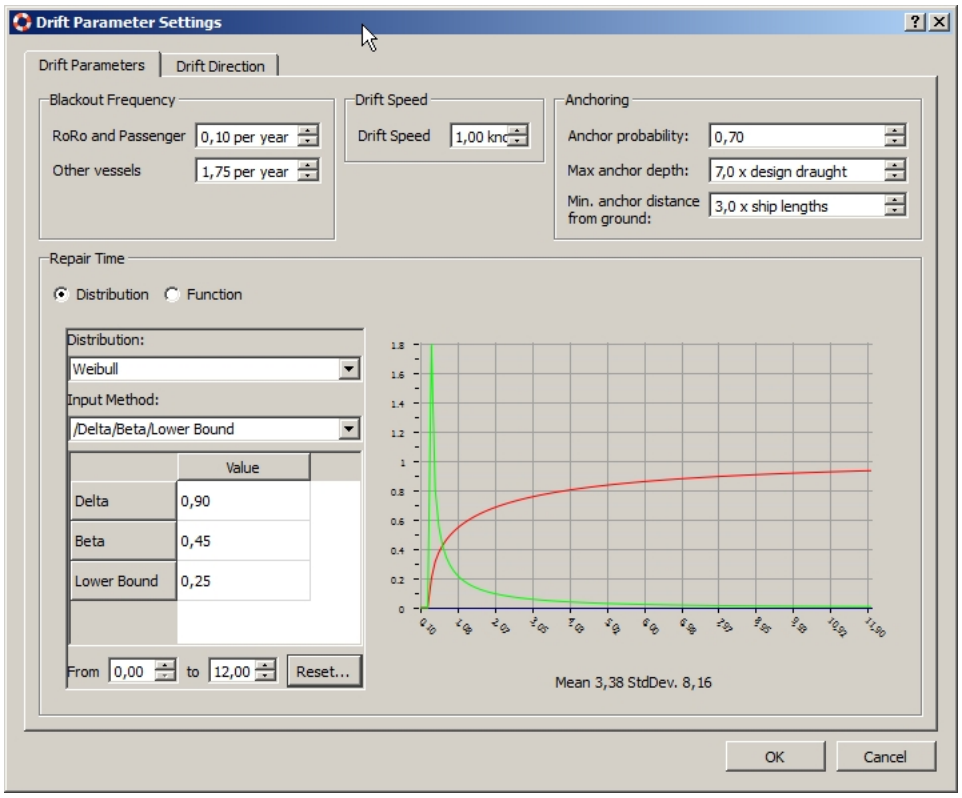

When a route has been defined you can add or subtract traffic from the legs in the waypoint. This is done by e.g. selecting 'Add traffic North/West...' and opening a CSV file with numbers for each ship type and ship length category. You can select the 'Create empty template file...' and save a file that you can e.g. open in Excel and modify and there after use to add or subtract.



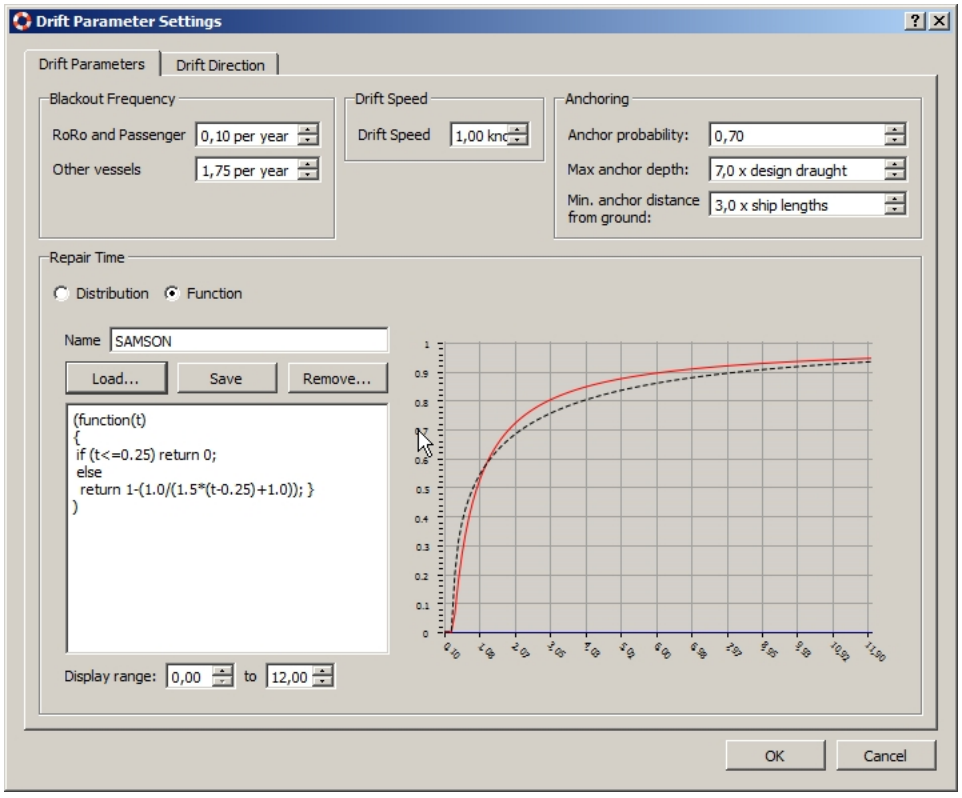

14. Traffic menu: Using the traffic menu you can save all traffic from all the legs to one CSV file. This file can then be opened in e.g. Excel and modified and there after re-imported into IWRAP.




15. The 'Load...' menu item simply loads and sets the values. You can also e.g use the 'Load and Add...' to add additional traffic. 'Load and Subtract...' removes the traffic and 'Load and multiply...', multiplies the traffic with the factor specified in the file.
16. Note, that you should only change the traffic amounts in the files and not modify the layout or other tags in the files.
17. Drifting parameters and settings have undergone major refactoring for this release. The parameters for the IWRAP standard Repair time Weibull has been adjusted. The previous settings were based on rather old literature studies, the new values have been found by comparison with studies performed in the Netherlands in the SAMSON project.

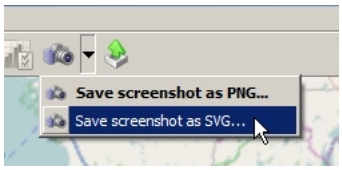



The SAMSON project uses a function, this is now also possible in IWRAP.

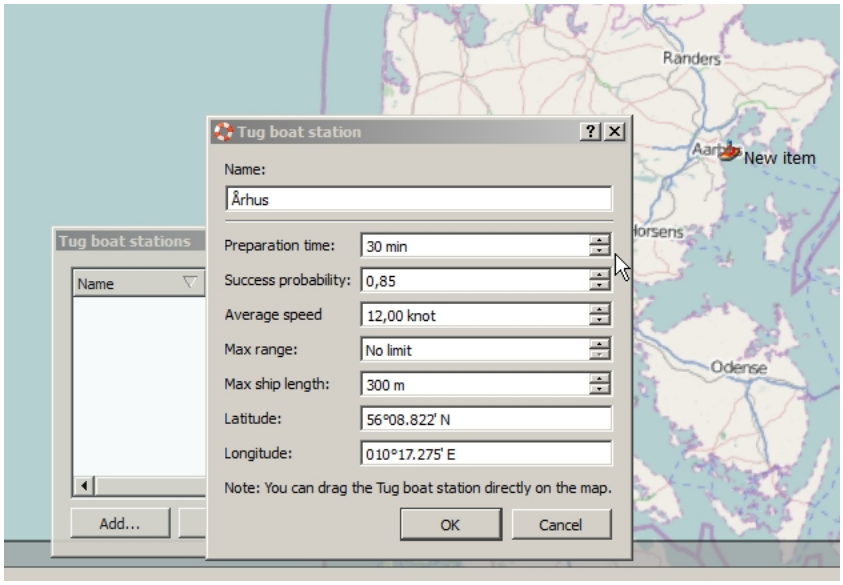



You can either load an existing function, e.g. the SAMSON function or you can write your own. The function must be written in JavaScript.

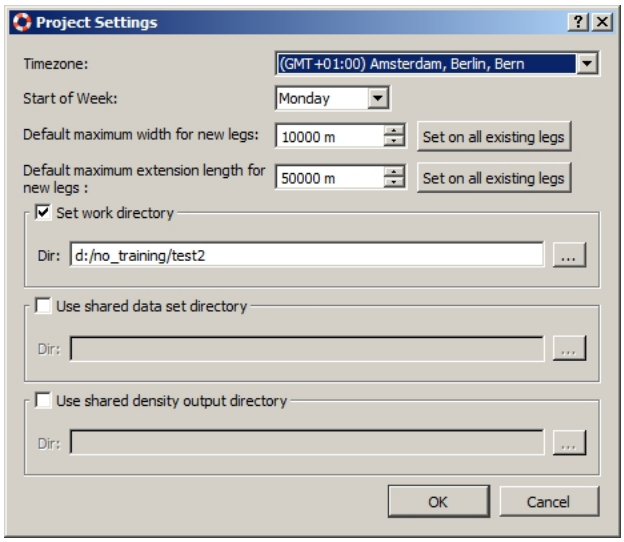
18. SVG screenshot: SVG is a vector format, i.e. so it looks much better than the raster screenshot when printed.



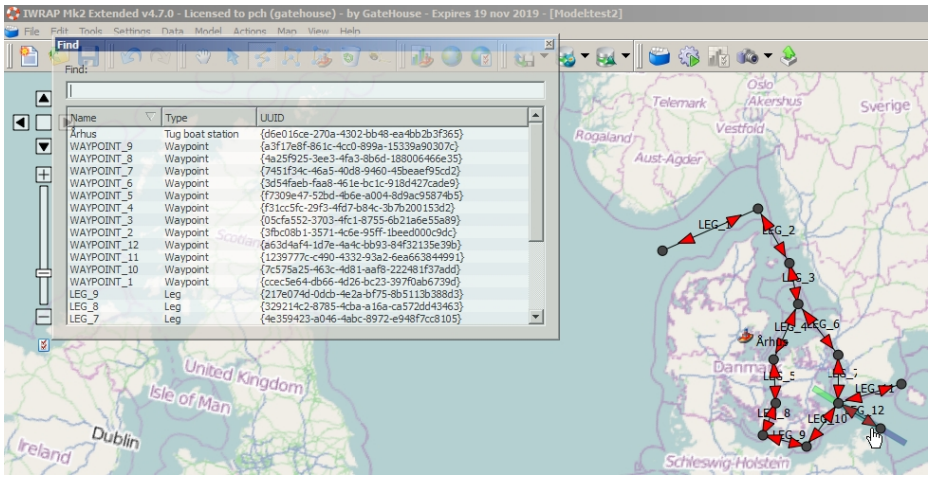

19. Tug stations: It is possible to specify the location of tug stations and define their range of operation. This is used for drifting ships, i.e. it is calculated if the Tug Boat can reach the drifting grounding or allision event in time. If this is possible the success of the actual tug operation is specified by the 'Success probability'.




20. New map view settings: Show way point label (disabled by default) and possible to change label font and size.
21. If you have several models that use the same data set you can now share the data sets between them, see 'Use shared data set directory' below. You will normally find the data set in the 'imported_ship_data' sub folder of the working dir of the project you want to share data with. You can also share the density plot data with another project, see 'Use shared density output directory' below.



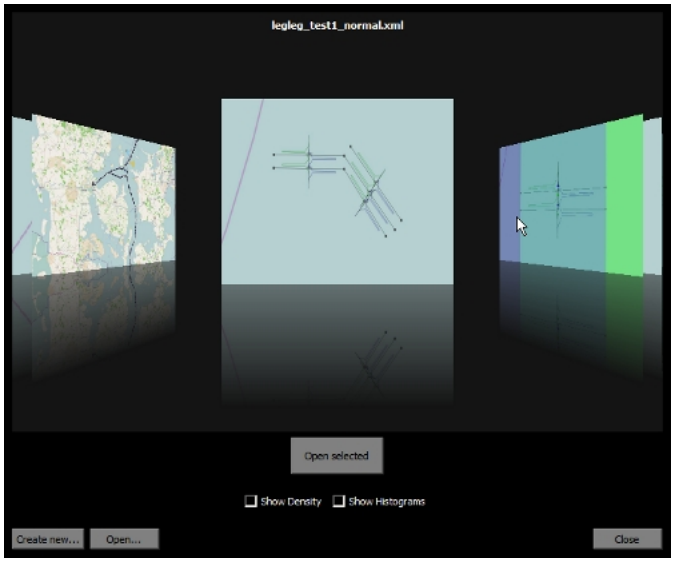

22. New find/search function, press CTRL+F, enables you search for all model items.



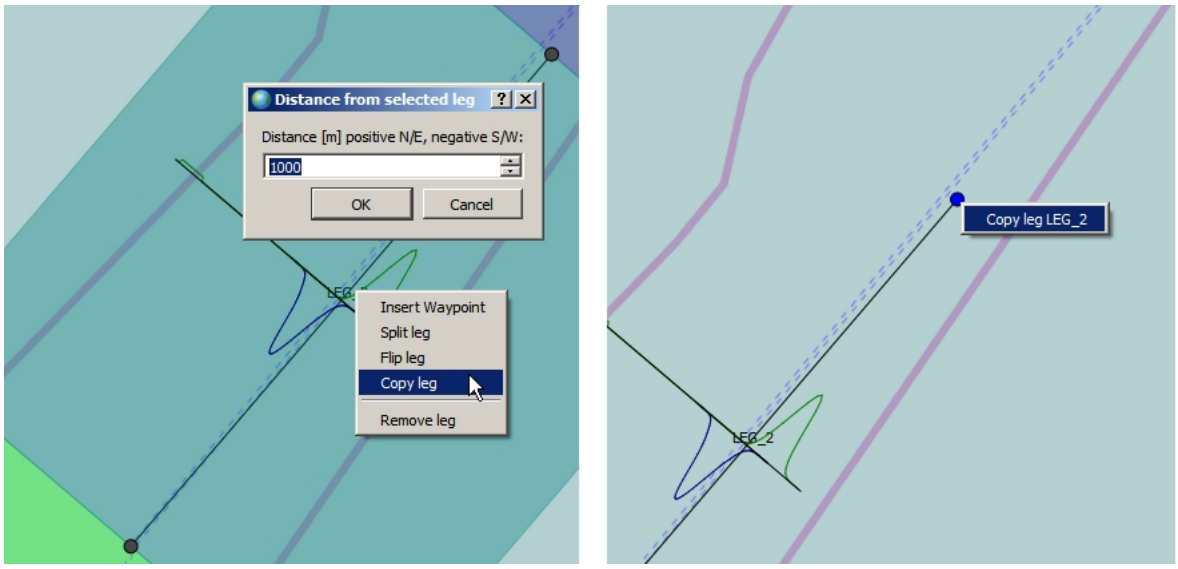

23. Many minor fixes, e.g. fixed problem with the Google earth integration so if you have had problem with this you may want to try again.

### *Version 4.6.1*

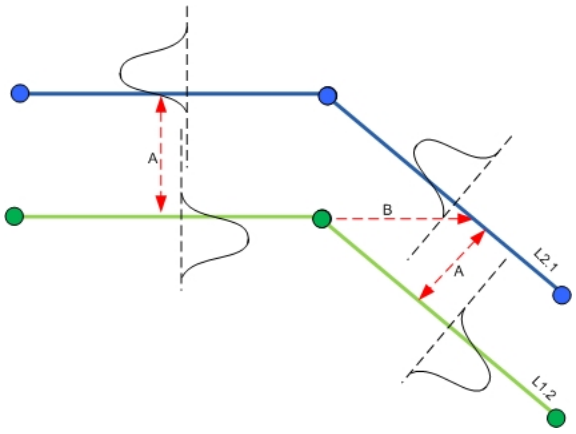
1. New startup window. When you open your models, a signature screenshot will be stored for each model. The screenshot along with the name of the model can be used to open an existing model. Note, that before a screenshot is generated the IWRAP logo is shown, so if you previously have opened some projects you will see a IWRAP logo, these will automatically be replaced by screenshots as you work with your models. If you have more projects, you can press on the left or right hand side of the screenshot to iterate through the projects or use the left/right/page up/page down keys. Users with extended licenses can tick off the 'Show Density' or 'Show Lateral Histograms', to open these straight away when the project is opened. You can also press the 'Close' button and just open projects as usual from the file menu.



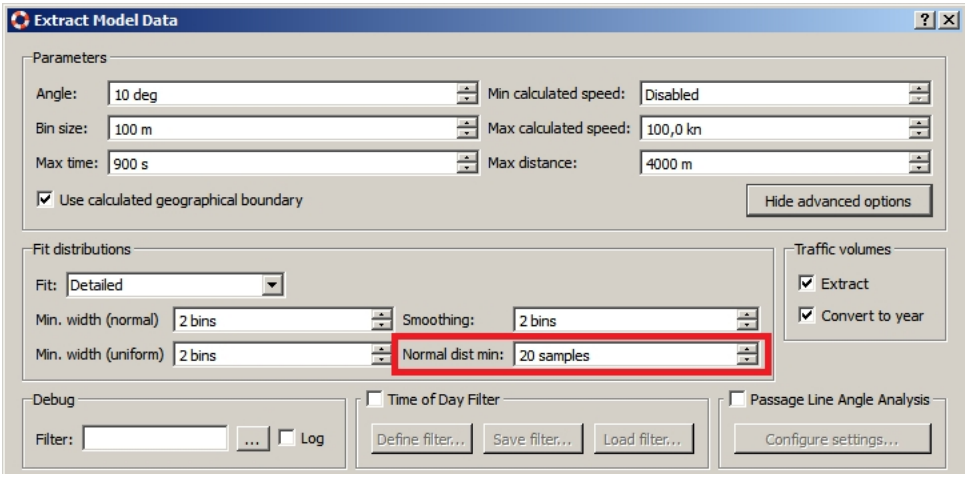

2. Own ship handling. If your model is based on data import, IWRAP will now handle cases where the same ship travels both ways on a leg, e.g. ferry traffic.
3. Copy leg. It is possible to copy a leg in two ways. You can right-click on the leg itself and specify the distance the copied leg should be displaced from the original. You can also right-click on a waypoint an copy a leg, the copied leg will then be connected to the waypoint and extend onwards in the same direction and same distance as the original.



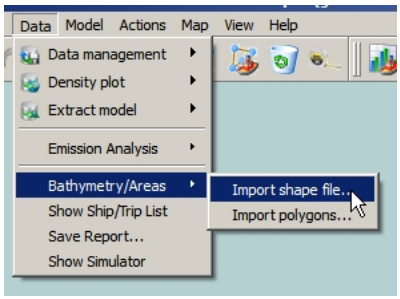

4. Flip leg. It is possible to flip a legs waypoints by right clicking on the leg.
5. Leg to leg traffic. Parallel legs can now interact in IWRAP. You can specify how parallel the legs should be to allow this, in the 'Incident Analysis 'Settings'.
   The parallel case is illustrated with an 'A' the following picture. Another scenario that is now handled, is the case where a ship may go on at the end of a leg into the traffic stream of another leg, as illustrated by a 'B' below.



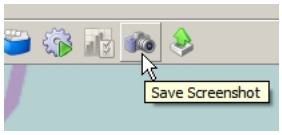

6. Normal dist min. When extracting data from AIS, a new parameter has been added 'Normal dist min.' This means that there has to be more this number of samples before Normal distributions are used for the fit, if there are fewer then only a uniform distribution is used.



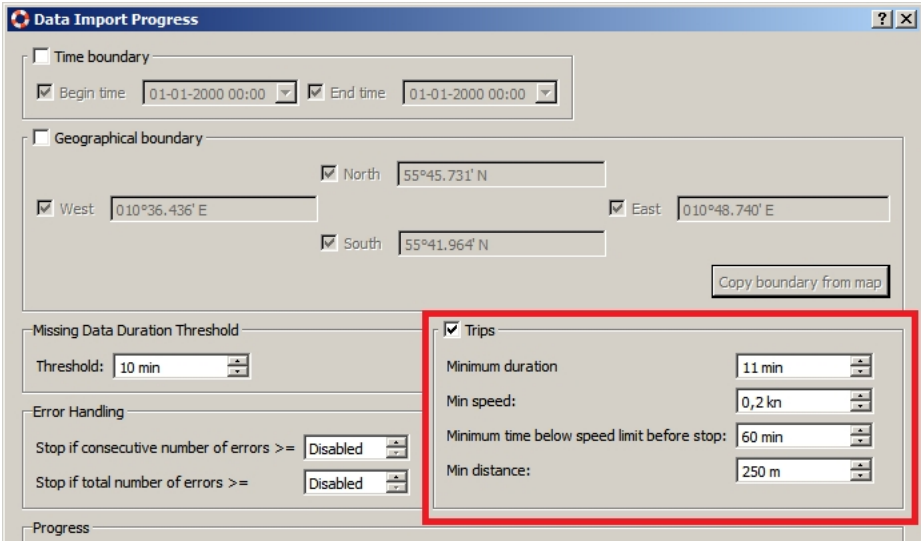
7. When comparing results, percentages are now always relative to incidents per year.
8. Load shape files. It is now possible to import polygons from shapefiles.



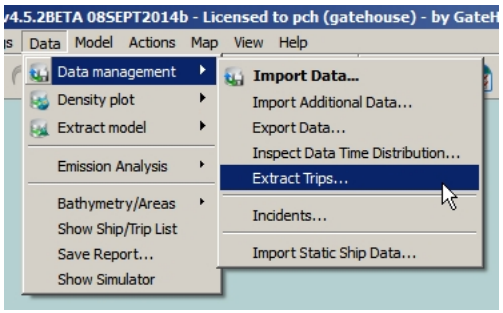

9. Built in polygon database. IWRAP now has a built in basic shape database for land and islands. The detail level is very basic, but can be used to get started on a new model.
10. File name saved as UTF8
11. Show help PDF. The PDF help file can now be accessed from the help menu.
12. Fixed timezone problem, with e.g. Canada.
13. Save screenshot. Its now possible to save the model and result views as PNG files.



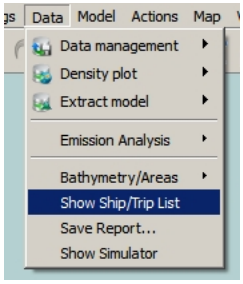

14. Save report. You can save a text file containing the traffic distribution of each leg in the mode, access this feature from
15. 'Data/Save Report...' .
16. Ship/Trip list. IWRAP can now display tracks/trails/trips of individual ships. In order to use this you have to extract trips first, you can either do this when you do the normal import:



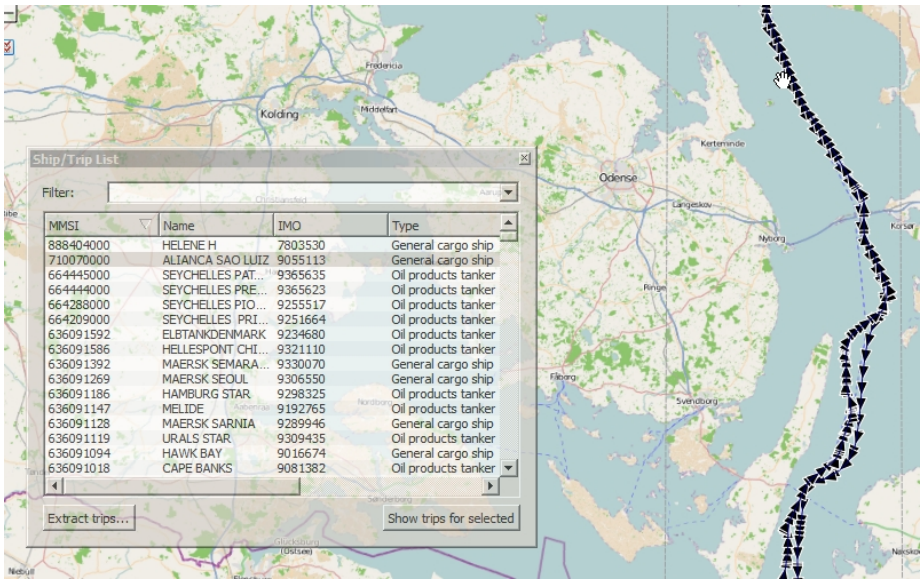

or you can extract it from an existing data set:



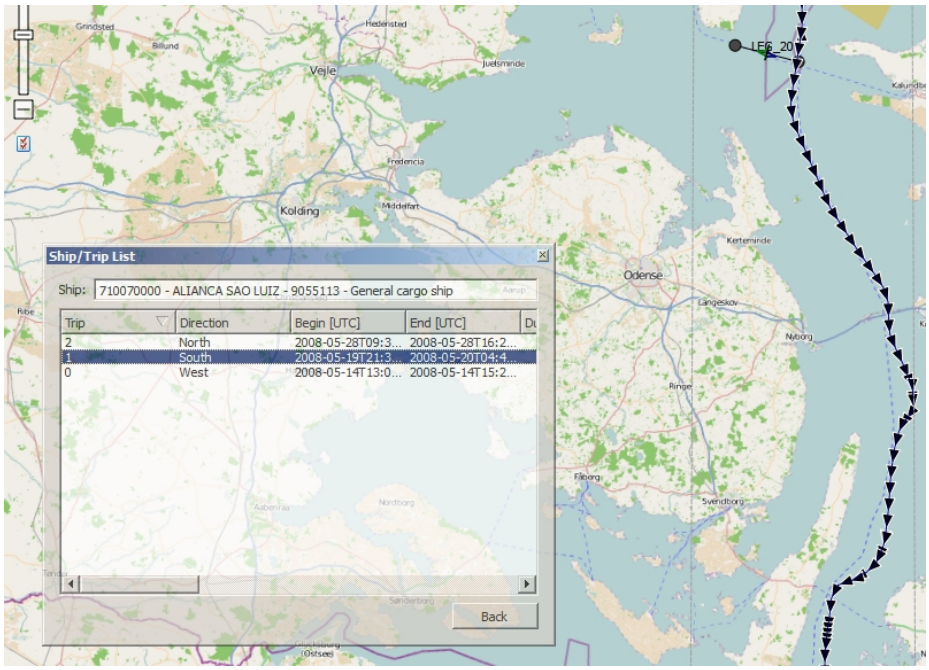

The result can be accessed from:




This will display a list with all the ships. When you double click one of the lines all the trail data for this ship will be shown on the map.




If you press the 'Show trips for selected', a list with the trips for this ship will be shown, you can again double click one of the lines to see the particular trip on the map.



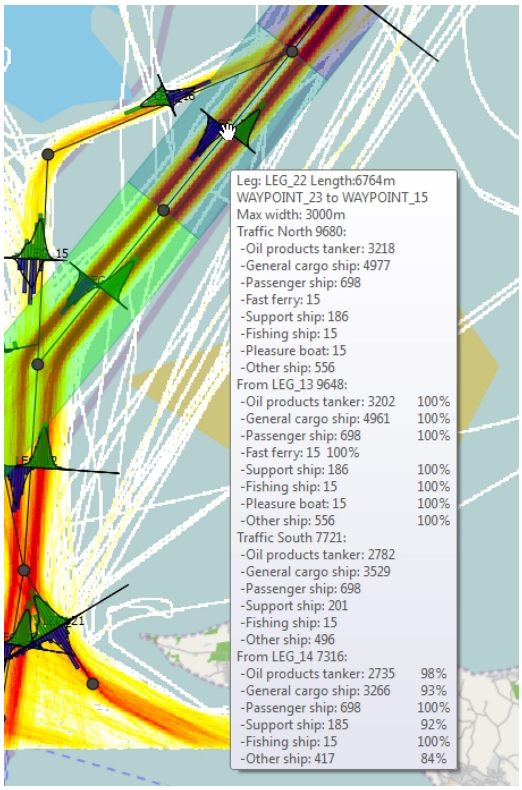

17. Access this, i.e. the release notes, from the help menu.

### *Version 4.5.1*

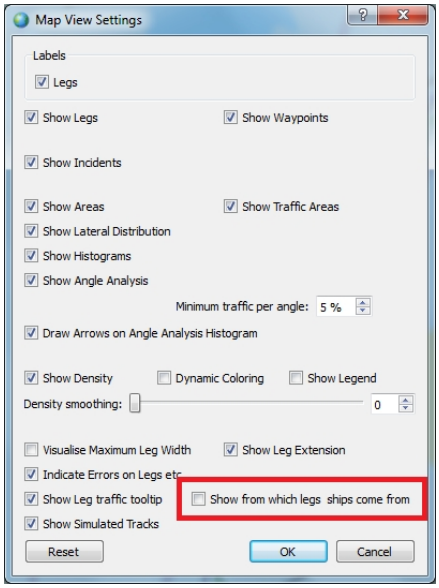
1. Fixed problem when changing to Leg to leg traffic absolute numbers.

### *Version 4.5.0*

1. Fixed problem with OSM maps.
2. Leg to leg traffic is now extracted as absolute numbers when extracting data from AIS. When creating a model manually absolute number can also be used.
3. In the Leg to leg editor, used cells now have a green background, to make it easier to distinguish them from not-used cells.
4. In the Leg to leg editor, now has a 'Hide unused columns' button.
5. Added possibility to inspect traffic flow, e.g. at a leg or waypoint you can now inspect where traffic is coming from via the tool-tip. This can be useful to insure that the traffic is captured.

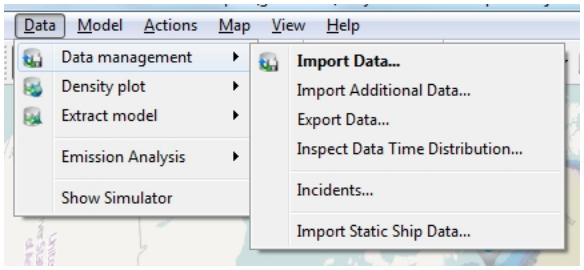



6. The traffic flow information on the legs is hidden by default, because the tooltip can get quite large. It can be enabled from the 'Map View Settings dialog':



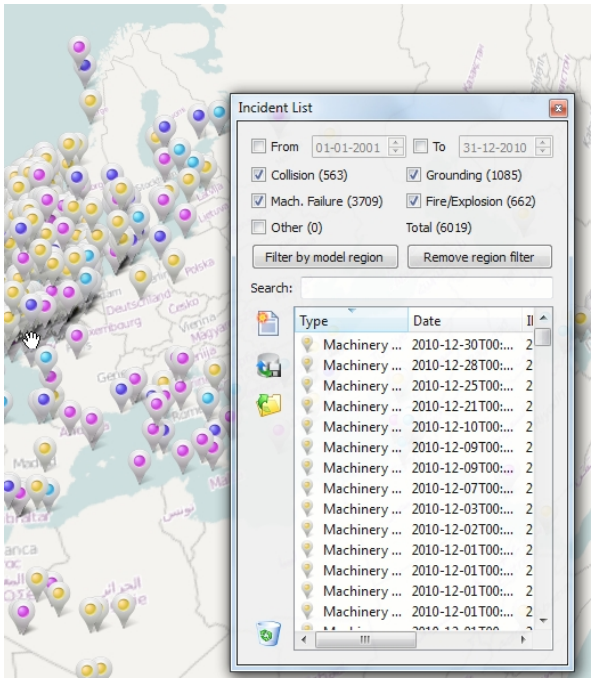

### *Version 4.4.0*

1. Simplified dialogs, complex dialogs now have a 'Show advanced options' button.
2. Rearranged data menu.

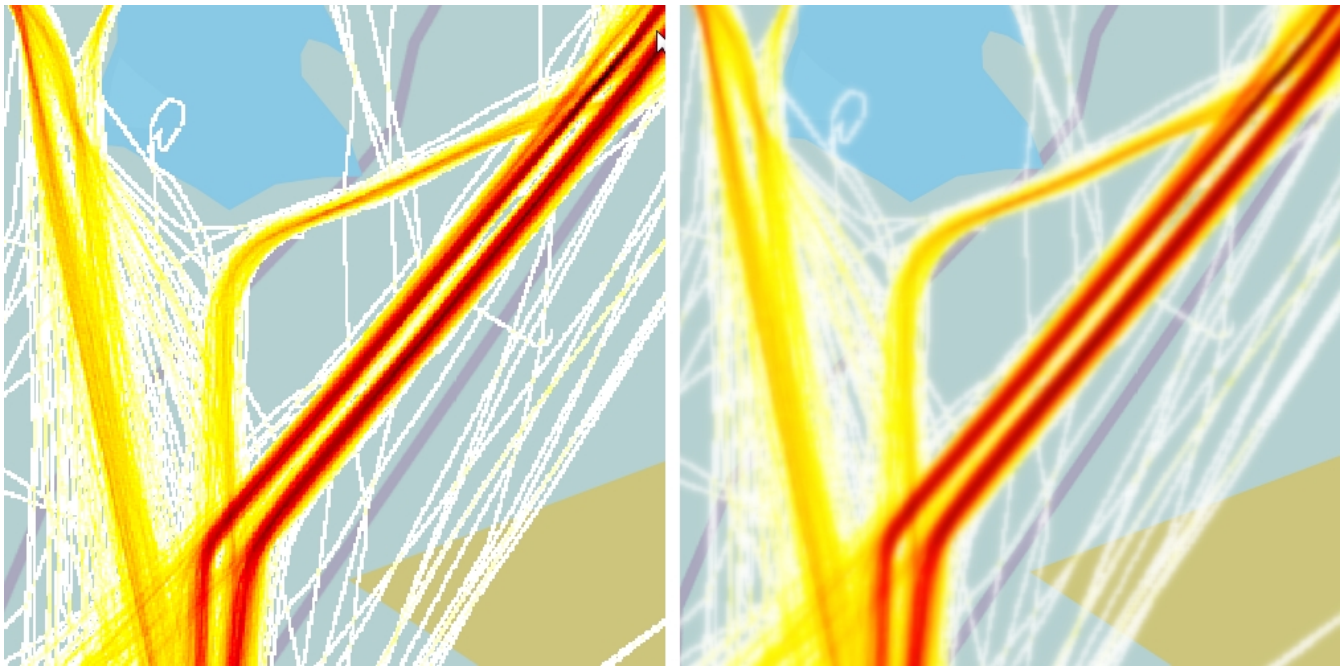


3. Added toolbar menu for data management, traffic density and extract model.

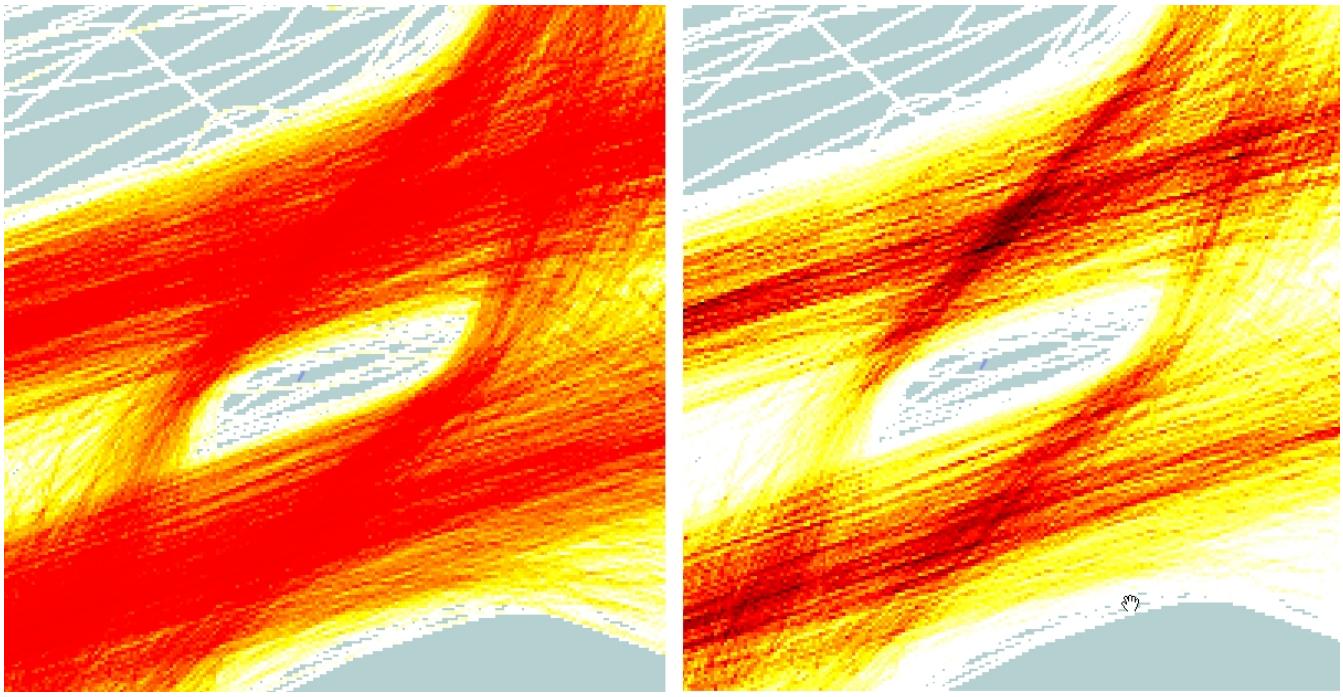
4. When importing data, IWRAP now stores the header signature along with the format. This means that IWRAP will
5. automatically recognize the format the next time you want to load a file with the same header signature.
6. It is now possible to copy the designed file format to/from clipboard, e.g. when importing AIS data.
7. If you need help while importing data, a "Data snippet to clipboard" has been added. This will copy 10 lines from the
8. chosen file, this can then be send to iwrap@gatehouse.dk if you need assistance.
9. Support for importing and displaying incidents, see 'Data/Data management/Incidents...'



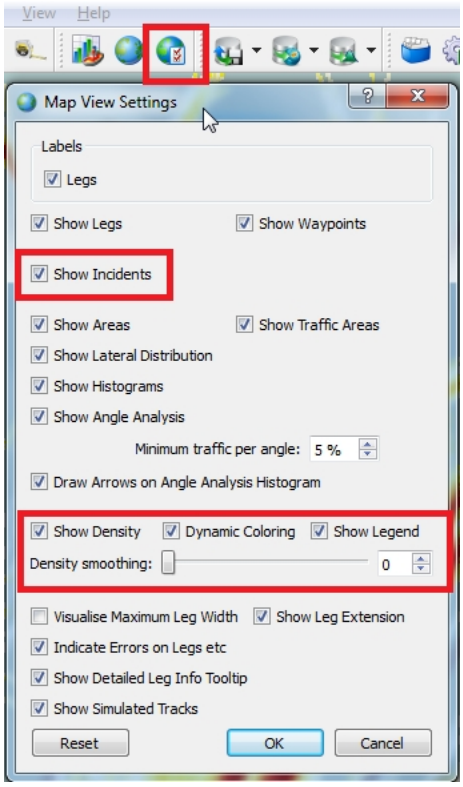

10. Traffic Density smoothing (blurring). (Disabled by default see Map view settings)



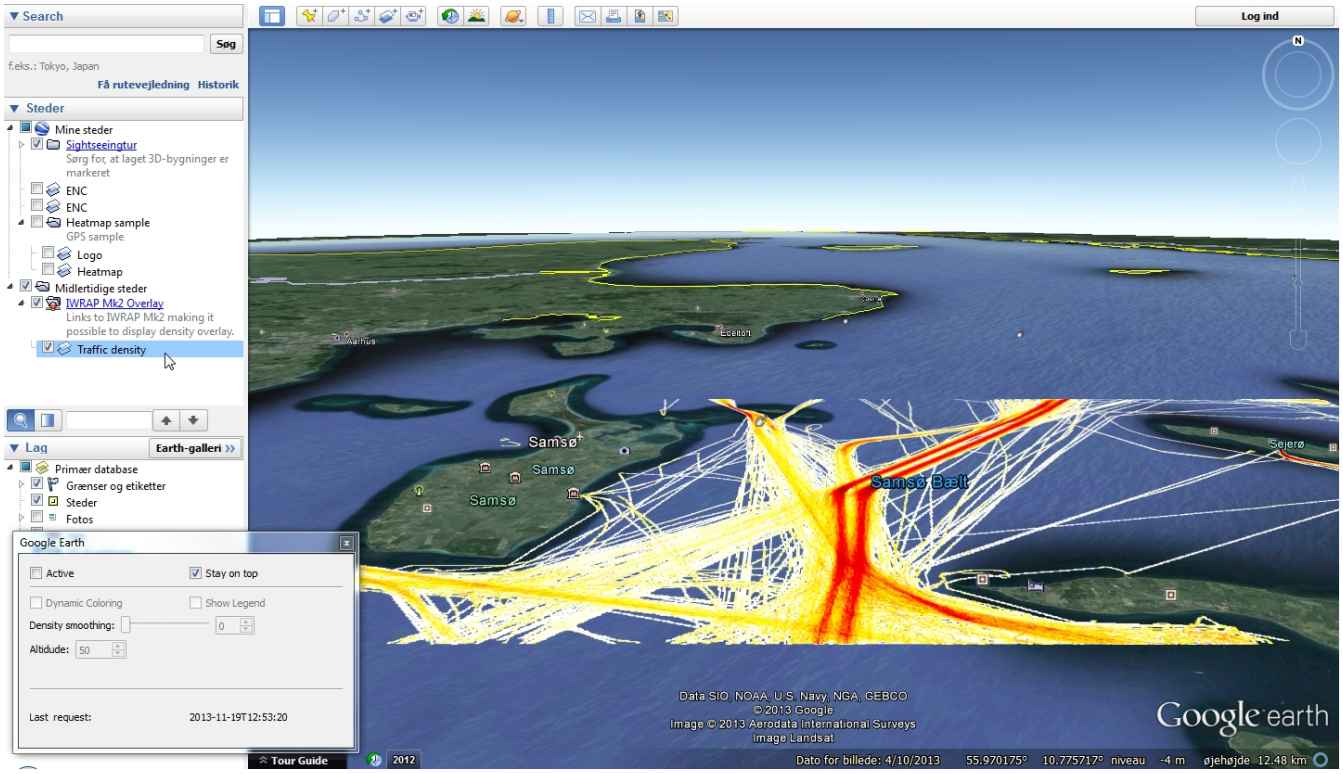
11. Traffic Density legend. (Disabled by default see Map view settings)
12. Traffic Density dynamic coloring. (Disabled by default see Map view settings)



13. New Map view settings.




14. IWRAP now has a new AIS-TEXT ship type format parser, which tries to guess the ship type from a string, e.g. if the string contains the word 'cargo' it is interpreted as a cargo ship type.
15. Fixed bug when using undo while drawing a leg.
16. Fixed data import problem for CSV files with quotes.
17. IWRAP now supports a variety of different position formats, see Position Format.
18. Possibility to show Traffic Density plots on Google Earth.

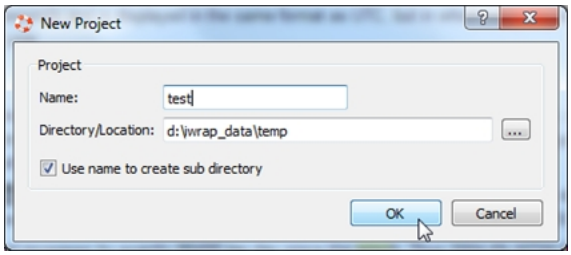



***Version 4.2.0***

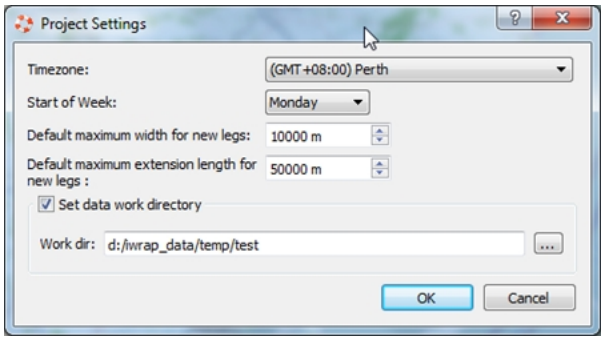
1. Possibility to define drifting parameters per leg.
2. Leg distance and angle shown when creating or editing.
3. Detailed leg pop-up is only shown when hovering above the center of the leg.

***Version 4.1.0***

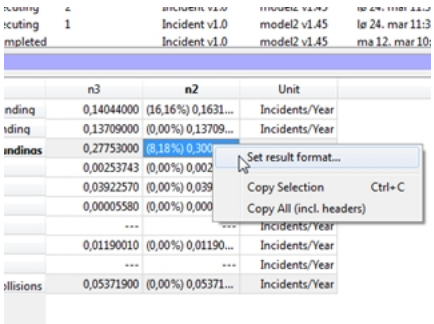
1. A new "Use name to create sub directory" option has been added to the "New Project" dialog. If this option is used in the example below the project data will be created and stored under "d:\iwrap_data\temp\test". This option makes it easier to create and manage several projects.



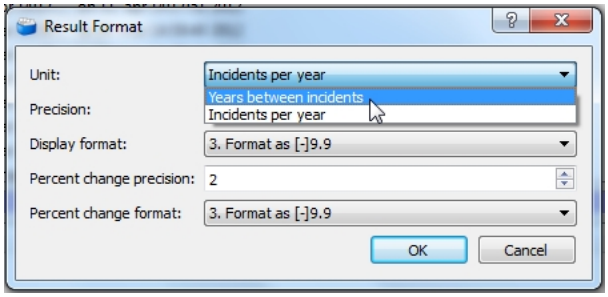

2. The new directory is also used as the default location for working with AIS data, if the "Set data work directory" is used in the project settings, the directory will be stored in the model and used as reference point when working with AIS data. This will create the following structure at the selected work dir.
   \imported_ship_data : Used to store the imported IWRAP data from e.g. AIS.
   \model_extraction_temp : Used to store temporary data when generating models from imported data ship data.
   \density : Used to store generated density plot data.
   \emission : Used to store generated emission data.



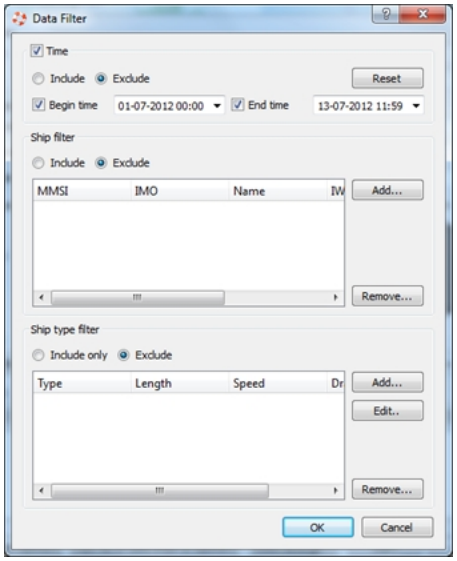

3. When comparing results, the change in percent relative to the first selected job is shown:



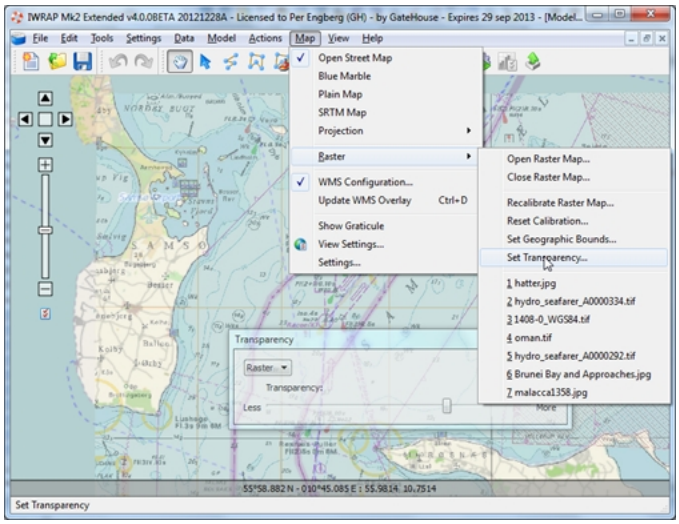

When you right-click on the results, it is possible to select between "Years between incidents" and "Incidents per year", and select the precision of the numbers:




4. It is now possible to add additional data to an already existing dataset, i.e. the existing dataset will be merged with the new data.
5. You can now use Unix/Posix time stamps when importing data, i.e. seconds since 00:00:00 UTC 1. January 1970. The
6. 64bit version includes milliseconds.
7. When creating a density plot or using the new emissions calculation feature it is now possible to a time filter as well as the regular ship and ship type filters. It is possible to exclude or include a certain period.



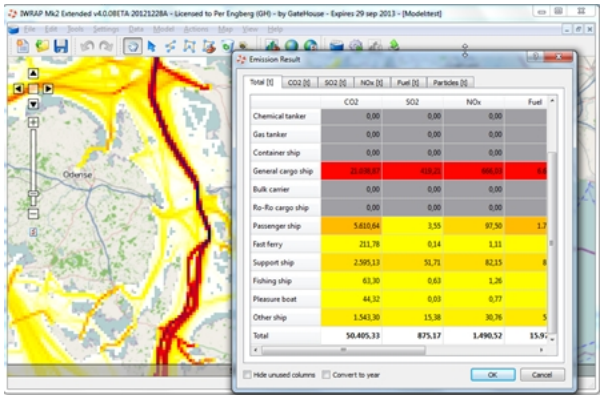

8. When using Raster maps the maps are now projected on top of the background map instead of being shown in a separate window. It is possible to control the transparency of the Raster map.




9. It is now possible to use regular WMS services that do not support tiling.
10. GeoTIFF raster maps can now be imported without having to specify boundaries.

11. A new Emission Analysis has been added to IWRAP. An emission density plot is created to show where the emissions occur. A result view shows how many ton CO2, SO2, NOx are emitted and how many ton fuel is consumed, by ship type and ship length category.

    Note!, this is first version of the algorithm, the results have been checked, and seem to be reasonable. Later a more advanced version of the algorithm will be released.



***Version 4.0.0***

1. Web Map Service (WMS) support has been added
2. New traffic area algorithm, it is now possible to define areas/regions with different traffic compositions.
3. A time of day filter option has been added to the density and data extraction algorithms. It is possible to define the filter manually or to use the sun position.
4. A passage line angle analysis has been added to the data extraction algorithm.
5. Drifting groundings analysis has been improved with anchor handling.
6. Set default parameters when creating a new model, can be changed in 'Settings/Project Settings...'.
7. It is possible to define the maximum 'Leg extension' length, and thereby limit Drifting groundings at the Leg ends. The maximum extension length is also used for the new area traffic algorithm.
8. Possibility to handle a NMEA format where a comma is used separate a timestamp and the NMEA string.
9. Milliseconds can now be parsed in timestamps.
10. A new join leg possibility has been added.
11. When a Leg is split or a waypoint is added in the middle of a leg, the old legs Traffic and Lateral distributions are now copied to the new Leg.
12. IWRAP now handles quoted strings correctly in CSV import.
13. Fitting error dialog now shows frequency/traffic per leg per shiptype and total.
14. A copy to clipboard is added to the Fitting error dialog.
15. Indicate Leg traffic frequencies on tooltip/mouseover Legs on the maps.
16. Map view settings has been extended with new options and added to the toolbar and menu.
17. Control import stop on errors, i.e. it is possible to disregard errors or specify a maximum number of errors.
18. Minimum density changed from 25m to 10m.
19. Fixed bug in import data progress bar, wouldn't work properly if file(s) had too many lines, now uses 64 bits, instead of signed 32 bit.
20. Problem regarding enabling/disabling density ship filter fixed.
21. Extract optimization, check for overlapping legs.
22. Copy Leg traffic distribution bug fixed, reduction factor was no correctly copied.
23. When creating a new model, IWRAP tries to detect your geographical location from your Internet connection and center and zoom to that location.

***Version 3.4.0***

1. A Ship filter is added to the density plot, making it possible to specify which ships should be included or removed.
2. A red arrow on a leg is now used to indcate that there is something to be done i.e. adding traffic or adding distributions.
3. A red marker with a question mark is used to indicate if two legs cross without having a waypoint.

***Version 3.3.0***

1. A density export feature is added to the Extended/Commercial version, see 'Data/Density/Export...', new density values will be converted to yearly numbers. Old density plots are not converted, you will need to generate the plot again, but this is only necessary if you want to export them.
2. Fixed problem when drawing polygons, now it is no longer possible to select leg/waypoint when drawing the polygon.
3. If the polygon tool is selected, polygons are always shown transparent.
4. The red color used for warning non-simple polygons is set to transparent.
5. A new toolbutton has been added to the 'Area List', shotcut for 'Settings/Depth Color Settings...' menu.
6. Help file could not always be activated, fixed, tested on Xp and Vista.
7. User profile too large problem, limit on map download size has been added, can be adjusted in the new 'Map/Settings...' menu item. The default is 100MB hard disk space and 30MB memory. It is also possible to clear the cache from this menu item.
8. Fixed problem when trying to store a model where you dont have write access (the Vista problem), you will now get a warning if you dont have write access.
9. 'Current path' was used as default in many places in IWRAP, this has been replaced with the users 'home path'.
10. IWRAP will generate a .dmp file in your home path if it crashes, please send them to me, I can use the information to fix the error.
11. Fixed issues when closing the project, it was not possible to cancel correctly.
12. Added check for model xml file consistency, will e.g. fail if .xml only contains polygons.
13. Added help file in pdf format, you can find it in the directory where you installed IWRAP. It is not perfect, but at least it is printable.
14. Fixed problem when trying to quit while splash bitmaps where shown at startup.
15. It is now possible to import, data where there is no timestamp on the second part of the message 5, e.g..

    1-4-2008 14:06:38 < tab > !AIVDM,1,1,,A,33u=Qm?qh20nEWbQ0IB3K87l0000,0*19
    1-4-2008 14:06:58 < tab > !AIVDM,2,1,2,A,53u?j?
    P1joL=<@HP000eDhhDp00000000000000l1HA4440HtP00000,0*6A
    !AIVDM,2,2,2,A,000000000000000,2*26
    1-4-2008 14:07:01 < tab > !AIVDM,1,1,,B,14QsDc04Qn19nJ`P1?;9F7Il0800,0*52

16. Density quantile calculation speed optimization
17. Marble stars plugin has been added ;-), zoom out on the globe to see it in action

***Version 3.2.0***

1. Improved visualisation of results on map, results are normalized according to length of Legs and Polygon segments.
2. Added check for non-unique guids in polygons in the .xml, if they are not unique IWRAP will try to fix them.
3. Added features for adding a Waypoint in the middle of a Leg, splitting and joining a Leg
4. Changed the default depth color settings, i.e. the deeper the darker. If you are upgrading

and earlier version of IWRAP you can go to 'Settings/Depth Color Settings...' menu item and use the Reset button to get the new default colors.
5. It is now possible to specify the depth values with one decimal precision.
6. The decimal precision has been increased in the storage of floating point numbers.
7. Fixed bug in kml import, imported polygons where not simple because start and end points where the same.

***Version 3.1.0***

1. First time you run a new version, the release notes will be shown
2. Fixed bug when loading mixed distribution from xml, this error may affect models that use distributions other than normal and uniform
3. Proxy settings now handles port number with more than 2 digits
4. Added automatic check for and download of IWRAP Mk2 updates. A check is performed automatically when starting the application and can be invoked manually from the file menu.
5. Major change to the handling of bathymetry i.e. areas/polygons.
6. In order for IWRAP to work correctly it is important that all area polygons are Simple, a check for 'Simple' polygons is added, polygons are colored red if they are not Simple, the points that cause the problem are also indicated with red.
7. A polygon has to be selected from a list (or on the map) before it can be edited.
8. Google Earth like editing of points in the polygon, i.e. no more dragging points to add a new one, just select a point and start clicking to add new points.
9. Possibility to delete complete polygon.
10. Points with identical coordinates are removed.
11. Empty polygons are removed when storing the model.

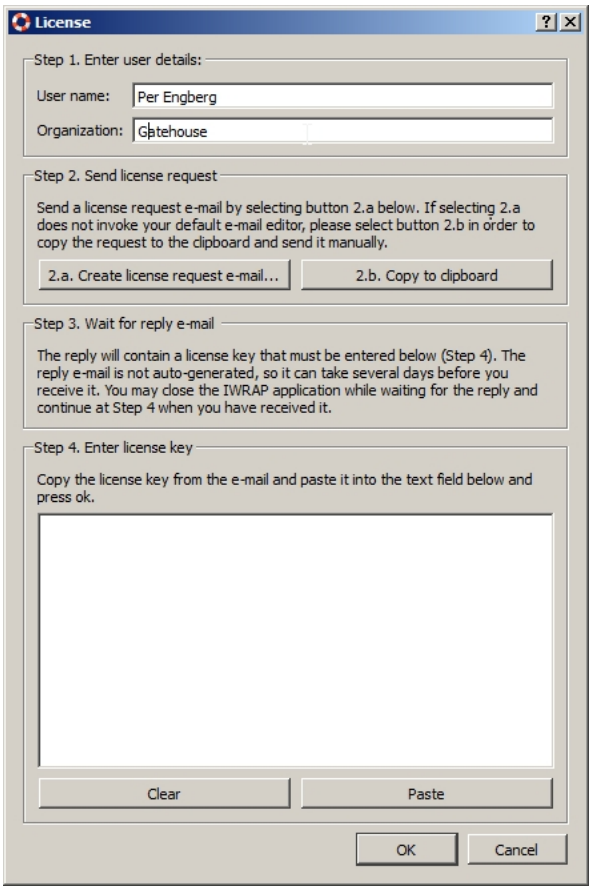
***Version 3.0.0***

1. First release of extended functionality.
2. Marble based map engine.

# Getting Started

## Obtaining a License

In order to obtain a license key you must install IWRAP and run the application. You will the see the following dialog:




Please enter your name and the name of your organization.

