IWRAP Mk2

Training session

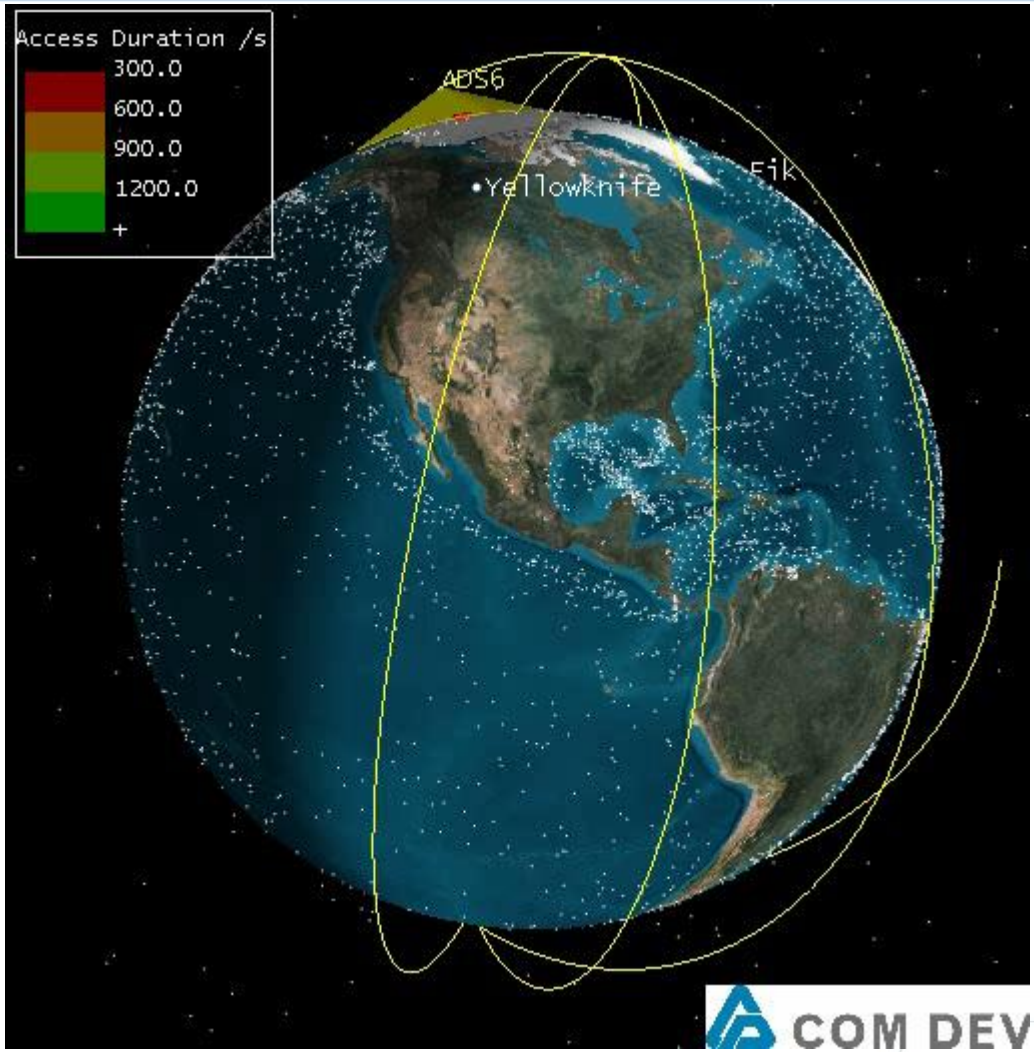
IALA

Per Christian Engberg

October 2017, Nørresundby

GateHouse

Space AIS data

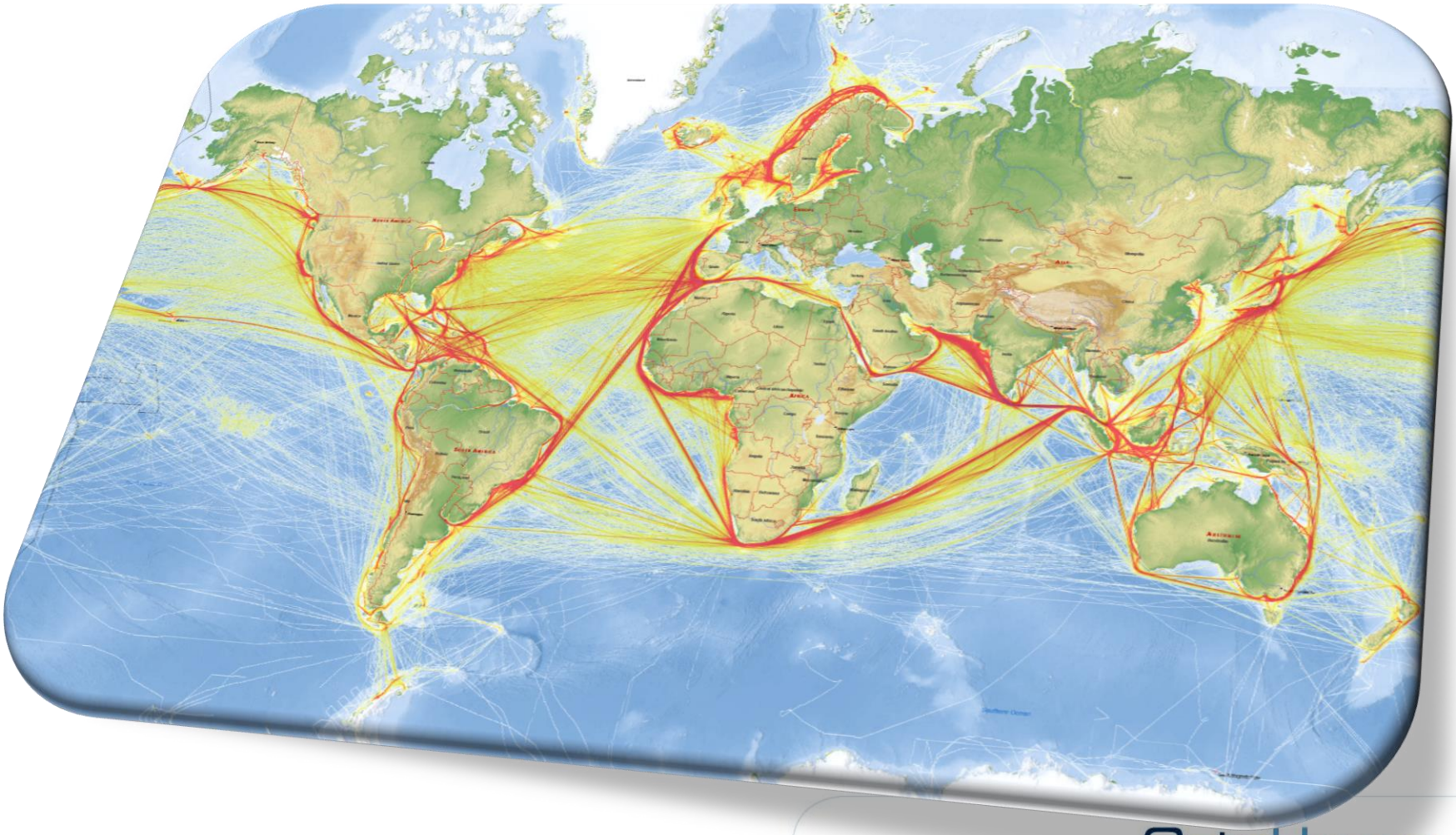


Provided in cooperation with our Canadian partner, exactEarth.

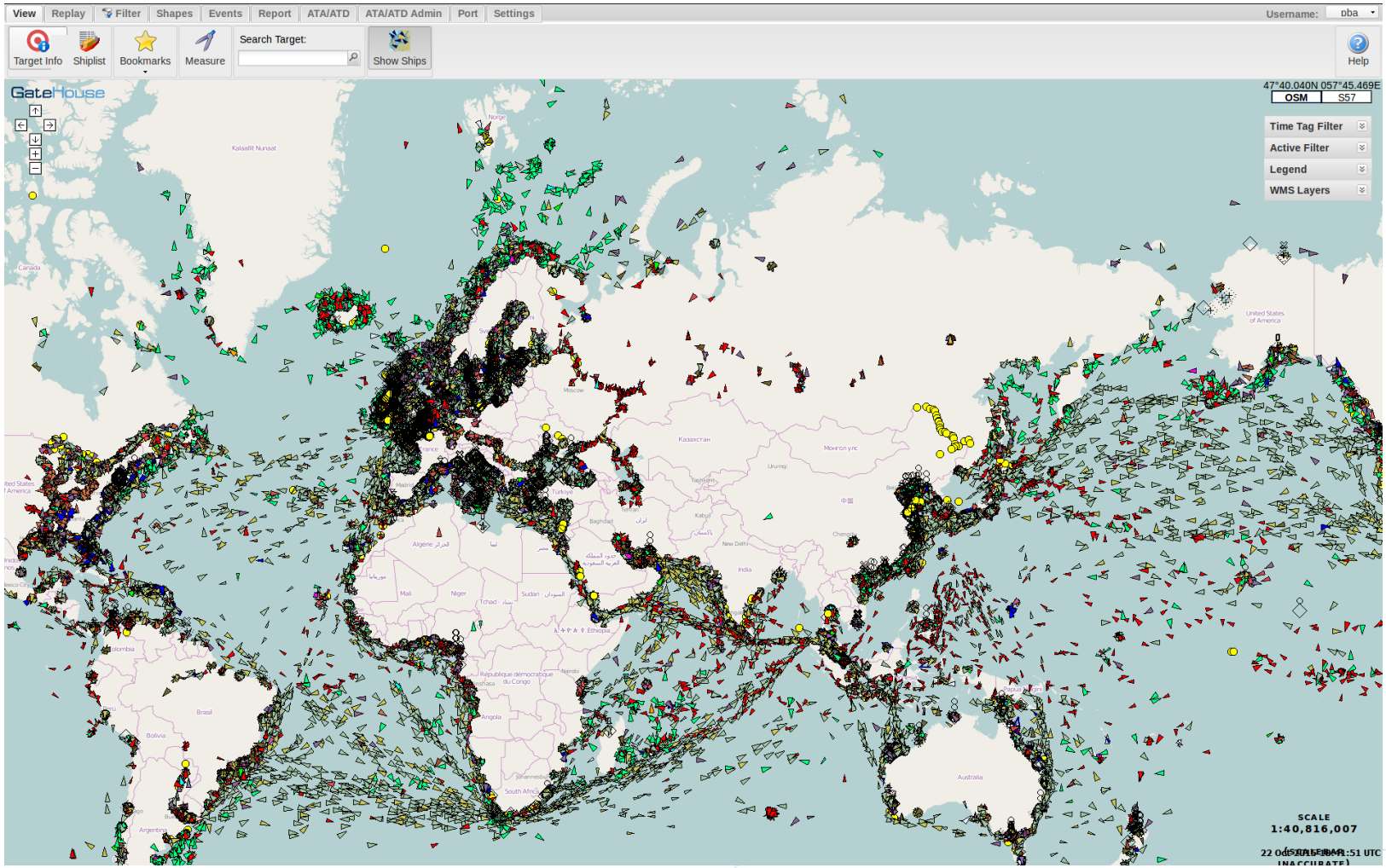
- 5 satellites in orbit
- 6 earth stations
- Less than 2 hour global revisit

GateHouse

World wide coverage



World wide coverage (>100.000 vessels)

