IWRAP exercises

Contents

Exercises 1 to 6 are introductory exercises and can be accomplished using the free version of IWRAP. Exercise 7-10 requires the commercial version as the models are created using AIS data.

Exercise 1, head-on collision

Start IWRAP by double clicking on the icon . Once the splash screens have been shown you should have a screen like Figure 1.

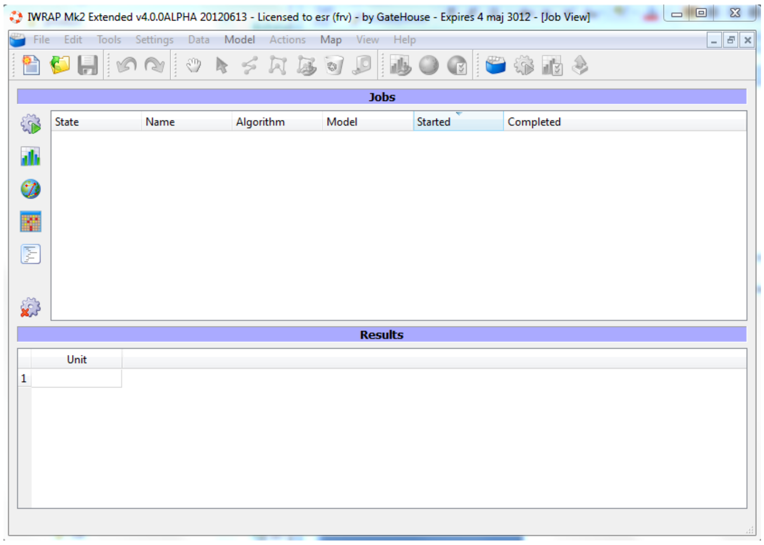


Figure 1: Main Screen when IWRAP is started

Go to *File* in the main menu and select *New*.

The program then asks for the name and the location of the project. Each project should be located in its own folder. So before continuing press the button and navigate to the location where the IWRAP projects should be located. Create a folder called 'IWRAP models' and inside this folder create a new folder called Exercise 1. Now you should be able to press the OK button.

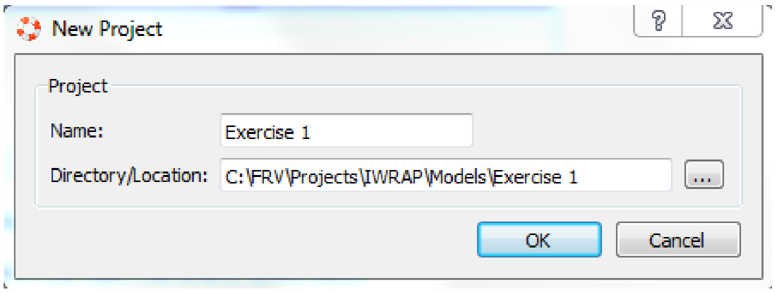


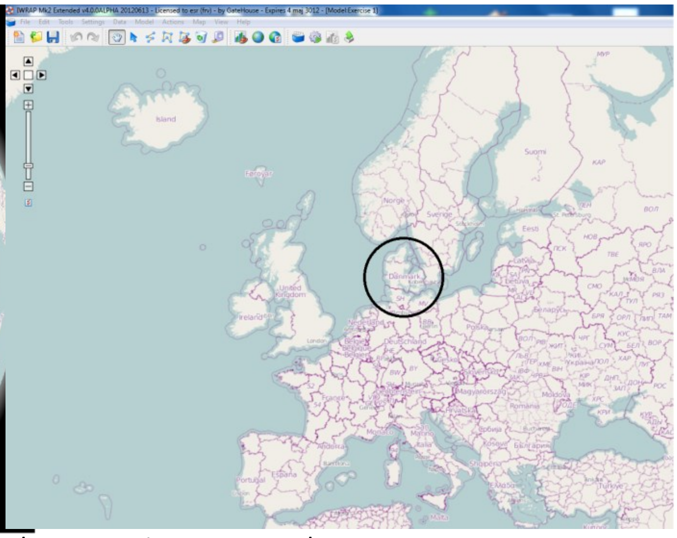
Figure 2: Each IWRAP project should be located in its own folder. The path here is just an example

IWRAP then gives you the opportunity to change some of its settings. For now just press OK.

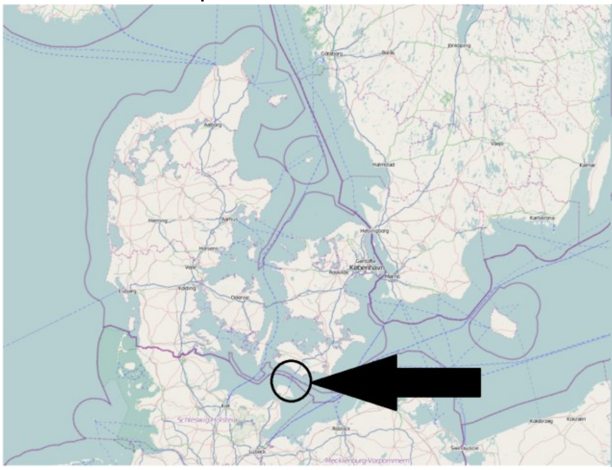
Provided you are connected to the Internet a map should now appear. Using the wheel button on the mouse or the zoom slider to the left you can zoom in and out. By selecting you can you can move around the map. To measure distances select . If you select Map in the main menu you can chose different maps and projects. But for now use the default map. Make sure you are connected to the Internet as the map is fetched from there.

Zoom in on Europe, then on Denmark and then on the strip of water between Germany and Denmark called Femern Belt. See the figures below. By holding down the ctrl-key you can make a zoom box.

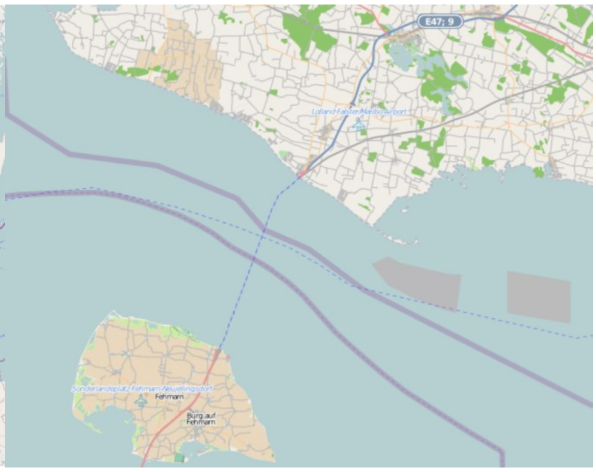
Zoom in on Europe



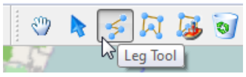
Then zoom in on Denmark



Then zoom in on Femern Belt



Femern Belt between Germany and Denmark

Now select the Leg tool: 

Create a leg by clicking at the beginning and the end of the desired location for the leg. See Figure 3. The red arrows on the leg indicate that data are missing for both directions.

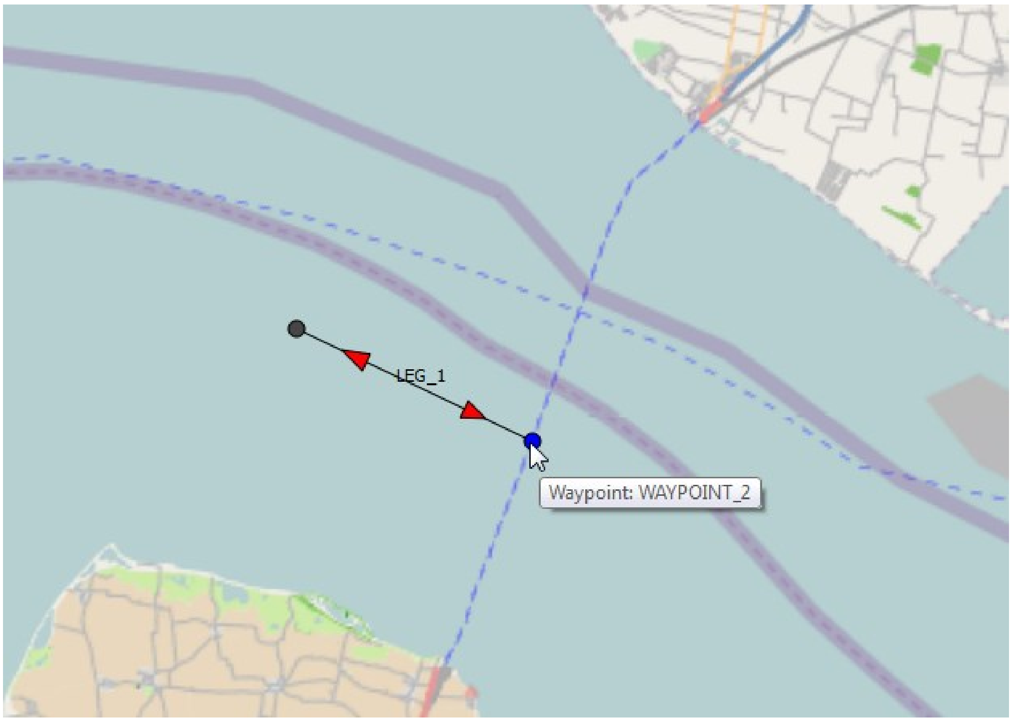
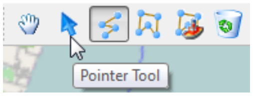


Figure 3: Create a leg by select the leg tool and click at the begining and end of the desired location

Select the pointer tool 

and double click on the leg. This should bring up the following window:

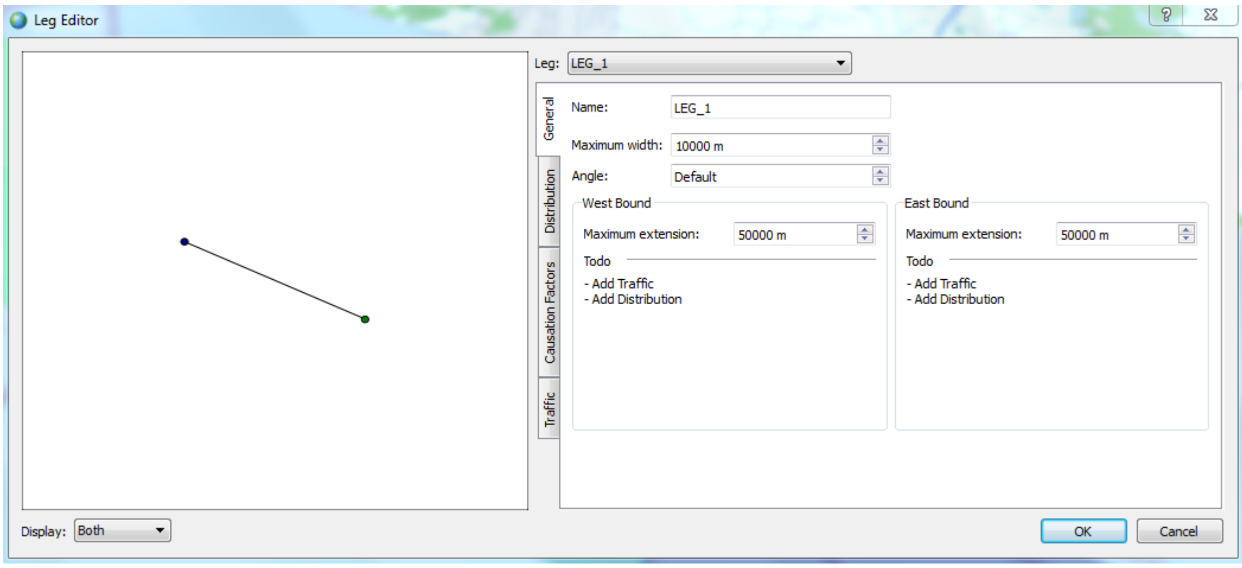


Figure 4: Leg editor window. Here you assign ships, there lateral distributions and causation factors

Select the Traffic tab. Then change the names as below. Now double click on the Edit button

