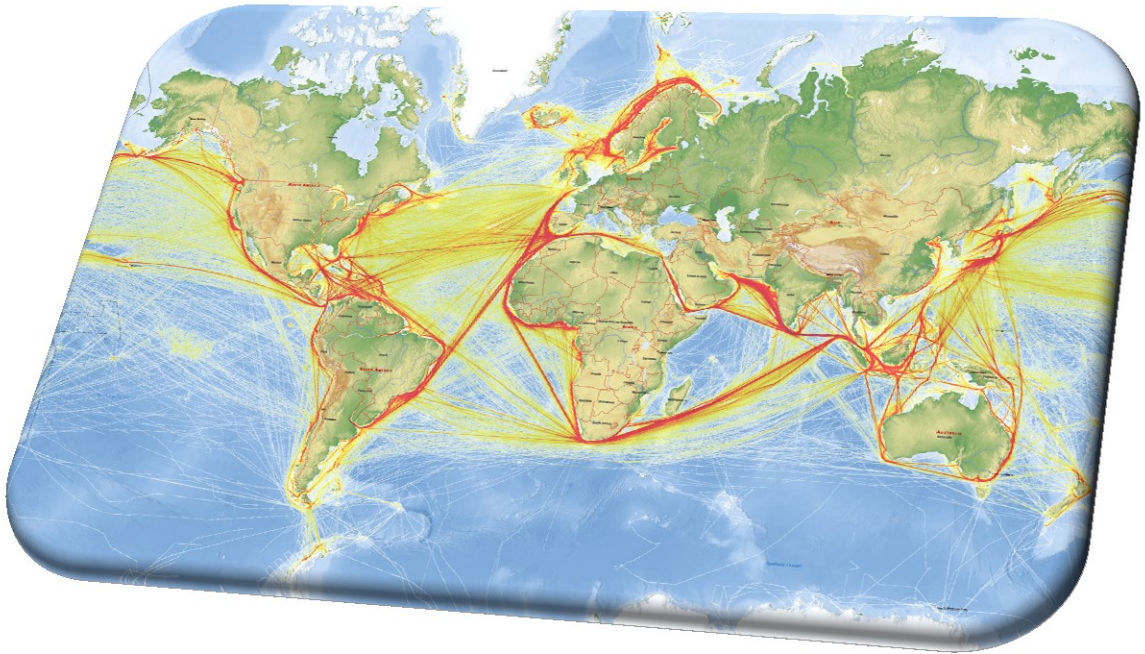
IWRAP Mk2

Training session



Training Session

Oktober 2015, Singapore

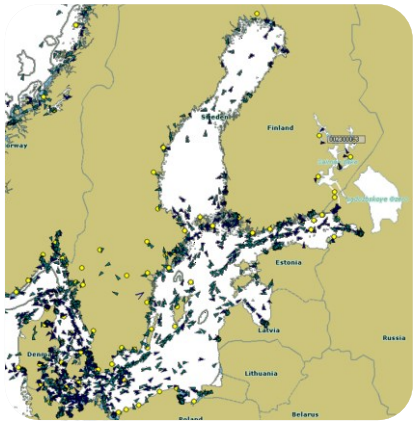
GH Development of Maritime Tracking & Surveillance

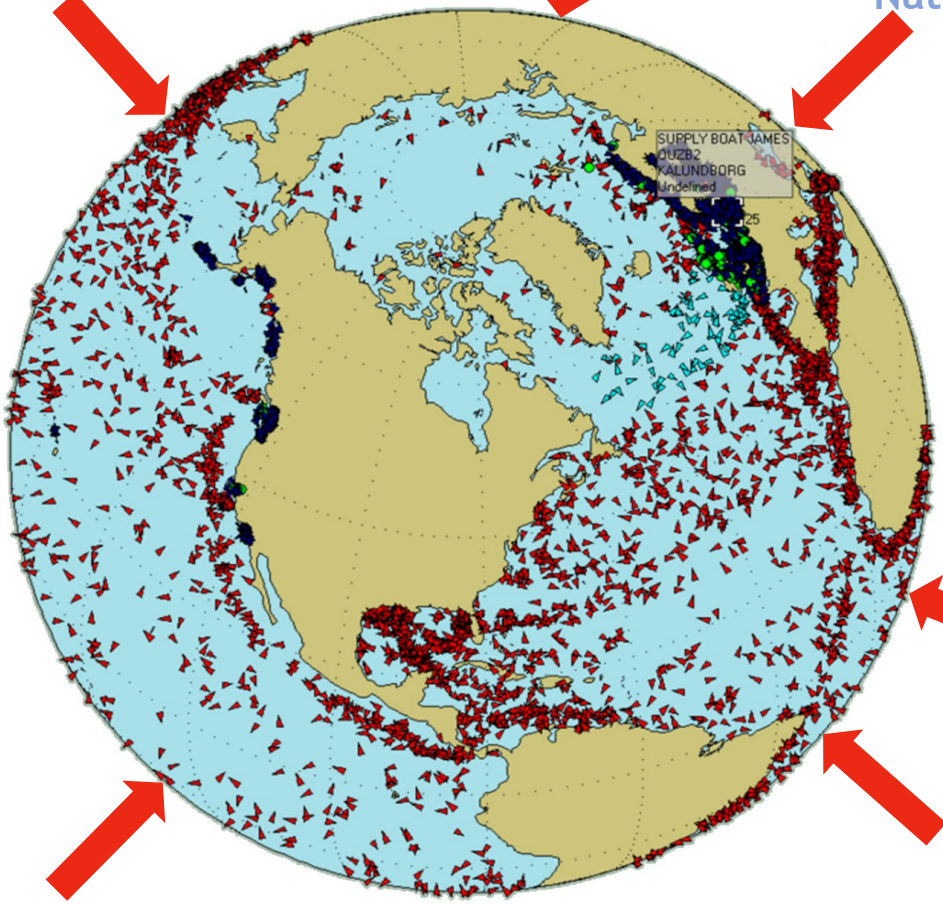
Diff. sensors

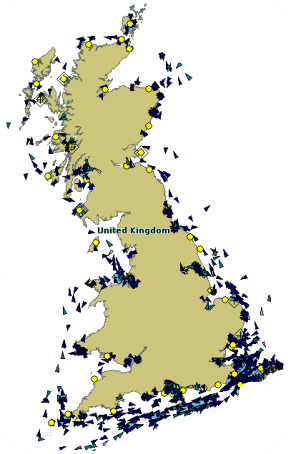
International cooperatives and Data Exchanges:

- Helcom
- Safeseanet
- IALA net

National AIS Networks







Radar

LRIT

Space AIS

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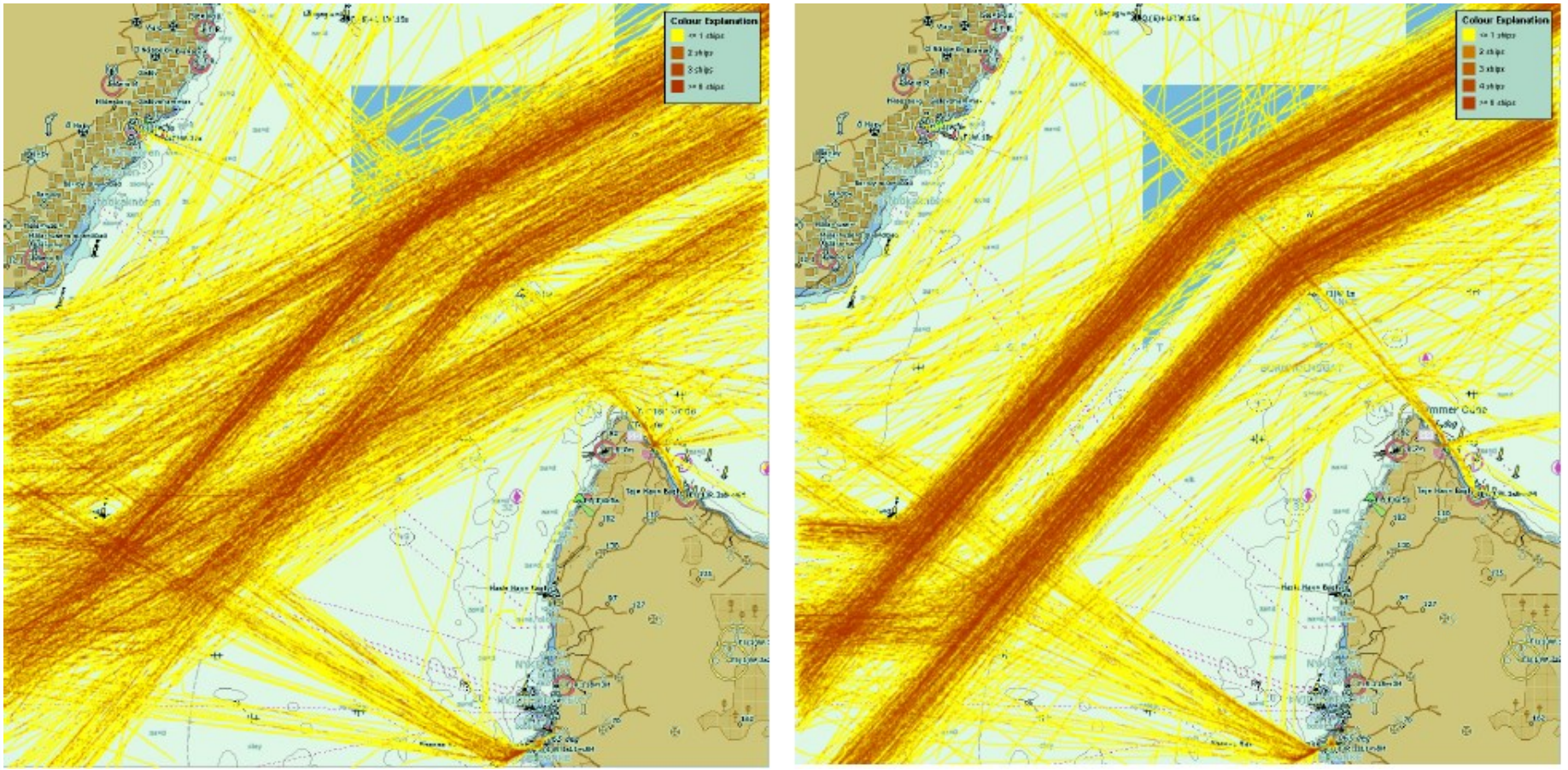
WebSTAT – AIS Statistics



Traffic density for Hammergat before and after the new traffic separation scheme was applied

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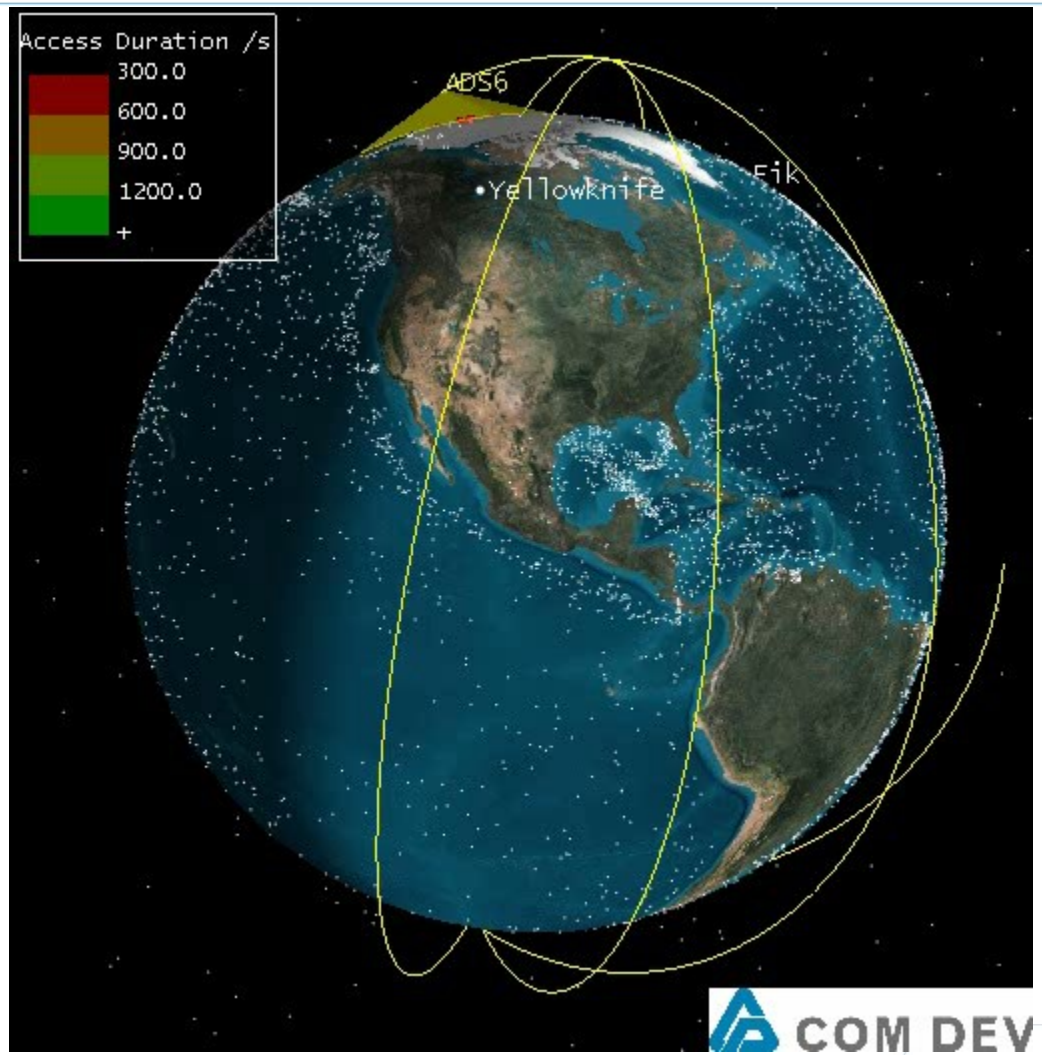
Space AIS data



Provided in cooperation with our Canadian partner, exactEarth.

- 5 satellites in orbit
- 6 earth stations
- Less than 2 hour global revisit

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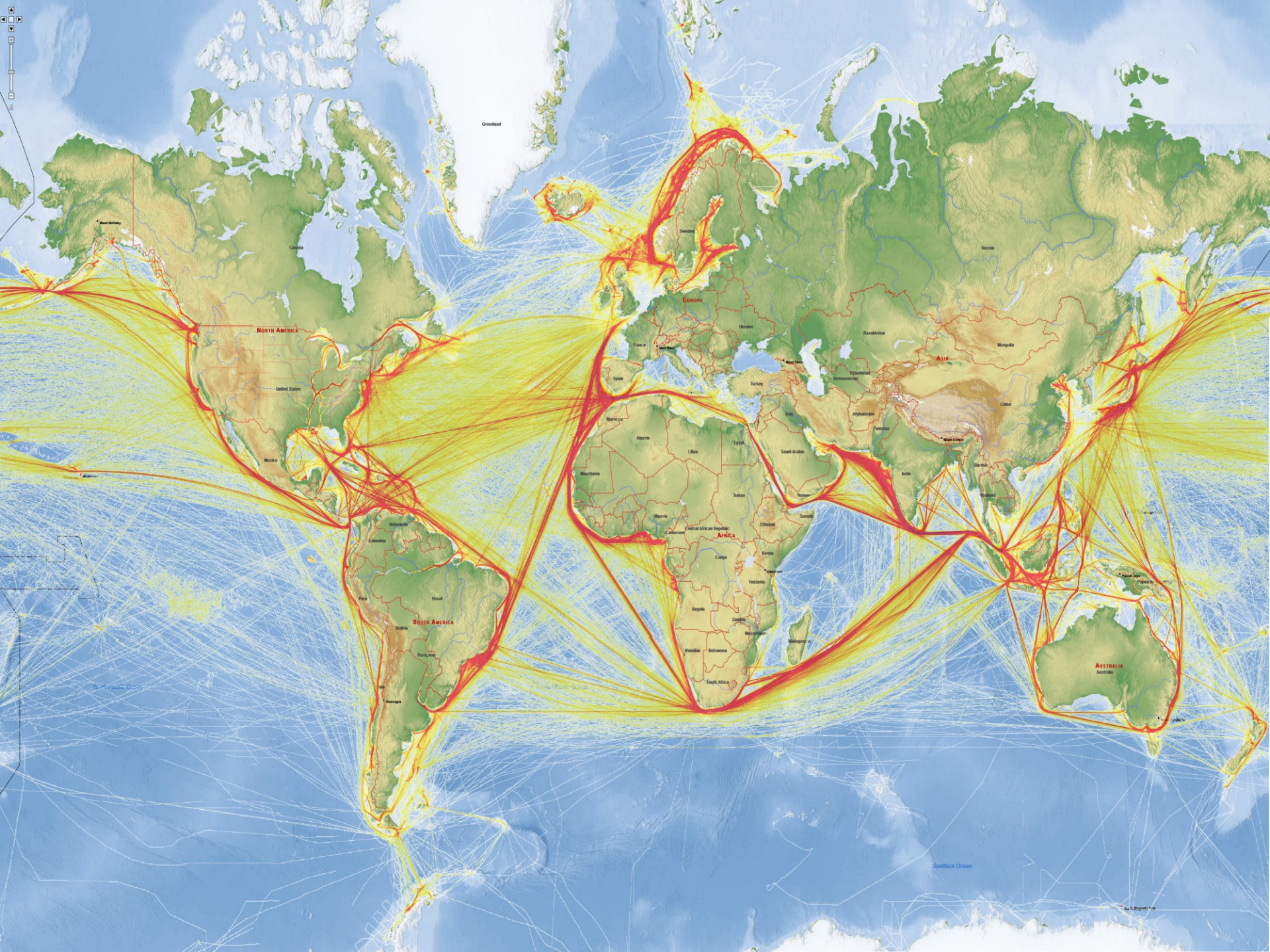
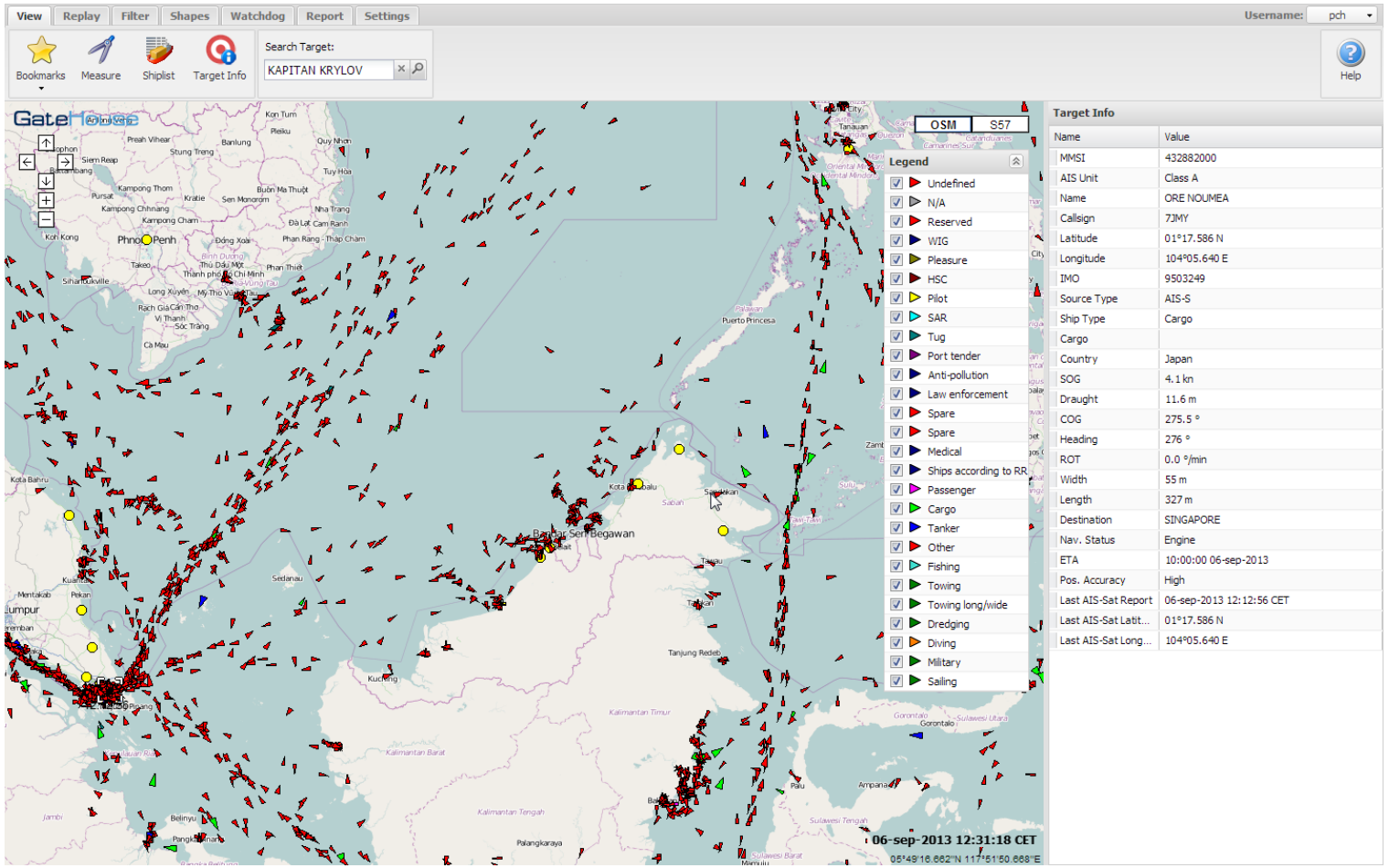