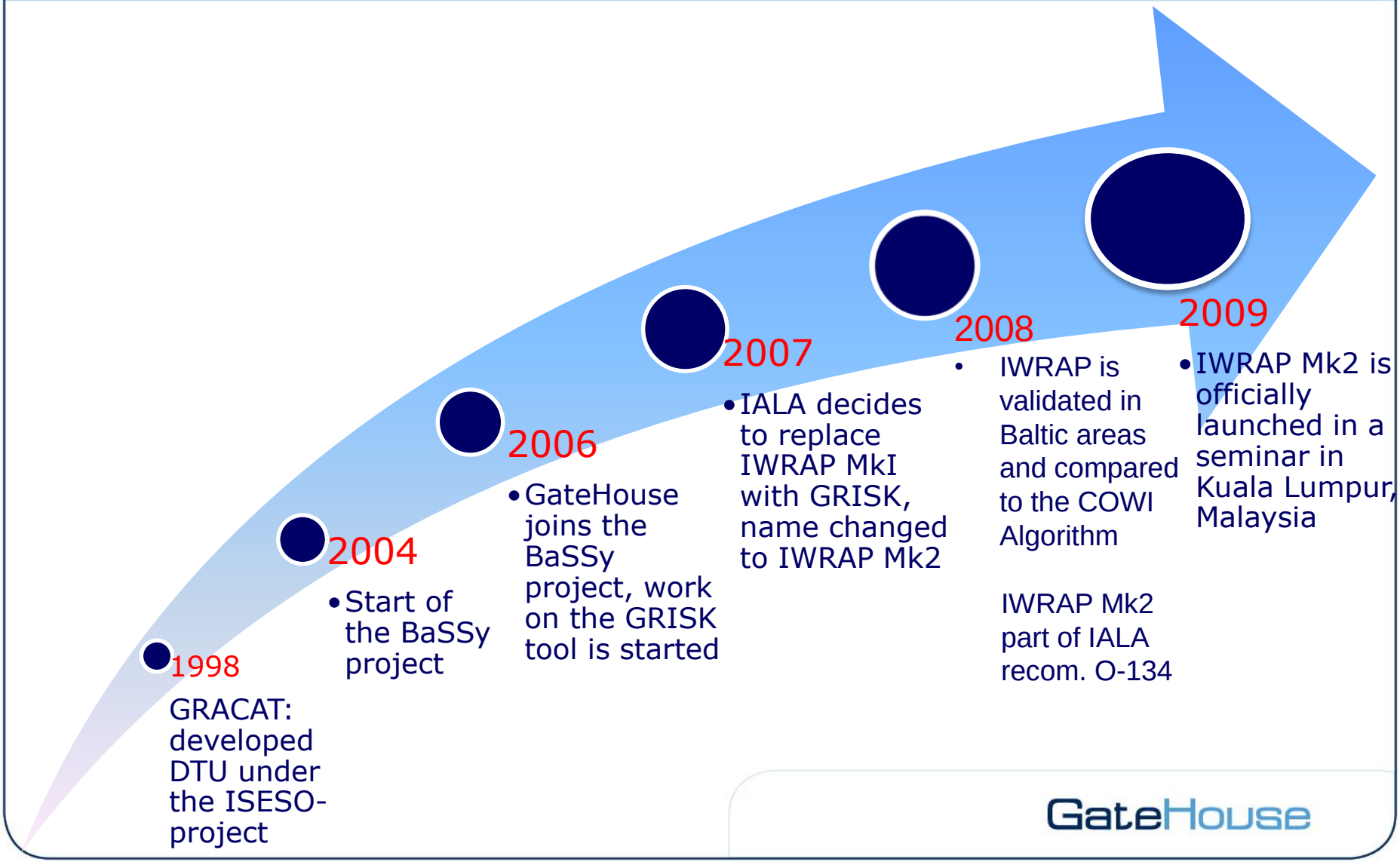


GateHouse

IWRAP Mk2
Background

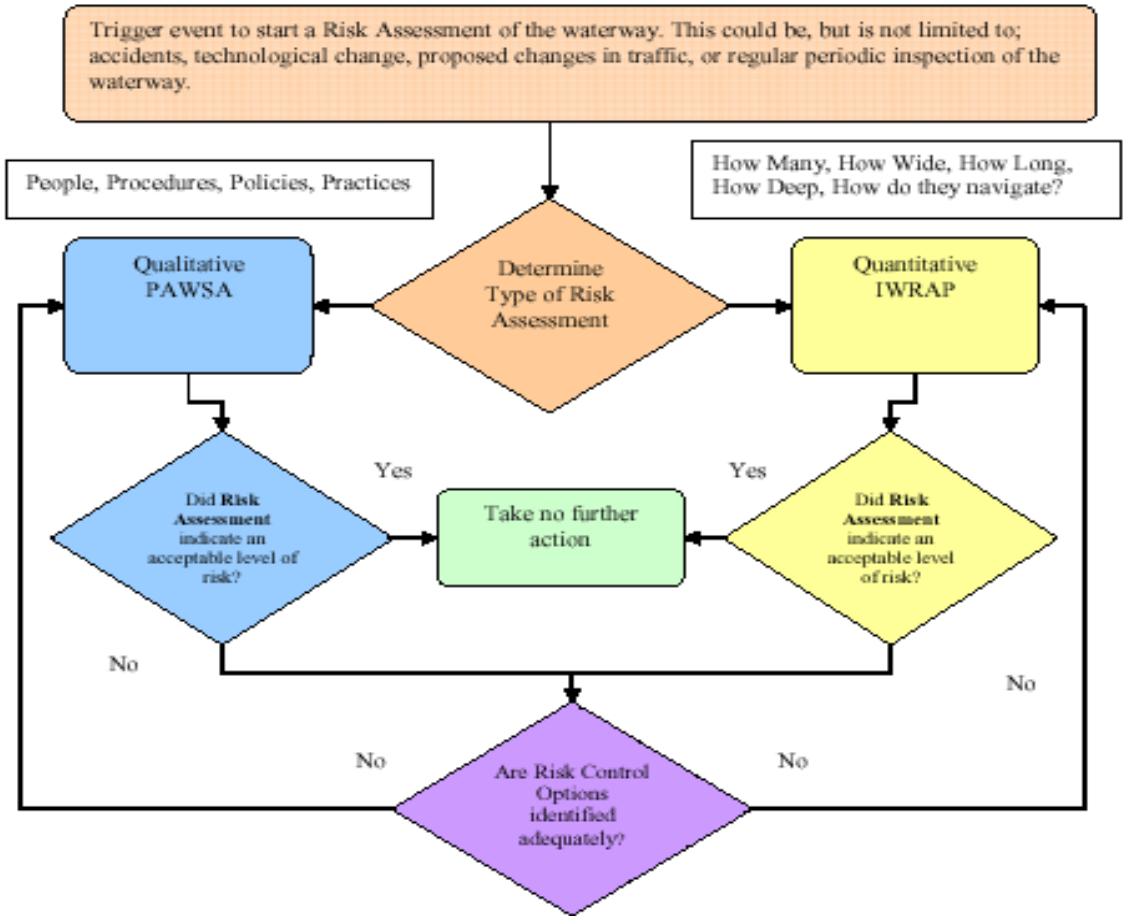
GateHouse

History of the IWRAP Mk2 tool…



GateHouse

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



GateHouse

The IALA Risk Management Tool Steering Group

DK -	Omar Frits Eriksson	(Chairman, dean of the IALA WWA)
	Michael Skov	(Head of DMA)
	Erik Sonne Ravn	(Analyst)
	Per Engberg	(Developer ++)
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, former dean of the IALA WWA)
US	Burt Lahn	(Analyst, PAWSA expert, USCG)
AUS	Mahesh Almchandani	(Analyst, AMSA)
CH	Roger Gao	(Professor)

GateHouse

IWRAP Mk2 Freemium license model

Basic version free to use for all IALA members

Commercial version using AIS

Standard License (IALA members)
Price per user for a one year license: 3500€
Following years: 2800€

Standard License (non-IALA members)
Price per user for a one year license: 6000€
Following years: 4500€

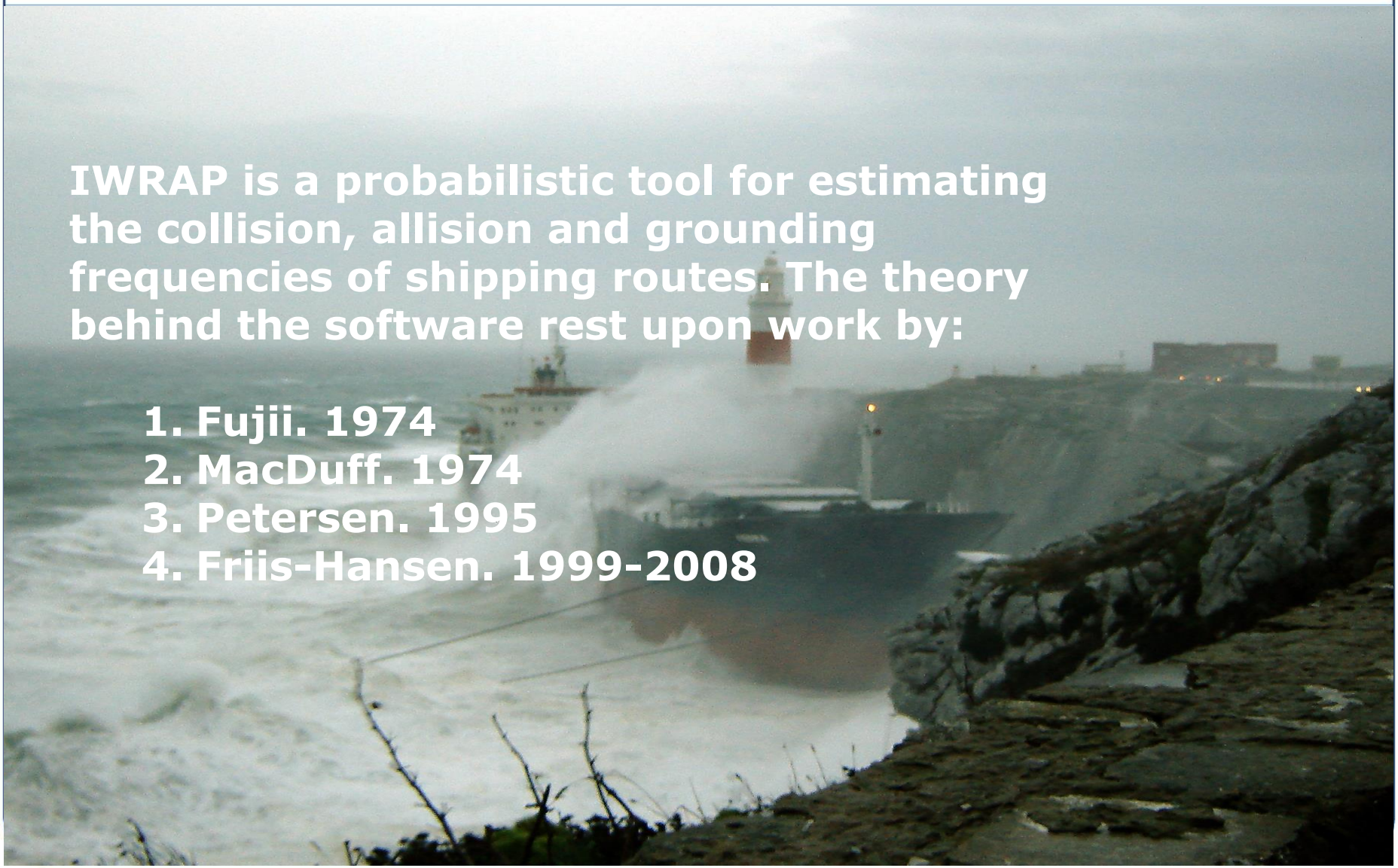
Educational Institution License (Educational use only)
Price per user for a one year license: 2900€
Following years: 2400€

GateHouse

IWRAP Mk2
Theory

GateHouse

Theoretical background



IWRAP is a probabilistic tool for estimating the collision, allision 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 Factor x Geometrical Frequency

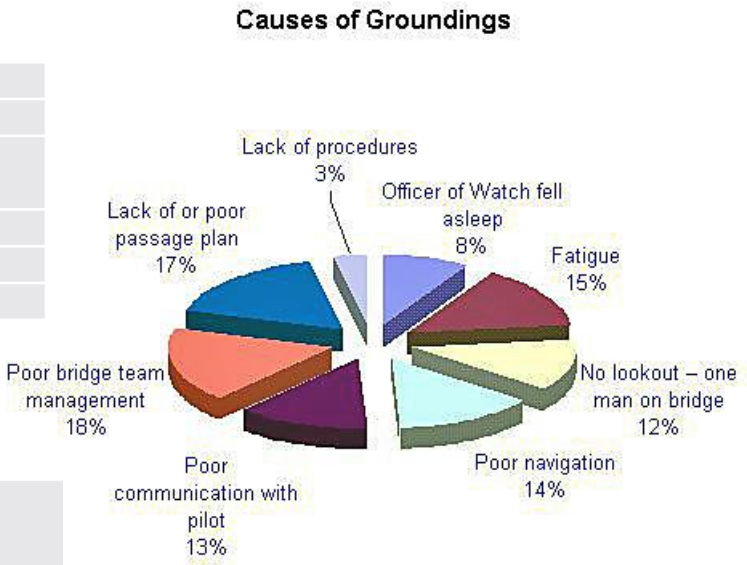
What may affect Pc

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

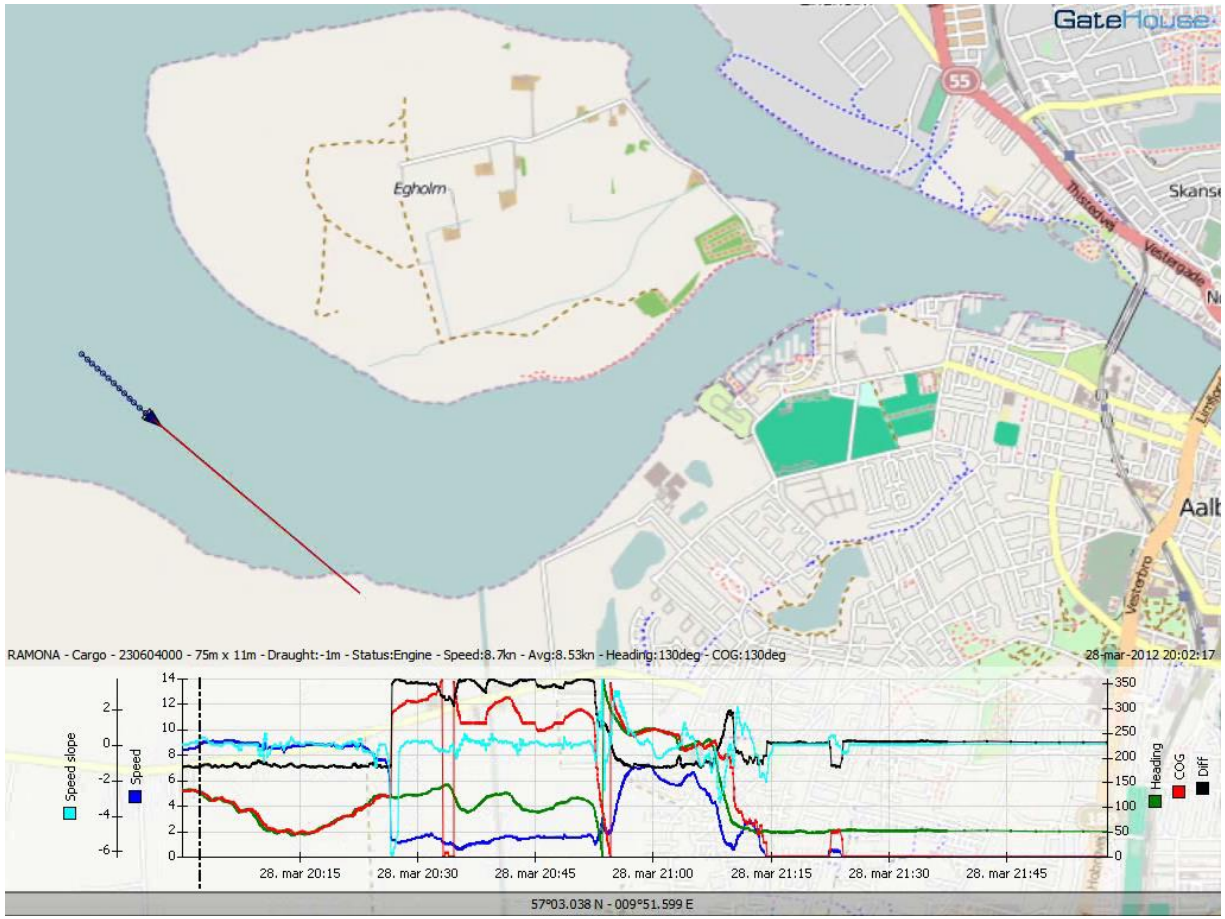
GateHouse

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

E.g. 3 Accidents in <4 years

GateHouse

P_C Example…

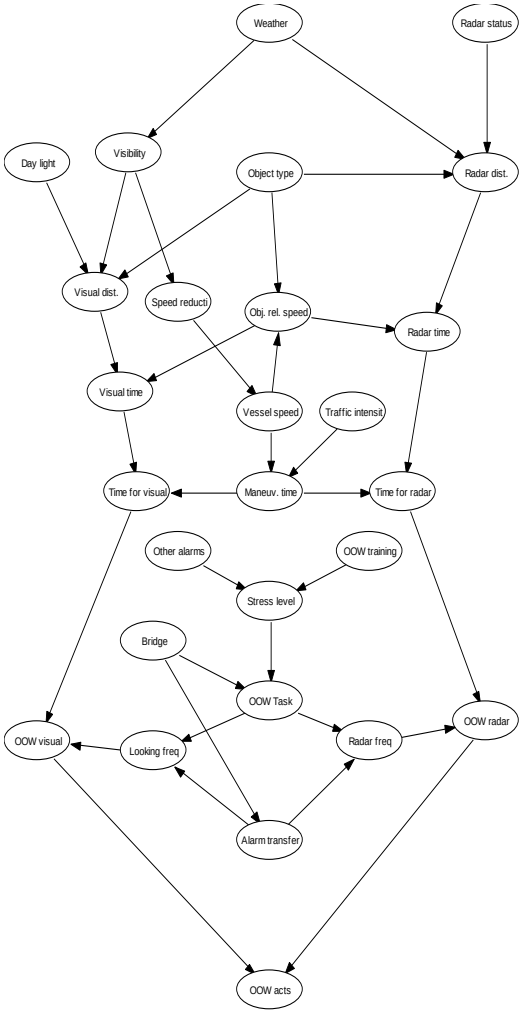


GateHouse

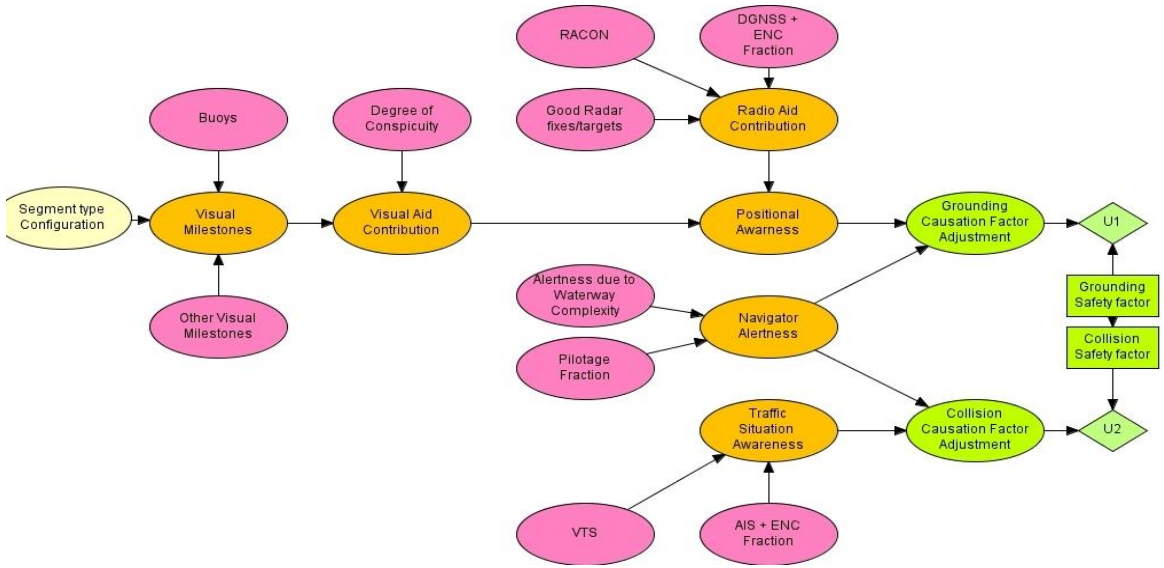
Consequence

GateHouse

Bayesian Network for Causation Factor



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



GateHouse

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]