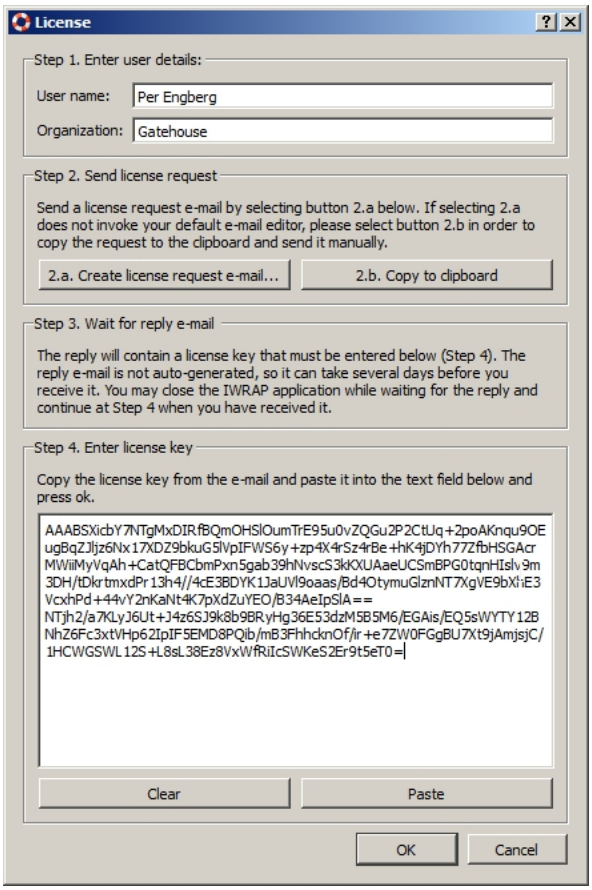
Now, to obtain the license key you should try and press "2.a. Create license request e-mail", this will try to launch your email client. If this works just send the email. If it does not work you must use option "2.b. Copy to clipboard", i.e. you must manually send an email to "iwrap@gatehouse.dk" and paste in the contents of the clipboard.

The contents of the clipboard will be a string similar to this (but not identical)

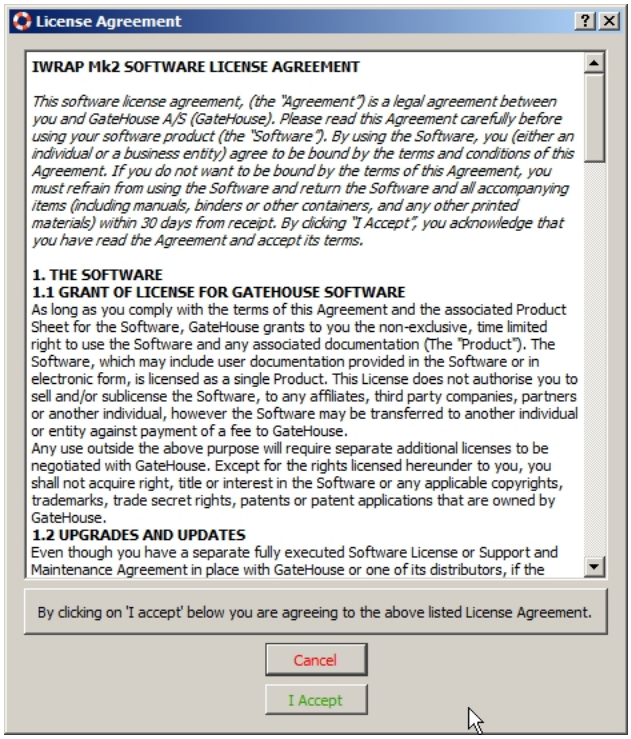
AAAA7nicbc7LCsIwEAXQXxF02VuSpjFtVk7bpG580Kq4VQh1pVAfm9J/NxE3gjDcxeEOM8uq0UPL6bhuqSLOJBe7MVrMpisq9cAYrEVSgAzy1OcYfY0ThIFSyKU3k6HgsCUUg5QgFYx+Tfyx9M9u6M0zWIUkAxOwHDIYI/jTiQrph9PnzX3b6K3rJ+banV3fBdo0ta5PD3e5Pe8uwME0+iVjEbM3a1s74A==

After you have send the email you must wait for GateHouse to respond with a license key, this is a manual process so it may take hours or even days.

When you get the key in the repsonse from GateHouse you must paste the returned key in to step 4, similar to:




If all is well you will be shown the license agreement, after you press "I Accept" you are ready to go...




The key is locked to the computer if you would like to get a new key for another computer just repeat the process.

## Basic Concepts

The following describes the method used to perform the frequency analysis. The frequency analysis is based on a mathematical model.

To estimate the frequency of collisions and groundings the software package IWRAP Mk2 is

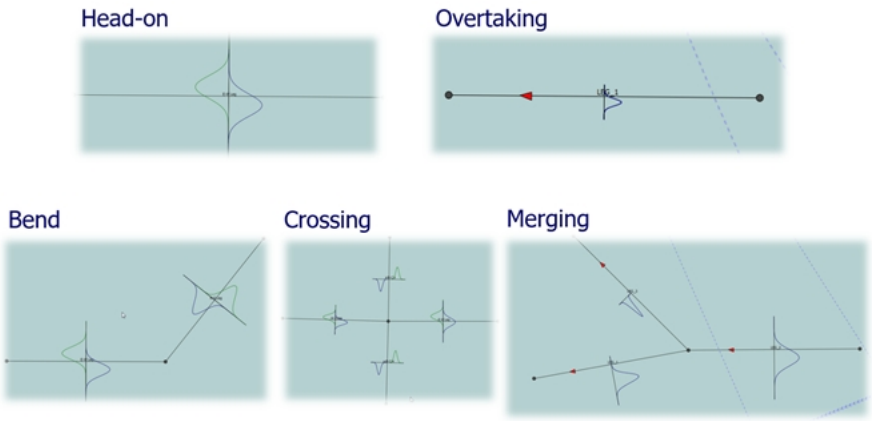
used. IWRAP is an abbreviation for IALA Waterway Risk Assessment Program. The mathematical model used in IWRAP was first introduced in 1974 by Fuji and MacDuff, and has since been modified by Petersen and Friis-Hansen. The method is purely probabilistic i.e. based on statistics. IWRAP Mk2 has been part of the IALA risk toolbox, mentioned by IMO SN Circular 296, since 2008.

The area of interest is modeled using a number of sailing routes called legs. A leg goes from one waypoint to another. Several legs may be connected to the same waypoint, e.g. at a crossing or at a merging location. To each leg a statistical distribution is assigned describing how far from the leg center the ships sail. The number and type of ships sailing in each direction of the leg is also found. The general idea is to calculate how many collisions and groundings will occur if all the ships sail straight ahead without making any evasive manoeuvres. This gives the number of geometrical collisions and groundings. Ships do of course not generally sail with blindfold, but sometimes ships actually behave as they do. About 1 or 2 in 10,000 encounters are not avoided the way they should. This is called the causation factor. The causation factor models the probability that the officer on watch does not react in time given he is on collision course with another vessel, or alternatively on grounding course. The value of the causation factor is of course essential for the model. IALA has together with a group experts defined a set of globally applicable causation factor values. The values have been determined by a number of analysis where the number of incidents has been known, this way it is possible determine the causation factor.

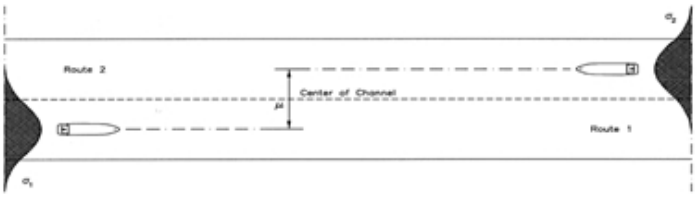
The total number of collisions is the number of geometrical candidates multiplied by the causation factor. So, one part of IWRAP is geometry and statistics and the other part is the human factor. The method has been extensively tested and found to estimate the number of collisions and groundings close to the observed numbers all around the world. IWRAP has a specific causation factor value for each type of incident. Although it is possible to modify the causation factors in IWRAP, the default IALA defined values are used in this study. IWRAP can calculate the following types of incidents:

- Head-on, i.e. ships sailing straight or almost straight at each other.
- Overtaking collision
- Crossing collision
- Merging collision, i.e. ships from several legs merge at a waypoint
- Bend collision, i.e. a ship makes a turn at a waypoint on to a new leg
- Area traffic collision (ships not on routes, e.g. fishing)
- Powered grounding
- Drifting grounding
- Powered allisions
- Drifting allisions

Some of the different incident types are shown below, as they are modeled in IWRAP:

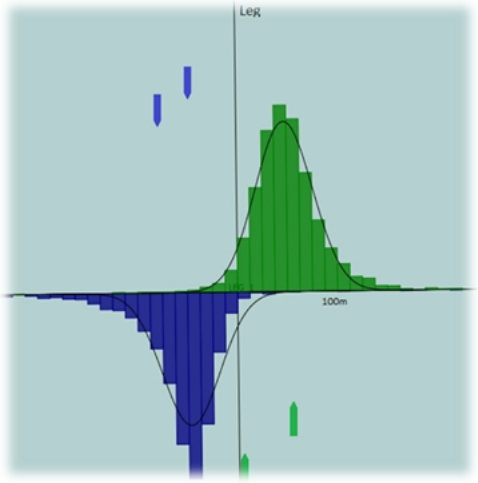



The following figure shows an example of the calculation of the head-on incident type. A statistical distribution for each direction is found. Given the width and speed of the ships the probability that two ships will be on a collision course can be calculated. This is then multiplied by the probability that the ships do not take evasive actions (The causation factor).




The statistical function can be found using historical AIS data. This is done by making a cross section of the leg and creating a histogram for each direction. IWRAP has the capability to create a mathematical representation of these histograms using a number of probability functions. Figure 3 shows an example with a north/south going leg where the green north going traffic and the blue south going traffic is fitted/approximated using a Normal distribution. It is not uncommon that, given that there is enough traffic, the traffic can be very well described using just one Normal distribution. But, there is also many cases where just one Normal function is insufficient. The mathematical model in IWRAP can handle these cases by combining more Normal distributions or by combining Normal distributions with Uniform distributions. The distributions are also referred to lateral distributions.

With regards to Crossing-, merging- and collisions, knowing the angle between the two legs, number of ships and the size of the ships it can be calculated how many ships will be on a collision course. This is then multiplied by the probability that the ships do not take evasive action (The causation factor).

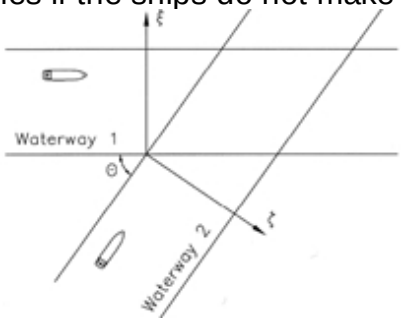



There are two types of powered groundings that are covered by the IWRAP model:

- **Powered grounding I:** The ship forgets to turn. In the mathematical model in IWRAP, the default setting is that every 3 minutes the navigator is given an opportunity to notice the

forgotten turn.

- **Powered grounding II:** With a certain probability, the ships will be outside the lane. The causation factor then determines if the ships do not make an evasive action and grounds.




These two types are illustrated on the figure above. With respect to drifting grounding the ship is given a probability for having an engine break-down and a probability distribution for the repair time. Given input for the probable drift directions and drift speed it can be calculated how many ships will ground before the engine is repaired or the anchor can stop the drift.

Allisions are modeled the same way as grounding.

IWRAP MK2 distinguishes by default between the following ship types:

- Crude oil tanker
- Gas tanker
- Container ship
- General cargo ship
- Bulk carrier
- Ro-Ro cargo ship
- Passenger ship
- Fast ferry
- Support ship
- Fishing ship
- Pleasure boat
- Other ship

Each ship type is divided into a number of length categories in 25m intervals, 0-25, 25-50 etc., ending with 400 and above. Not all these types can be derived from AIS, this means an alternative data source is needed to distinguish e.g. between the different tanker types.

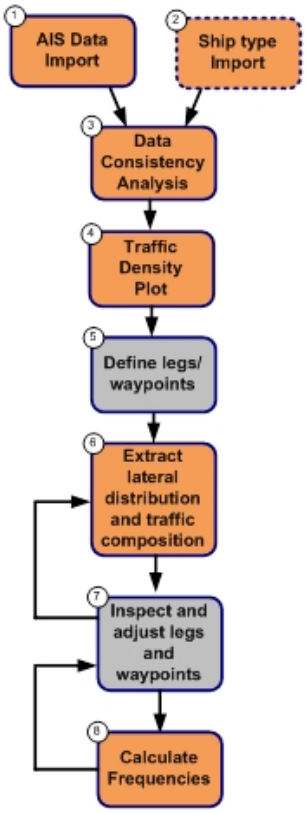
## Basic Work-flow

This section describes the basic work-flow used for creating a model. The work-flow depends on the type of license you have.

If you don't have the extended/commercial version you will not be able to create the model based on AIS data, i.e. you will have to guess where to put waypoints/legs and the amount of traffic and composition of the traffic. Please contact iwrap@gatehouse.dk if you would like to know more about the commercial license.

Using the free/basic version will start by adding some waypoints/legs, see Adding Legs and Waypoints, and then add lateral and traffic distributions, see The Leg Editor and Leg to Leg Traffic. If you e.g. have bathymetry data you can import it or manually draw the bathymetry polygons, see Defining Bathymetry.

If you have a commercial license you should follow the steps shown below.




In step 1 the AIS data is imported into IWRAP along with any extended data about the ship types, e.g. from Lloyds or manually entered, step 2. Next, step 3 in the figure, the data consistency must be checked. This is primarily a question of analyzing if the dataset contains too many gaps. IWRAP can to a certain extend handle gaps in the data but of course a perfect dataset without gaps is preferable. It may also be a good idea to try and do a high speed replay of the data and inspect if there are any obvious data issues.

The fourth step involves creating a traffic density plot for the area of interest. This traffic density plot is then used in step 5 to define the model using e.g. legs and waypoints. Using the location of the legs and waypoints IWRAP can extract traffic patterns from the imported AIS data, see step 6. During this process the histograms and lateral distributions are extracted as well as the traffic composition, i.e. the types of ships, length, average speed, average draught, for each direction of the leg. At the waypoints IWRAP analysis and creates a model for how ships move from leg to leg. It is common to iterate, and adjust the location of the legs and waypoint and do the extraction again, because it is first when an extraction has been performed that it can be determined if all the correct traffic is assigned to each leg and waypoint.

When the analyst has a satisfactory model, the frequencies can be calculated by IWRAP running an IWRAP analysis job. This may then also reveal a number of inconsistencies so again the model may be adjusted and the calculation be run again.

The steps are described in the following sections:

- Step 1: See Importing AIS Data
- Step 2: See Importing Static Ship Type Data
- Step 3: Use e.g. Imported Ships and Trips or Replay
- Step 4: See Generating a Traffic Density Plot
- Step 5: See Adding Legs and Waypoints
- Step 6: See Extract Model Data
- Step 7: See Adding Legs and Waypoints
- Step 8: See Running the Risk Algorithm

You can also start by following the Training Guide, see Training Guide

## Training Guide

The first time you start IWRAP and you create a new project/model the training guide will popup and guide you through the creation of your first model.

The guide covers the following topics:

1. **Define/Create Model Area**
   The model area is a polygon that defines you models boundary, i.e. only data inside of the model area will be used when you e.g. extract data from AIS or import bathymetry.
   See also Specifying the Area of Interest

2. **Get Data**
   The next step is to import or download AIS data, see
   Importing AIS Data or Download from data from Cloud Server for more details. Downloading data is only available on certain systems.

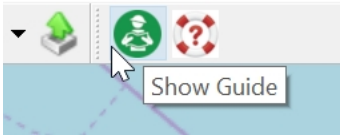
3. **Traffic Density**
   After you have imported some data, you should generate a Traffic Density plot. This plot indicates traffic intensity, which will assist you in identifying where you should place your legs/fairways. See also Generating a Traffic Density Plot

4. **Create Model**
   There are many items that can be modeled but the main element is creating the leg layout and extracting traffic composition and lateral distribution for each leg, see also Extract Model Data

5. **Define Bathymetry**
   In this step you either draw the bathymetry manually, see Defining Bathymetry, or extract it from either ENC, see Extract from ENC or ESRI Shape files, see Extract from ESRI Shape.

6. **Run Model**
   Finally you are ready to try and run/execute your model and inspect the results, e.g. collisions per year etc. See Running the Risk Algorithm

IWRAP will try to show the Guide every time you finish one of the above tasks, if you need to get back to the guide you can always select from the toolbar.




## Minimum System Requirements

The recommended minimum PC configuration for using IWRAP is:

1. Windows 7
2. INTEL I5
3. 8GB RAM
4. 128GB SSD HDD

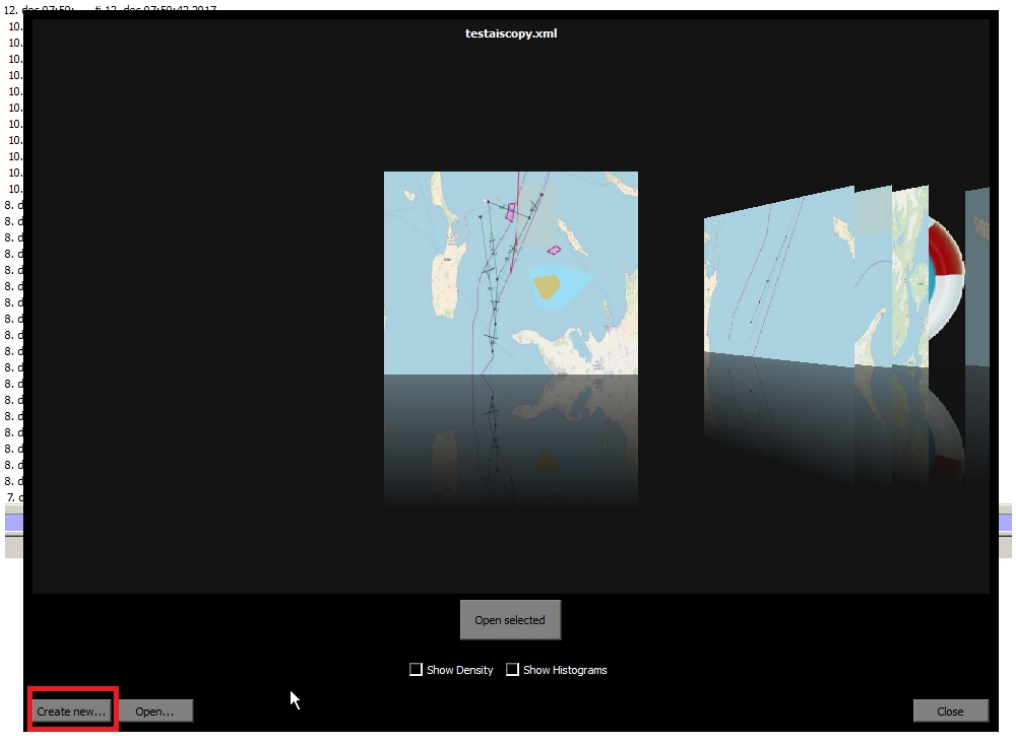
The above numbers of course depends on the size of the dataset you are going to work on.

# Working with Models

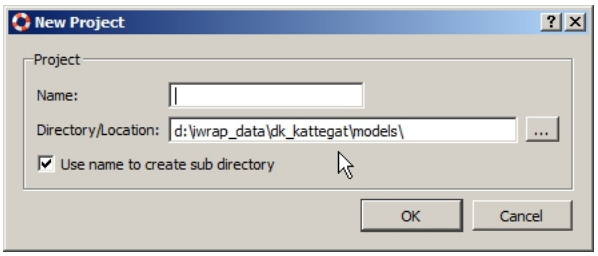
This section describes how models are created and modified:

## Creating a new Project/Model

When you first start IWRAP you will see a view similar to this.

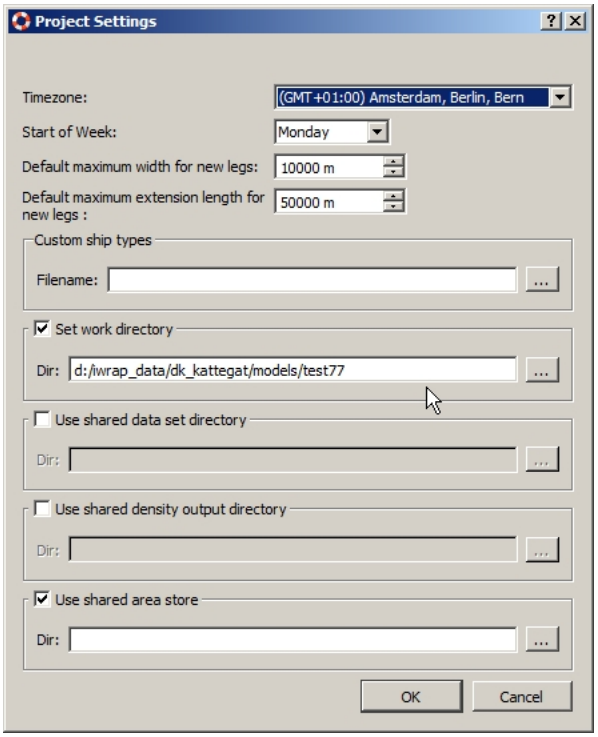



Select "Create new..." in the bottom left corner, you will see the "New Project" dialog:



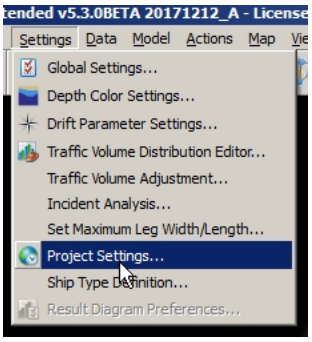

Please enter a name for a project and select a location where you want to store it.Wen you press "OK" IWRAP will automatically create a sub directory at the location you have chosen.

When you select "Ok", you will see the "Project Settings Dialog":

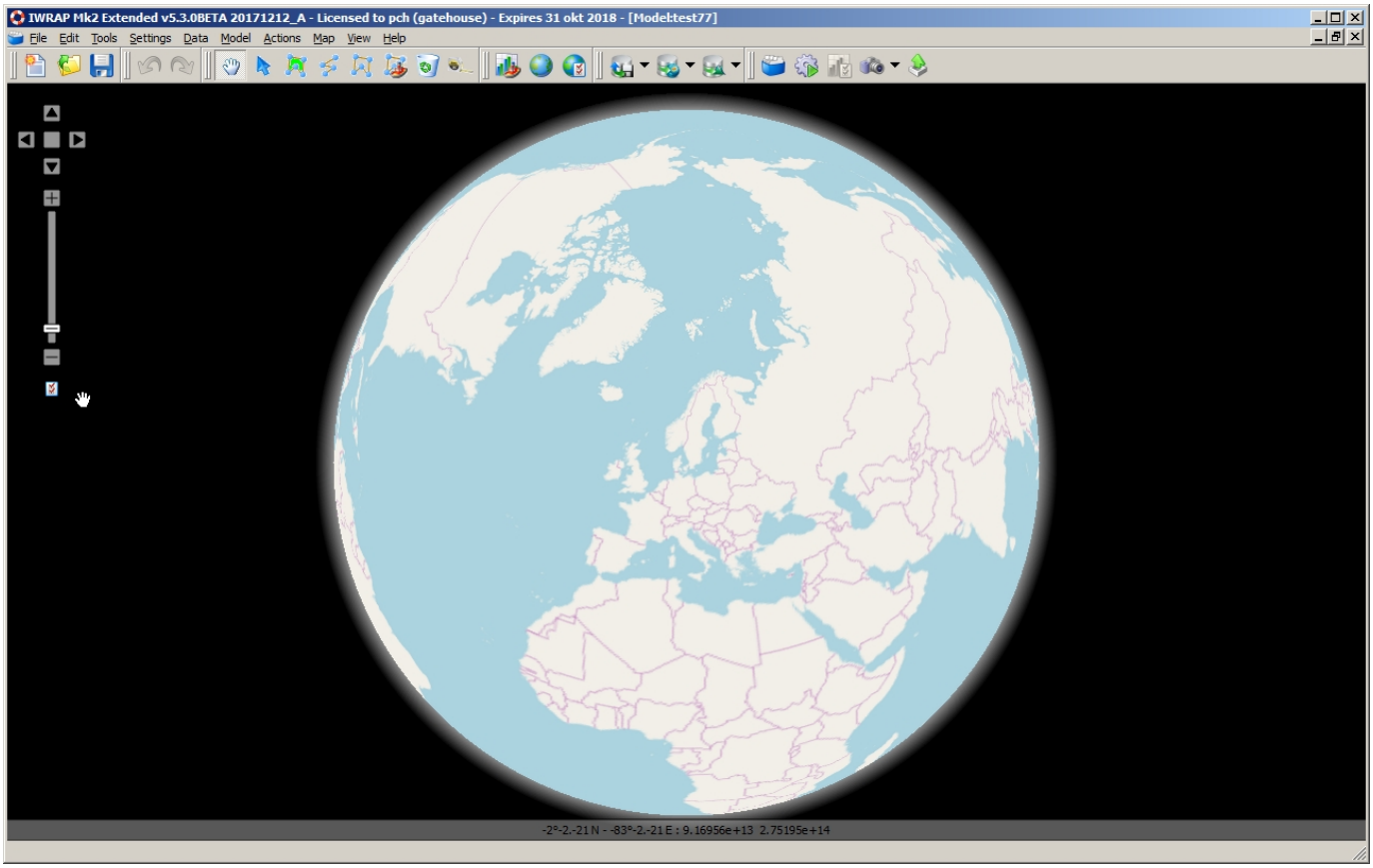



Press "Ok" to finish the creation of your new model.

The Project settings can always be altered later from this menu item:

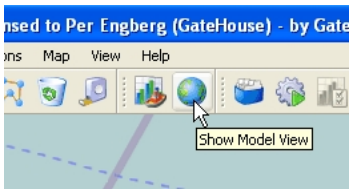



When the new project has been created you will see the "Model view"



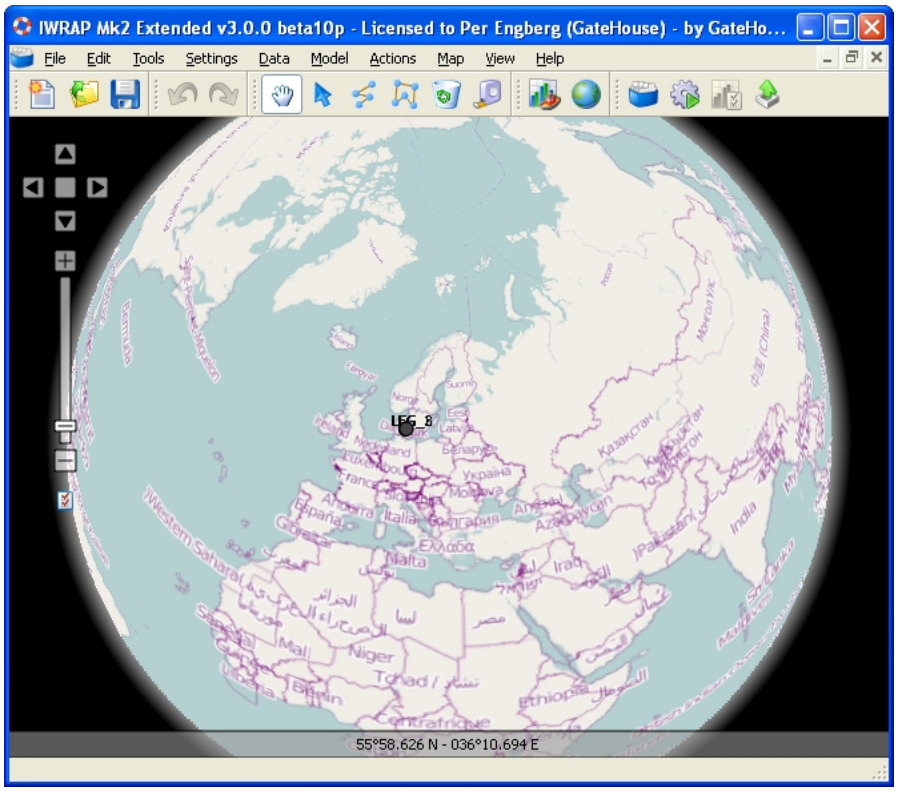

## Using the Map

If a model is loaded the Model View can always be displayed using the toolbar icon:

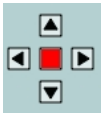



If no map is shown, you may be missing an Internet connection or you may have to configure Proxy settings, go to File/Configure Proxy... in the menu.

If the tool is active it is possible to click the left mouse button and pan/drag the map. The maps can also be moved using left/right/up/down keys. Zooming can be done using the mouse wheel or +/- or Page-up/Page-down keys.



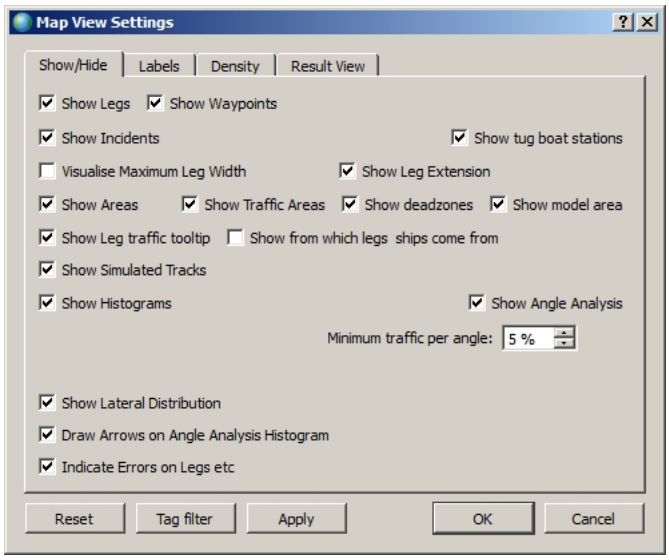

The left hand side of the map contains a Navigator that can also be used to control the map, a useful feature is the 'zoom to fit' button indicated with red below.



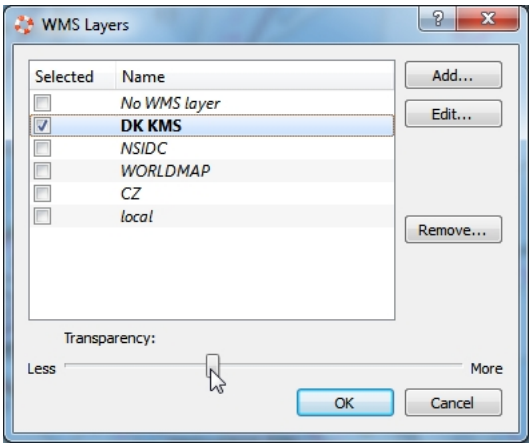
It is possible to adjust the view using the View Setting, click the View Settings button below the Navigator:

Or from the toolbar:

The View Settings dialog is displayed:



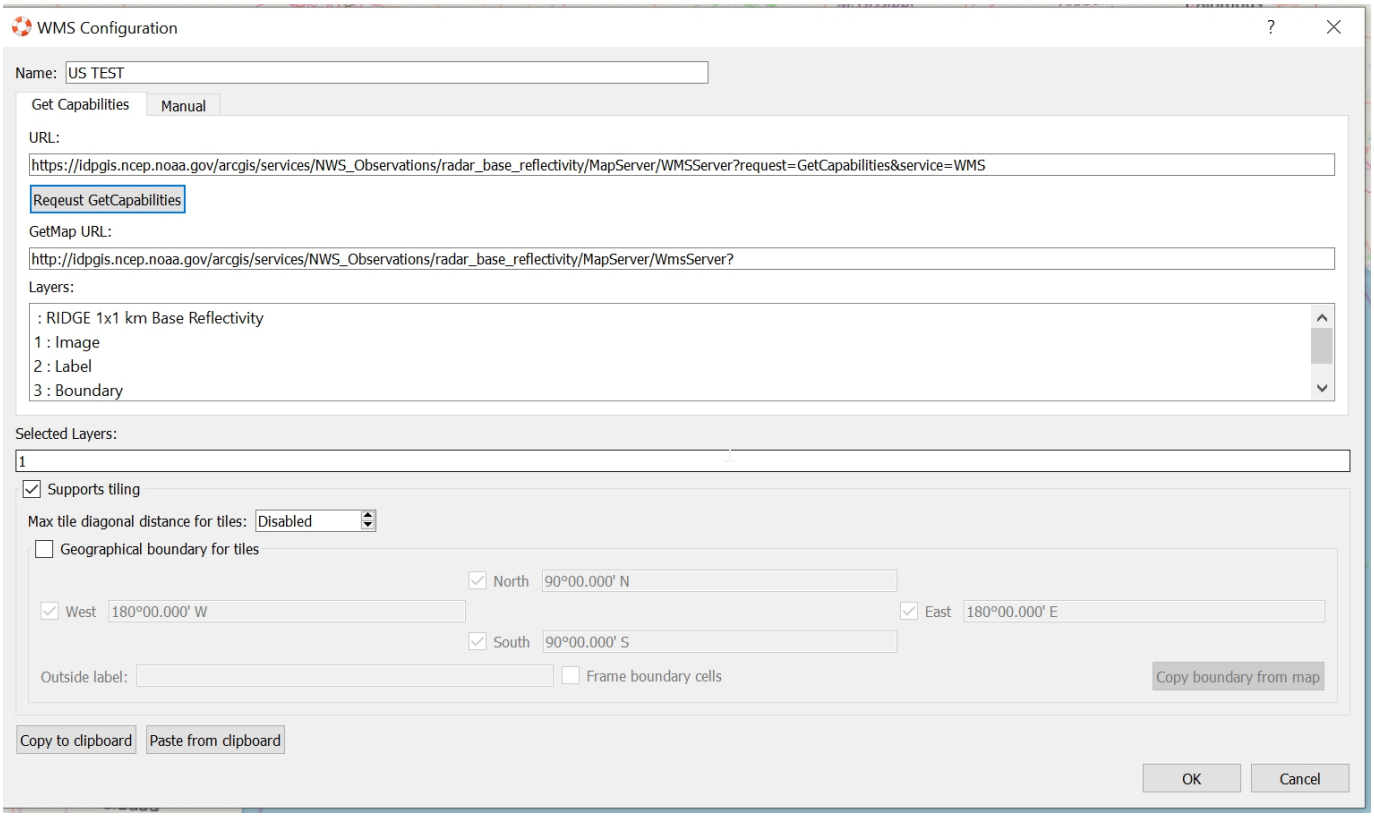

A WMS layer can be added from 'Map/WMS Configuration'.:



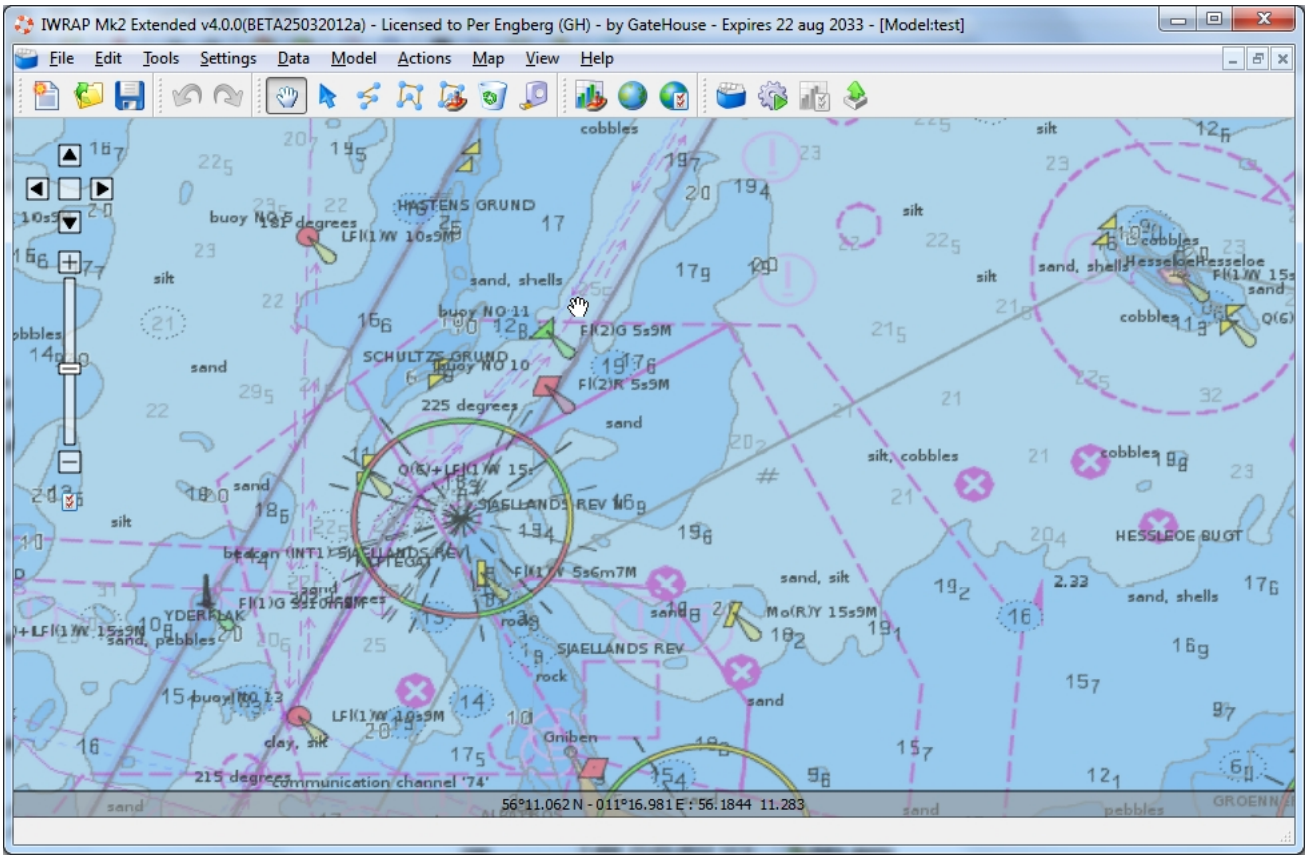

One or more WMS services can be defined, but only one can be active at the time. The WMS layer is drawn on top of the background map e.g. OpenStretMap, the WMS layer can be made transparent so that it is possible to mix and see both maps.

Defining a WMS service can be done by adding the URL to perform the GetCapabilities function. If this succeeds you will be able to select a Layer you can display. You can use "Supports Tiling" to enable that cells will be download and store don disk.

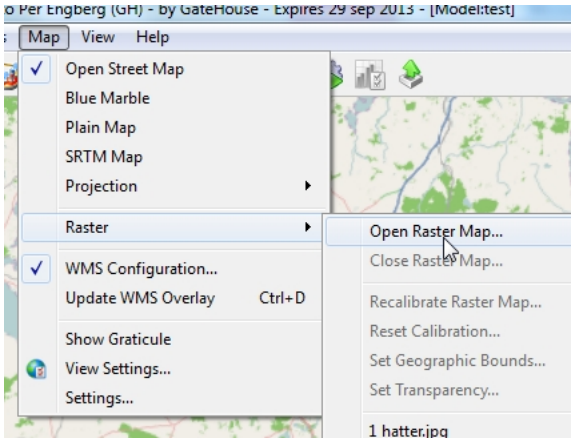
If you have a WMS service you want to use, feel free to contact iwrap@gatehouse.dk for additional support.



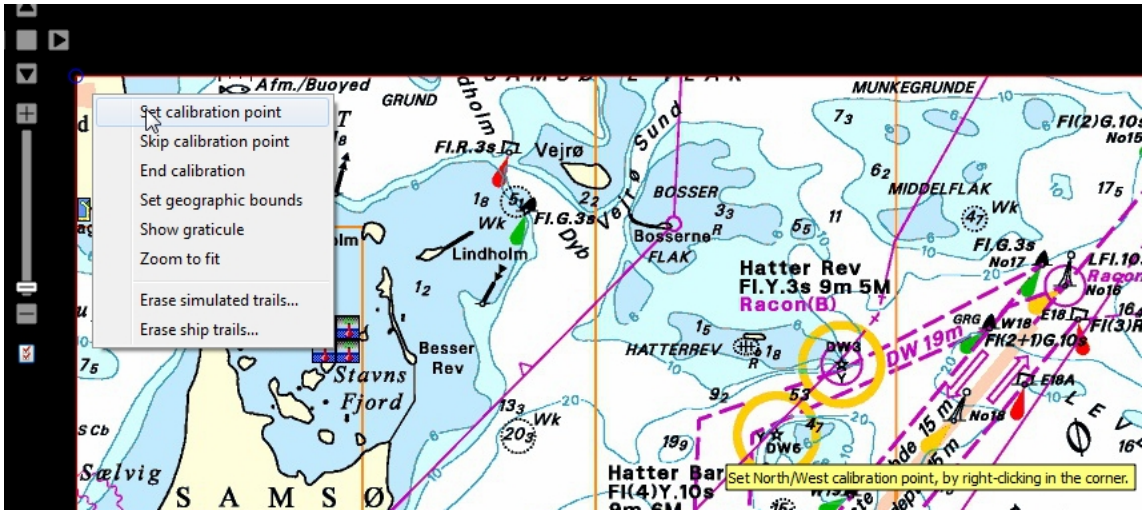

Here is an example of a commercial Danish WMS layer.



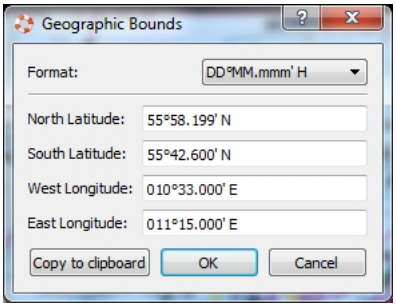

A Raster map can be added from 'Map/Raster/Open Raster Map...'.:



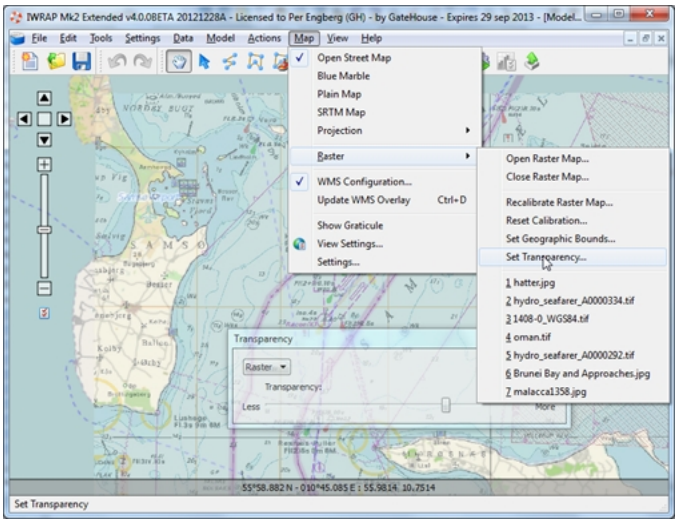

Select the file you want to import. If the file is not a GeoTIFF you will be asked to calibrate the map. Calibration is only necessary if the chart has a boundary, then you have to right click and specify each corner of the map. If the map does not have a boundary you can skip the calibration.



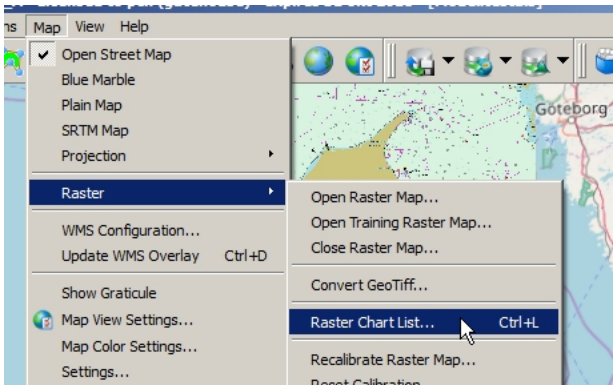

If the file is not a GeoTIFF you can enter the geographic bounds of the chart:



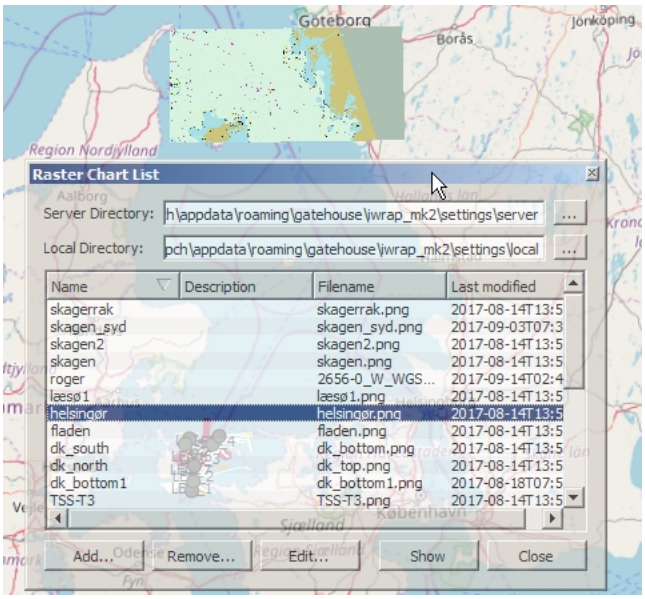

The raster map is now displayed on top of the background map. It is possible to control the transparency of the Raster map.




It is possible to collect all the raster charts in a special Raster Chart List:




The list makes it easy to access maps, furthermore you can specify a directory on a server and sync with the contents, so several users can easily share the same maps.

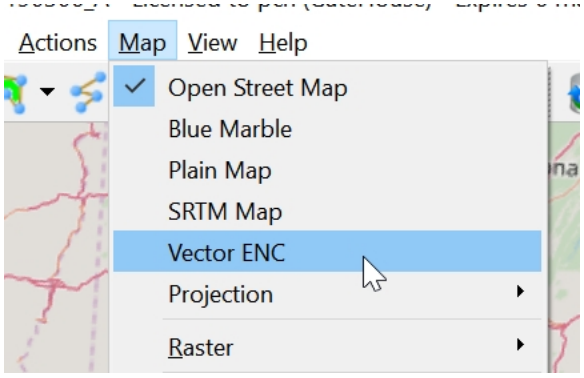



In order to add a mpa to the list just open the raster map and open the list and then press the "Add" button.

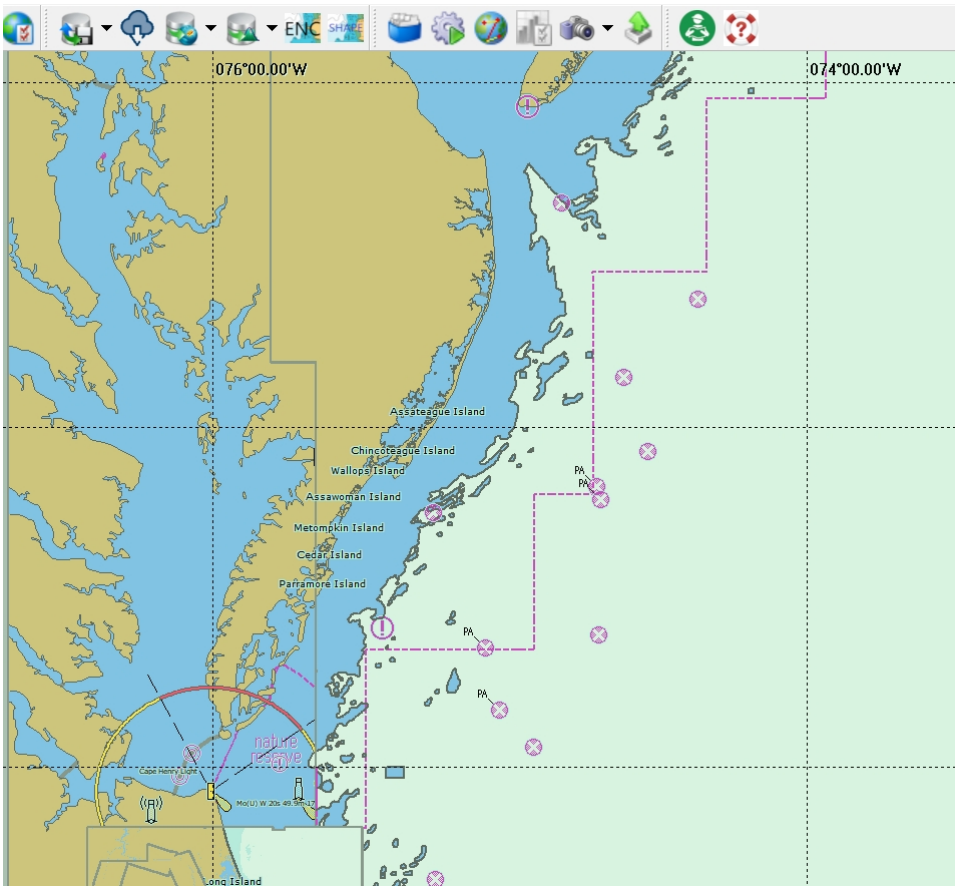
## Using ENC

The use of Electronic Natutical Charts (ENC) is only available on IWRAP installations that supports this.

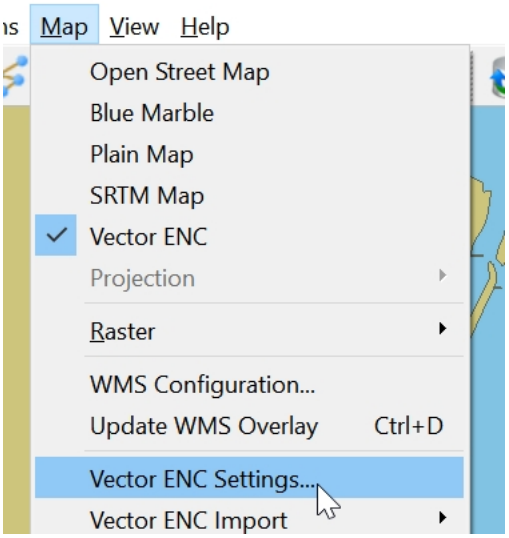
In order to display the ENC select:



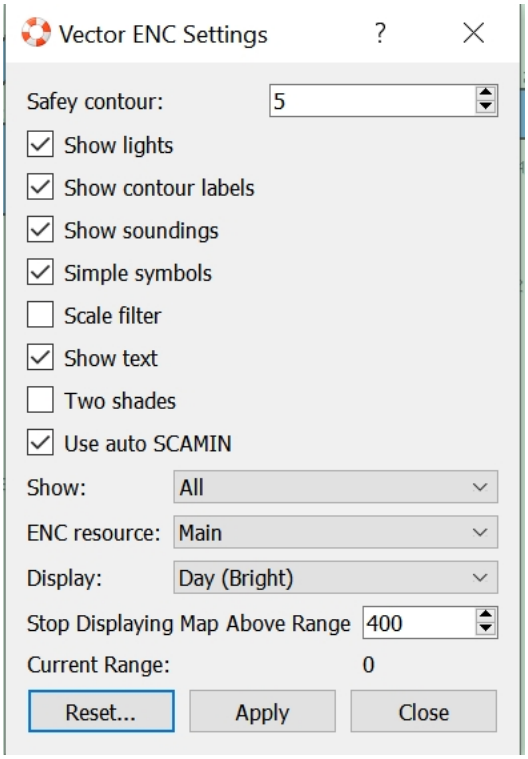

This will display e.g.




The Vector ENC display can be controlled using, "Map/Vector ENC Settings":




These are the possible Vector ENC settings:



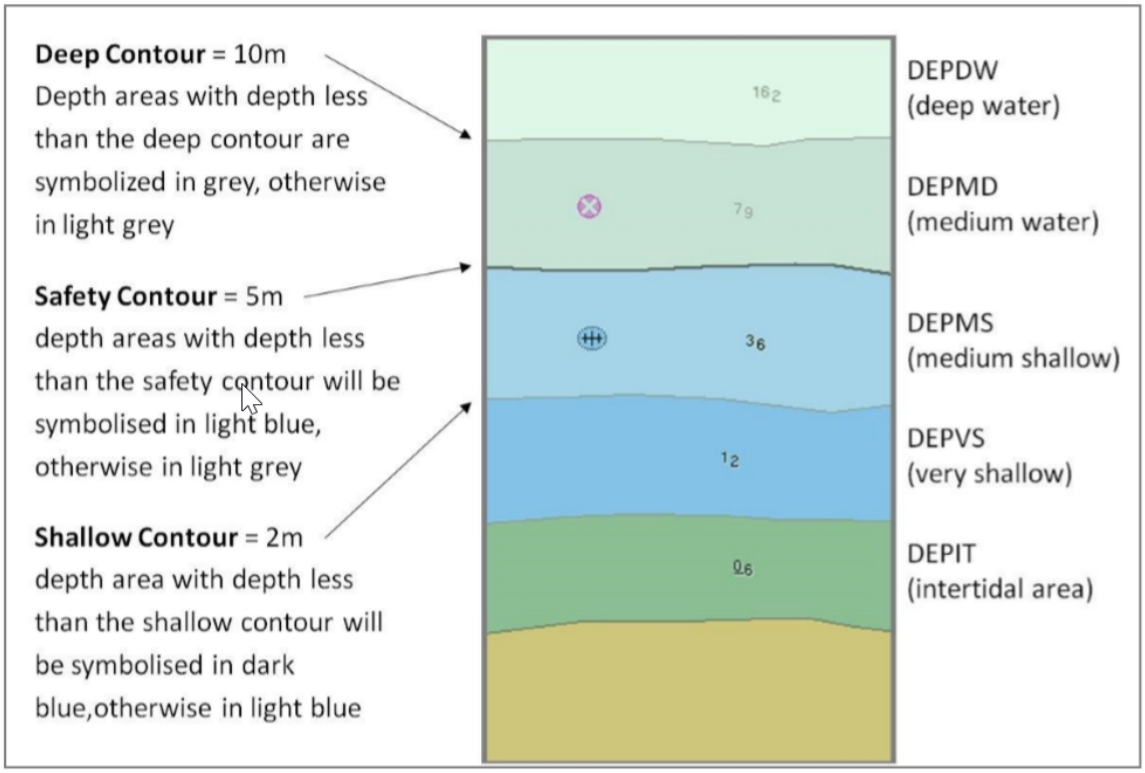

Depth contours are lines of equal water depth. The setting of the emphasized depth contours influences the presentation of depth areas. There are three emphasized different depth contours:

**Safety Contour**
This contour defines which water areas have sufficient depth for safe navigation. It is symbolized as a thick solid line. The safety contour also defines the boundary of shallow and deep-water areas.

Deep contour is set to 2 x Safety contour and shallow contour is set to ½ x Safety Contour.

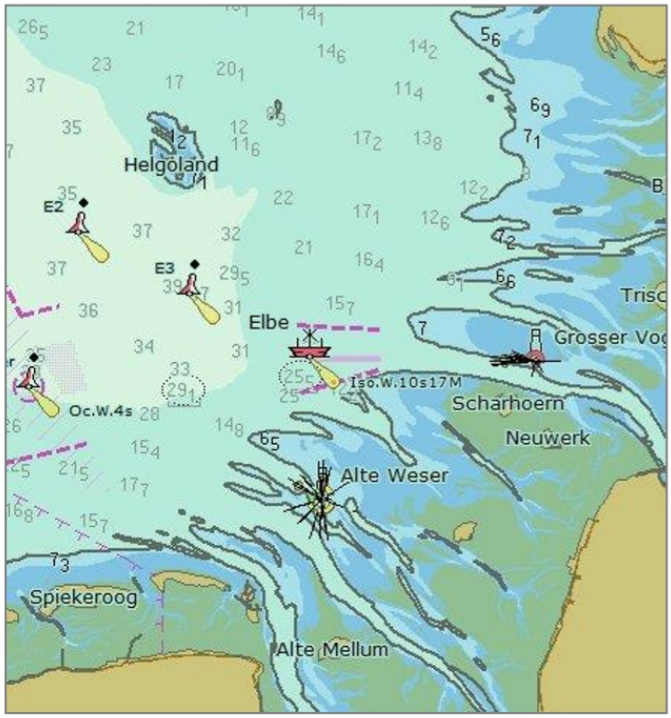
**Shallow Contour:**
This contour is always located in the shallow water area defined by the safety contour. It divides this area again into two areas that are each symbolized with a different color. The value of shallow contour must be smaller than the one of safety contour.

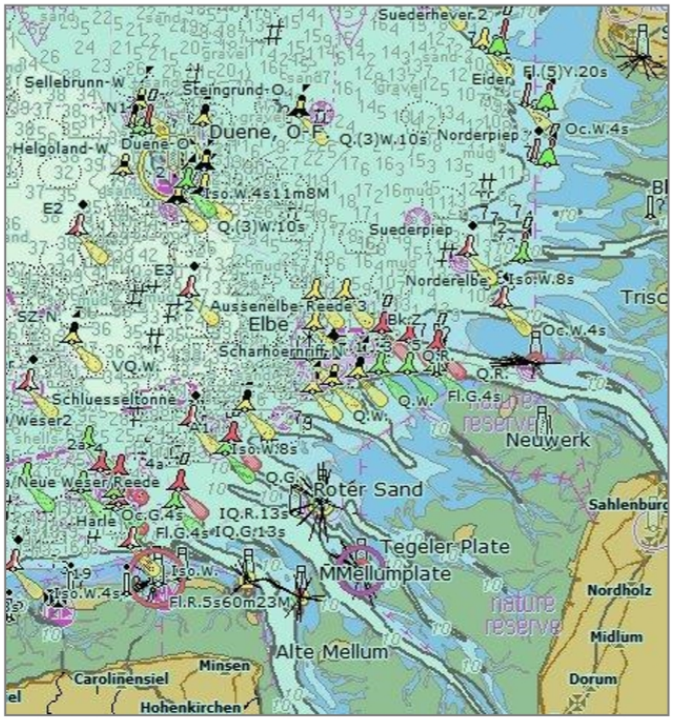
**Deep Contour:**
This contour has the same function as the shallow contour except for the deep-water area.