Greenland
Canada
Mount McKinley
NORTH AMERICA
United States
Mexico
EUROPE
Sweden
Ukraine
France
Spain
Turkey
Russia
Kazakhstan
Mongolia
ASIA
Uzbekistan
Turkmenistan
China
Afghanistan
Pakistan
Iraq
Saudi Arabia
India
Burma
Thailand
Morocco
Algeria
Libya
Egypt
Mauritania
Sudan
Yemen
Somalia
Ethiopia
Nigeria
Cameroon
Central African Republic
AFRICA
Kenya
Congo
Tanzania
Angola
Zambia
Mozambique
Madagascar
Namibia
Botswana
South Africa
Venezuela
Colombia
Brazil
Peru
Bolivia
Paraguay
SOUTH AMERICA
AUSTRALIA
Australia
Papua N.
Southern Ocean

Singapore AIS traffic seen from Space...



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IWRAP Mk2
Background

KASI Training Session

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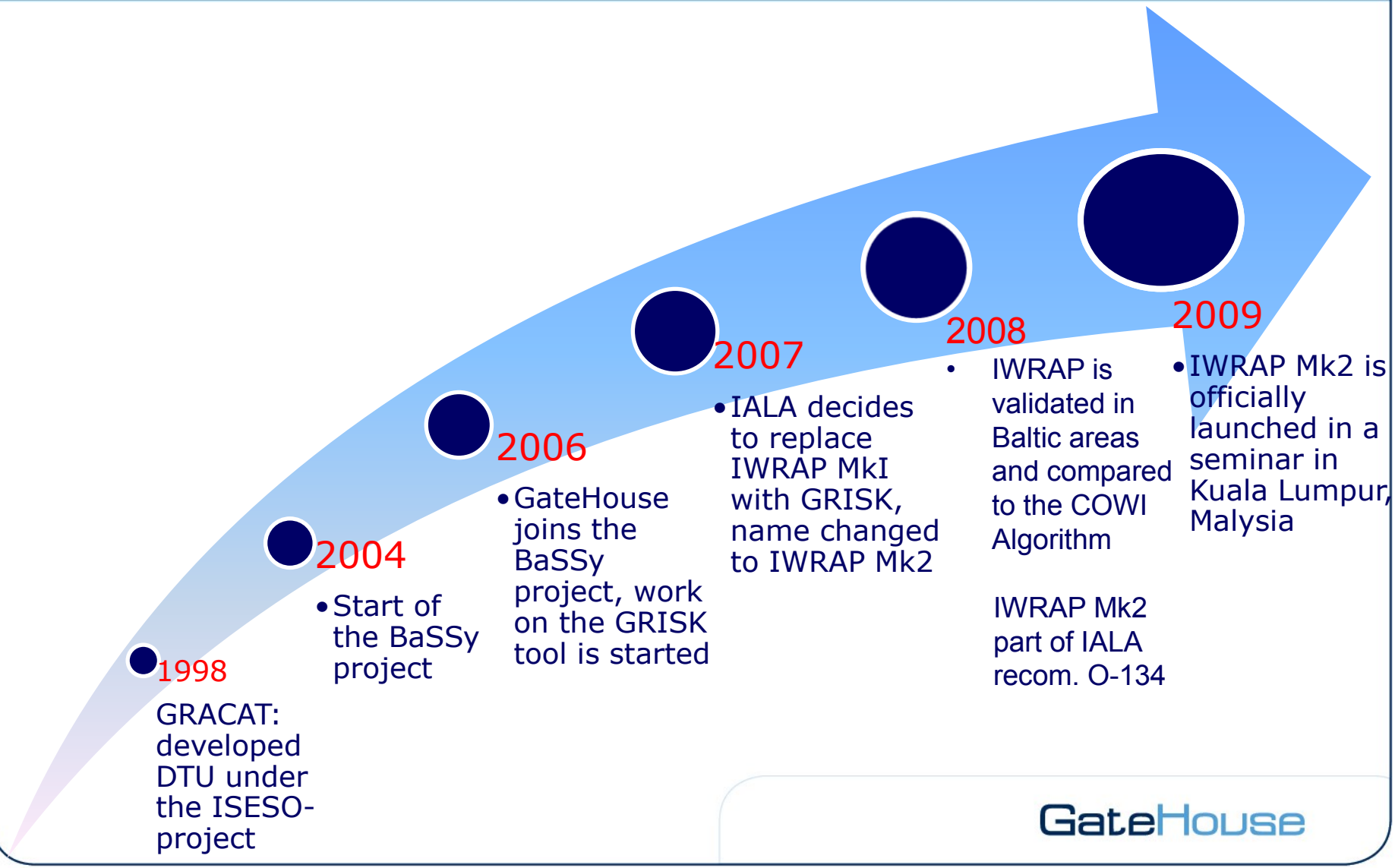
History of the IWRAP Mk2 tool…



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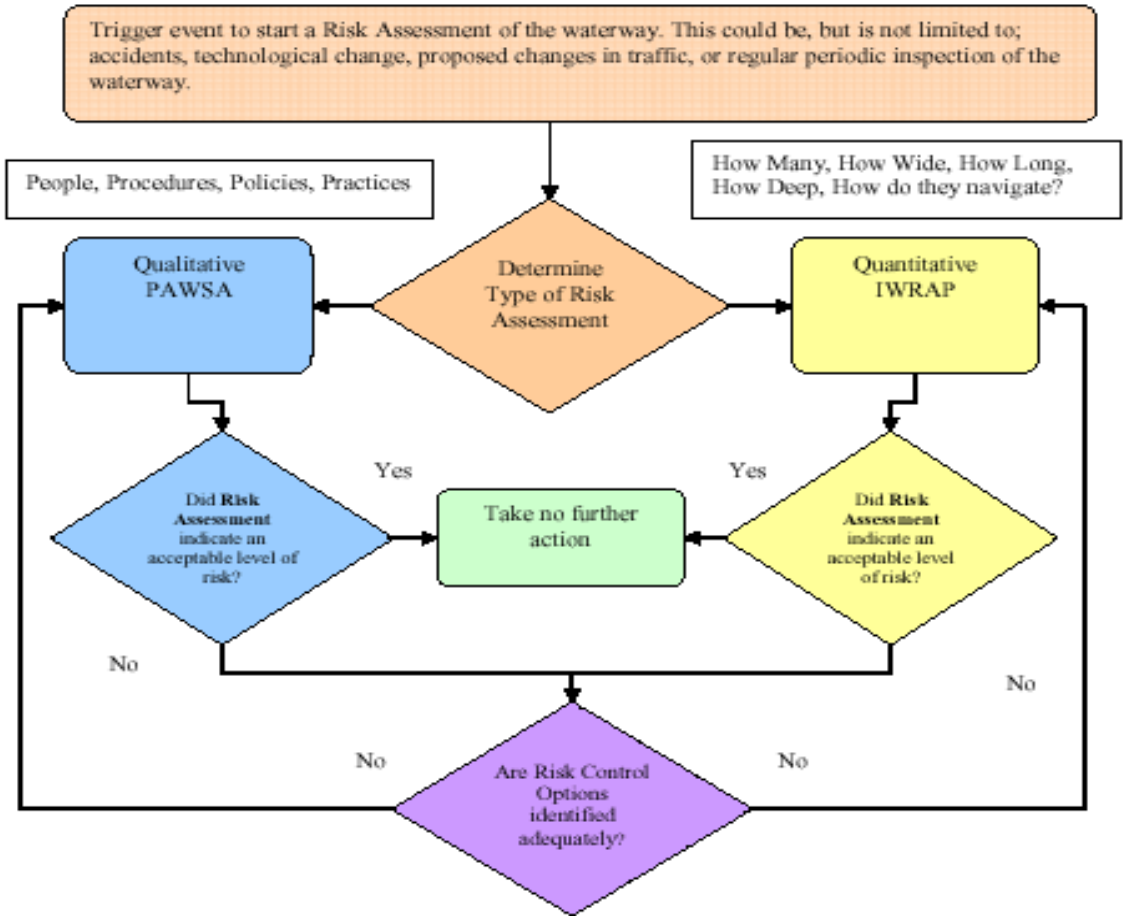
O- 134 IALA Risk Management Tool for Ports and Restricted Waterway



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The IALA Risk Management Tool Steering Group

DK -	Omar Frits Eriksson	(Chairman)
	Michael Skov	(Head of DMA)
	Erik Sonne Ravn	(Analyst)
	Per Engberg	(Programmer++)
FI	Markus Porthin	(Analyst)
	Penti Kujala	(Professor)
UK	Roger Barker	(Trinity House)
DE	Knud Benedict	(Professor)
NO	Trond Langemyr	(Senior Adviser NCA)
FR	Jean Charles Leclair	(Admiral, dean of the IALA WWA)
US	Burt Lahn	(Analyst, PAWSA expert, USCG)
	Mike Sollosi	(USCG)
AUS	Mahesh Almchandani	(Analyst, AMSA)
CH	Roger Gao	(Professor)

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IWRAP Mk2

GateHouse IWRAP Mk2 goal:

"Make IWRAP Mk2 a worldwide accepted generic tool for analysis of maritime traffic data and facilitate sharing of methods and algorithms."

This implies:

1. Not only the current IWRAP Mk2 risk algorithm.

2. Tools for ship traffic analysis e.g. using AIS data, e.g. near miss analysis.

3. Open source plugins, i.e. third party developers

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IWRAP Mk2

Basic tour of IWRAP UI

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IWRAP Mk2

Installation:

Basic terms:

What is the Joblist, Model view, Result view, etc

IWRAP Mk2
Theory

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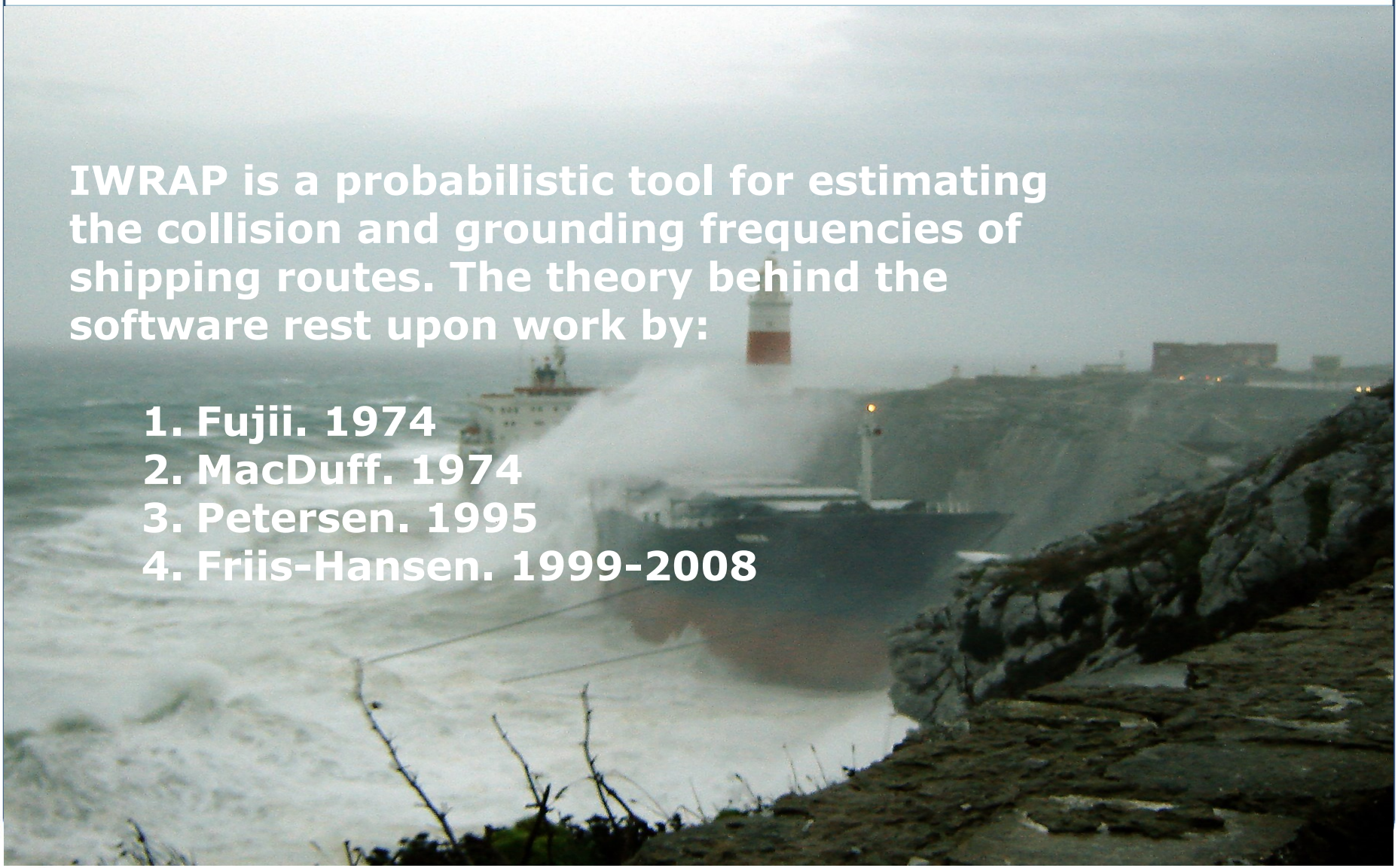
Theoretical background



IWRAP is a probabilistic tool for estimating the collision and grounding frequencies of shipping routes. The theory behind the software rest upon work by:

1. **Fujii. 1974**
2. **MacDuff. 1974**
3. **Petersen. 1995**
4. **Friis-Hansen. 1999-2008**

The Basics

Risk = Probability x Consequence

$$\lambda_{\mathrm{Col}} = P_C \cdot N_G$$

Collision Frequency = Causation probability x Geometrical Frequency

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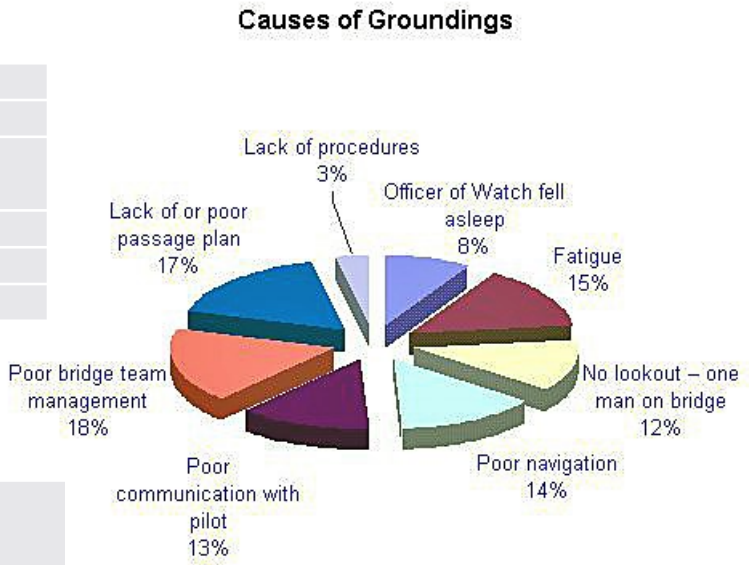
What may affect Pc

80% of the Pc is estimated to be comming from Human errors:

Although some postulate 100% ;-)

Personal:

Inadequate training	Carelessness	Ego
Physical limitations	Wishful thinking	Laziness
Inadequate communication	Ignorance	Greed
Bad judgement	Negligence	Alcohol
Fatigue	Folly	Mischief
Boredom	Panic	Violations



Organization:

Ineffective regulatory requirements	Production orientation	Inequitable promotion / recognition
Poor planning / training	Cost-profit incentives	Ineffective monitoring
Poor communications	Time pressures	Ego
Low quality culture	Rejection of information	Negative incentives
Low worker morale	Complex structure	Violations