GateHouse

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**

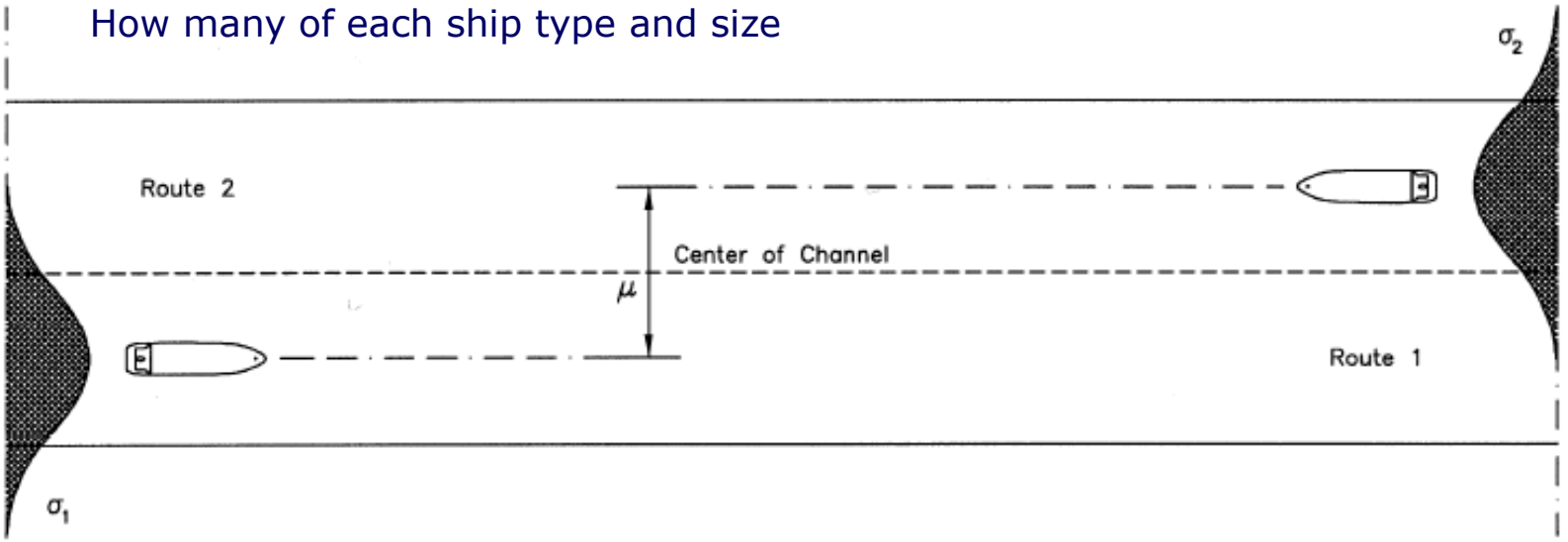
GateHouse

Modelling of collisions, e.g. Head-on

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

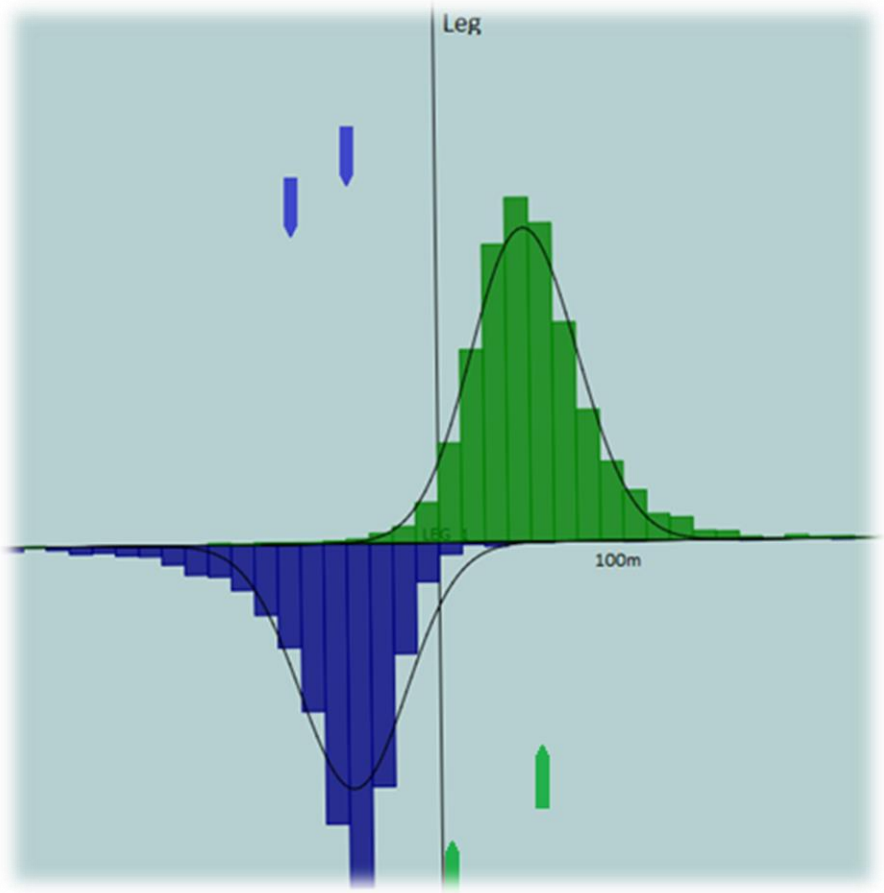
Calculate the geometrical frequency N_G using:

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



GateHouse

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.

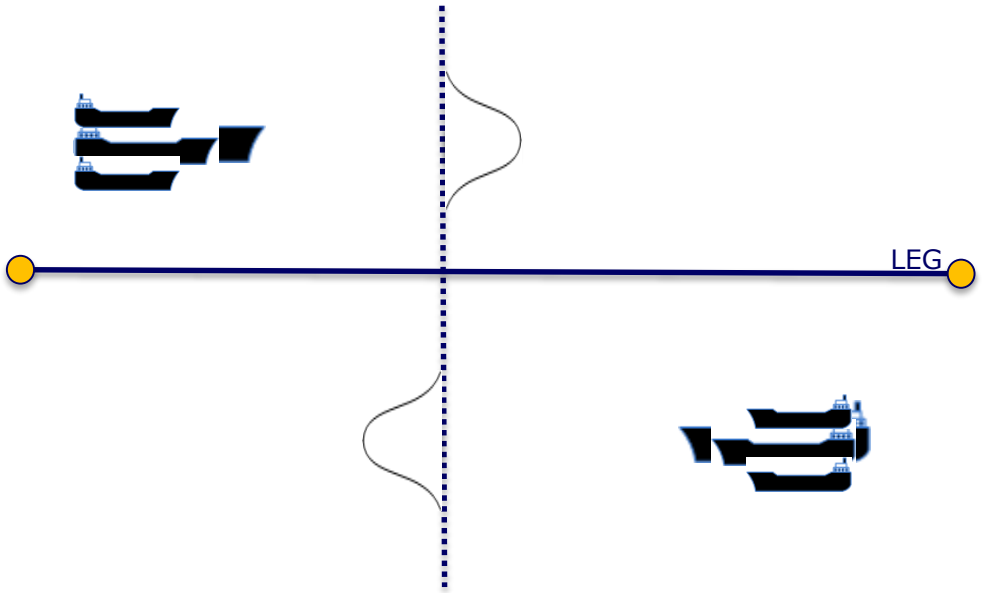
Normal distribution (μ=380 m, σ2=230 m)

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

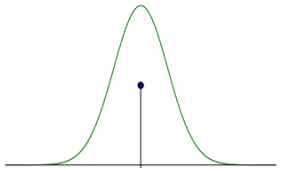
The probability that it will be at x=380 m is:
P(x<330)=0.41; P(x<430)=0.59;
P(330<x<430)=0.18

Lateral Distributions…

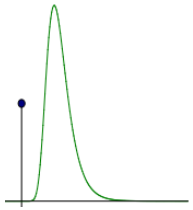


GateHouse

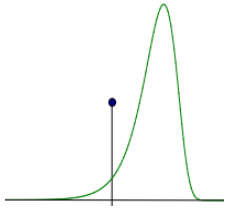
Distributions in IWRAP



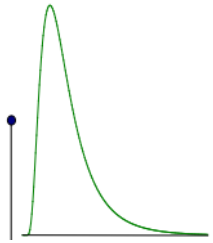
Normal distribution
(Mean, std. dev.)



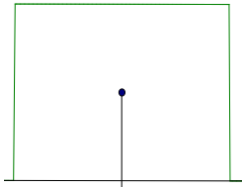
Gumbel maximum
(Mean, std. Dev.)



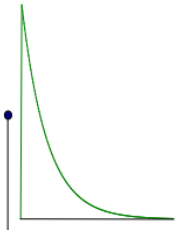
Gumbel minimum
(Mean, std. dev)



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

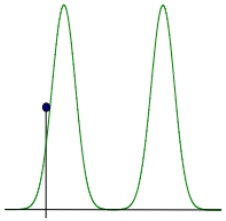


Uniform distribution
(lower-, upper bound)



Weibull
(Mean, std. dev, lower bound)

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



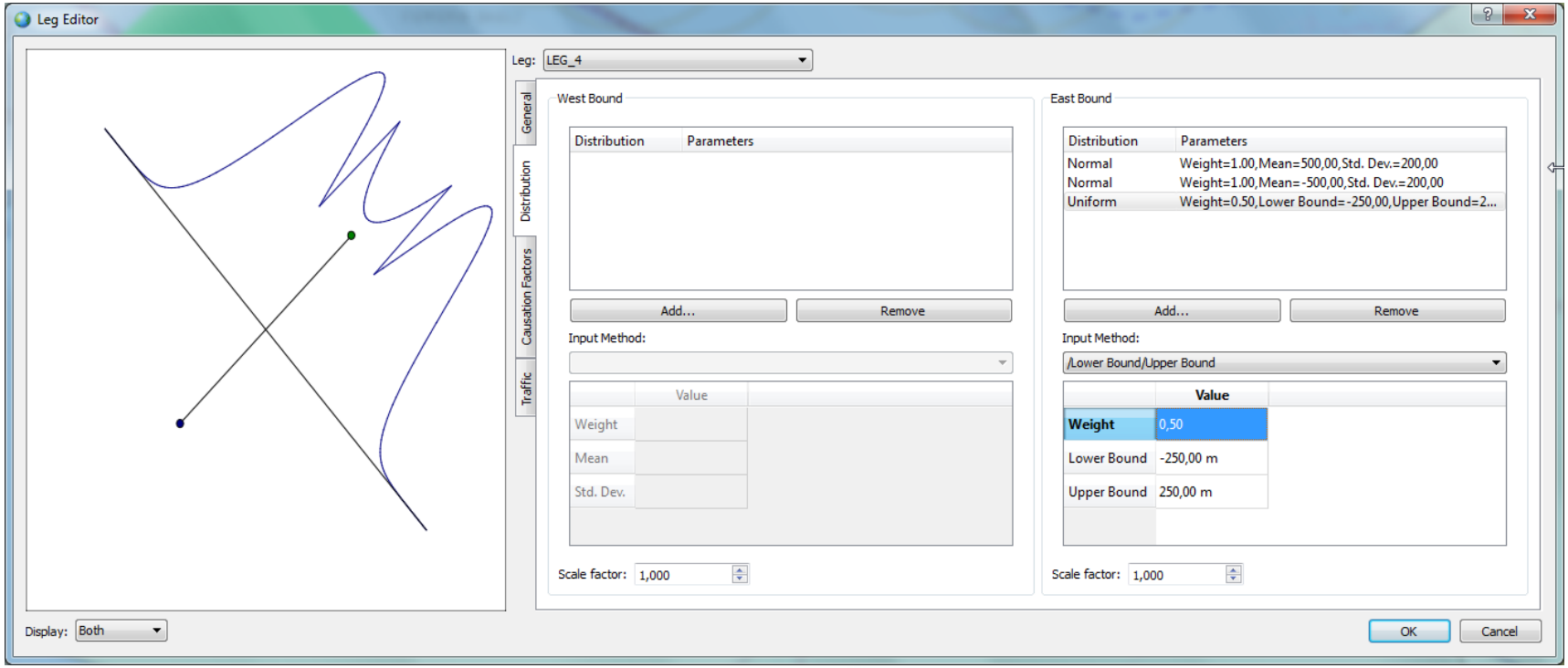
Any combination
Here 2 normal dist.

GateHouse

Mixed Distributions in IWRAP

Any number of any type of distribution can be mixed,

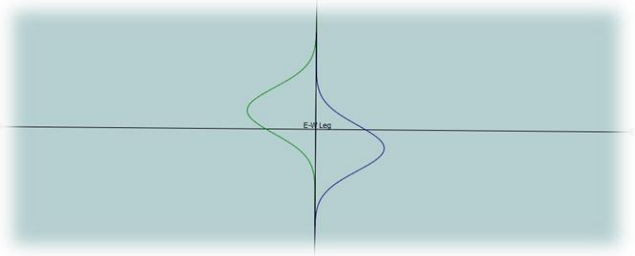
A combination of a number Normal and Uniform distributions is in most cases sufficient