You can choose between All, Standard or Base IMO display categories, etc.

The appearance of the chart images very much depend on the correct coding of the charts. S-57 provides a so-called SCAMIN attribute which defines at which scale an object shall be displayed during zooming in or suppressed during zooming out. Since the use of the attribute SCAMIN is not mandatory for the chart producer there might be charts which have no SCAMIN or no proper SCAMIN values.
The following two pictures show the chart display with SCAMIN and without SCAMIN.



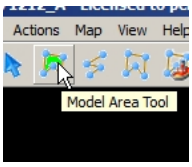



Not using SCAMIN does not only impair the display of the chart but also the performance of the chart display.
In case chart objects have no SCAMIN the setting "Use Auto SCAMIN" can be used to assign SCAMIN during the symbolization.

When the Scale Filter is checked map Kernel performs a check for every symbol before it is drawn. If a symbol would overlap an already visible symbol of exactly the same shape, size and color then it will not be drawn. This has two positive effects: 1. In most cases the drawing speed is increased because many symbols are suppressed, and 2. The screen is less cluttered.
No information will be lost, because one symbol is still visible at the overlap position.

## Specifying the Area of Interest

The "Model area", i.e. the area of interest, can now be specified as a polygon using this tool:

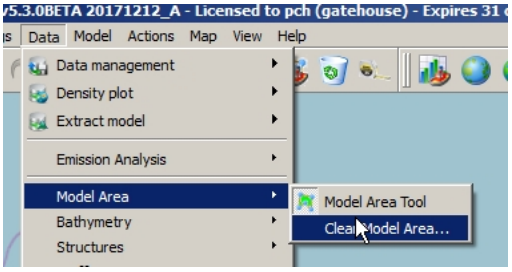



Simply select the tool and start drawing the area on the map by clicking on the map.

You  will see a slight difference in color inside/outside of the area.

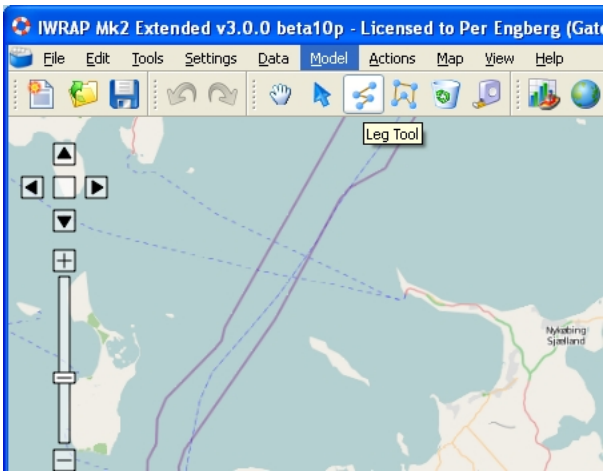
The "Model area" will be used as a filter when you import AIS data.

You can clear the area model using this menu item:

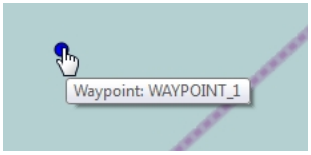



## Adding Legs and Waypoints

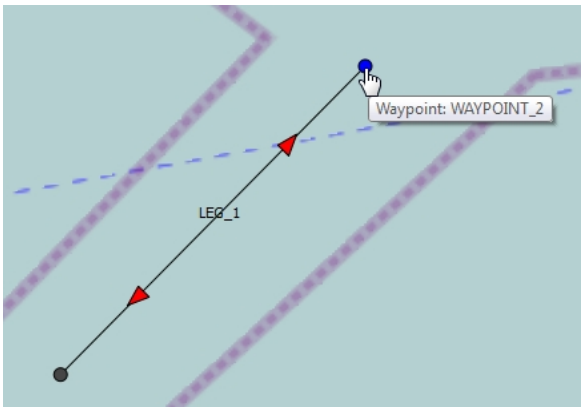
Before adding a Leg, start by zooming in on the area of interest. Then select the Leg Tool from the toolbar:



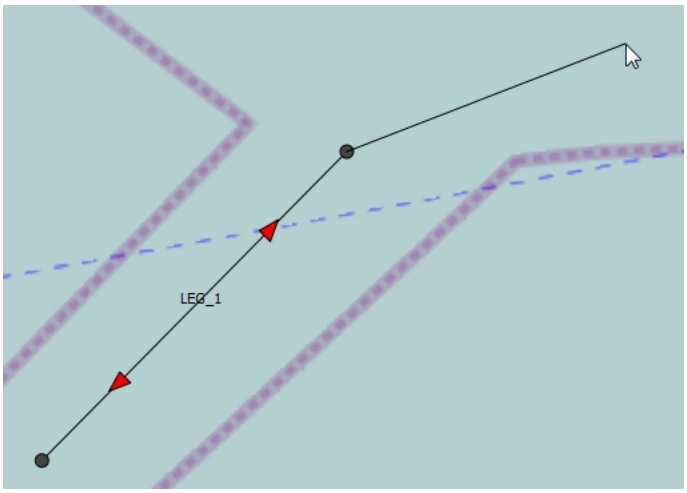

Then click once with the left mouse button at the position where you want to start the leg, this will add the start Waypoint:




Then click and release once with the left mouse button at the position where you want the leg to end and thereby add the end Waypoint:

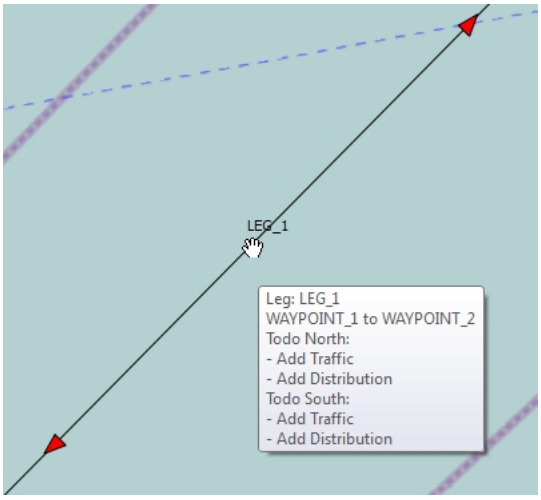



If you want to add a new Leg that is connected to 'LEG_1', then move the cursor over the Waypoint where you want the Leg to start, the cursor will change to a hand symbol. Click once with the left mouse button, the leg is started, and move the cursor to where you want it to stop.

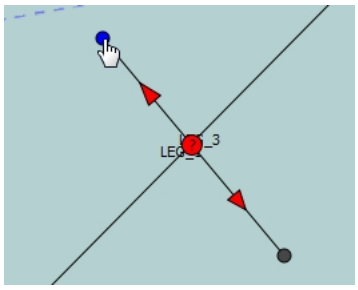



The red arrows that are shown in each direction, indicates that there has to be added some traffic and latterral distribution. When the cursor is above the leg, a tool tip indicates what is to

be done.




If you add a new leg that crosses another leg you will also get an error indication.



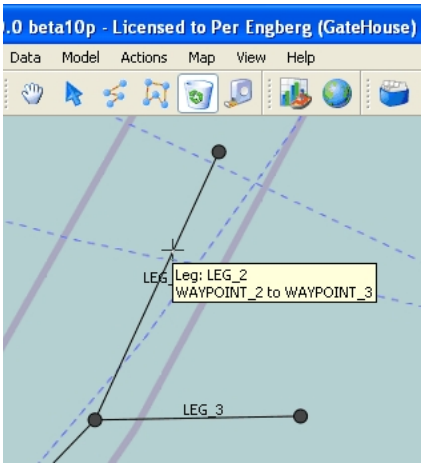
A waypoint should be added at the intersection.

When you have completed adding legs you should end by selecting the Pan tool again:

After you have added the legs you can proceed with specifying Leg characteristics, using The Leg Editor

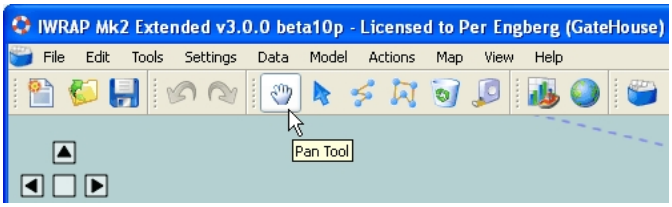
## Removing Legs and Waypoints

In order to remove a Leg you should zoom in on the area of interest and select the . Move the cursor above the Leg you want to remove, it will change into a cross-hair symbol:




Click the left mouse button and the Leg will be removed, redundant Waypoints are also removed. If you remove a Leg by mistake use the undo function

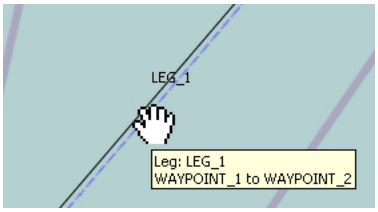
When you have completed editing the legs you should end by selecting the Pan tool again:



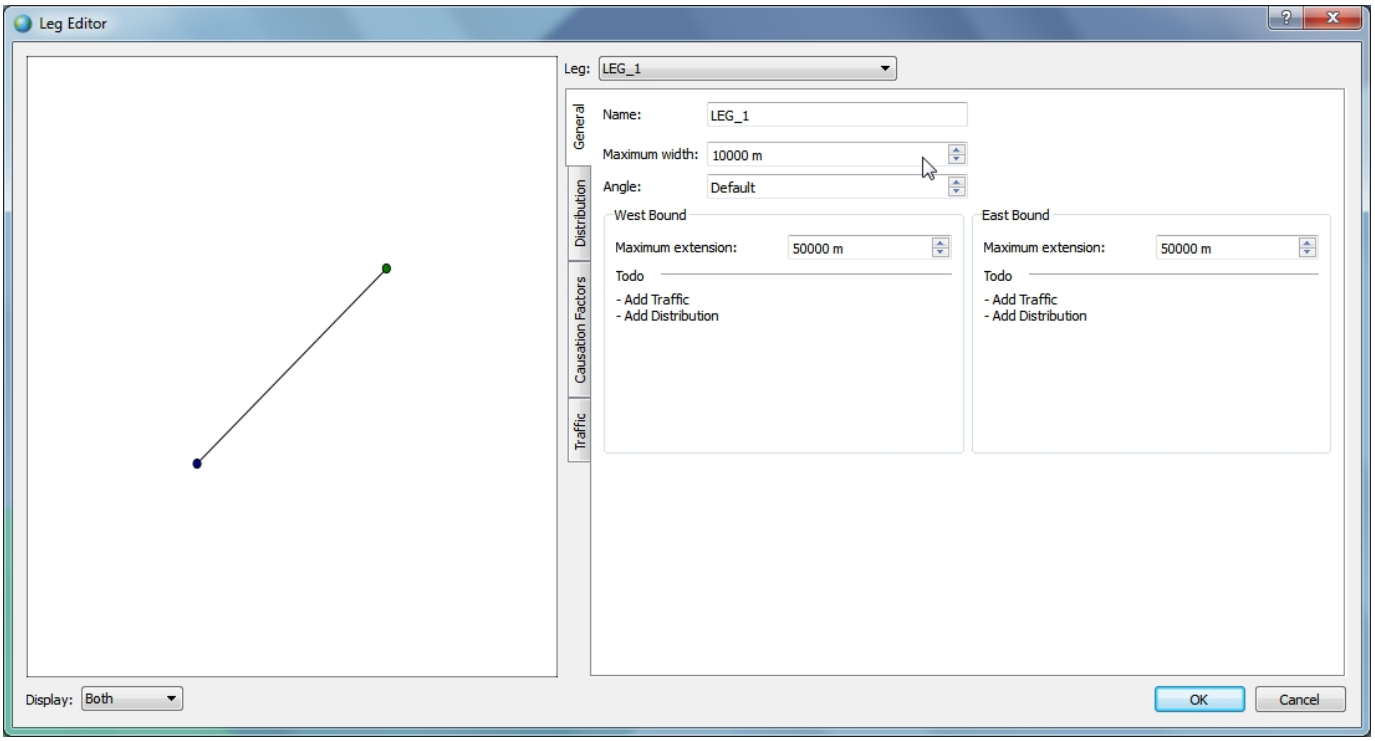

Not matter which tool is selected, you can also always right click on a Leg and select 'Remove Leg...'.

## The Leg Editor

The Leg Editor is used to specify Lateral Distribution as well as Traffic Volume compositions in each direction of the Leg. The Leg Editor is shown when you double-click on a Leg. Move the cursor above the Leg until the tool-tip is shown and double-click:



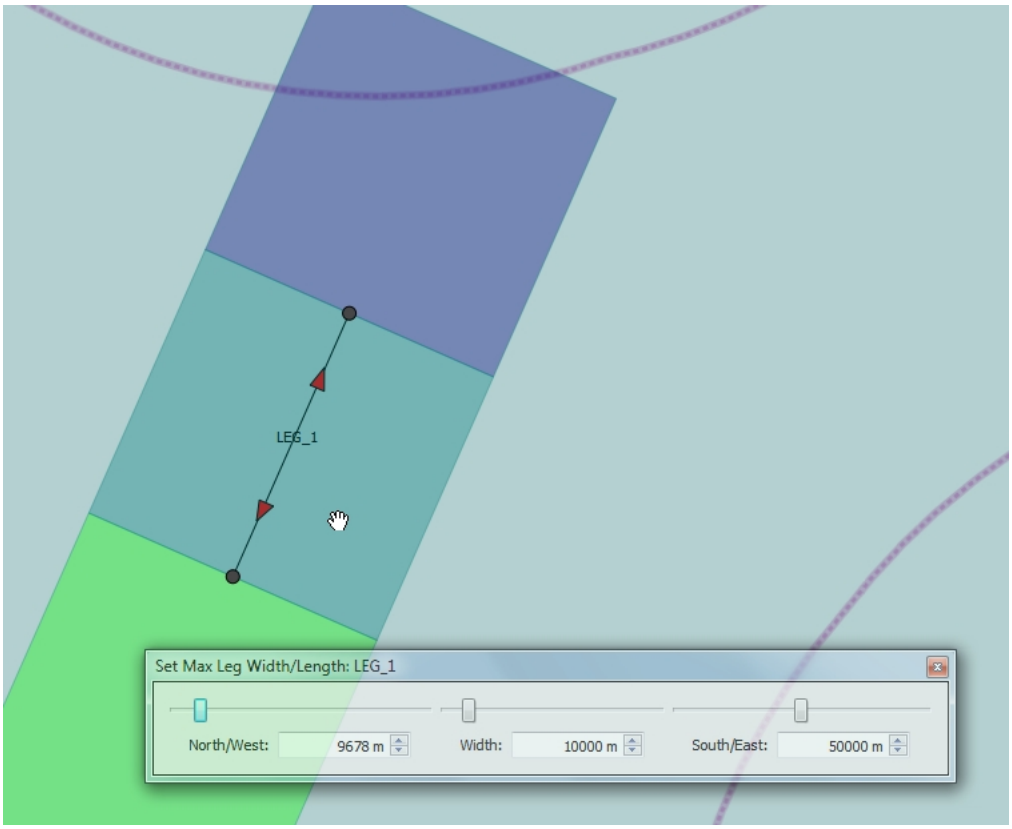

The Leg Editor will appear:




Here you can change the name of the Leg. Maximum width and Angle are used when extracting model data from AIS. The Maximum Width and the Maximum Extension in each direction are illustrated on the following image:

The Maximum Extension is used to control drifting groundings and area collisions, i.e. drifting groundings and area collsions will only occur within the indicated boundaries. You can use 'Settings/Project Settings...' to modify Widths/Extentions for all Legs and/or set the default value for new Legs.

You can also use the 'Settings/Set Maximum Leg Width/Length...' settings. You do this by clicking and selecting the leg you want to modify, and adjusting the width/Length using the sliders or the numerical inputs.

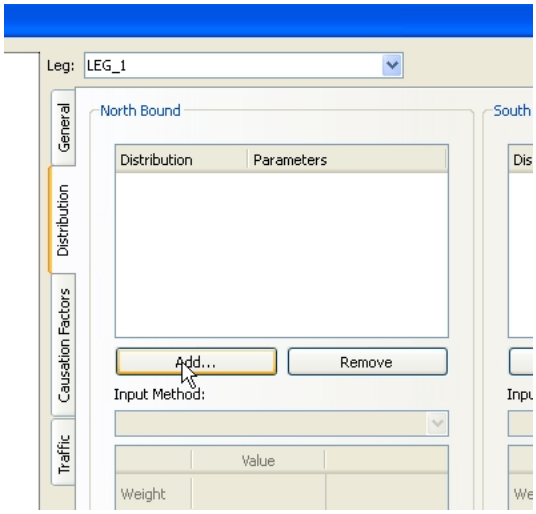



You can now proceed with specifying:

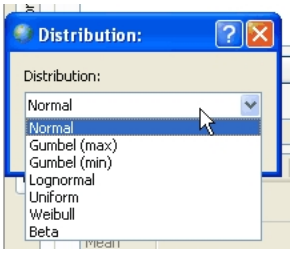
- Lateral Distribution
- Causation Factors
- Traffic Volumes

## Lateral Distribution

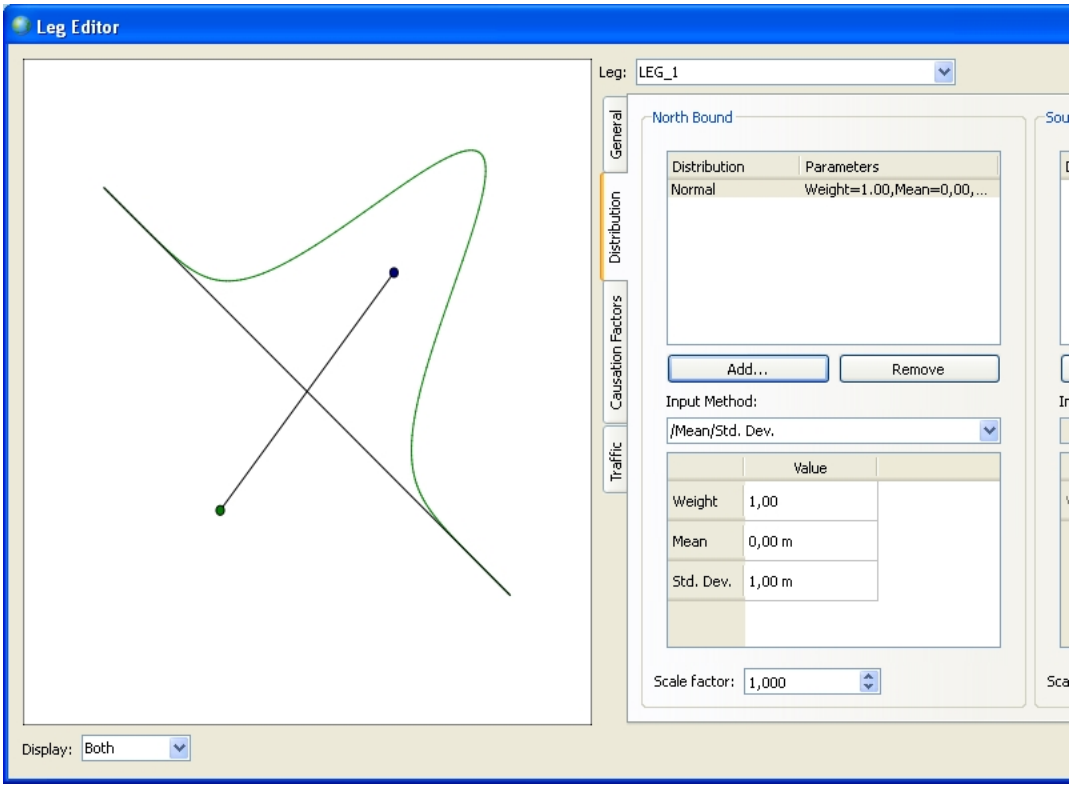
The Lateral Distribution can be added by selecting the 'Distribution' tab. The Distribution tab enables you to specify Lateral Distributions in each direction, just press the Add button:



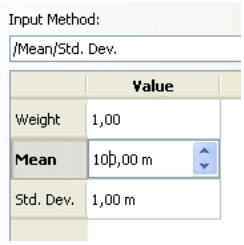

It is possible to choose from the following distributions;




If you e.g. select a Normal distribution, a Normal distribution with mean 0 m and standard deviation 1 is added:

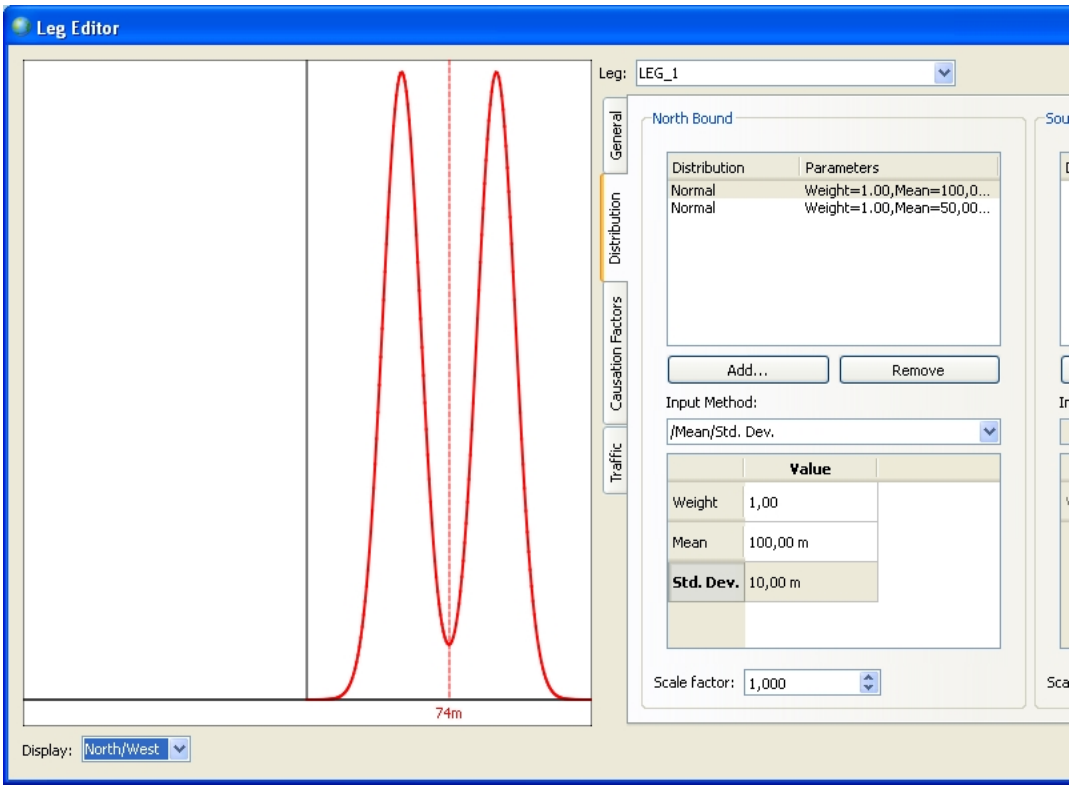



You can of course modify the mean and standard deviations by entering values (press enter or click outside the field for the change to have effect):

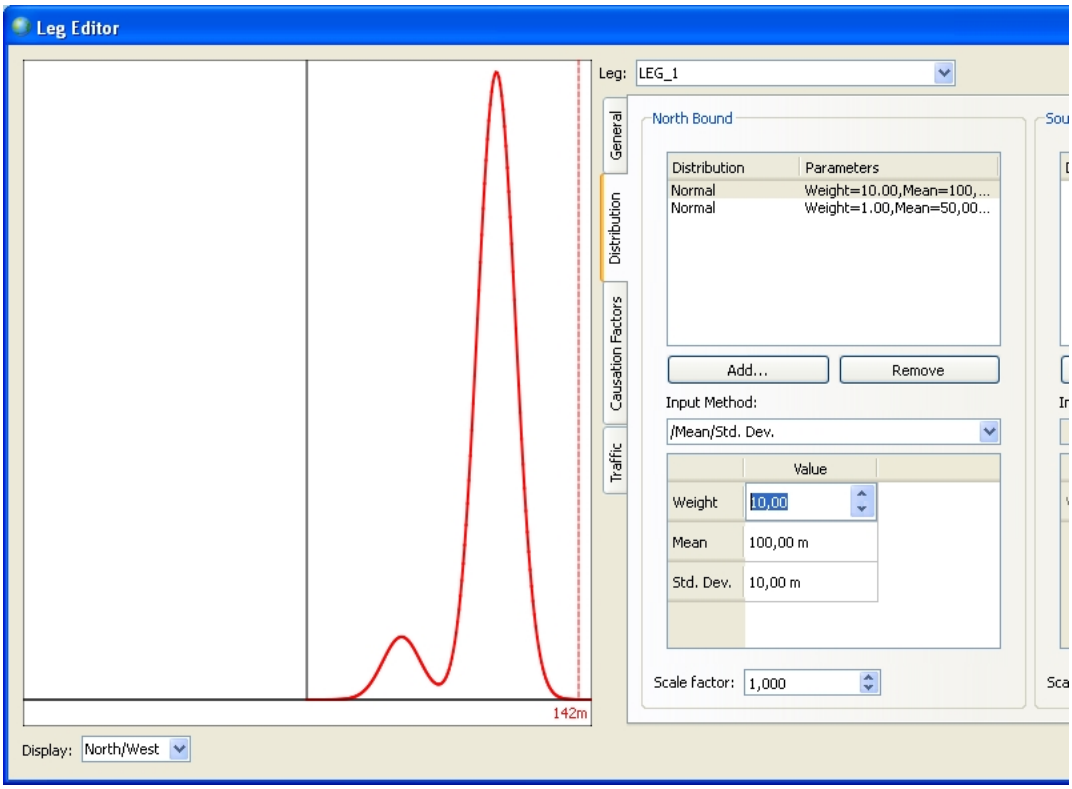



Note that it is also possible to change the Input Method:

You can add and combine any number of distributions, the following example shows 2 Normal distributions combined, note that the Left hand side has changed, you do this by selecting 'Display' in the lower left corner of the dialog.




The Weight parameter can be used to control the relationship between the distributions, if we e.eg set the weight of the first Normal Distribution to 10 instead of 1, we get the following:




The Scale factor is only used when fitting to histograms extracted from, e.g. AIS data.

## Causation Factors

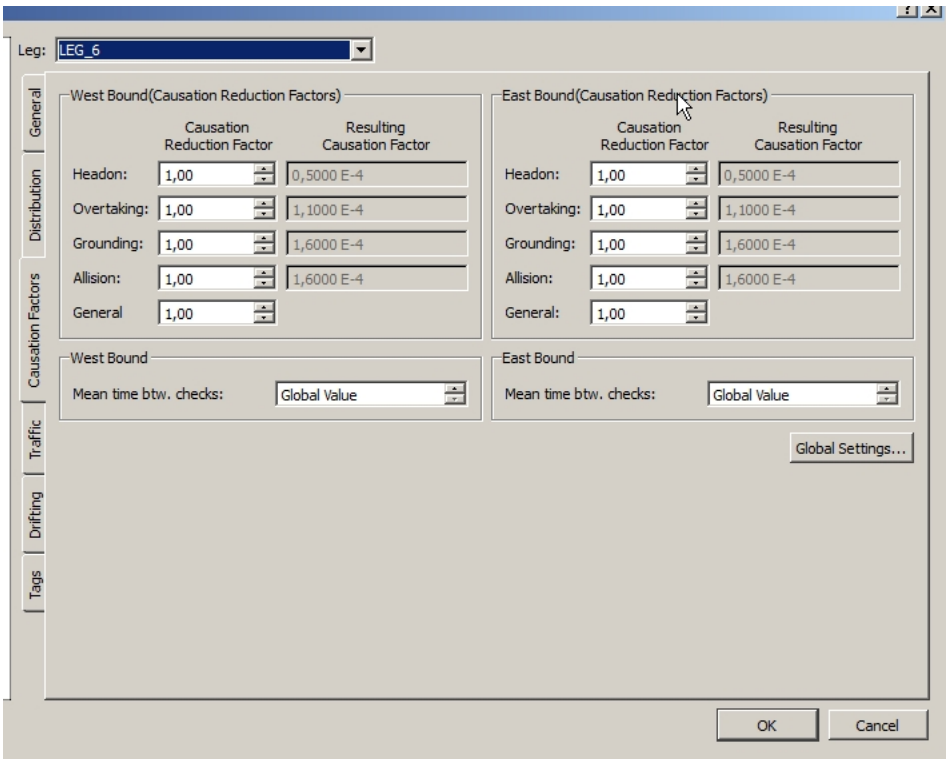
The causation factor specifies the probability that the officer on the watch will fail to react, e.g. in case the vessel is on collision course with another vessel or the vessel is about to ground.

The causation factors are important for the results since they act as reduction factors on the calculated number of blind navigation collisions. In the specification of the causation factors it

should be considered if navigators exhibit extraordinary awareness; possible because of two navigators being present on the bridge. For ferry routes it is typically the case that the causation factor is lower than the average due to the navigators increased situation awareness.

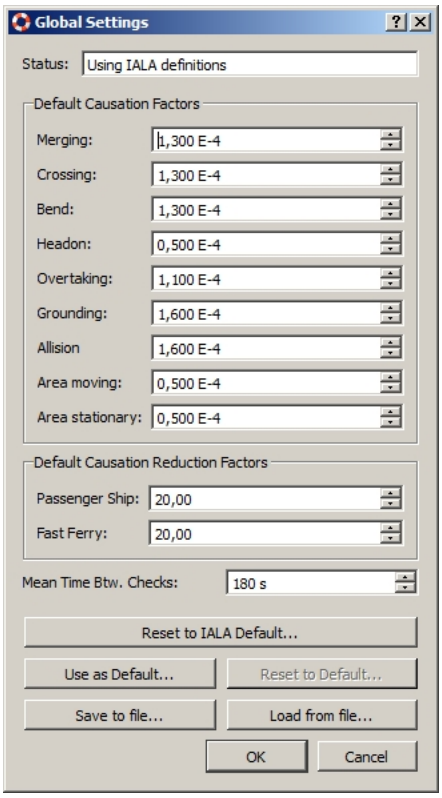
IWRAP Mk2 has a set of causation factors for different events, e.g. head-on collision and grounding. The application uses values that have been selected by IALA experts. The default IALA values can be altered but this is not recommended. Instead the user should apply causation reduction factors, i.e. the causation factor is divided by the reduction factor.

The causation factors reduction can be specified in each direction of the Leg, by selecting the Causation Factor tab:




It is also possible to set the causation reduction on each ship type and size category, see Traffic Volumes.

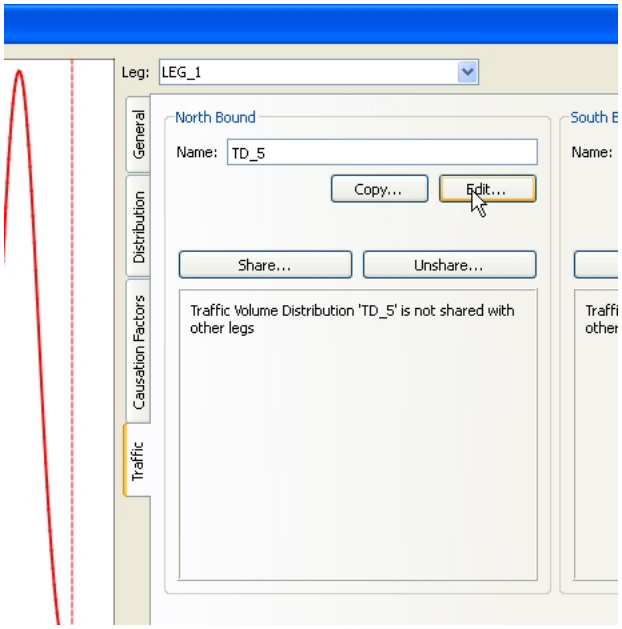
Pressing the 'Global settings...' button, invokes the Global Settings dialog, note that if you change anything here you can always invoke 'reset to IALA default...'. The Status field in the top of the dialog indicates if IALA settings are used.



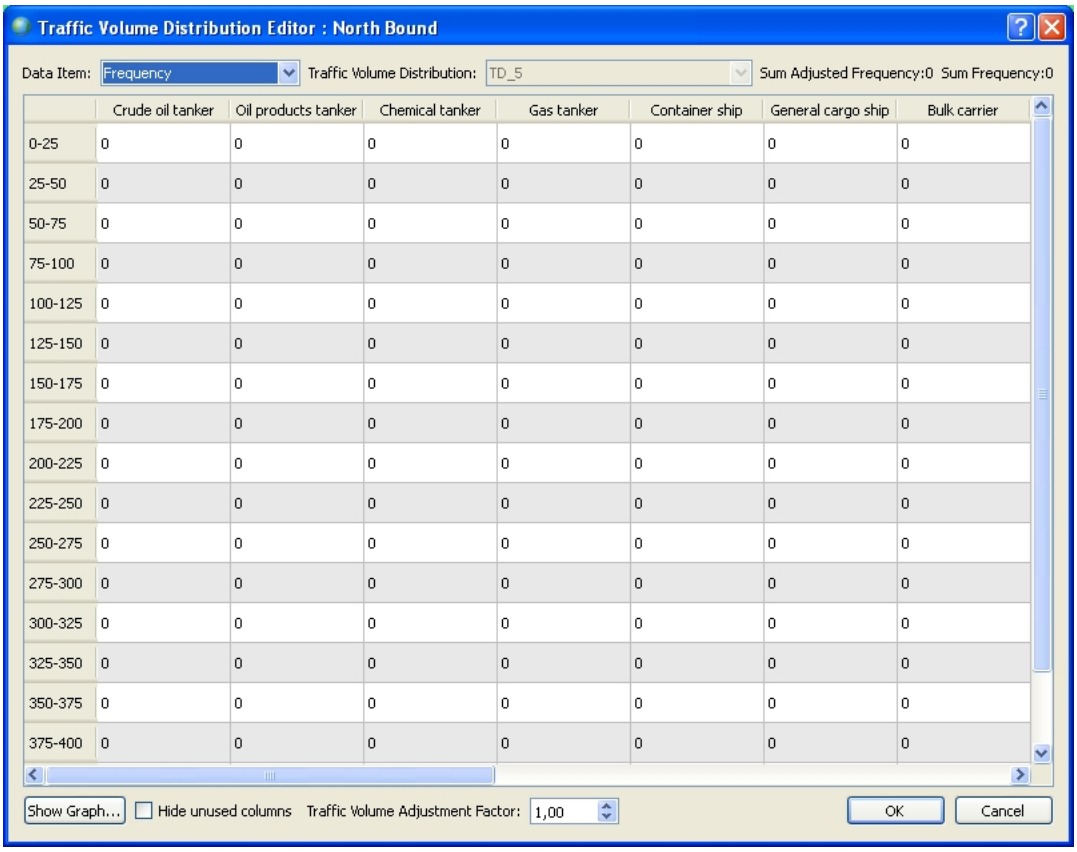

As you can see the ferry types have by default a reduction factor of 20.

## Traffic Volumes

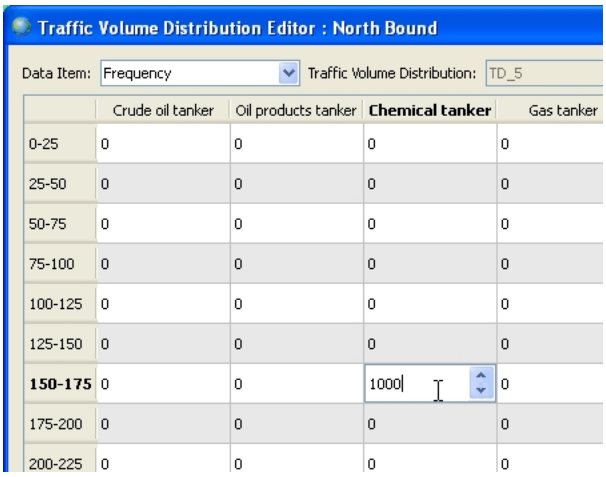
The Traffic Volumes specifies the amount of traffic on the Leg. This is specified for each direction the Leg separately. In order to enter the Traffic Volumes you should select the Traffic tab on in the Leg editor:




If you press the Edit button in one of the two directions the Traffic Volume Distribution Editor is invoked:

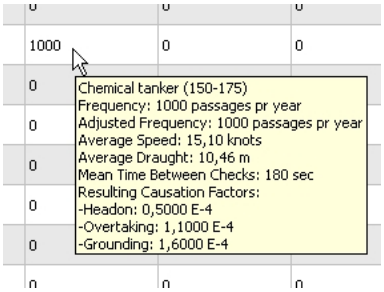



The Traffic Volume Distribution is defined as the annual number of ships operating on the leg in one direction. The annual number of ships operating on the route is specified as a function of ship type and length. In the example shown here we specify that 1000 Chemical Tankers in the length interval 150-175 are traveling north on the selected Leg per year. Just click on the cell to activate the editor, enter 1000, and press return/enter.

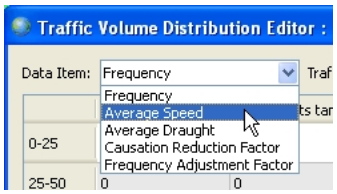



If the upper right corner the total is displayed i.e. 'Sum Frequency'.

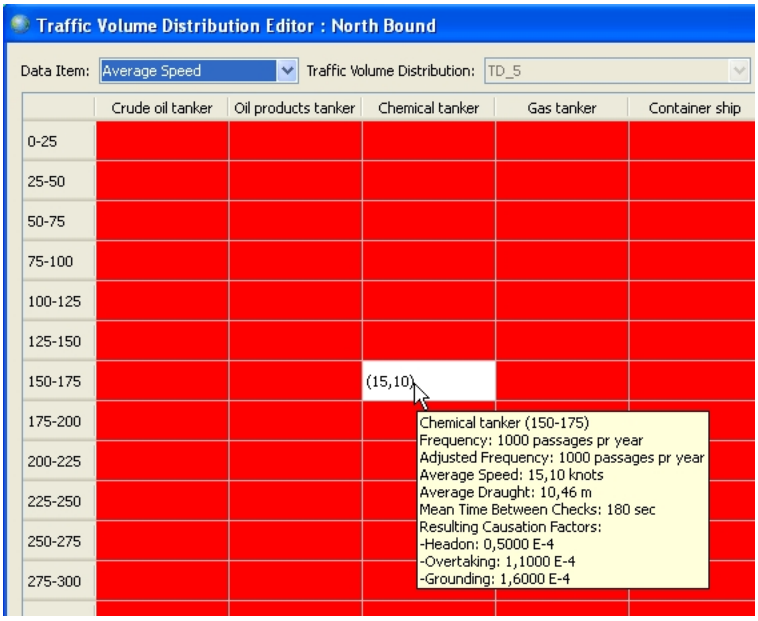
If you move the cursor over the cell, you get a tooltip:



Here you see details for all parameters that affect the calculation for the cell, in this case Chemical Tanker [150-175]. These parameters, e.g. the average speed, can be modified by selecting the Data Item:




Selecting the Average Speed changes the appearance of the table:



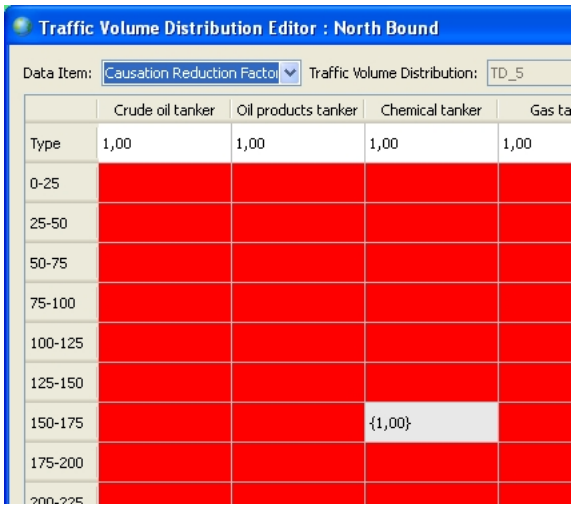

The red cells indicate that the Frequency is zero, so in this case we only have one cell where we can specify Average Speed. You don't have to enter a value, as you can see a number is already indicated i.e. (15,10), this the built-in Average Speed of this class of ship, so if you dont enter any value 15,1 knots is used in the calculations.

If you enter e.g. 10 knots, you will still be able to see the built-in value in parenthesis for reference.

If you enter e.g. 0 in the field it will go back to use the built-in default value

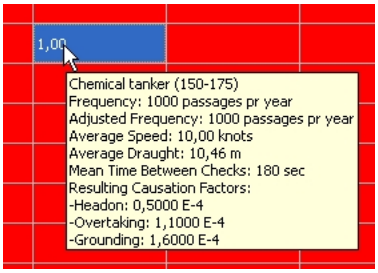
The same principle is used for Average Draught, i.e. you select Average Draught in the Data Item and enter the value in meters, again a built-in value is used by default.

In the Data Item drop-down box you can also select a Causation Reduction Factor:

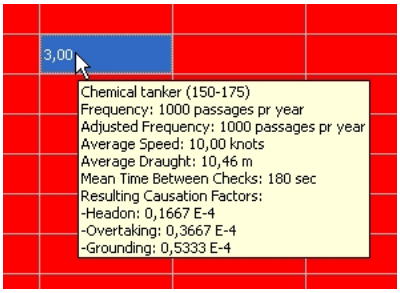



This table can be used to adjust the Causation Factors for a specific type of ship i.e. the top row or a specific length category.

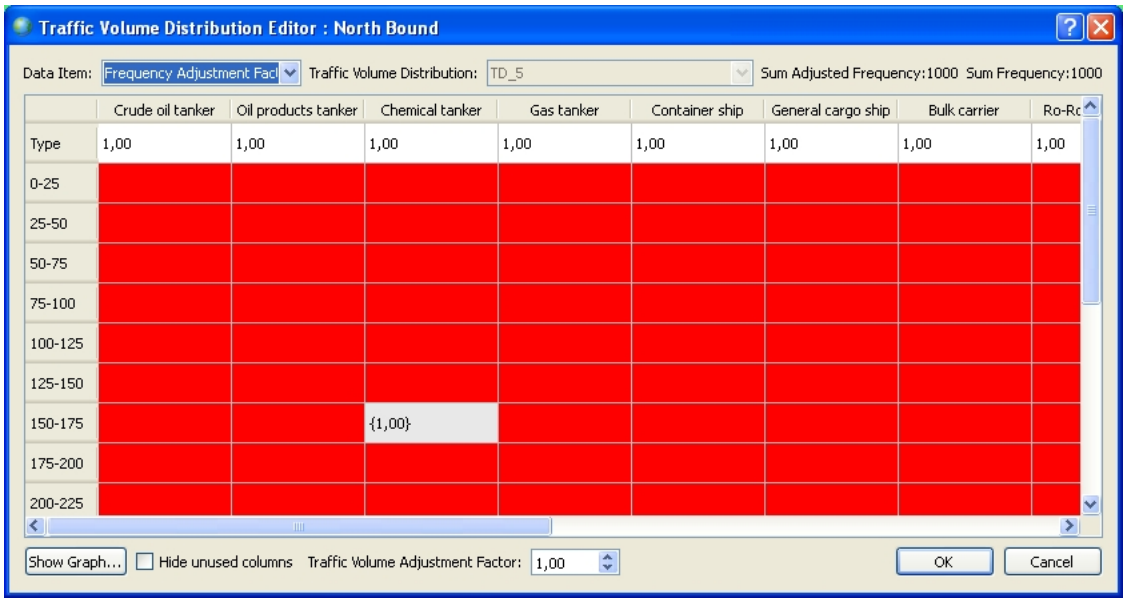
Move the cursor on top of a cell to see the currently used factors:



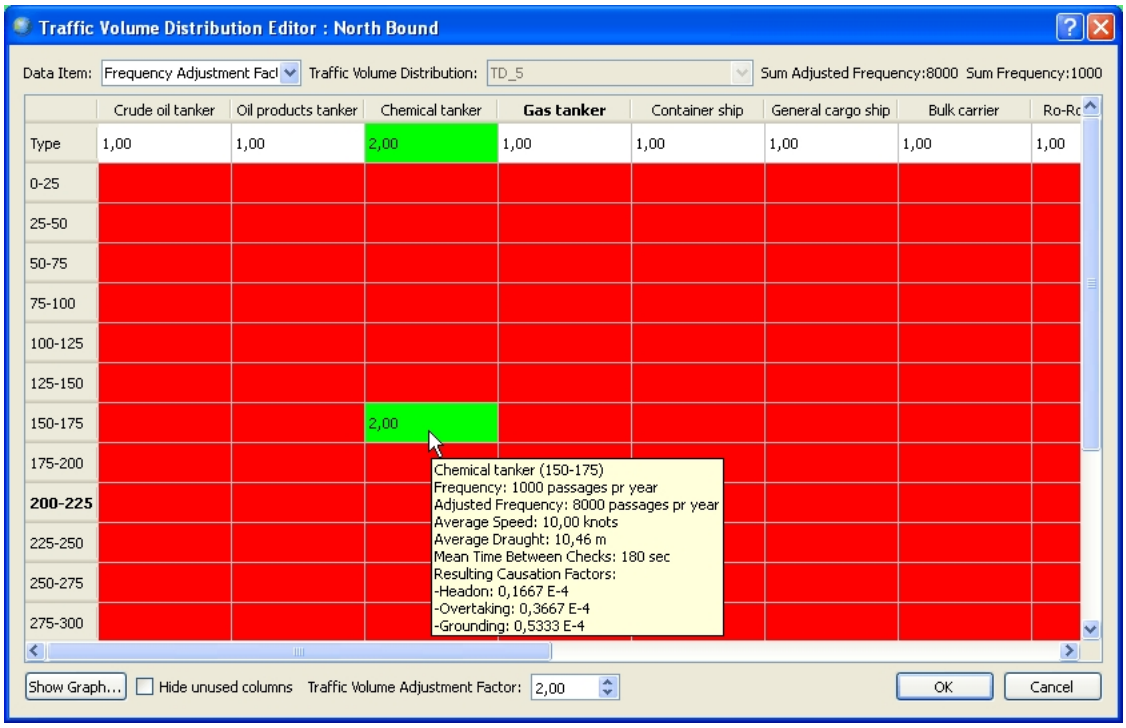

If you e.g. enter 3, you will see the factors drop by this factor.




The Traffic Volume Distribution Editor also allows you to multiply the Frequencies by an adjustment factor. This can be done for the entire table, see the 'Traffic Volume Adjustment Factor' in the bottom of the dialog or for each type of ship or specfic length category of a ship type by selecting Frequency Adjustment Factor in the Data Item drop-down box.




In the example shown below a factor of two has been specified for the entire table, Chemical Taker ship type and the 150-175 meter category, so in total the 150-175 meter category is multiplied by 8 i.e. (2x2x2), i.e. 8000 is used in the calculations.

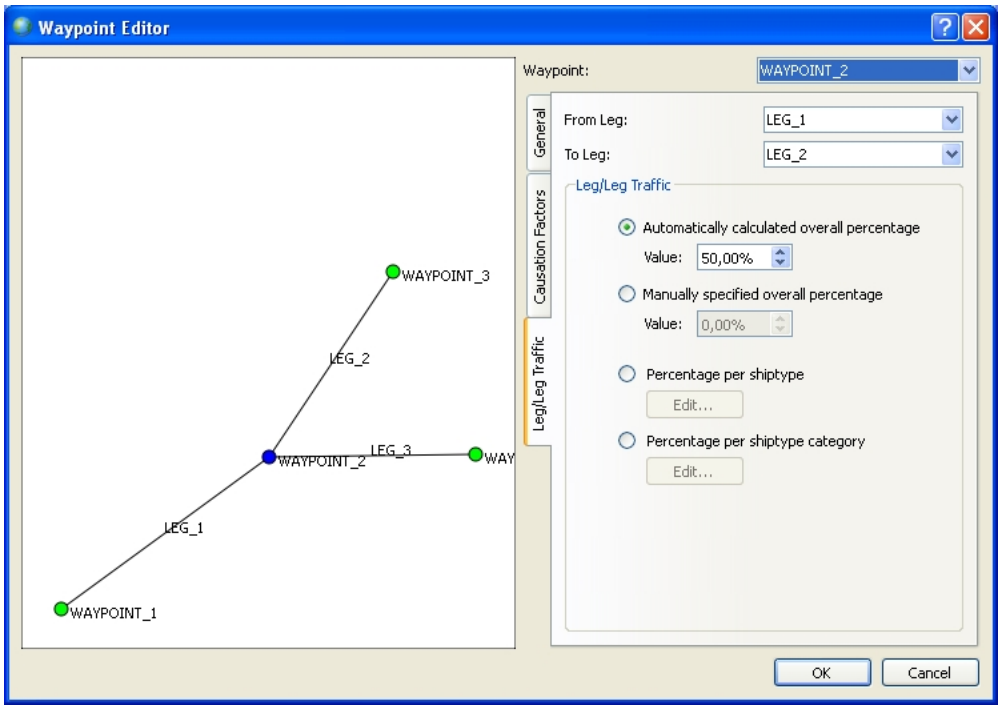



On any of the tables you can right-click and copy the data to the clipboard.

## Leg to Leg Traffic

The leg/Leg Traffic tab is used to specify how traffic is going through a junction waypoint. A junction is a Waypoint that is connected to more than two other waypoints. For junction waypoints it is possible to specify the amount of traffic going from one Leg to another.

If you do not have any information about the traffic it will be divided equally among the legs, i.e. you check the 'Automatically calculated overall percentage' option which is he default for new Legs. In this case we have 3 legs, so 50% of the traffic coming from 'LEG_1' will go on to 'LEG_2', the rest to 'LEG_3'.

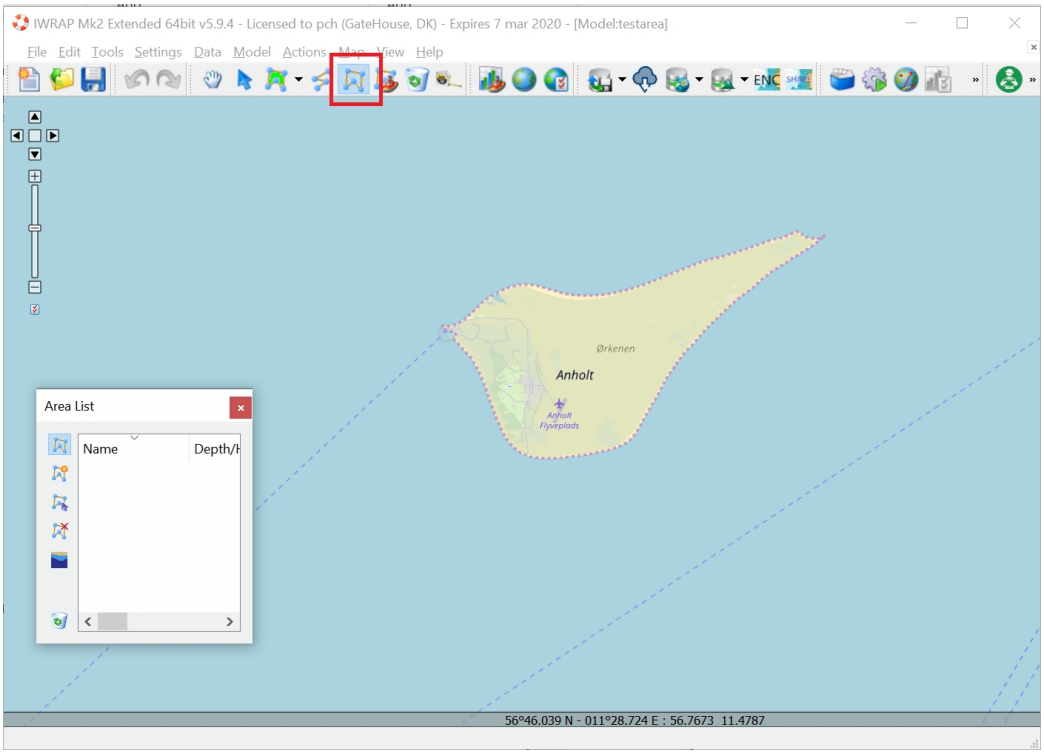



You can also manually choose to set the percentage, select a 'From leg' and a 'To leg' and check the 'Manually specified overall percentage' option and enter a value.

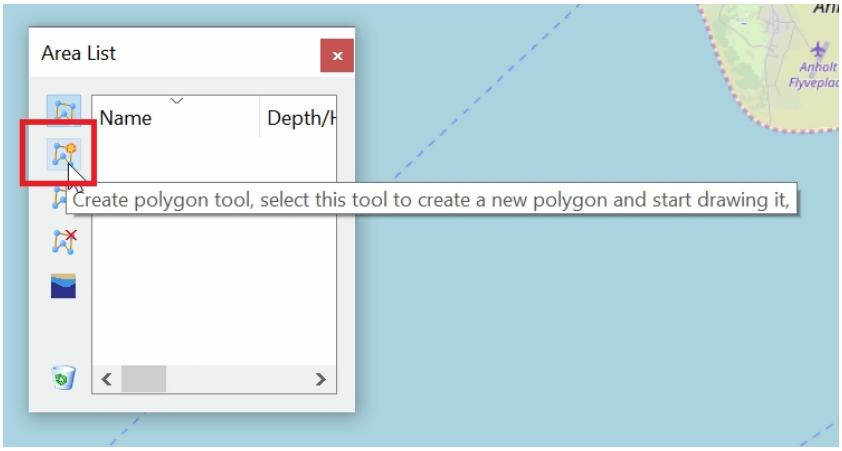
The most complex option is to specify the percentages per ship type or ship category. The last option is if of course the most detailed, and is primarily used when using the import data feature.

## Defining Bathymetry

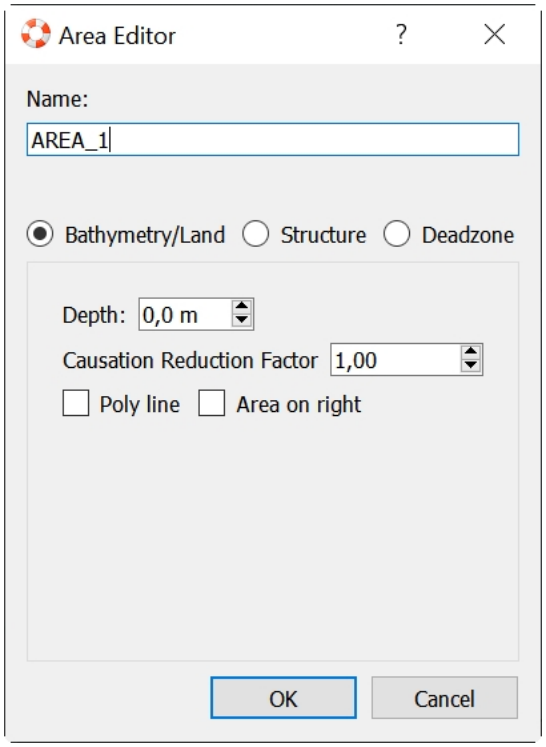
Bathymetry can be defined using one or more polygons with different depth values. Start by zooming in on the region of interest and select the polygon tool from the toolbar:



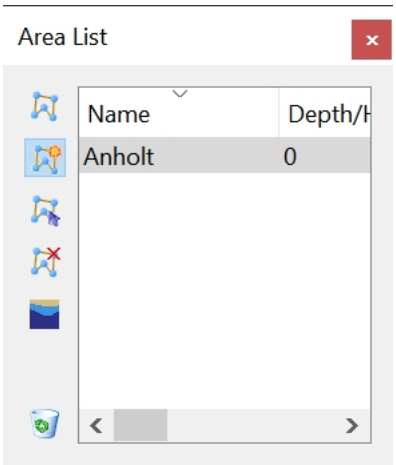

The 'Area List' is shown in the lower left corner of the screen. In order to add a new polygon/area select the 'Create polygon tool'.