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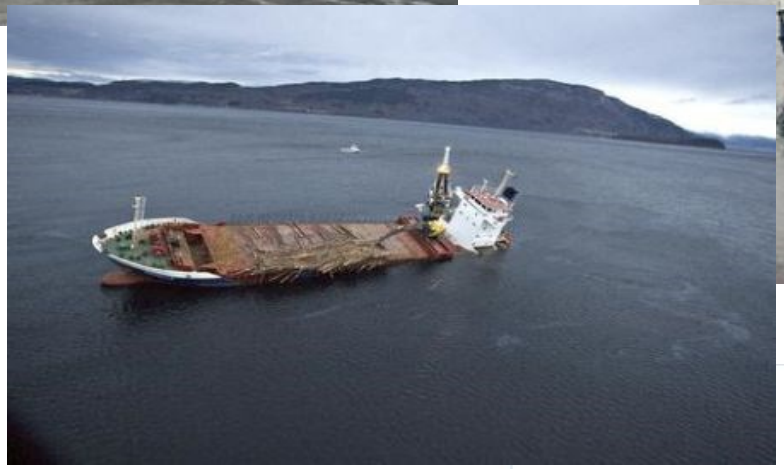
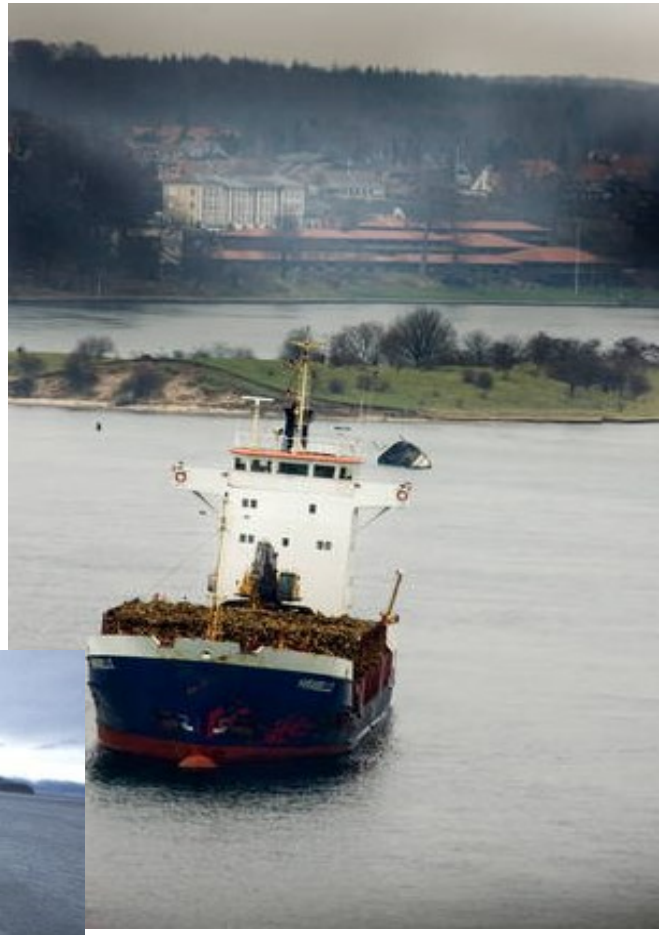
Some ”ships” seem to have higher P_C than others…

E.g. 3 Accidents in <4 years





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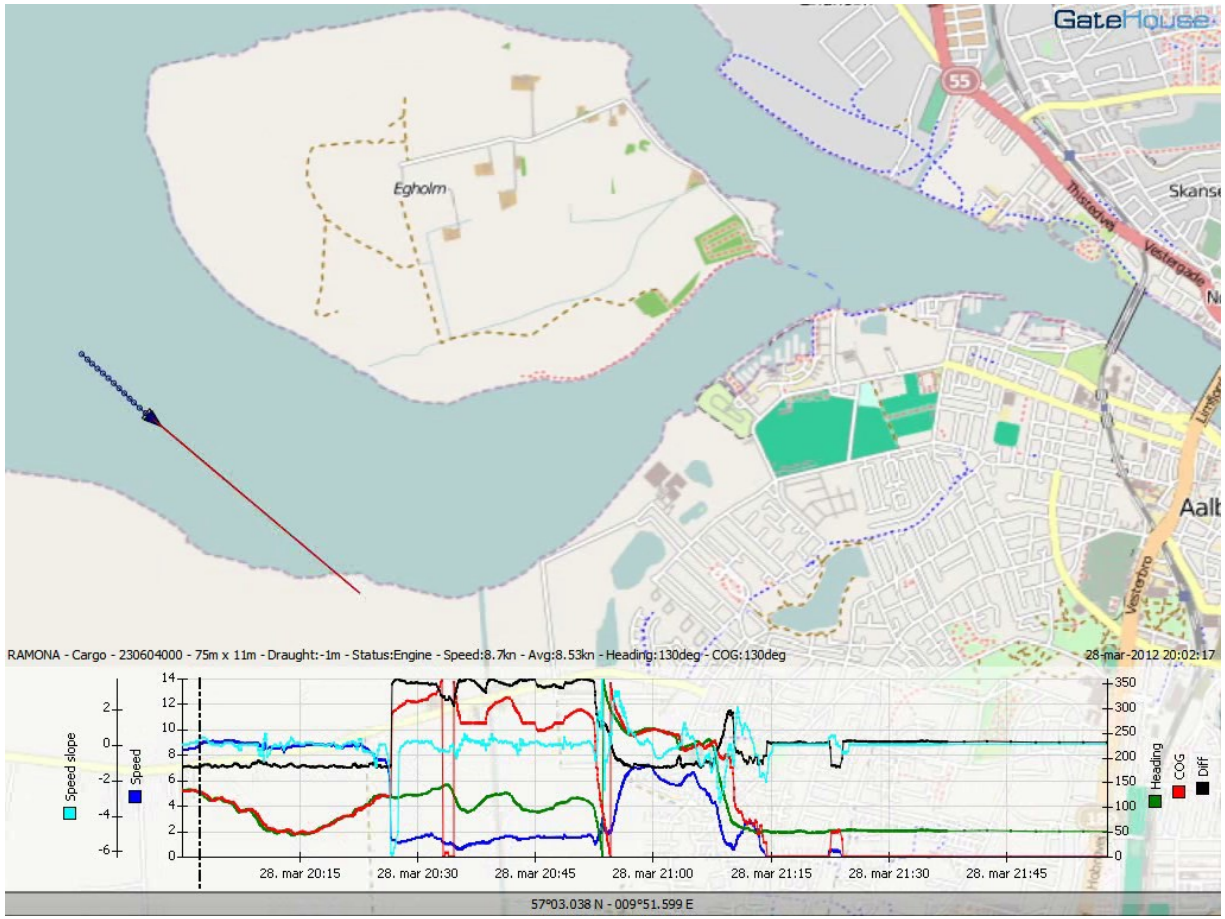
P_C Example…



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Consequence

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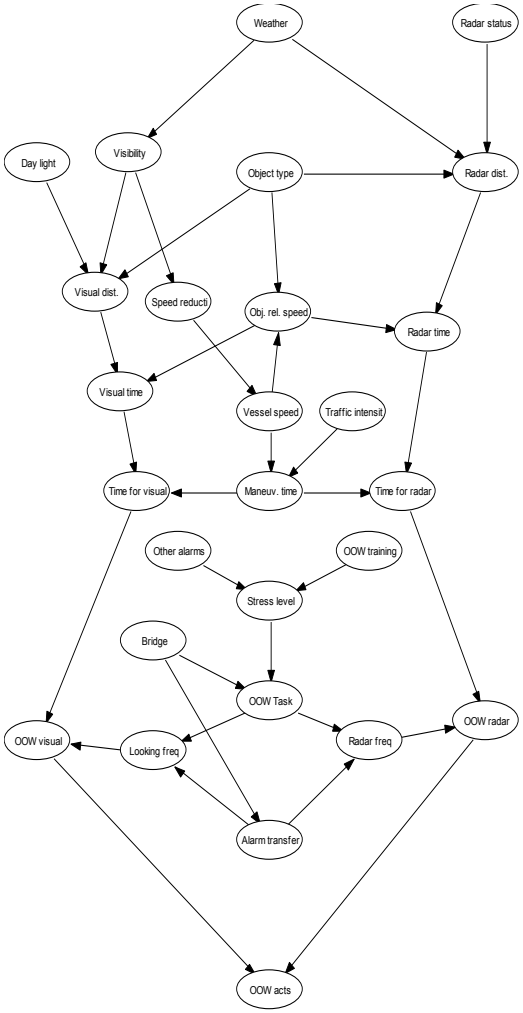
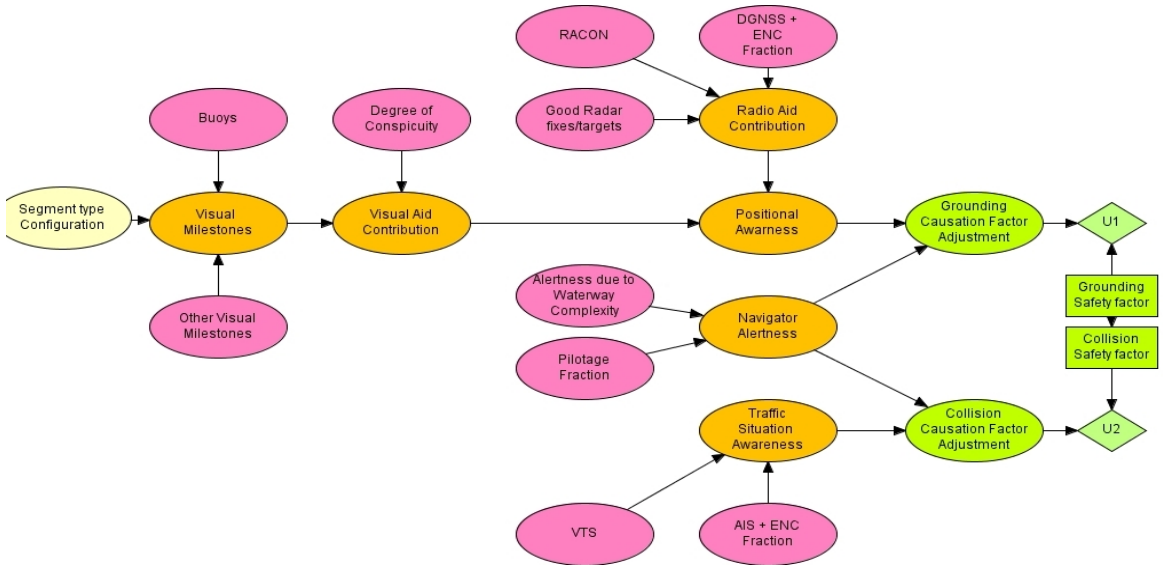
Bayesian Network for Causation Factor



Work is in progress at IALA to define a Bayesian Network, These are just an examples…



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Causation Factors from Litterature/studies…

Ship-ship collisions			
Location	**P_c [$\times 10^{-4}$]**	**Comment**	**Reference:** see [20] for ref.
Dover Strait	5.18	Head-on, no traffic separation	MacDuff [21]
Dover Strait	3.15	Head-on, with traffic separation	MacDuff [21]
Øresund, Denmark	0.27	Head on	Karlson *et al.* [19]
Japanese Straits	0.49	Head on	Fujii & Mizuki [9]
Japanese Straits	1.23	Crossings	Fujii & Mizuki [9]
Dover Strait	1.11	Crossings, no traffic separation	MacDuff [21]
Dover Strait	0.95	Crossings, with traffic separation	MacDuff [21]
Strait of Gibraltar	1.2		COWIconsult
Japanese Straits	1.10	Overtaking	Fujii & Mizuki [9]
Great Belt, Denmark	1.30	At bends in lanes	Pedersen *et al.* [24]
Danish waters	3.0	Head-on and overtaking Crossings also?	COWIconsult Oil and Chemical Spills, 2007

Vessel grounding			
Location	**P_c [$\times 10^{-4}$]**	**Comment**	**Reference:** see [20] for ref.
Japanese Straits	[1.0; 6.3]	Collisions and grounding	Fujii
Japanese Straits	1.58		Fujii & Mizuki [9]
Japanese Straits	[0.8; 4.3]		Matsui
Dover Strait	1.55	No traffic separation	MacDuff [21]
Dover Strait	1.41	With traffic separation	MacDuff [21]
Strait of Gibraltar	2.2		COWIconsult
Øresund, Denmark	2.0		Karlson *et al.* [19]

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Types of Incidents in IWRAP

1. **Head-on**
2. **Overtaking collision**
3. **Crossing, merging & bend collision**
4. **Area traffic collision (ships not on routes, e.g. fishing)**
5. **Powered grounding**
6. **Drifting grounding**

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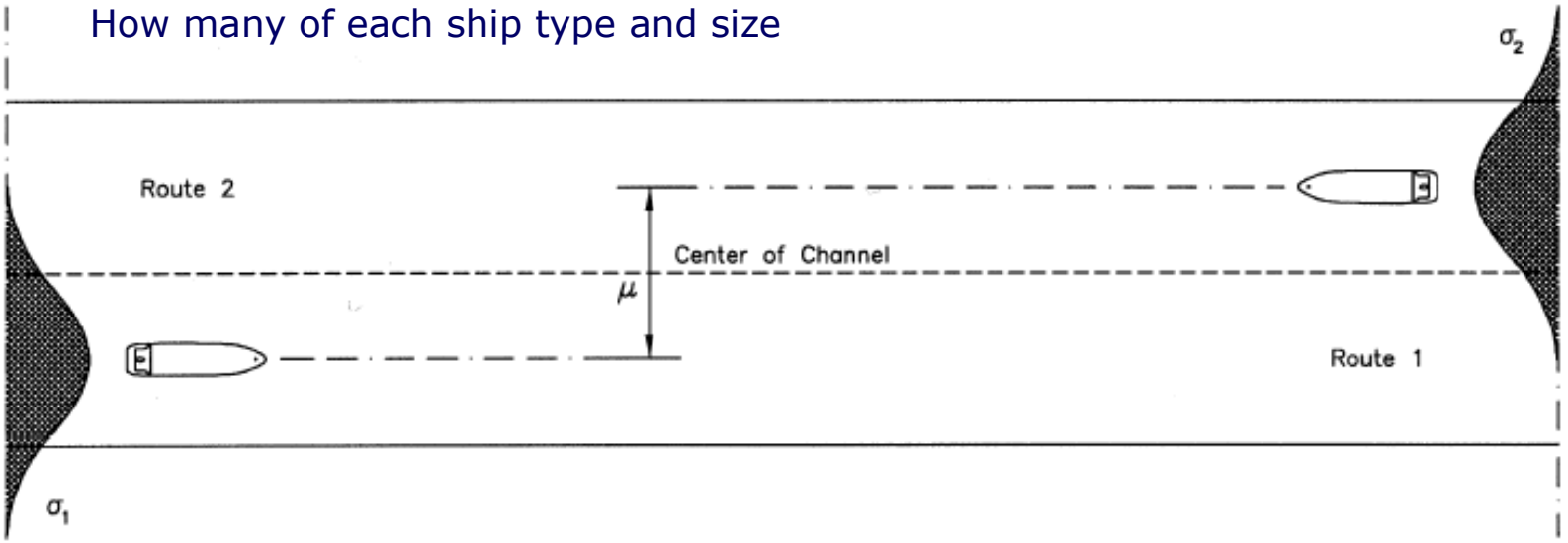
Modelling of collisions, e.g. Head-on

$$\lambda_{\text{Col}} = P_C \cdot N_G$$

Calculate the geometrical frequency N_G using:

- **Lateral distribution,**
  Identifies where ships move on the fairway/leg
- **Traffic distribution/composition**
  How many of each ship type and size



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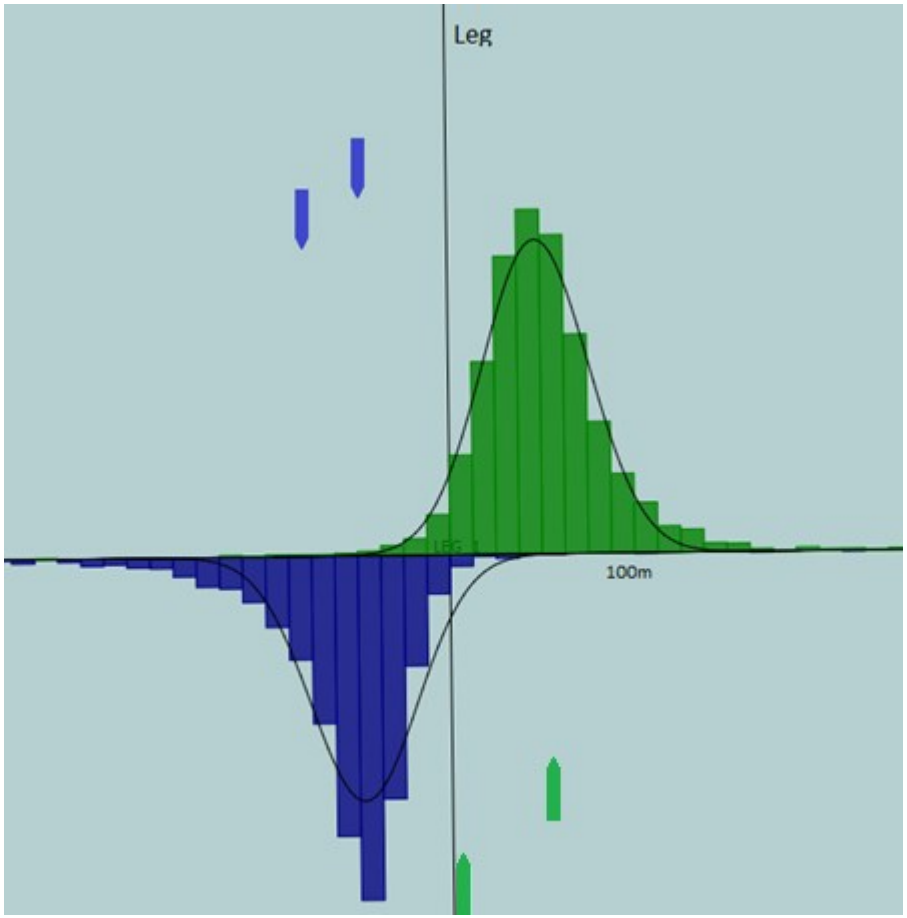
Ship Distributions



Divide the passage line into intervals. Count the number of ships passing through each interval. This gives a histogram. A probability function (Normal) can then be fitted to the histogram.

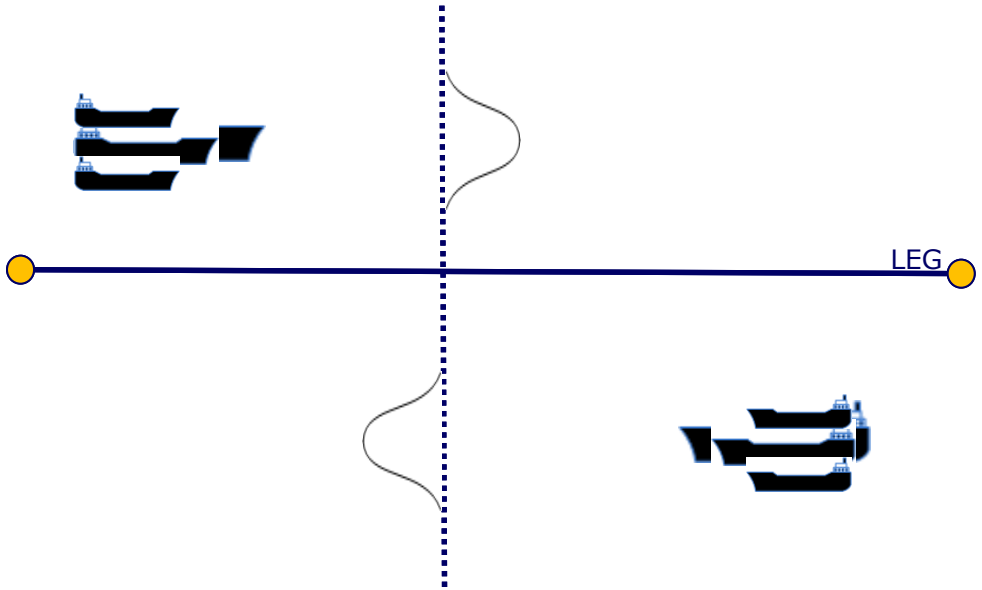
Normal distribution (μ=380 m, σ2=230 m)

The probability that a 50 m wide ship is touching the leg, x=0:

P(x<-50)=0.03; P(x<50)=0.08
P(-50<x<50)=0.05

The probability that it will be at x=380 m is:
P(x<330)=0.41; P(x<430)=0.59;
P(330<x<430)=0.18

Lateral Distributions…



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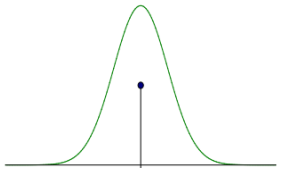
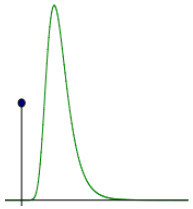
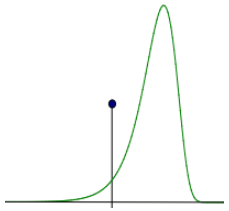
Distributions in IWRAP



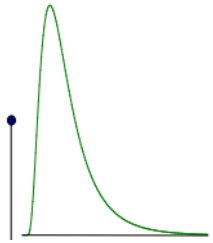
Normal distribution
(Mean, std. dev.)