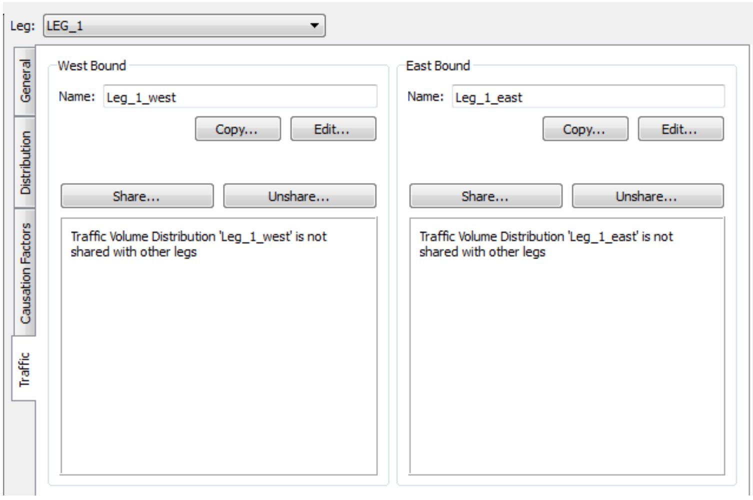
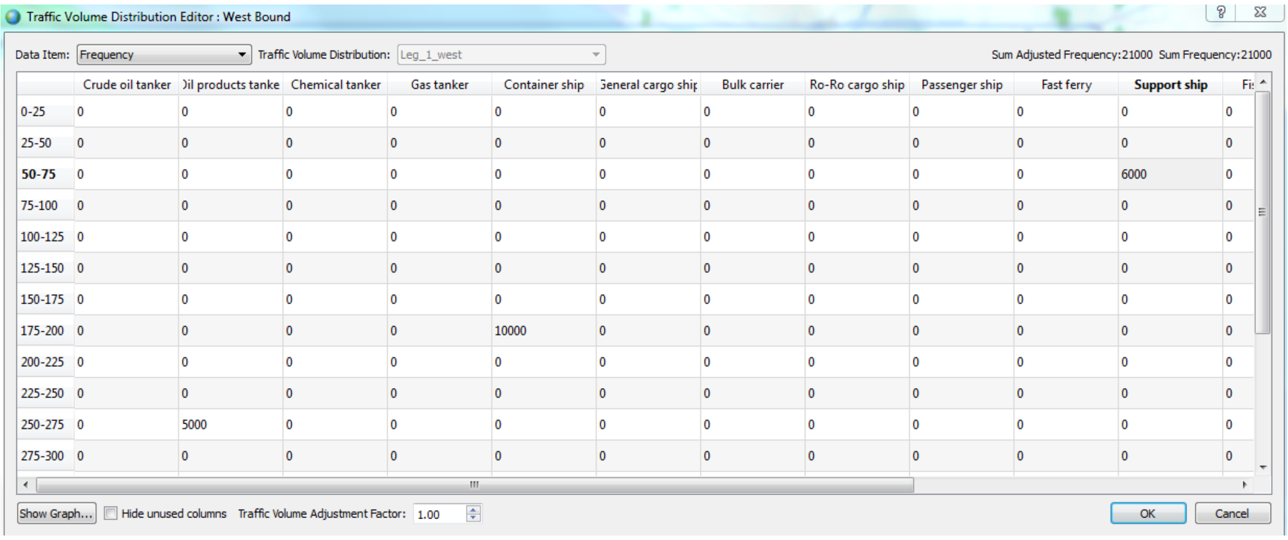


Figure 5: Traffic tab. Here you can enter traffic volumes and share volumes between legs

A matrix where the number of ships categorized by types and length intervals now appears



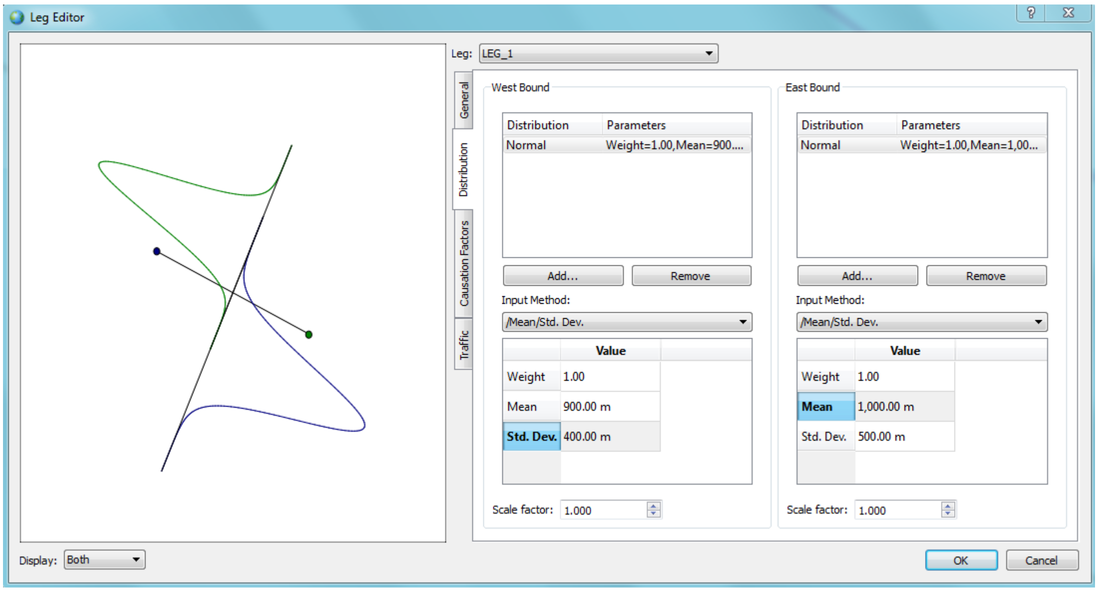
	Crude oil tanker	)il products tanke	Chemical tanker	Gas tanker	Container ship	Seneral cargo ship	Bulk carrier	Ro-Ro cargo ship	Passenger ship	Fast ferry	Support ship	Fi
0-25	0	0	0	0	0	0	0	0	0	0	0	0
25-50	0	0	0	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0	0	6000	0
75-100	0	0	0	0	0	0	0	0	0	0	0	0
100-125	0	0	0	0	0	0	0	0	0	0	0	0
125-150	0	0	0	0	0	0	0	0	0	0	0	0
150-175	0	0	0	0	0	0	0	0	0	0	0	0
175-200	0	0	0	0	10000	0	0	0	0	0	0	0
200-225	0	0	0	0	0	0	0	0	0	0	0	0
225-250	0	0	0	0	0	0	0	0	0	0	0	0
250-275	0	5000	0	0	0	0	0	0	0	0	0	0
275-300	0	0	0	0	0	0	0	0	0	0	0	0

Figure 6: Traffic volume editor. Here the number of ships of a given type and size is given for each direction

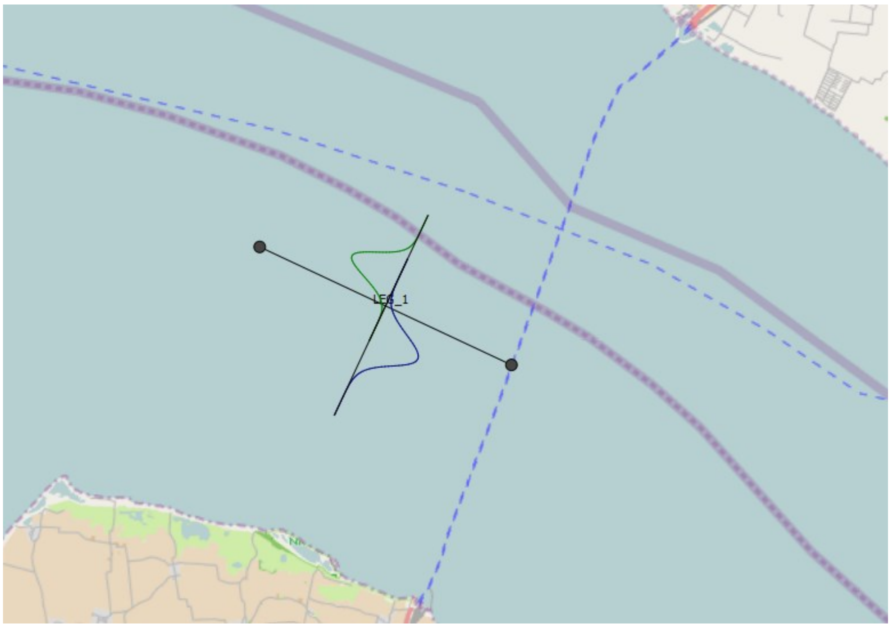
Use the same number of ships for the east bound direction. By clicking at the top left empty cell in the matrix you can select the entire matrix and copy it. Then open the east bound matrix and paste the traffic to this. Notice you can hide the unused columns by checking the checkbox below the matrix. Also notice you can edit the speed, draught and causation factors in the dropdown list at the top of the window.

<u>Lateral distributions</u>

In the leg editor window press the tab called Distribution. Then press the Add button for the west bound direction. Select a normal distribution. Enter 900 for the mean value and 400 for the standard deviation. For the east bound distribution enter 1000 and 500 for the standard deviation.



Exit the leg editor by pressing OK. Save the model by pressing the Save-icon. You should now have a picture like below:



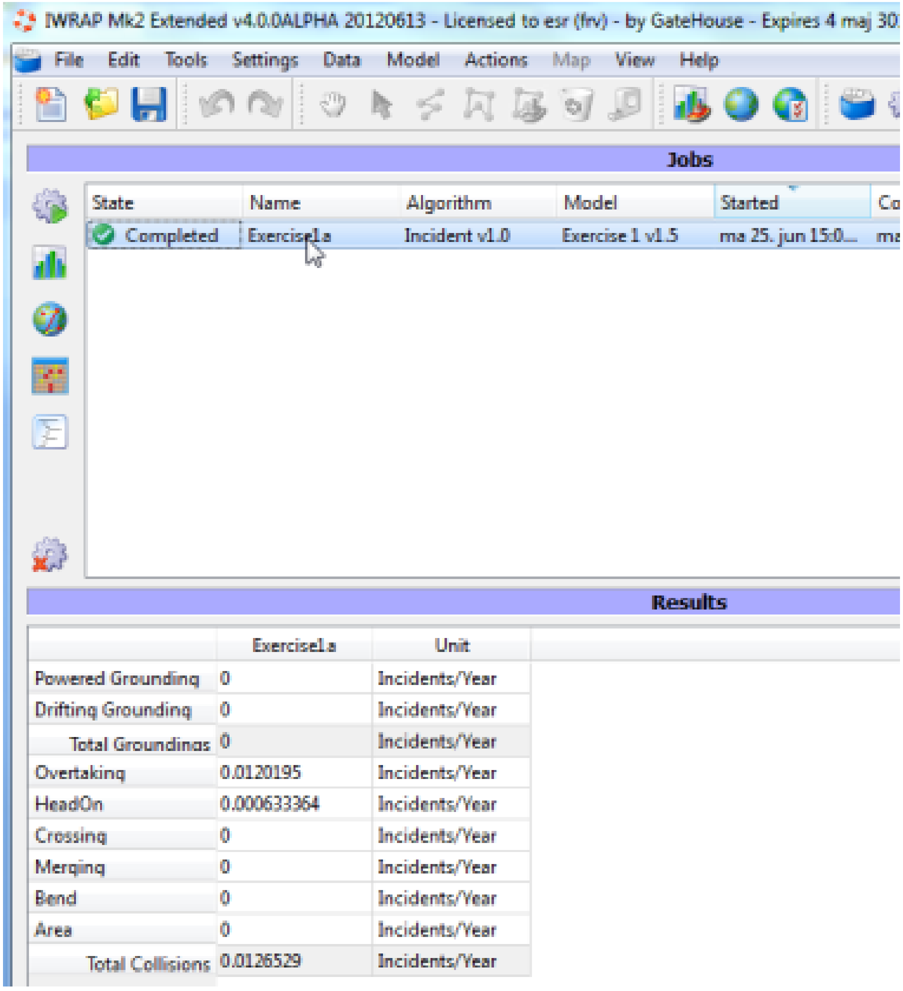
Now you have a model with a single leg that contains ships of different sizes sailing east- and westward. The two lateral distributions describe where the ships are sailing relative to the leg.

Press the ‘Start job’ icon. If the program asks ‘Do you want to uploade…’ press No.

Name the job ‘Exercise1a’ and press OK.

Now click on the first line where it says ‘Completed’. The overall results from the job are then shown at the bottom of the screen. Here we see that for this model there will be 0.01265 collisions per year or one collision every 79 years. Because we have only defined a single leg there are only head-on and overtaking collisions.

Pressing the button at the right shows the collision frequencies for each ship type filtered by collision type and/or leg.



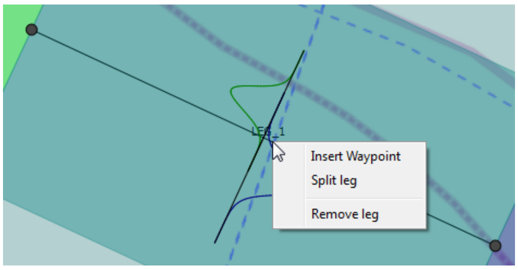
Exercise 2, crossing collisions

In this exercise we will see how to copy a leg, split a leg and

Create a new folder called ‘Exercise 2’

Open ‘Exercise 1’ and go to ‘File’ and save it as ‘Exercise 2’ in the new folder.