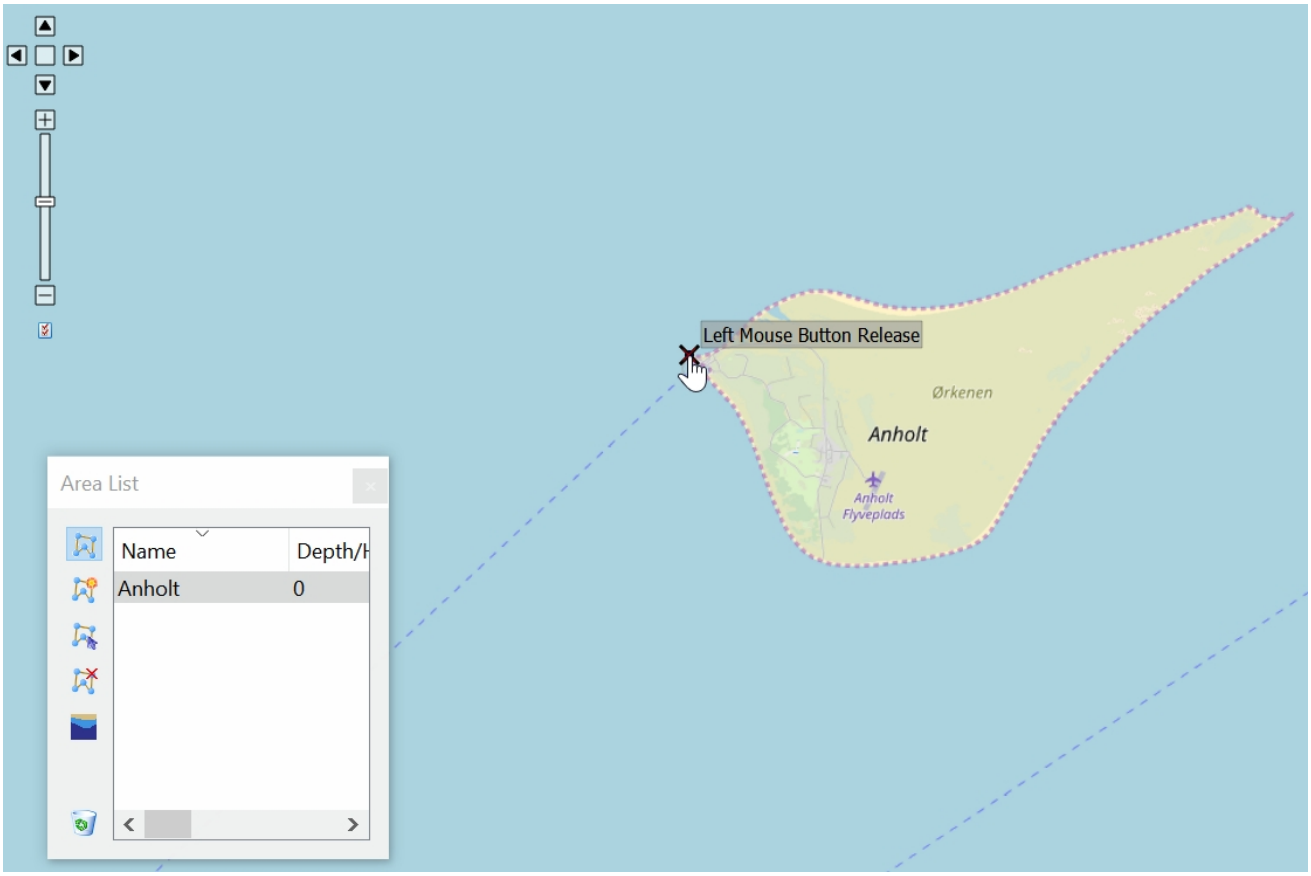

The 'Area Editor' is invoked, enter name and depth of the area:




Press ok and the new area is added to the 'Area List'. You can always double-click on an item in the list to bring up the 'Area Editor'.

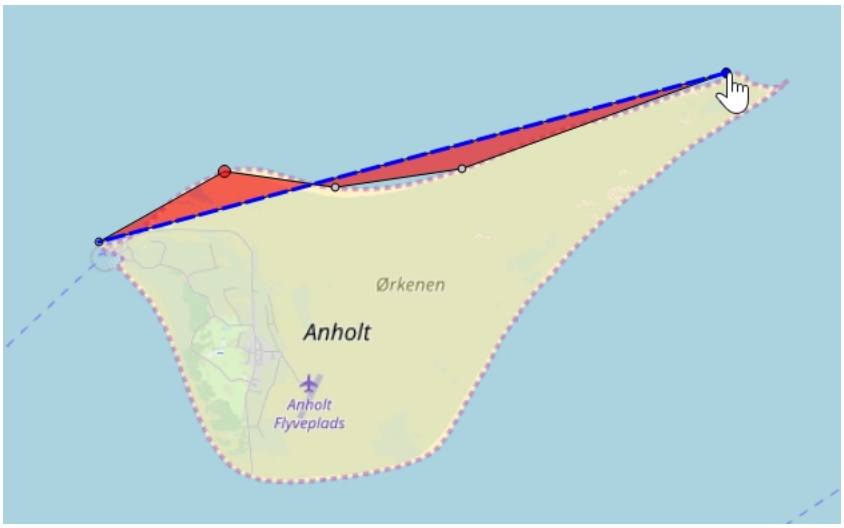


Now you can start drawing the area by clicking with the left mouse button on the map.

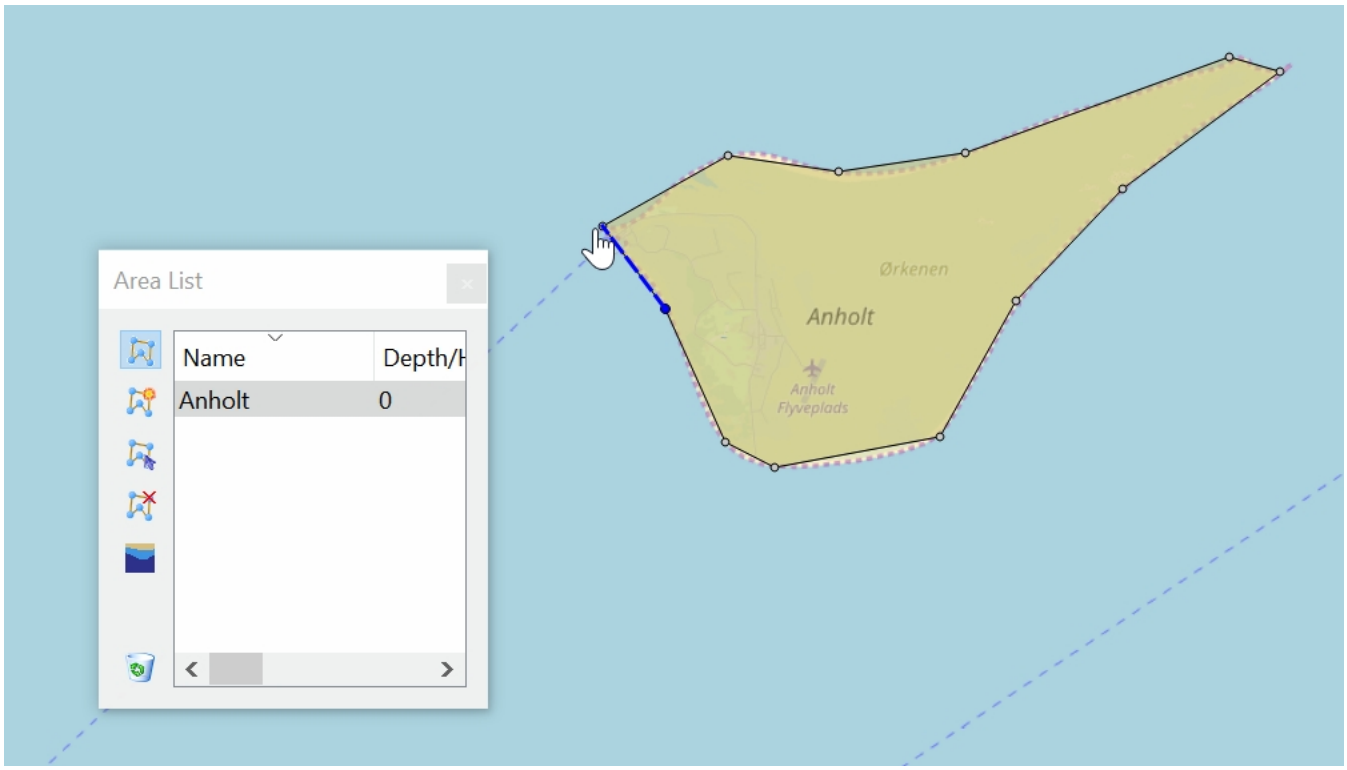



To add more points to the Polygon you just keep on clicking on the map.

The polygon may turn red when you add points, this indicates that the polygon is not Simple (e.g. has crossing lines), just keep on adding points until the complete area is specified and then remove line crossings.

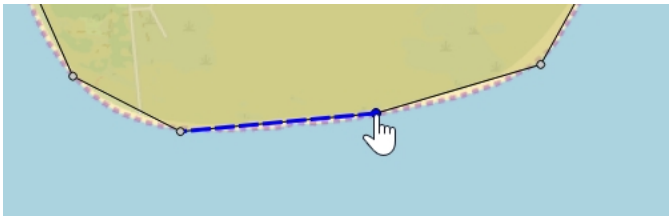



When you are done drawing, the polygon should not be red.




If you need to add a point between 2 existing points, just click the neighboring point:

it will turn blue, and the next edge will also turn blue and dotted. If you now click the map the blue dotted line will be split:

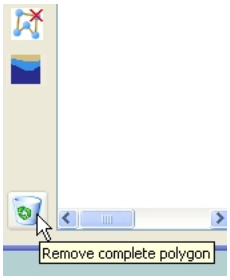


In order to remove a single point in the polygon select:

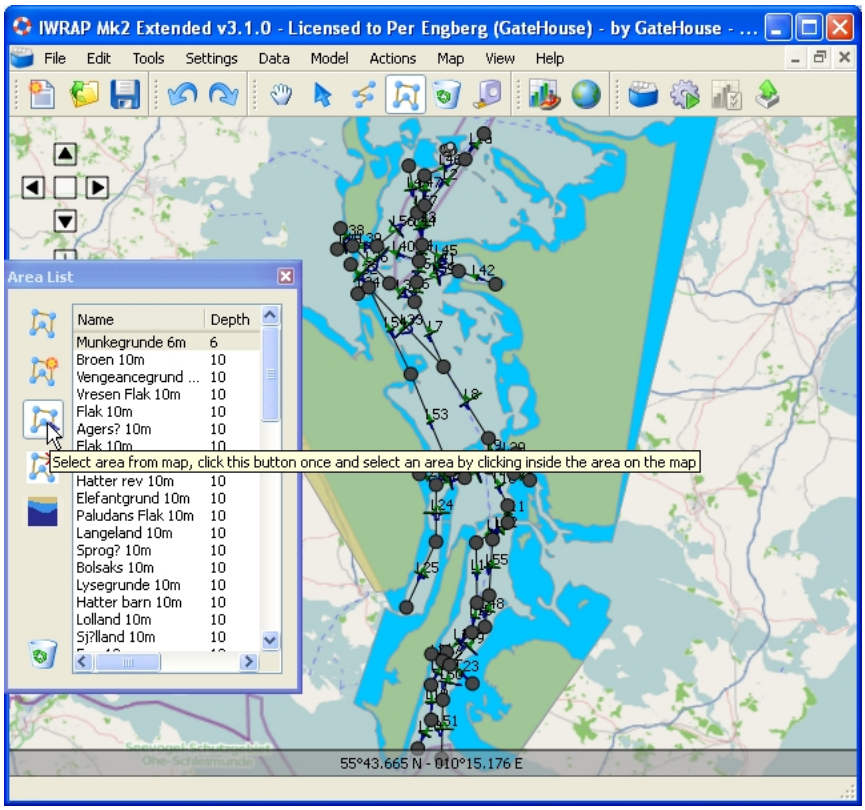
and simply click on the point you want to remove.  You can also select the point and right-click and select delete.

When you have completed removing points select the edit tool again:

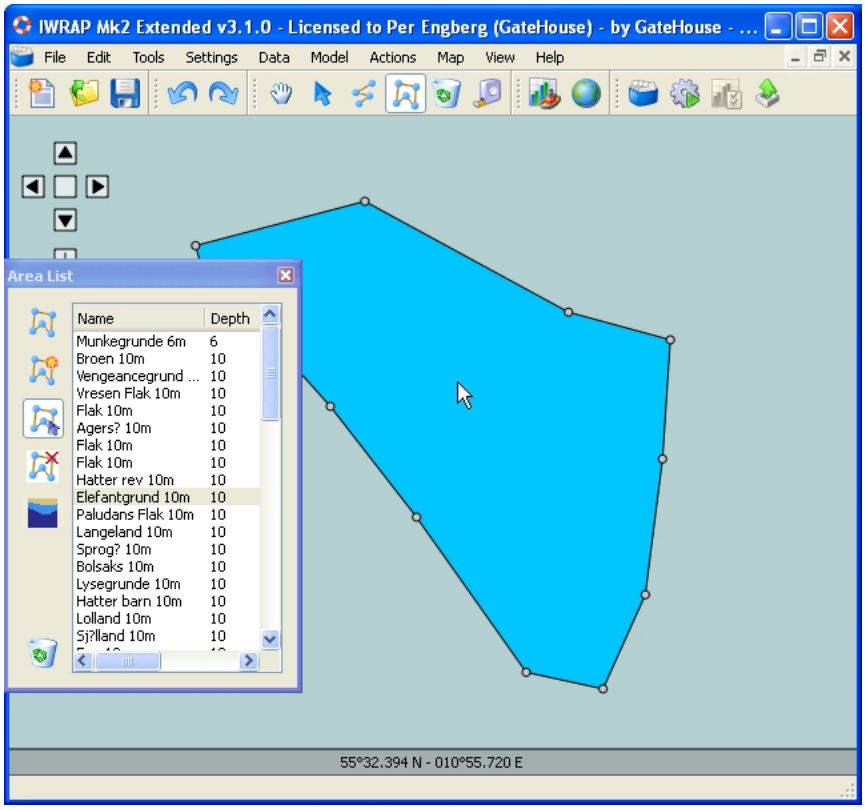
You can remove a complete polygon by selecting it in the list and clicking the 'Remove Complete Polygon' button.




If you have many polygons in your model, you can select them by clicking in the list or you can select them from the map by using the 'Select area from map' tool.




When you click inside the area on the map the area is selected in the list and map is centered on the area:



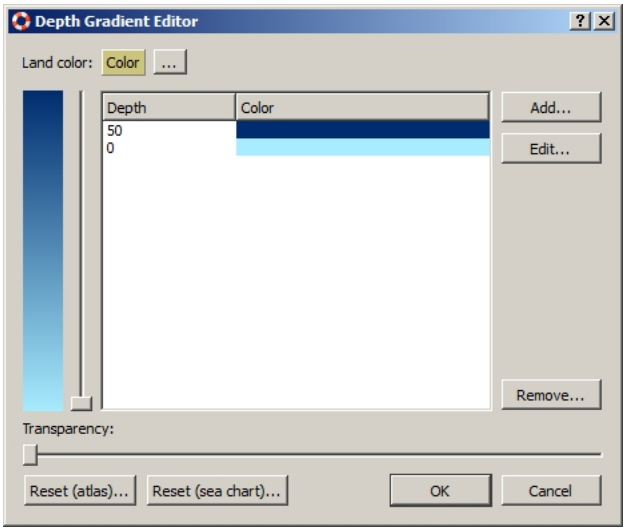

Select the edit tool to start editing the selected polygon.

You can also right-lcik on an area and either select Edit or Remove.

You can make the fill of the polygon transparent and modify the colors by activating the 'Settings/Depth Color Settings...' menu item or clicking the  tool

file:///C:/user/gh/iwrap/impl/doc/images/polygon_color_setting_tool.png

button:



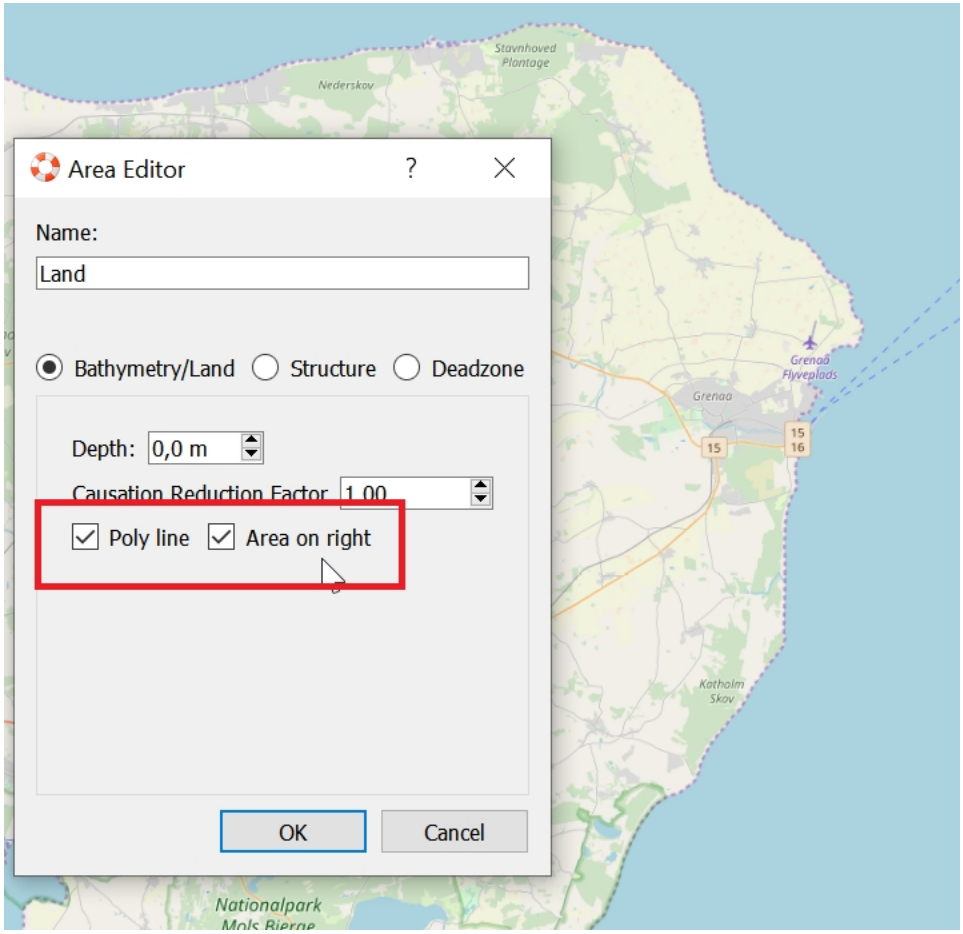

The 'Reset (atlas)' button makes deep area dark and shallow areas ligther, 'Reset (sea chart)' does the inverse.

Use the bottom slider to change transparency for all depth colors.

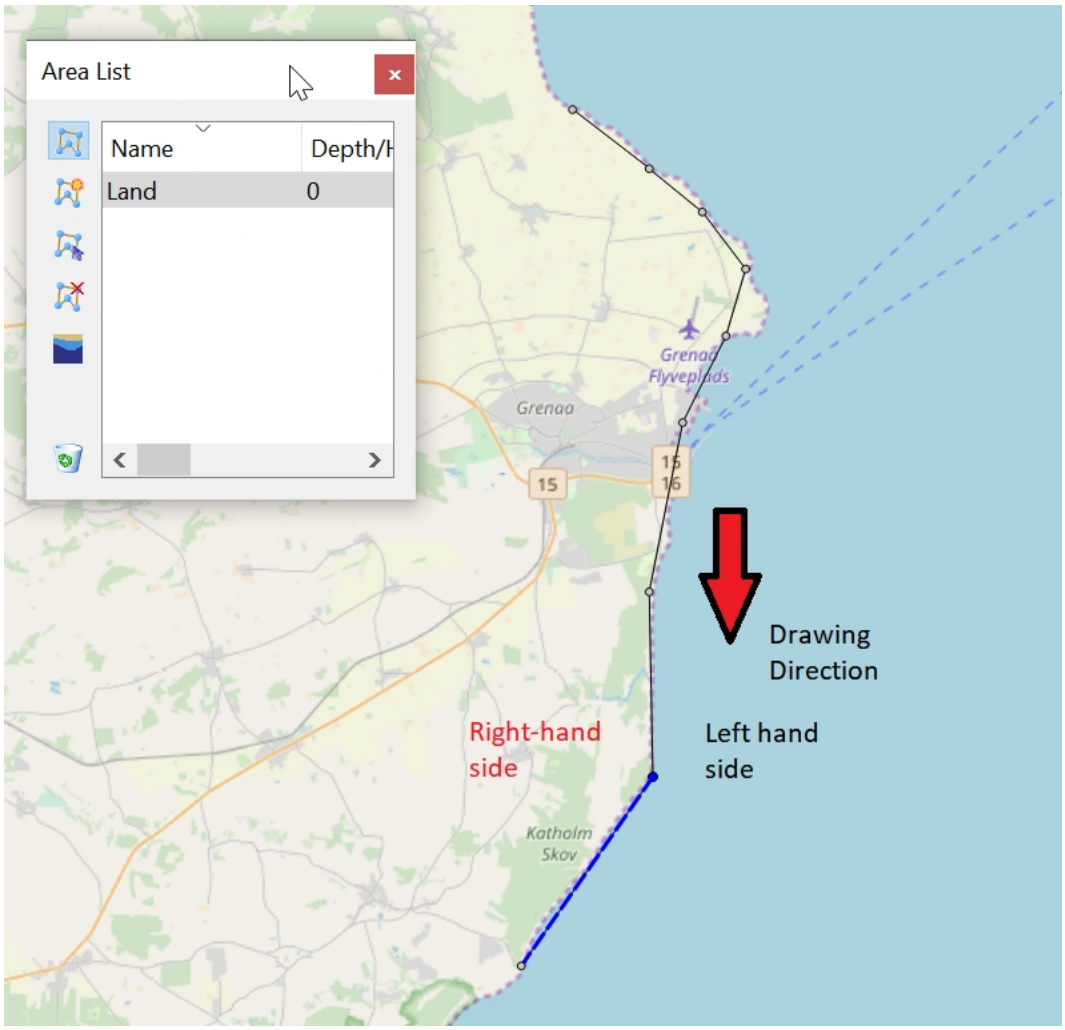
When you have completed editing polygons you should end by selecting the Pan tool again:

Polygons for Bathymetry can also be imported from the Data menu from ESRI shape or KML files. E.g. import Bathymetry shape file from 'Data/Bathymetry/Import ESRI shape file...', see Extract from ESRI Shape. On IWRAP installations that have a SevenCs ENC dongle bathymetry can also be imported from ENC, see Extract from ENC

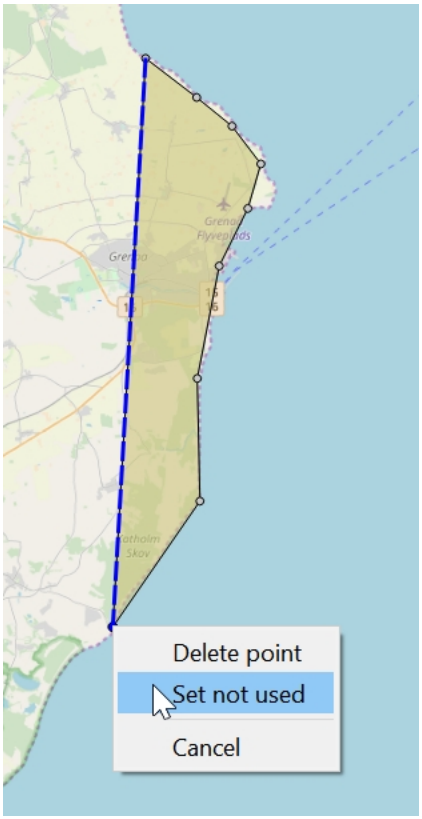
Normally bathymetry should be defined as polylines but it is also possible to use polylines. Polylines are sometimes generated when importing from eg. ENC:




When using polylines it is important to specify if the area in on the left or on the right hand side of the polyline. In this example the area, i.e. 0 meter depth, is on the right hand side seen from the drawing direction.



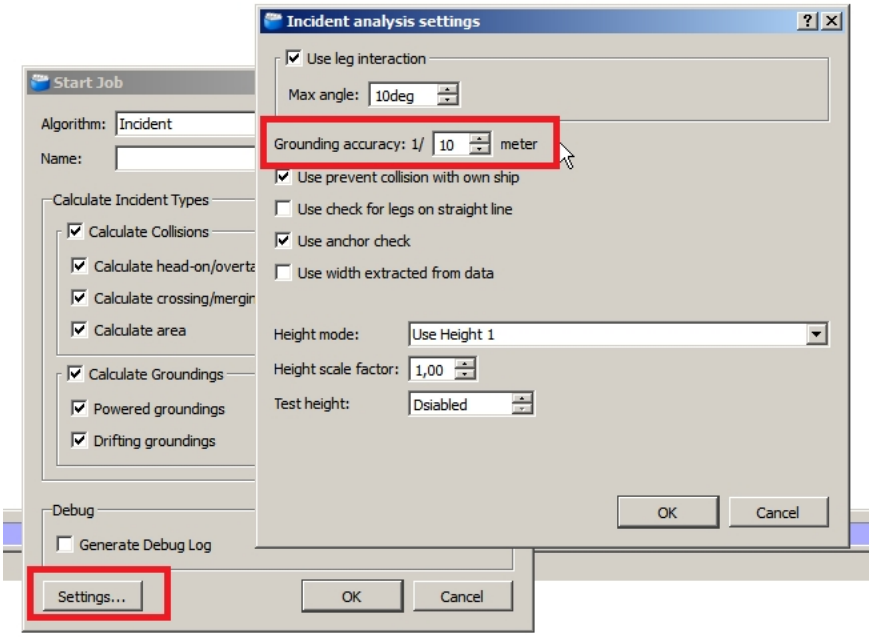

It is possible to specify that an edge should not be used in probability calculations, e.g. in this example the blue line is not part of the contour, so you can right click and select "Set not used".




This will make the edge turn red, to indicate that it is not used:

This e.g. used when extracting from ENC, i.e. cell boundaries which are not actually depth part of the depth curves are set to "not used".

The accuracy of the grounding calculations can be controlled, default is tenth of a meter. If you have models with very detailed bathymetry it is recommended that you e.g. use ½ meter accuracy. You can set the accuracy when you start a new job. The accuracy is stored in the model.



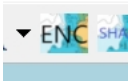

## Extract Bathymetry

If you have ESRI shap files for your area you can import these, or if you have an IWRAP with ENC support you can extract bathymetry directly from the ENC

### Extract from ENC

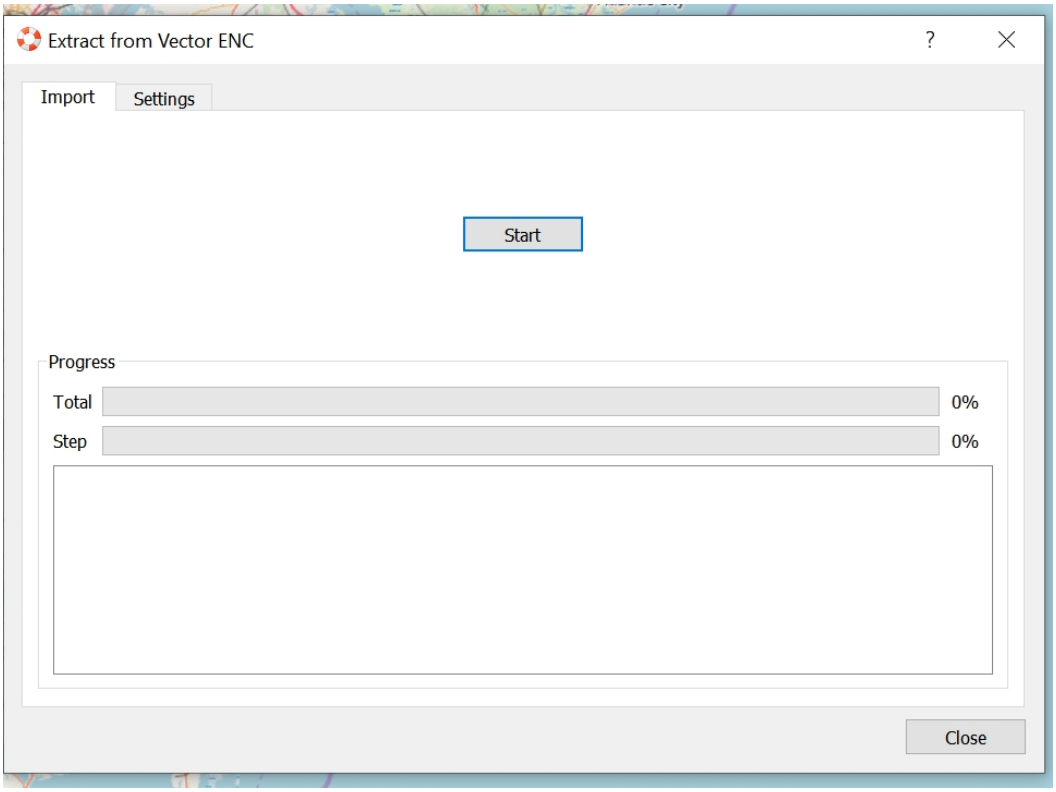
Extracting bathymetry from ENC requires that you havea Dongle and a an IWRAP with ENC license.

To start extracting data, select the ENC icon on the toolbar:




Or select Data/Bathymetry/Extract from Vector ENC.

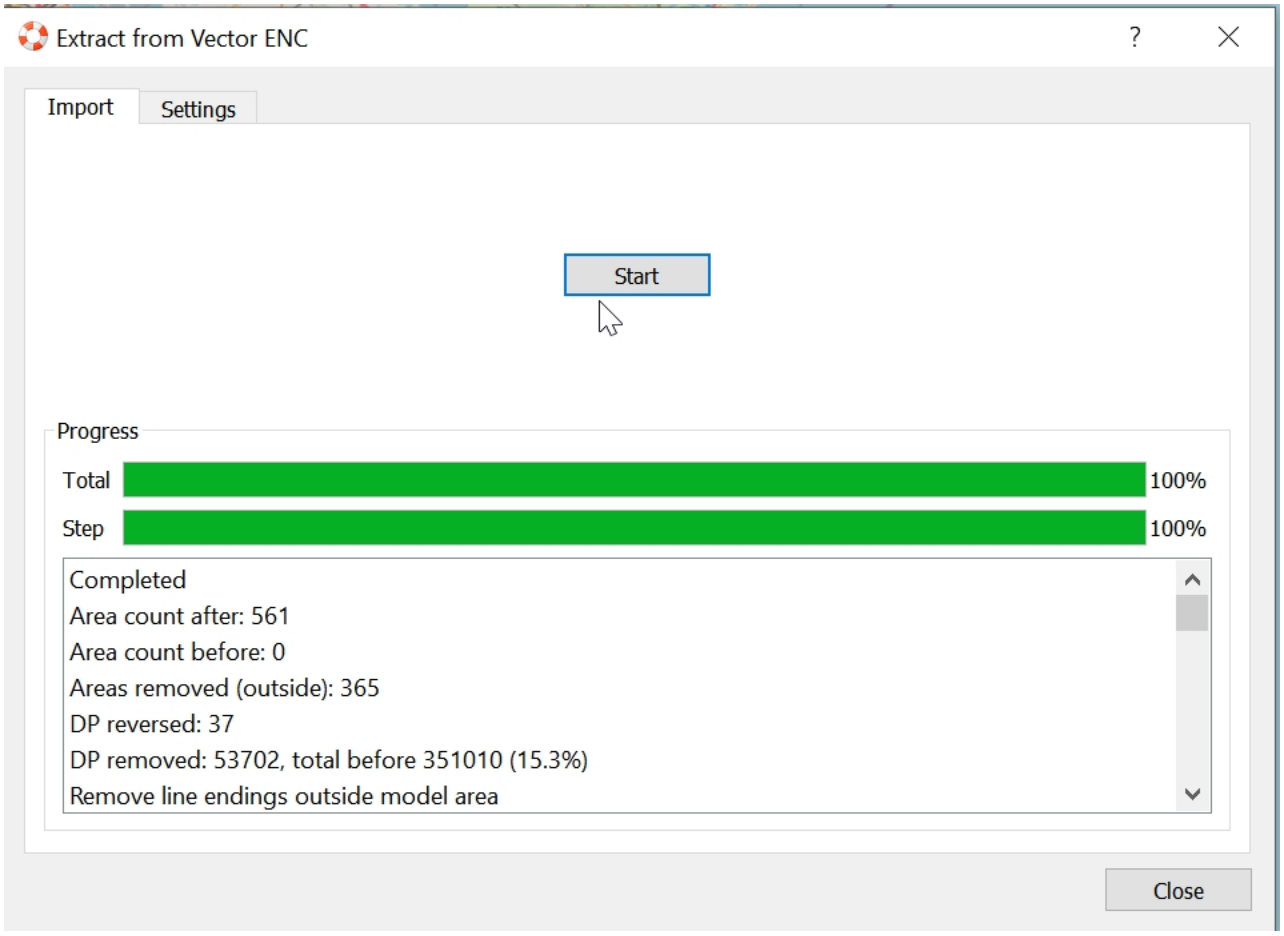
This will show the following dialog.



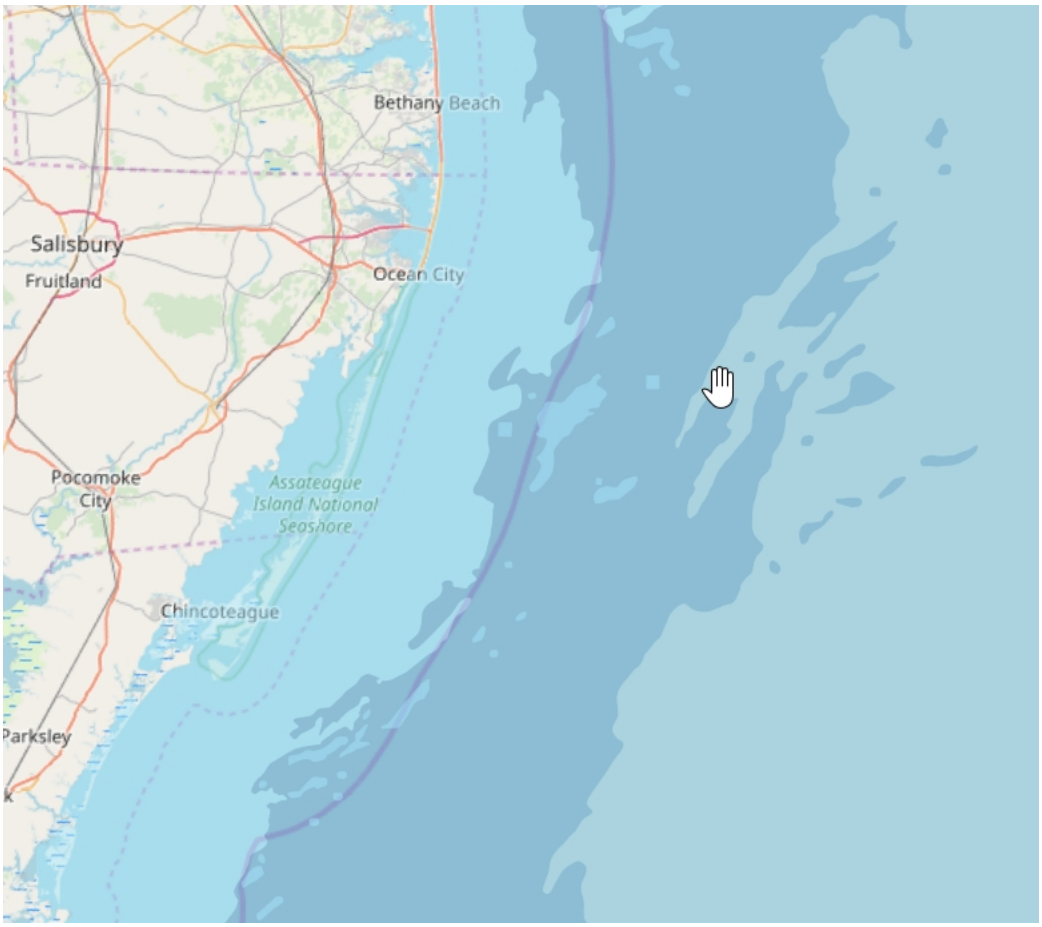
Typically you can just press start and let IWRAP use the default settings.

When you start the import IWRAP will automatically remove all other polygons that have been import by ENC.

Here is an example of importing US NOAA cells.

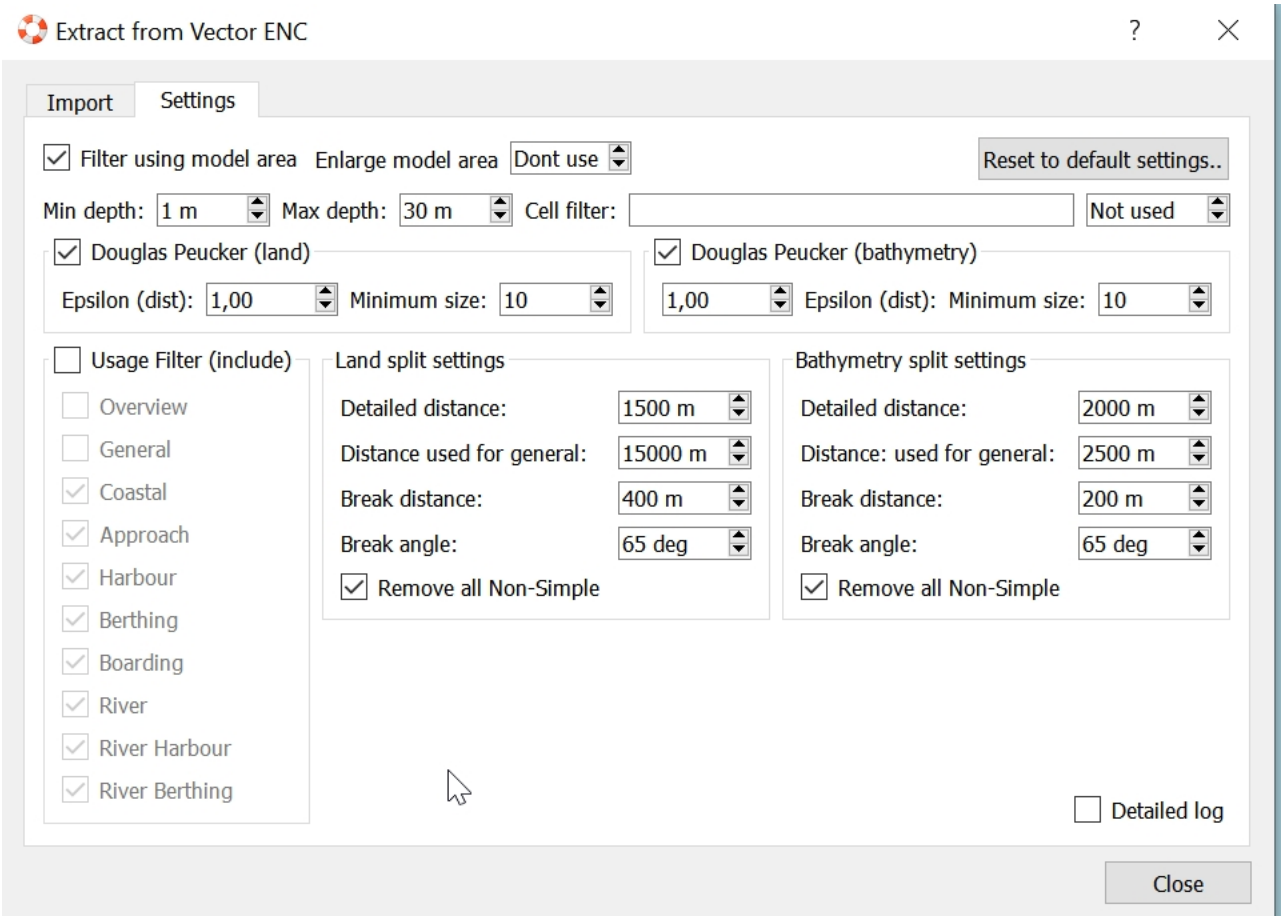



And a part of the extracted bathymetry.




There are also a lot of settings that can be adjusted, the main parameters are:

1. Min/Max depth, by default IWRP does not import land e..g depth zero, because ENC typically has a 1 meter curve. Max depth is by default 30 meters.
2. The Douglas Peucker algorithm is used to simplify polygons in order to not get too many vertices, and Epsilon value of one meter is used by default.This algorithm decimates a polygon/curve composed of line segments to a similar curve with fewer points. You might want to disable the algorithm if you get gaps in the extracted data.
3. Usage Filter, ENCs are divided into different usage categories with different levels of detail, e.g. Harbour is more detailed than Overview. In some cases you might want to force the use of the General level. IWRAP will by default try to automatically figure out if General should be included.
4. Lan split and Bathymetry split are advanced settings that are used by IWRAP to determine which vertices are actual depth curves and which are just cell boundaries.




## Extract from ESRI Shape

ESRI Shape files can be imported using:

On the toolbar, or Data/Bathymetry/Import ESRI Shape...

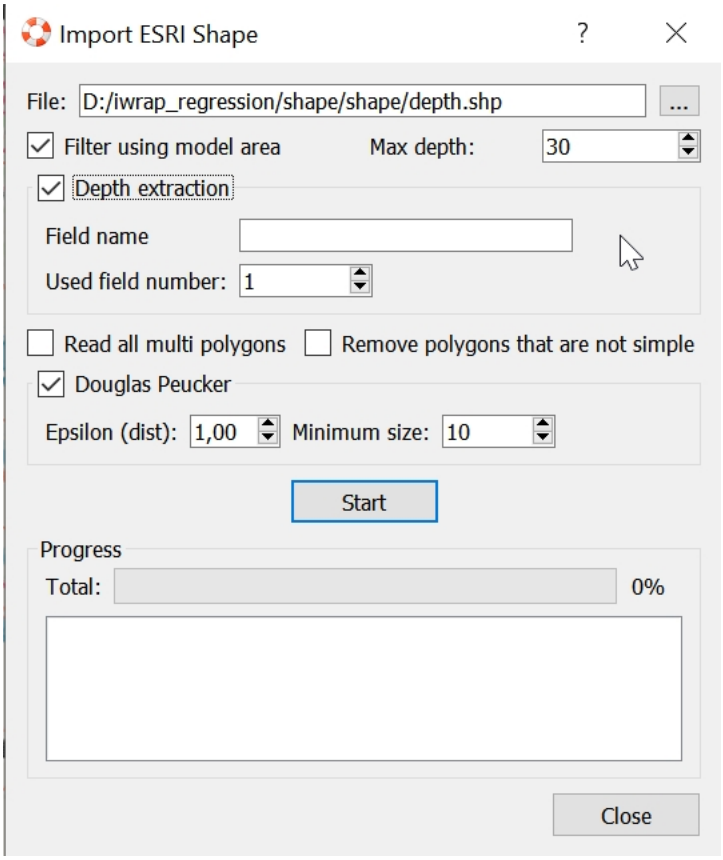
You must specify the file to be imported, in the example shown belo it is called depth.shp.

In order to extract the actual depth value you should specify the field name or the field number that contains the depth value.

IN order to minimize the polygons extracted it is recommended that you enable "Filter using mode area" and set the Max depth to e.g. 30.

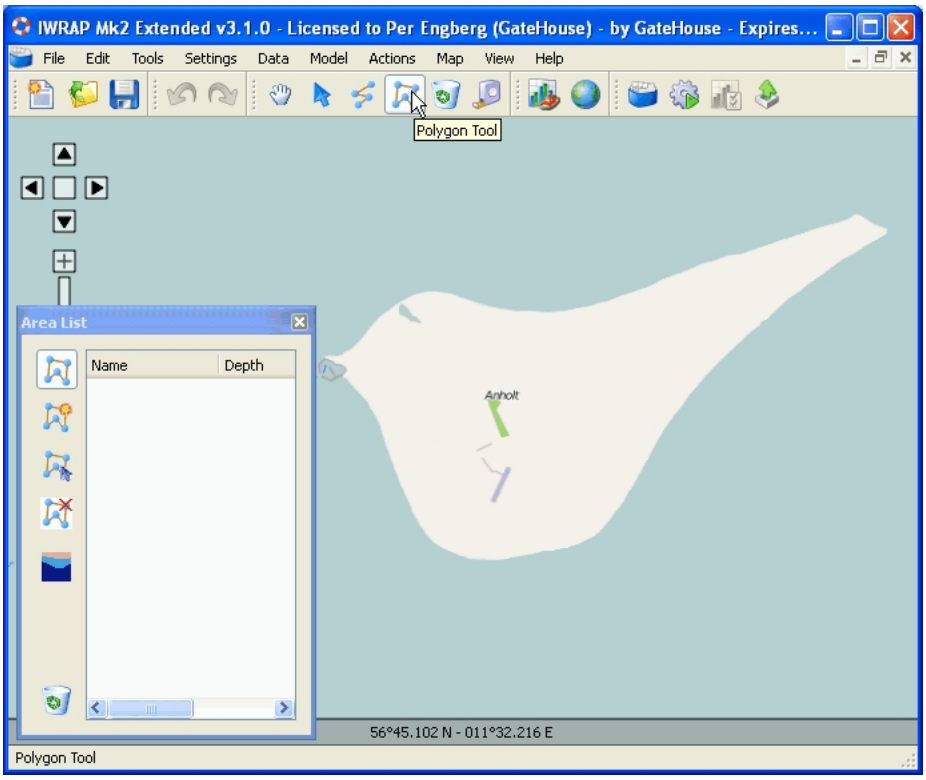
The Douglas Peucker algorithm is used to simplify polygons in order to not get too many vertices, and Epsilon value of one meter is used by default.This algorithm decimates a polygon/curve composed of line segments to a similar curve with fewer points. You might want to disable the algorithm if you get gaps in the extracted data.

When you start the import IWRAP will automatically remove all other polygons that have been import from the same Shape file.

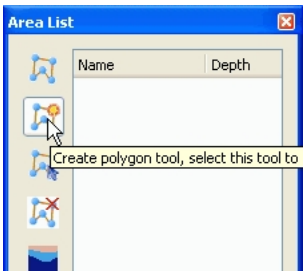



## Defining Structures

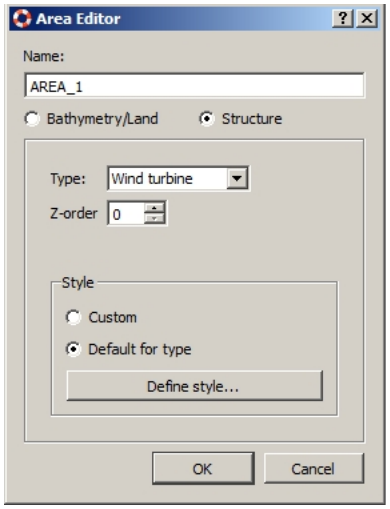
Structures can be defined using one or more polygons. The structure polygons are created the same way as bathymetry polygons. If you want to add a bridge, please use the Bridge Editor. Start by zooming in on the region of interest and select the polygon tool from the toolbar:




The 'Area List' is shown in the lower left corner of the screen. In order to add a new polygon/area select the 'Create polygon tool'.



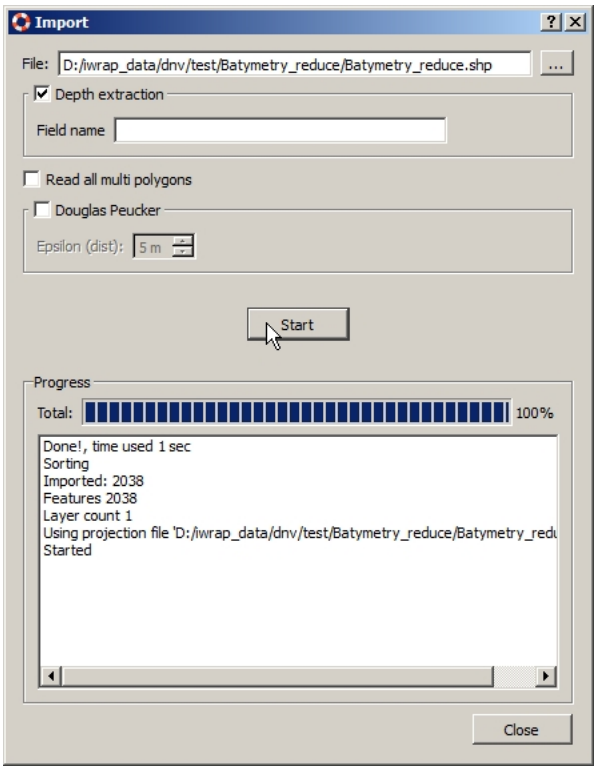

The 'Area Editor' is invoked, enter name  of the area:




Select the 'Structure' radio button and select the type of structure you want to model. Press ok and the new area is added to the 'Area List'. You can always double-click on an item in the list to bring up the 'Area Editor'.

Besides this the structure polygon is created the same way as a bathymetry polygon.

Polygons for Structures can also be imported from the Data menu from ESRI shape or KML files. E.g. import a Structure shape file from 'Data/Structure/Import ESRI shape file...'.

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When importing Shape files it is possible to specify a field that contains the depth of the

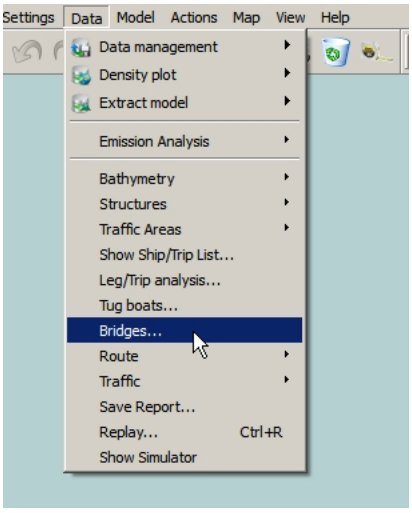
polygon. Furthermore it can be specified how multi polygons are to be handled, sometimes all of them should be included, but the default is to only include the first layer (i.e. they may be interior rings).

For both Shape and KML files you can choose to simplify the polygons by using the Doglas-Peucker algorithm.

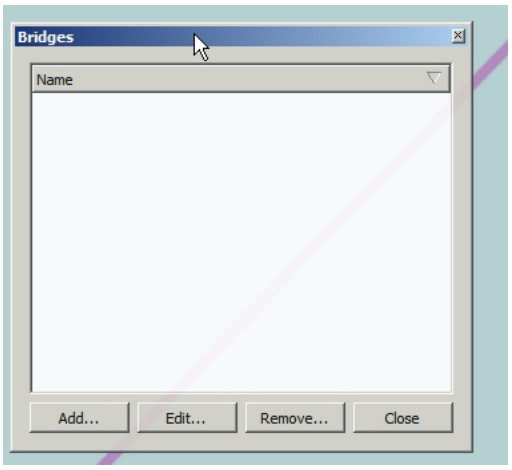
Note that when you import polygons from a file each polygon is tagged with the name of the file. Each time you import the file the polygons from that file will be deleted first.

## Bridge Editor

Bridges should always be created using the Bridge editor. In order to create a bridge, select 'Data/Bridges...' in the menu.



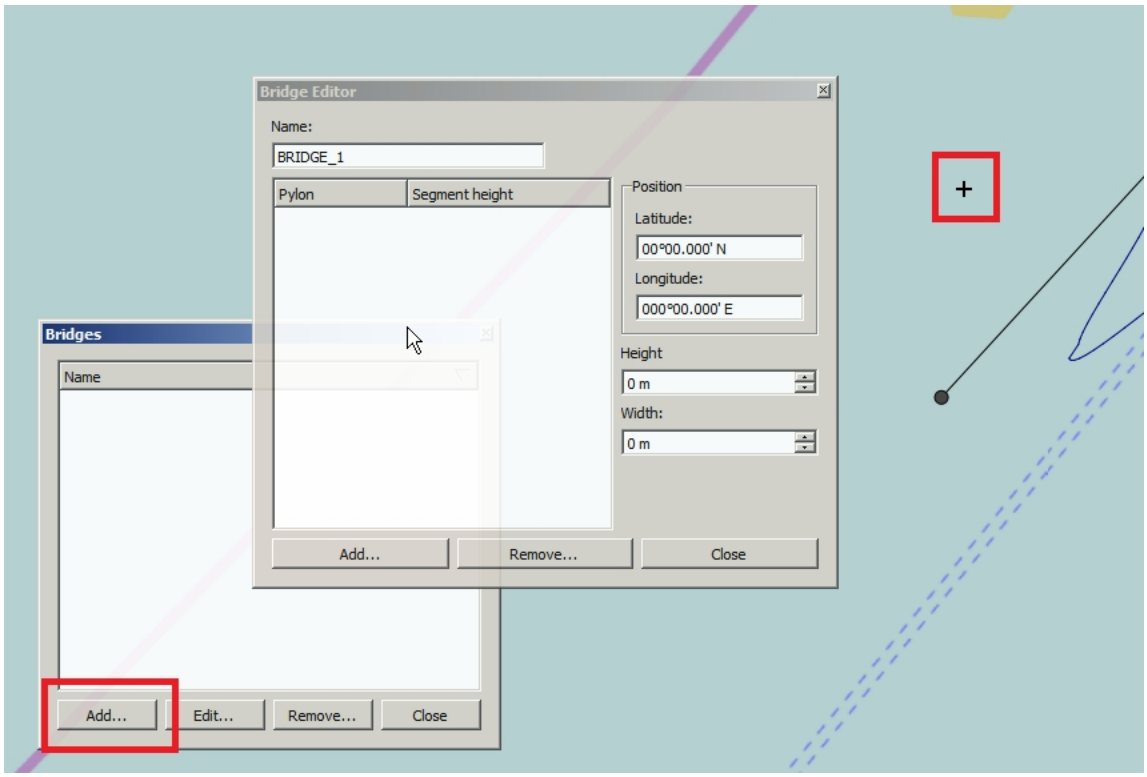

This will bring up the Bridge list widget:



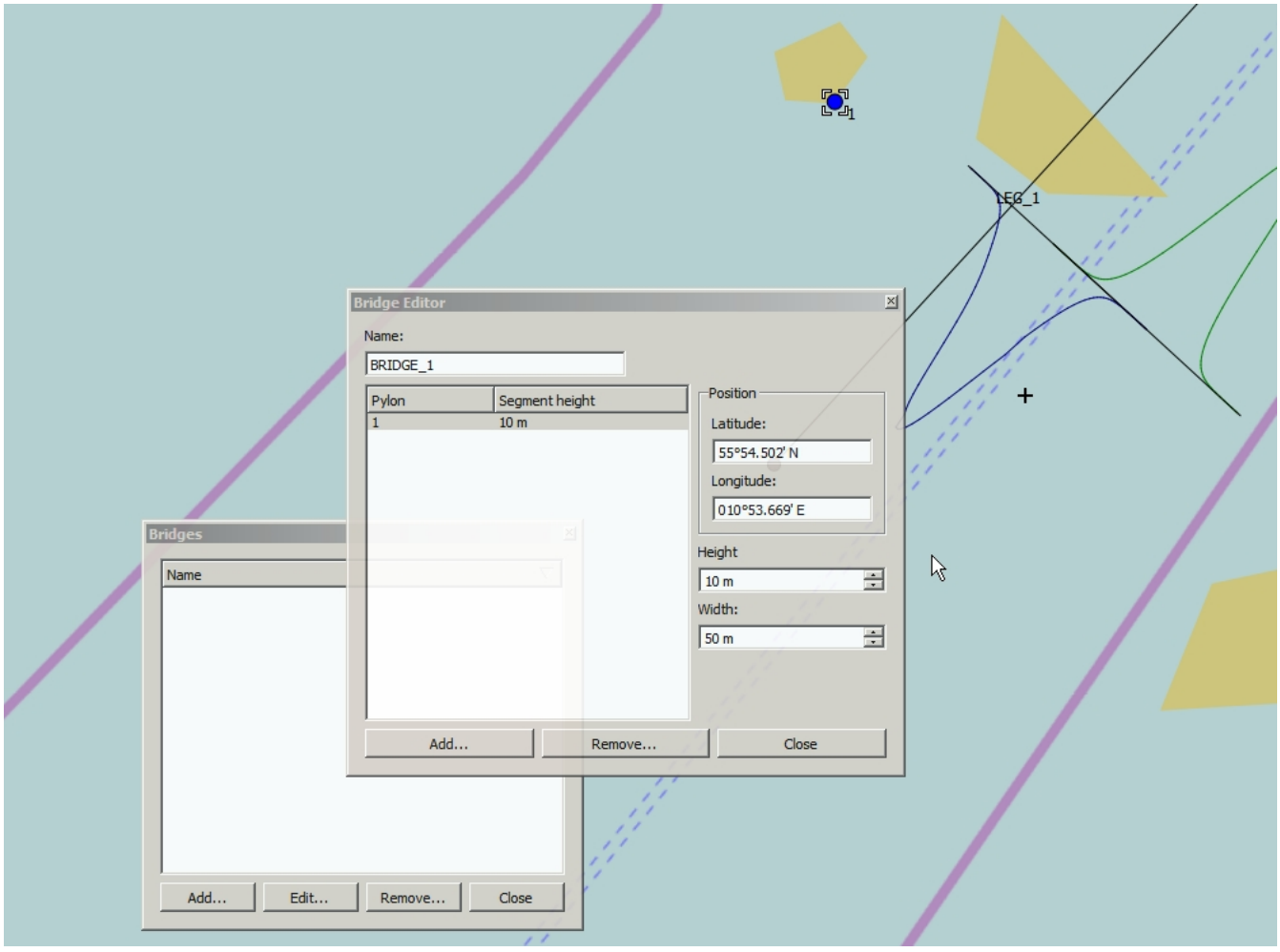

This list will contain all the bridges that you define.