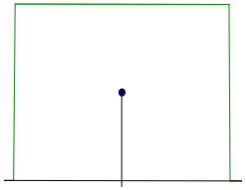
Gumbel maximum
(Mean, std. Dev.)



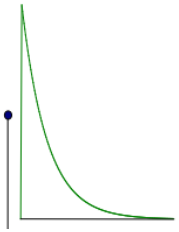
Gumbel minimum
(Mean, std. dev)



Log normal
(Mean, std. dev, lower bound)

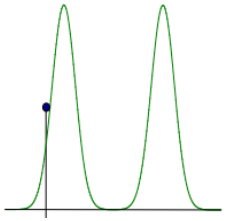


Uniform distribution
(lower-, upper bound)



Weibull
(Mean, std. dev, lower bound)

Beta distribution
(Mean, std. dev, lower bound, upper bound)



Any combination
Here 2 normal dist.

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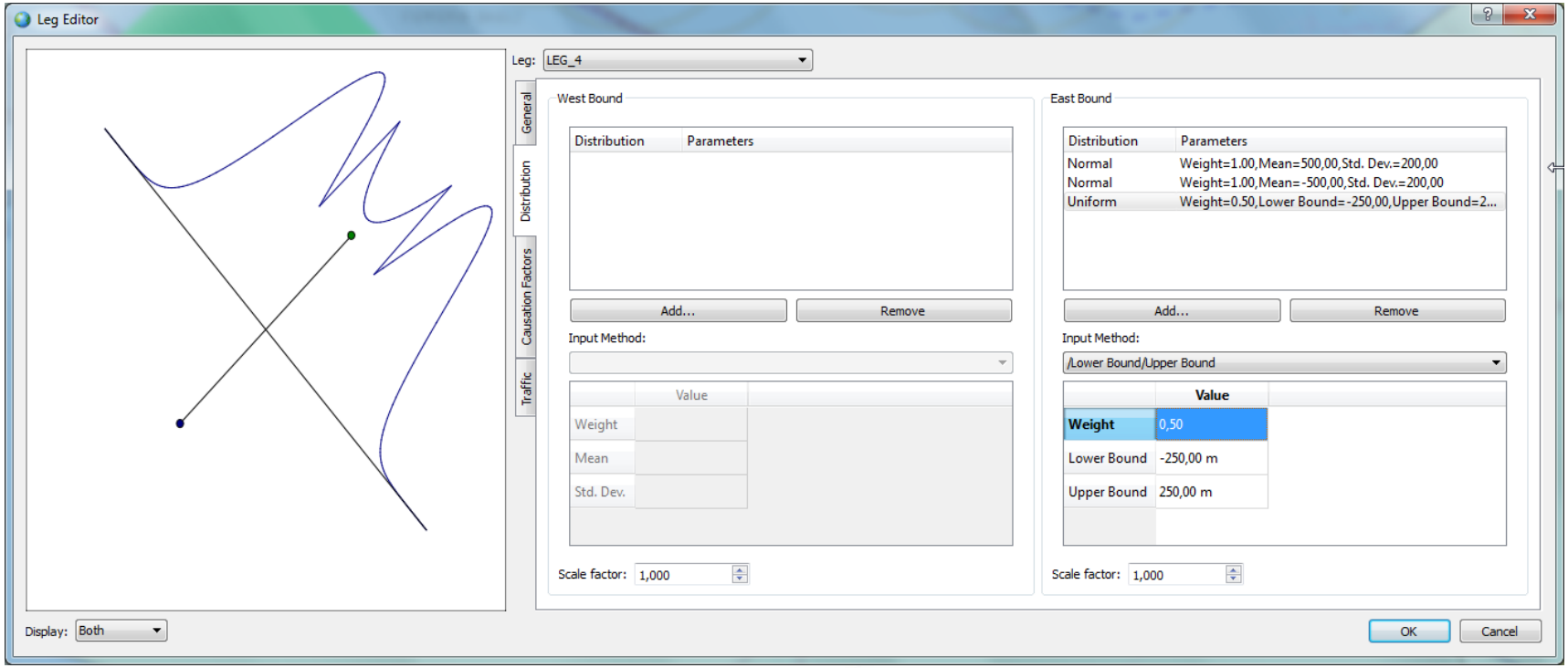
Mixed Distributions in IWRAP

Any number of any type of distribution can be mixed,

A combination of a number Normal and Uniform distributions is in most cases sufficient



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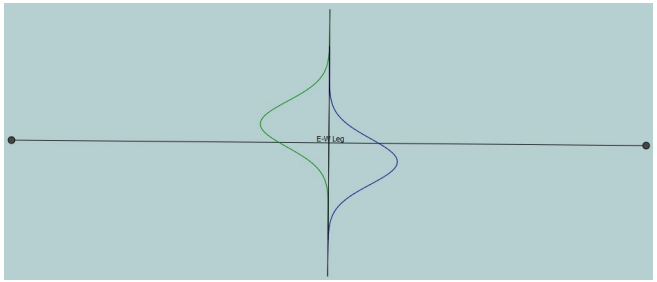
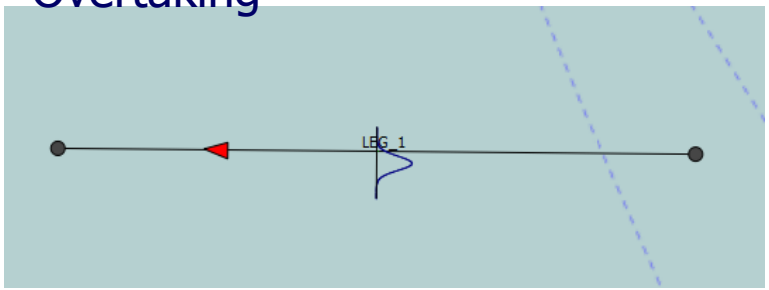
Collision modelling

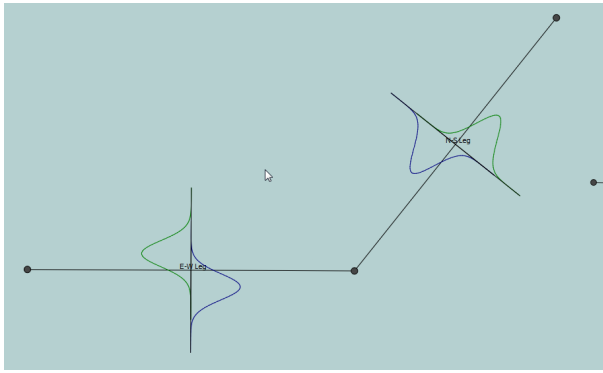
Head-on



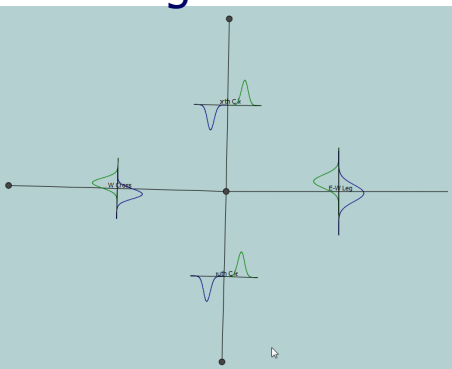
Overtaking



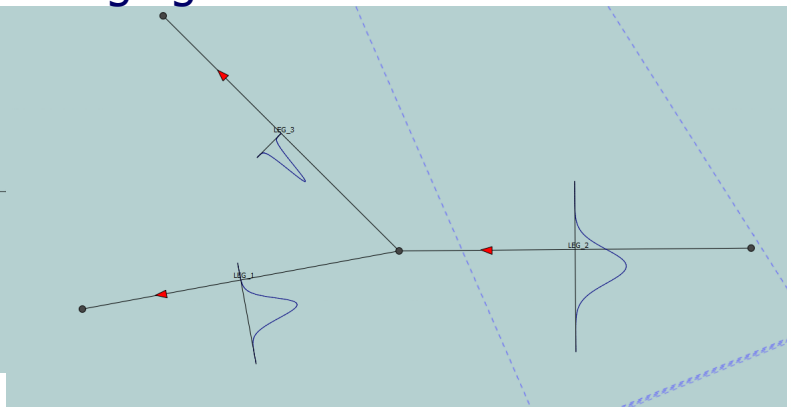
Bend



Crossing



Merging



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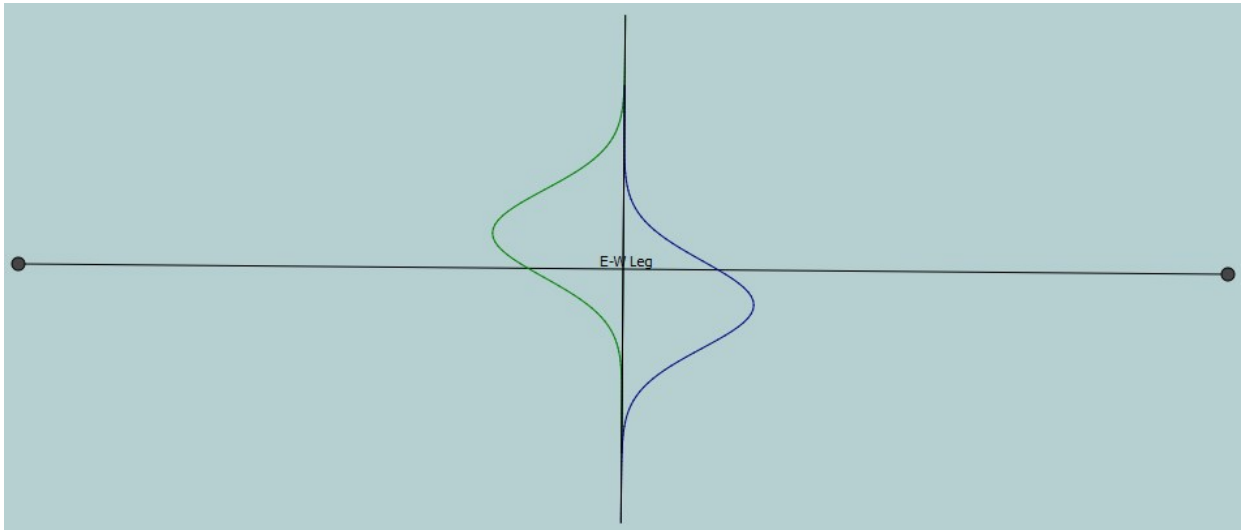
Test case A1: Head-on



Risk reducing measures:
-Separate traffic

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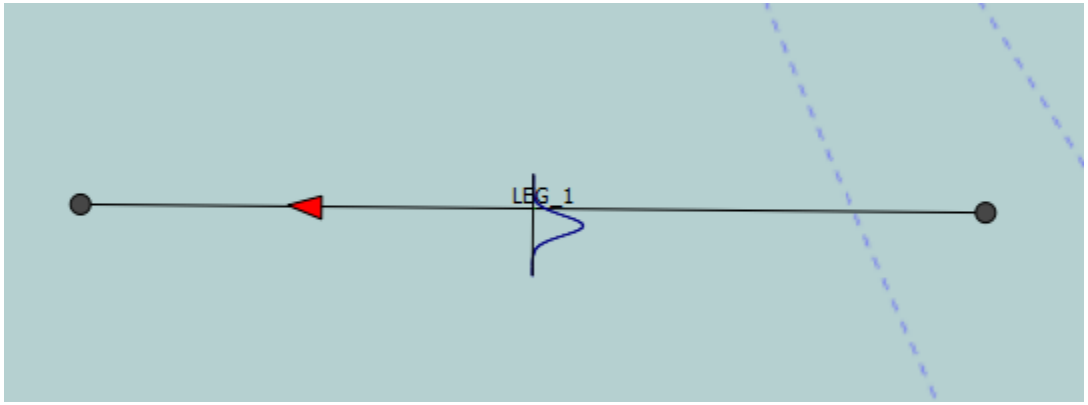
Test case A2: Overtaking



Add 2 different types with different mean speeds.
Look at Struck/Striking results…

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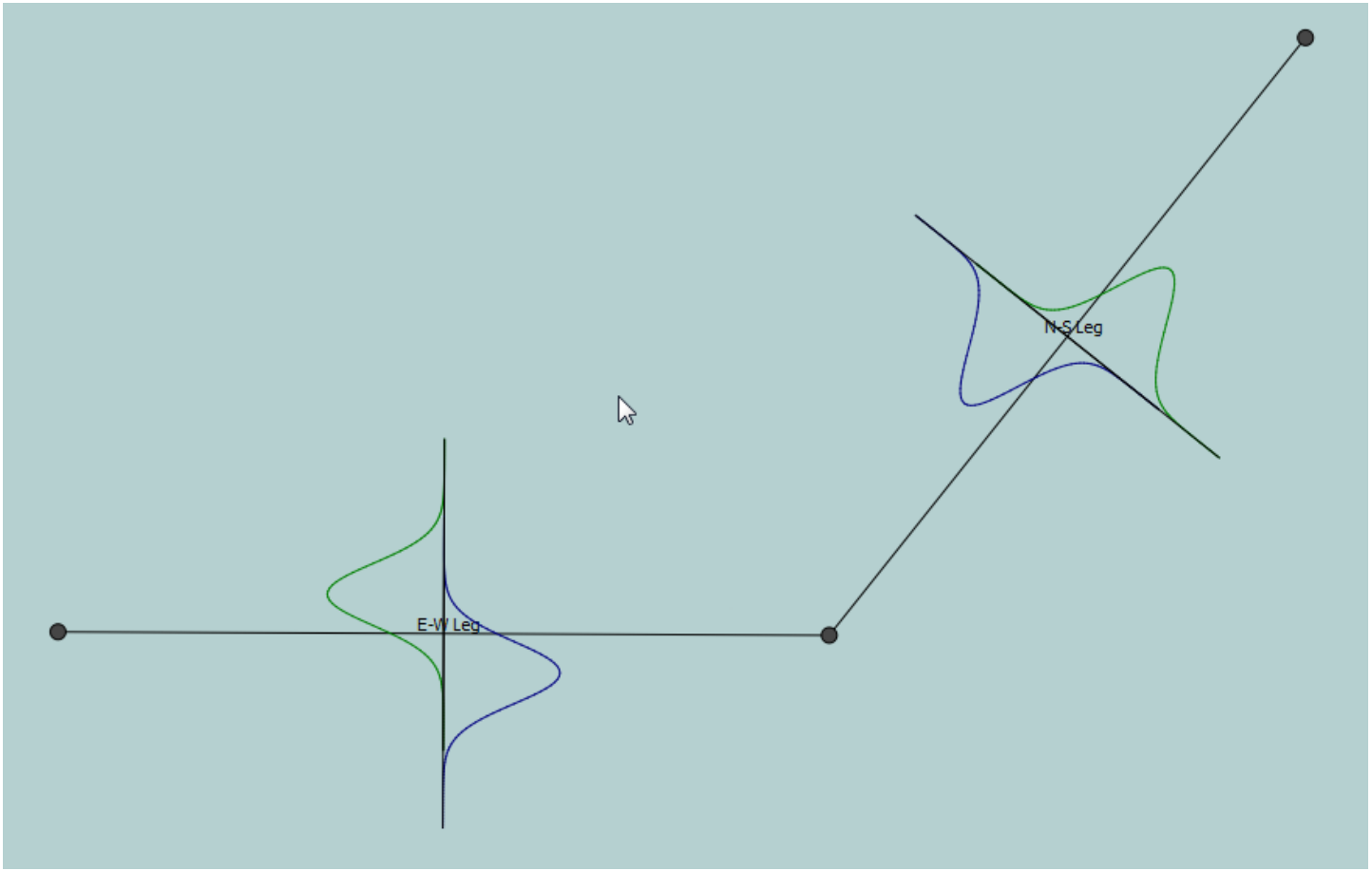
Test case B: Bend collisions



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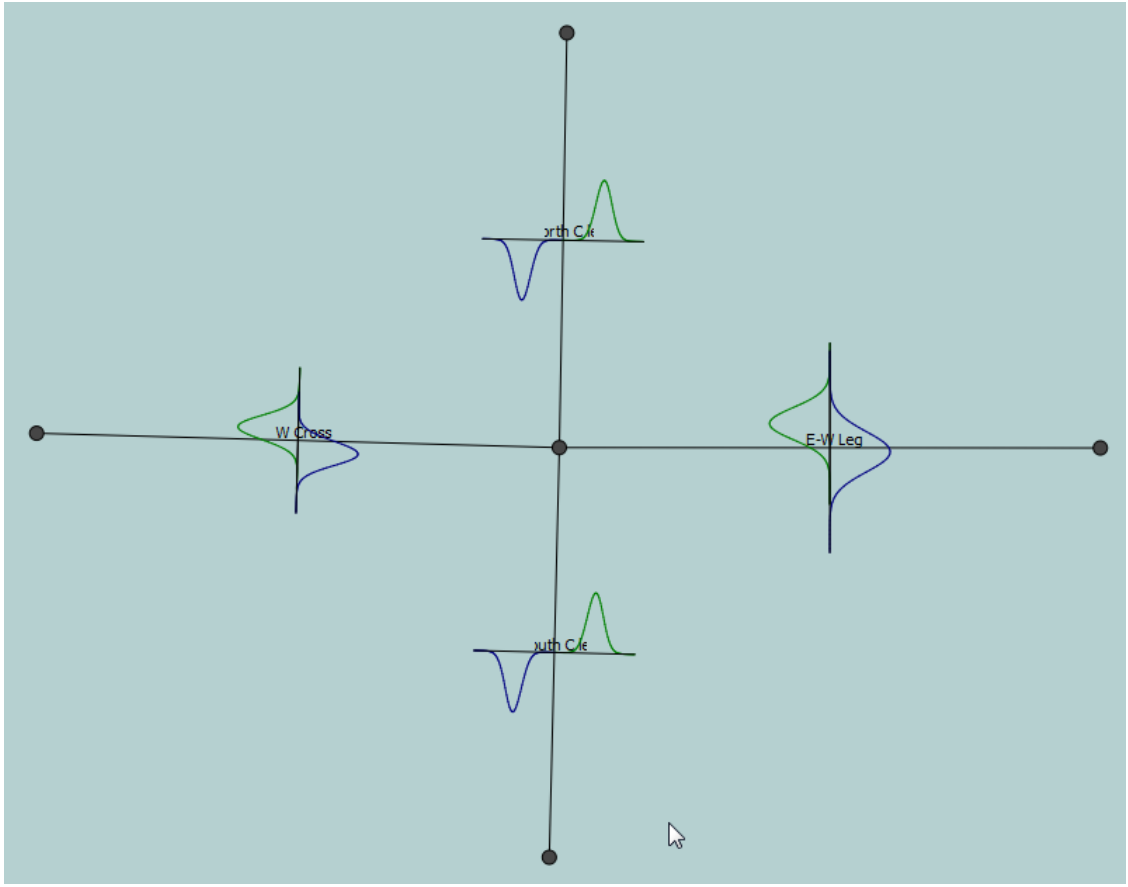
Test case C: Crossing collisions