Drag the endpoint of leg 1 eastward so that its length is doubled. (First select the pointer tool)

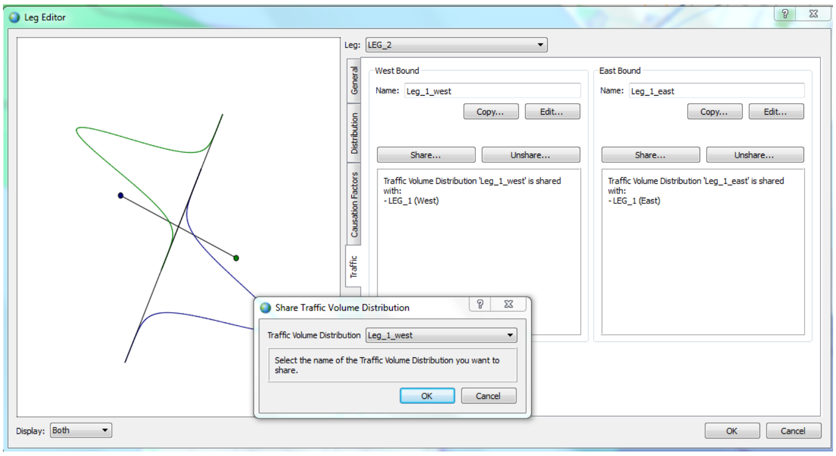
Right click on the middle of the leg 

and select Insert waypoint.

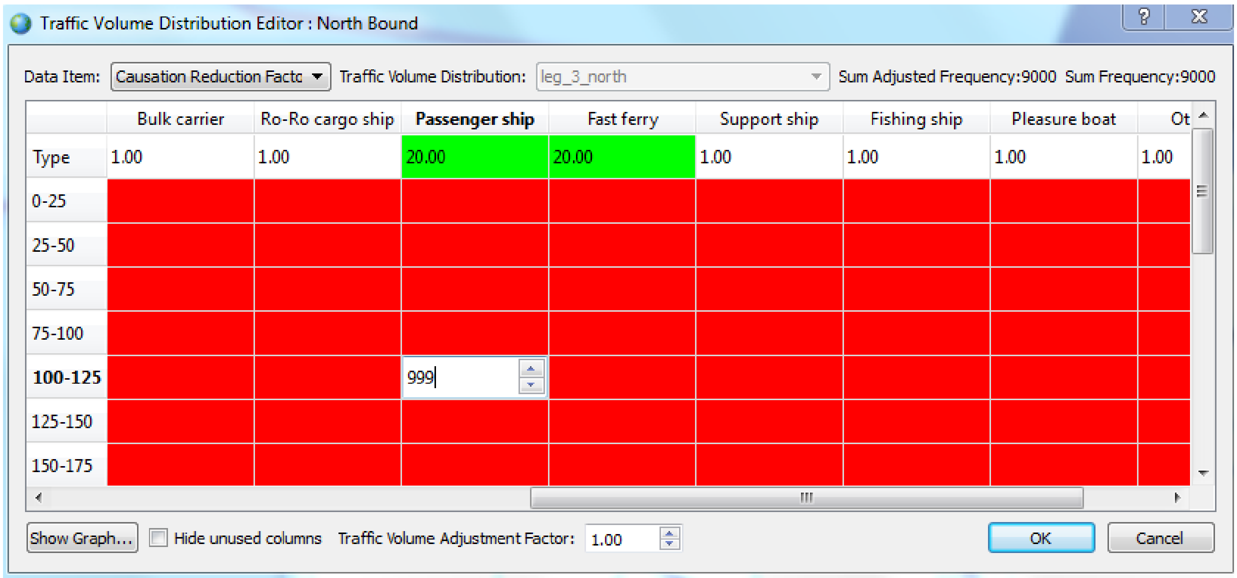
Now you have two legs with the same traffic and distributions. It is a good idea to double click on the new leg and change the names of the traffic volumes to Leg2_west and Leg2_east.

Because the traffic on Leg1 and Leg2 is the same it is useful to use the share function. This means that if you change the number of ships on Leg1 then this is automatically made for Leg2. Double click on Leg2 and select the Traffic tab. Then press the ‘Share’-button for the westbound traffic. In the listbox select ‘leg1_west’. Do the same for the east-bound traffic and select ‘leg1_east’ in the list box. Notice that when shared all the traffic volume names changes to the same name.

Notice that the lateral distributions are not shared, because even though the number of ships are the same they might be distributed differently (sailing closer or farther apart).



Even though Leg 3 and Leg 4 have 9000 passages a year it is actually the same 4 passenger ships that are crossing. This means that IWRAP will overestimate the number of head-on collisions for these two legs. To remedy this double click on Leg3 and open the Causation factors tab and change the head-on causation factor reduction to 999. Do the same for Leg4. Now ships on Leg3 and Leg4 do not collide with themselves. The drawback of this is of course that when where are several ferries on the leg then they will not collide either. But remember that no model is perfect. Alternatively open the Traffic Volume Editor and choose Causation factor reduction in the drop down box at the top right. Change the causation factor to 999 for the passenger ships on Leg3 and Leg 4.



Now select the Leg tool again and create two new legs like on the figure below. Add 9000 passenger ships of length interval 100-125m in both directions. Set the lateral distributions to normal distributions with mean 400m and standard deviation 300m.

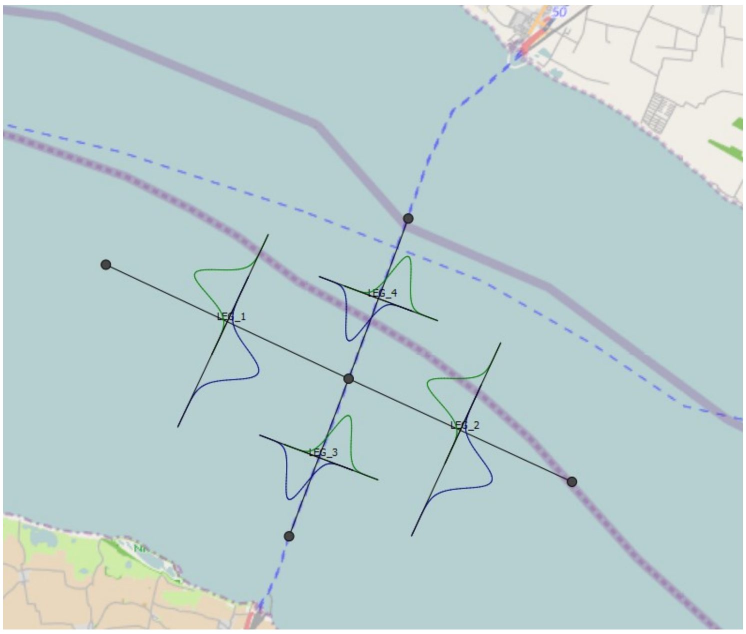


Figure 7: Final model for exercise 2

Now we need to tell IWRAP how the traffic sails in the waypoint connecting the four legs. Double click on the waypoint in the middle and select the bottom tab. Now you have to specify what percentage sails from Leg1 to Leg2 (100%). Leg2 to Leg1 (100%). Leg3 to Leg4 (100%). Leg4 to Leg3 (100%). IWRAP then automatically figures that no traffic sails from Leg1 to Leg3 etc.

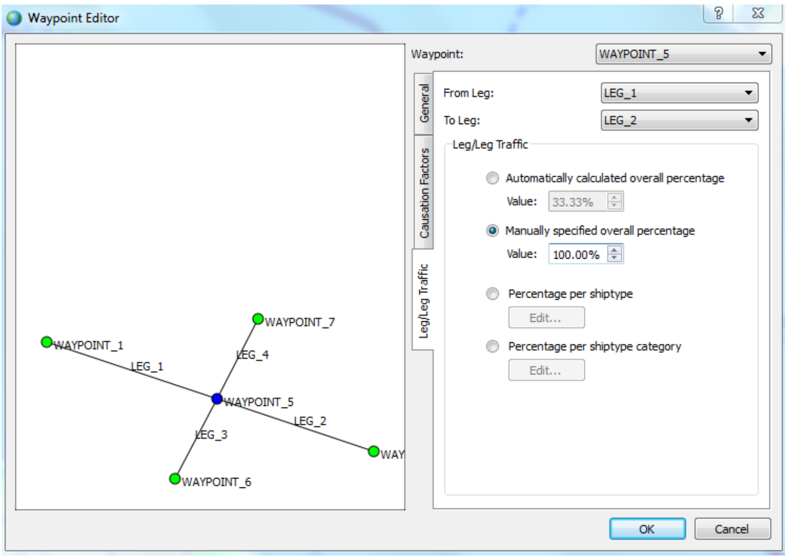


Figure 8: Assigning how the ships cross a waypoint. Which percentage go from leg1 to leg2 etc.

Save the project and then run the job by pressing the 'Start job' icon . You should now also have crossing collisions in the result overview. There are no bend or merging collisions because all the ships cross the waypoint.

Exercise 3, grounding

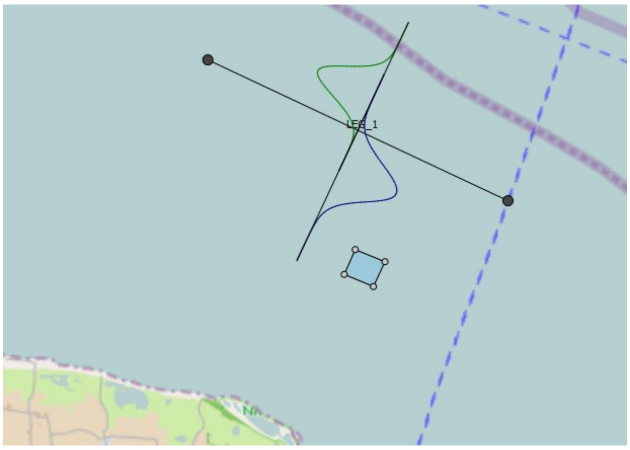
The purpose of this exercise is to create bathometry using polygons and to understand the two methods IWRAP uses for calculating powered grounding.

Create a new folder called ‘Exercise 3’

Open ‘Exercise 2’ and go to ‘File’ and save it as ‘Exercise 3’ in the new folder.

Delete Leg 4, Leg 3 and Leg 2 by selecting the ‘Delete tool’ and then clicking on the legs. Remember to select the Pointer tool when finished. You should now have a single leg as below.

Select the Area tool . A new window appears. Select the ‘New area’ . Set the depth to 10.0m. Now make a rectangular area by clicking 4 times on the map.



When running this model you get around 0.0015 powered groundings per year. Notice there is also a drifting grounding result. We will get back to this later. Try to create a zero meter polygon inside the 10m polygon. When running the model you get more groundings than before because the support ships on leg 1 are now also hitting the ground.

Move the ground area to the east, so that it is behind leg. Then run the model. Now go back to the model view and double click on the leg. Change the eastbound extension value to 1000m. Run the model to that there are no groundings. The two extension values tell IWRAP how fare in front of the leg it is possible to forget a turn. To do this for a number of legs it is easier to select Settings->Set max. leg Width, and then use the slider. The central blue box around the leg is used when importing AIS-data.

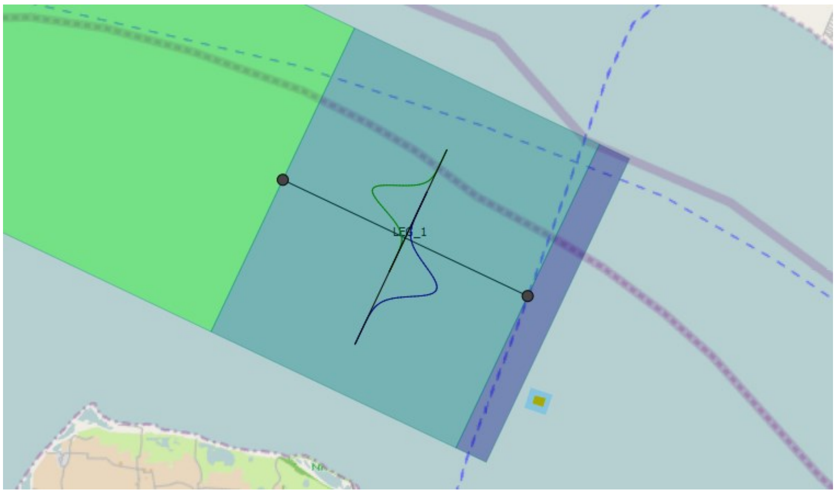


Figure 9: The green and purple boxes indicate how far from the leg ships can forget to turn or hit a ground. The box around the leg is only used by the commercial version to indicate how far from the leg AIS data can be associated with this leg.