Press the 'Add' button in the lower left of the list widget in order to add and define a new bridge:

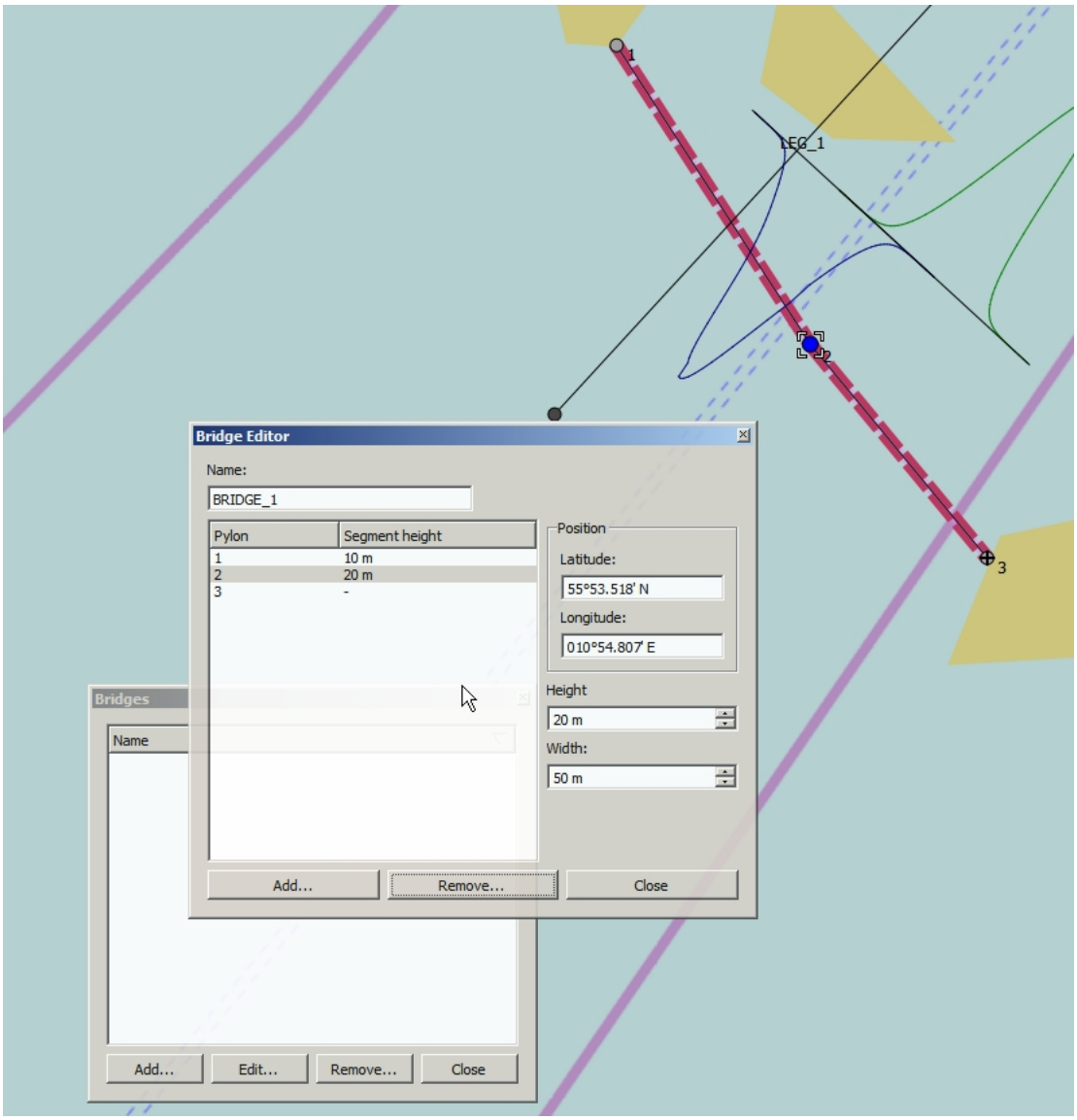
This will bring up the Bridge editor widget:




Here you add the pylons of the bridge. You can specify the height of the following bridge segment as well as the width. When you press 'Add' a pylon is added at the + shaped marker on the chart, here highlighted by a red box. After you have added the Pylon, you can drag it on the chart or adjust the position in the latitude/longitude fields.

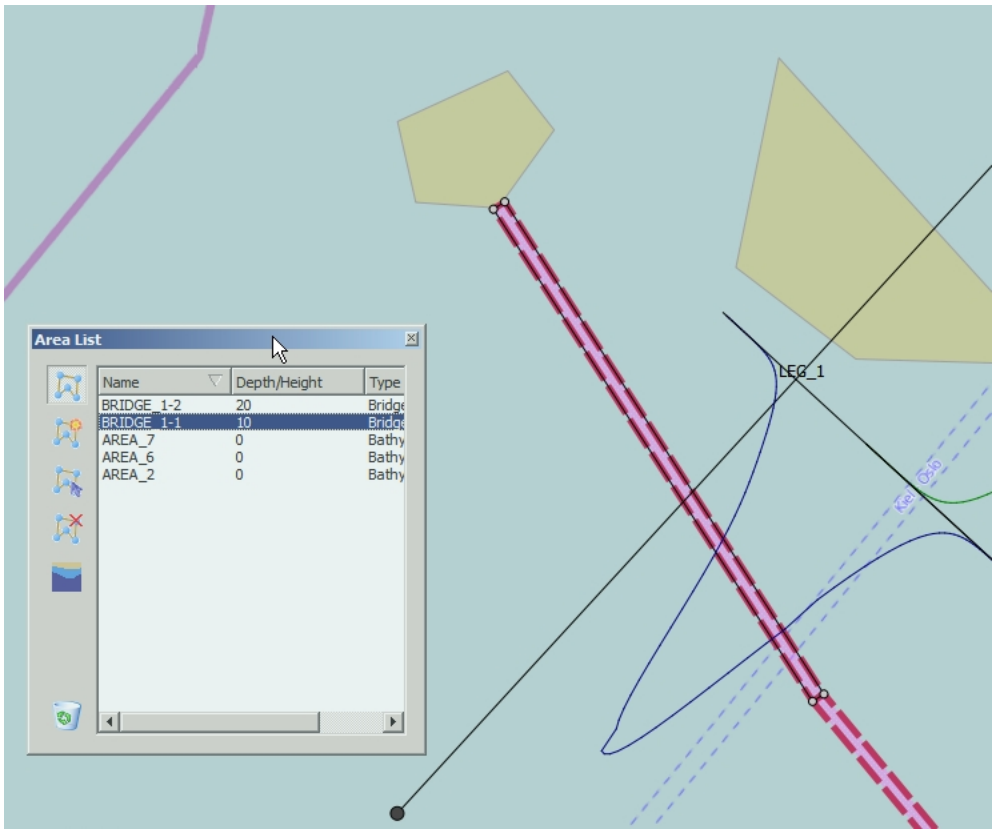


After you have added the first Pylon, simply move the center of the chart i.e. the + to the location where you want to add the next pylon and press 'Add'.




Here we have a complete bridge, with three pylons, i.e. two segments. The first segment has an average height of 10m and the next has 20m.

After you close the Bridge editor it has created two area polygons, you can inspect them by opening the Area editor. The polygons named 'BRDIGE 1-1' and 'BRDIGE 1-2'. If you need to modify these polygons you must do it using the Bridge editor, otherwise you risk losing your changes. If you want to delete them you should also do it via the Bridge editor.



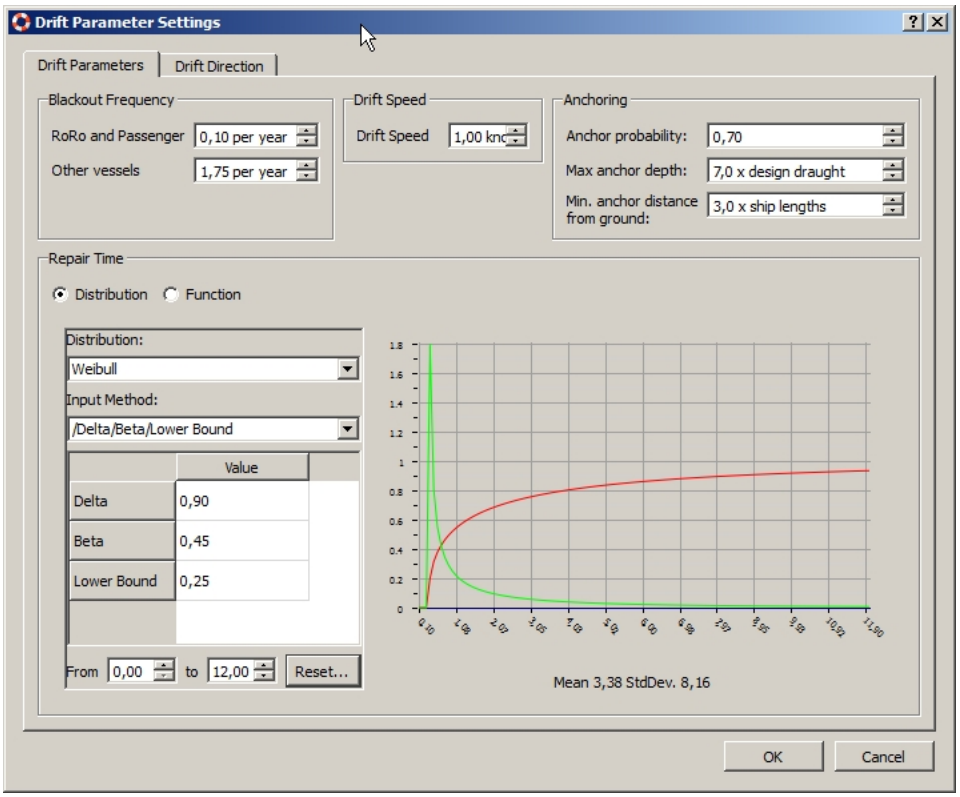

## Drifting

The two main causes for a ship to be drifting are 'rudder stuck' and blackout of the main engine. 'Rudder stuck' is not dealt with in IWRAP. A blackout may be caused by e.g. contaminated fuel, internal fault in the main engine, or failure of the electrical system. The seriousness of the incident depends on the location at which the blackout occurs, the wind/current direction, wind/current speed, and of course the duration of the blackout (that is the drifting time). If a high degree of redundancy has been built into the engine room then the command over vessel may be regained in relative short time. In other situations, the drifting time may be of order of hours. The drifting scenario may be remediated either by repairing the

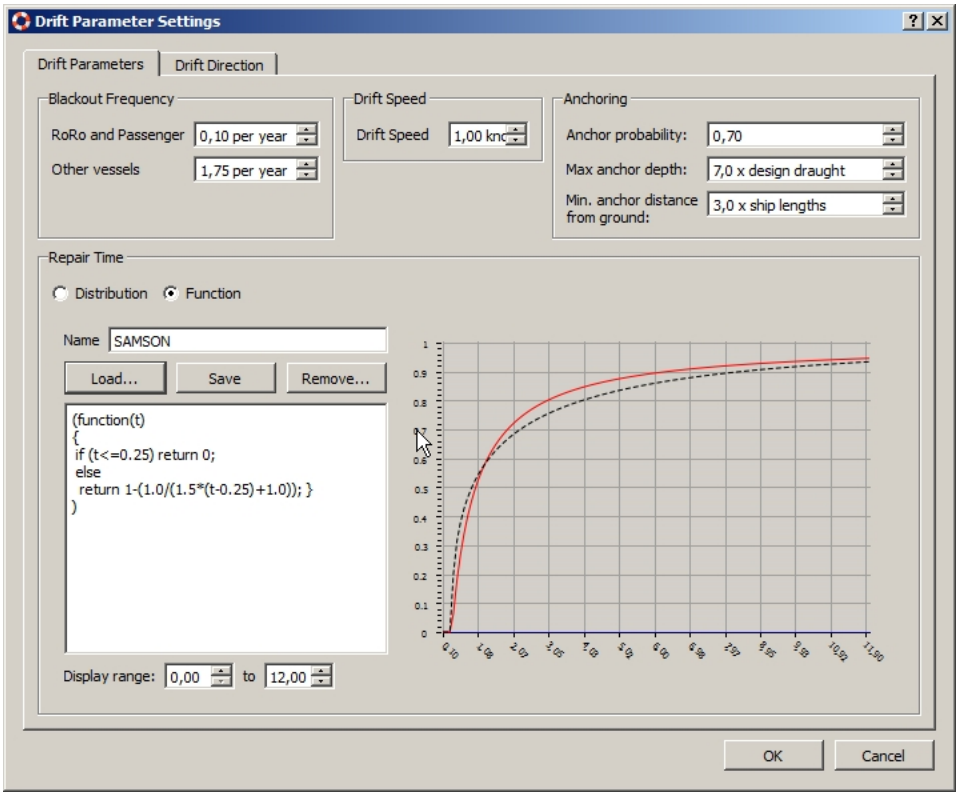
problem, by anchoring the vessel or by calling a tug boat.

Failure of propulsion machinery may occur at any location along the Leg. A Poisson process is used to model the probability of having a blackout along a leg segment of length.

The probability of no repair is defined by the complementary distribution function of the repair time distribution. The default repair time distribution is modeled as a Weibull distribution.

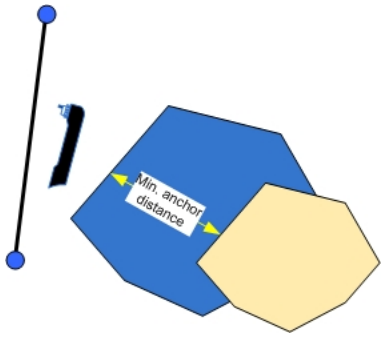



It is also possible to select a function, you can write your own or e.g. load a predefined.

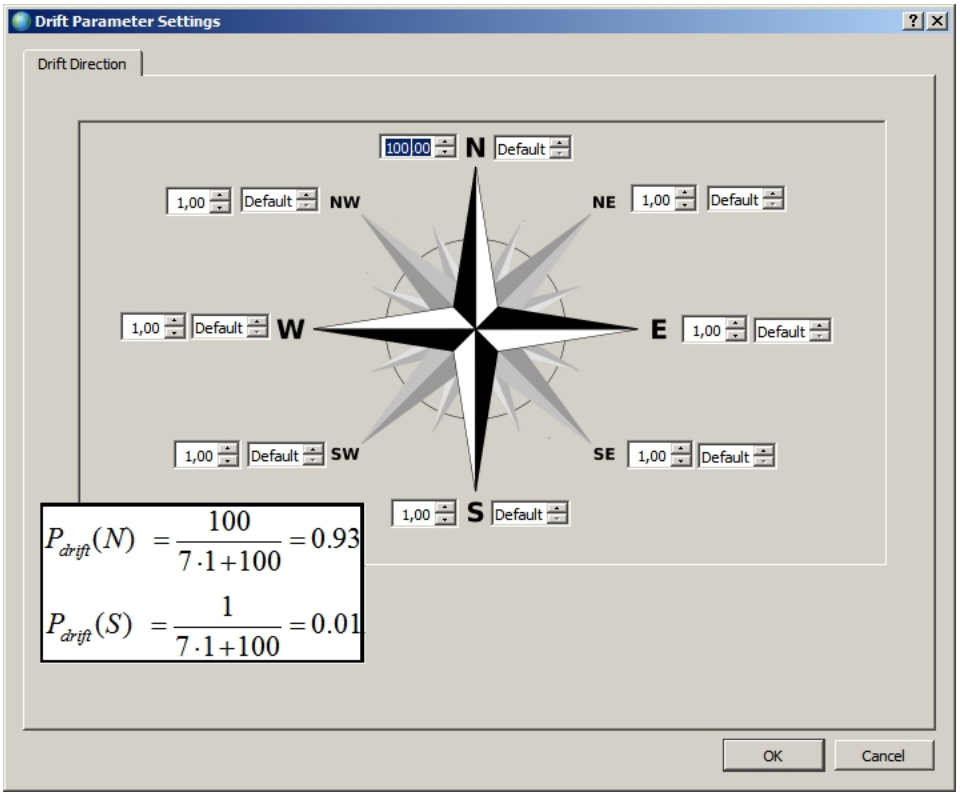



The probability of anchoring when drifting can be specified, note that a certain minimum

distance is required for the ship to anchor, i.e. there must be an area that is below the max anchor depth that is longer than the minimum anchor distance in order for the ship to be able to anchor.



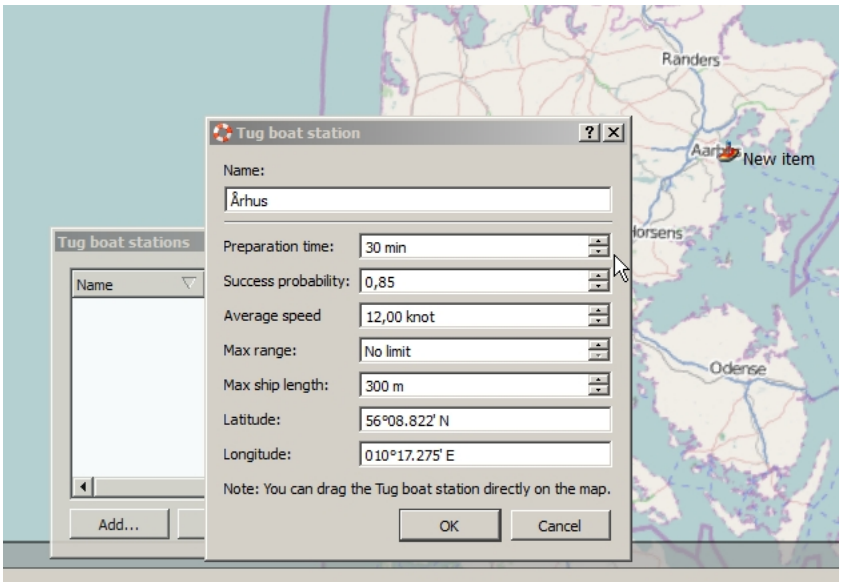

The drift direction can currently only be specified for the entire area. Note that this is not a windrose, the factors in each direction can be used to specify the drifting direction.




In the shown example the N factor is set to 100 and the rest to 1, this means that the probability of a north bound drifting direction is 0.92 and the other directions have a probability of 0.01.

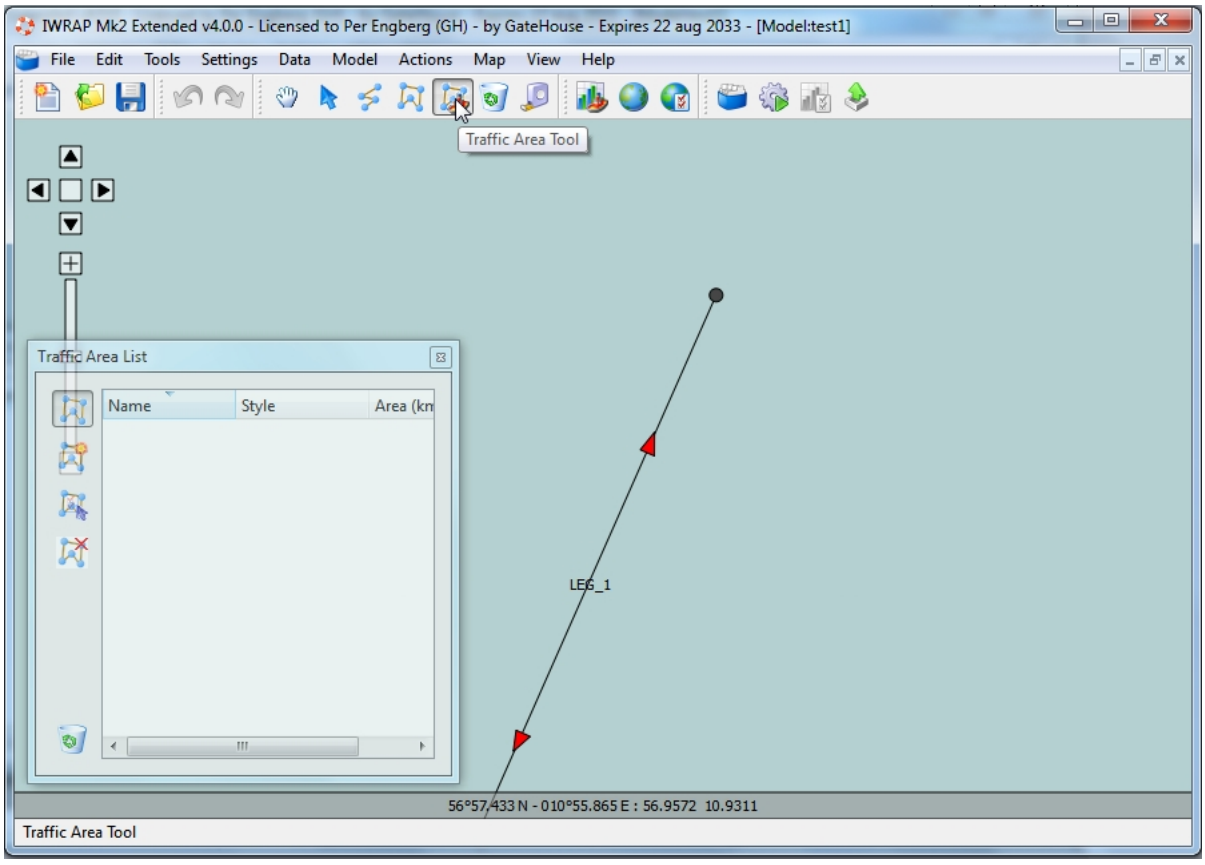
It is also possible to set the maximum drift distance for each direction, default is 50km.

It is possible to specify the location og tug stations and define their range of operation. This can be done from the menu 'Data/Tug boats...', this will invoke the 'Tug boat stations' dialog. Select 'Add..' to add a new tug boat station. Using these definitions it is calculated if the tug boat can reach the drifting grounding or allision event in time. If this is possible the success of the actual tug operation is specified by the 'Success probability'.

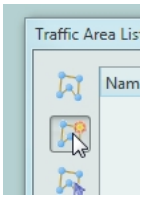



## Traffic Area

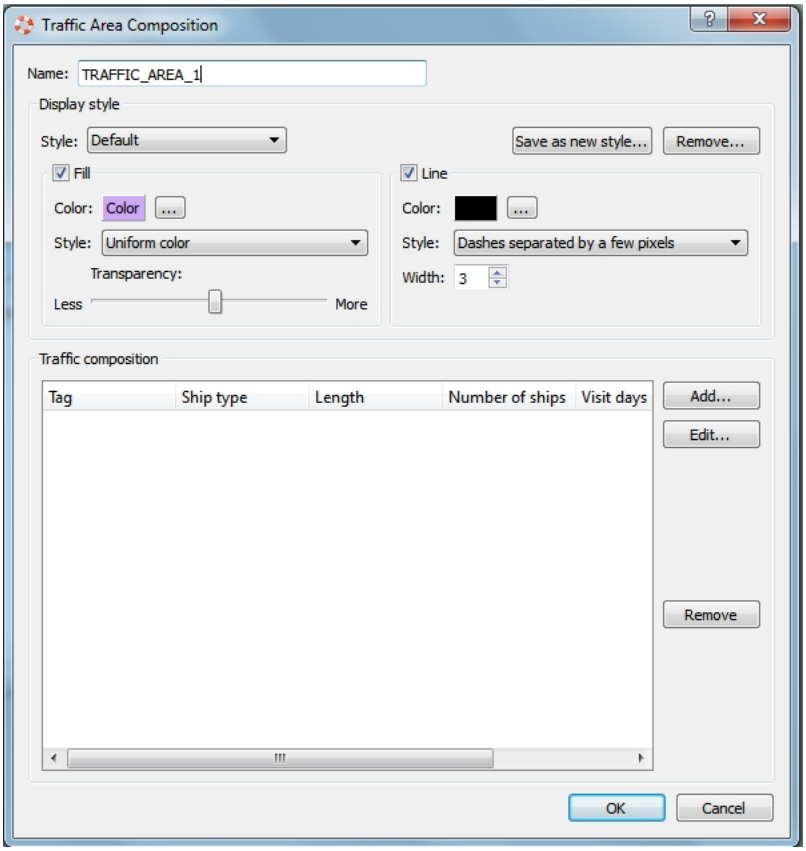
A Traffic Area can be used to model traffic that does not follow traffic lanes e.g. fishing or dredging In order to add a Traffic Area, start by zooming in on the region of interest and select the 'Traffic Area' tool from the toolbar:



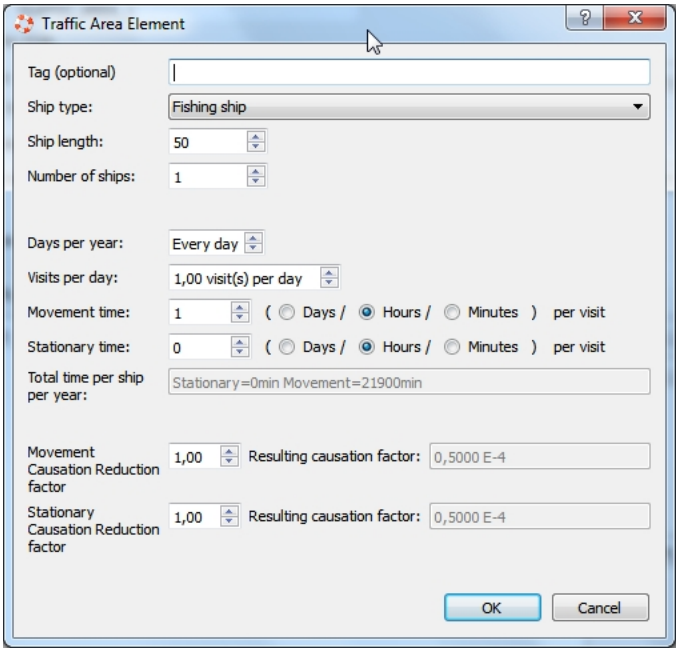

The 'Traffic Area List' is shown in the lower left corner of the screen. In order to add a new traffic area select the 'Create polygon tool'.



The 'Traffic Area Composition' dialog is displayed:



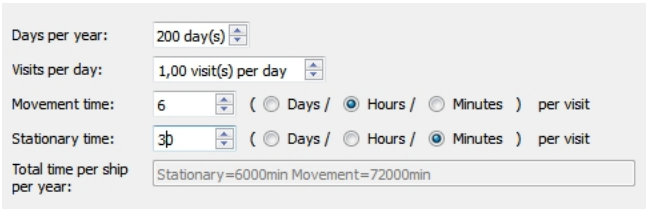

The 'Traffic Area Composition' dialog is used to define the different types of traffic in the area. Press the 'Add...' button in order to add a new Traffic Area Element.



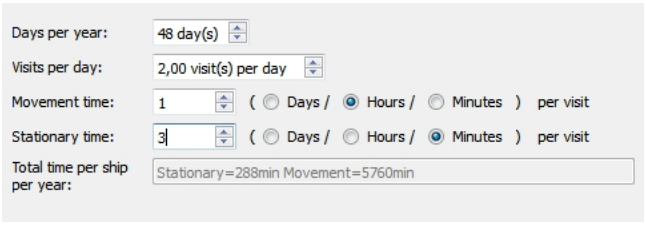

Choose the type of ship you would like to model, the average length and the number of ships.

Next you have to specify how often and how long time the ships are moving and are stationary inside the area.

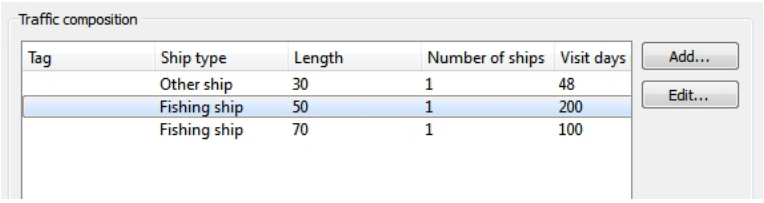
If you e.g. have a number of fishing ships, the configuration could be like this:




If you e.g. have a number of dredging ships, where each ship is active 48 days per year and each of these days the ships make two trips to the area, in each trip it is stationary for 3 hours and moving for 1 hour, the configuration could be like this:



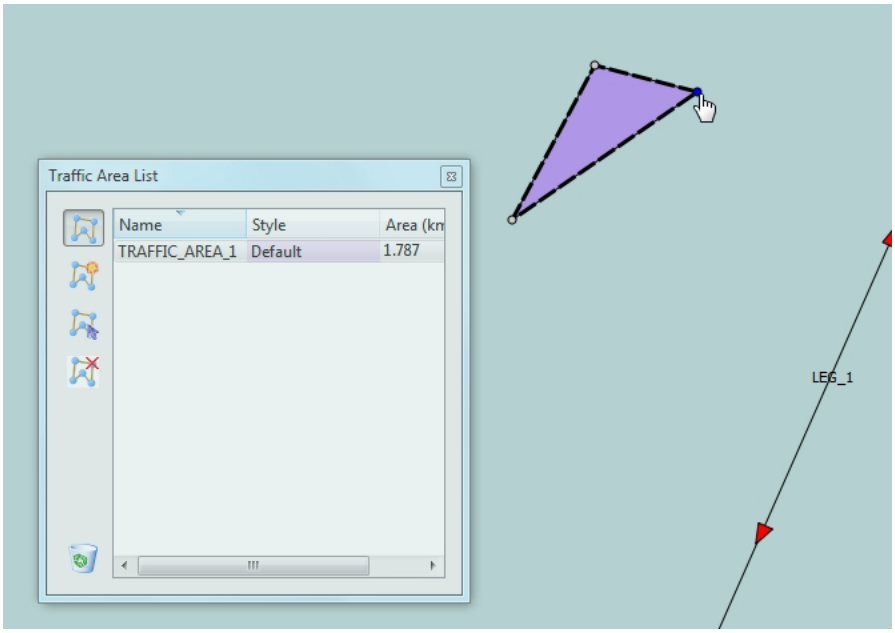

Press Ok when done. You can add as many Traffic Area Elements as you want to the Traffic Composition:




You could e.g. add different fishing or dredging patterns.

When you are satisfied with the Traffic Area Composition, press Ok.

Now you must start drawing the area by clicking on the map and thereby adding vertices to the area polygon. See Defining Bathymetry for more detailed description on how to handle area polygons.




## Using Data

This section describes how to use data, e.g. AIS data. In order to use the data for risk analysis you need to have the commercial license, this means it is not possible to create a density plot or extract model data from AIS using the free version. It is however possible to try and import AIS data in the free version and e.g. try and do a replay of the

data.

## Importing Static Ship Type Data

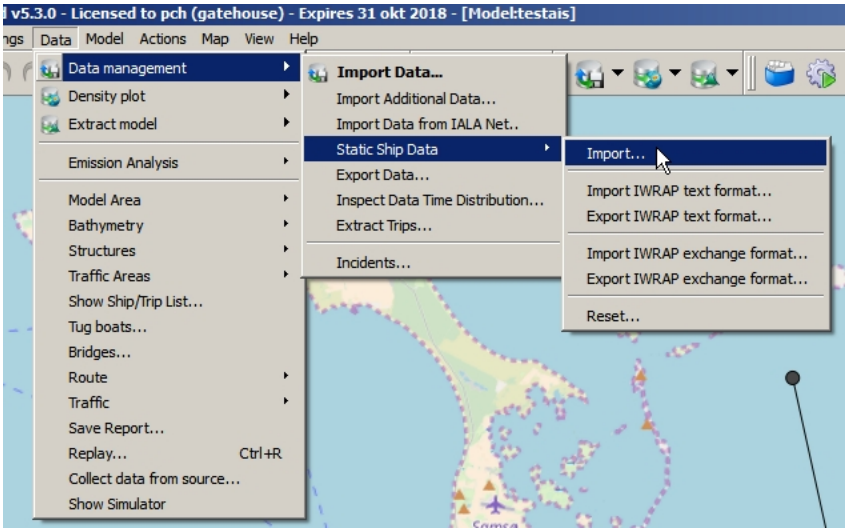
This step is used to populate the IWRAP Static Ship Data database. This can be used to identify the correct type and length of specific ship. This step is not mandatory, if it is not used the ship type and length will be extracted from the dynamic data, i.e AIS data (mesg 5).

IWRAP MK2 distinguishes by default between the following ship types:

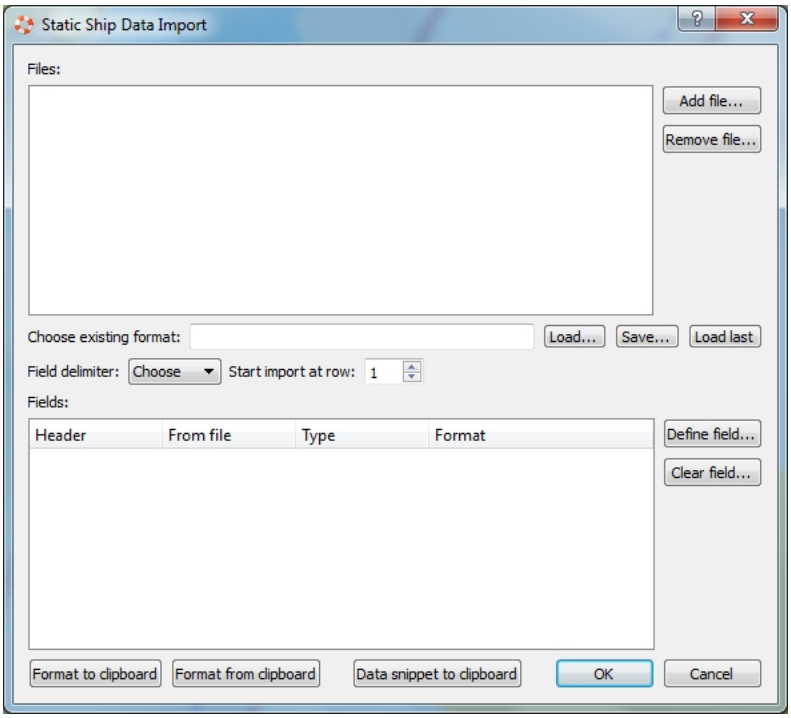
- Crude oil tanker
- Gas tanker
- Container ship
- General cargo ship
- Bulk carrier
- Ro-Ro cargo ship
- Passenger ship
- Fast ferry
- Support ship
- Fishing ship
- Pleasure boat
- Other ship

Each ship type is divided into a number of length categories in 25m intervals, 0-25, 25-50 etc., ending with 400 and above. Not all these types can be derived from AIS, this means an alternative data source is needed to distinguish e.g. between the different tanker types, e.g. Lloyds.

In order to import the data, select 'Data/Import Static Ship Data' from the menu:



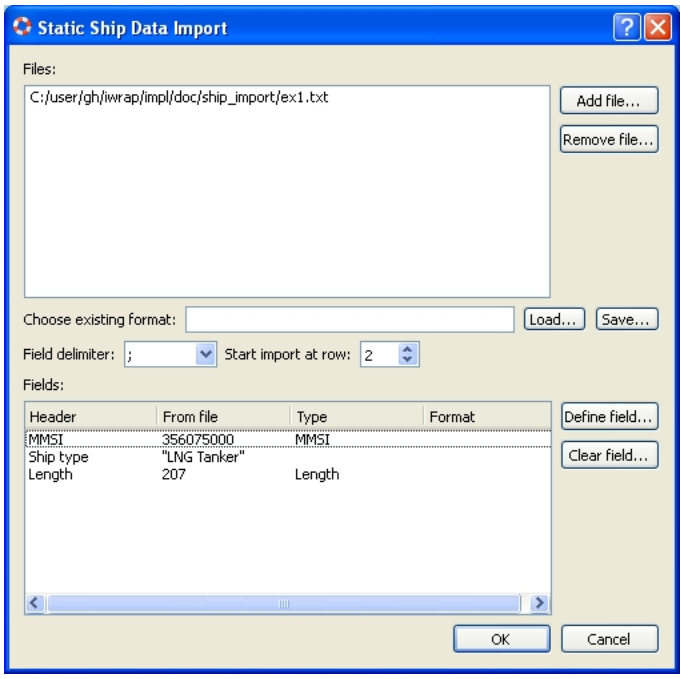

the 'Static Ship Data Import' dialog is invoked:




IWRAP supports import of text files with different separators. The text file should contain an MMSI number, a ship type (in Lloyds format) and the length of the ship. A file could e.g. look like this:

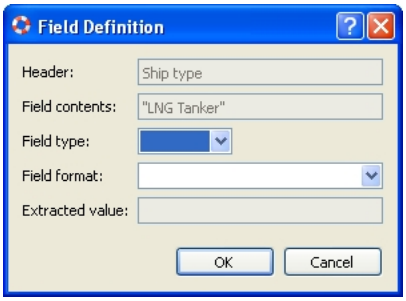
MMSI;Ship type;Length
356075000;"LNG Tanker";207
219495000;"General Cargo Ship";69

This example file contains a header and 2 ships. Press 'Add File...' to add the file, IWRAP will guess which field separator/delimiter is used in this case semicolon. IWRAP also automatically detects that the first line is a header, and therefore 'Start import at row' is set to 2, and that the first column contains MMSI and the third is the Length.

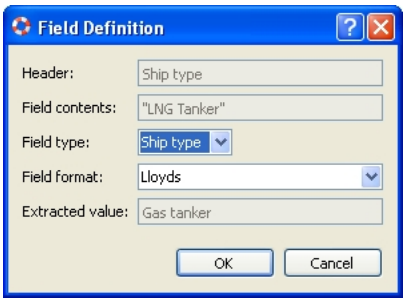



IWRAP therefore add 3 lines to the Fields list. The second line with Header 'Ship Type' does not have a type, you must specify this yourself, select the line and press 'Define Field...' or

simply double click on the line, the 'Field Definition' dialog is shown:



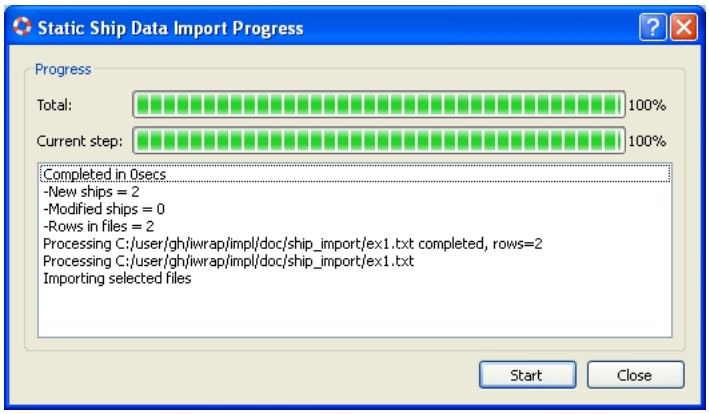

Set 'Field type' to 'Ship Type' and set 'Field format' to 'Lloyds.




IWRAP indicates how the field will be interpreted i.e. the 'Extracted value' will be 'Gas tanker'. IWRAP supports 3 ways of specifying type:

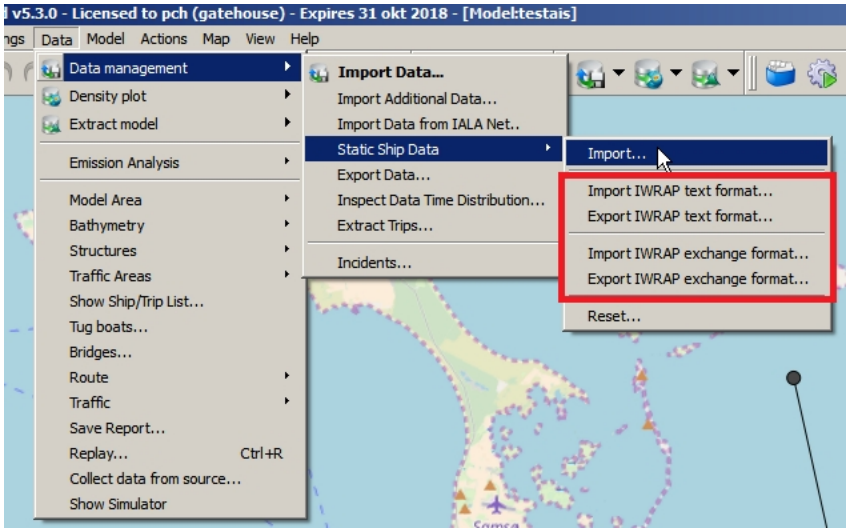
- 1. Lloyds: Uses Lloyds definition of ship types and maps them to IWRAP types.
- 2. AIS: Uses definition from Message 5: Ship static and voyage related data ITU-1371, see 'Type of ship and cargo type' field, so e.g. 60 is a passenger ship, 80 is a tanker etc.
- 3. IWRAP: it is also possible to specify the IWRAP types directly (case insensitive)
  - Crude oil tanker
  - Gas tanker
  - Container ship
  - General cargo ship
  - Bulk carrier
  - Ro-Ro cargo ship
  - Passenger ship
  - Fast ferry
  - Support ship
  - Fishing ship
  - Pleasure boat
  - Other ship

Press ok to close the 'Field Definition' dialog, press ok again to display the 'Static Ship Data Import Progress' dialog. Press 'Start' to import the data



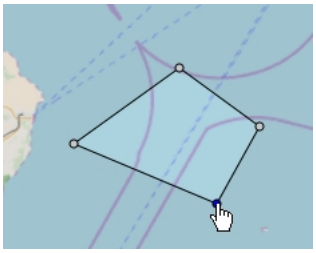

The data has now been imported to the database.

If you have several PC or you want to share your database with other users you can use the different Import/Export features. use the "Import/Export IWRAP exchange format..." to exchange with other IWRAP users:




## Importing AIS Data

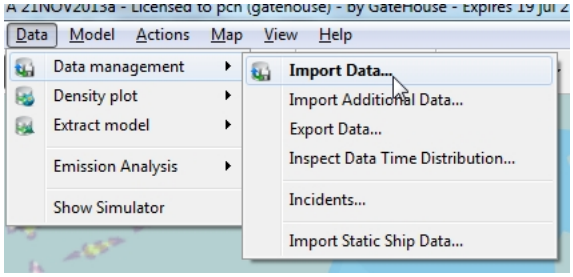
Before you import AIS data you need to define your model area. The model area is a polygon that defines the geographical extent of the model. Use to create the model area and click on the map to add model area vertices, each time you click the map a new vertice is added. You can move the vertices by dragging them or add more if needed.



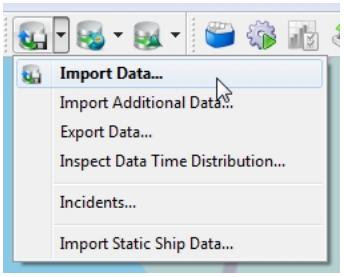
The model area should be as simple as possible i.e. contain as few vertices as possible to speed up the import.

If you need to clear the model area and start from scratch you can clear it using the "Data/Model Area/Clear Model Area.." menu item

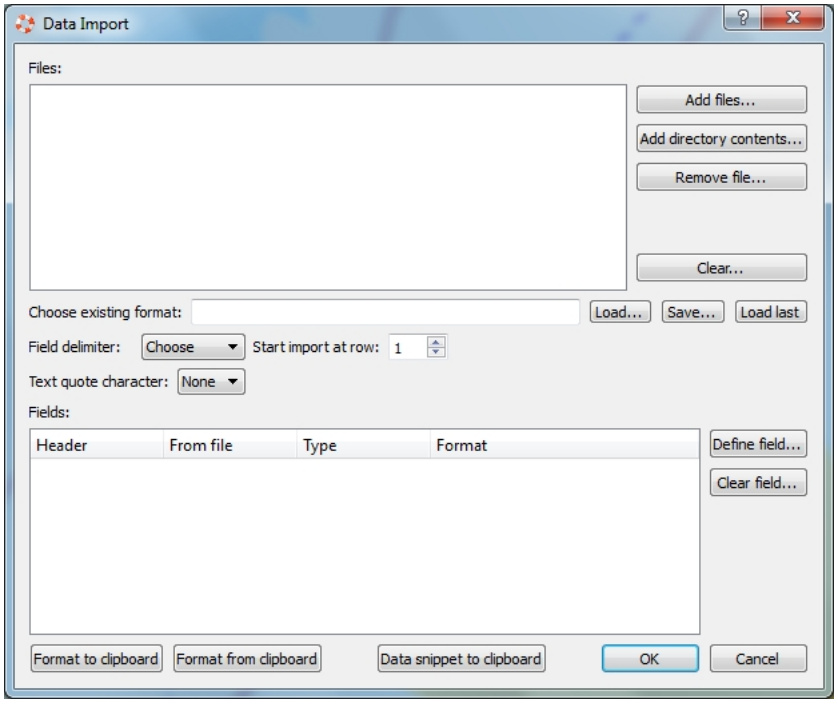
To import dynamic ship data, i.e. typically AIS data, select 'Data/Data management/Import Data' from the menu:




or using the tool buttons:




the 'Data Import' dialog is invoked:




IWRAP supports import of text files with different separators. The text file can have different contents. The recommended format is to have raw AIS NMEA with timestamps, e.g:

1-4-2008 14:06:08 < tab > !AIVDM,1,1,,A,13tsWl?0011:9UHQQj87DHEn00Rj,0*43
1-4-2008 14:06:38 < tab > !AIVDM,1,1,,A,33u=Qm?qh20nEWbQ0IB3K87l0000,0*19
1-4-2008 14:06:58 < tab > !AIVDM,2,1,2,A,53u?j?
P1joL=<@HP000eDhhDp00000000000000l1HA4440HtP00000,0*6A
1-4-2008 14:06:58 < tab > !AIVDM,2,2,2,A,000000000000000,2*26
1-4-2008 14:07:01 < tab > !AIVDM,1,1,,B,14QsDc04Qn19nJ`P1?;9F7Il0800,0*52

< tab > indicates a tab character.

It is also possible to import, this format i.e. no timestamp on the second part of the message 5.

1-4-2008 14:06:08 < tab > !AIVDM,1,1,,A,13tsWl?0011:9UHQQj87DHEn00Rj,0*43
1-4-2008 14:06:38 < tab > !AIVDM,1,1,,A,33u=Qm?qh20nEWbQ0IB3K87l0000,0*19
1-4-2008 14:06:58 < tab > !AIVDM,2,1,2,A,53u?j?
P1joL=<@HP000eDhhDp00000000000000l1HA4440HtP00000,0*6A
!AIVDM,2,2,2,A,000000000000000,2*26
1-4-2008 14:07:01 < tab > !AIVDM,1,1,,B,14QsDc04Qn19nJ`P1?;9F7Il0800,0*52

If you only have raw NMEA data but don't have a timestamp for each line you should divide your data into one file per day (UTC), and name each file with year, month and day, xxx_yXXXX_mX_dX.tmp, e.g.:

myfile_y2010_m2_d1.tmp, myfile_y2010_m02_d01.tmp, myfile_d1_m2_y2010.tmp

If you have Comment Block data, select the NMEA format, e.g.

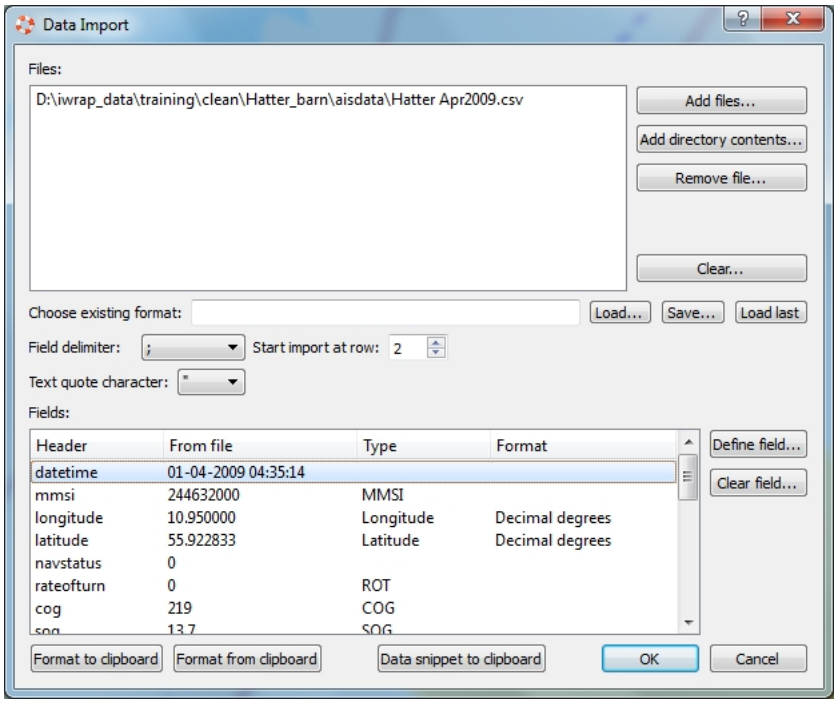
\g:1-2-
0569,c:1351245336*22\!BSVDM,2,1,0,A,53P;1j@2@0i784uOH010Dq@4hTp400000000000t1@
t::6e;N5Tm83@DQhDQ,0*58
\g:2-2-0569*57\!BSVDM,2,2,0,A,E4p23l1@002,0*20
\c:1351245453*5E\!AIVDM,1,1,,B,13P;1j@01uOjJ2jQbfk3eC140<0L,0*4A
\g:1-2-0570,c:1351245244*2E\!BSVDM,2,1,0,A,53l;DL01r5P3TP`GP00= \g:2-2-
0570*5F\!BSVDM,2,2,0,A,00000000002,0*3D
\c:1351245453*5E\!BSVDM,1,1,,B,13l;DL000g0daWNOjJ>s:I4f0HCM,0*6F

You can also import data from a CSV file like:

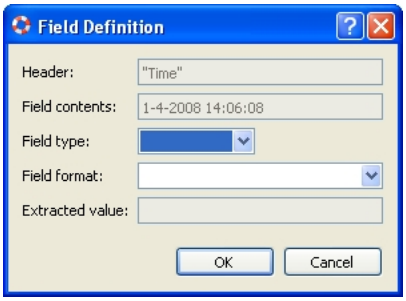
"Time";"mmsi";"Lon";"Lat";"COG";"SOG";"Heading";"IMO";"CallSign";"Name";"TypeOfShipAnd
Cargo";"Size_A";"Size_B";"Size_C";"Size_D";"Draught"
1-4-2008
14:06:08;355863000;10,542466670;55,492083330;136,900000000;5,600000000;146;8812631;"3
FRK5";"ID BULKER";70;146;28;16;12;6,200000000
1-4-2008
14:18:26;355863000;10,544116670;55,479200000;239,000000000;3,300000000;241;8812631;"3
FRK5";"ID BULKER";70;146;28;16;12;6,200000000
1-4-2008
14:23:06;355863000;10,537700000;55,476283330;215,900000000;2,400000000;216;8812631;"3
FRK5";"ID BULKER";70;146;28;16;12;6,200000000
1-4-2008
14:32:07;355863000;10,537583330;55,474600000;285,200000000;0,200000000;27;8812631;"3F
RK5";"ID BULKER";70;146;28;16;12;6,200000000

If the file contains quoted strings dont forget to select a Text Quote Character i.e. single or doible quote.

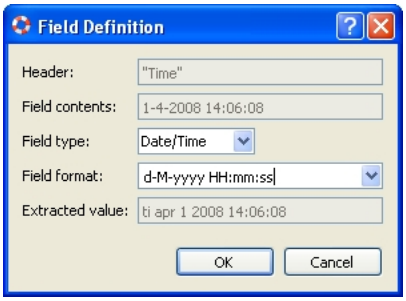
If you have a file like this IWRAP will automatically detect some of the fields/columns using the first line (because it contains 'mmsi').




Notice that IWRAP has inserted a 'type' in some of the fields above e.g. the MMSI number. IWRAP has also automatically determined the field delimiter to be semicolon and the first data row to be the second and thereby skip the header. In this case you have to define the Time field, do this by selecting the line and click 'Define field' or just double-click on the line, the 'Field Definition' dialog will appear.




Select the Date/Time field type and select the Field format:



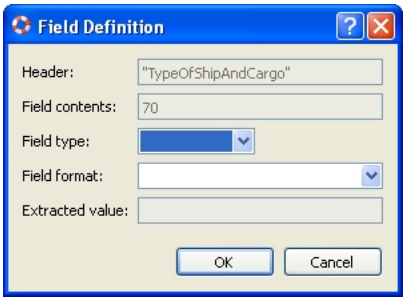

Notice that the 'Extracted value' now reflects the value as interpreted by IWRAP. Please check that the interpretation is correct. If you have another time format that is not listed in the Field format, you can type it directly, see Time Format

The easiest way to input positions is to use decimal degrees, but IWRAP supports a variety of different other formats as well, see Position Format

Press ok to accept the new definition.

Another field that should be handled with care is the 'Ship Type'. In the example handled here a 'TypeOfShipAndCargo' derived from AIS is specified, double-click on this field to display the

Field Definition dialog:

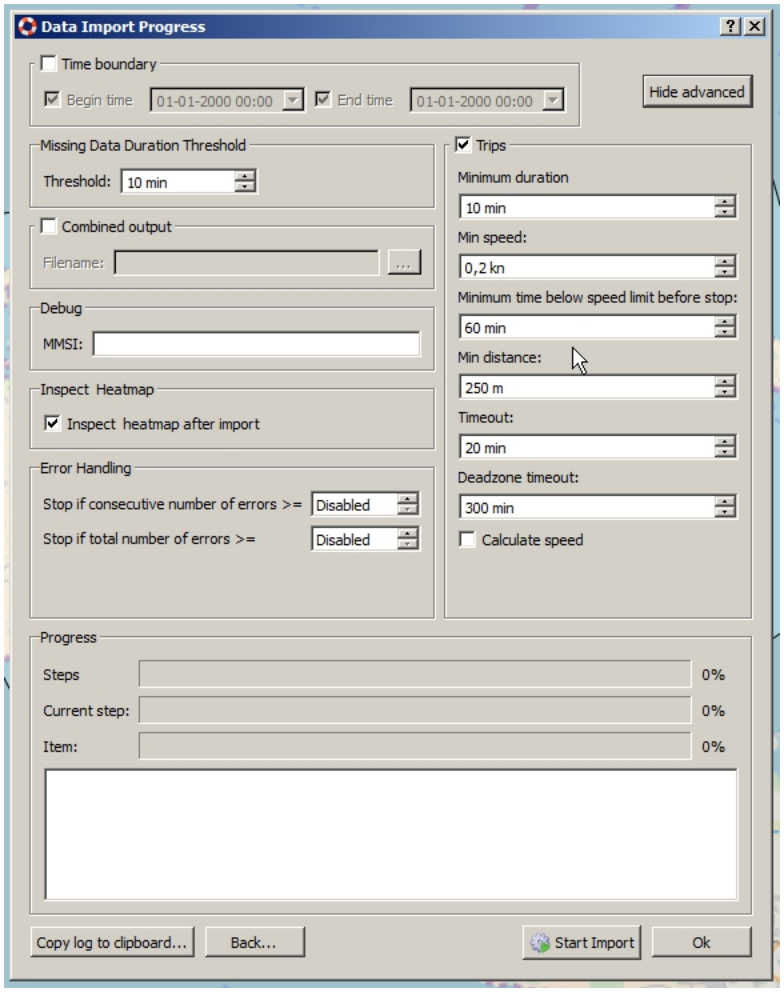



Set 'Field type' to 'Ship Type' and set 'Field format' to 'AIS. IWRAP indicates how the field will be interpreted i.e. the 'Extracted value' will be 'General cargo ship'. IWRAP supports 3 ways of specifying the ship type:

- 1. Lloyds: Uses Lloyds definition of ship types and maps them to IWRAP types.
- 2. AIS: Uses definition from Message 5: Ship static and voyage related data ITU-1371, see 'Type of ship and cargo type' field, so e.g. 60 is a passenger ship, 80 is a tanker etc.
- 3. IWRAP: it is also possible to specify the IWRAP types directly (case insensitive)
  - Crude oil tanker
  - Gas tanker
  - Container ship
  - General cargo ship
  - Bulk carrier
  - Ro-Ro cargo ship
  - Passenger ship
  - Fast ferry
  - Support ship
  - Fishing ship
  - Pleasure boat
  - Other ship

Press ok to accept the new definition.

When all the fields have been defined, press ok again to invoke the 'Data Import Progress' dialog. Here you can limit the dataset in time and geography and you can set the 'Missing Data Duration Threshold'. This threshold is used to determine periods of missing data, the default is 10 minutes. IWRAP keeps track of the data consistency in order to convert the derived figures in to yearly figures.

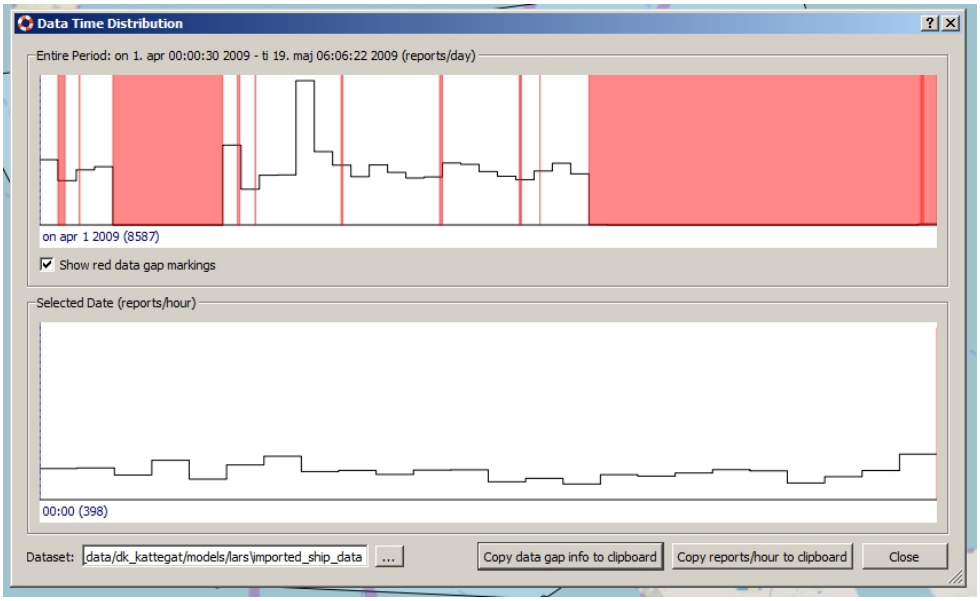



The 'Trips' section is used to extract trips from the dataset, it is possible to uncheck this and do it later from the 'Data/Data management/Extract trips..'' menu.