Ensure only crossing! (adjust waypoint)

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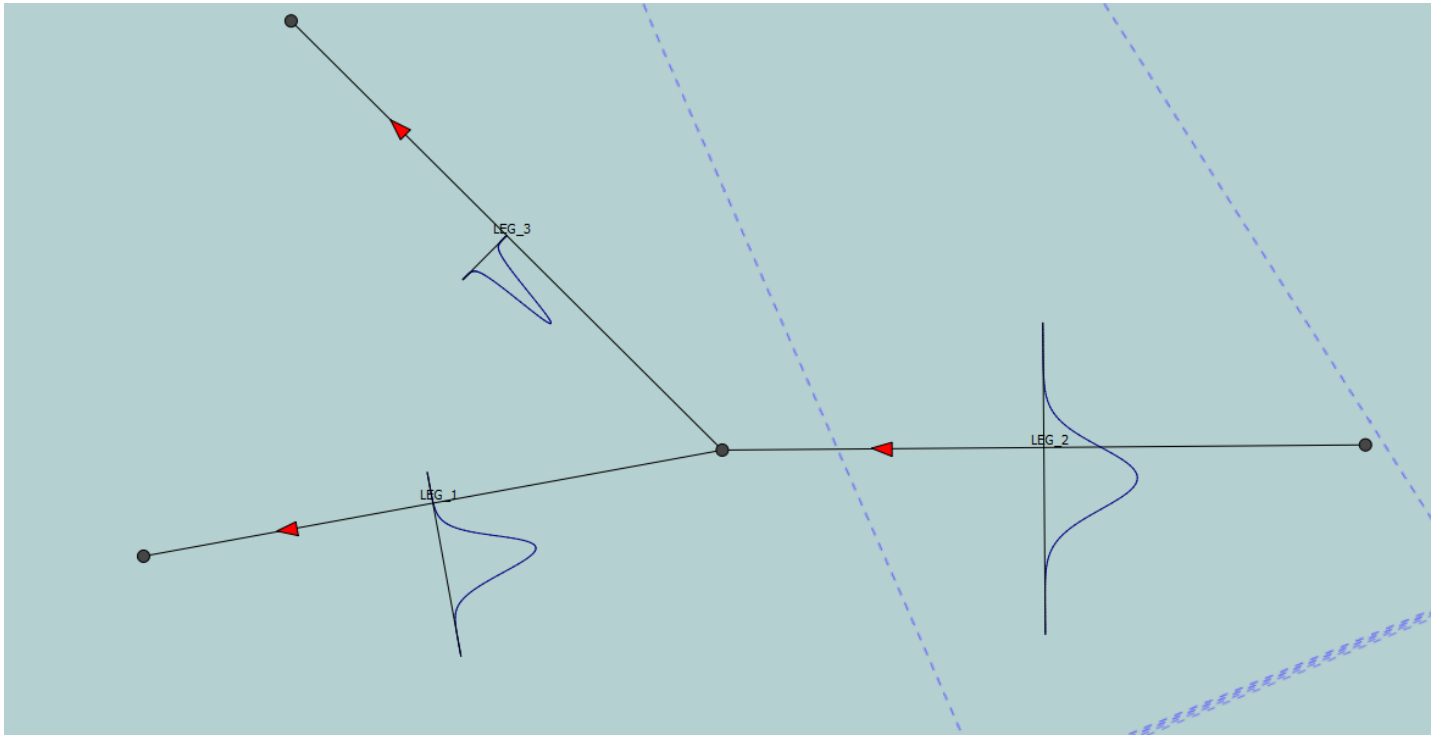
Test case D: Merging




www.fraps.com
Apr 7, 2006 7:47:33 am
7 am
8 am
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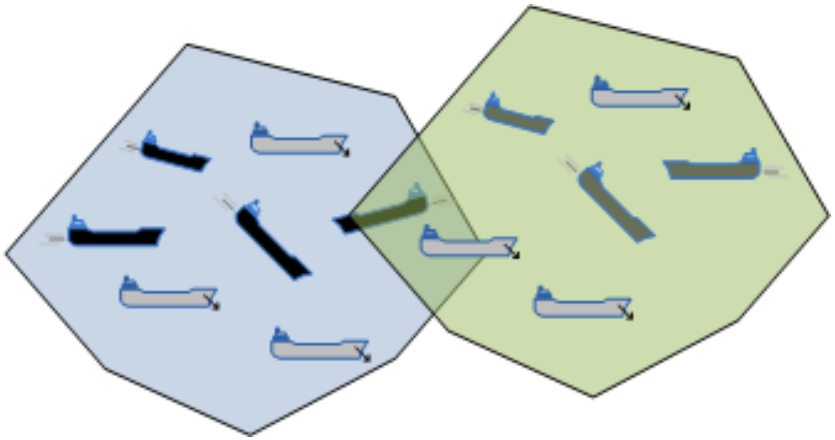
Fehmarn
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2009 Google
Imagery Dates: Mar 4, 2000 - Mar 5, 2006
lat 54.582889° lon 11.102563° elev 0 m
Eye alt 36.03 km

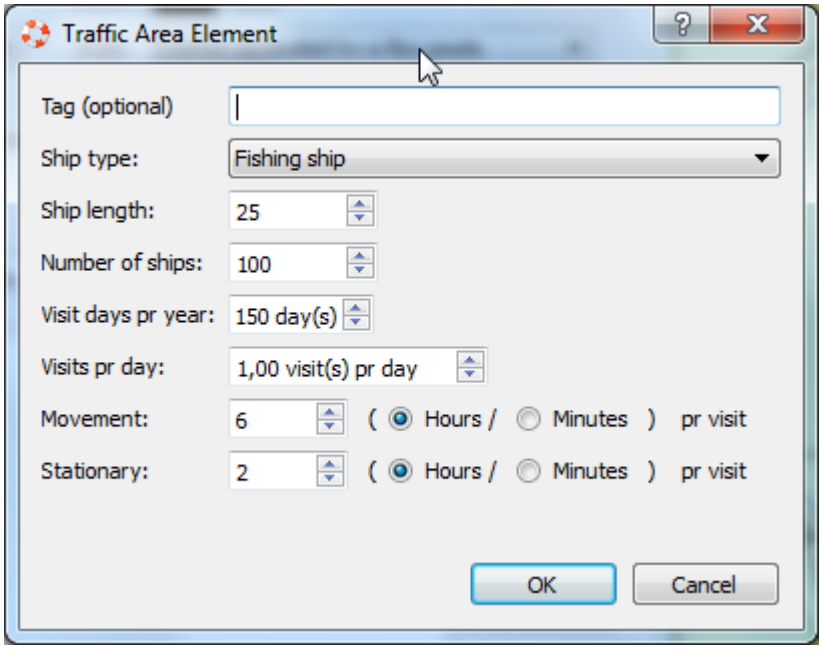
Area Collisions

Area Traffic: A number of areas with different ”Traffic Area Composition”.

A ”Traffic Area Composition” consists of a number of ”Traffic Area Elements”.

A composition can have several elements and a model can have several areas.





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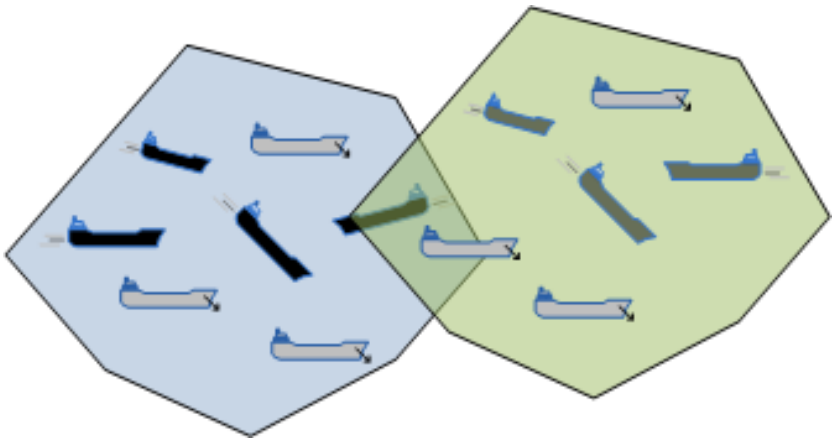
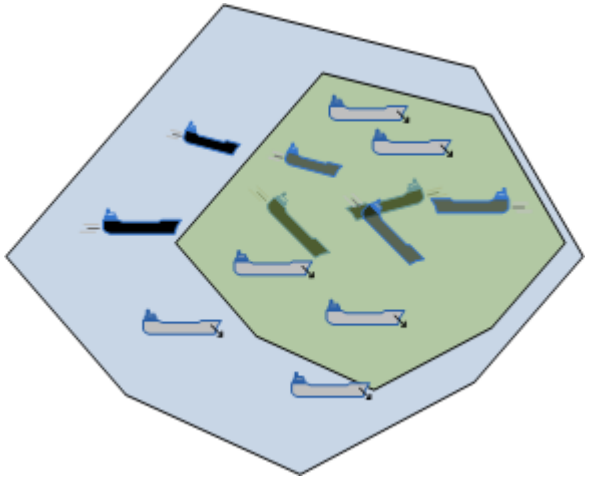
Area Collisions

Areas may overlap, can be used to e.g. model different fishing level intensities.





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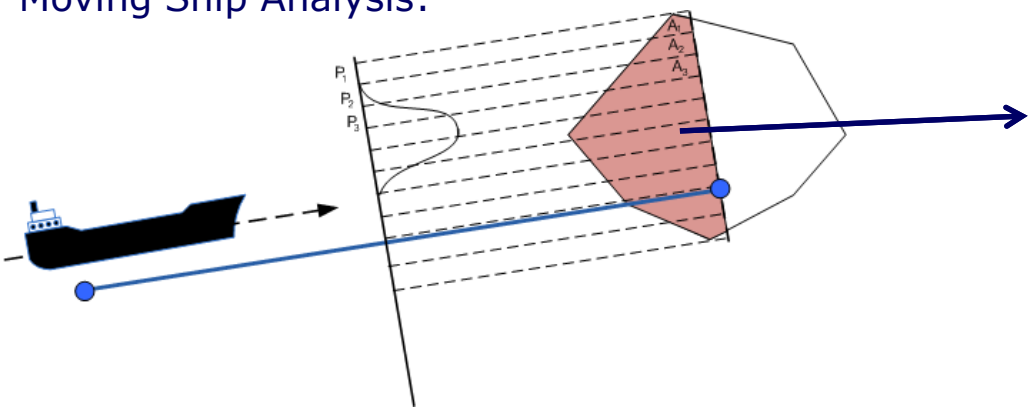
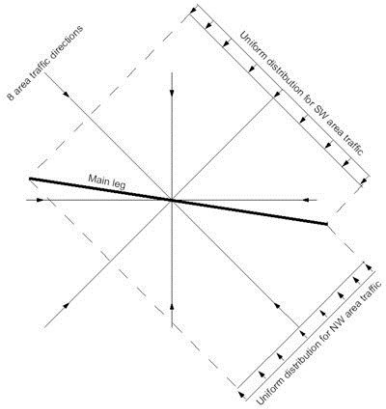
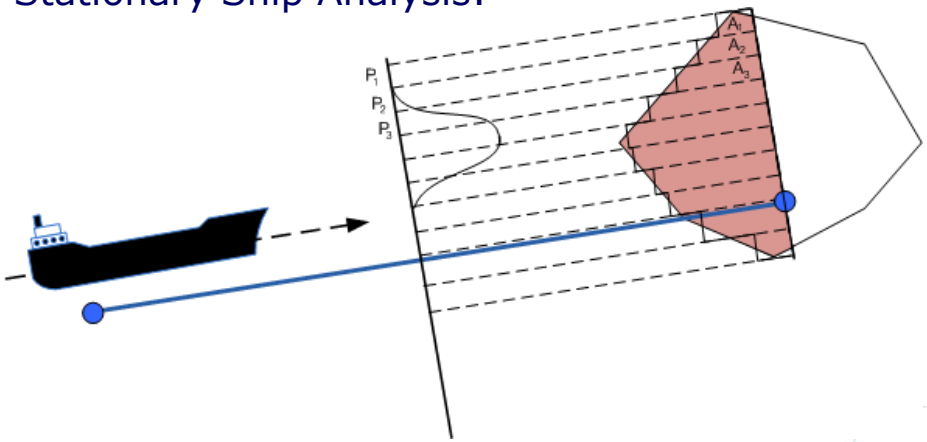
Area Collisions

Moving Ship Analysis:





Stationary Ship Analysis:



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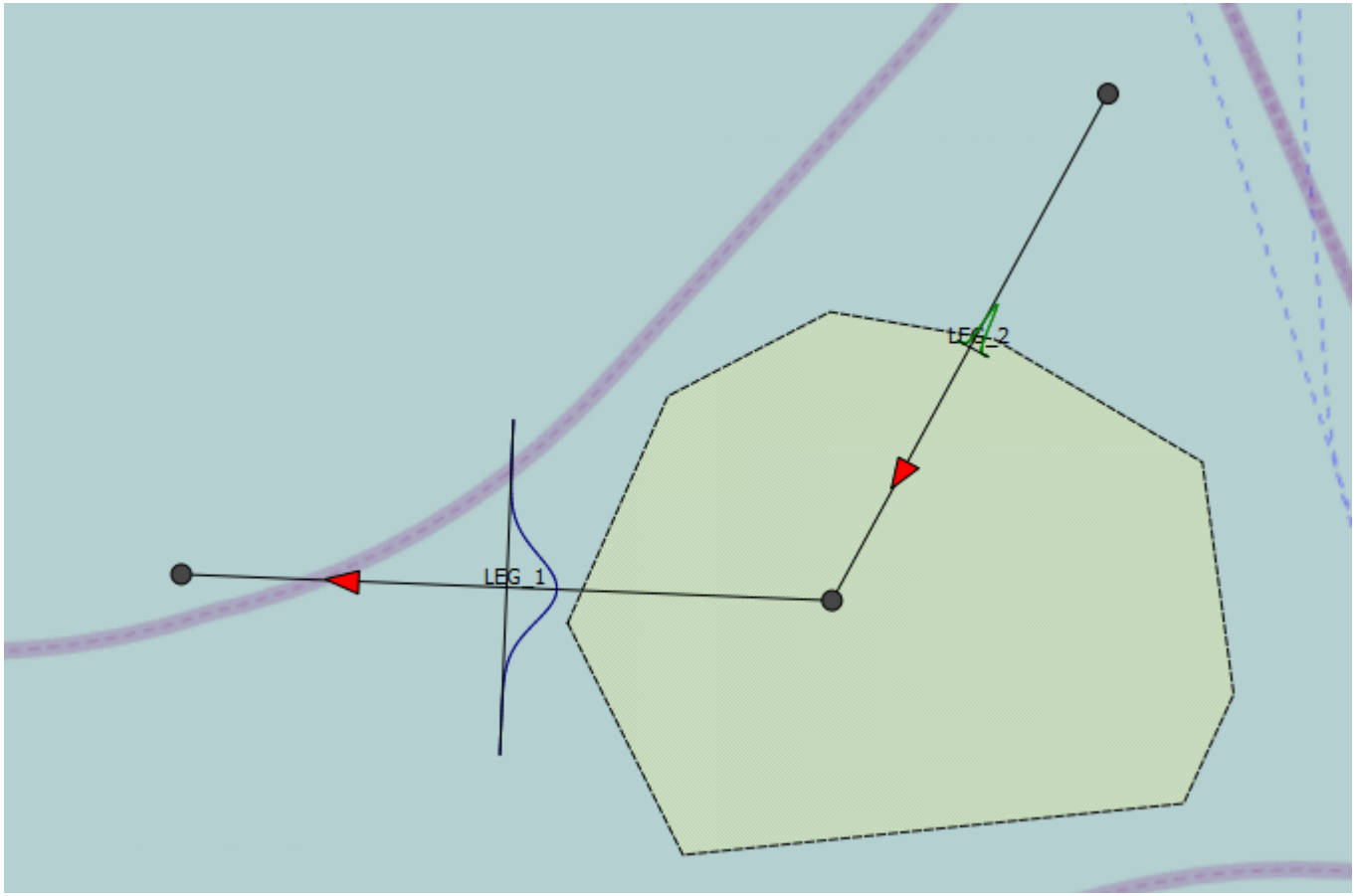
Test case G: Area collisions



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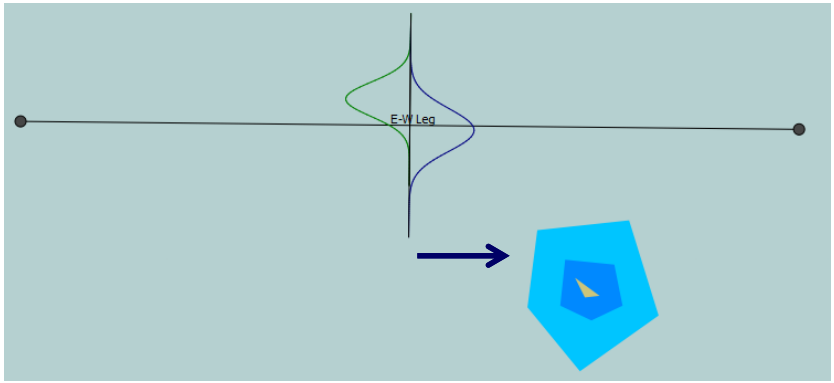
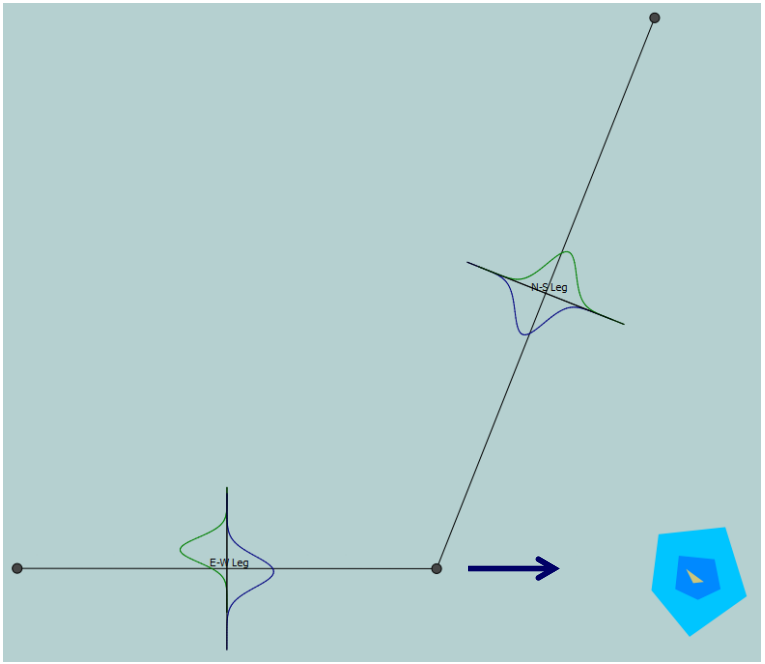
Powered Grounding Categories