In the Job view press the 'Show result diagram' icon . Then press the 'Add' button in the new window. Name it 'Groundings' and for the description write 'Polygons on x-axis'. Then press the add button. Choose 'Powered grounding'. Click OK twice and then press the Show button. You should now get a diagram as below. This shows that Area_1 contributes ten times more than Area_2. Instead of having the polygons on the x-axis you could have the legs.

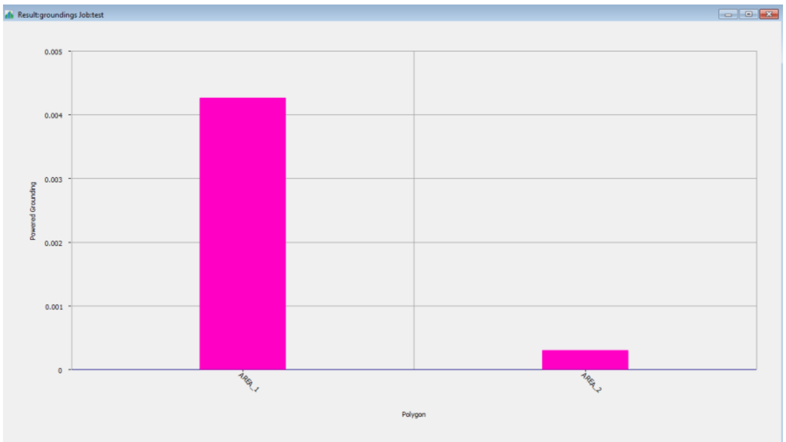


Figure 10: Diagram showing the number of groundings for each area polygon

Another view is the Result view. From the job view press the on left side. Now legs, points and polygons are coloured according to how many incidents happen there. The colouring is relative and blue is where the most incidents happens and white is fewest. Because the scale is relative a blue colour does not necessarily mean that the situation is bad. It is just where most incidents occur.

Exercise 4, importing a chart from an image file

(Not an exercise, just information)

The chart can be in most graphical formats such as jpg, bmp or png.

The coordinates of four corners of the map must be known in order to scale it in IWRAP. These do not have to be the corners of the image as there might be a margin round the chart. For example in the image below the coordinates of the bold rectangle are known and therefore the chart can be scaled in IWRAP. You can only show one raster map at a time, but IWRAP remembers the maps and scale, so they can

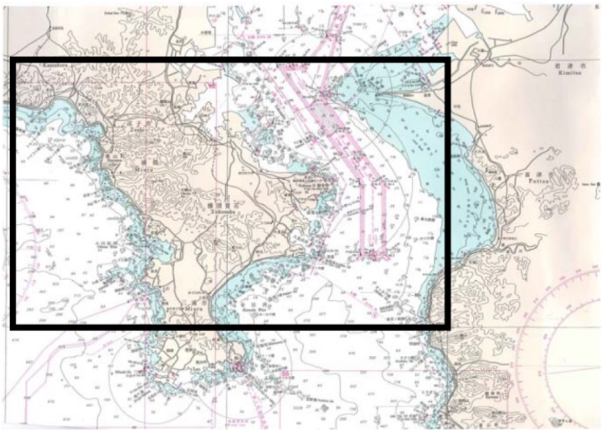
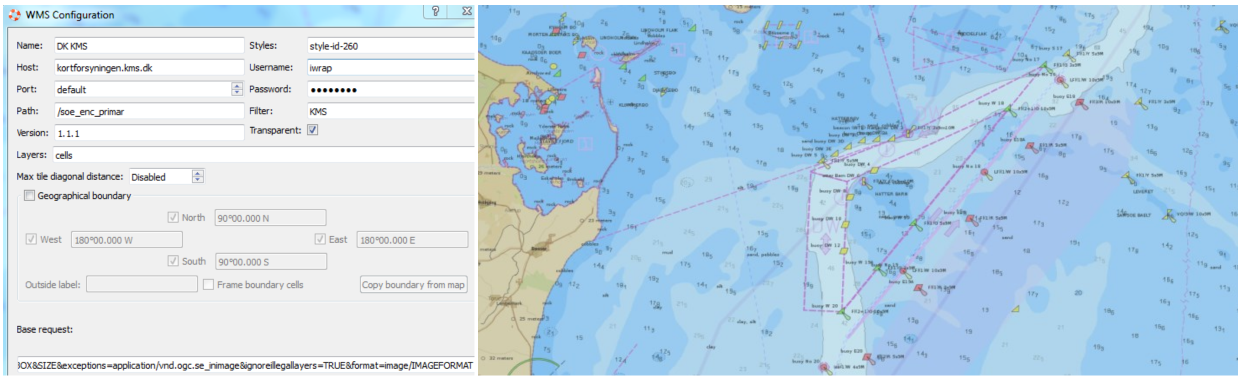


Figure 11: The black square indicates where the coordinates are known.

Open a project or create a new project. In the main menu select *Map* and then select *Raster* and *Open raster map*.

Once the image file is selected, you are asked to input the coordinates of the four boundaries. Now follow the instructions. If the boundary of the image corresponds to the given boundary values you can just press No and you are done. Otherwise you have to right click on each corner starting at the top left and then clockwise round.

If you have access to a WMS chart you can ask IWRAP to connect to this. From the Map menu select WMS configuration.



Example of the Web map service (WMS)

Exercise 5, drift grounding

(Not an exercise, just information)

Drift grounding estimates how many ships experiences a black-out and then run aground. The parameters can be found in Settings->drift parameter settings.

The blackout frequency is the number of blackouts a random ship will experience every year.

Drift speed is the speed a ship having a black out will drift with.

Anchoring: If the water depth and seabed permits then a drifting ship can stop the drift using its anchors. The anchor probability models the seabed. If 1.0 then the anchor can always get a grip. Also the depth of the water must be less than a certain value in order to anchor. Finally the anchor does not descend directly under the ship, but some ship lengths away. This means that the anchor must grip at some distance before the ground.

Repair time: In most cases a blackout will be repaired within a couple of hours. In some cases it takes perhaps half a day and in few cases it takes several days. This can be described using either a Weibull distribution or a lognormal distribution. During this time the ship can drift.

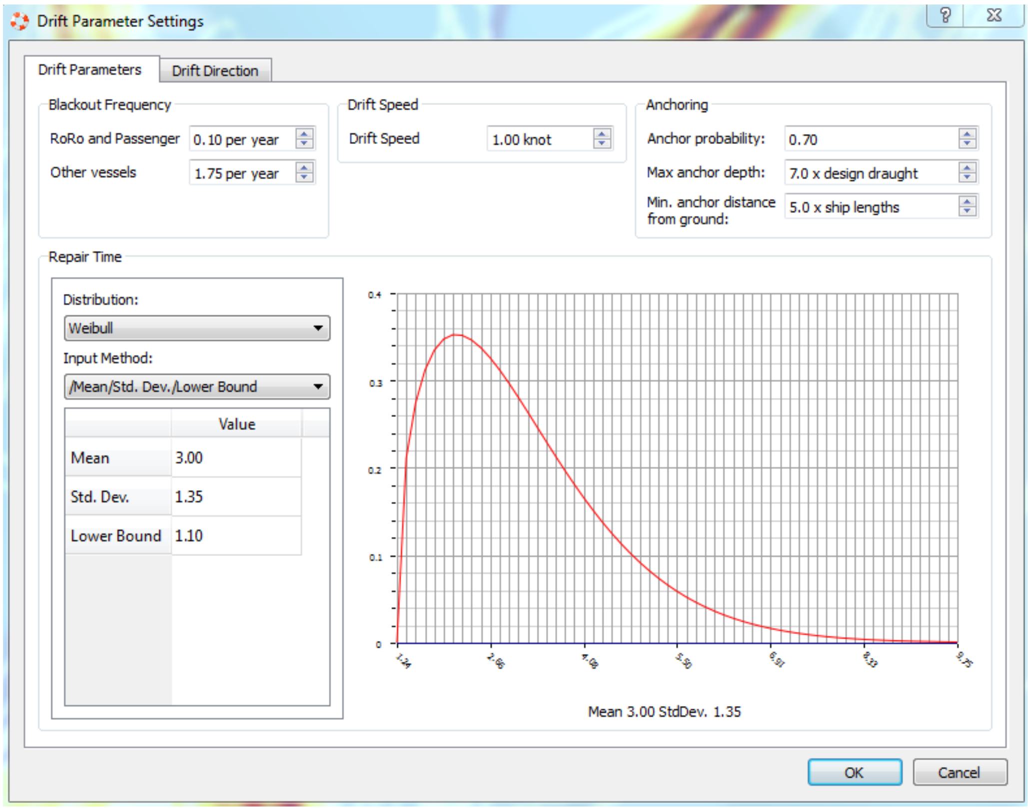


Figure 12: The parameters for drifting

The drift direction tab is the combined effect of wind and current. The compass directions are divided into eight directions which are given a relative weight. So if the ship should drift westward 30% of the year, then the value for $weight_{west}$=0.3 and the sum of the other seven values should be equal to 1-0.3=0.7. Or $weight_{west}$=30 and the sum of the other seven values should be equal to 70.

Exercise 6, area collision

(Not an exercise, just information)

Area traffic is used to include non AIS ships, fishing ships or ships that are not sailing on specified routes. Here you can define an area as a polygon. This polygon then consist of a number of elements each given by the parameters below. These specify how many ships of a certain type and length are present in the area. Also how often the ships are sailing in the area and how often they are not sailing are specified here.

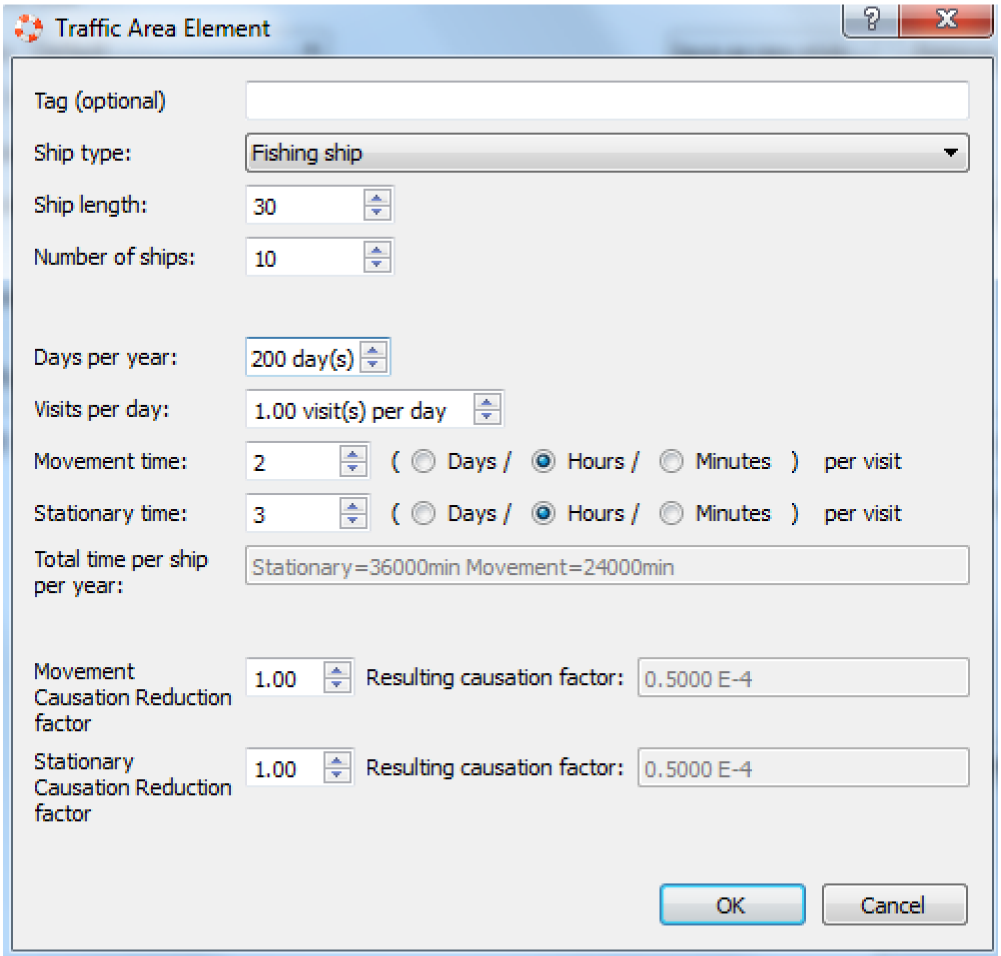


Figure 13: Parameters for including traffic that does not follow specified legs

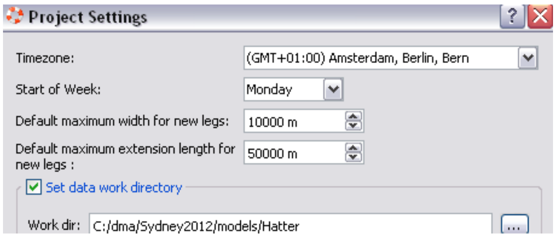
To calculate the number of area collisions in the area, two methods are used and the sum of the two, are then added to get the total number of area collisions.