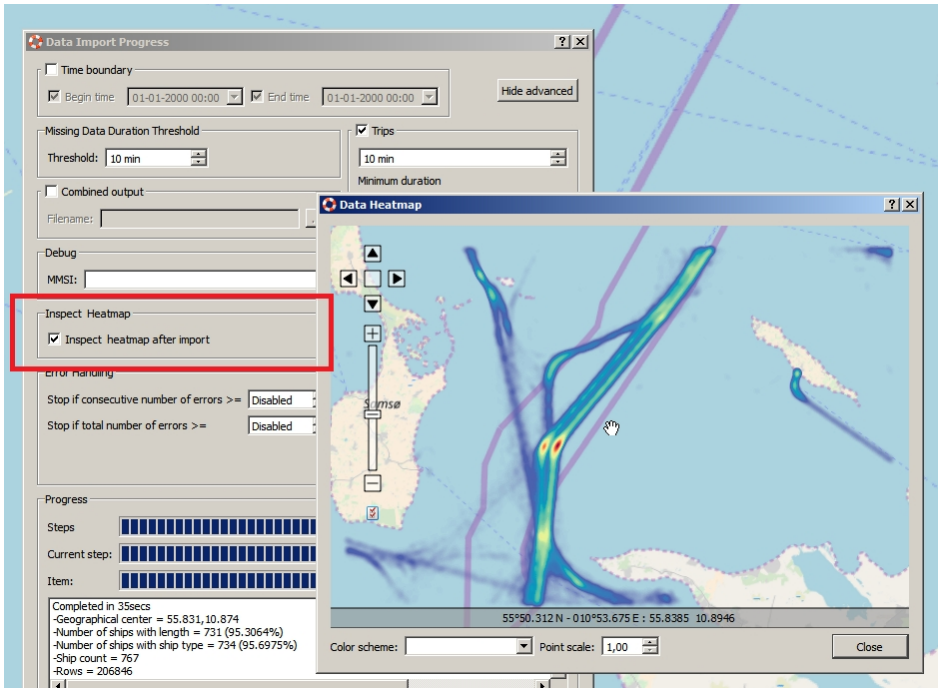
When you choose 'Start import' you must specify a directory for the new dataset. You can only have one dataset per directory.

By default, IWRAP does not stop when errors are encountered in the files, instead a log entry is added to the log window with the errorneous data and the line number in the file. You can make IWRAP stop when errors occur by e.g. defining "Stop if total number of errors >=" the maximum errors that you will tolerate.

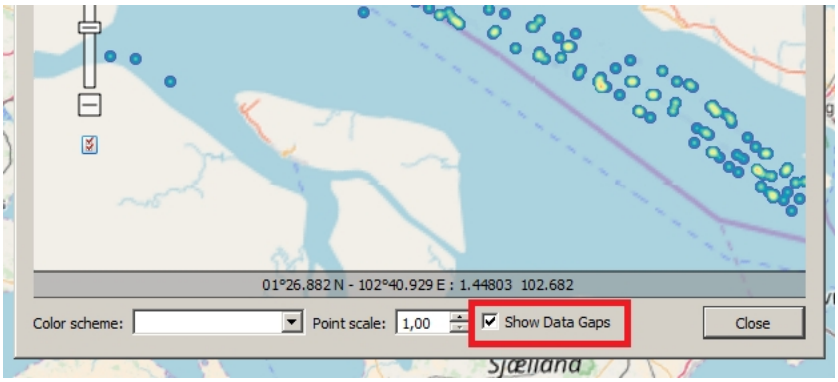
When the data import has been completed a Data Time Distribution view is shown. The top section shows the entire imported period. The bottom section shows one day, i.e. you can hover over the uper section and the lower section will show the detail for the particular day under the cursor. The red areas indicate periods with no data.




When you close the Data Time Distribution view and If you have chosen to create a heatmap view, a heatmap of all imported data points is shown.




"Show Data Gaps" can be used to indicate gaps in the data i.e. ares where there is no coverage, note that that at the boundary of the model area there may be indicated some data problems, these can be disregarded.

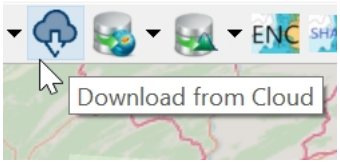


When the dataset has been successfully imported you are ready to try Generating a Traffic Density Plot

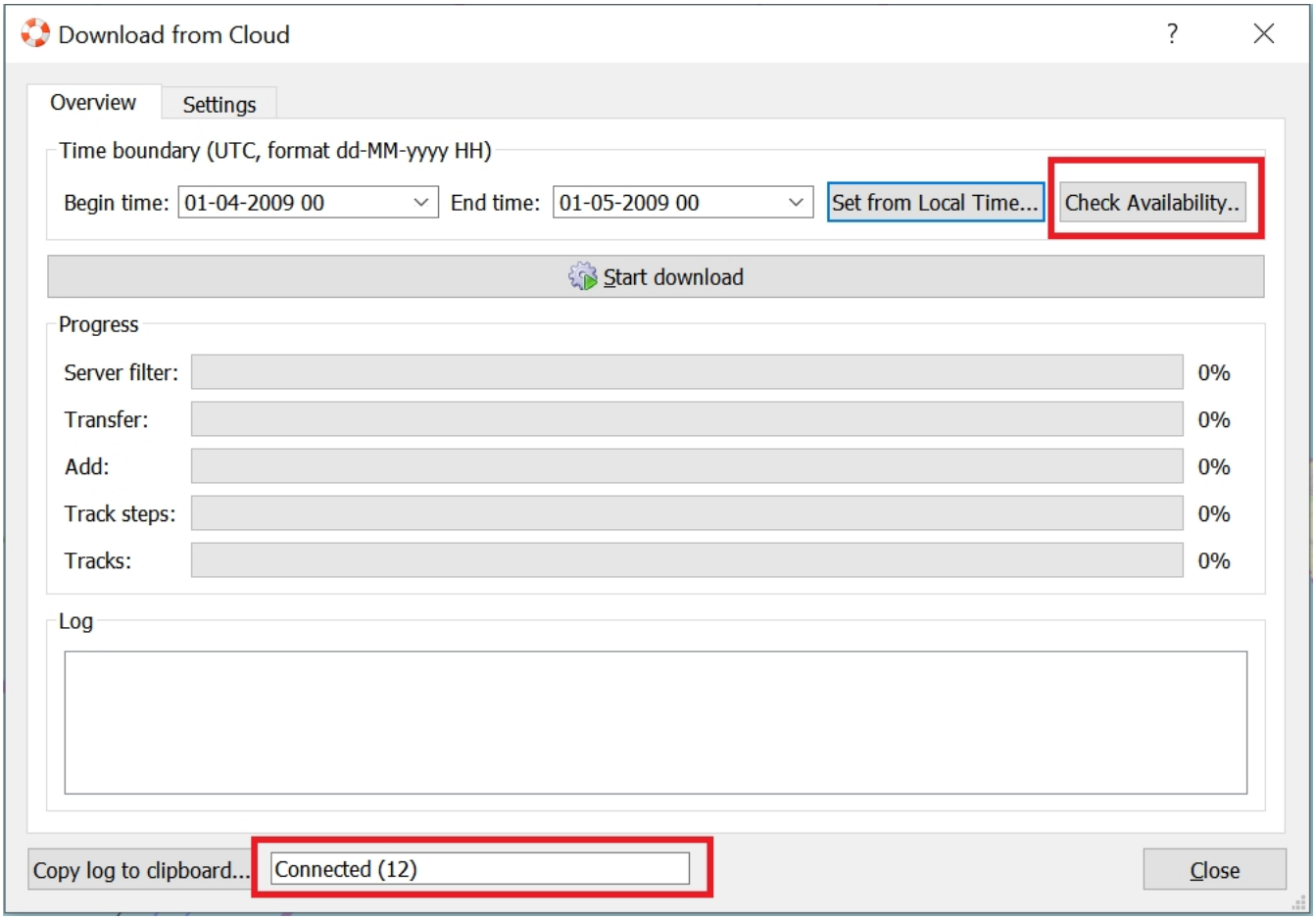
.

## Download from data from Cloud Server

Downloading data from the cloud is only available in IWRAP solutions that are connected to a cloud server, i.e. you must have the "Download from Cloud" icon on the toolbar.




When you select the menu item, the following dialog will be shown.

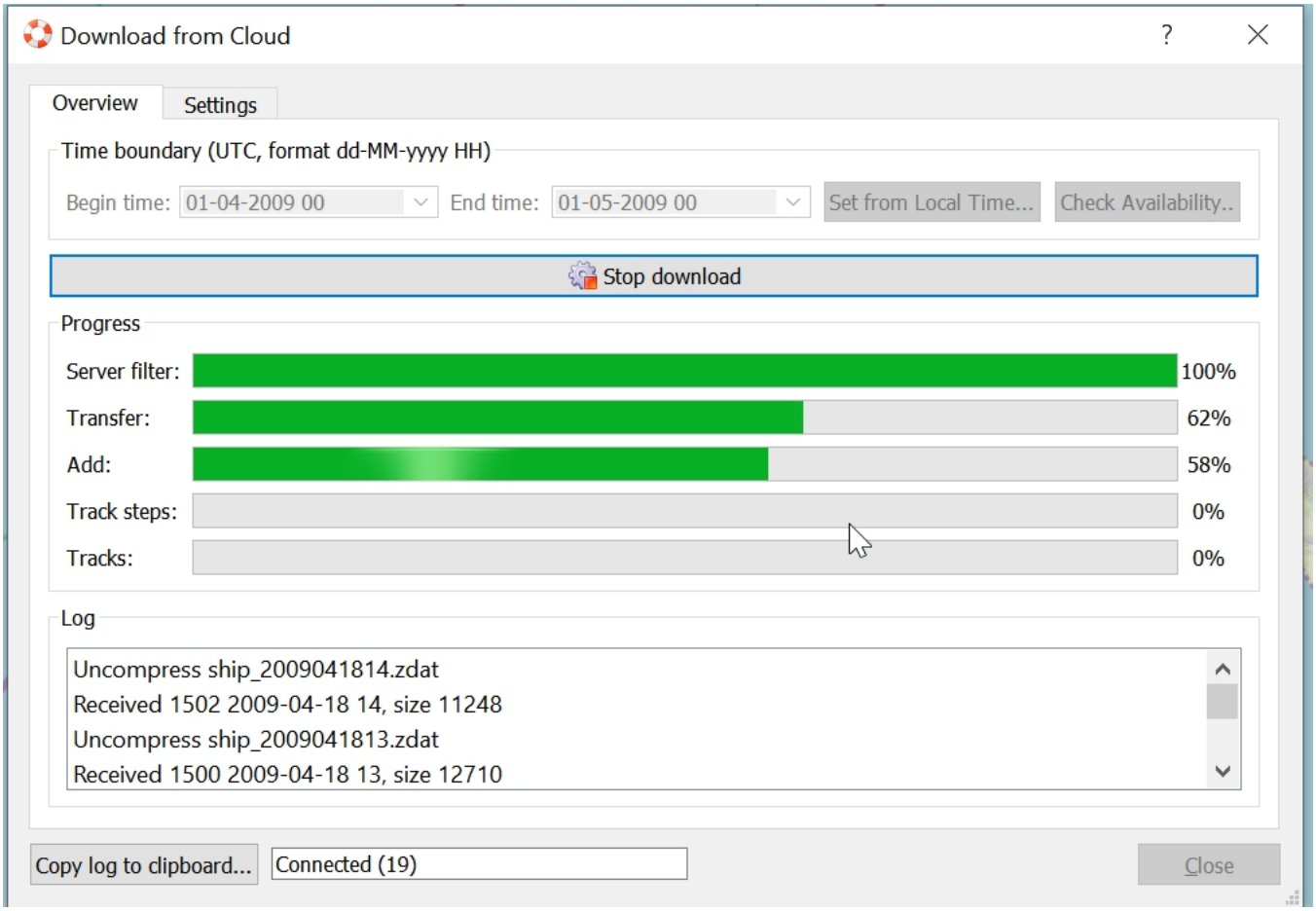



Notice the cloud connection state is shown in the bottom of the dialog. The number written in parentheses is server ping delay in milliseconds, here 12. The lower this value is the better the communication link quality.

You can now specify the begin/end time directly or you can select "Check Availability", see Check Cloud Data Availability.

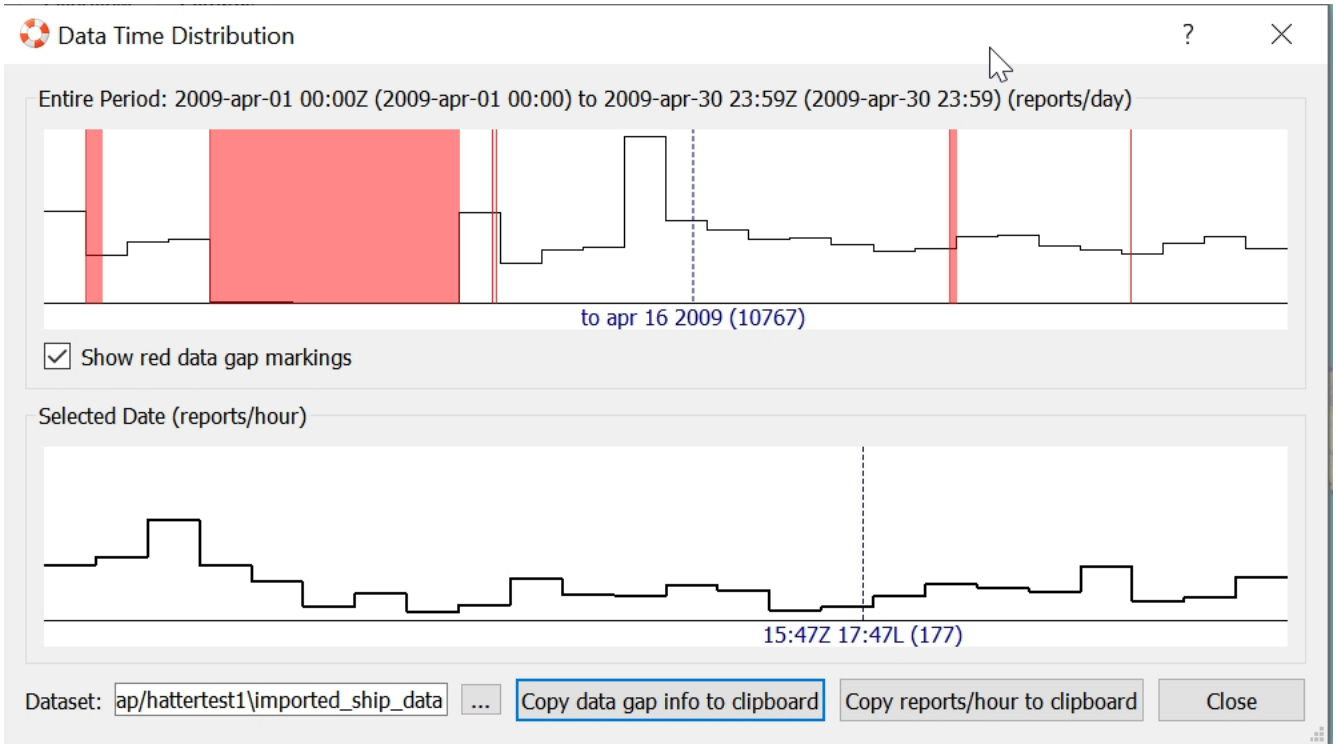
Depending on the area size you should be careful not to select a time frame that is too long in many cases 2-4 weeks is enough. If you have a large area and a large time frame it will of course take long time to download the data.

Press "Start download" to start the download.



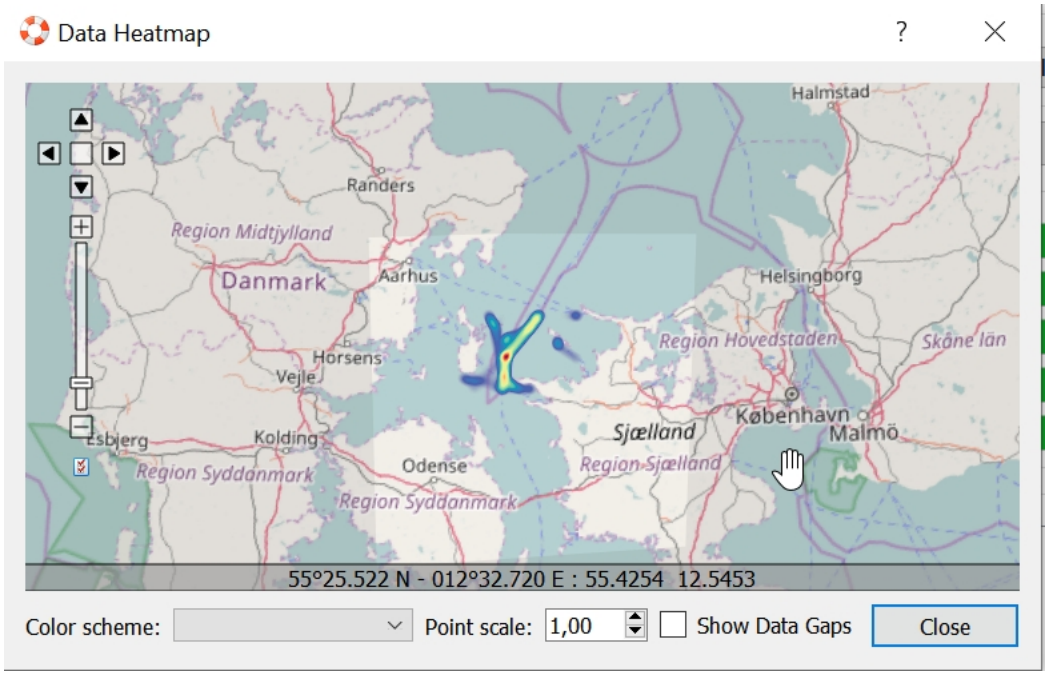

The cloud server will filter the data available using the Model Area, the "Server Filter" progress bar shows the state of the filter. After that the data has been transfered and add'ed IWRAP will extract tracks.

When the data has been downloaded the "Data Time Distribution" will be shown indicating gaps in the dataset with red.



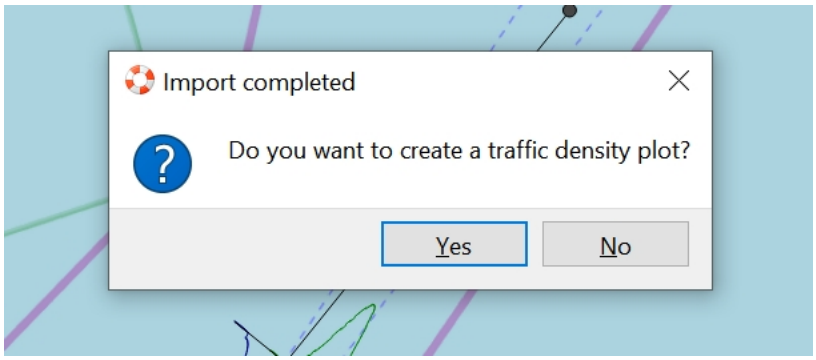

Press Close.

A Data Heatmap view will be shown, indicating where the most samples are.




Press Close and Close again.

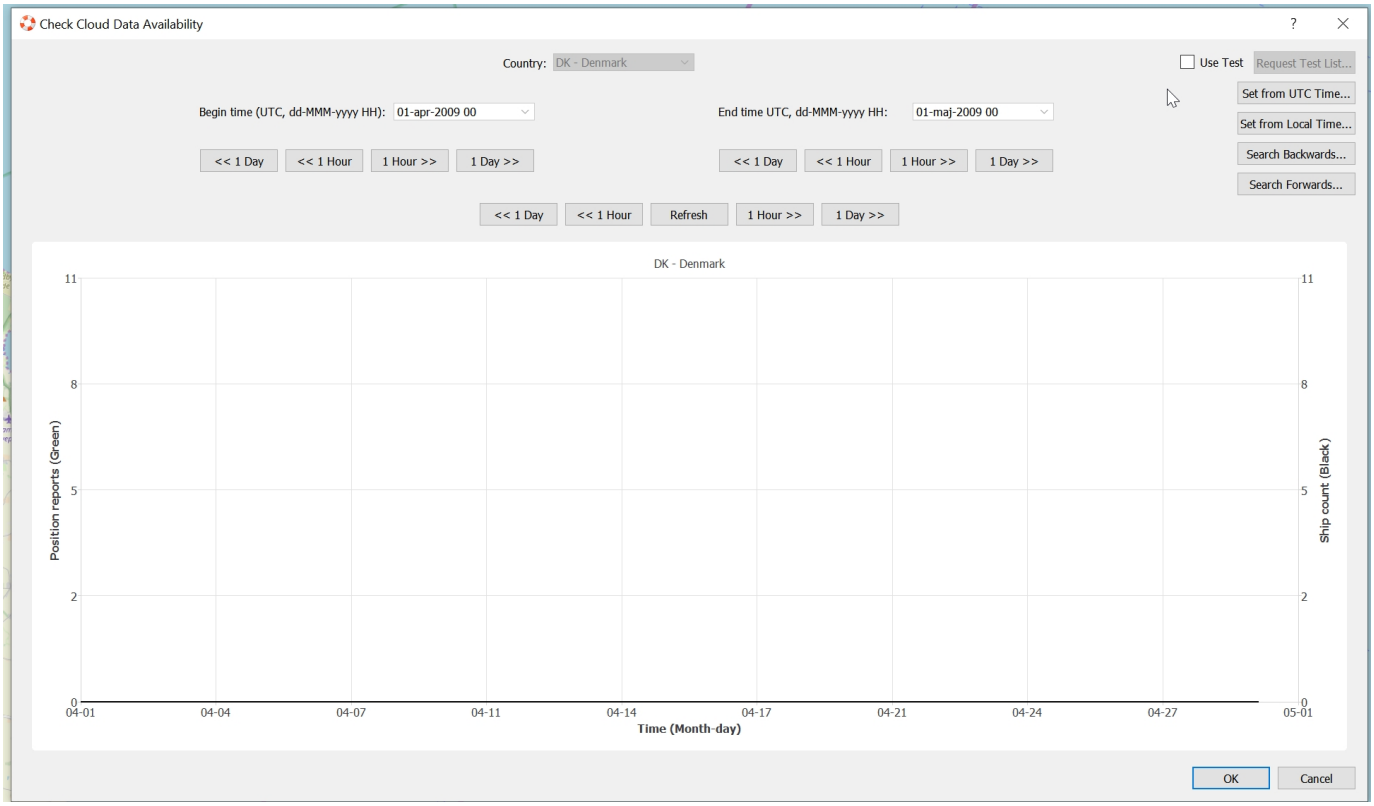
You will be asked if you want to create a traffic density plot.



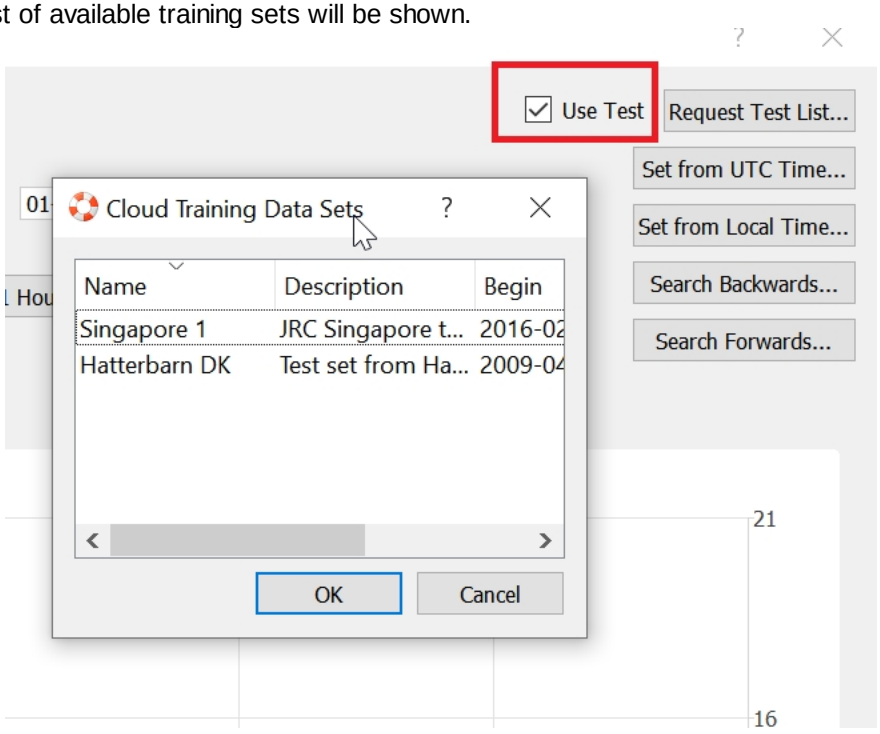

## Check Cloud Data Availability

This dialog can be used to check if data is available on the server.

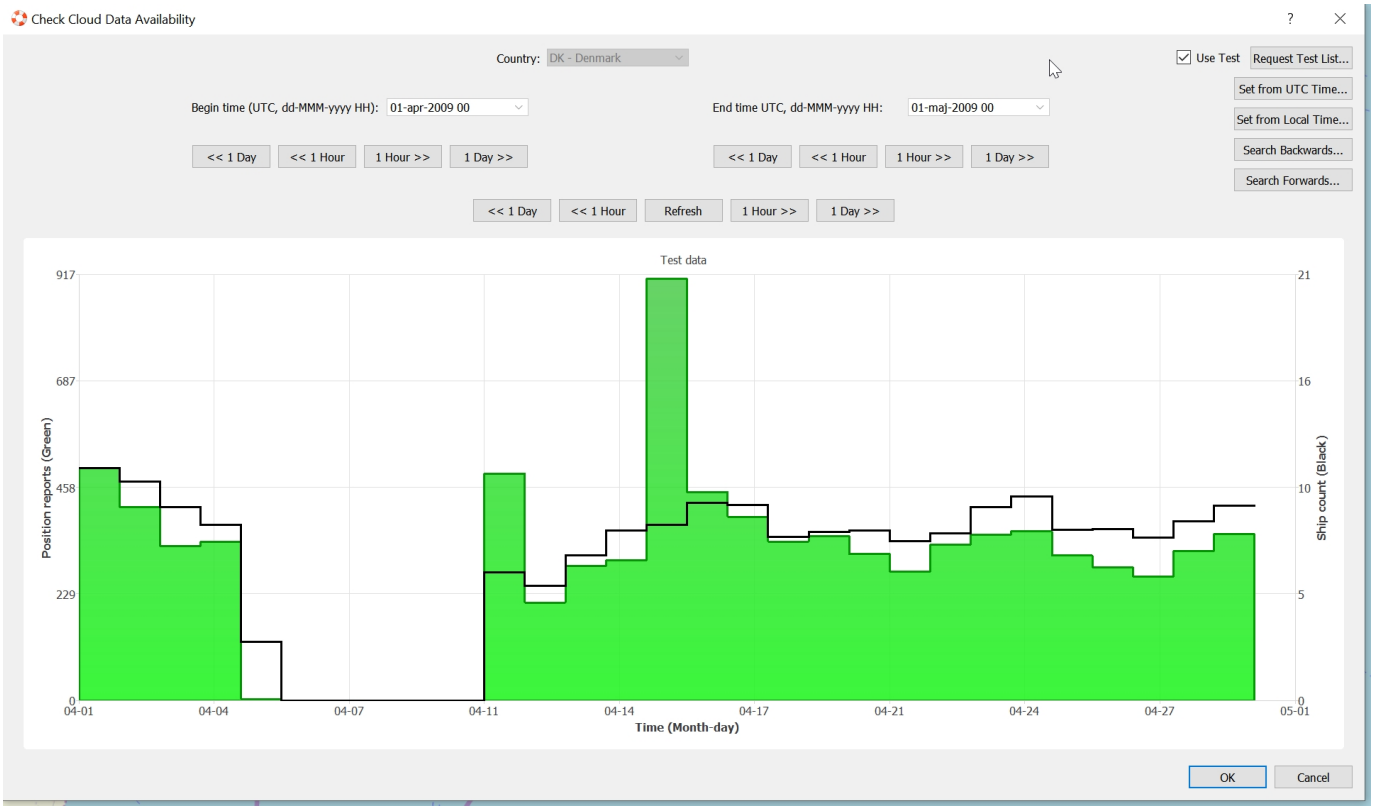
If no data is shown you can try and press "Search Backwards" or "Search Forwards" to find the last/next periods with data.




If no data is available and you want to test the use of IWRAP you can select "Use Test". If IWRAP is connected to the cloud server a list of available training sets will be shown.




If you select e.g. the "Hatterbarn DK" dataset the begin/end time will be set and the following will be shown:



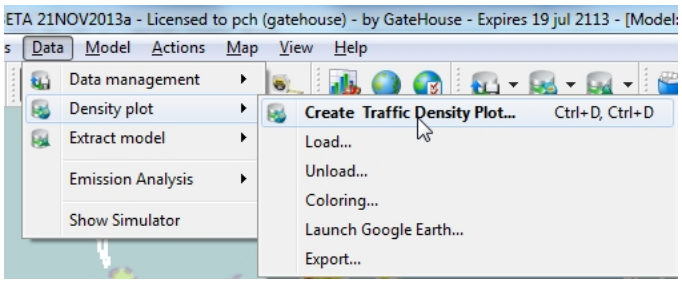

The green graph indicates data availability. The black curve indicates the number of ships.

If you are satisfied with the dataset selection press Ok and  press Start Download.

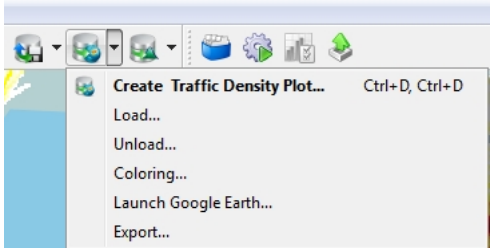
## Generating a Traffic Density Plot

Note: This feature can only be used if you have a commercial license.

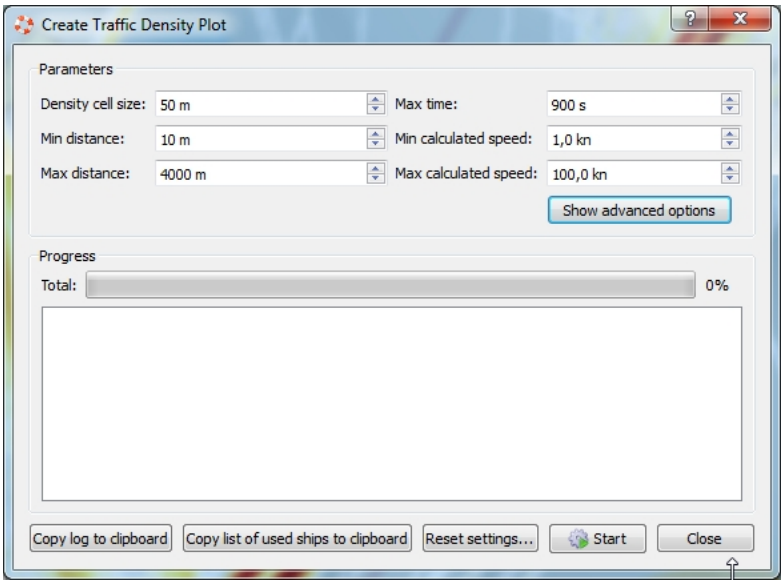
A density plot can be generated based on an imported dataset, select 'Data/Density plot/Create...' from the menu:



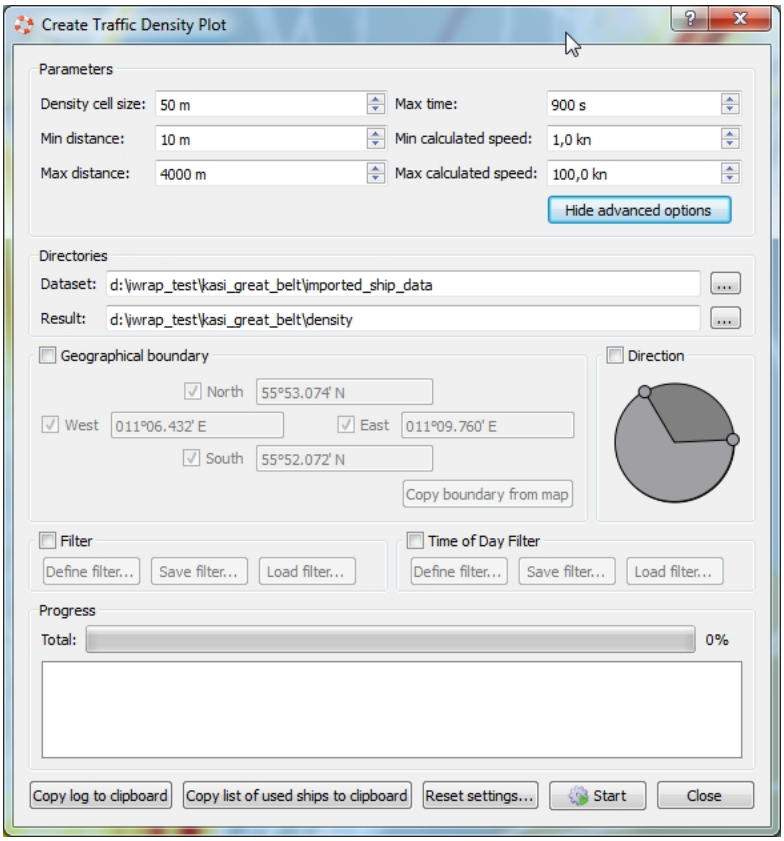

or using the tool buttons:



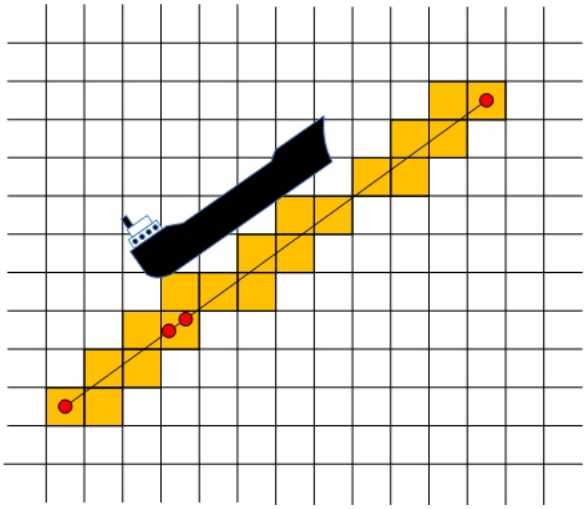
Select the location of the dataset you want to use and specify the location of the result data. You can only have one Density plot in each result directory.




Press 'Show advanced options' to see all possible settings.




The density plot created by IWRAP is a so-called traffic density plot, i.e. it divides the region into a number of cells and counts the number of visits to each cell. A counter is maintained for each cell and increased by one every time a ship visits the cell. If a ship emits more than one position report in the same cell (i.e without leaving the cell in between) the counter will only be increased by one. The algorithm also interpolates between cells if the distance between consecutive reports is below time and distance thresholds. In the figure below the red dots indicate position reports, as shown on this figure the counter in each cell is only increased by one and interpolation is used between reports.

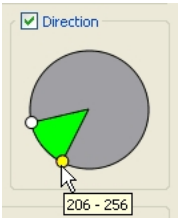


A number of parameters can be used to control the creation of a density plot:

- Density cell size.
- Min distance. Minimum distance between included samples.
- Max distance. Maximum distance between interpolated samples, i.e. samples are included but not interpolated.
- Max time. Maximum time between interpolated samples, i.e. samples are included but not interpolated.
- Min calculated speed, samples with speed below this limit is not included.
- Max calculated speed, samples with speed above this limit is not included.

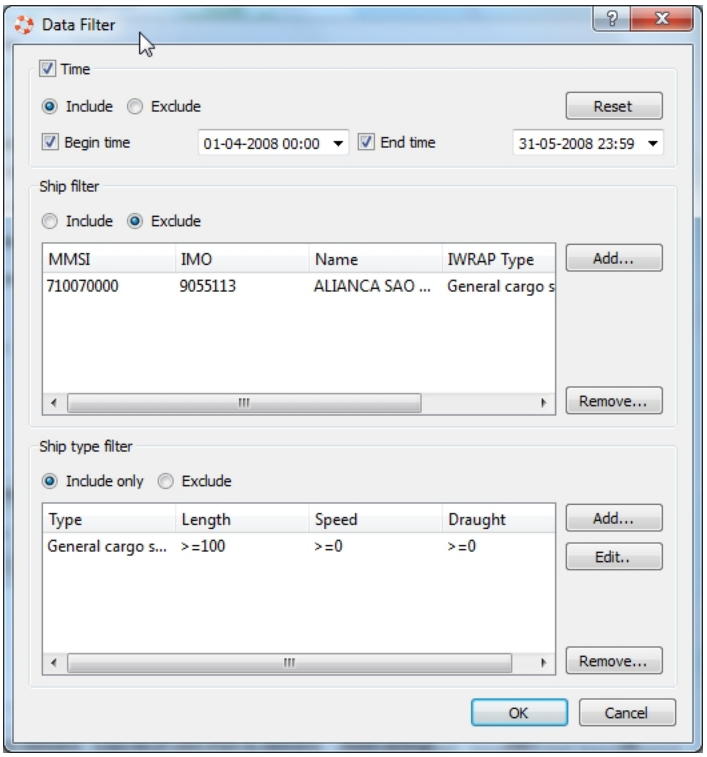
You can use the 'Geographical Boundary' to create several plots that focus on certain areas, this a great help to increase the details.

The Direction filter can be used to only include ships moving in a certain direction. In the example below ships having a heading between 206 and 256 degrees are included. Use the mouse to drag the yellow end-point indicators, right-click on the wheel to set the boundaries or flip the values or use the mouse wheel to rotate the wheel.




The Direction filter can be used to only include ships moving in a certain direction. In the example below ships having a heading between 206 and 256 degrees are included. Use the mouse to drag the yellow end-point indicators, right-click on the wheel to set the boundaries or flip the values or use the mouse wheel to rotate the wheel.

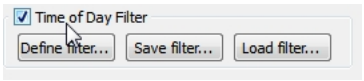
The Data filter can be used to specify constraints on which Ships should be included in the plot, press 'Define filter...'.



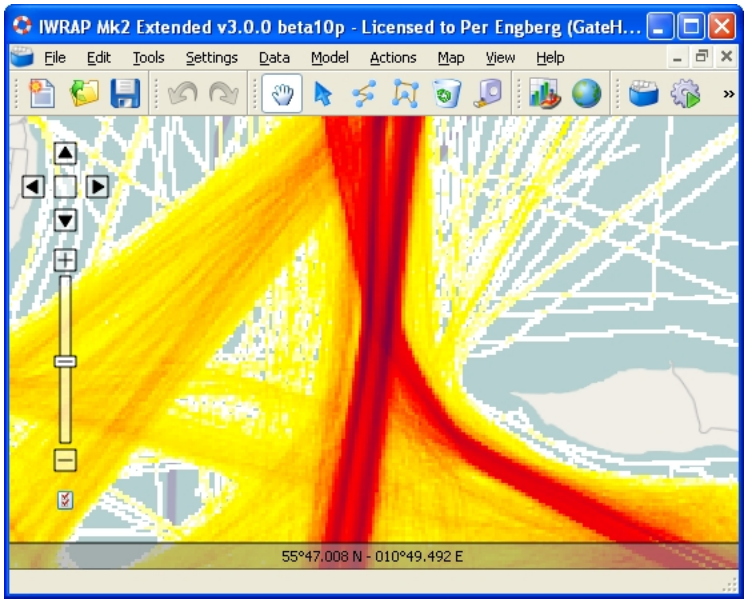

It is possible to include or exclude specific ships, or specify a filter for a ship type. The ship type filter can be specified for 'Any' ship or for one or more of the IWRAP ship types. In the above example it is chosen to exclude a specific ship and include all other ships with a speed >= 10.

It is also possible to exclude a period or only include a certain period of the dataset.

The Time of Day Filter can be also be used to filter the dataset.

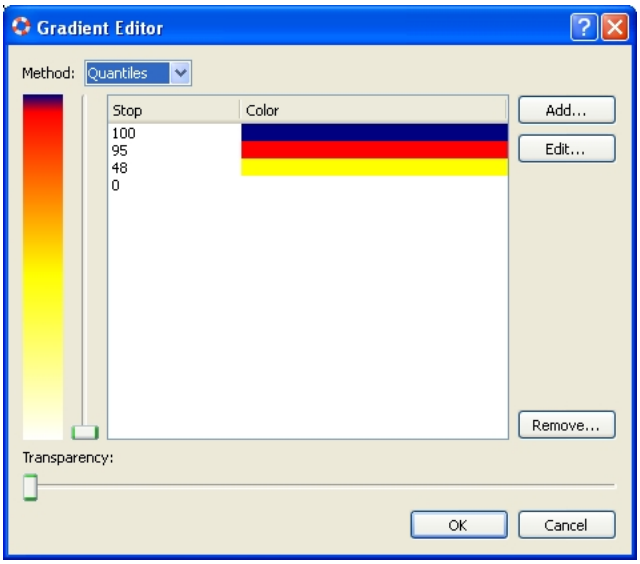



Press Start to create your density plot. When the creation is completed press close. If you have not already opened a model, open or crate a new one and, zoom in on the density plot.



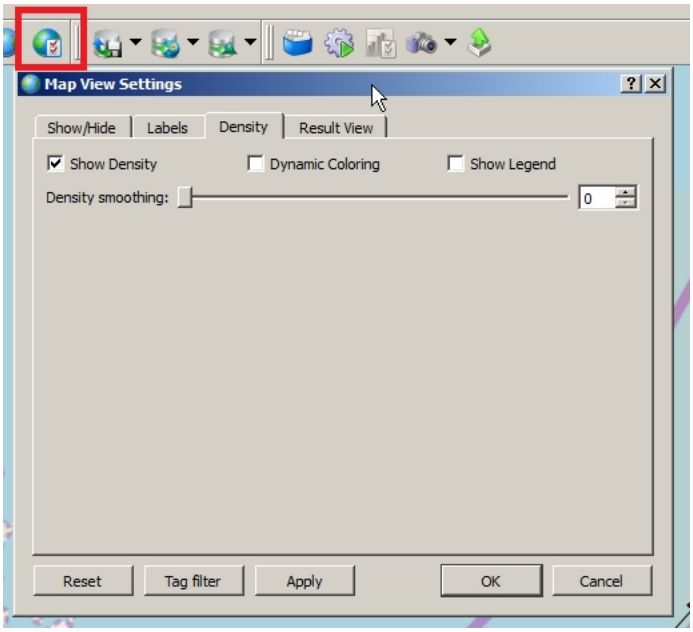

You can Load/Unload density plots from the 'Data/Density plot' menu and you can control the

coloring of the plot using 'Data/Density plot/Coloring'

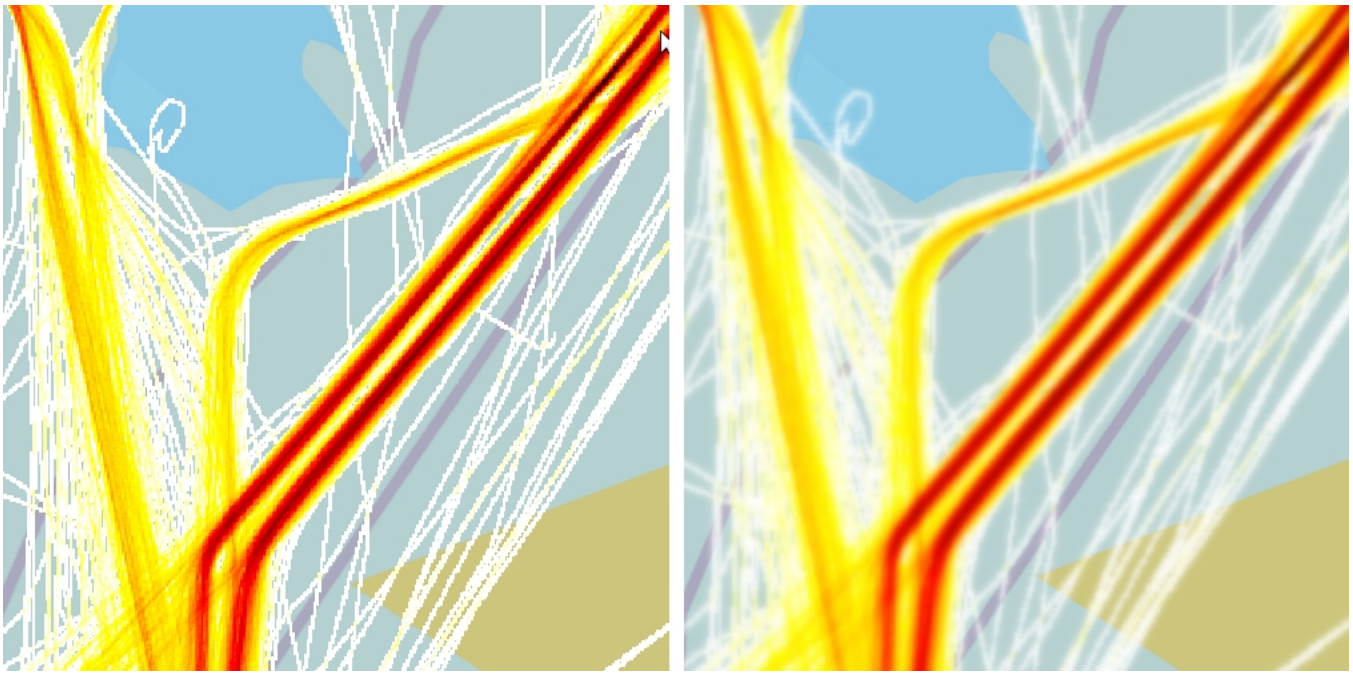



Add/Edit/Remove color stops or use the vertical slider to adjust the position of the stops, by selecting a stop in the list and dragging the slider. Use the horizontal slider to adjust transparency.

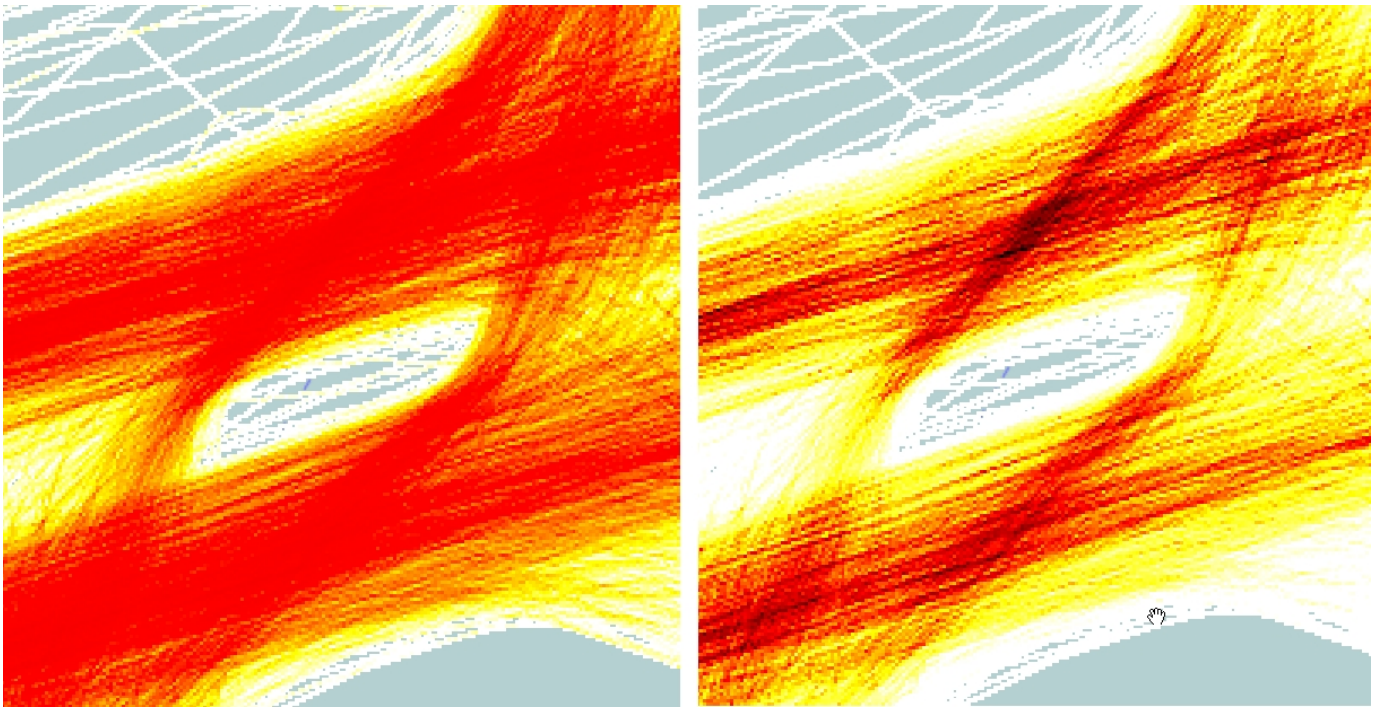
There are a number of display settings for the density plot that can be controlled using the 'Map View Settings':




It is possible show/hide the plot, add a legend, and it is possible to smooth the plot:



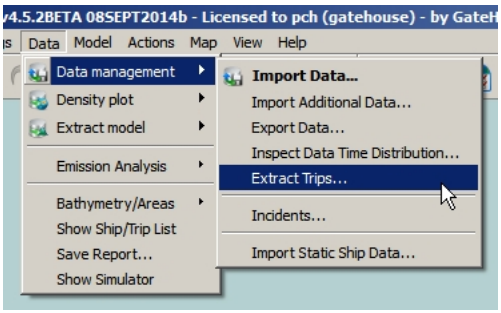
It is possible to enable dynamic coloring, when this option is enabled the color scale only uses the cells currently in the view:



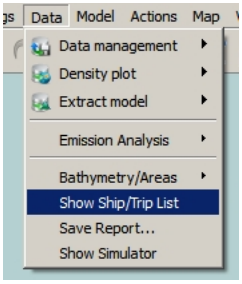
You can export the density data to a text file using the 'Data/Density plot/Export...' menu item.

## Inspecting Imported Ships and Trips

IWRAP can display extracted ship tracks/trails/trips of individual ships. If you have not extracted the trips when you imported your data you have to extract them first, you can do it now from the 'Data/Data management/Extract trips..' menu.

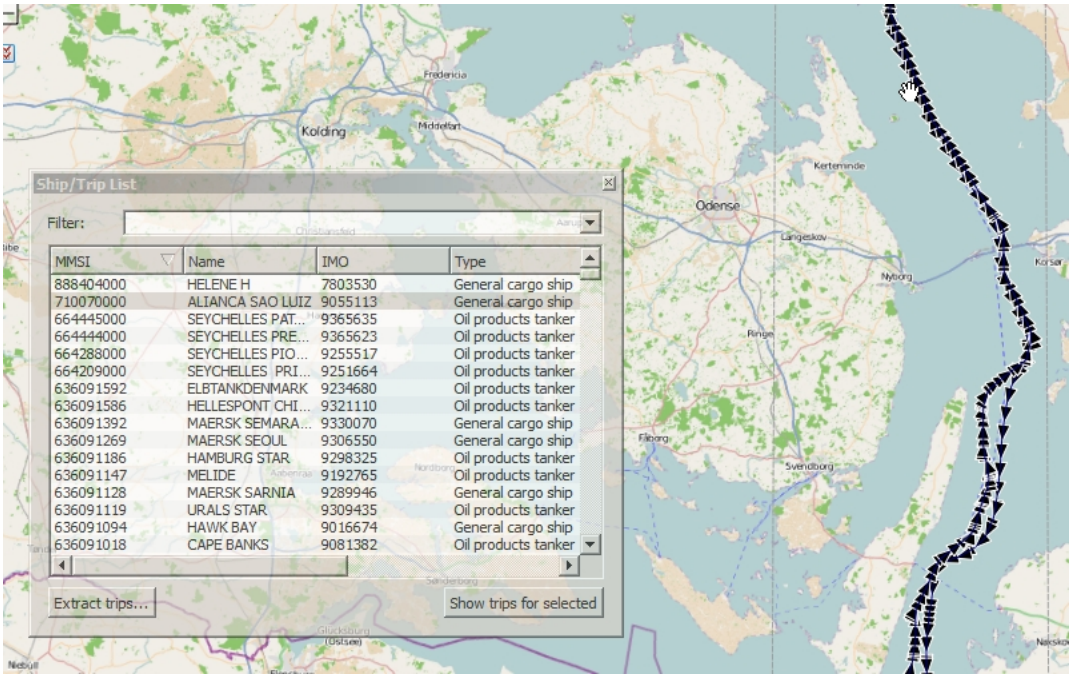



The result can be accessed from:

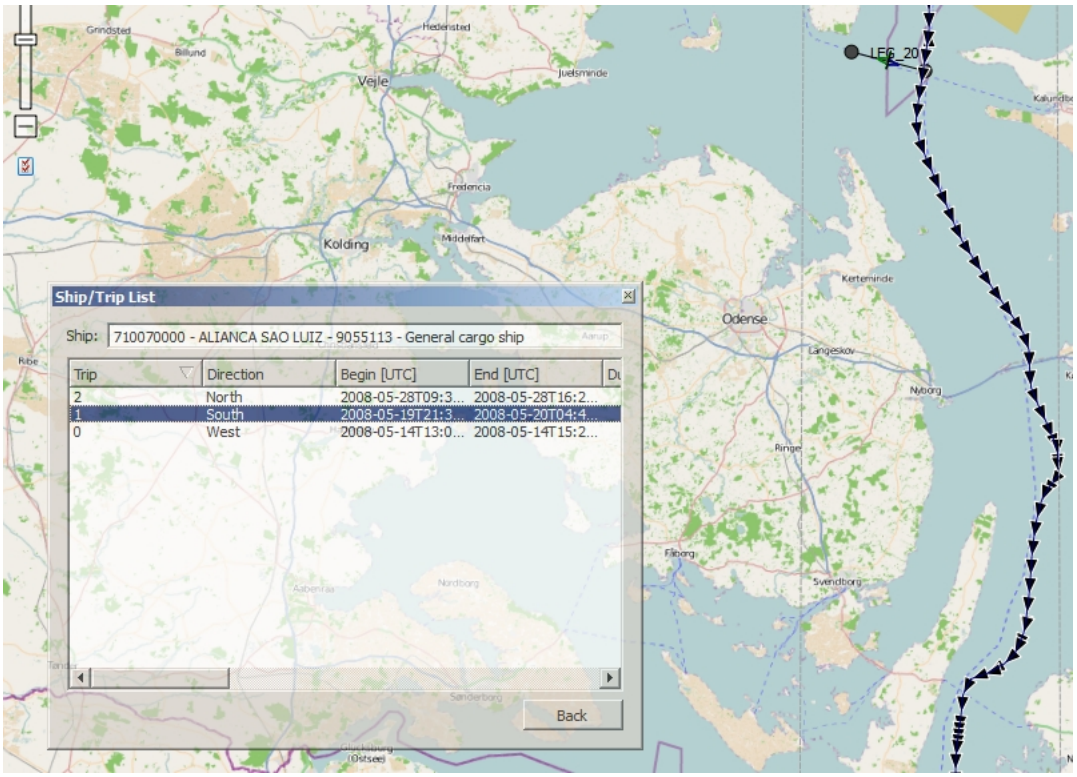



This will display a list with all the ships. Its a good idea to have look at the imported ships and check how many of the have type and length.

When you double click one of the lines all the trail data for this ship will be shown on the map.




If you press the 'Show trips for selected', a list with the trips for this ship will be shown, you can again double click one of the lines to see the particular trip on the map.

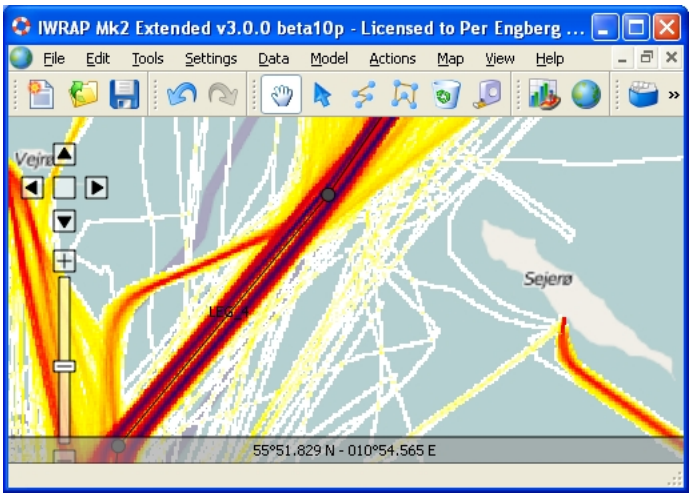



## Extract Model Data

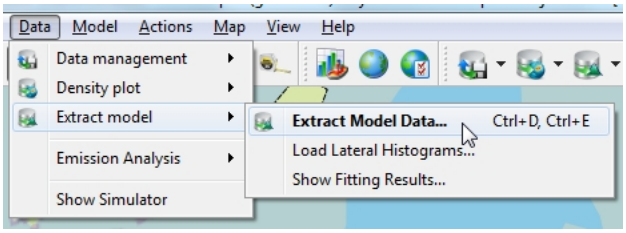
Note: This feature can only be used if you have a commercial license.