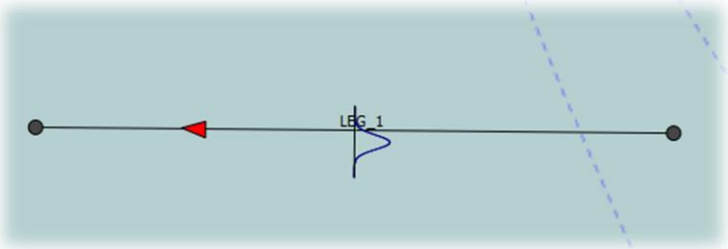
GateHouse

Collision modelling

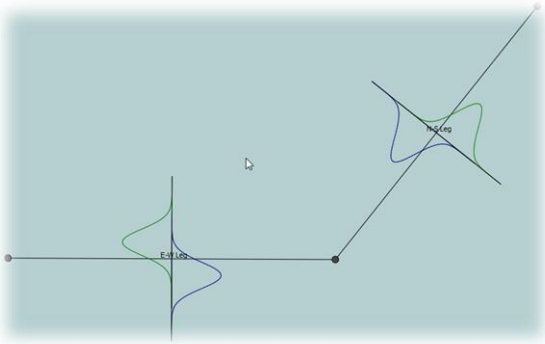
Head-on



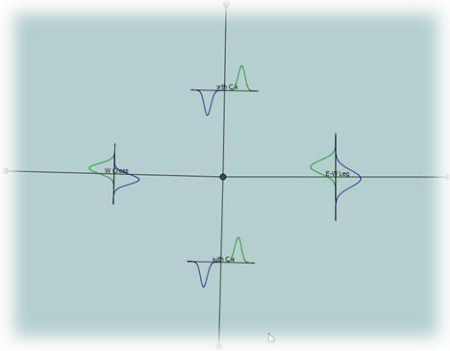
Overtaking



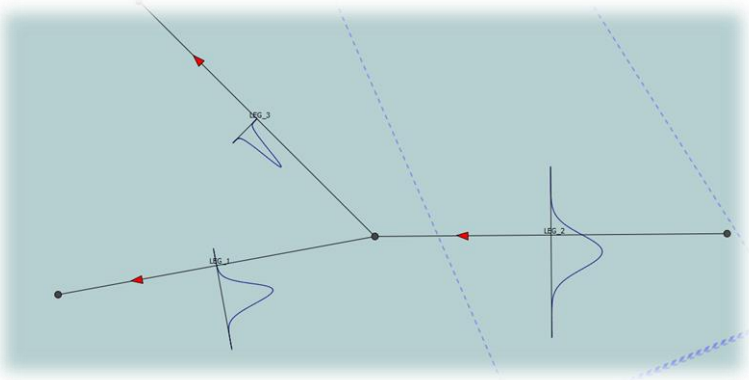
Bend



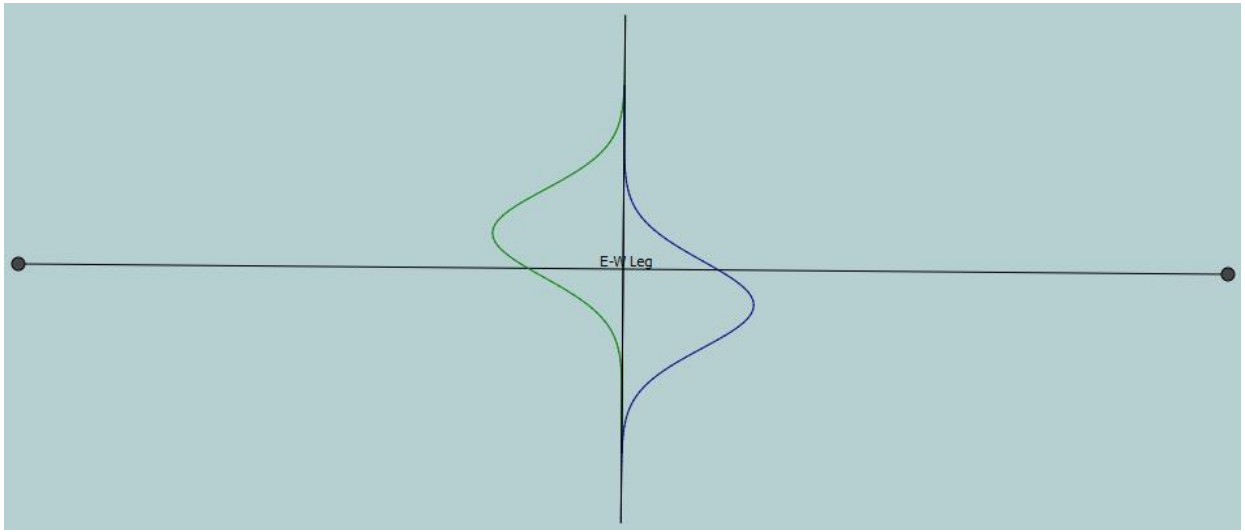
Crossing



Merging



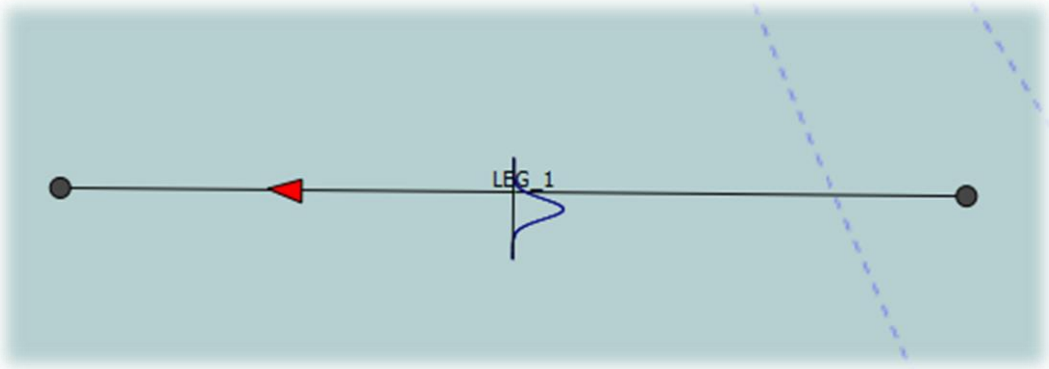
Test case A1: Head-on



Risk reducing measures:
-Separate traffic

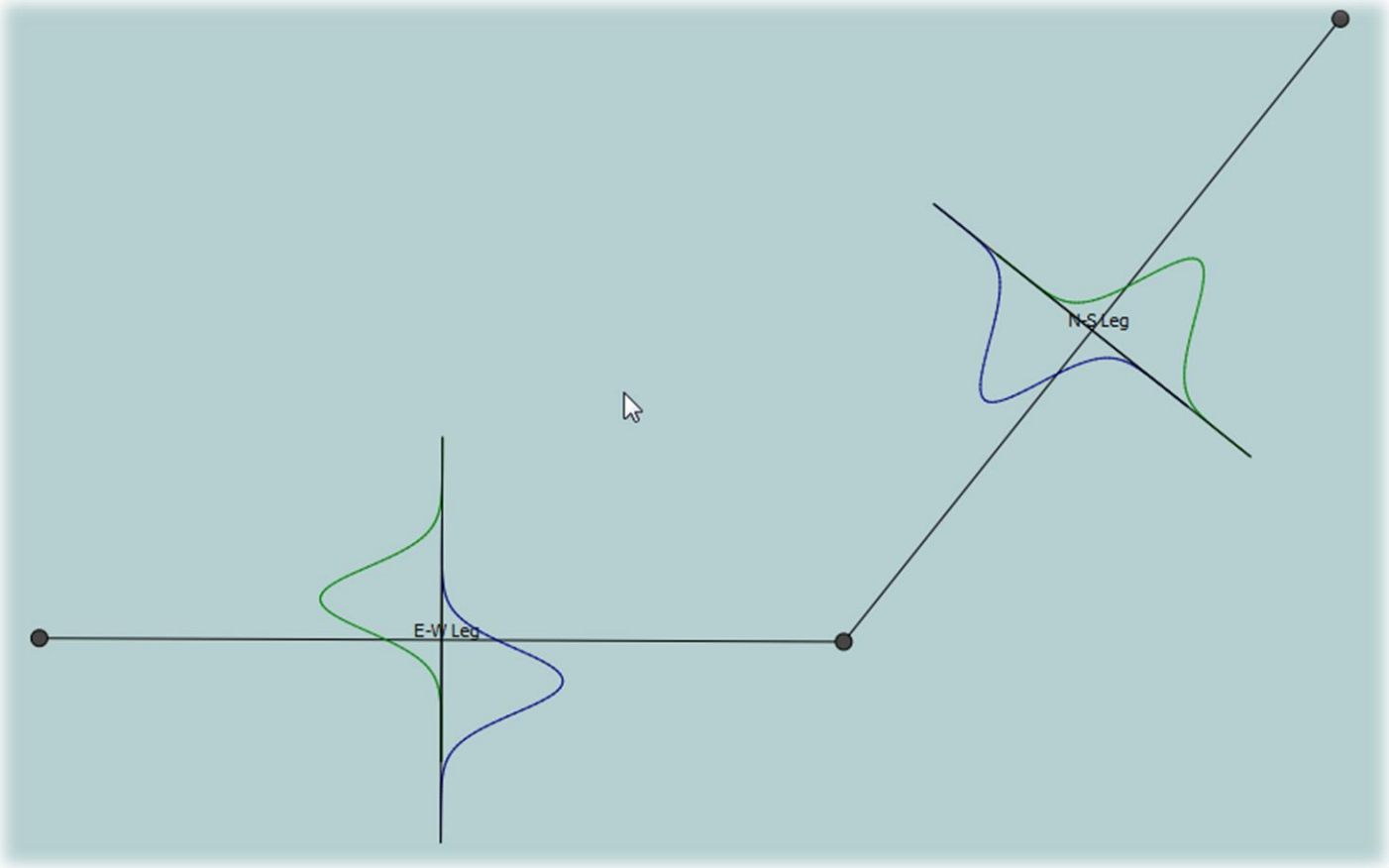
GateHouse

Test case A2: Overtaking



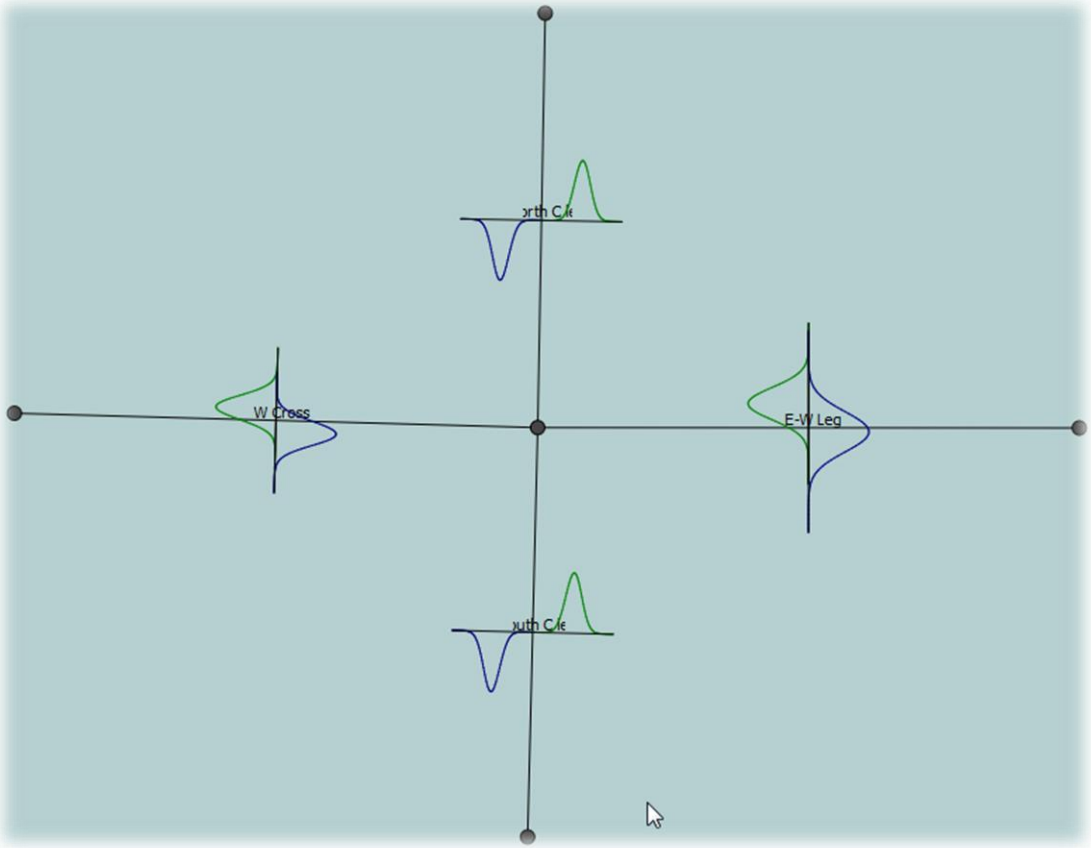
Add 2 different types with different mean speeds.
Look at Struck/Striking results…

Test case B: Bend collisions



GateHouse

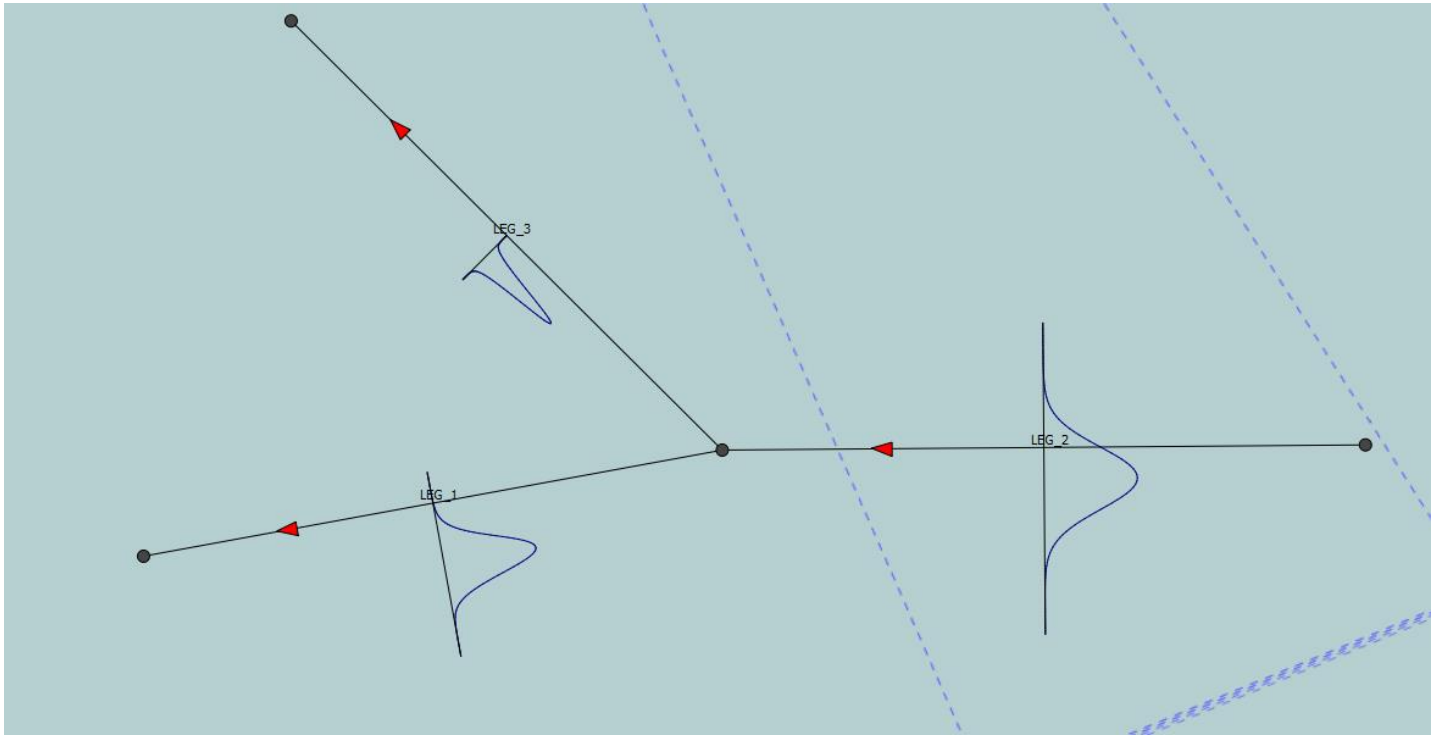
Test case C: Crossing collisions



Ensure only crossing! (adjust waypoint)

GateHouse

Test case D: Merging



GateHouse

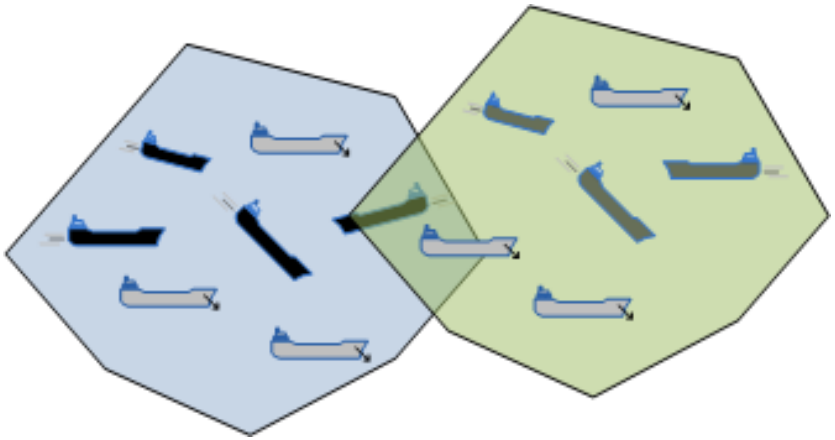

www.fraps.com
Apr 7, 2006 7:47:33 am
7 am
8 am
© 2010 Tele Atlas
Image © 2010 GeoContent
Image © 2010 COWI A/S, DDO
Fehmarn
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2009 Google
Imagery Dates: Mar 4, 2000 - Mar 5, 2006
lat 54.582889° lon 11.102563° elev 0 m
Eye alt 36.03 km

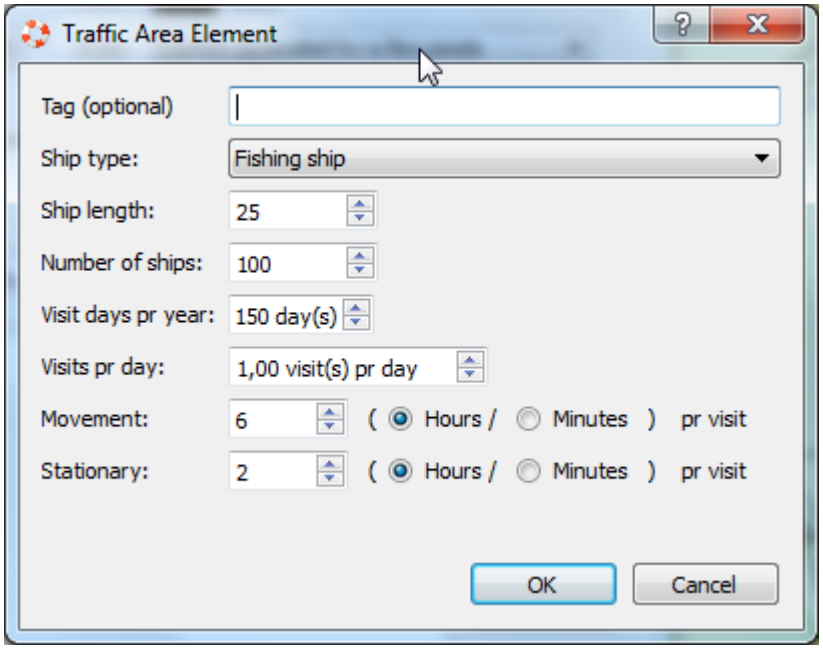
Area Collisions

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.