In the input window above we have 10 fishing ships of length 30 meters. They visit the defined area 200 days a year. They are sailing inside the area 2 hours every time and they are laying still 3 hours every time.

Exercise 7, importing AIS data

AIS data can be imported as decoded tables or as raw nmea sentences. The data can be stored in several files. Here we will import a file with decoded data.

Create a new project called *Hatter*. Make sure you check the check box 'Set data work directory'. This will create the needed folders for the data handling.



Then in the main menu select Data->Import data. Press the *Add files* button in the new window and locate the file Hatter Apr2009.csv. IWRAP now tries to identify the columns in the file. The only two fields it cannot identify are the timestamp and the ship type field. So double click on the first row where the header is called datetime. We see that the type has not been identified. In the small dialog box that appears select the field to be a datetime and the field format to be 'dd-MM-yyyy HH:mm:ss'. Then press OK. You have now defined the datetime column. Double click on the line called 'typeofshipandcargo'. Let the field type be ship type and let the format be AIS. It is very important that you use 'type of ship and cargo' when using AIS data.

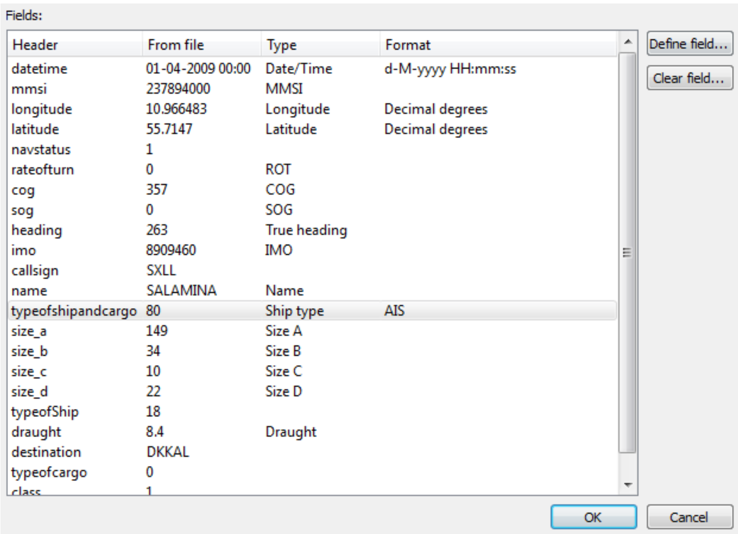


Figure 14: Setting up the format for the AIS-data file

Press *OK* to continue. If you will be using the same AIS format latter, you can save the format. In the next window you have the option to import only AIS data for a certain area or date. This can be a good idea if the AIS data covers a large area or time span. Press the *Start* button.

NOTE: In this example position and static data were in the same file. It is also possible to have the static data in one and the position data in other files.

Once the AIS data has been imported IWRAP comes up with an analysis for how much data was imported and if there are any gaps in the data. For example between April 5 and April 10 there is gab in the data:

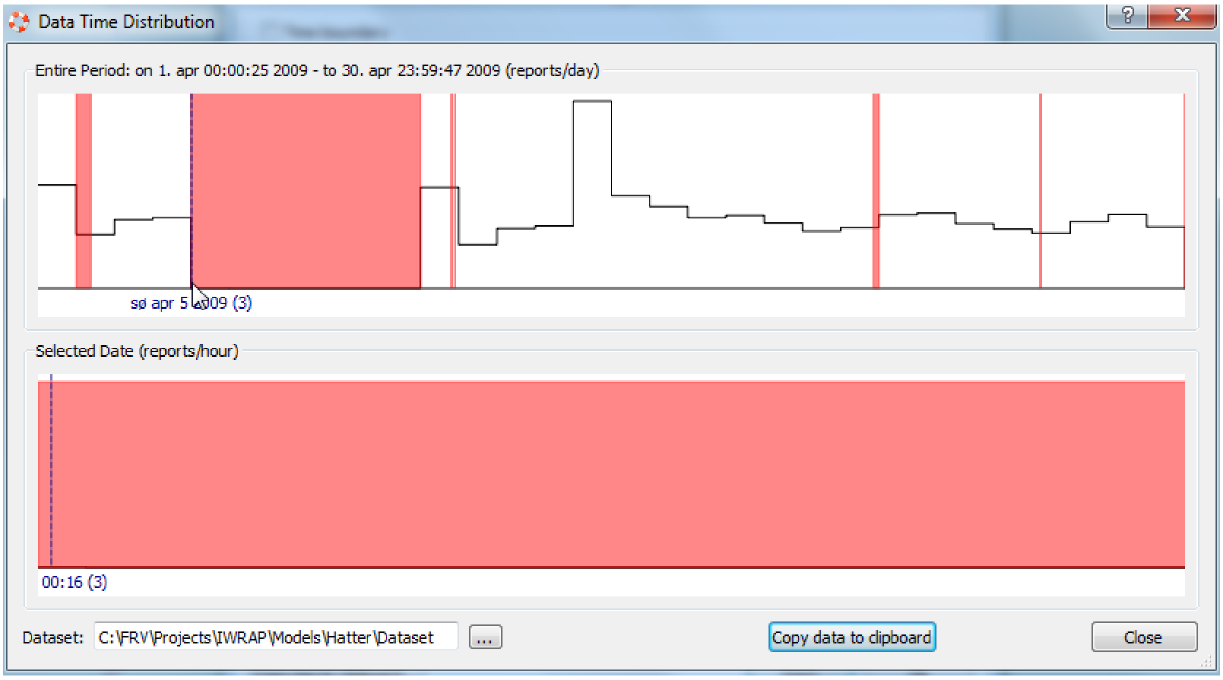


Figure 15: When AIS-data has been the program shows the time gabs

Finally some useful information about the imported data and how the import process went are given:

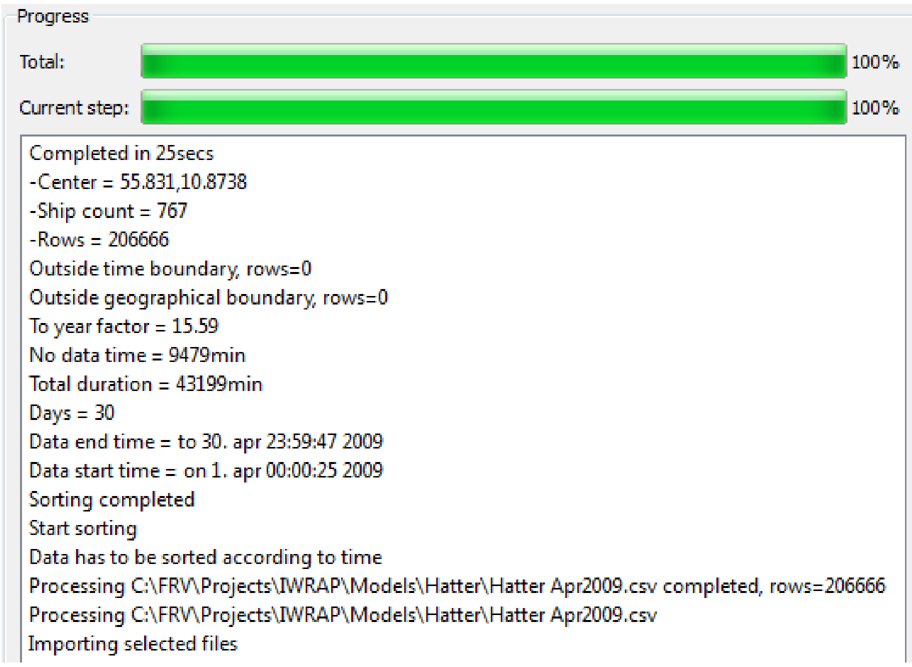


Figure 16: Information about how the import went

Exercise 8, Density plot

When AIS data has been imported the next step is usual to make a density plot of the data.

In the main menu select *Data->Density plot->Create*

In the window that now appears you can to specify where the AIS dataset is located, then where the density plot should be stored. Here we use the default location.

Parameters

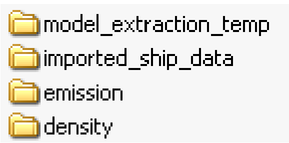
If the AIS data covers several thousand square km the cell size should be increased to perhaps 400m or more.

If the data contain gaps IWRAP will fill these by interpolating between points. Therefore it must know when a track should be stopped and when to continue it:

- 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.

It is also possible to have the density plot made for only certain ships or only for night time data or daytime data or for certain directions. Remember to uncheck them, as IWRAP remembers the last parameters used.

The folder of each IWRAP model should contain the following sub folders. These are created by IWRAP by default:



Suggested file structure for each IWRAP project. The folder imported_ship_data contains the by IWRAP processed aisdata. Density contains the density plot. The user can have several density folders if she wishes. Notice the emission folder. This is still in development. The results from this are only test results.

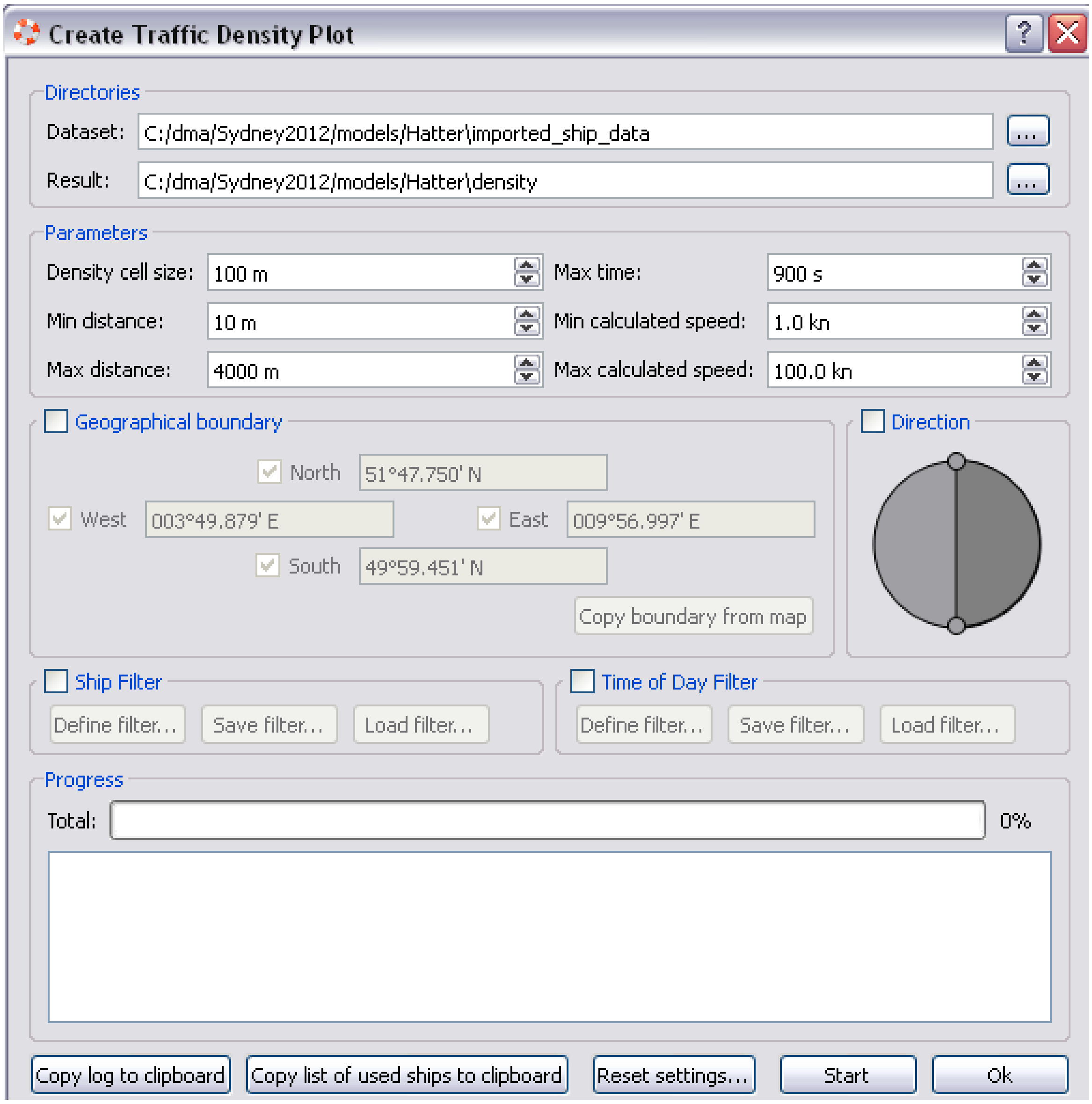
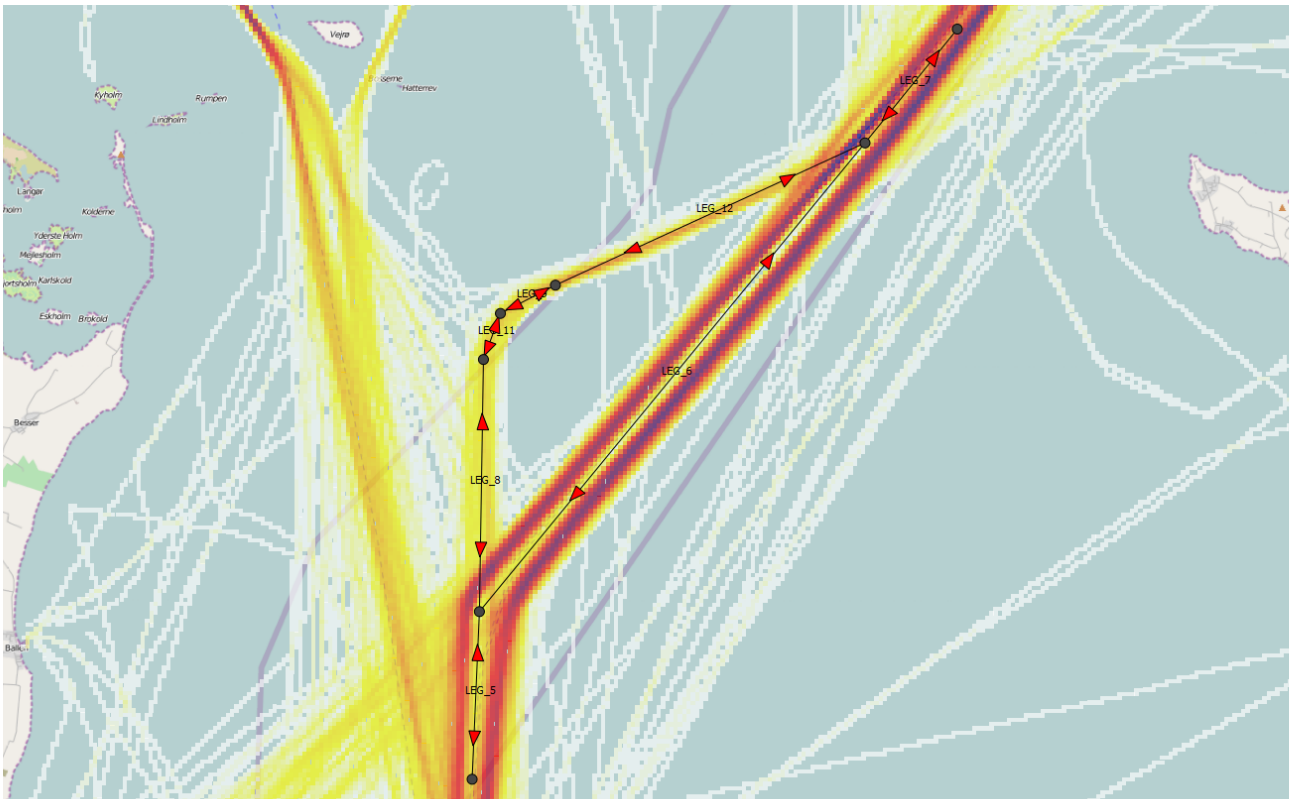