The extraction algorithm will extract a lateral histogram for each direction of each leg and use the histograms to determine the lateral distributions. Furthermore the traffic volumes will be determined and the leg to leg traffic will be extracted.

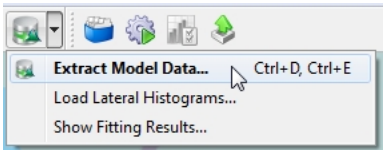
You should already have imported some traffic data into a dataset, created a density plot, and entered the legs, i.e. you should have something like shown below:



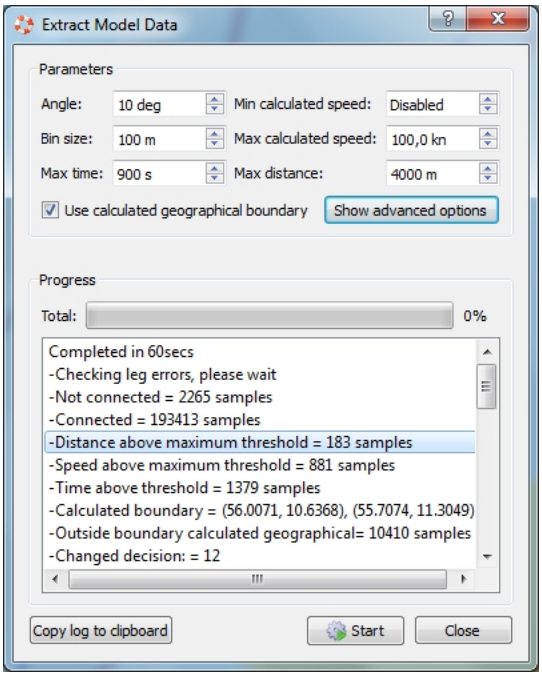

Ensure your model is loaded and select 'Data/Extract Model/Extract Model Data...' from the menu:



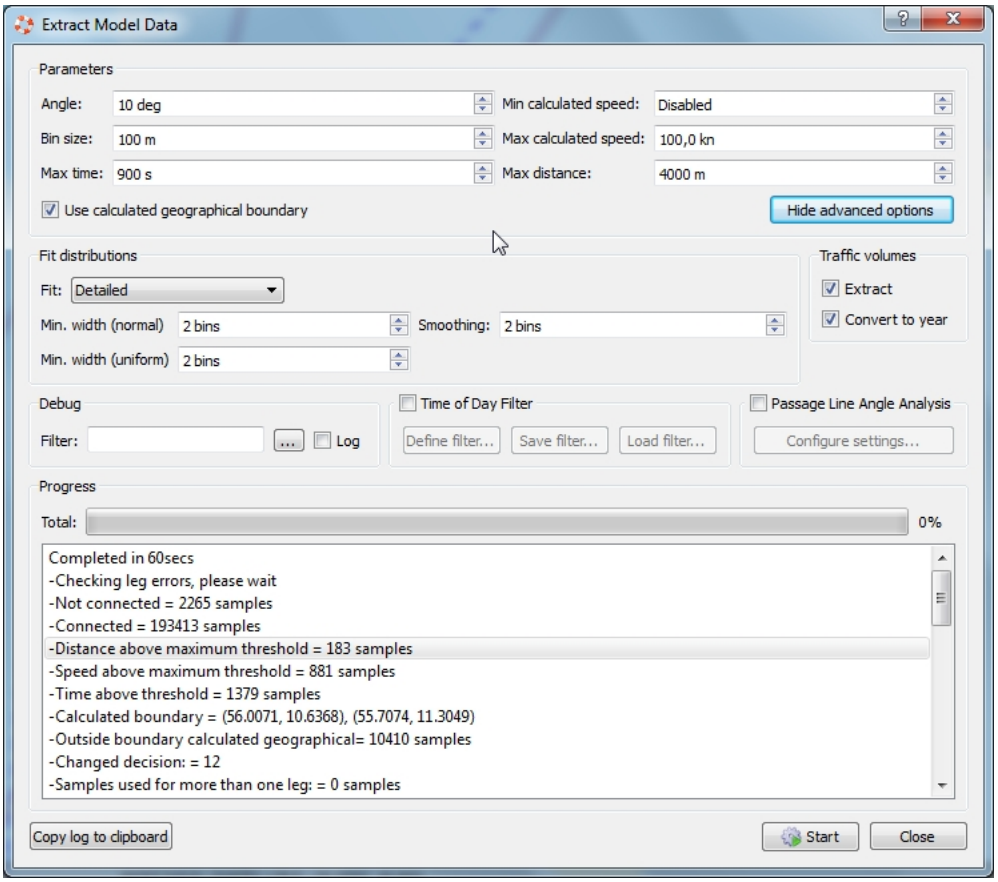
or using the tool buttons:




The extract model data dialog is invoked, from here you can tailor the extraction parameters and run the extraction algorithm. Start by selecting the dataset location you want to use and specify a result directory/location. You should select different result directories for different datasets.

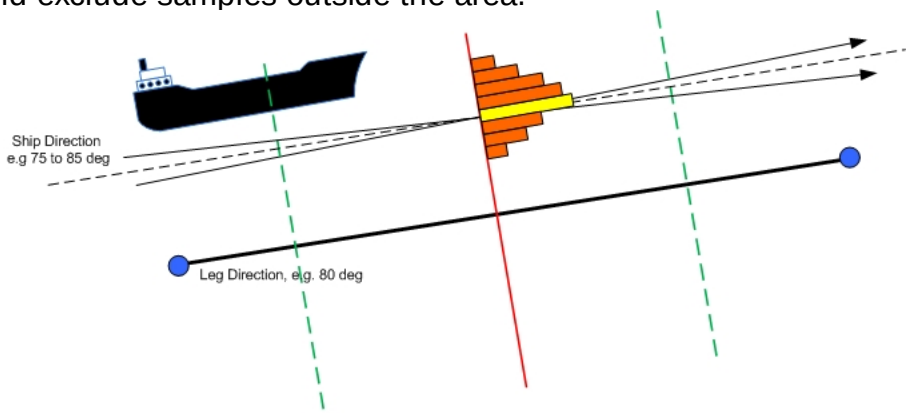



Press 'Show advanced options' to see all possible settings.



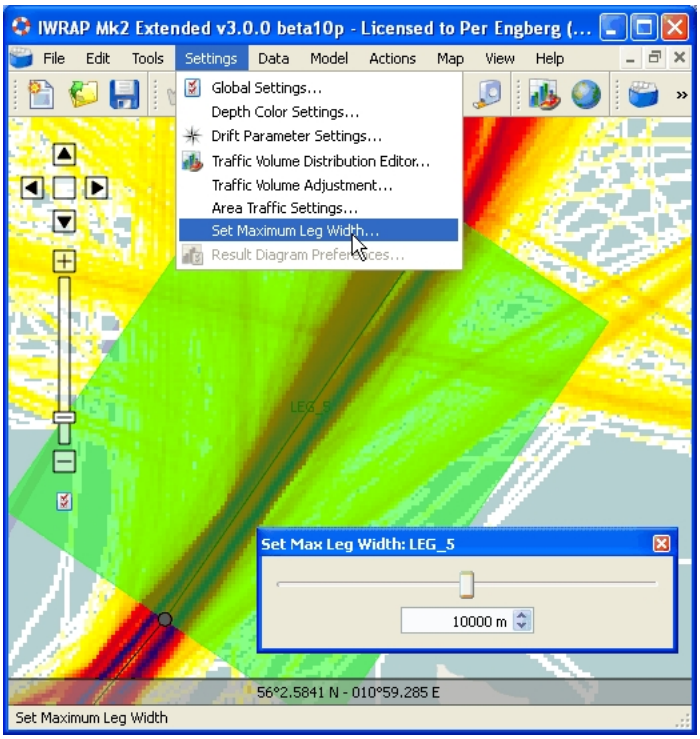

The following parameters can be adjusted:

- Angle, the maximum difference in the direction of the ship and the Leg. The picture below shows and example where the Leg has an angle of 80 degrees, in this example the Angle is set to 5 degrees so the ship must have a direction between 75 and 85 degrees. It is also possible to specify this value per Leg, see Leg Editor.
- Bin size. The size of the bins/intervals of the generated histogram.
- Max time. Maximum time between samples, i.e. if samples are separated by more than this factor a new journey is assumed.
- Min calculated speed, samples with speed below this limit is not included.
- Max calculated speed, samples with speed above this limit is not included.
- Max distance, i.e. if samples are separated by more than this factor a new journey is assumed.
- Use calculated geographical boundary, if this option is used IWRAP will calculate a boundary and exclude samples outside the area.

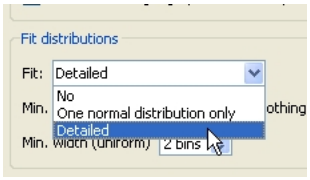



Another parameter that affects the extraction algorithm is the Leg width, the Leg width is by default set to 10km, this means that the algorithm will not use crossings that are further than

5km away from the Leg center. The width can be adjusted using the Leg Editor, or you can use the 'Settings/Set Maximum Leg Width/Length...' settings. Click on the leg you want to modify, and adjust the width/Length using the sliders or the numerical inputs.



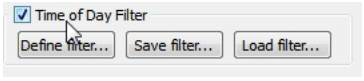

The 'Fit Distributions/Fit' should be set to 'Detailed' in order to do the best possible fit. If 'Detailed' is selected IWRAP will try to use a combination of multiple uniform and normal distributions. The other options can be used in case you need to quickly generate histograms in order to adjust the position of the legs/waypoints. You will typically start by not doing a detailed fit and validate the leg/waypoint locations.




The 'Min width (uniform)' specified that the width of a uniform distribution can not be less than the number of bin width specified. Similarly the 'Min width (normal)' sets a constraint on the standard deviation of normal distributions. The 'Smoothing' option enables you to apply a 'blur' filter, i.e. each frequency in the resulting histogram has a value equal to the average value of its neighboring frequencies. It is a form of low-pass ("blurring") filter..

The 'Traffic Volumes' section can be used to control whether traffic volumes should be extracted or not and whether they should be converted to yearly numbers. Normally they should be converted to yearly number, this option should only be used for validation/inspection.

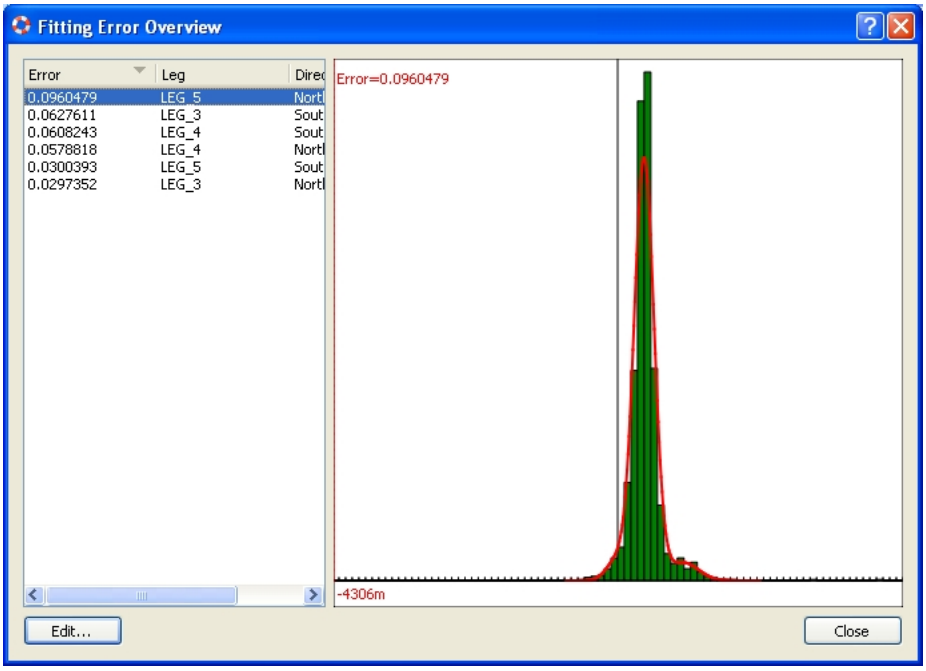
The Time of day filter can be also be used to filter the dataset.



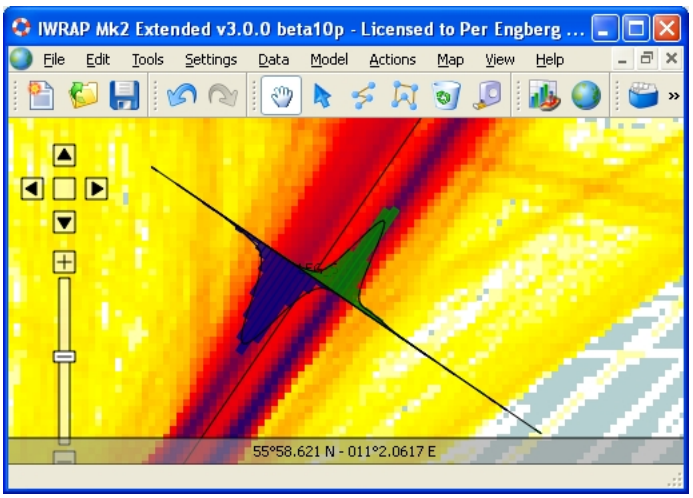

Press Start to perform the extraction, this may take several hours depending on the amount of data and the number of legs.

After IWRAP has extracted the data the Fitting Error Overview is displayed, this overview shows the fitting results ordered by the fitting error. In some cases it is impossible for IWRAP to do a

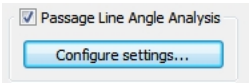
fit, in such situations you should define the distribution manually.




The following shows the result of the extraction on the model view.

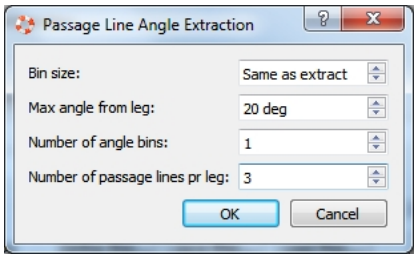



It is also possible to use the Passage Line Angle analysis to validate that the Legs are positioned correctly.



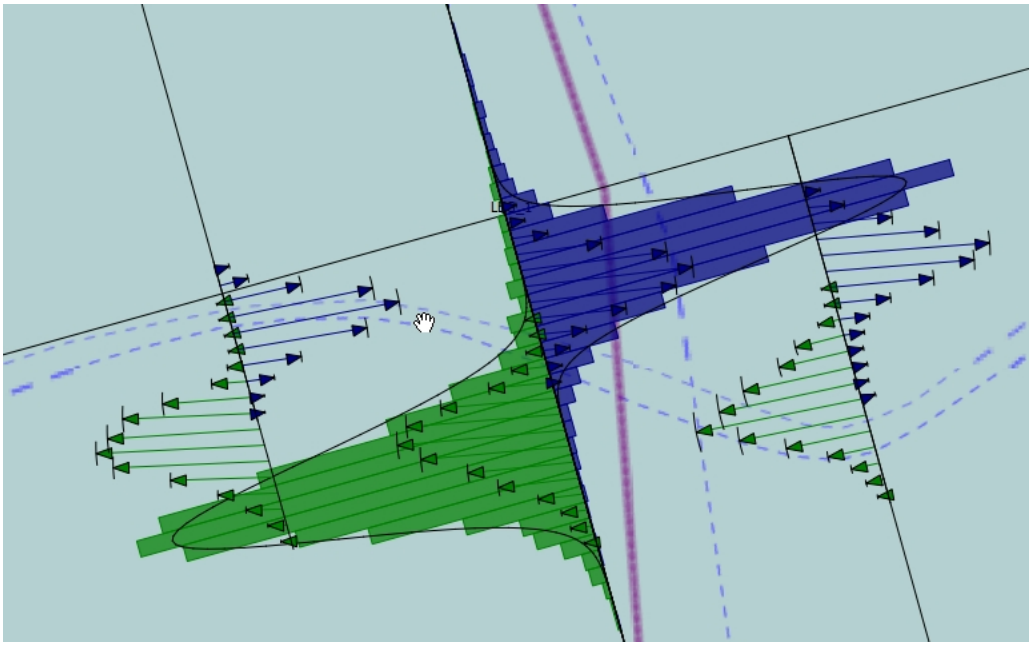

This analysis divides a passage line in to a number of bins and analysis the ships crossing angle. The result is a plot where a line is drawn from the center of the bin, the direction of the line is mean of the angles and the length is relative to the number of ships. The lines of the plot should follow the direction of the Leg.

The following parameters can be specified:

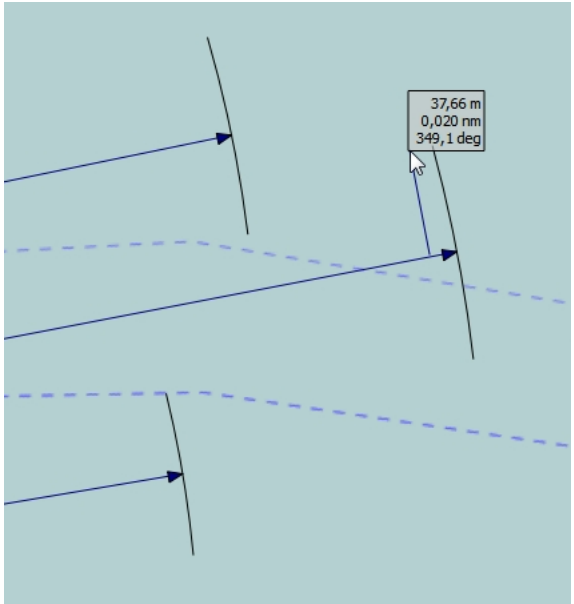



The parameter 'Number of angle bins' is used to divide the 180 degrees that each bin spans (or in this cas 20+20=40), into a number of bins, the result is that more than one line will be drawn from each bin.

Here is an example of a plot generated with the above parameters:

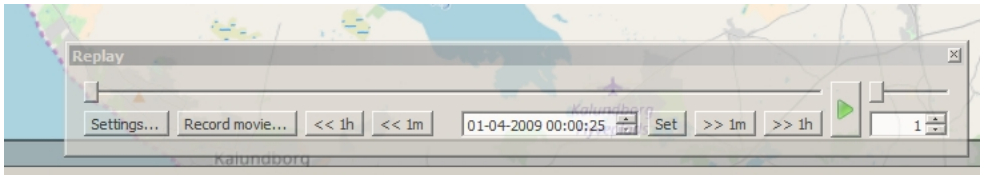


At the tip of each line, an arc is drawn illustrating the standard deviation of the angles of that particular bin.

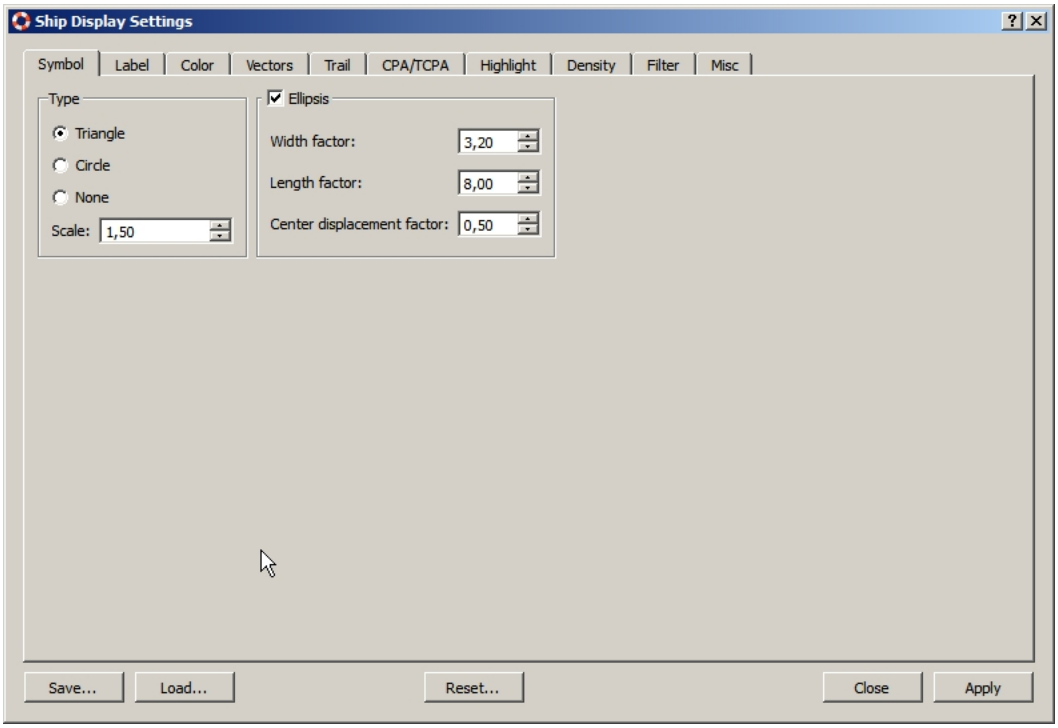



## Replay

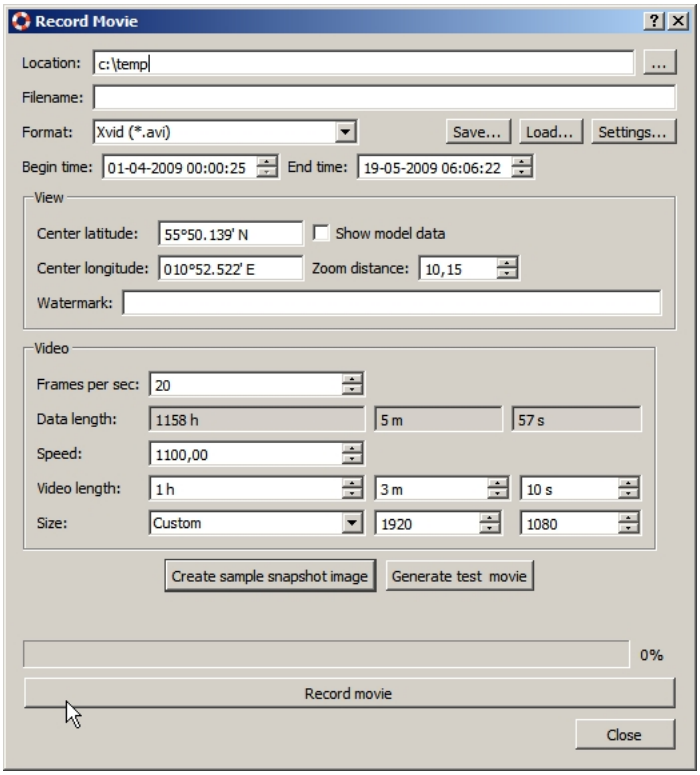
In order to replay you first need to import some AIS data and create a dataset. Then you can invoke the replay option by selecting 'Data/Replay...'. This will show the replay tool.




Using this tool you can replay data directly on the map. Click on 'Settings...' to customize the appearance of the ship symbols, colors, trails, vectors etc.




On the replay tool you can also select the 'Record movie...' option in order to record and save a video.



Choose a location for your video files. If you dont put in a filename, a name will be automatically be generated for you.

Select the video format, Xvid is recommended. The IWRAP installer will by default install the Xvid codec for you, if you didn't select that option you can always run the Xvid installer manually from the IWRAP installation directory.

The replay view is by default centered on the center of your map display, using the same zoom level/distance. Use 'Show model data' to show your legs etc. on the video.

You can either directly define the replay speed or you can simply specify the 'Video length" in which case the speed will be automatically calculated for you.

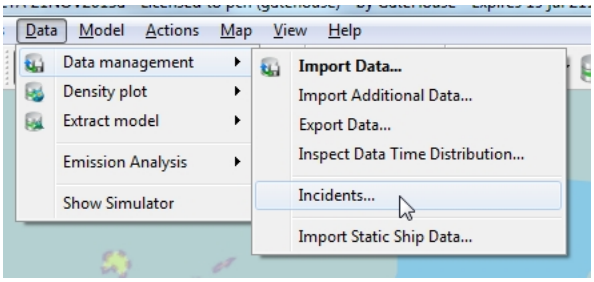
Generating a video can be time consuming. In order to quickly test your settings before you start you can either use 'Create sample snapshot image' or 'Generate test video' to check if everything is ok.

When ready, simply press 'Generate movie...'.

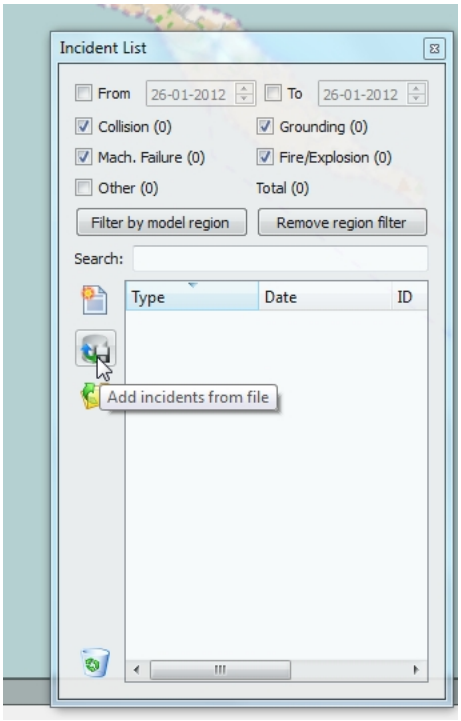
## Importing Incident Data

Import of historical incident data is purely optional.

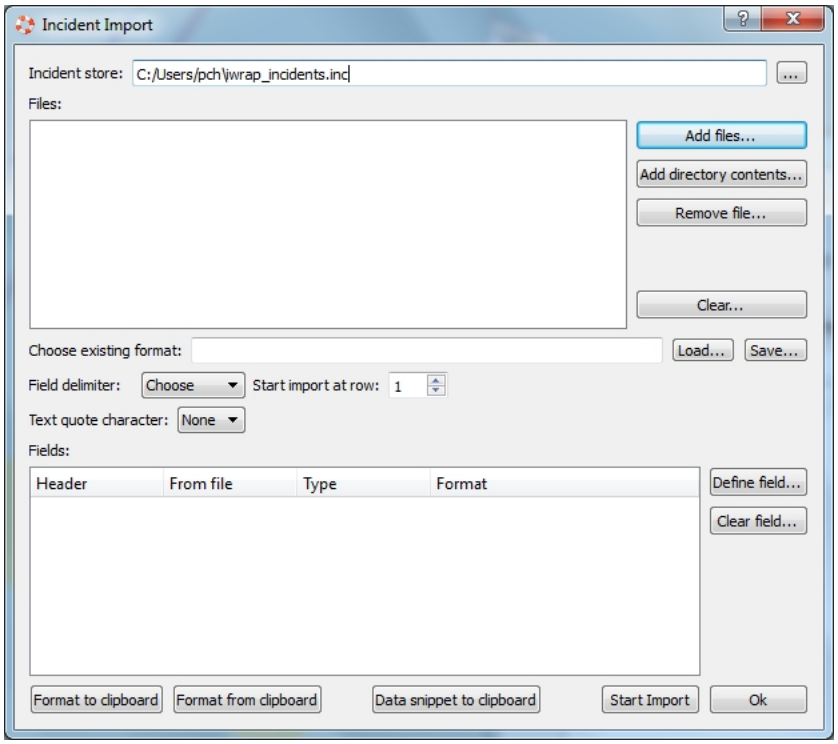
This step is used to import historical incident data, select 'Data/Data management/Incidents...' from the menu:



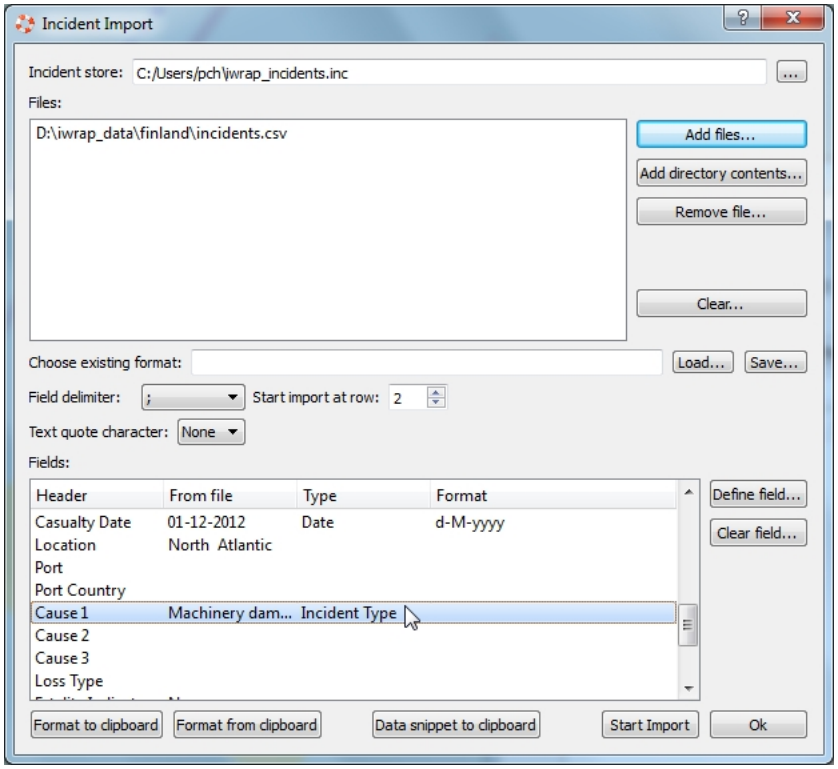

the 'Incident List' is displayed:



press the 'Add incidents from file' tool button in order to import incidents, the 'Incident Import' dialog is shown:




Press 'Add files...' or 'Add directory contents...' to add one or more files to be imported.



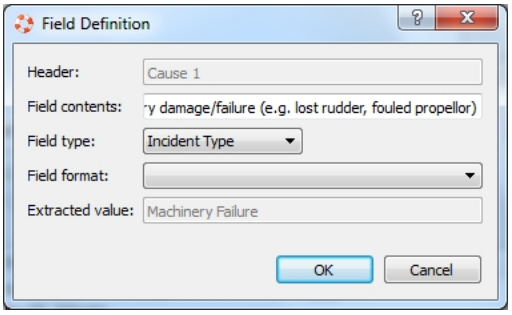

If you have a CSV file with a header IWRAP will automatically try to detect some of the fields/columns.

If the file contains quoted strings dont forget to select a Text Quote Character i.e. single or doible quote.

Notice that IWRAP has inserted a 'type' in some of the fields above e.g. the MMSI number. IWRAP has also automatically determined the field delimiter to be semicolon and the first data row to be the second and thereby skip the header.

It is important to define 'Incident type', 'Date' or 'Date/Time', 'Latitude' and 'Longitude' fields. Furthermore a 'Case ID' field can be imported in order to uniquely pinpoint each incident.

In order to define a field select the line, e.g. the 'Cause 1' column and click 'Define field' or just double-click on the line, the 'Field Definition' dialog will appear.



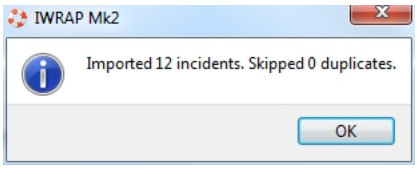

Select the 'Field type', in this case 'Incident type'. Notice that the 'Extracted value' now reflects the value as interpreted by IWRAP. Please check that the interpretation is correct. If the 'Incident type' contains 'colli' as part of the contents it is interpreted as a collision, i.e. is does not matter if the field cotains other characters as well. It is also not case sensitive, so upper and lower case characters can be mixed.

| Contains | Result |
|---|---|
| colli | Collision |
| fire | Fire/Explosion |
| explosion | Fire/Explosion |
| machinery | Machinery Failure |
| ground | Grounding |

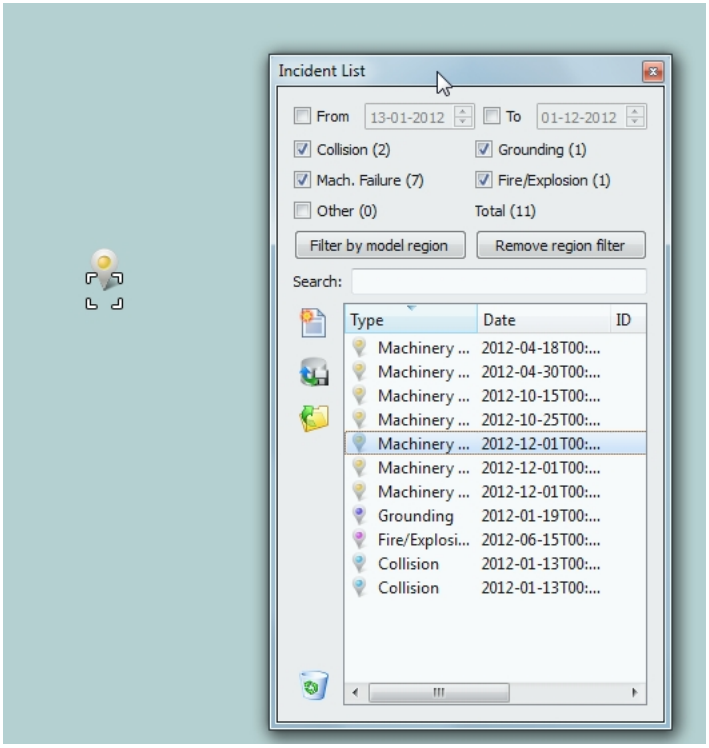
When you specify e.g. the Date and the if the format that is used is not listed in the Field format, you can type it directly, see Time Format.

The easiest way to input positions is to use decimal degrees, but IWRAP supports a variety of different other formats as well, see Position Format.

When all the fields have been defined, press 'Start Import', if the import succeeds the number of imported incidents is show:




The resulting imported incidents are here after show in the 'Incident List'.

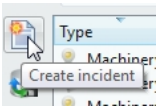



Click on a incident in the list in order to find it on the map or select the icon on the map in order to select in the list (the pointer tool must be selected).

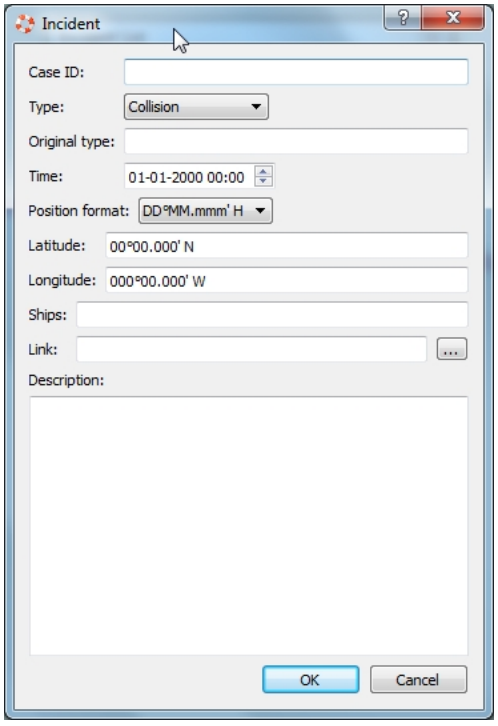
Use the check boxes e.g. 'Collision' in order to specify which incidents should be shown on the map and in the list. The From/To fields can be used to filter the incidents according to time.

If you have defined a model you can use 'Filter by model region' in order to only show the incidents that are 'inside' the model area.

Incidents can be create manually by selecting the 'Create incident' tool button:



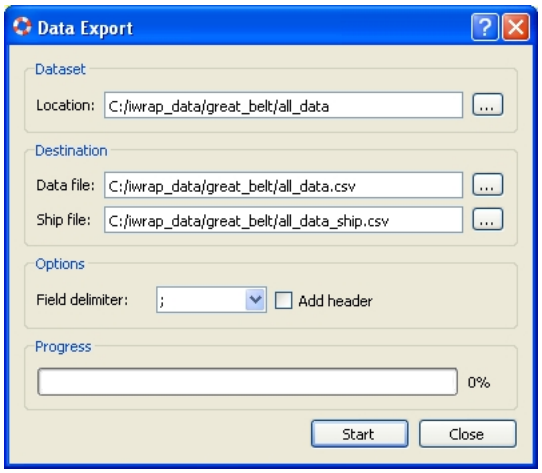

The Incident edtitor is invoked:



The Incident edtitor can of course also be used to edit and/or enrich imported Incidents.

## Export AIS Data

The export data feature enables you to export a dataset to CSV format. This can be used for validation or exchange of data. The Data file will contains the dynamic data and the Ship file will contains static information about the ship. If you specify an empty Data file only the ship information will be exported.

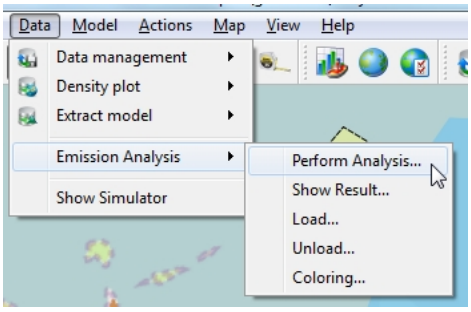



## Calculating Emissions

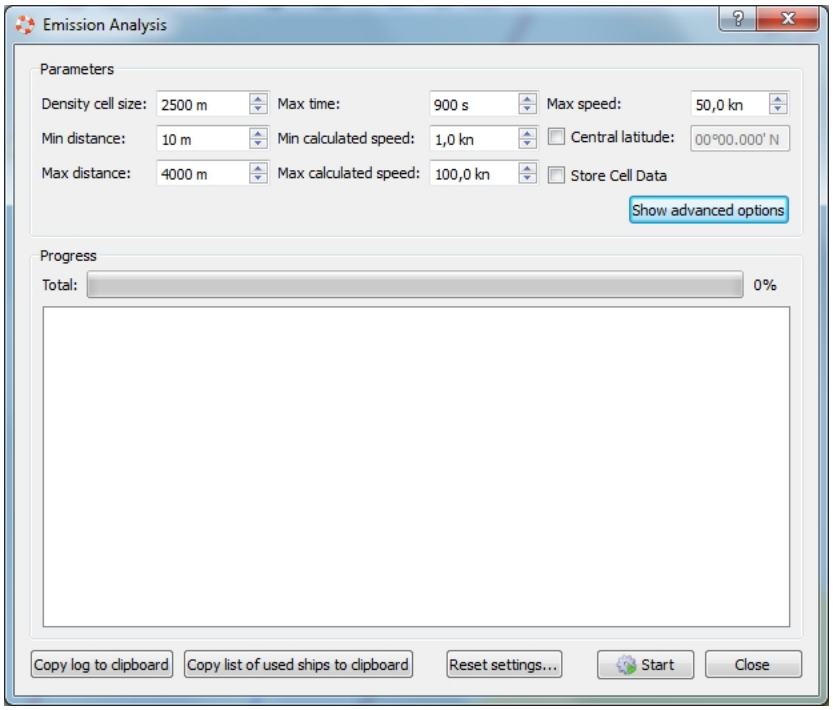
Note: This feature can only be used if you have a commercial license.

Note: The current implementation, version 1.0, of the emission calculation algorithm is quite basic. The plan is to implement a more advanced version in the next major IWRAP release.

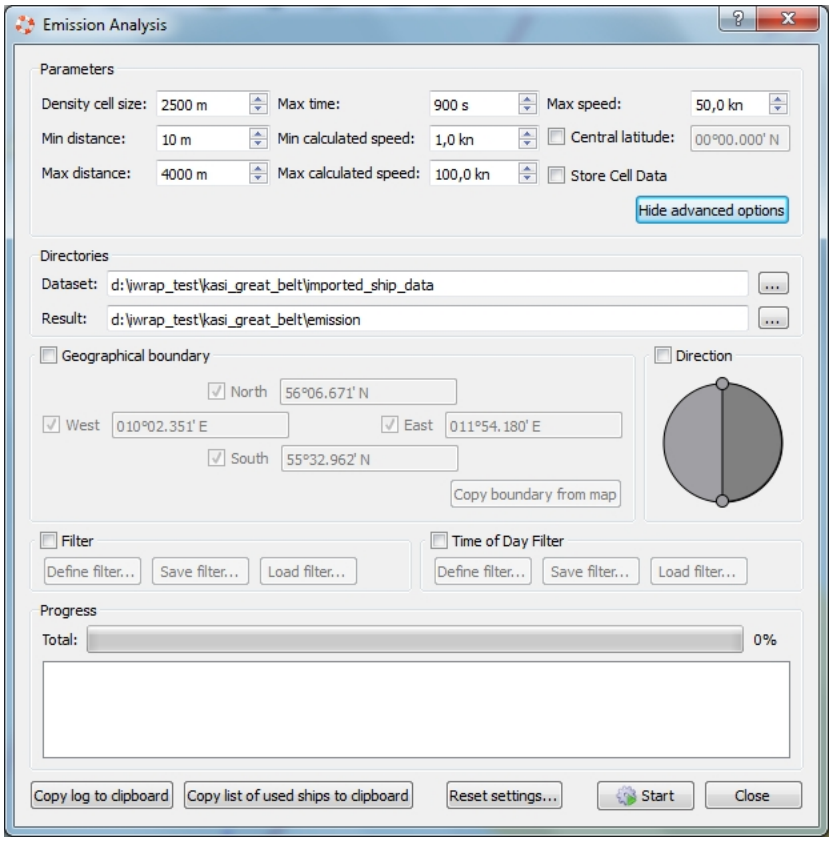
An Emission calculation can be performed based on an imported dataset, select 'Data/Emission Analysis/Create...' from the menu:




Select the location of the dataset you want to use and specify the location of the result data. You can only have one Emission Analysis in each result directory.

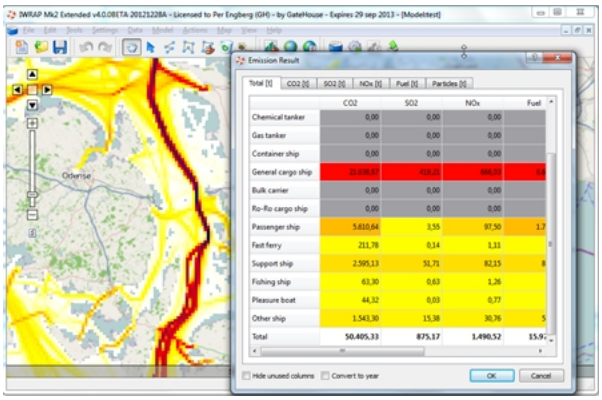



Press 'Show advanced options' to see all possible settings.




A number of parameters can be used to control the creation of a the analysis, the parameters are mostly identical to the Density Plot. A "Max Speed" parameter is used here to filter away reports with too high speed values. The "Store cell data" is used for development of the new more advanced algorithm and should normally not be checked.

Press Start to create your Emission Analysis. When the creation is completed, a dialog with the aggregated results is shown and a density plot is displayed on the map. If you have not already opened a model, open or crate a new one and, zoom in on the density plot.

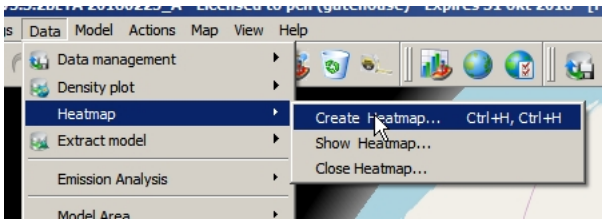


You can Load/Unload Emission data from the 'Data/Emission Analysis' menu and you can control the coloring of the plot using 'Data/Emission Analysis/Coloring', similar to the Traffic Density Plot.

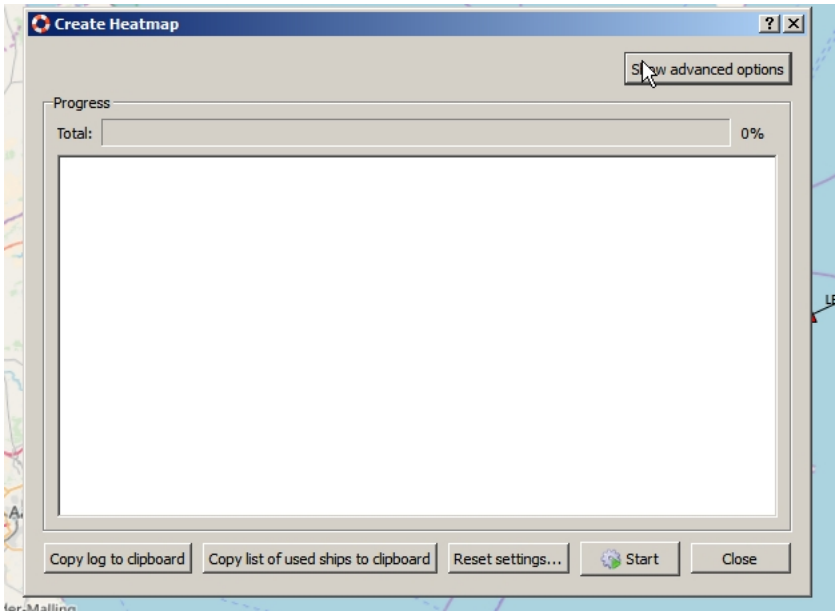
## Creating heatmaps

Note: This feature can only be used if you have a commercial license.

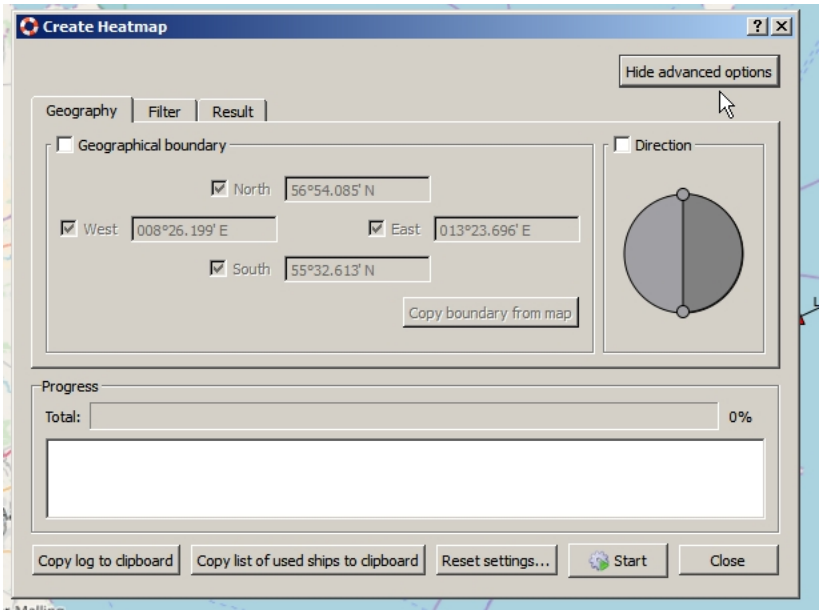
A heatmap plot can be generated based on an imported dataset, select 'Data/Heatmap/Create heatmap...' from the menu:

1. 


The dialog is similar to the density dialog, but a bit simpler because there is no interpolation parameters:




Press 'Show advanced options' to see all possible settings.

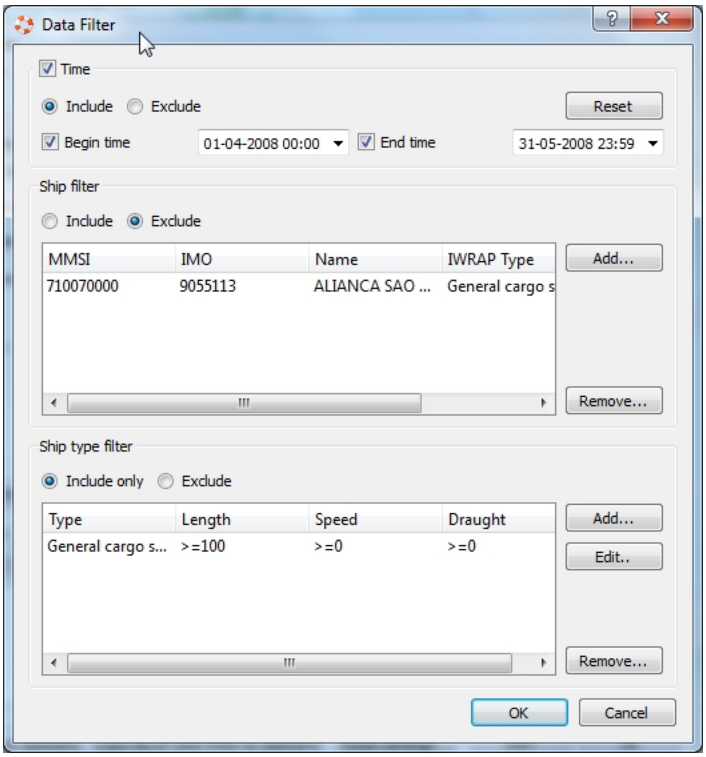



You can use the 'Geographical Boundary' to create several plots that focus on certain areas, this a great help to increase the details.

The Direction filter can be used to only include ships moving in a certain direction. In the example below ships having a heading between 206 and 256 degrees are included. Use the mouse to drag the yellow end-point indicators, right-click on the wheel to set the boundaries or flip the values or use the mouse wheel to rotate the wheel.

The Direction filter can be used to only include ships moving in a certain direction. In the example below ships having a heading between 206 and 256 degrees are included. Use the mouse to drag the yellow end-point indicators, right-click on the wheel to set the boundaries or flip the values or use the mouse wheel to rotate the wheel.

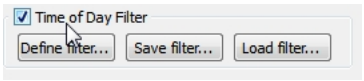
The Data filter can be used to specify constraints on which Ships should be included in the plot, press 'Define filter...'.



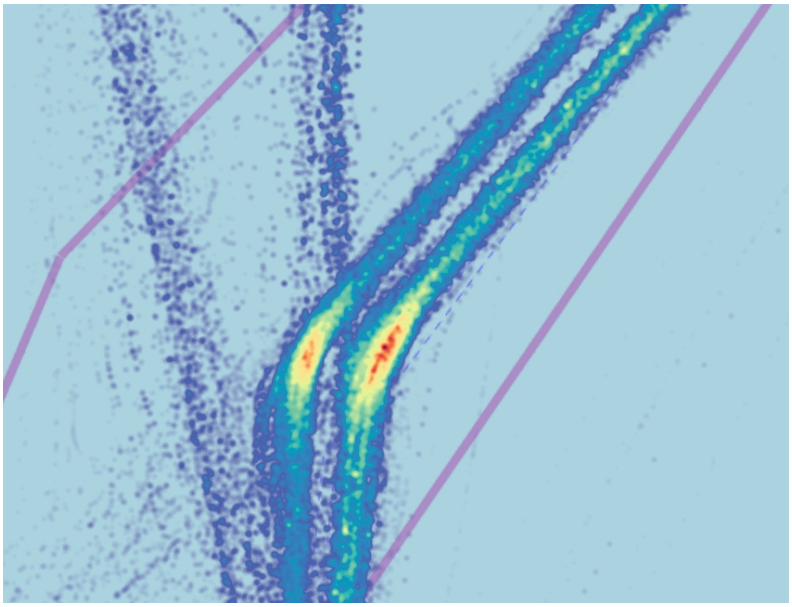

It is possible to include or exclude specific ships, or specify a filter for a ship type. The ship type filter can be specified for 'Any' ship or for one or more of the IWRAP ship types. In the above example it is chosen to exclude a specific ship and include all other ships with a speed >= 10.

It is also possible to exclude a period or only include a certain period of the dataset.

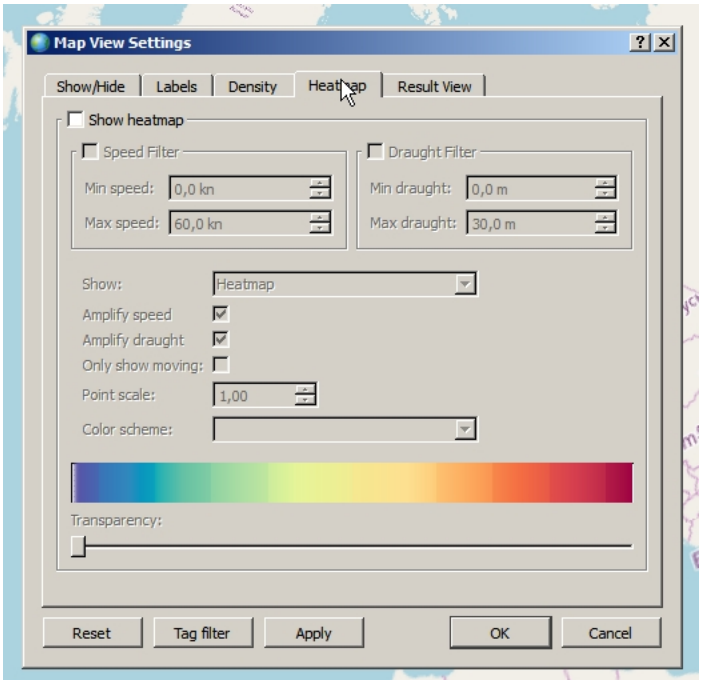
The Time of Day Filter can be also be used to filter the dataset.




Press Start to create your heatmap plot. When the creation is completed press close. If you have not already opened a model, open or crate a new one and, zoom in on the heatmap plot.



There are a number of display settings for the heatmap that can be controlled using the 'Map View Settings':




The Speed and Draught filters can be used to filter the data.

In the Show selector you can choose between a "Heatmap" created using this dialog, or "All Imported" data or "Traffic Density".

"Amplify speed" means that each sample is multiplied by the speed, "Amplify draught" is the same for draught..

When the data is created a smaller dataset is created that only contains ships with speed above 8knots. When "Only show moving" is selected then this smaller dataset is used.

Point scale can be used to enlarge each of the heatmap points.

Finally the color scheme and transparency can be specified.

## Passagelines

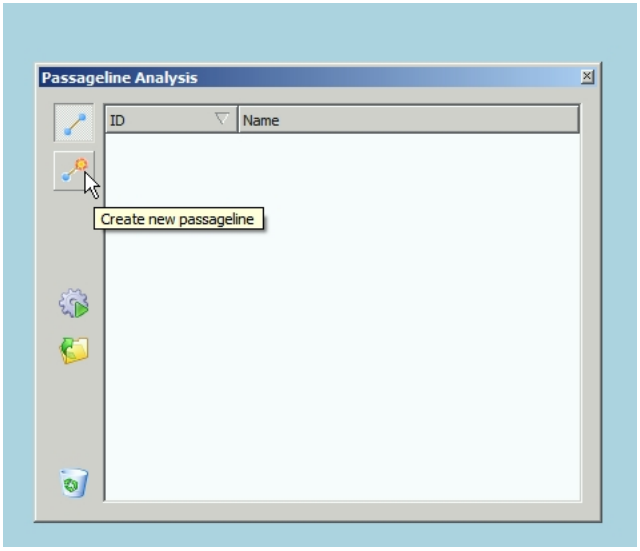
Note: This feature can only be used if you have a commercial license.

It is possible tor create passagelines and count traffic crossing these lines.

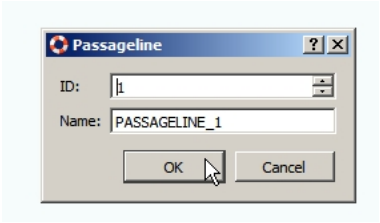
This is different from creating legs, and counting traffic on a leg, because when you have a leg the traffic has to follow the leg in order to get assigned to the leg.

Go to Data\Passageline Analysis in order to create a new passageline.

Select "Create New Passageline"

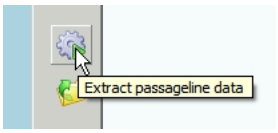



Enter an ID and a a name, the ID is only used in result files:

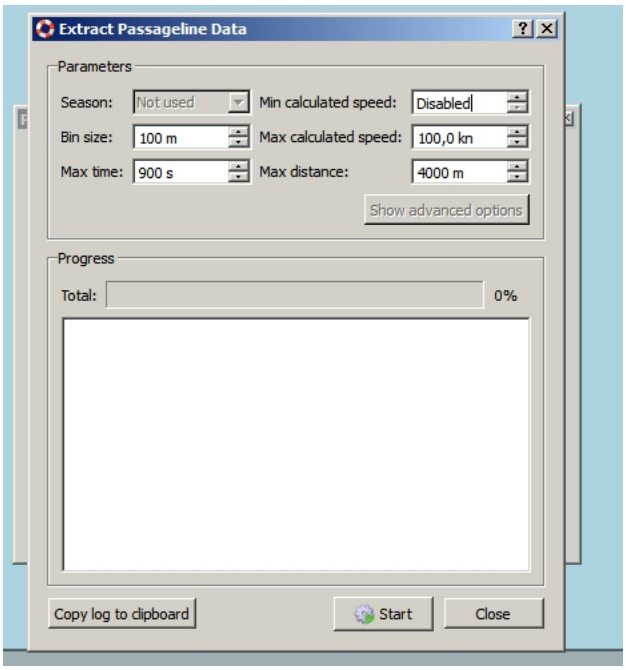



Thereafter click on the map to start the line and move the cursor and press one more time to end the line.