Category I



Category II



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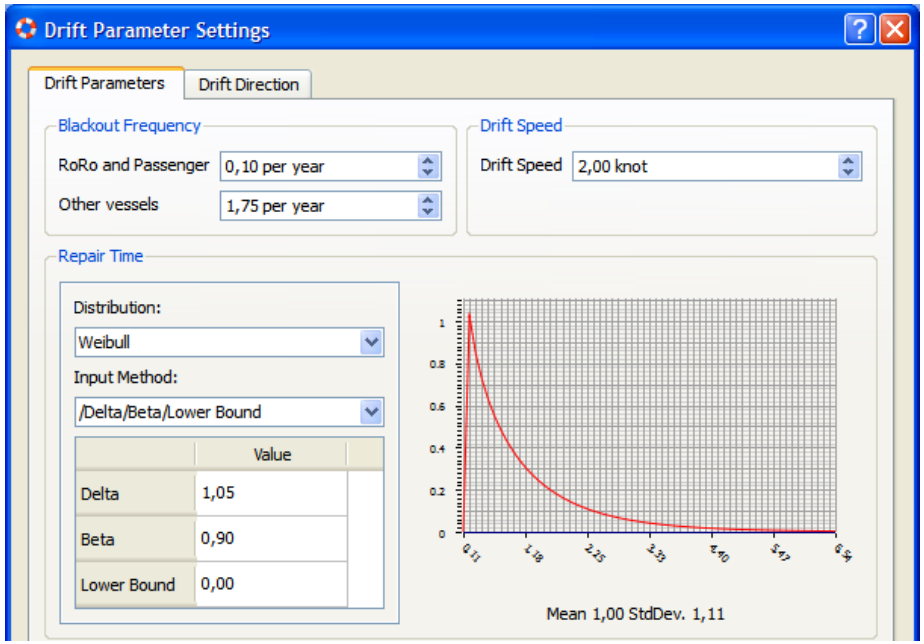
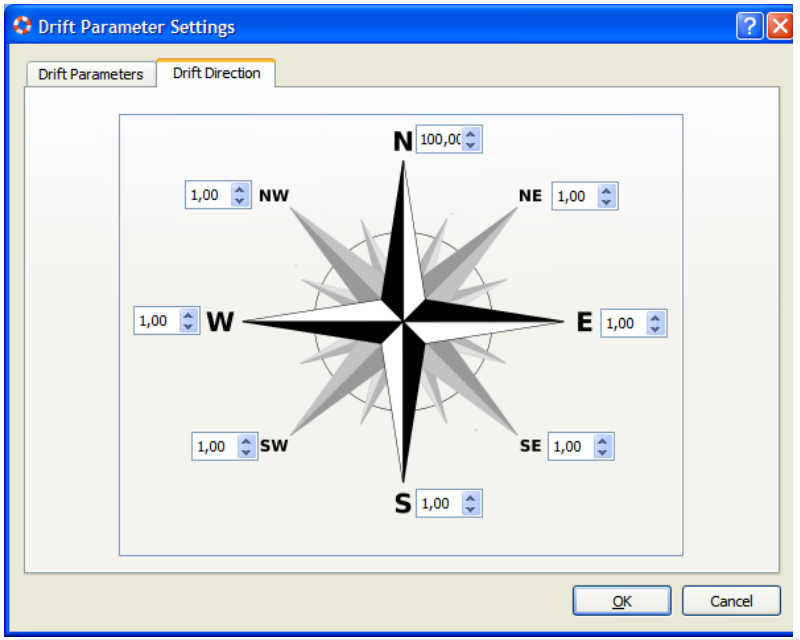
Drifting Grounding

1. **Failure/”blackouts” of propulsion machinery may occur at any location along the leg/waterway. This is in IWRAP modeled as a Poision process.**
2. **In the current version it is possible to use an overall drift direction specification.**
   In the next version it will be possible to do it per leg.
3. **The ”Repair time”, i.e. for how long time the vessel will drift.**





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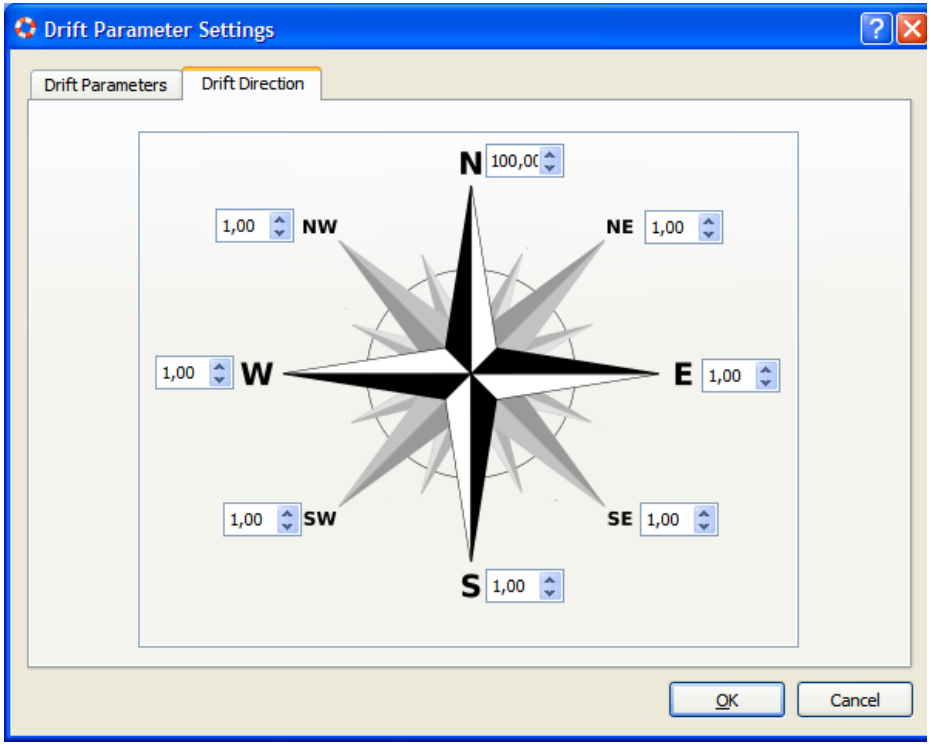
Drift Direction

$$N^{\text{drift}}_{\text{grounding}} = N_{\text{ship}} \int_{\psi=0}^{360} P_{\text{drift}}(\psi)$$

P_{drift} (ψ) defines the probability of drifting in direction ψ

$$P_{drift}(N) = \frac{100}{7 \cdot 1 + 100} = 0.93$$

$$P_{drift}(S) = \frac{1}{7 \cdot 1 + 100} = 0.01$$



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Drifting Grounding: Repair Time

The default repair time distribution is modeled as a Weibull distribution,

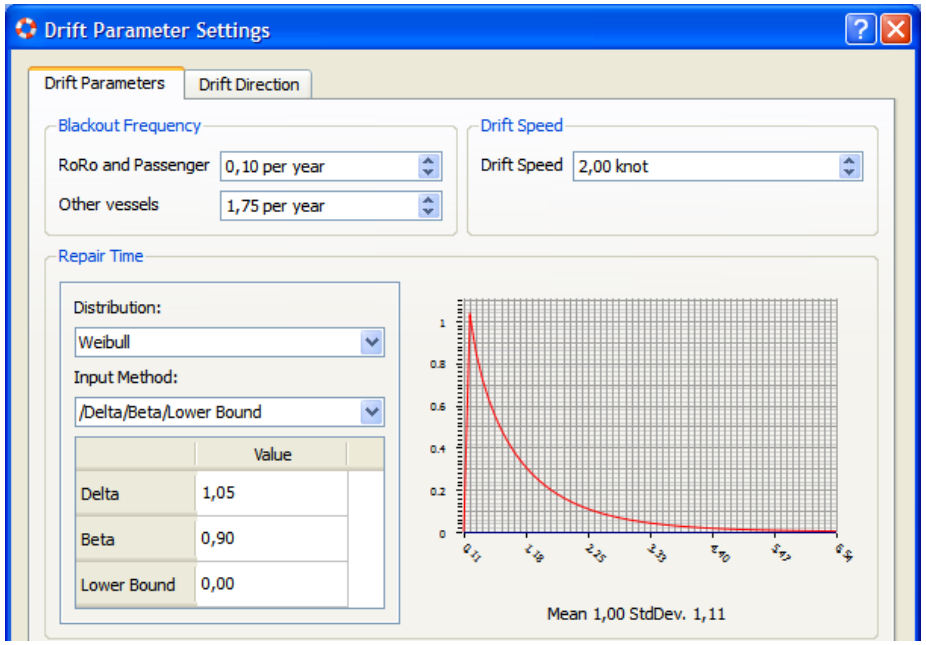
$$F_{\text{no repair}}(t) = \exp\left(-a\,t^{b}\right)$$

with scale parameter a = 1.05 and shape parameter b = 0.9 , which gives a mean value of 1 hour and standard deviation of 1.13 hour.

The time to grounding is defined as

$$t_{ground} = d_{ground} / v_{drift}$$

in which v_{drift} is the (uncertain) drifting speed and $d_{ground}(x)$ defines the distance from the leg segment to the ground.



IWRAP Mk2
Using AIS Data

KASI Training Session

September 2013, Sabah Malaysia

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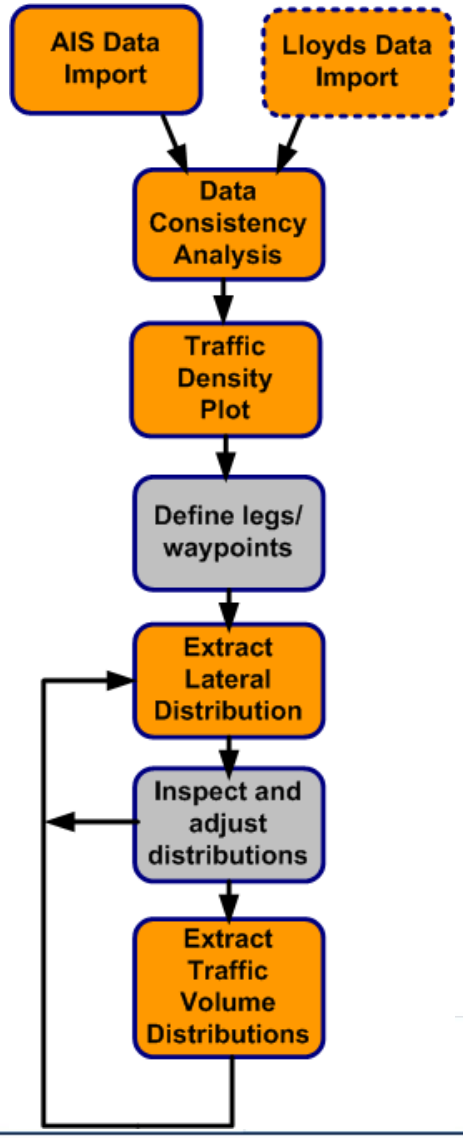
The Basics

1. Import Static Ship Data if available
2. Import AIS data in the correct format
3. Create density plot
4. Chart overlay
5. Draw legs
6. Extract model data. Vol., distributions. etc.
7. Create depth curves
8. Run model and do what if analysis

Using AIS data



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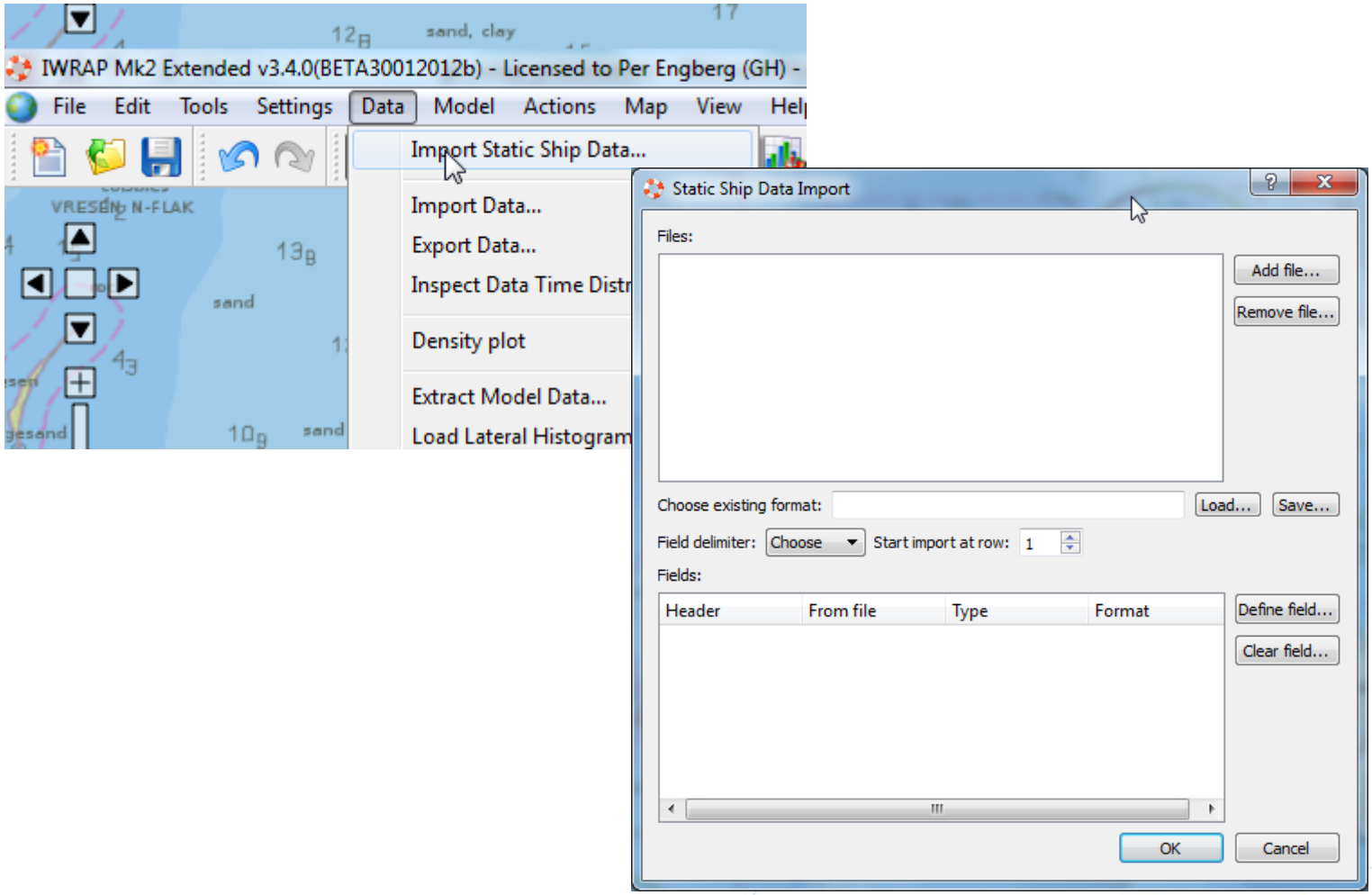
Import Static Ship Data (if available)



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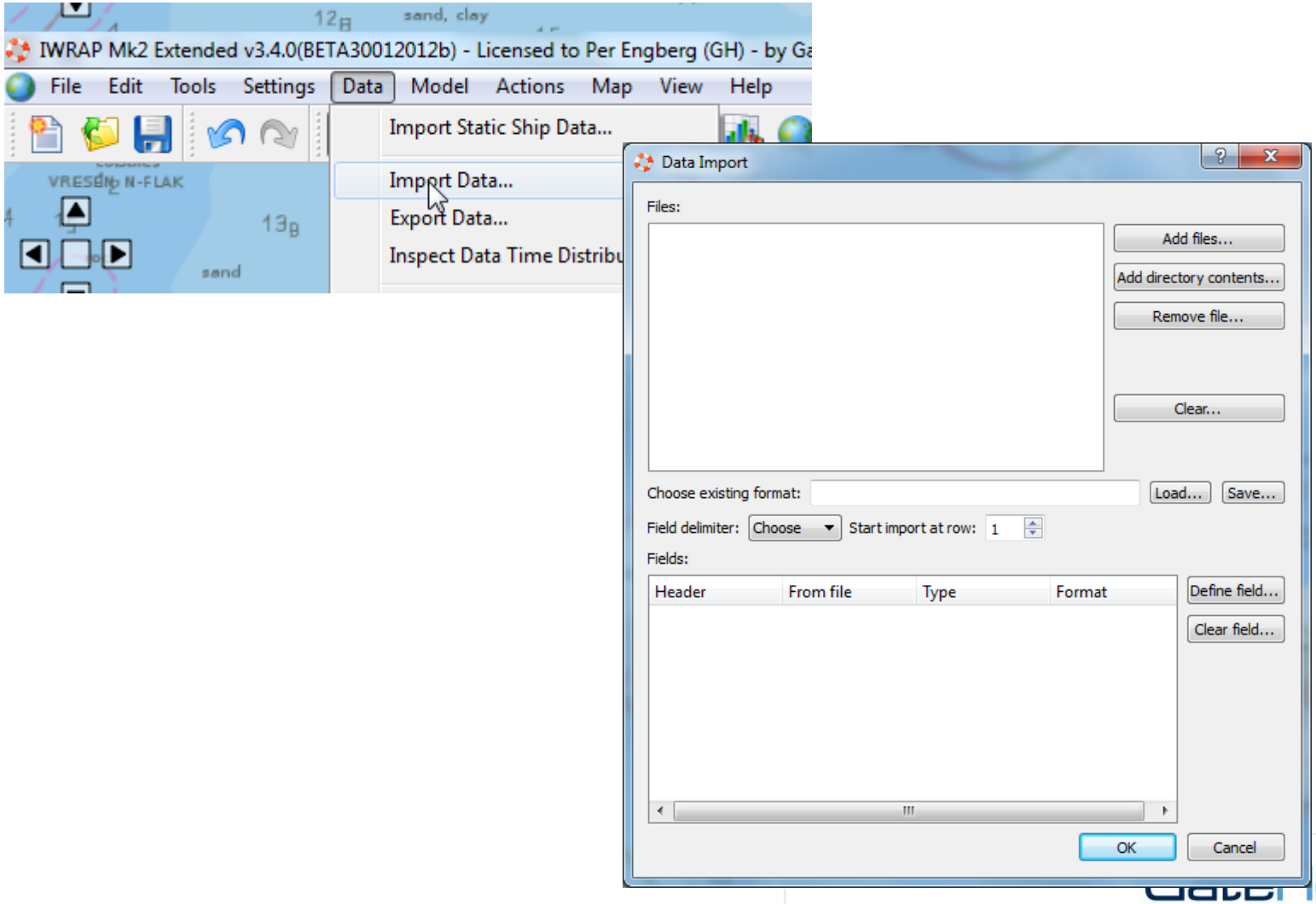
AIS to IWRAP Ship Types (1371.1)