Figure 17: User interface for creating a density plot

Exercise 9, extracting model data

The density plot can be used as a guide for creating the legs in the model. Notice that when you have a traffic separation you should not locate a leg in each lane. Instead locate the leg in the middle between the two tracks. Try not to have too many legs next to each other as IWRAP only calculates leg wise and point wise. There are no interactions between the legs unless they are connected.

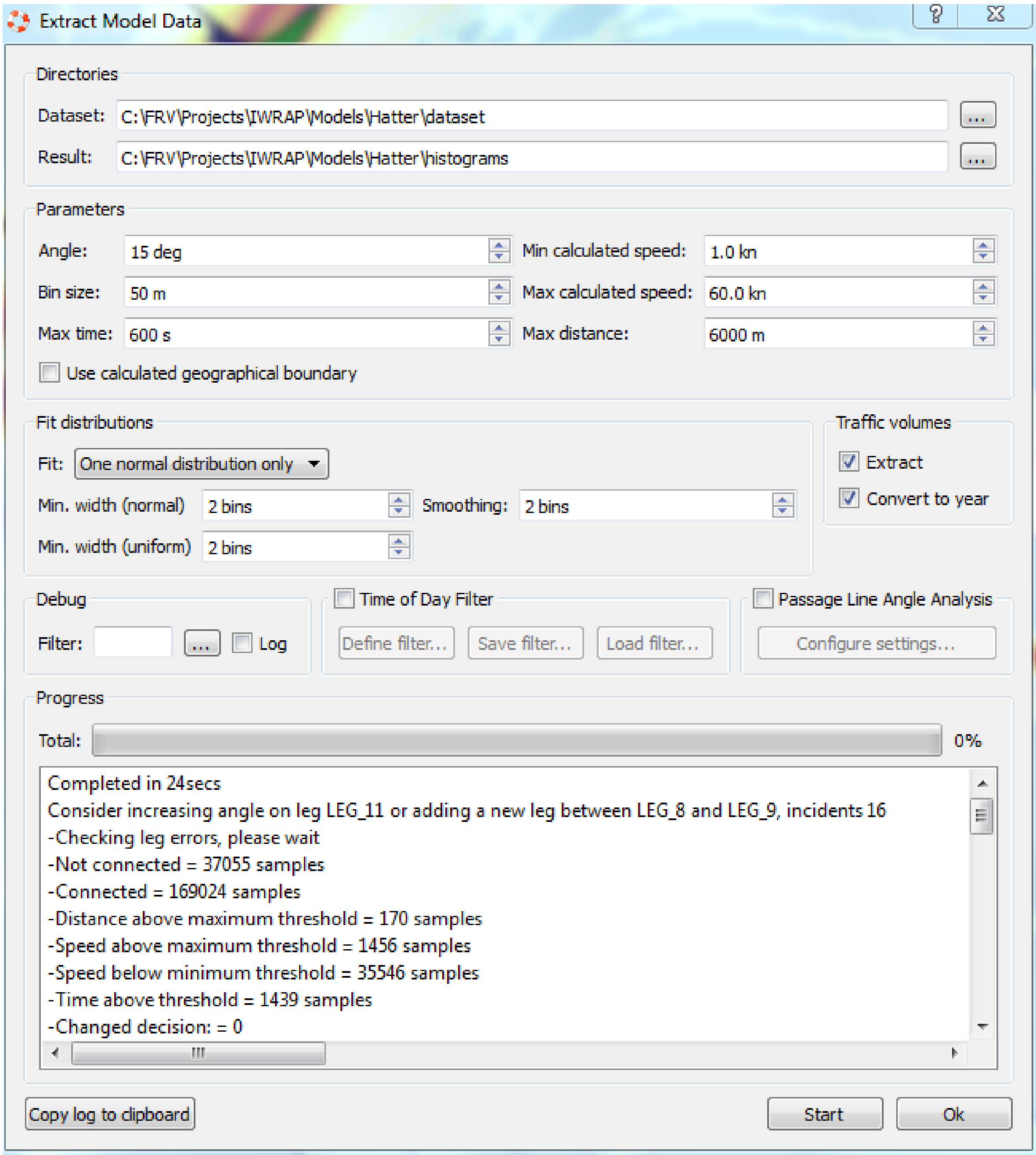


Try to create the legs in the figure above. Feel free to create more. Be careful not to make the legs too long when the lateral distributions changes. Leg 5 might be too long unless the ships sail in the same way on the entire leg. Here it looks like they sail similarly at beginning, middle and end of the leg.

If you click on a leg the width of the leg is shown in colour. Only AIS ships within the middle box are included at that leg. If you double click the leg you can set the width manually. The width should be changed for all the leg to somewhere around 3000m. In the Settings menu you can set the width of the legs graphically.

Also notice that you can set the angle for each leg. The angle determines how parallel with leg the ships must sail in order to be included. If the angle is 0 then they must sail parallel in order to be included. If the angle is 90 then all ships sailing along the leg is included.

In the main menu select Data->Extract Model Data



You should now have a window like the figure above. Notice how IWRAP calculates the flow of traffic and then warns you that some of the traffic on leg11 seems to be missing. Change angle for this leg to 20 degrees. Then run the extract again. This time make a check in Passage Line Angle analysis.

When the new model has been extracted it might look a bit messy. So click on the icon below the zoom slider. Here you can control what to see. Uncheck histograms and lateral distributions. Now you can use the arrow histograms to see if you have positioned the legs correctly. For example you can see that the long vertical leg contains some of the ships sailing north-west.

Try to go through the distributions and understand what the mean value and standard deviation mean. Try also to make the distributions using the detailed checkbox.

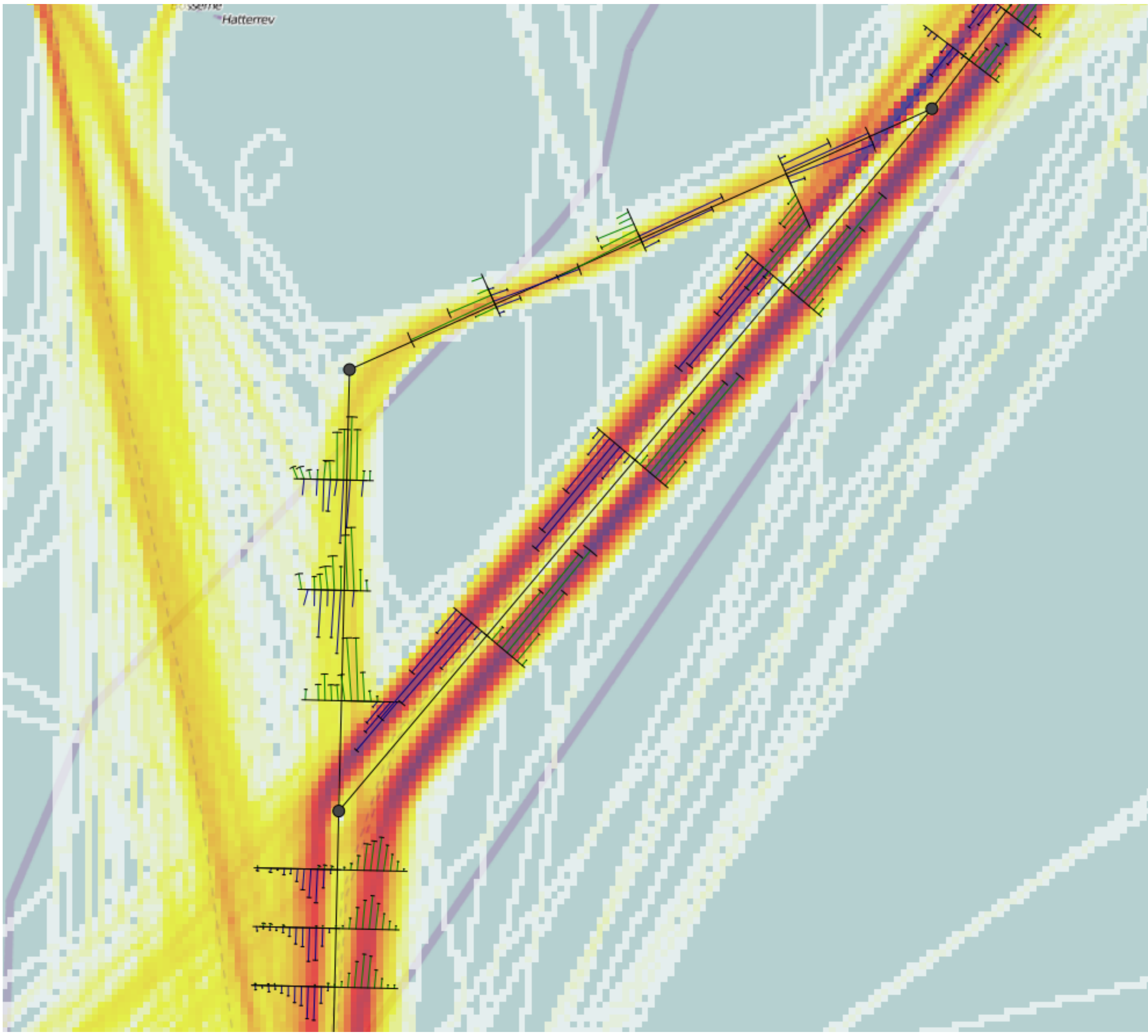


Figure 18: analysis of the average course the ships take on the legs. The sharp turn in the deepwater route could be split into two legs.

