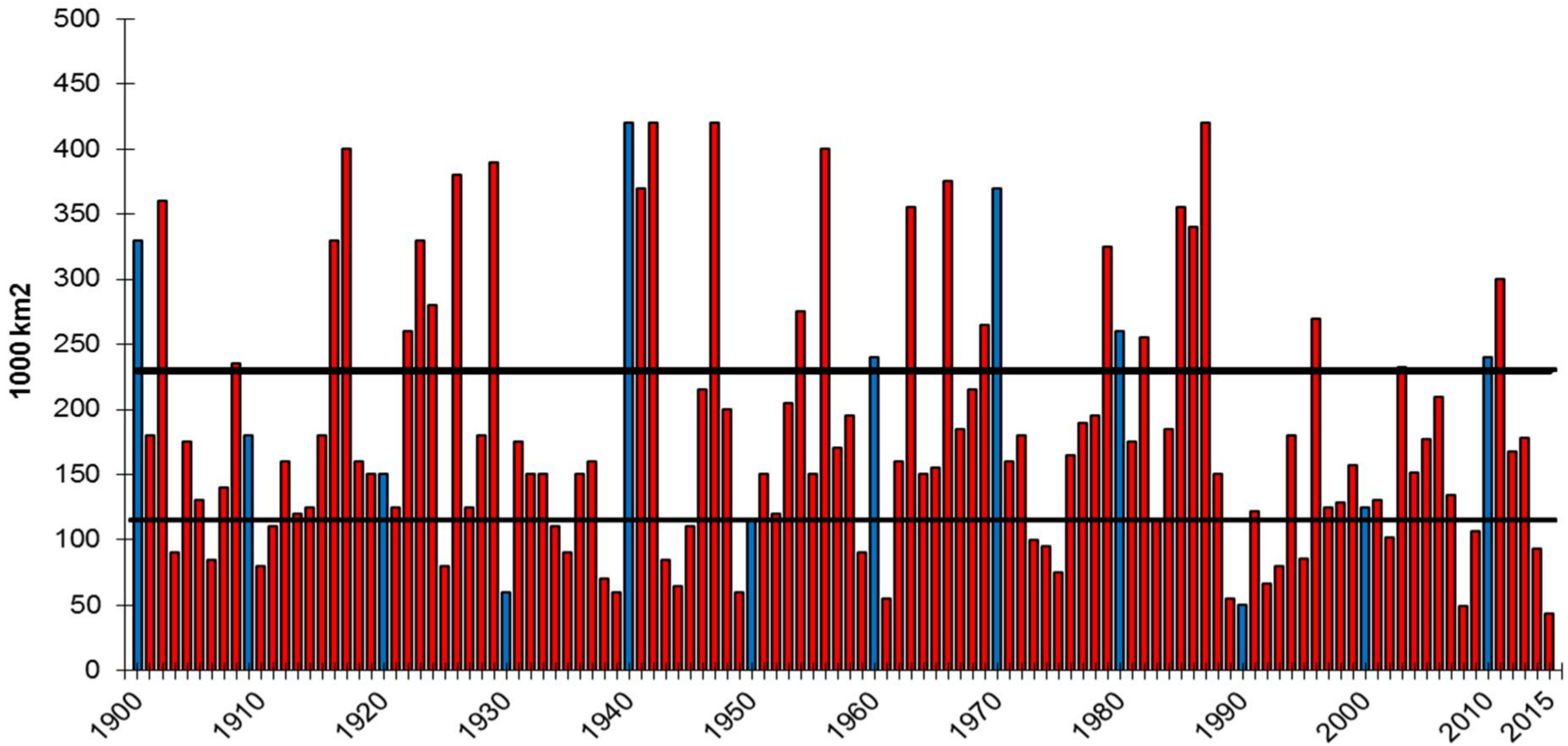
WINMOS
WINTER NAVIGATION
MOTORWAYS OF THE SEA

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

Ice extension Baltic Sea region 1900 – 2015



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The maritime traffic patterns are continuously changing

Changes in the size of ships

Increased volumes

Implications of new environmental rules

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The aging icebreaker fleet

"Different horses for different courses"