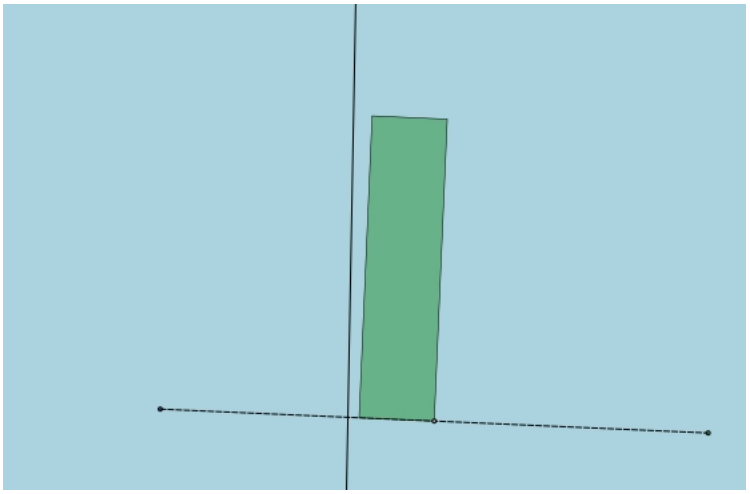
When you have created the passagelines, press "Extract passageline data"



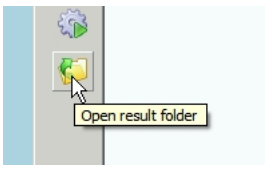

Enter the bin size you want to use and press "start".



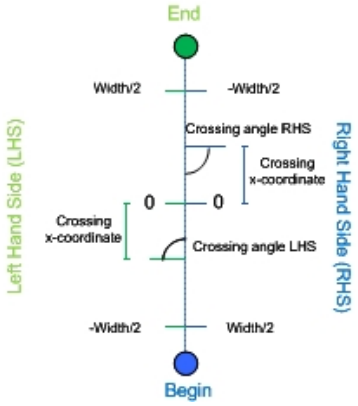

The histograms is shown on the map.



To view the results go to:




The results of a passagline is devided into Right Hand Side (RHS) and Left Hand Side (LHS). See the figure below. The "Begin" point is the first point you create when you start drawing a line, by default it has a blue color.




In the result dir you will find files that contains the histogram results and lists of all the crossing events.

*_main_rhs.csv and *_main_lhs.csv files contains result in histogram form.

| Field | Description |
|---|---|
| line_id | line ID as entered when creating the line in IWRAP |
| bin_index | Index of the bin, see above figure |
| from_lat [WGS84] | From coordinate WGS84 |
| from_lon [WGS84] | |
| to_lat [WGS84] | To Coordinate WGS84 |
| to_lon [WGS84] | |
| from_utm_zone [UTM] | From coordinate UTM |
| from_utm_band [UTM] | |
| from_easting [UTM] | |
| from_northing [UTM] | |
| to_utm_zone [UTM] | To coordinate UTM |
| to_utm_band [UTM] | |
| to_easting [UTM] | |
| to_northing [UTM] | |
| bin_start [m] | Start f the bin, zero is in the middle of the passageline |
| bin_end [m] | End of the bin |

| | |
|---|---|
| count | Count |

*crossing* files contain a row for each crossing event.

Note: -1 is generally used if the value is unknown

| Field | Description |
|---|---|
| crossing_id | All crossings are given a unique ID |
| mmsi | |
| imo | |
| length | Ship length |
| width | Ship width |
| size_a | |
| size_b | |
| size_c | |
| size_d | |
| depth | |
| height1 | |
| height2 | |
| height3 | |
| shiptype iwrap | IWRAP ship type |
| shiptype org | Original ship type from import |
| class_b | 0 = class A, 1 = class B |
| bin_index | The index of the bin where the crossing occured, see figure above, from 0 - "no of bins -1"<br>RHS: 0 is at End<br>LHS: 0 is at Begin |
| crossing X coordinate | RHS: From End to Begin<br>LHS: From Begin to End<br>0 value is center |
| crossingLat [WGS84] | Crossing coordinate |
| crossingLon [WGS84] | |
| crossingZone [UTM] | |
| crossingBand [UTM] | |
| crossingEasting [UTM] | |
| crossingNorthing [UTM] | |
| estimated crossing time | Estimated crossing time |
| estimated crossing time_msecs_since_epoch | |
| crossingAngle | RHS: Angle from Begin<br>LHS: Angle from End |
| crossingSpeedCalc | Speed calculated using previous/next pos and time. This is of course dependent on the accuracy of the time information |
| crossingSpeedAvg | The average speed of the previous and next samples |
| crossingCog | Average of previous/next |
| crossingHeading | Average of previous/next |
| distanceBetweenSamples [m] | Distance between previous and next samples in meters |
| timeBetweenSamples [s] | Time interval between previous and next samples in seconds (float) |
| previous_tripId | Following fields contain data regarding the sample before the crossing |
| previous_sampleId | |
| previous_time | |
| previous_time_msecs_since_epoch | |

| | |
|---|---|
| previous_lat [WGS84] | |
| previous_lon [WGS84] | |
| previous_zone [UTM] | |
| previous_band [UTM] | |
| previous_easting [UTM] | |
| previous_northing [UTM] | |
| previous_heading | |
| previous_cog | |
| previous_draught | |
| previous_sog | |
| next_tripId | Following fields contain data regarding the sample after the crossing |
| next_sampleId | |
| next_time | |
| next_time_msecs_since_epoch | |
| next_lat [WGS84] | |
| next_lon [WGS84] | |
| next_zone [UTM] | |
| next_band [UTM] | |
| next_easting [UTM] | |
| next_northing [UTM] | |
| next_heading | |
| next_cog | |
| next_draught | |
| next_sog | |

It is possible to import passagelines from files, go to Data\Import Passagelines.

The file must have this format:

ID;Name;From latitude;From longitude;To latitude;To longitude

ID must be a number.

Example:

1;TEST;55.737643;10.705519;55.738751;10.834766

If the ID is used i.e. non zero, existing lines with same ID will be overwritten.

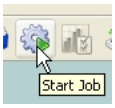
## Running the Risk Algorithm

This section will show you how to perform an analysis based on your model and inspect the results.

### Start a new Job

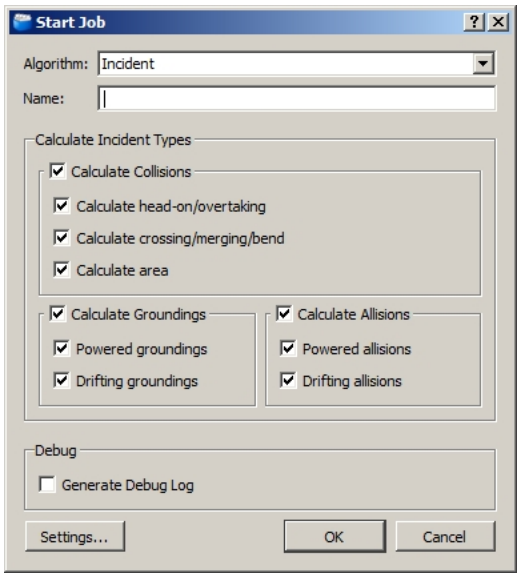
In order to run the risk algorithm you must first make sure that you have a complete model, i.e. with one or more legs and traffic and lateral distributions assigned to each leg.

A risk analysis job is run by selecting Start Job from the toolbar:



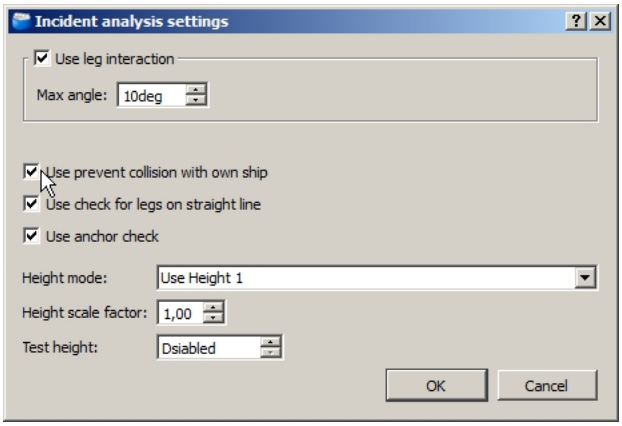

A warning dialog may be displayed indicating that a number of polygons/areas are not Simple, they are drawn with red color on the map, you should correct these polygons before continuing, see Defining Bathymetry.

The Start Job dialog is displayed, give the job a name:




As you can see it is possible to disable some of calculations, by default all are enabled. This is useful if you e.g. have a detailed bathymetry model, but are working on adjusting collisions, then you can temporarily disable grounding calculations to speed up your work. Remember to always perform your final analysis with all calculations checked!

Under the settings button you will find the following settings:




"Use leg interaction" means that ships on legs that are parallel within the "Max angle" will be able to collide with each other.

The statistical model, that IWRAP is based on treats all voyages individually, meaning that in theory a ship could collide with it self. The causation factors do handle some of these cases, but if you e.g. have a lot of ferry traffic this might give a problem. If the model is based on AIS data IWRAP keeps track of which ships are on the leg, if"Use prevent collision with own ship" is

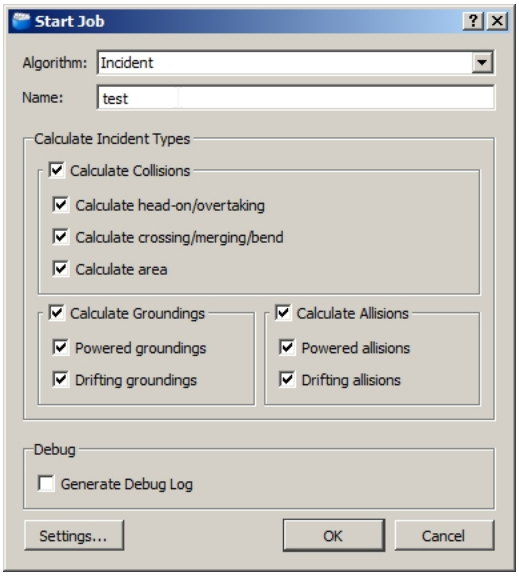
enabled IWRAP will make sure a ship can not collide with it self.

"Use check for straight line", is used to automatically set the leg extension to 0 if the legs are on a straight line, i.e. it does not make sense to check for grounding cases at the end of leg that just transitions in to a new leg where the direction of the leg is the same.

"Use anchor check" can bes used to temporarily disable the anchor check algorithm. The algorithm is very computational expensive so it may be disabled in some cases for faster analysis. Remember to enable it again.

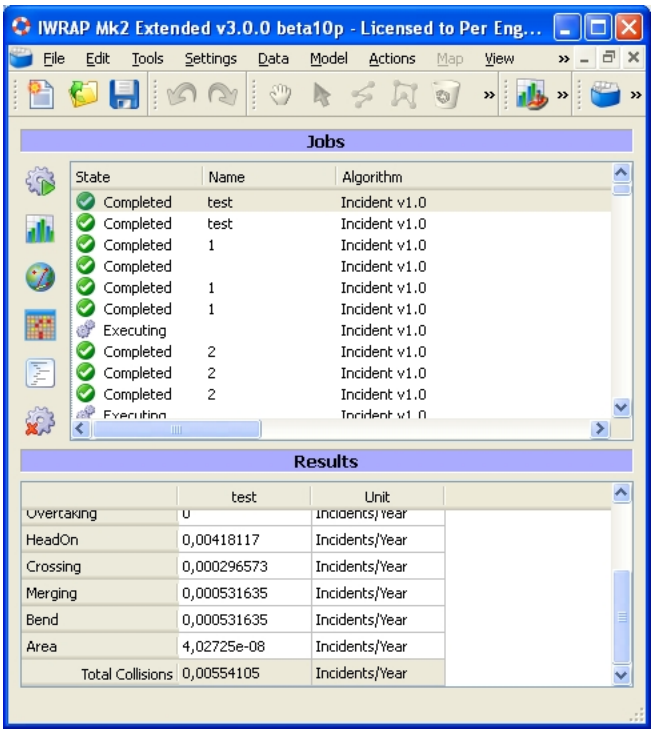
The "height mode" can be used to select the source of the height parameter used in the computations. It is possible to adjust the heights with the "Height scale factor" to e..g see what happens if ships are e.g. 10 percent higher. The "Test height" value can be used only for testing, to see if there will be any allisions, this must normally be disabled.

Go back to the "Start job" dialog:

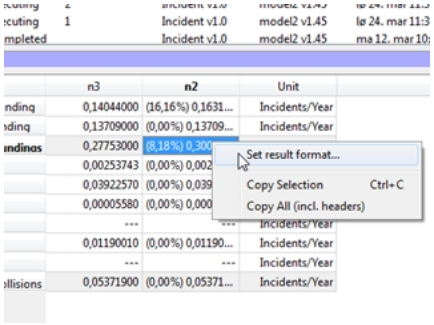



and press Ok. IWRAP Mk2 will take a snapshot of your current model and start processing. The job is added to the top of the Job list.

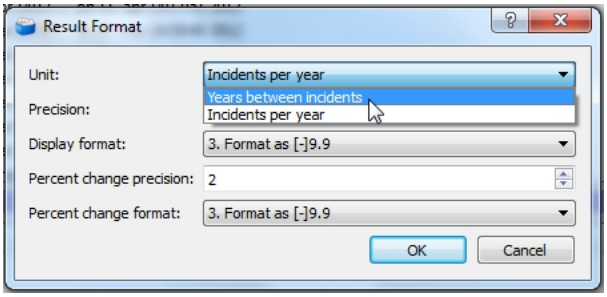
The Job will start in the 'Executing' state. Wait for the job to go to the 'Completed' state. If you select a job (also a job that currently is executing) the result of the analysis will be displayed in the lower Result window. If an executing job is selected the results of the analysis completed so far is displayed.




It is possible to select several jobs from the Job list and get the results shown in the Results list, this makes it easy to compare different runs. When comparing results, the change in percent relative to the first selected job is shown.



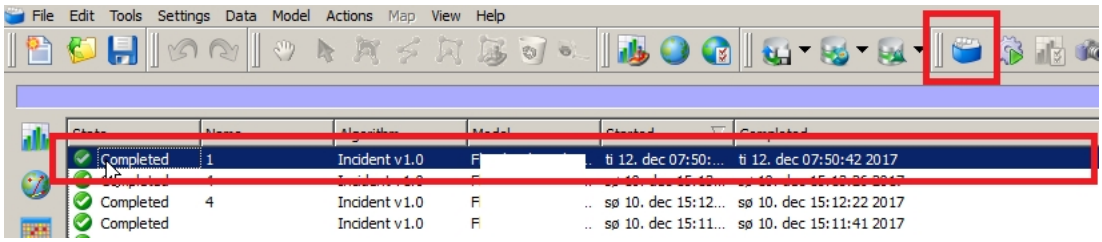

You can change the way the result is displayed by right clicking on the results and selecting “Set result format…”. You can select between “Years between incidents” and “Incidents per year”, and select the precision of the numbers.




## Inspecting Results

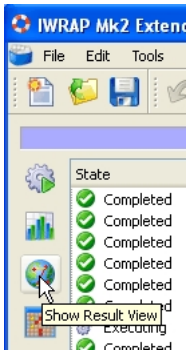
The section will explain how you can analyze the results of a job in further detail.

First make sure you have selected a job in the job list:

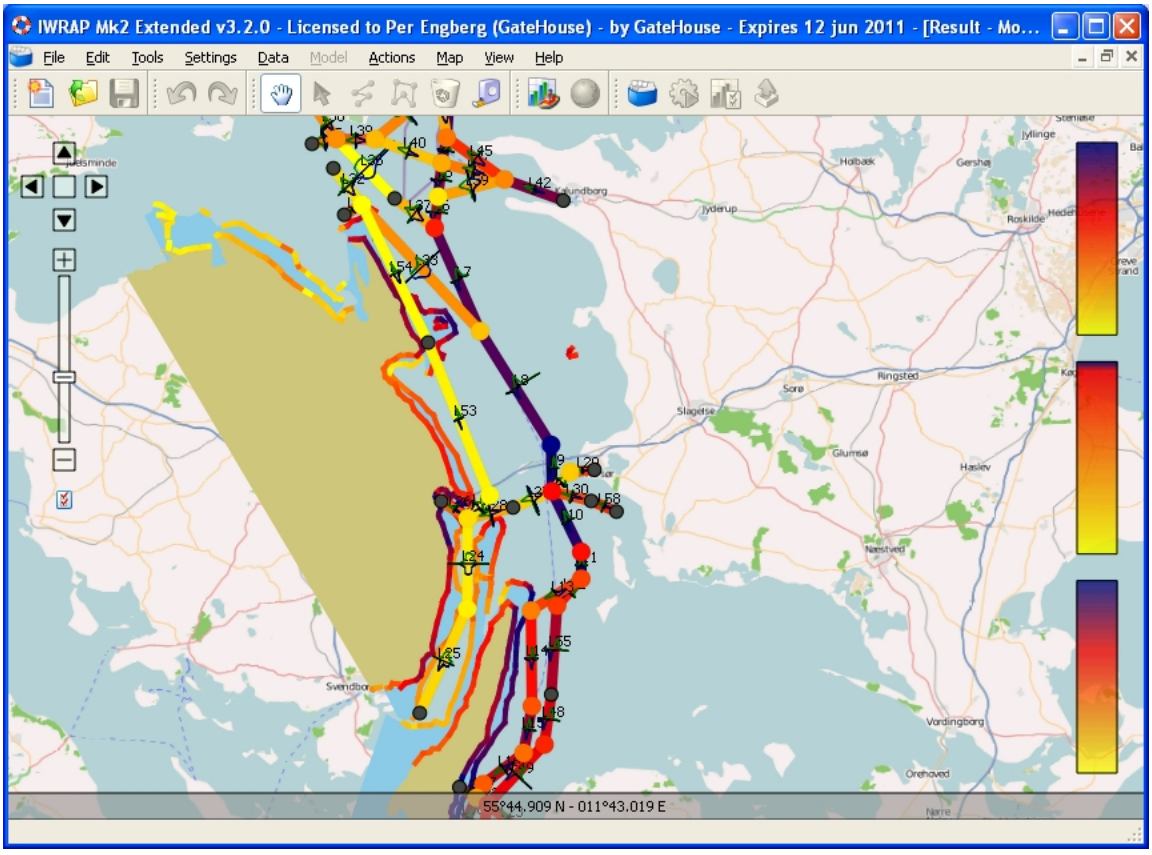



If the list is not visible press the icon in the top toolbar.

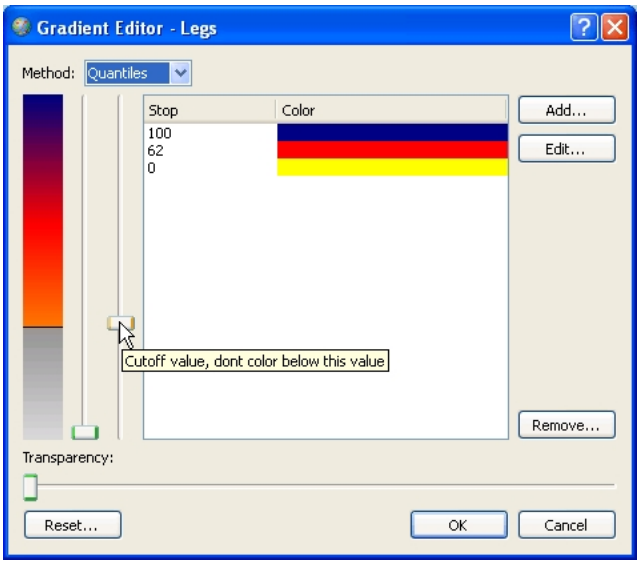
The result can be shown on a map by selecting 'Show Results View'.




The map is colored using 4  gradients, one for Legs, one for Waypoints and one for Bathymetry and one for Allisions.



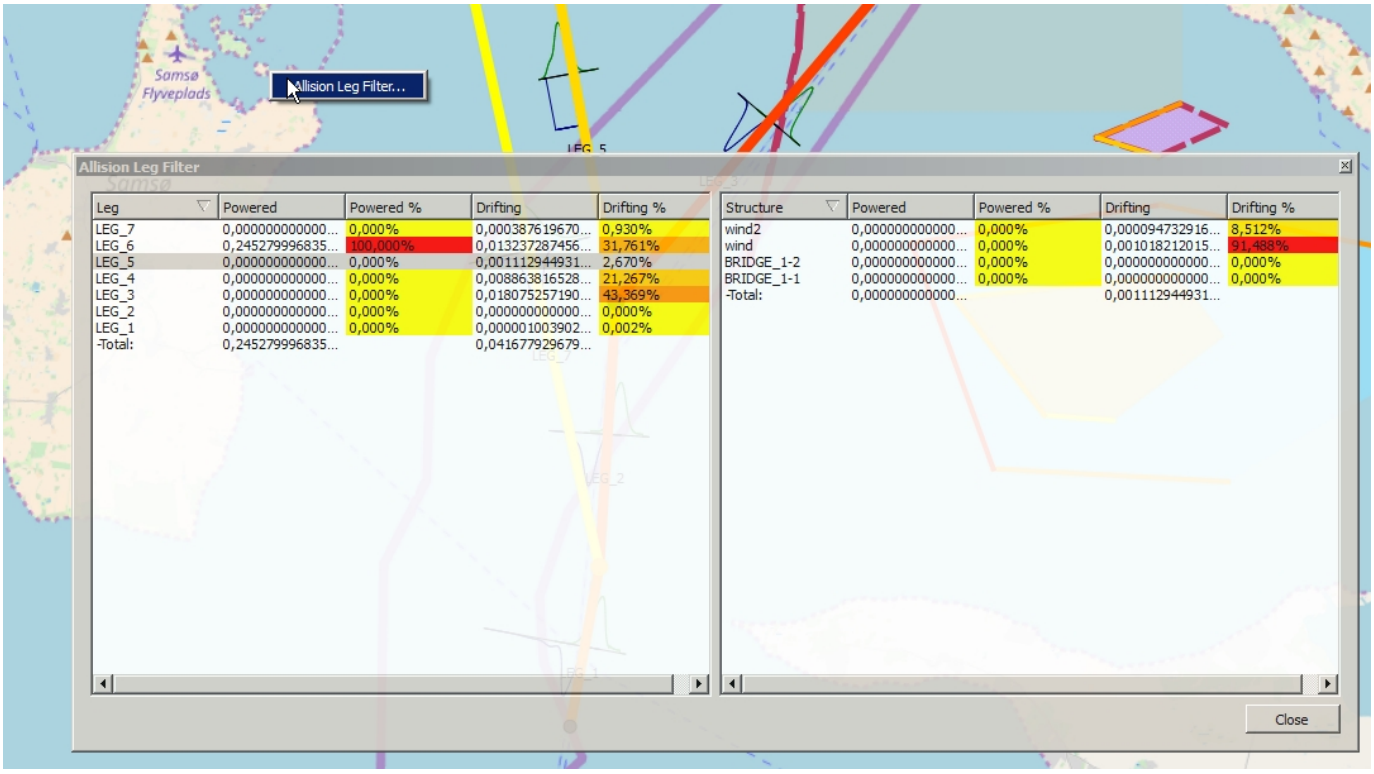
You can click on the gradient to change the color settings etc., the topmost is for the Legs, the middle is for the Waypoints and the last is for the Bathymetry. The default way of coloring is using Quantiles, you can also choose to use Percentage.




You can add, remove, and edit the colors. Note, the cutoff value slider, this can be used to define a limit on the values of interest, values in the gray area are not shown on the map.

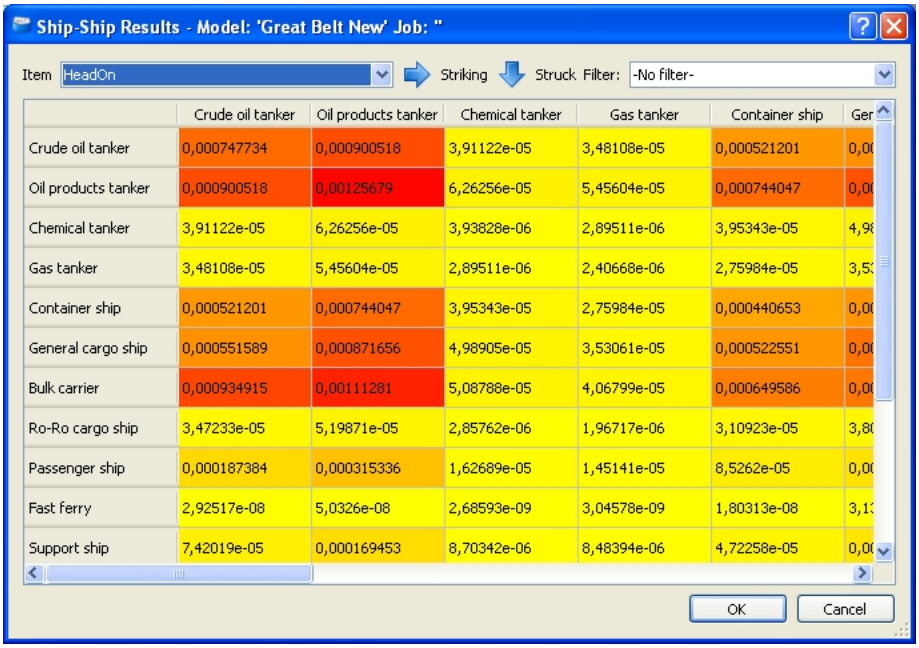
You can always select reset to return to factory default settings.

If your model has allisions you can right click on the map and choose "Allision Leg Filter...", here you can select a leg on the left side and and see the resulting frequencies for each structure on the right side. Note that the map is also affected i.e. the filter is also applied to the map.



For grounding you can use the similar "Grounding Leg Filter".

A second way of analyzing the results is by using the 'Ship-Ship results table', this can be activated from the Job view:

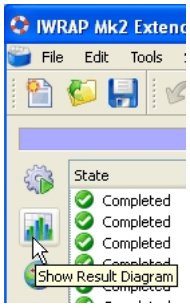



This table indicates the probability of incidents between ship types. The more red the higher the probability. Use Item to select from the different types of incidents; head-on, overtaking, etc. Using the filter you can e.g. filter on a specific Leg. If you right-click on the table you can copy the data to the clipboard.

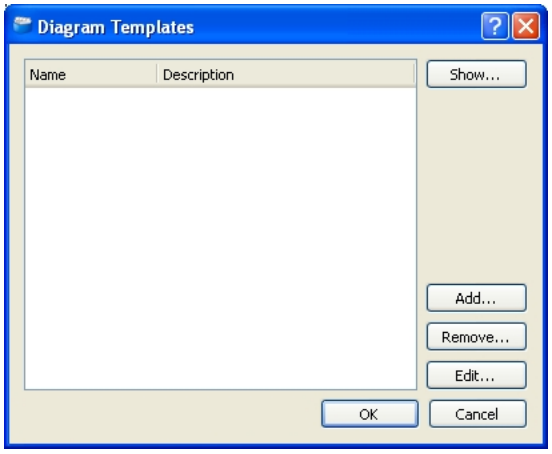
Use the button to analyze grounding results, and use to analyze allision results.

On the job view you  can choose the "Save html" option in order to  save all results to a number of html files. These files can easily be imported in to e.g. Word.

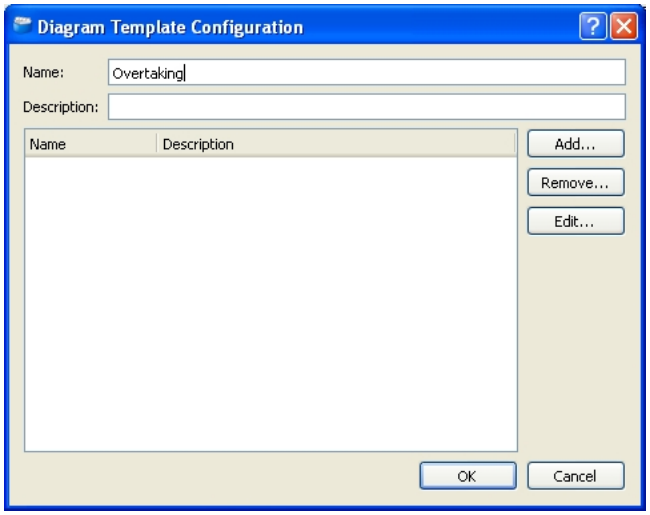
Another option to show results is to use 'Result Diagrams':



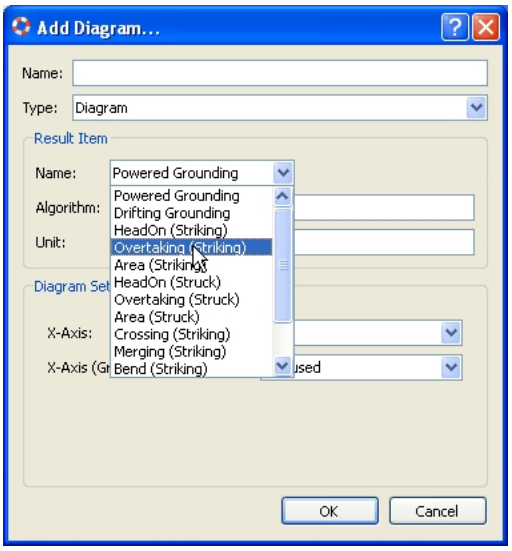

This will show the Diagram Templates dialog:



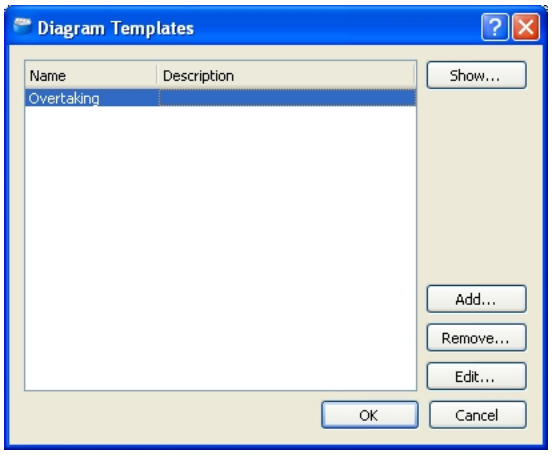

Press Add to define a new template.



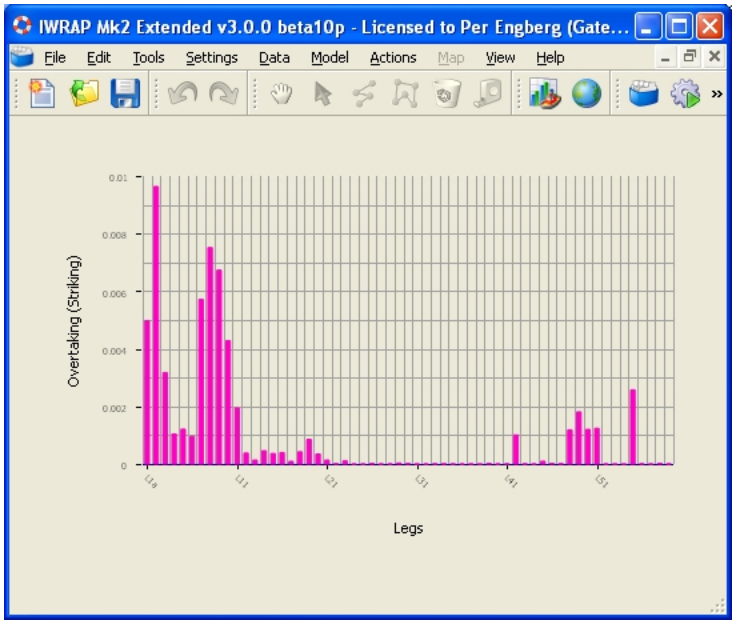

Give the template a name, and press Add to add a diagram:




Press Ok and press Ok again on the 'Diagram Template Configuration' dialog. Now you can double click on the new 'Overtaking' template or select it and press Show.

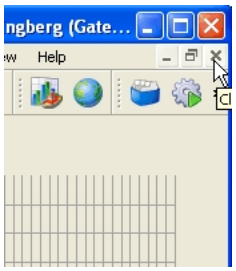



The diagram is shown:




The diagram template is of course stored and can be reused later.

Close the window by using the x in the top right corner or press CTRL+F4.



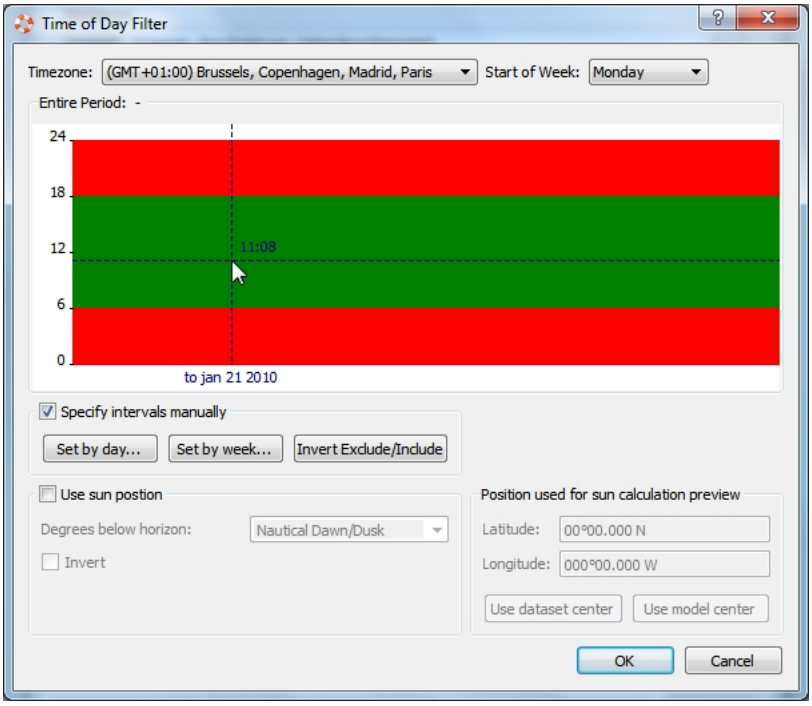

# Misc.

## Managing ENC

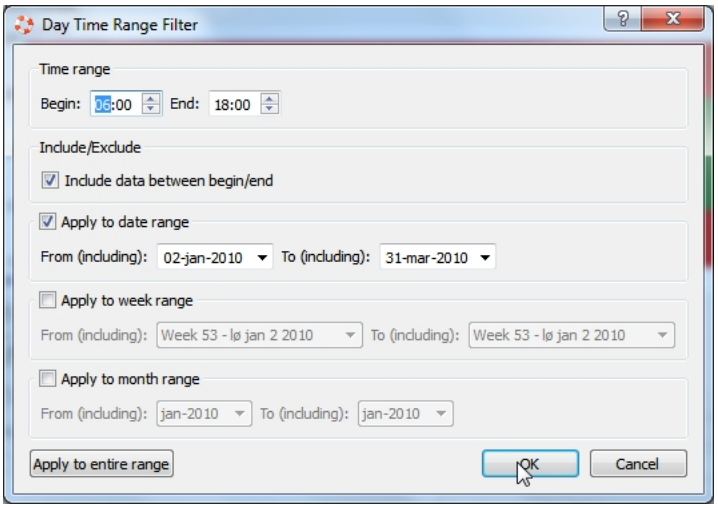
### Time of Day Filter

The Time of Day filter can be used to filter the dataset so that only specific hours of the day are included in the analysis.

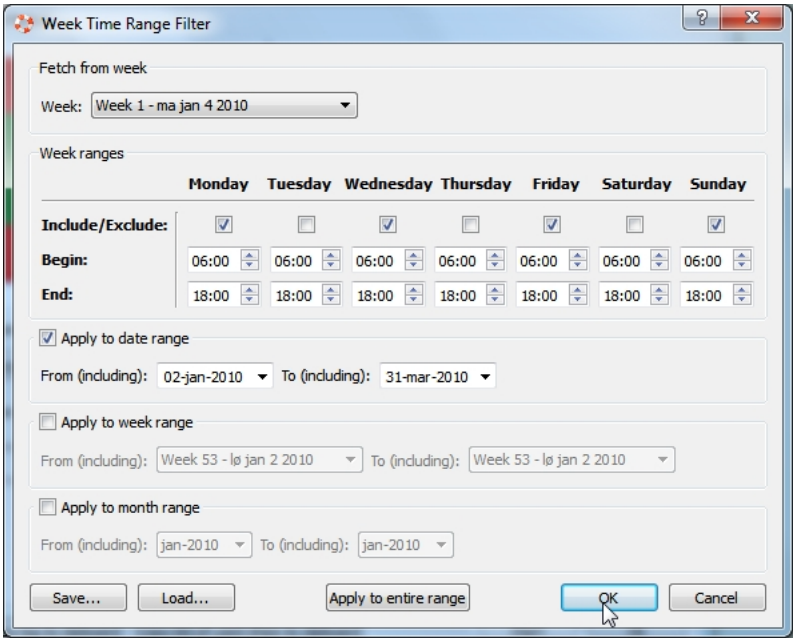
The graph in the top of the dialog visualizes the entire dataset, the time periods that will pass the filter are illustrated using green and the rest using red color.




The filter has two different modes: Manual or based on Sun position. In Manual mode you can specify the hours for each day using 'Set by Day...':



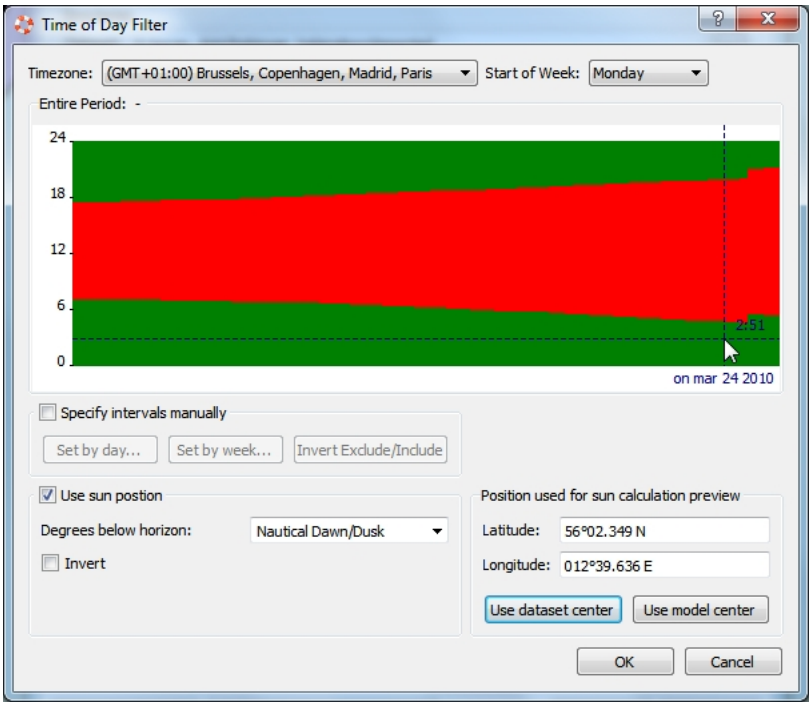

or 'Set by Week':




The above configuration will give the following filter for the dataset used in this example (Note that Tuesday, Thursday and Saturday have excluded the hours from 6 - 18 and the rest have them included:

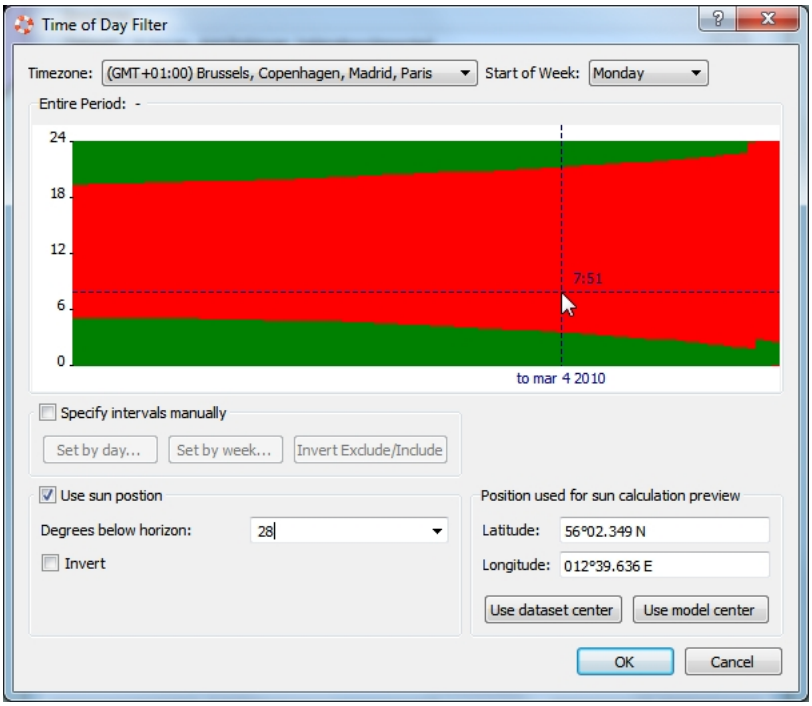
You can use the 'Invert Exclude/Include' to easily invert all of the days in the entire dataset.

In the sun position mode the elevation of the sun is calculated at each position in the dataset. The default is to use Nautical Dawn/Dusk, which means that the sun must be 12 degrees below the horizon.



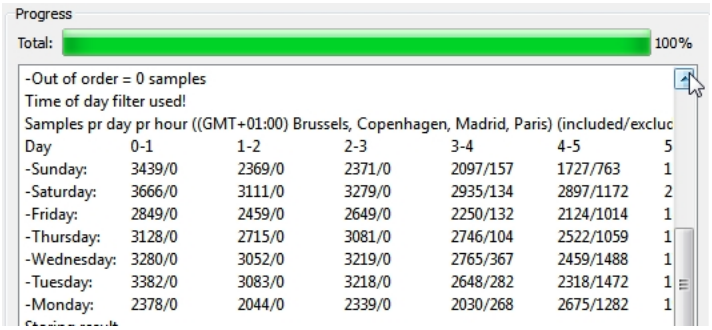

Note that the graph shown here uses the coordinate specified in the dialog, but when the filter is used the position will of course be used instead. Select 'Invert' to switch between including light/dark periods.

Instead of using 'Nautical Dawn/Dusk', you can select 'Apparent Sunrise/Sunset' or you can write a number of degrees, here we have specified 28 degrees below the horizon.




Press Ok to use the filter.

When you are using a Time of Day filter you can see the following table in the log. The table displays the number of samples include/excluded due to the filter for each day/hour of the week.




## Time Format

These expressions may be used for the date part of the format string:

| Expression | Output |
|---|---|
| d | the day as number without a leading zero (1 to 31) |
| dd | the day as number with a leading zero (01 to 31) |
| ddd | the abbreviated localized day name (e.g. 'Mon' to 'Sun'). |
| dddd | the long localized day name (e.g. 'Monday' to 'Sunday'). |
| M | the month as number without a leading zero (1-12) |
| MM | the month as number with a leading zero (01-12) |
| MMM | the abbreviated localized month name (e.g. 'Jan' to 'Dec'). |
| MMMM | the long localized month name (e.g. 'January' to 'December'). |
| yy | the year as two digit number (00-99) |
| yyyy | the year as four digit number |

**Note:** Day and month names must be given in the user's local language. It is only possible to use the English names if the user's language is English.

These expressions may be used for the time part of the format string:

| Expression | Output |
|---|---|
| h | the hour without a leading zero (0 to 23 or 1 to 12 if AM/PM display) |
| hh | the hour with a leading zero (00 to 23 or 01 to 12 if AM/PM display) |
| H | the hour without a leading zero (0 to 23, even with AM/PM display) |
| HH | the hour with a leading zero (00 to 23, even with AM/PM display) |
| m | the minute without a leading |

| | |
|---|---|
| | zero (0 to 59) |
| mm | the minute with a leading zero (00 to 59) |
| s | the second without a leading zero (0 to 59) |
| ss | the second with a leading zero (00 to 59) |
| z | the milliseconds without leading zeroes (0 to 999) |
| zzz | the milliseconds with leading zeroes (000 to 999) |
| AP or A | interpret as an AM/PM time. *AP* must be either "AM" or "PM". |
| ap or a | Interpret as an AM/PM time. *ap* must be either "am" or "pm". |

All other input characters will be treated as text. Any sequence of characters that are enclosed in singlequotes will also be treated as text and not be used as an expression.

For any field that is not represented in the format the following defaults are used:

| Field | Default value |
|---|---|
| Year | 1900 |
| Month | 1 (January) |
| Day | 1 |
| Hour | 0 |
| Minute | 0 |
| Second | 0 |

For example:

The 1 January 1998 00:01:02 represented by M1d1y9800:01:02 can be parsed using 'M'M'd'd'y'yyhh:mm:ss

## Position Format

The following is a list of examples of different position formats supported by IWRAP. The hemisphere can be given as either N/S/W/E or +/- and can be anywhere in the value string (except for 'Decimal degrees' and 'Dm,H' formats).

IWRAP currently only supports WGS84.

If possible 'Decimal degrees' should be used.

| Format | Value | Result |
|---|---|---|
| Decimal degrees | 58.65375 | 58.65375 |
| Dm,H | 5839.225,N | 58.65375 |
| DDMMSSss | W116°14'28.86 | -116.24135 |
| DDMMSSss | 116°14'28.86"W | -116.24135 |
| DDMMSSss | -116 14 28.86 | -116.24135 |
| DDMMSSss | -1161428.86 | INVALID |
| DD.d | -116.24135 | -116.24135 |
| DD.d | 116.24135° W | -116.24135 |
| DD.d | W116.24135° | -116.24135 |
| Dm,H | 00910.660,E | 9.17767 |

| | | |
|---|---|---|
| DDMM.mmm | 00910.660' E | 9.17767 |
| DDMMmmm | 009° 10.660' E | 9.17767 |

For e.g. DDMMmmm does not care if there is a ° charachter or not as a long as there is a separation, so "009 10 660 E" is the same as "009° 10.660' E" .

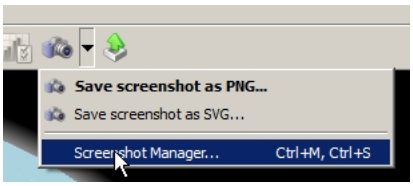
If the value has lower or higher precision than e.g. DDMMSSss it is possible to use e.g. DDMMSSs or DDMMSSsss, similar for DDMMmmm and DDMM.mmm.

The format string is the same for latitude and longitude, i.e. you should NOT write e.g. DDDMMSSss for longitude, always use DDMMSSss.

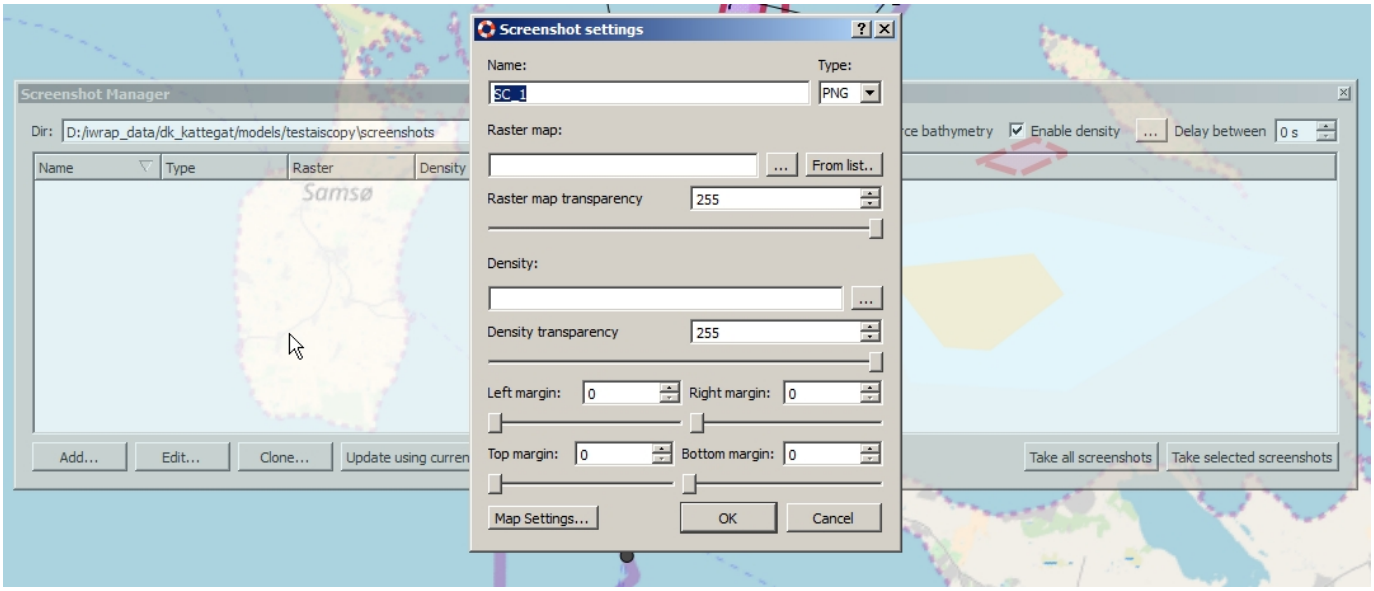
## Screenshot Manager

The Screenshot manager enables you to create screenshots with the same view settings many times. This is useful if you are writing a report and e.g. do small changes to the model and then want to take the screenshot with the same view settings again. You may also want to take several screenshots at the same view location with different view settings, e.g. with and without density plot.

The Screenshot Manager tool can be reached from this menu:

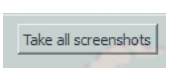



Press "Add" to create a new view:

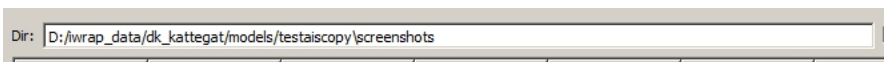



By default the current view settings will be stored for the screenshot settings.

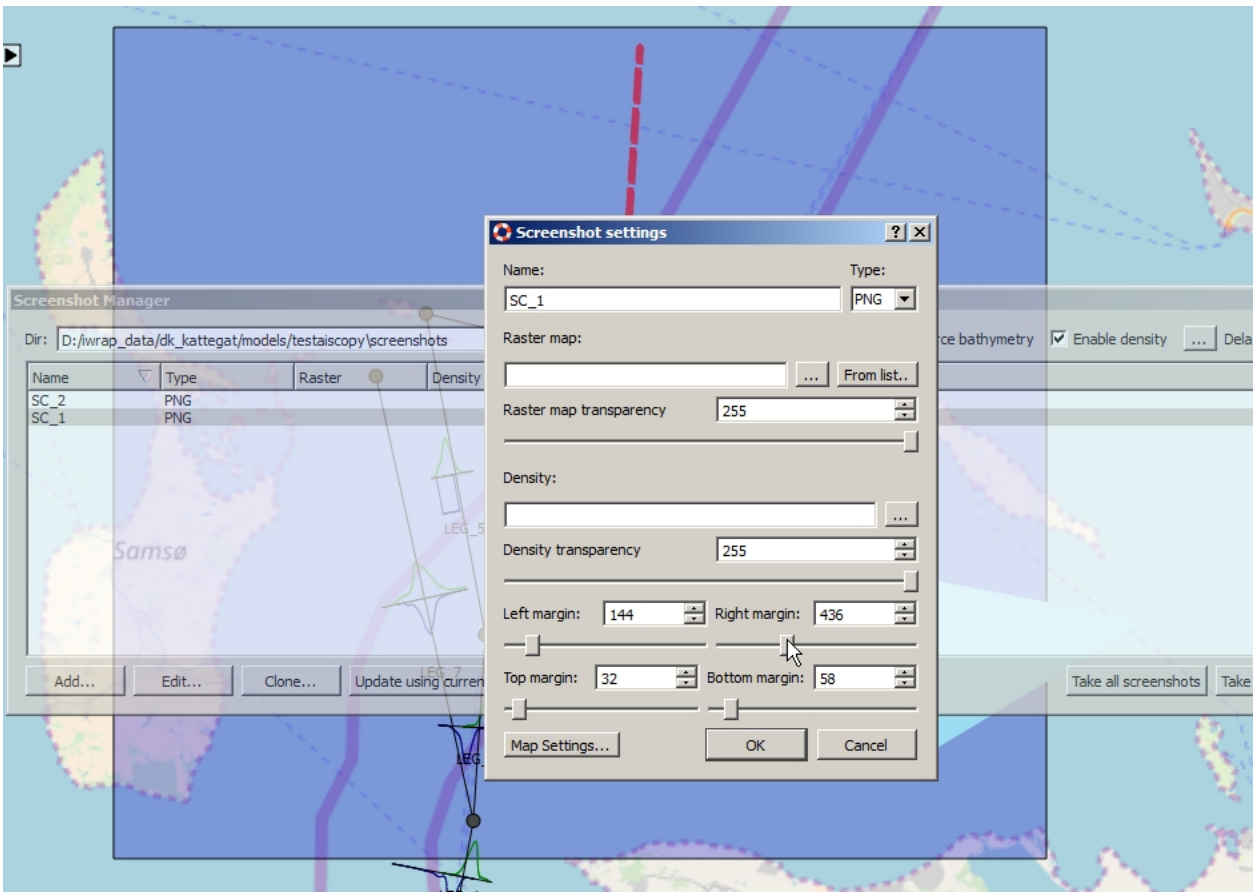
Try and press "Ok" and then:




The screesnhots will be stored in the "Dir" location:



Note that you can define a margin, like:

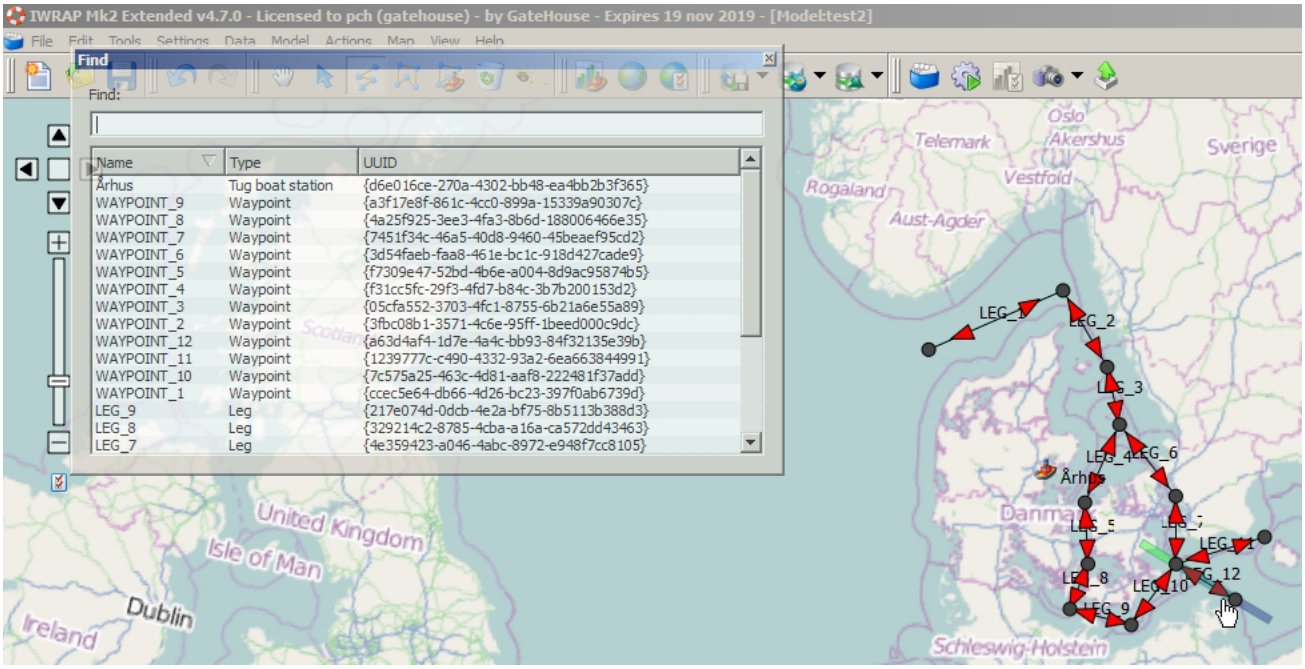



So here only the blue area will be part of the screenshot.

Use the "Clone" button to create a new item with the same view settings.

## Find/Search

Use CTRL+F to start searching for an element in the model:




## FAQ

1. **What input data is required?**
   For each leg you need to know the leg position, lateral distributions, and the traffic amount and composition. For each waypoint you need to know the amount and composition of traffic going from one leg to another. These data can be obtained from AIS data.

2. **How much AIS data is needed and how can it be gathered?**
   It depends on the area, but 2 weeks is recommended

3. **What are (typically) the costs for the purchase of AIS data?**
   GateHouse does not sell AIS data, you should contact the local authorities and ask them or maybe record your own data

4. **What is the price of Lloyds data?**
   This is normally decided on a case by case basis. Please contact Lloyds directly for a price.

5. **What is the price of the commercial IWRAP Mk2 license?**

   Please see:

   https://gatehouse.dk/maritime/products/ghmaritime-analytics/

6. **Can we use ENC's with IWRAP MK II?**

   No. IWRAP does not yet support proper ENC's.

   However Version 2.0 onwards of IWRAP supports Raster Charts as well as Web Map Services (WMS) such as Google Maps and Open Street maps. Google and Open Street give you only the coastline, not the bathymetry of the waterway so, at present, the only way to display Navigational Charts as background, is to use Raster Charts.