Identifiers to be used by ships to report their type			
Other ships			
First digit(1)	Second digit(1)	First digit(1)	Second digit(1)
1 - Reserved for future use	0 - All ships of this type	-	0 - Fishing (Fishing ship)
2 - WIG (Other ship)	1 - Carrying DG, HS, or MP, IMO hazard or pollutant category A	-	1 - Towing (Support ship)
3 - See right column	2 - Carrying DG, HS, or MP, IMO hazard or pollutant category B	3 - Vessel	2 - Towing and length of the tow exceeds 200 m or breadth exceeds 25 m (Support ship)
4 - HSC (Fast ferry)	3 - Carrying DG, HS, or MP, IMO hazard or pollutant category C	-	3 - Engaged in dredging or underwater operations (Support ship)
5 - See above	4 - Carrying DG, HS, or MP, IMO hazard or pollutant category D	-	4 - Engaged in diving operations (Support ship)
	5 - Reserved for future use	-	5 - Engaged in militaryoperations (Other ship)
6 - Passenger ships (Passenger ship)	6 - Reserved for future use	-	6 - Sailing (Pleasure boat)
7 - Cargo ships (General cargo ship)	7 - Reserved for future use	-	7 - Pleasure craft (Pleasure boat)
8 - Tanker(s) (Oil products tanker)	8 - Reserved for future use	-	8 - Reserved for future use
9 - Other types of ship	9 - No additional information	-	9 - Reserved for future use

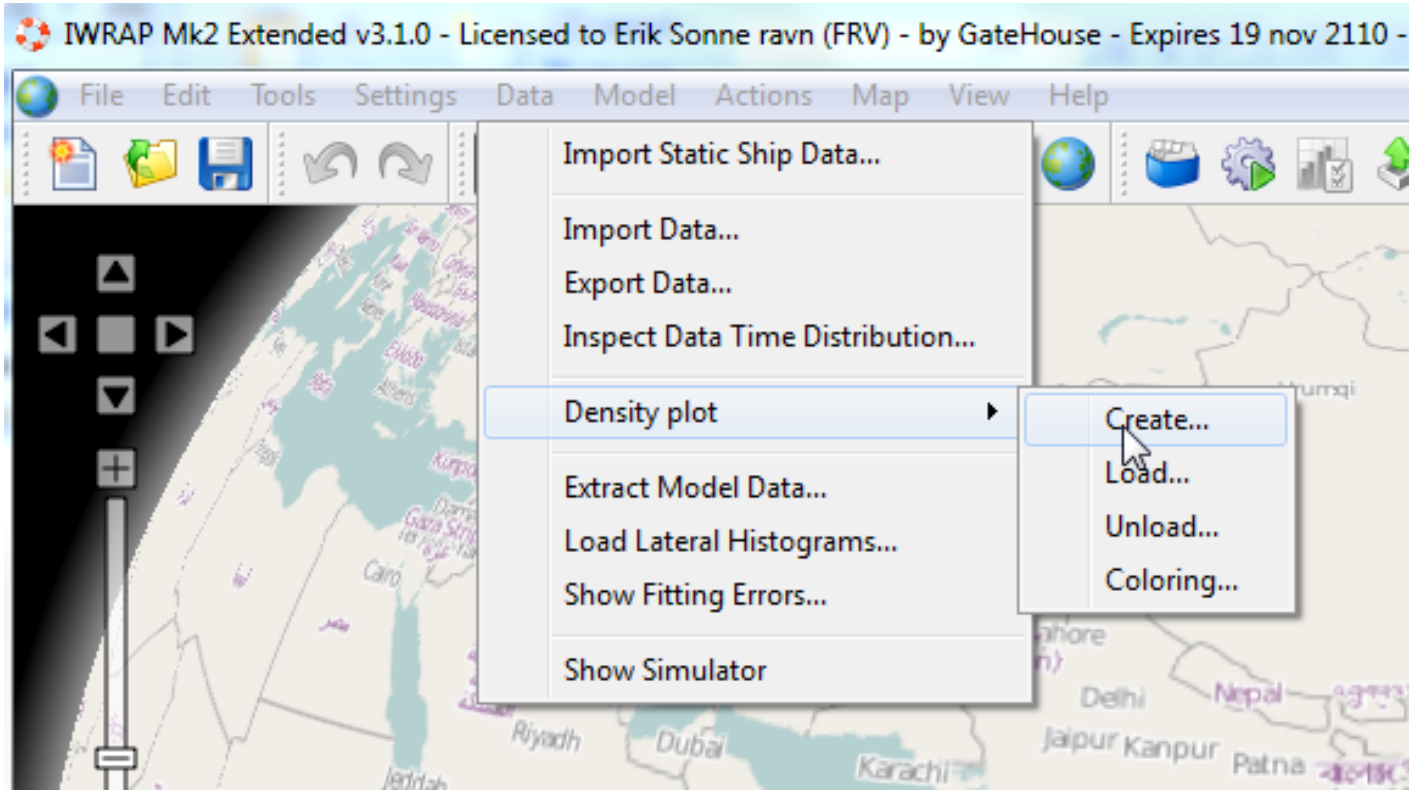
AIS to IWRAP Ship Types (part 2)

Identifiers to be used by ships to report their type	
Identifier No.	Special craft
50	Pilot vessel (Support ship)
51	Search and rescue vessels (Support ship)
52	Tugs (Support ship)
53	Port tenders (Support ship)
54	Vessels with anti-pollution facilities or equipment (Other ship)
55	Law enforcement vessels (Other ship)
56	Spare - for assignments to local vessels
57	Spare - for assignments to local vessels
58	Medical transports (Other ship)
59	Ships according to RR Resolution No. 18 (Mob-83) (Other ship)

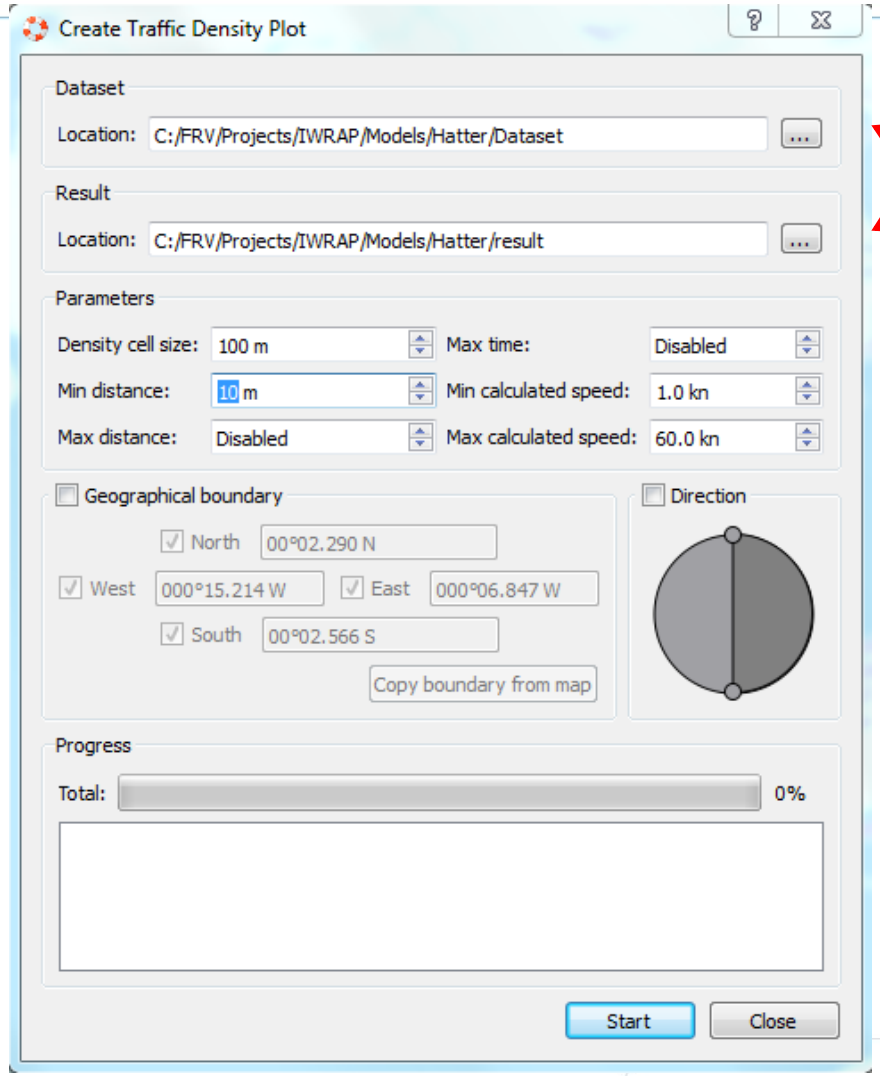
Import Data


IWRAP Mk2 Extended v3.4.0(BETA30012012b) - Licensed to Per Engberg (GH) - by Ga
File
Edit
Tools
Settings
Data
Model
Actions
Map
View
Help
Import Static Ship Data...
Import Data...
Export Data...
Inspect Data Time Distribu
sand, clay
sand
Data Import
Files:
Add files...
Add directory contents...
Remove file...
Clear...
Choose existing format:
Load...
Save...
Field delimiter:
Choose
Start import at row:
1
Fields:
Header
From file
Type
Format
Define field...
Clear field...
OK
Cancel

2. Generate density plot



2. Generate density plot



Dicipline here! Or you could end up using the wrong data

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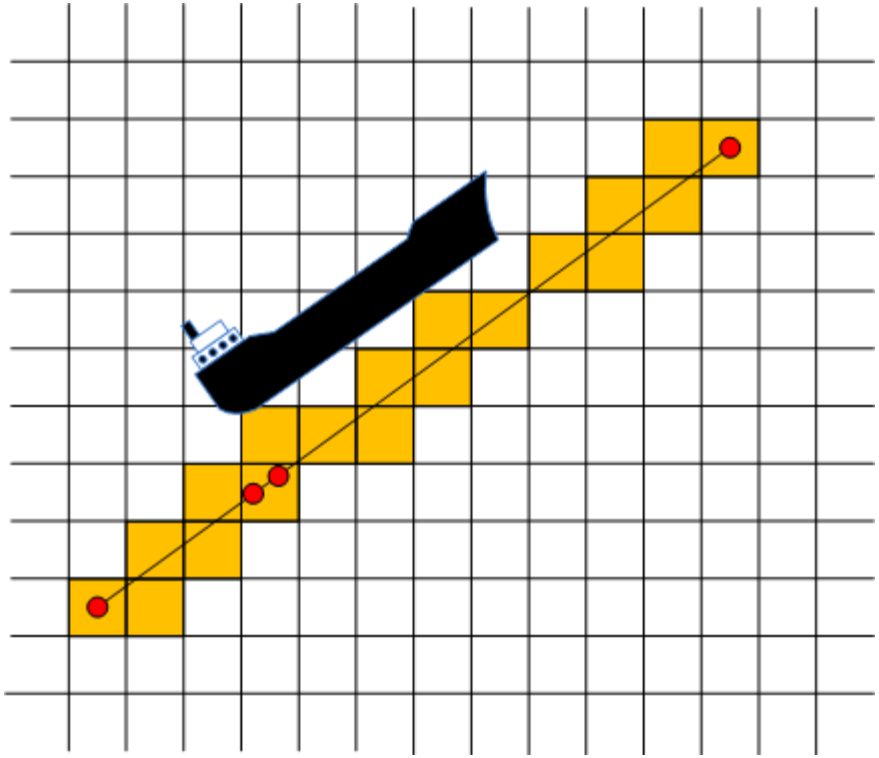
2. Traffic density



Each cell only ”hit” once and interpolationcis used

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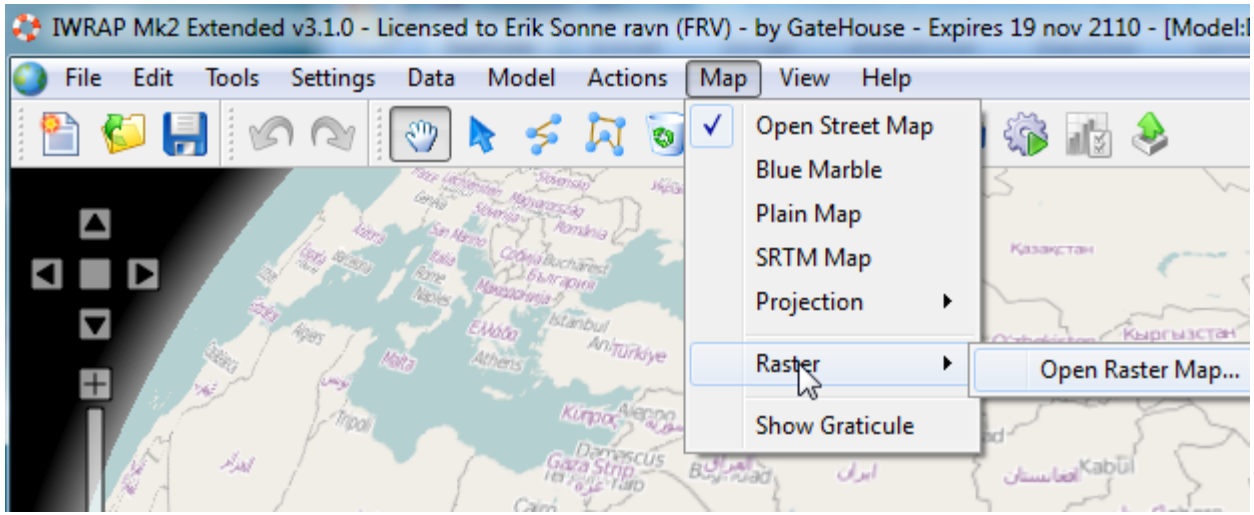
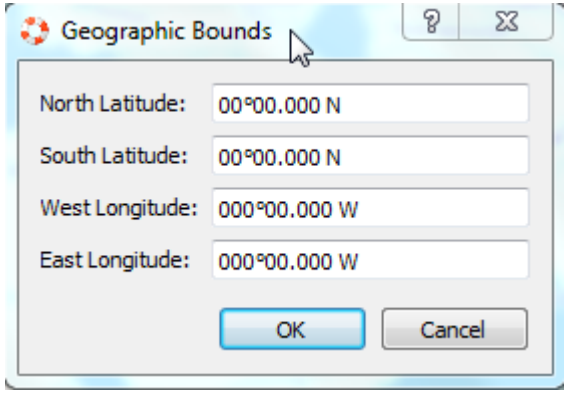
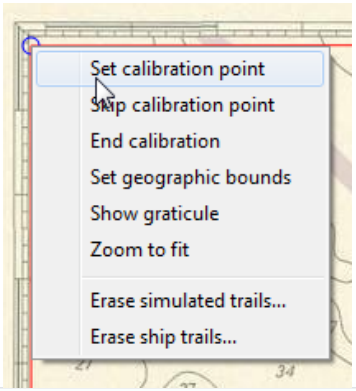
3. Overlay of raster charts







Use right click

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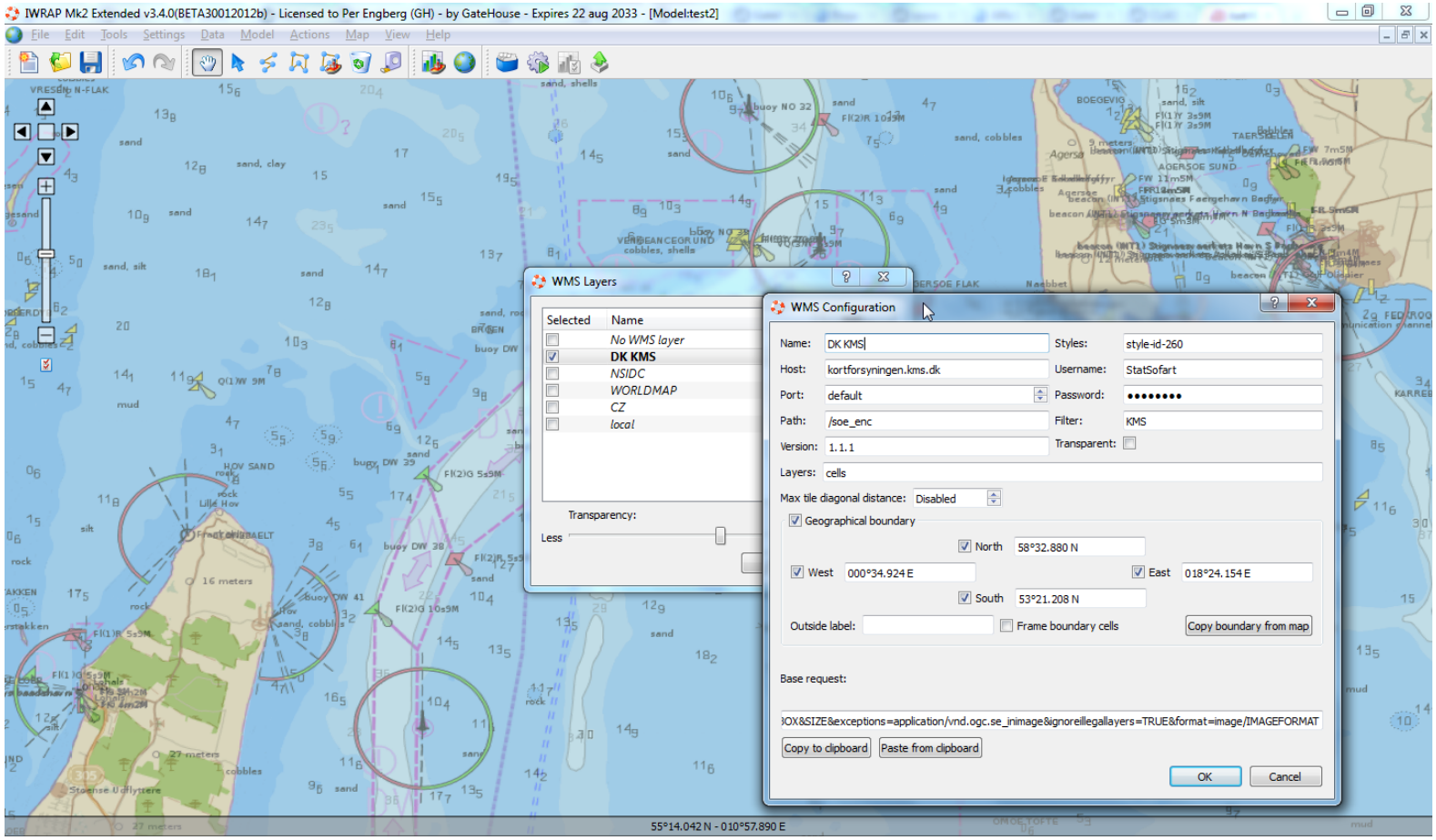
3. Overlay of Web Map Service layers