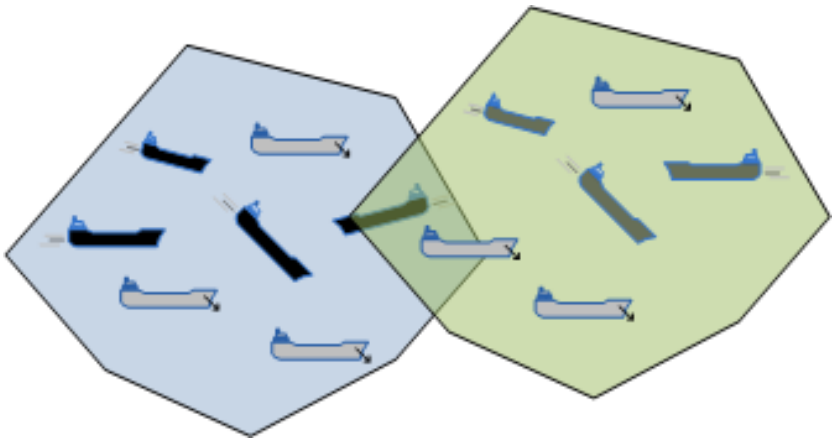


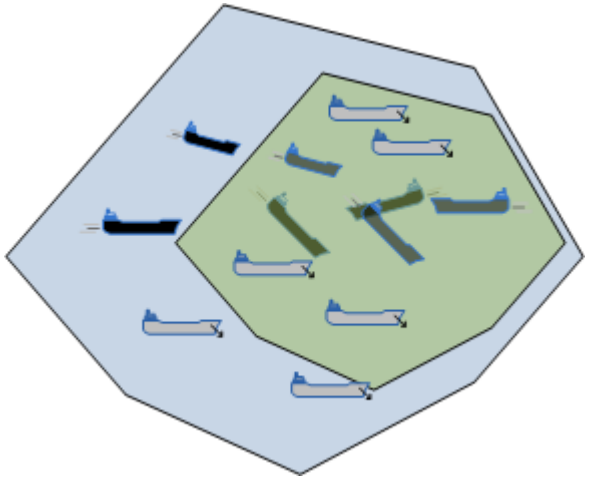


GateHouse

Area Collisions

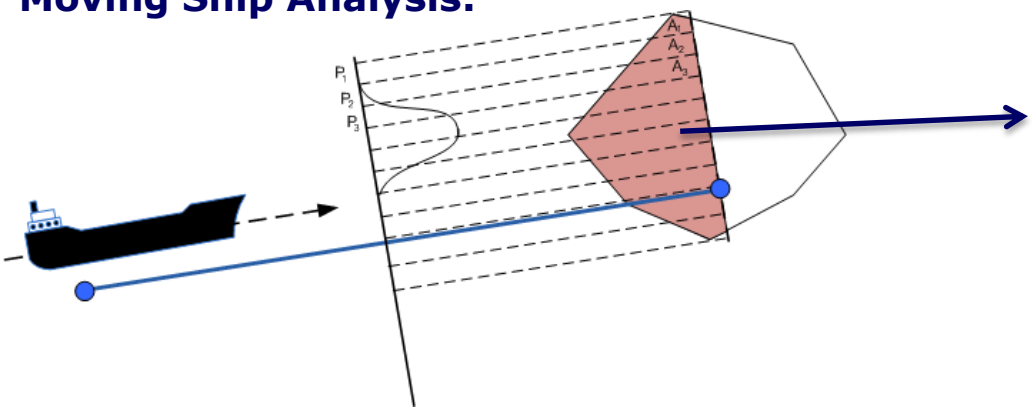
Areas may overlap, can be used to e.g. model different fishing level intensities.

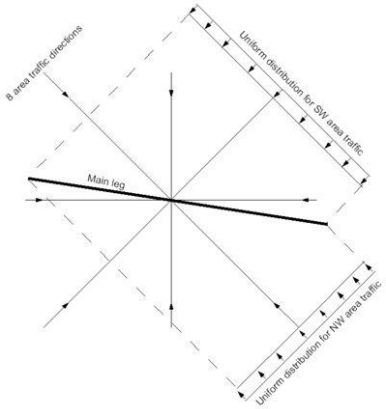




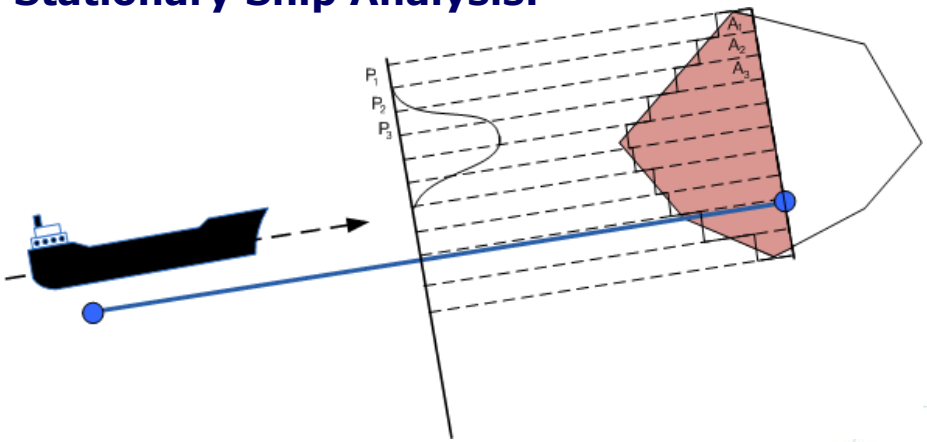
Area Collisions

Moving Ship Analysis:



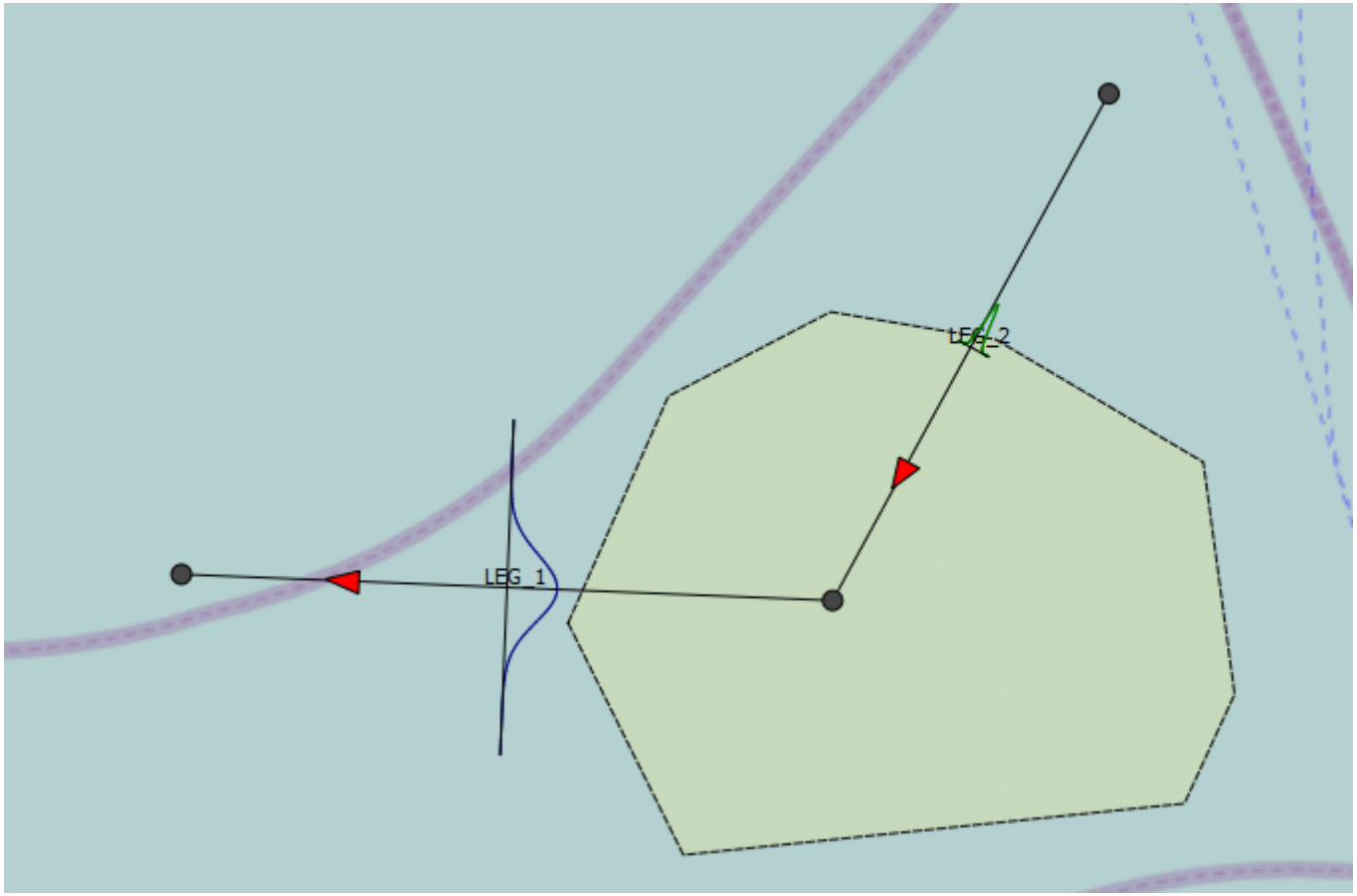


Stationary Ship Analysis:



GateHouse

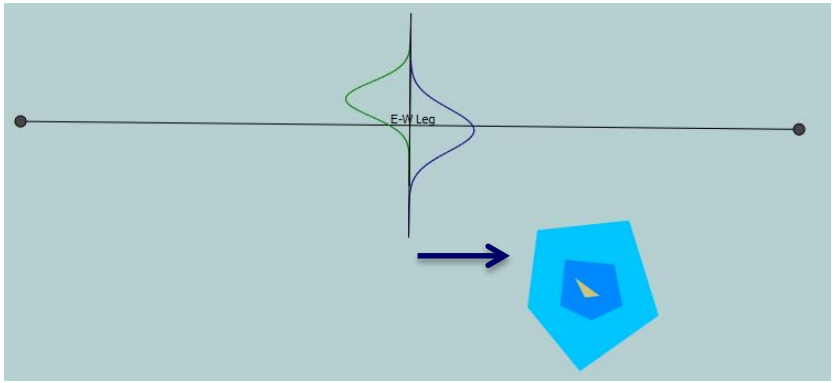
Test case G: Area collisions



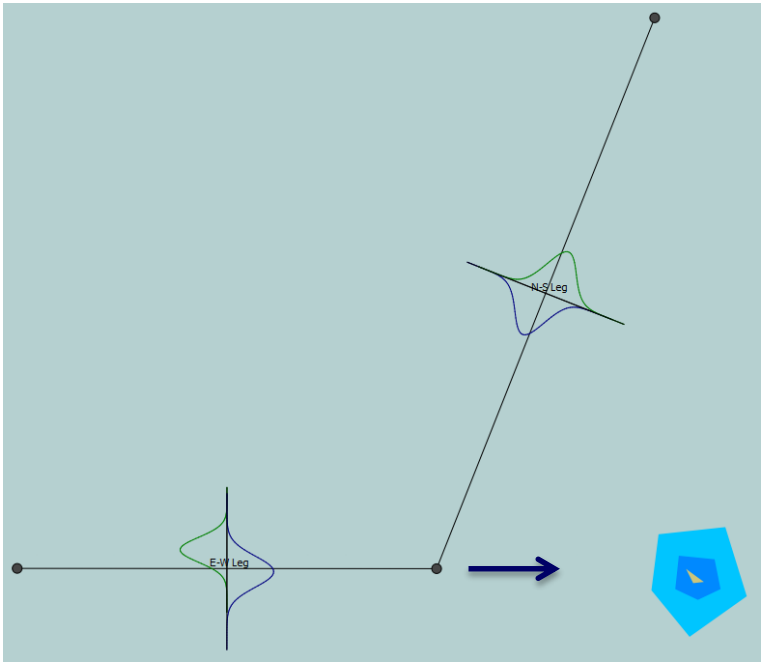
GateHouse

Powered Grounding Categories

Category I



Category II

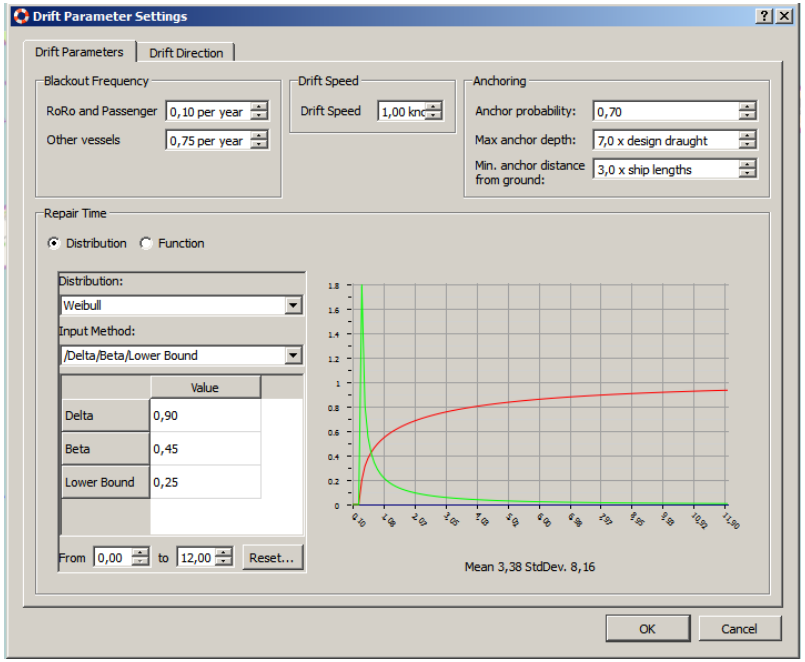


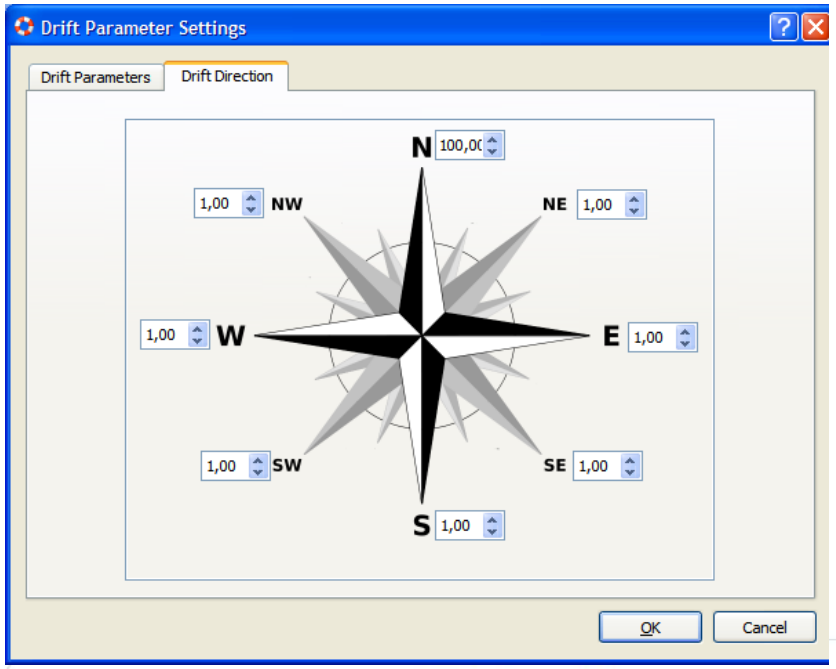
http://www.smp.no/nyheter/article9699729.ece