Exercise 10, include a map and create grounds

A map of the area is found together with AIS data. Try to import this. The geographical boundaries are found in a text file together with the jpg file. On the question 'Does the map have a margin?' answer No. Your screen should now look like:

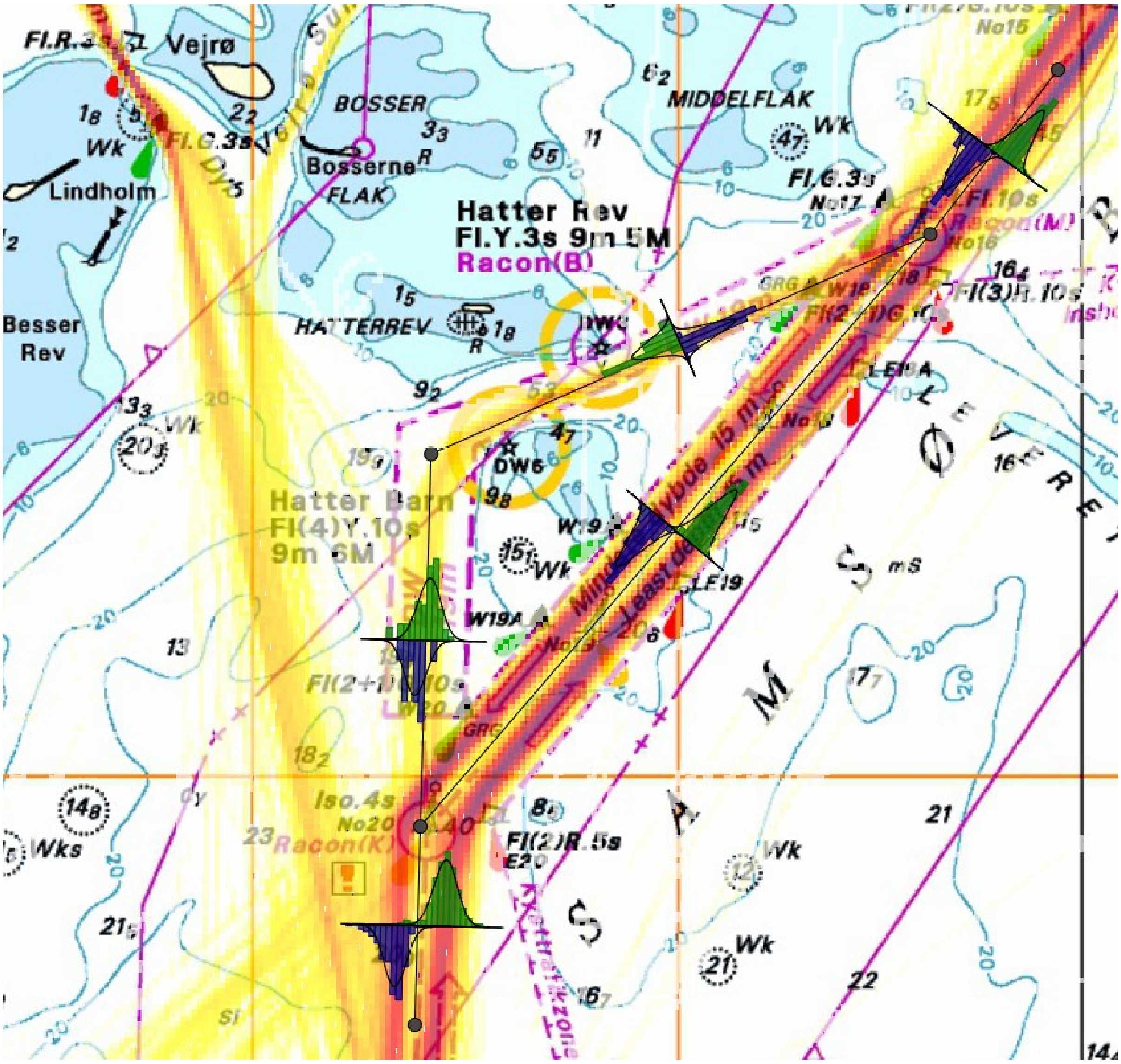


Figure 19: Adding a raster image

Create depth curves using the map.

Press the Area tool . Press  to make a new polygon. Give it a name and a depth then press ok. Now click along the desired depth curve to create the polygon. Notice that the polygon turns red if any of the polygon segments cross each other.

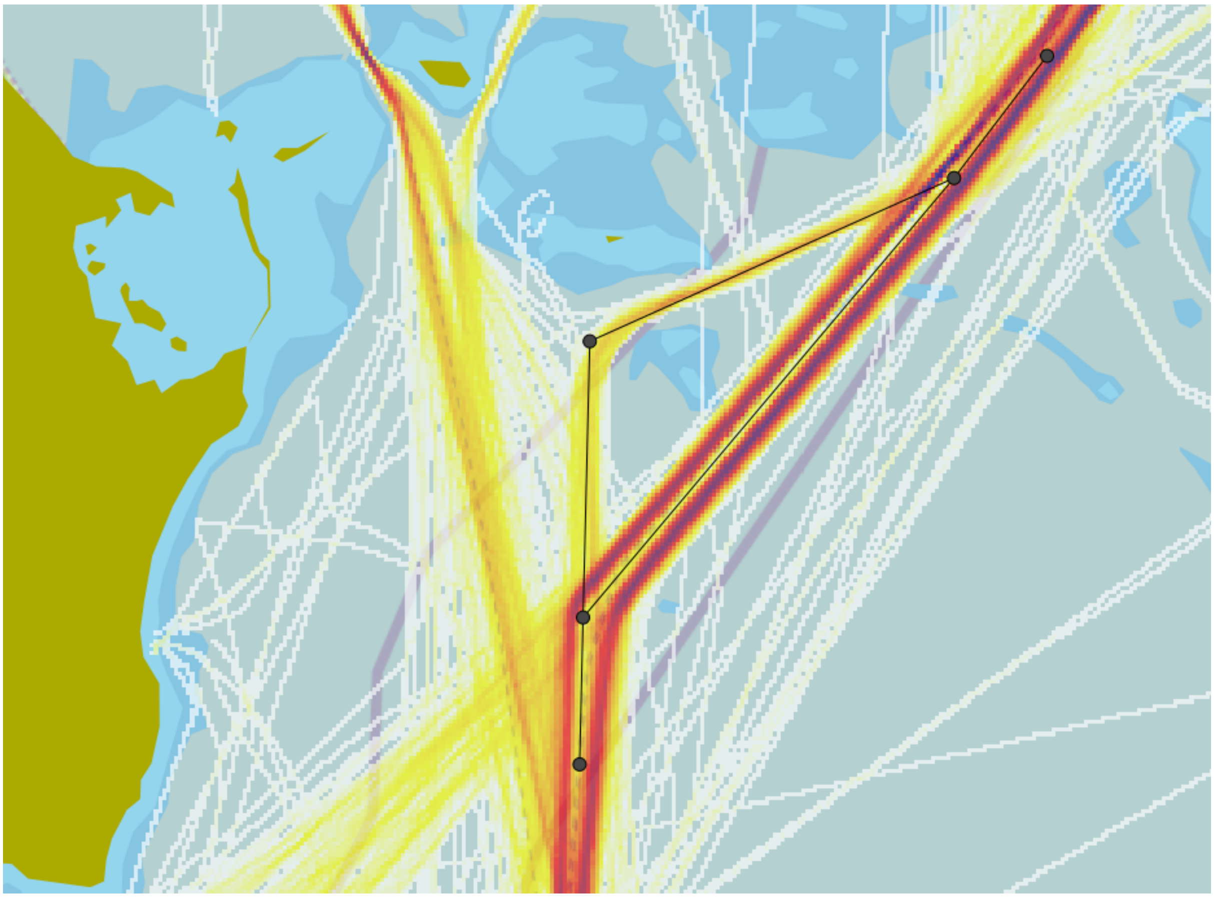


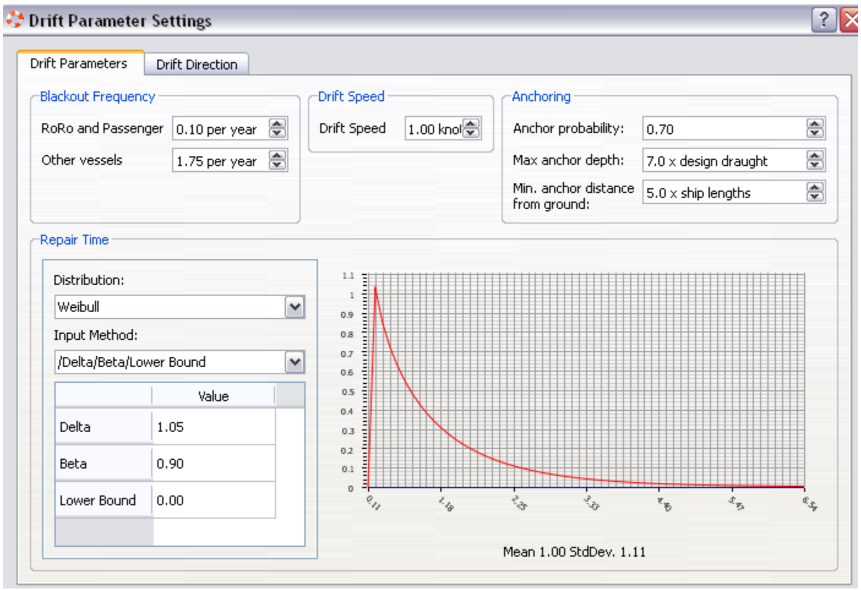
Figure 20: The bathymetry is created by drawing polygons using the imported chart

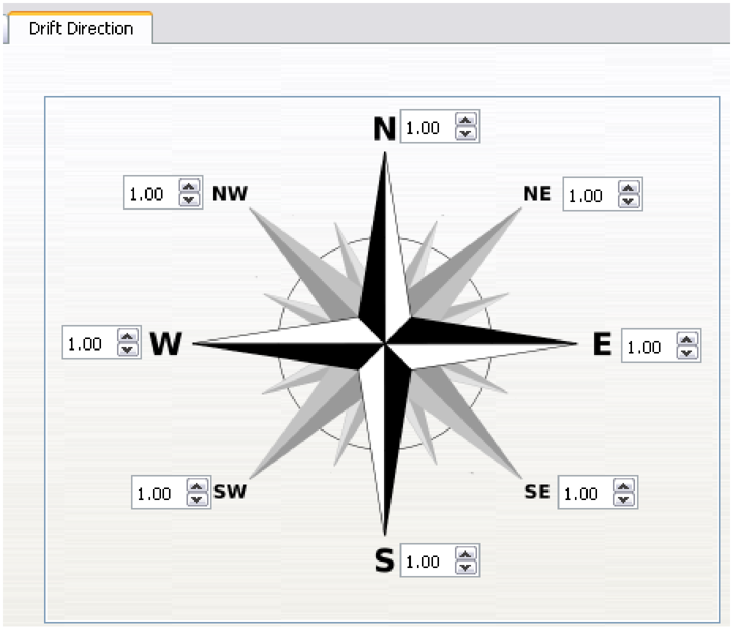
Exercise 11, drift grounding

Drift grounding occurs when a ship has an engine break down. The ship will then either drift until it grounds, or it can drop its anchor, or the engine is repaired before it grounds.

From the *Settings* menu select *Drift parameter settings*. The default values are that a ship drifts by 1 knot, being equally likely to drift in any direction. If you have knowledge of predominantly wind and current directions you change this here.

To can turn drifting off by setting the drift speed to 0 knots.





Relative weight for each drift direction.

Exercise 12, showing the results

When the model has run click . A screen like below now appears. This shows in color which leg or polygon has the most incidents. The blue leg at the top has the most head-on collisions. The vertical yellow leg has fewest incidents. As to junction points the lower point has most junction collisions.

Remember that it is a relative scale. A blue color does not mean that the leg/point has too many incidents; just that it has the highest among the legs/points.