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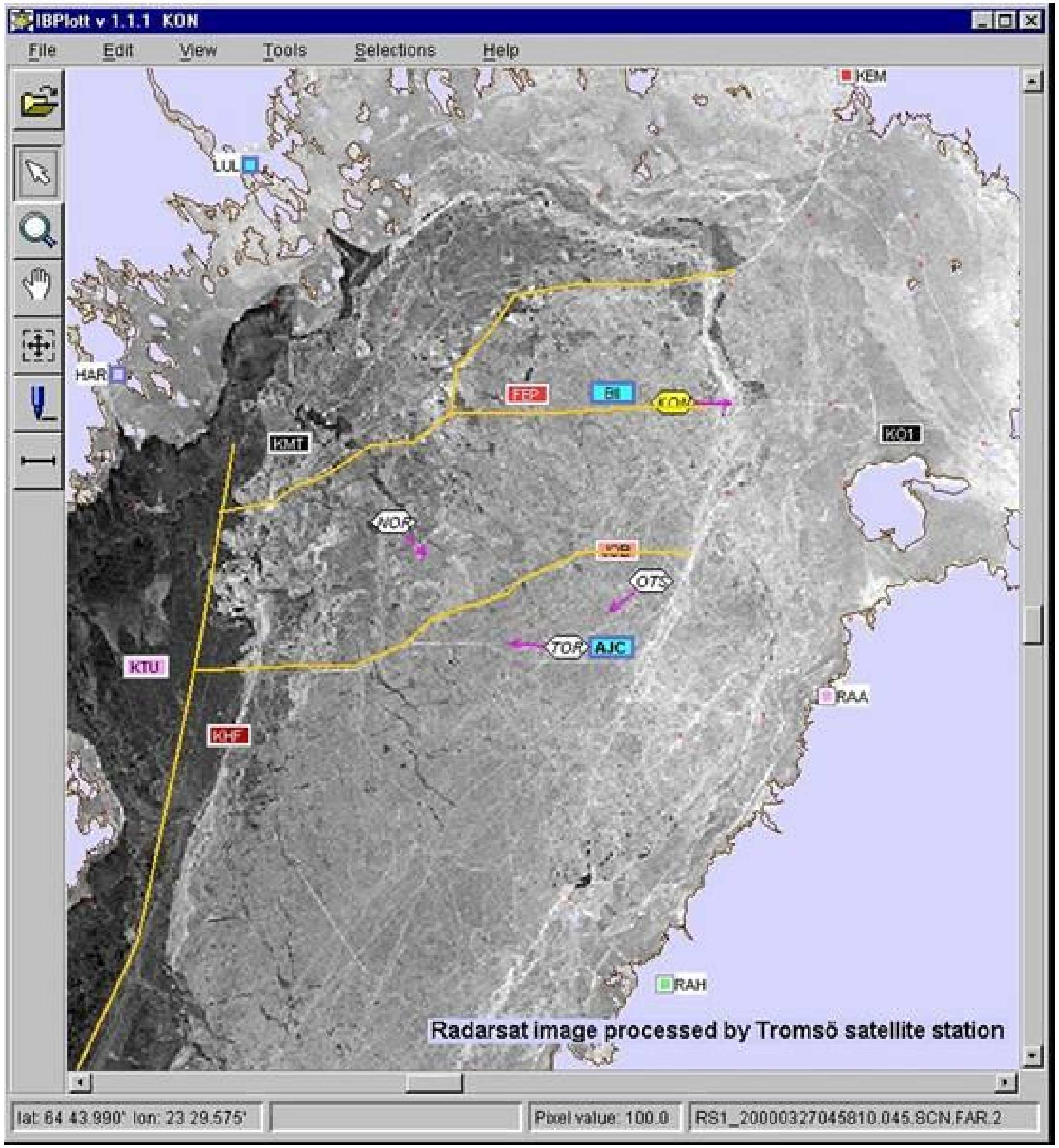
Activity 1

Description of the operative model

Morten Lindeberg
Pentti Kujala
Aalto University
Jarkko Toivola, Helena Niemelä
Finnish Transport Agency