GateHouse

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. **It is possible to use an overall drift direction specification or to do it per leg.**
3. **The ”Repair time”, i.e. for how long time the vessel will drift.**





GateHouse

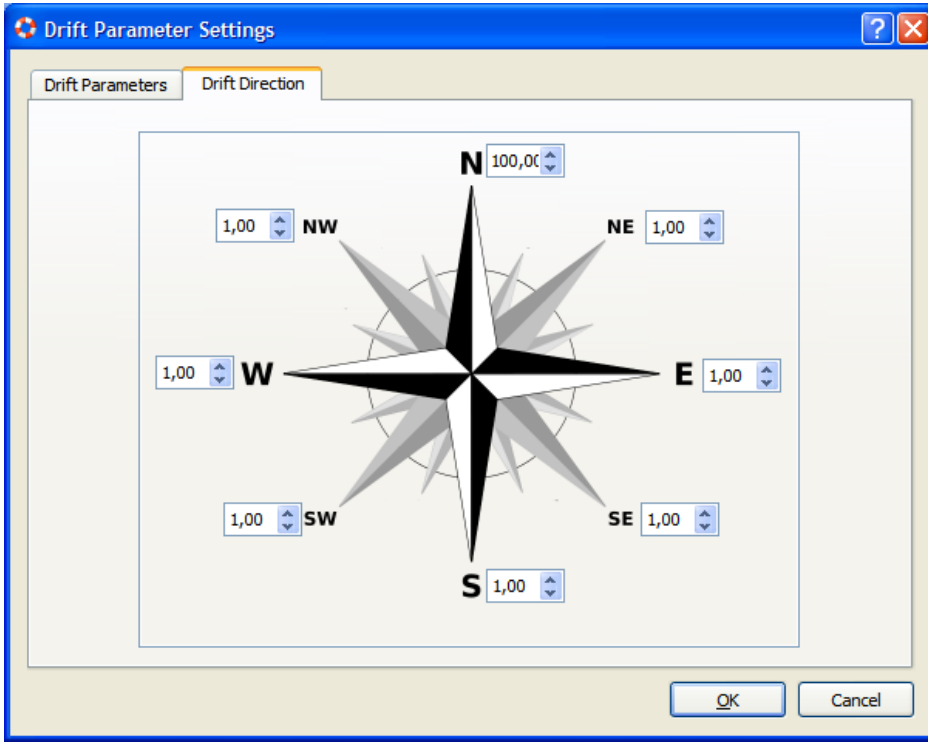
Drift Direction

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

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

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

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



GateHouse

Drifting Grounding: Repair Time

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

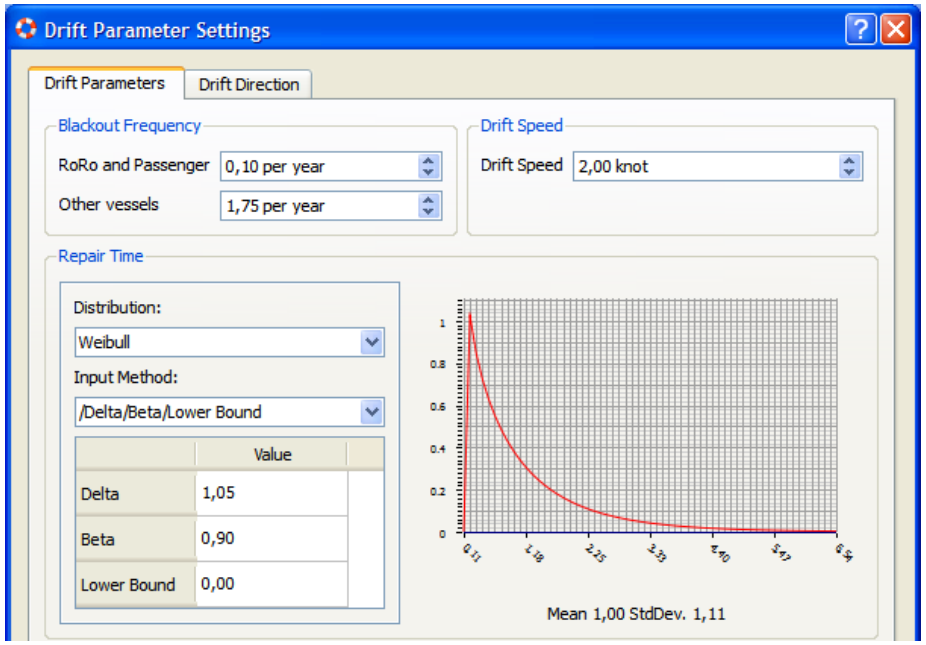
$$F_{\text{no repair}}(t) = \exp\left(-a\,t^{b}\right)$$

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.



GateHouse

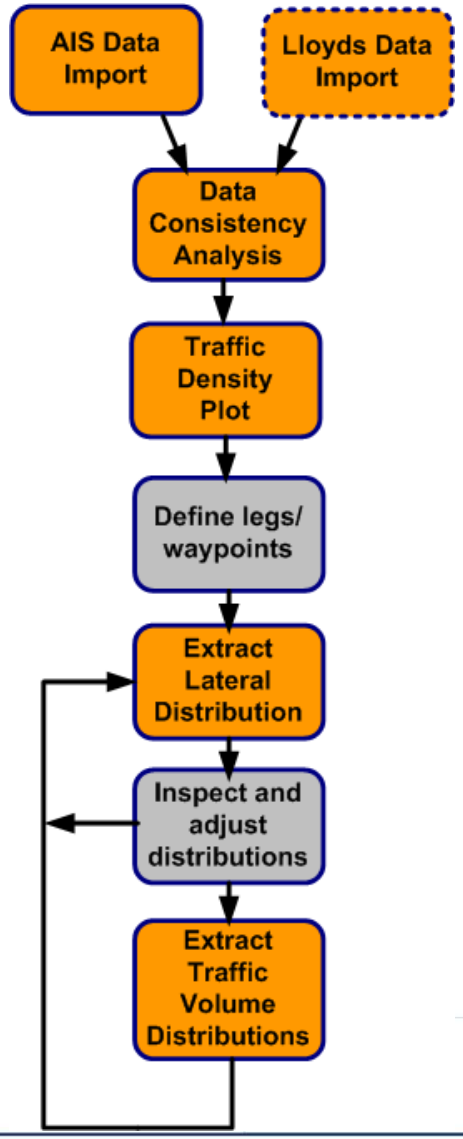
IWRAP Mk2
Using AIS Data

GateHouse

The Basics

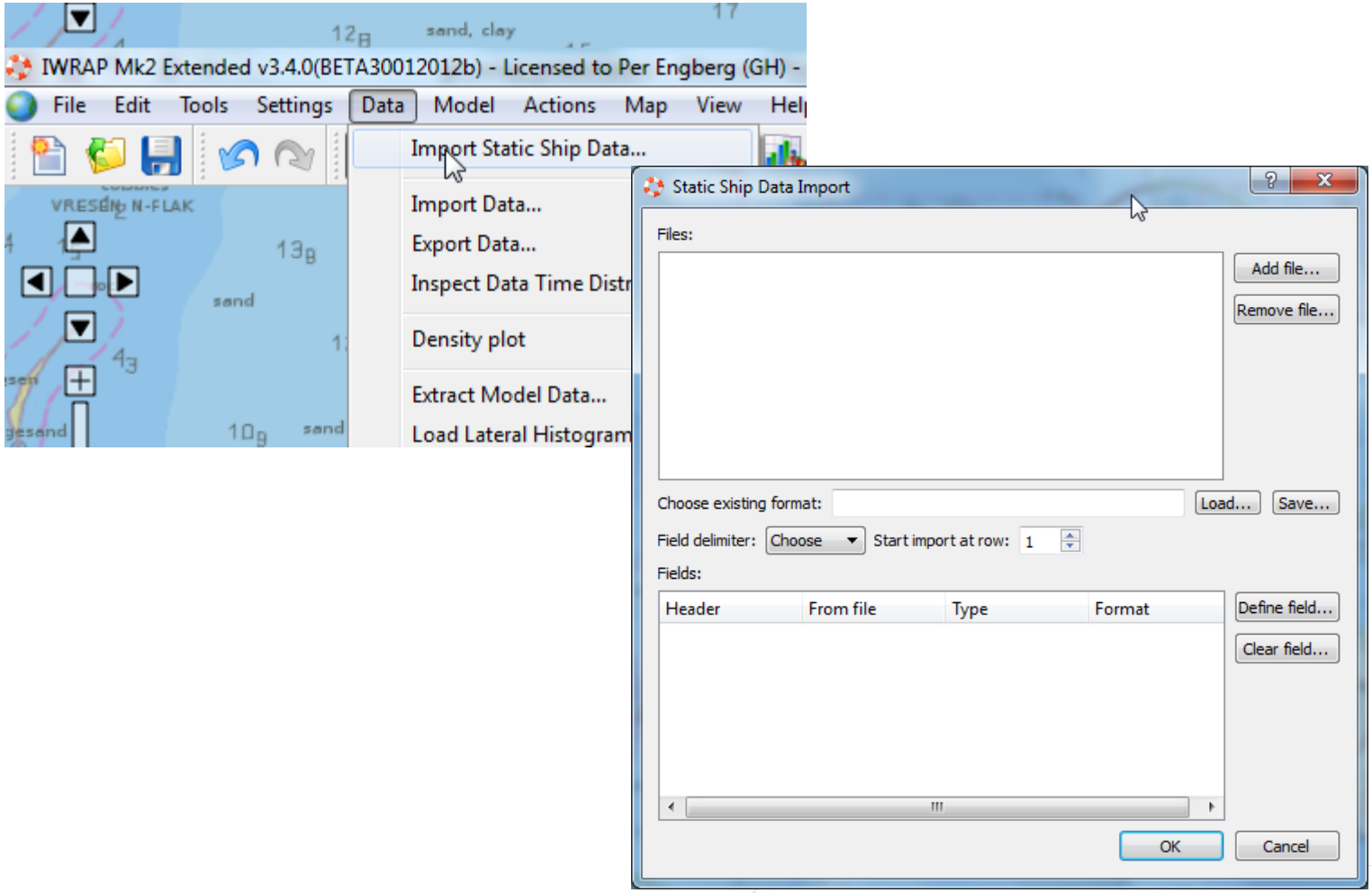
1. Import Static Ship Data if available
2. Import AIS data in the correct format
3. Create density plot
4. Chart overlay
5. Draw legs
6. Extract model data. Vol., distributions. etc.
7. Create depth curves
8. Run model and do what if analysis

Using AIS data



GateHouse

Import Static Ship Data (if available)



GateHouse

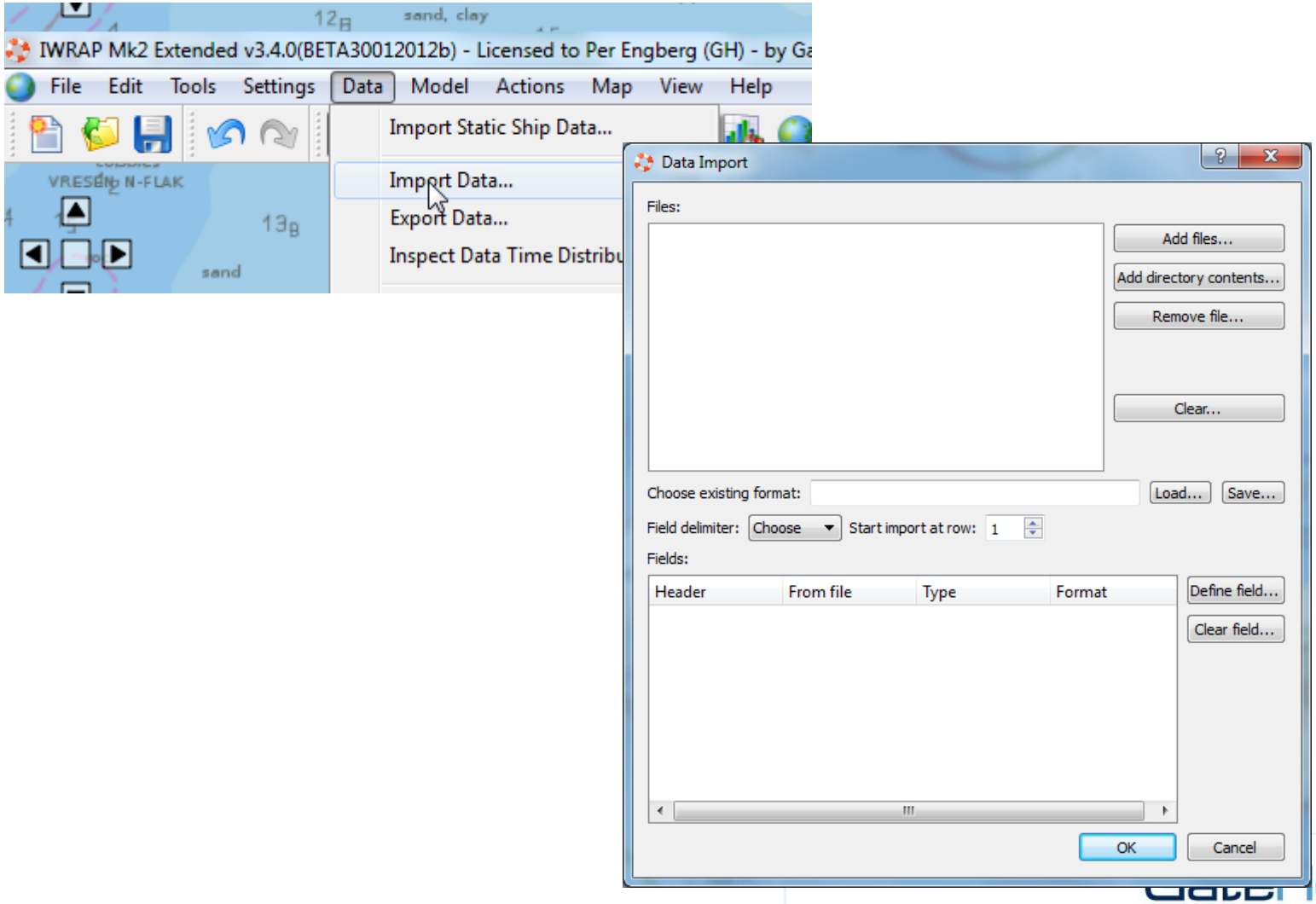
AIS to IWRAP Ship Types (1371.1)