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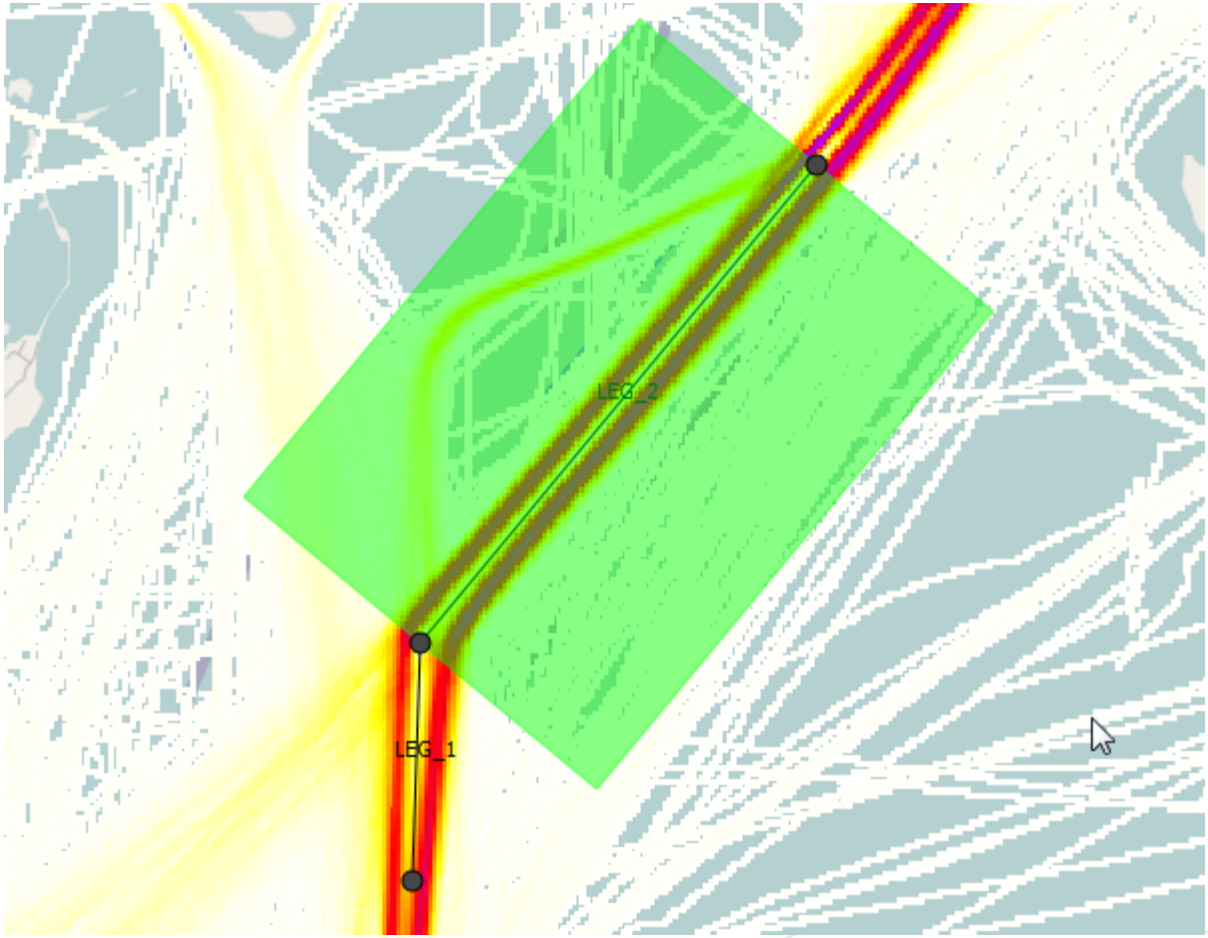
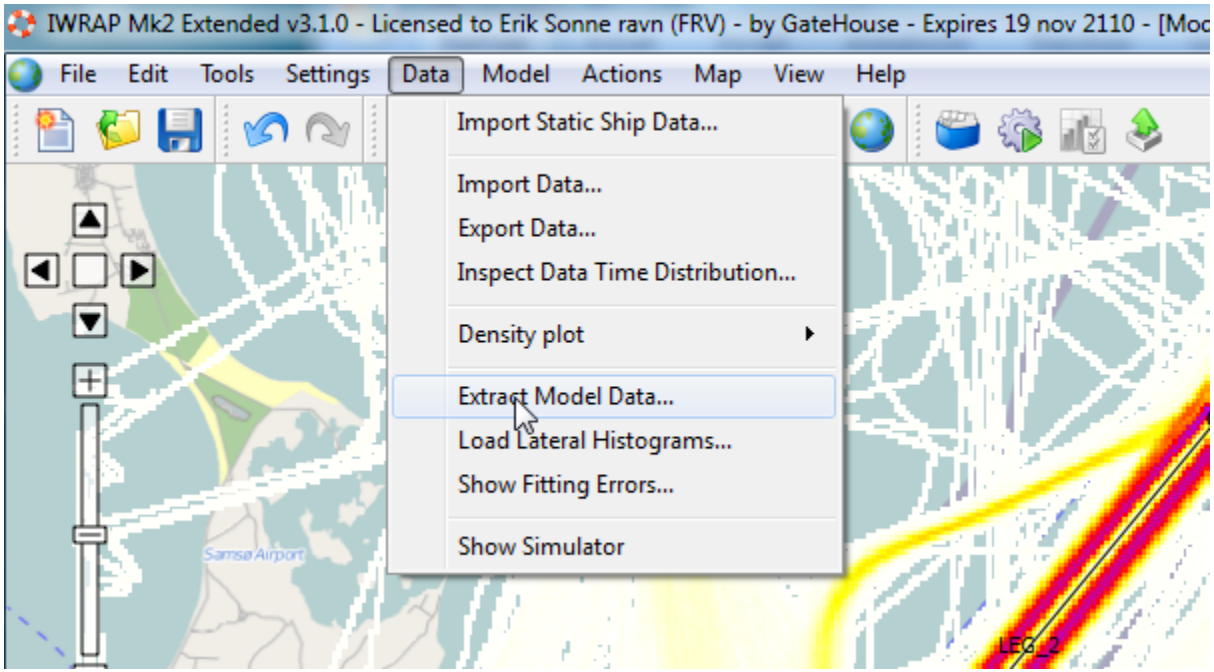
4. Create legs



Adjust the width of the legs

5. Extract model data



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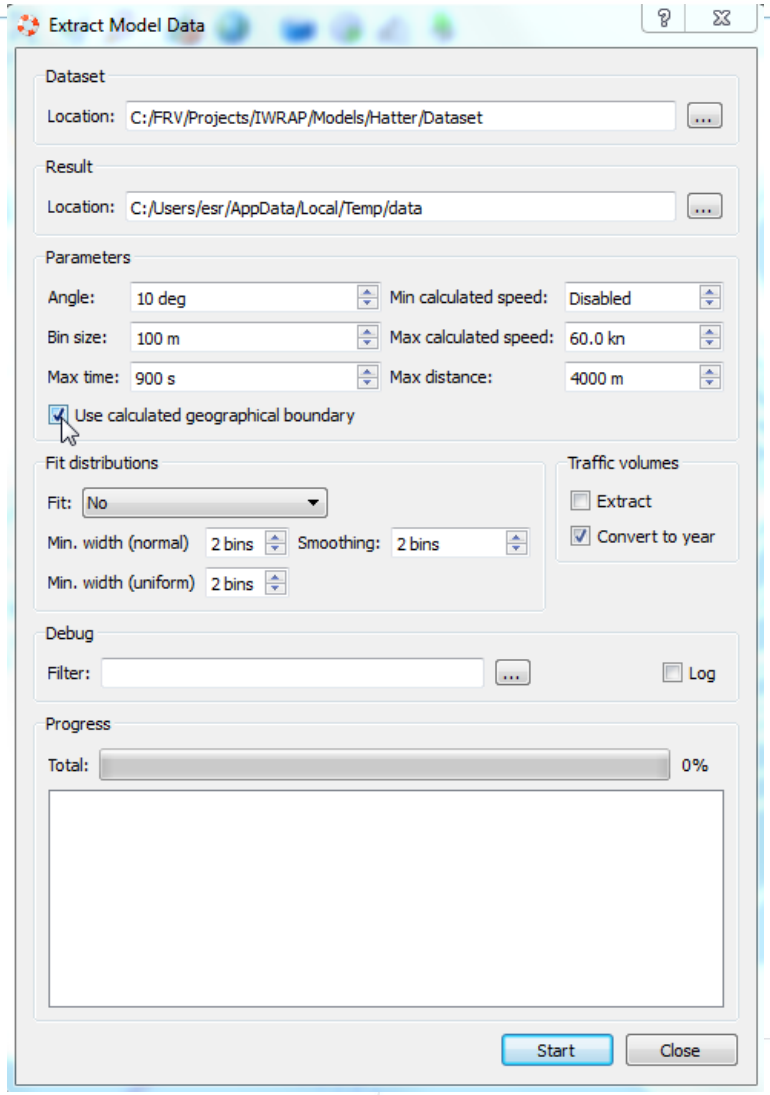
5. Extract model data

Wait with this only the legs have been located



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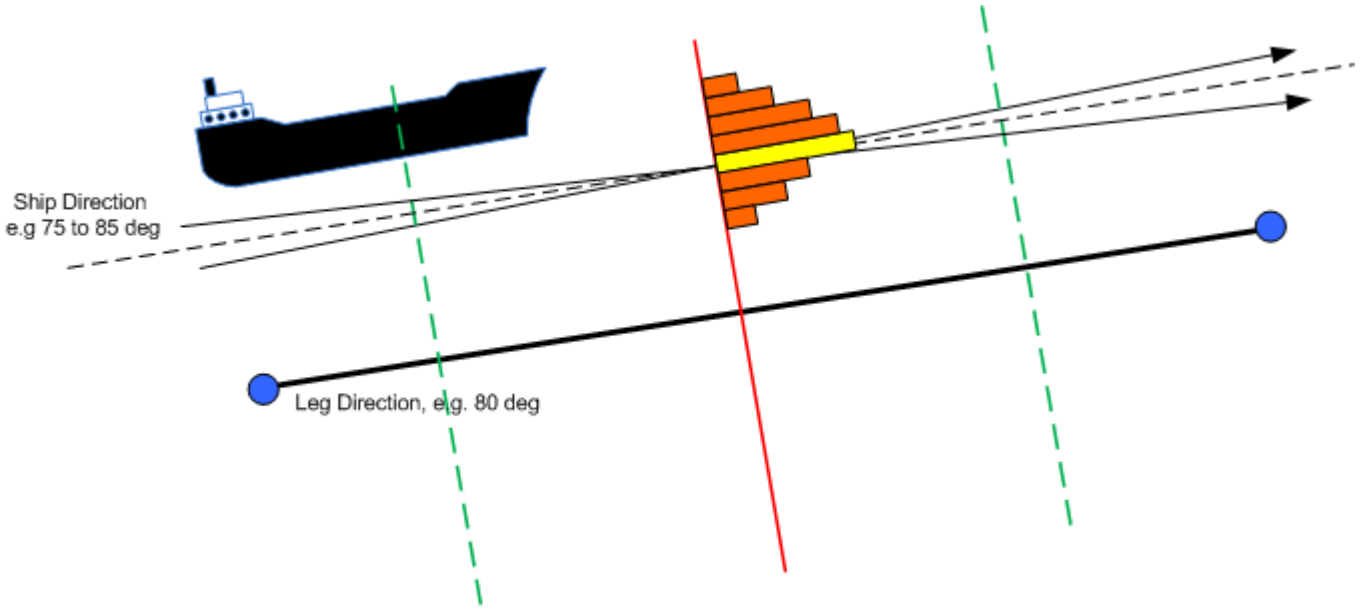
Histogram extraction algorithm



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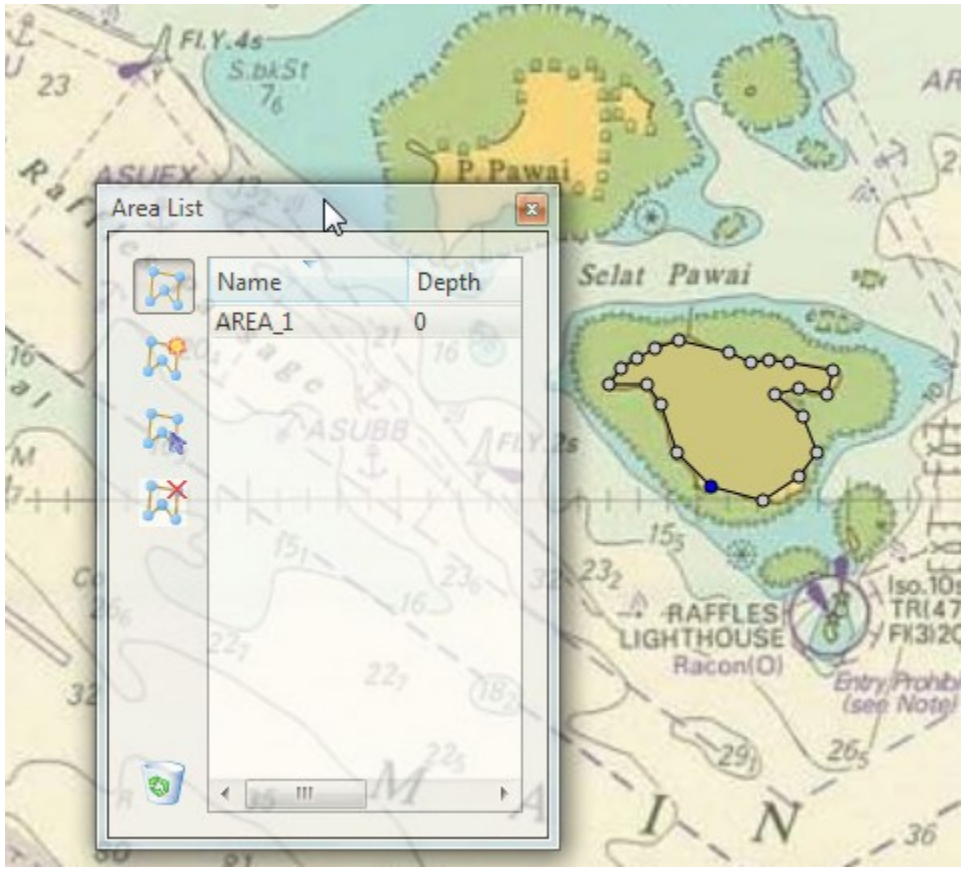
6. Depth curves

Depth curves can be imported or created using the polygon editor



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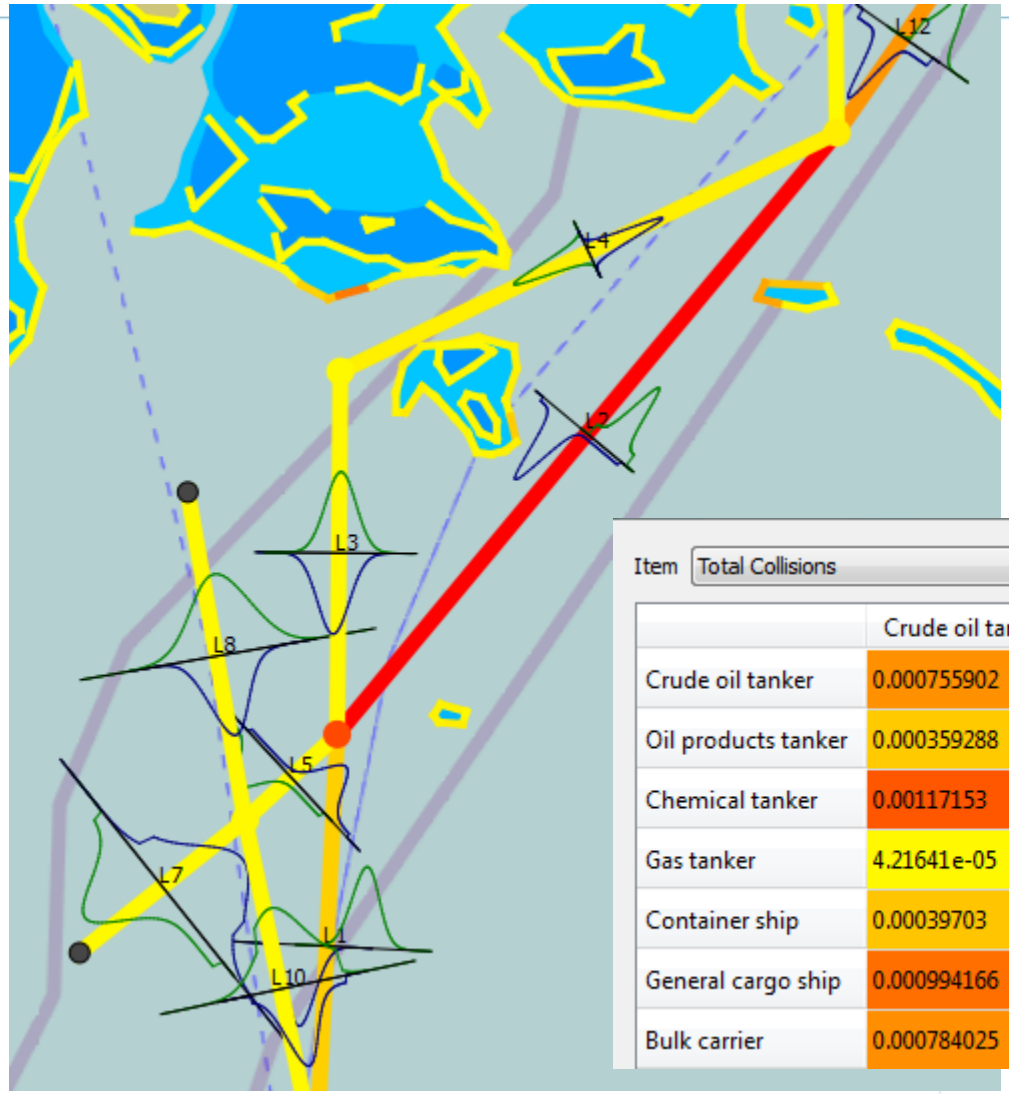
Run model and Inspect Results



	Hatter3	Hatter2
Powered Grounding	0.0993255	0.173198
Drifting Grounding	0.136376	0.127013
Total Groundings	0.235701	0.300211
Overtaking	0.0254244	0.0156494
HeadOn	0.00501114	0.00710918
Crossing	0.0046906	0.00384203
Merging	0.00566171	0.00239514
Bend	0.023018	0.0164033
Area	6.25829e-07	3.76635e-07
Total Collisions	0.0638065	0.0453994

Item: Total Collisions

Striking / Struck

	Crude oil tanker	Oil products tanke	Chemical tanker	Gas tanker	Container sh
Crude oil tanker	0.000755902	0.000326592	0.000658663	3.7102e-05	0.000559216
Oil products tanker	0.000359288	0.000166267	0.000453952	2.39363e-05	0.000370792
Chemical tanker	0.00117153	0.000626526	0.00164856	0.000107483	0.00173098
Gas tanker	4.21641e-05	2.35578e-05	7.70011e-05	3.55511e-06	5.70441e-05
Container ship	0.00039703	0.000206595	0.000695889	2.89057e-05	0.000387504
General cargo ship	0.000994166	0.000544339	0.00172212	8.96641e-05	0.00134074
Bulk carrier	0.000784025	0.000415358	0.00112078	6.95708e-05	0.00109947

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IWRAP Mk2
Misc info

June/July 2013

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Links

IALA:
http://iala-aism.org

IALA IWRAP Mk2 Wiki:
http://iala-aism.org/wiki/iwrap/index.php?title=Main_Page

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