IB NET

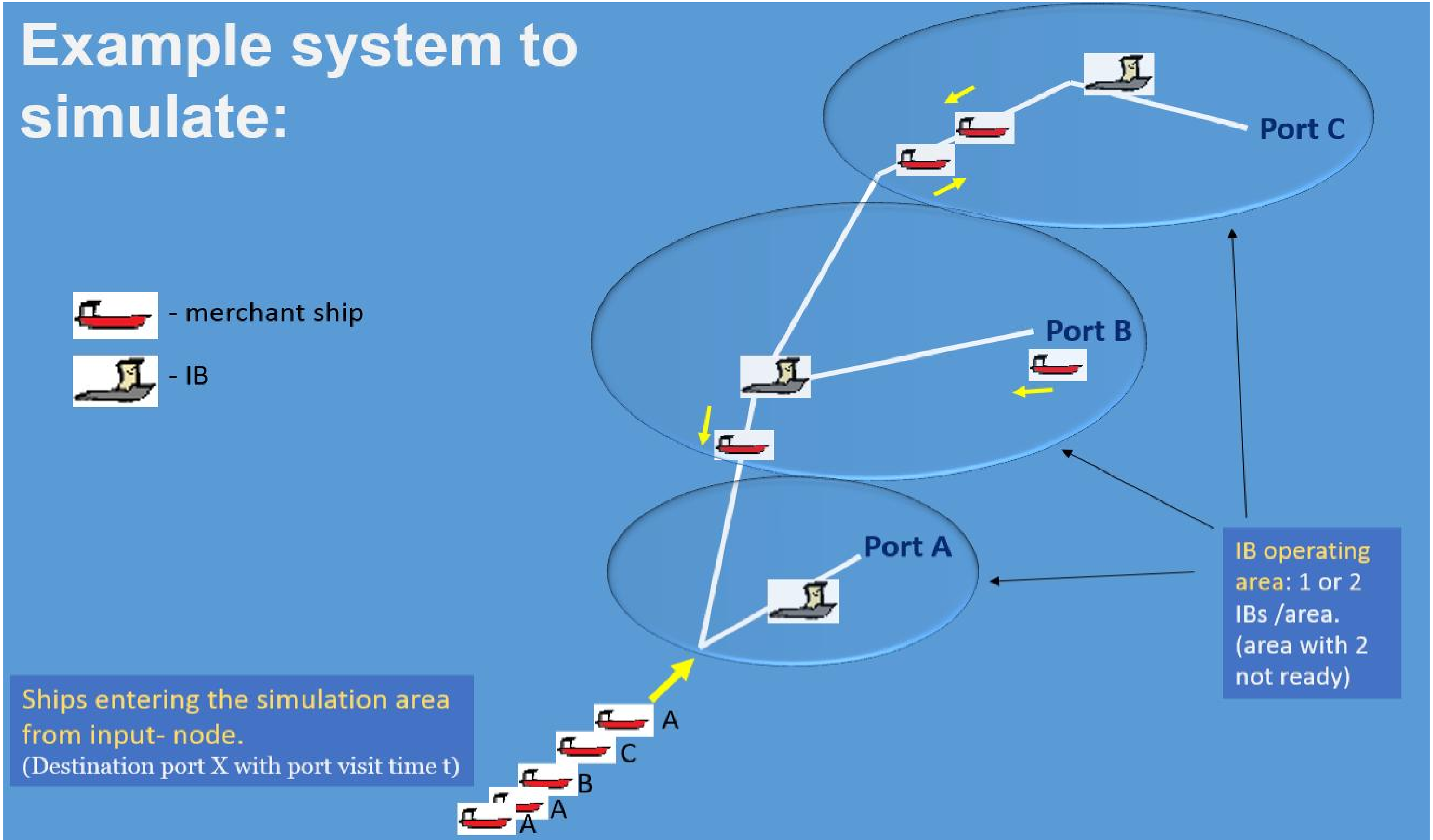
Research question:

Can the winter navigation system be simulated on a reliable way ?

Objective and purpose

- Objective
  - Events, and their occurance time and position match with reality ⟹ model successfull
- Purpose
  - Predict performance of the winter navigation system
    - Ex. effect of size and positioning of icebreaker fleet under different ice conditions

Example system to simulate:



Simulation inputs

Ice conditons

- Simulated routes are split into equally long smaller pieces. Each piece has its own time- varying ice conditions.

Model for ship speed in ice ("hv- graph")

- Individual for all ships, including icebreakers.