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

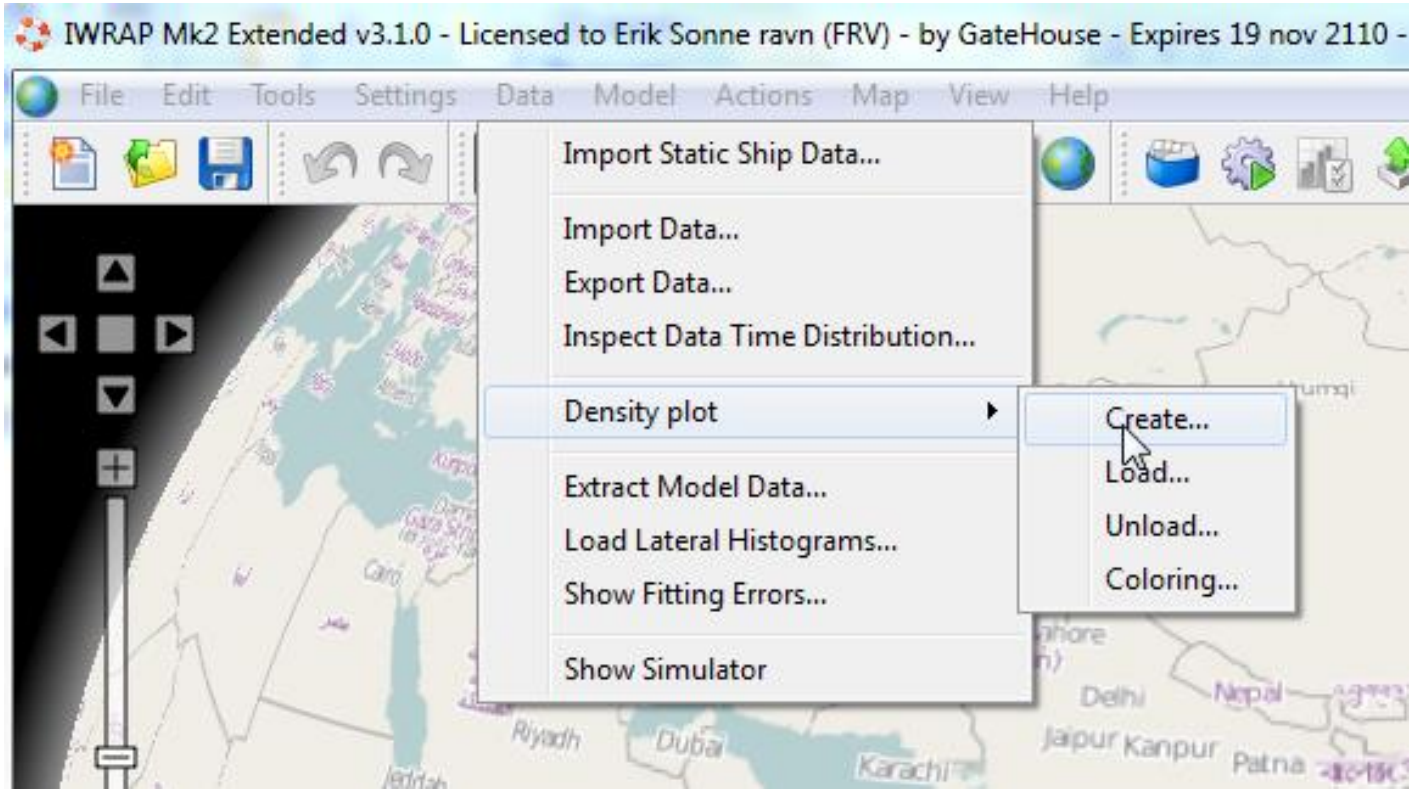
AIS to IWRAP Ship Types (part 2)

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)

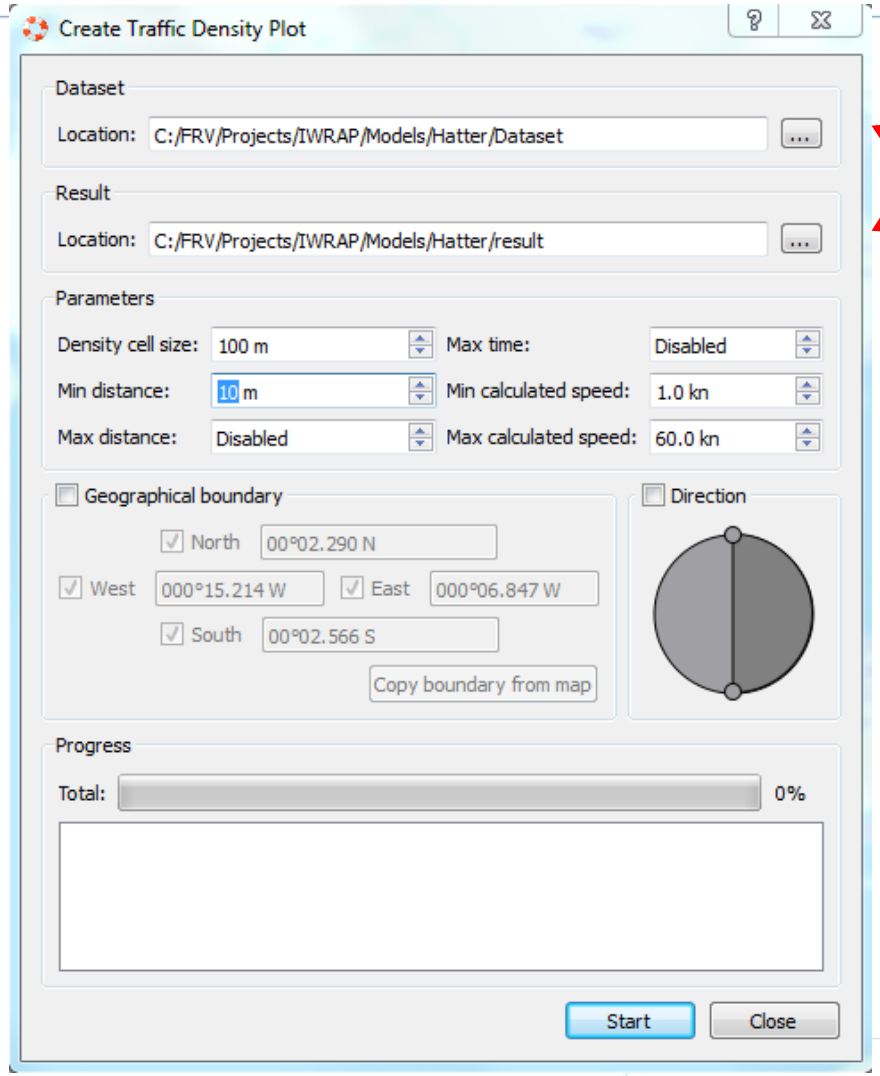
Import Data


sand, clay
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
VRESEN N-FLAK
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



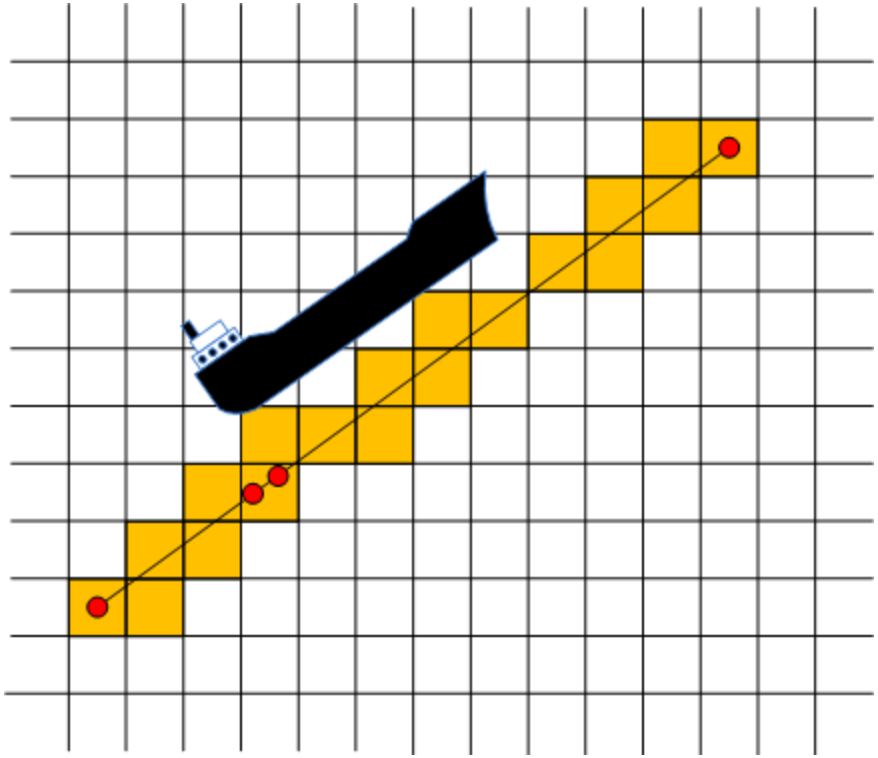
2. Generate density plot



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

GateHouse

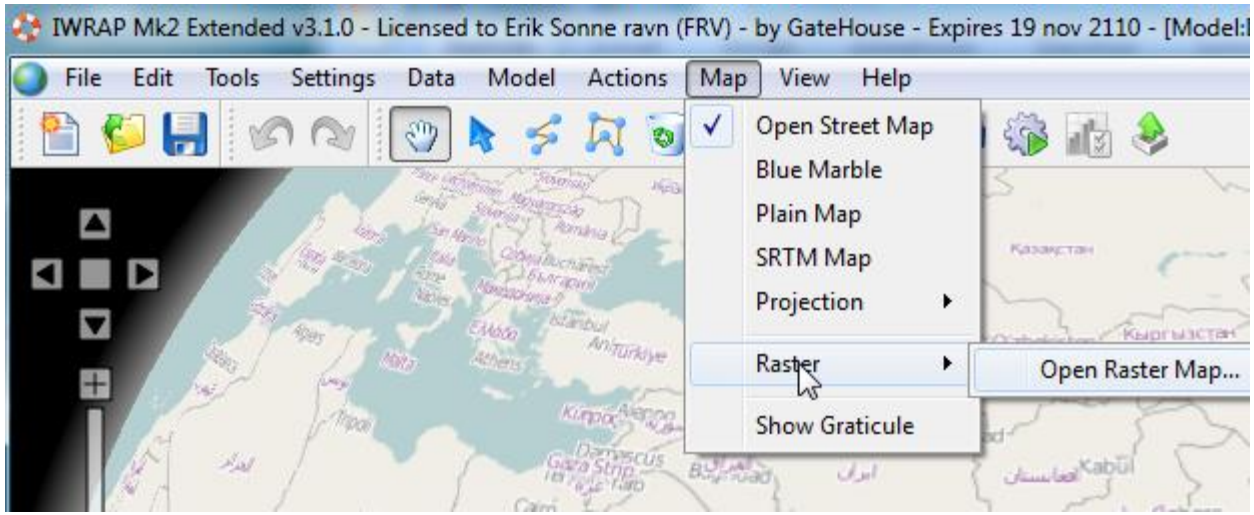
2. Traffic density

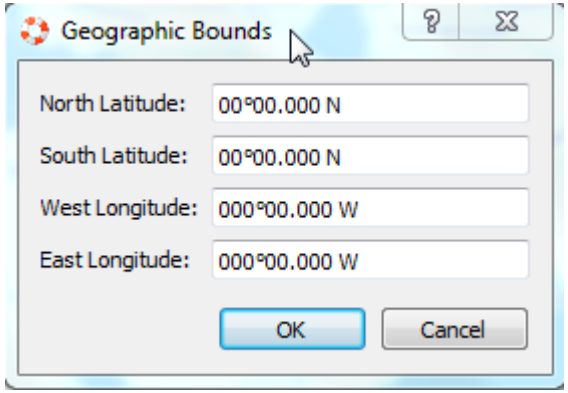


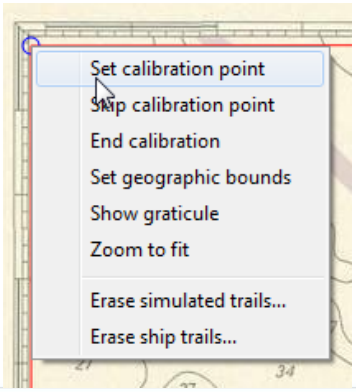
Each cell only ”hit” once and interpolationcis used