The coloring of the polygons can be difficult to use. (We still need to work on this)

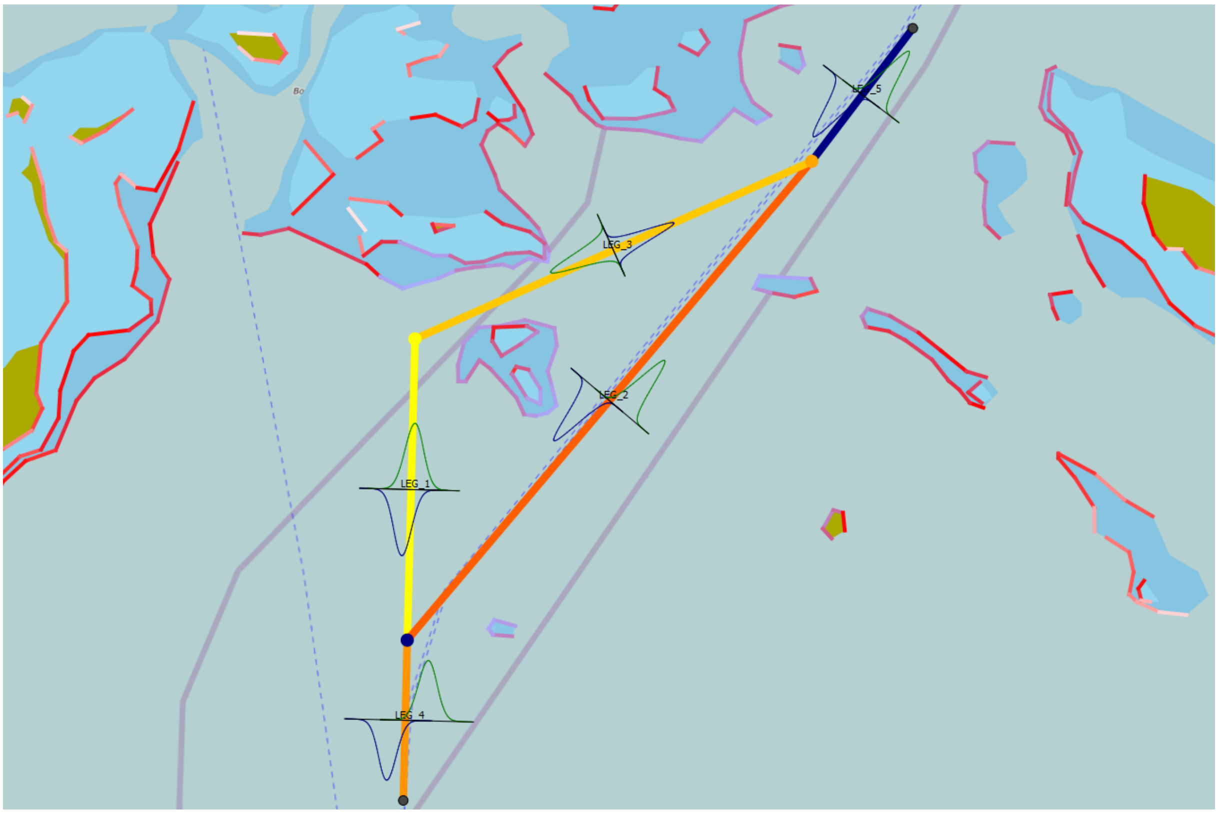
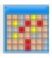
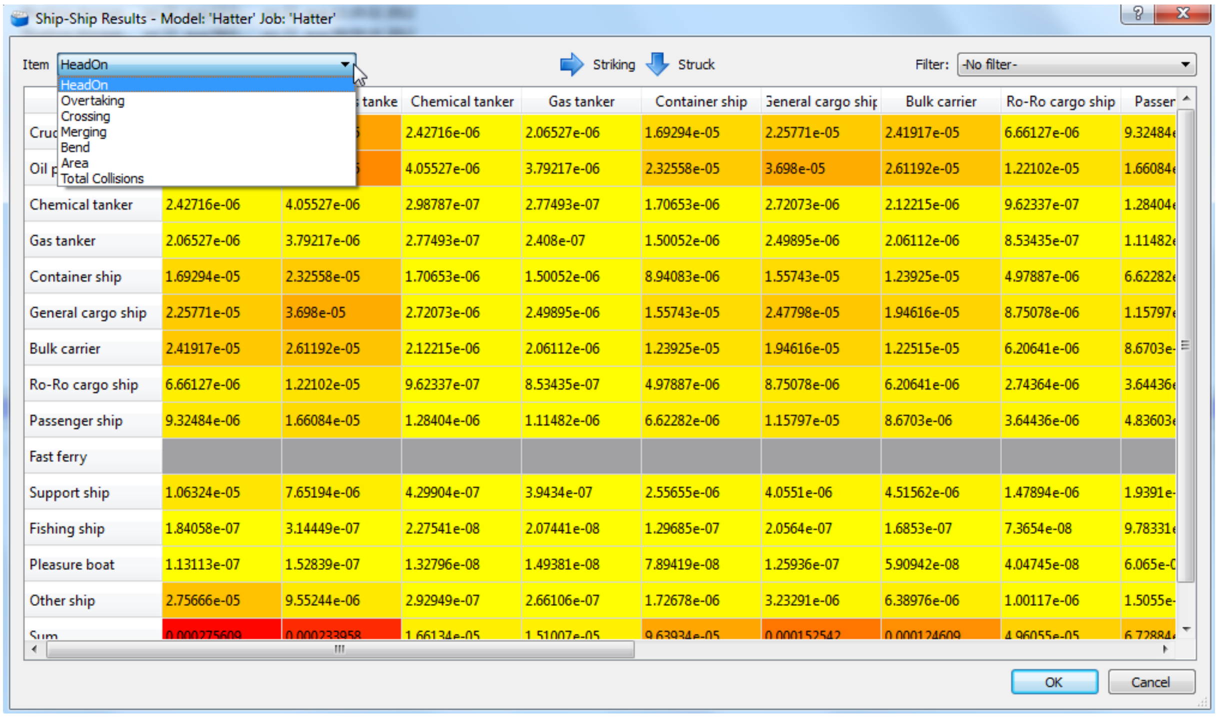


Figure 21: Colouring the incidents. The colour scale from few to most is white, yellow, red, blue

Matrix view

In the JobView press the  button. This brings up a matrix like below. Here you see the absolute values for the different collisions, ship type against ship type. The values can be shown for a single leg or all legs. The colouring is again relative.

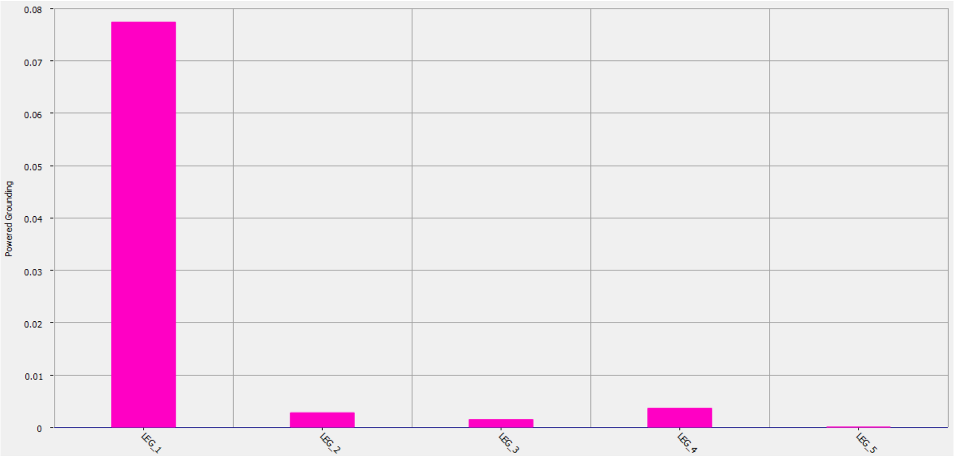


		tanke	Chemical tanker	Gas tanker	Container ship	General cargo ship	Bulk carrier	Ro-Ro cargo ship	Passer
Cruc			2.42716e-06	2.06527e-06	1.69294e-05	2.25771e-05	2.41917e-05	6.66127e-06	9.32484e
Oil p			4.05527e-06	3.79217e-06	2.32558e-05	3.698e-05	2.61192e-05	1.22102e-05	1.66084e
Chemical tanker	2.42716e-06	4.05527e-06	2.98787e-07	2.77493e-07	1.70653e-06	2.72073e-06	2.12215e-06	9.62337e-07	1.28404e
Gas tanker	2.06527e-06	3.79217e-06	2.77493e-07	2.408e-07	1.50052e-06	2.49895e-06	2.06112e-06	8.53435e-07	1.11482e
Container ship	1.69294e-05	2.32558e-05	1.70653e-06	1.50052e-06	8.94083e-06	1.55743e-05	1.23925e-05	4.97887e-06	6.62282e
General cargo ship	2.25771e-05	3.698e-05	2.72073e-06	2.49895e-06	1.55743e-05	2.47798e-05	1.94616e-05	8.75078e-06	1.15797e
Bulk carrier	2.41917e-05	2.61192e-05	2.12215e-06	2.06112e-06	1.23925e-05	1.94616e-05	1.22515e-05	6.20641e-06	8.6703e-
Ro-Ro cargo ship	6.66127e-06	1.22102e-05	9.62337e-07	8.53435e-07	4.97887e-06	8.75078e-06	6.20641e-06	2.74364e-06	3.64436e
Passenger ship	9.32484e-06	1.66084e-05	1.28404e-06	1.11482e-06	6.62282e-06	1.15797e-05	8.6703e-06	3.64436e-06	4.83603e
Fast ferry									
Support ship	1.06324e-05	7.65194e-06	4.29904e-07	3.9434e-07	2.55655e-06	4.0551e-06	4.51562e-06	1.47894e-06	1.9391e-
Fishing ship	1.84058e-07	3.14449e-07	2.27541e-08	2.07441e-08	1.29685e-07	2.0564e-07	1.6853e-07	7.3654e-08	9.78331e
Pleasure boat	1.13113e-07	1.52839e-07	1.32796e-08	1.49381e-08	7.89419e-08	1.25936e-07	5.90942e-08	4.04745e-08	6.065e-0
Other ship	2.75666e-05	9.55244e-06	2.92949e-07	2.66106e-07	1.72678e-06	3.23291e-06	6.38976e-06	1.00117e-06	1.5055e-
Sum	0.000275609	0.000233958	1.66134e-05	1.51007e-05	9.63934e-05	0.000152542	0.000124609	4.96055e-05	6.72884

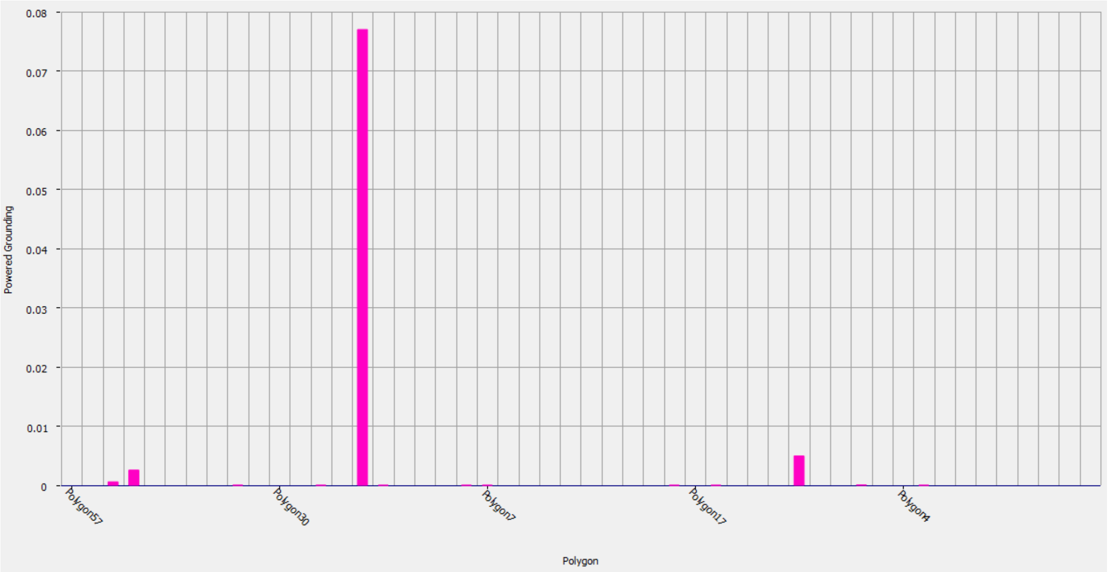
Result diagrams

Here you define your own diagrams.

For example the diagram below shows how much each leg contribute to the number of powered grounding



This diagram shows that a single polygon contributes a lot more that the others. Unfortunately it is difficult to see the polygon id. (We should fix this)



Hints

If you have a route with several legs joined together and no exits, then remember to check that the number of ships on each leg is the same for all the legs. If this is not the case, you could use the valid leg and share it with the other legs.

If the traffic sails on a long straight line, but widens or narrows, then do not make a single leg. Instead several legs with changing distributions should be made.

IWRAP can filter the ais-data according to the whether it is dark or daylight. That way an analysis can be made if the traffic pattern is different during office hours or during night time.