GateHouse

3. Overlay of raster charts



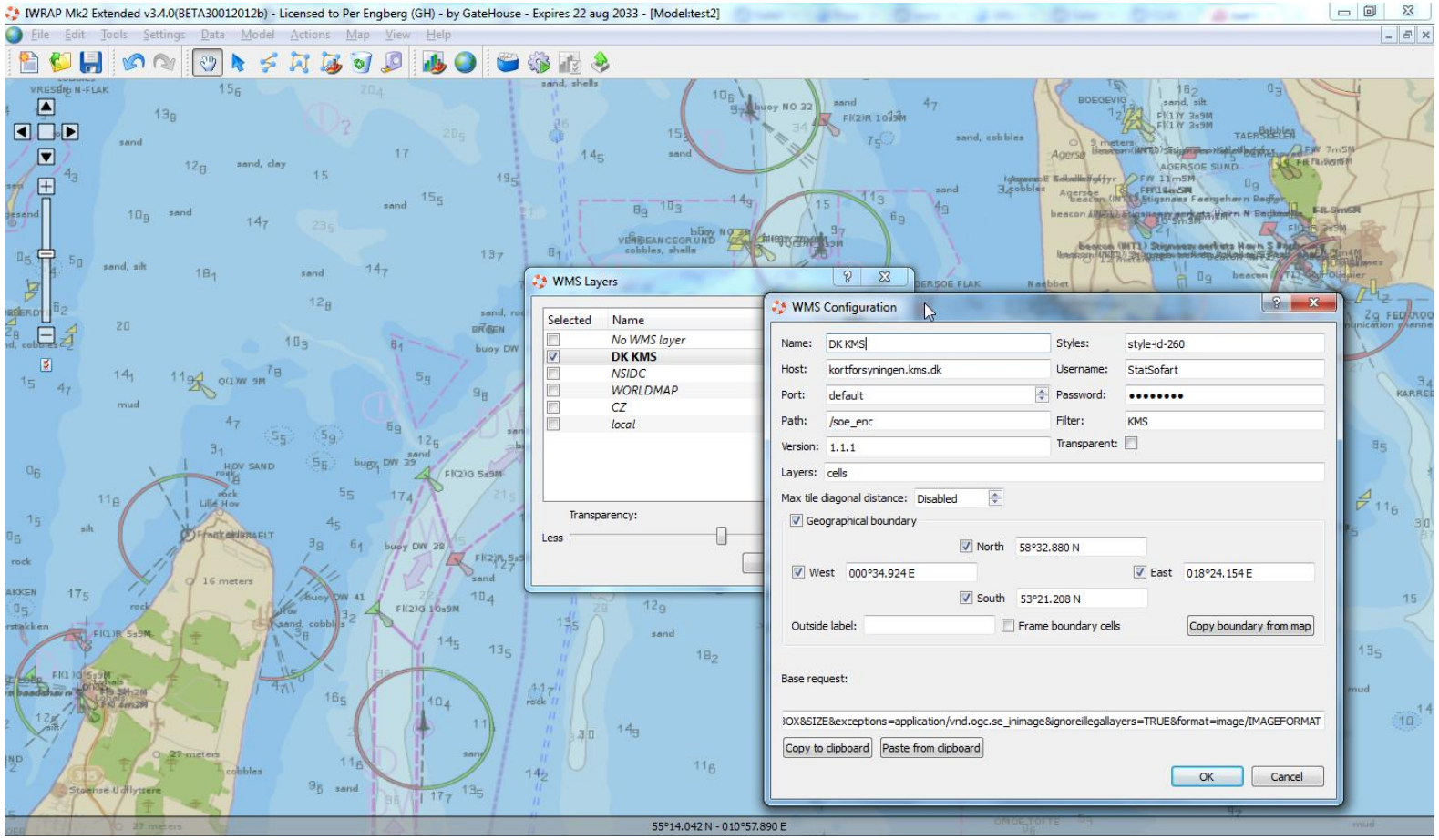




Use right click

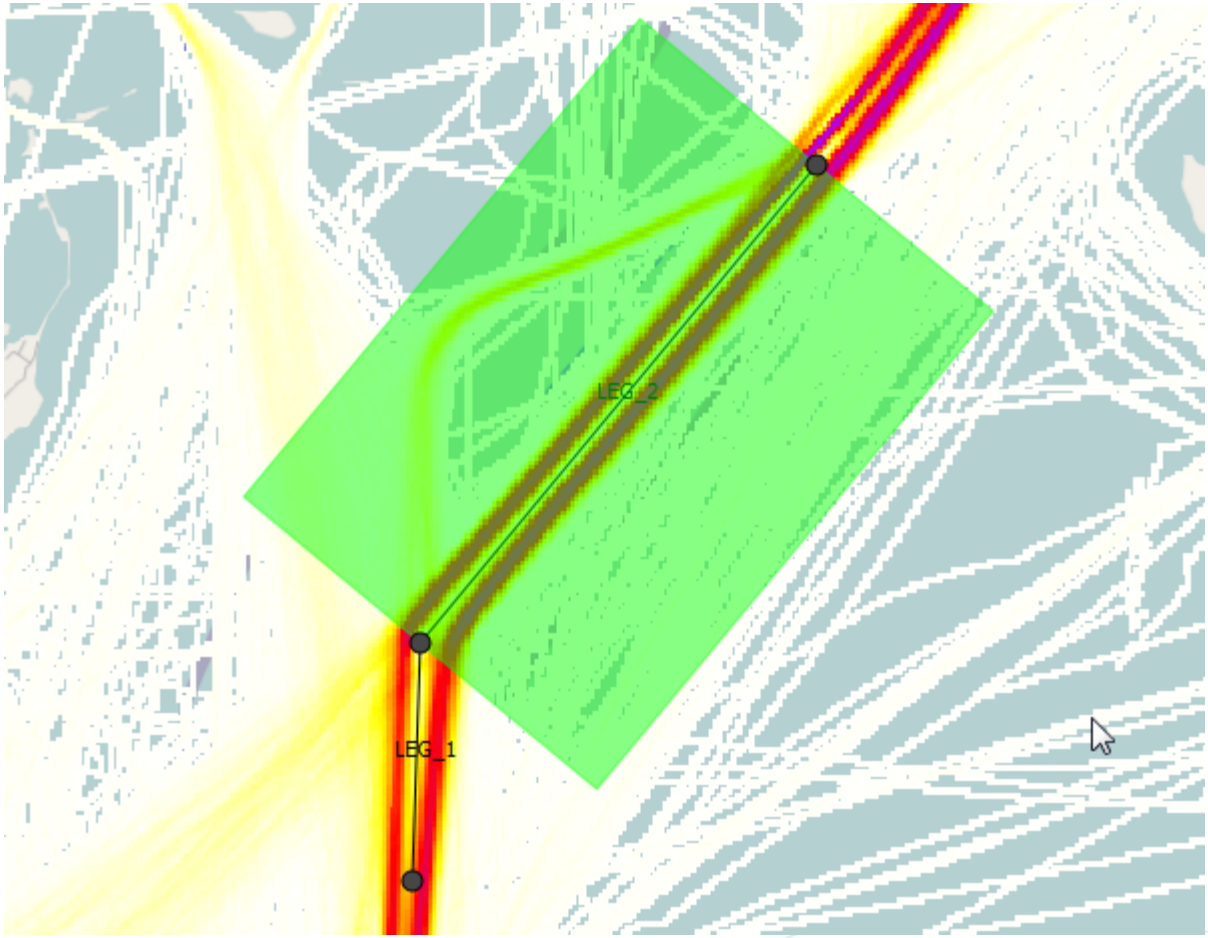
GateHouse

3. Overlay of Web Map Service layers



GateHouse

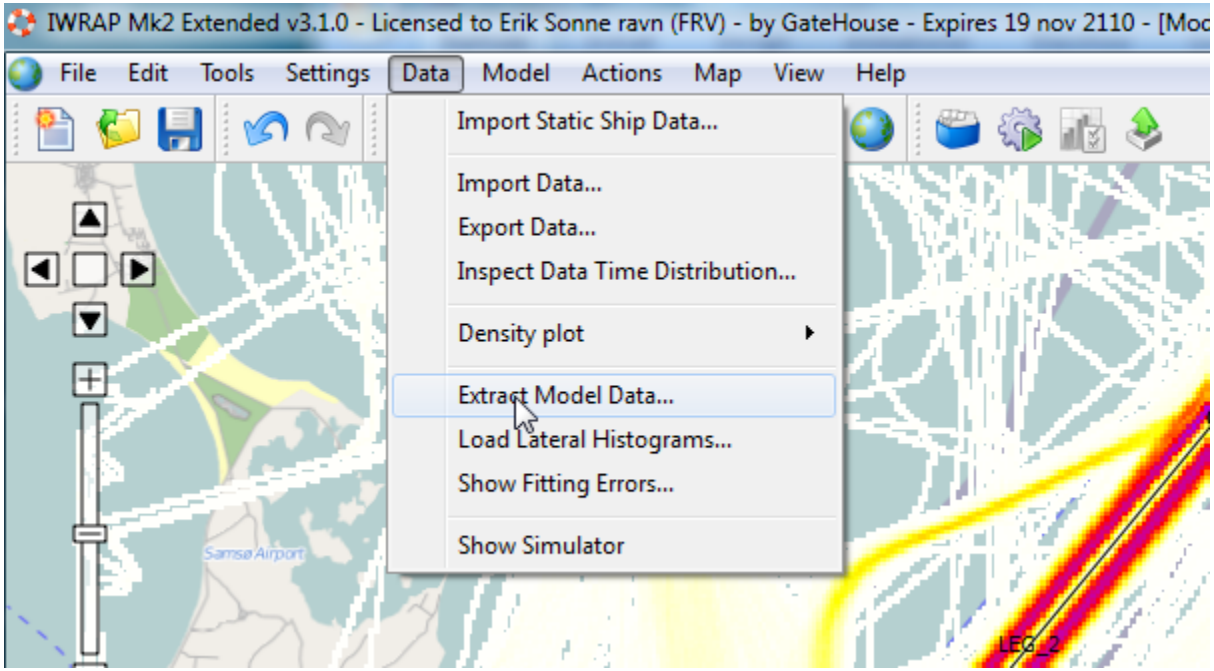
4. Create legs



Adjust the width of the legs

GateHouse

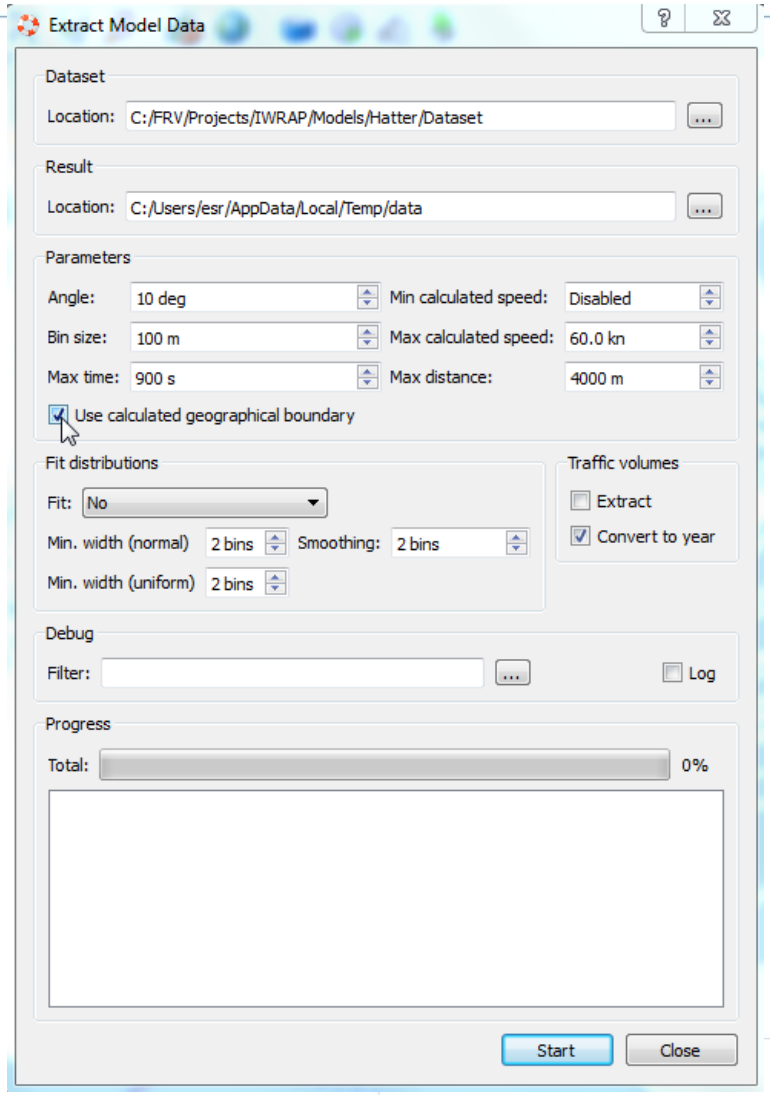
5. Extract model data



GateHouse

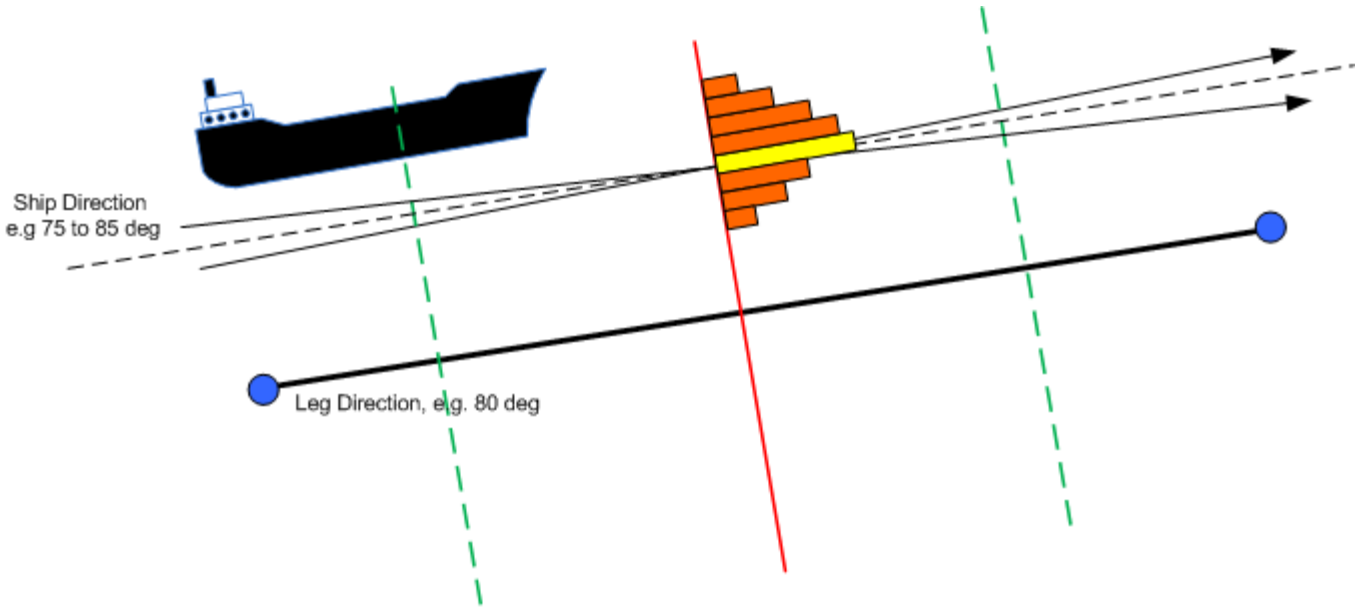
5. Extract model data

Wait with this only the legs have been located



GateHouse

Histogram extraction algorithm



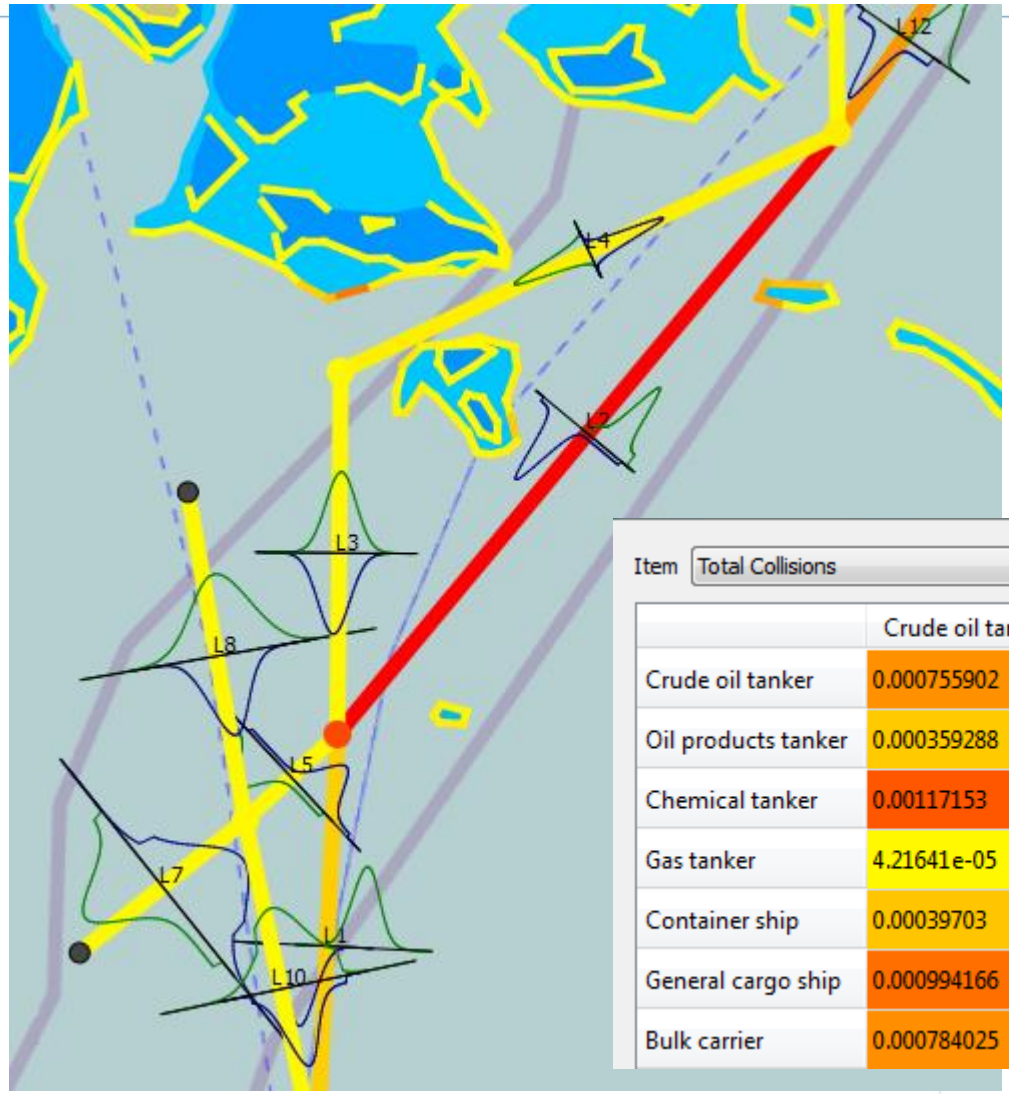
GateHouse

6. Depth curves

Depth curves can be imported or created using the polygon editor

GateHouse

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

GateHouse

IWRAP Mk2
Misc info

June/July 2013

GateHouse

Links

IALA:
http://iala-aism.org

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

GateHouse:
http://www.gatehouse.dk

GateHouse:
http:// webshop.gatehouse.dk

GateHouse IWRAP:
http://www.gatehouse.dk/en-US/Fields-of-Expertise/Maritime/Products/IWRAP-Risk-analysis.aspx

ghTrack®

your way to control

GateHouse