Time schedule of simulated ship traffic

(Input-node entering times)

Simulation outputs

- Times and positions of all notable events
  - arrive/ leave simulation area
  - Ship in need of assistance
  - Icebreaker starts moving
  - Assistance start/stop
  - arrive/ leave from port
- IB motor power for every travelled mile
  - Alone: chooses minimum power to still be in time
  - Assisting: power calculated from ice resistance at assist-speed (speed determined by merchant ship/s)

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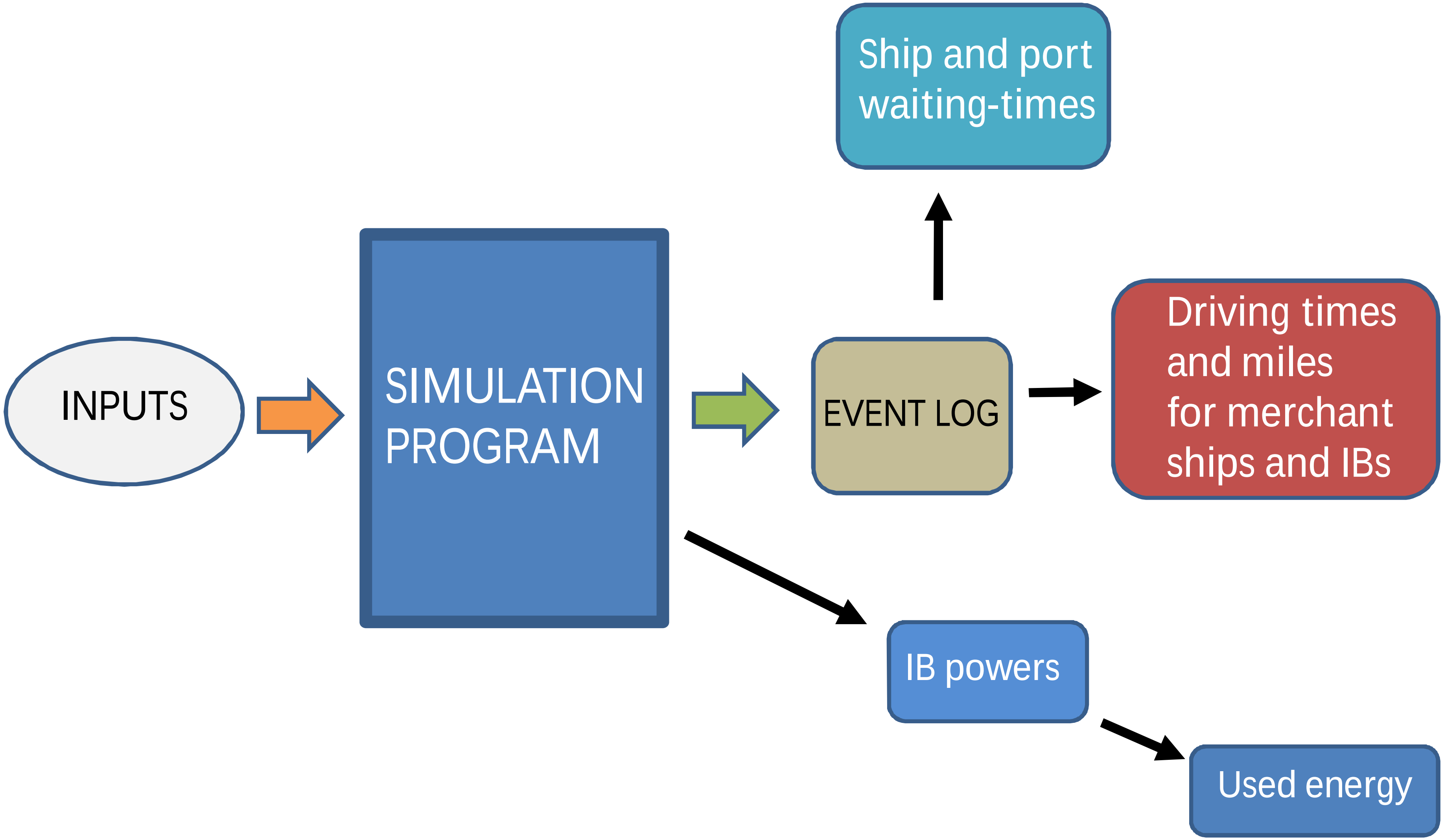
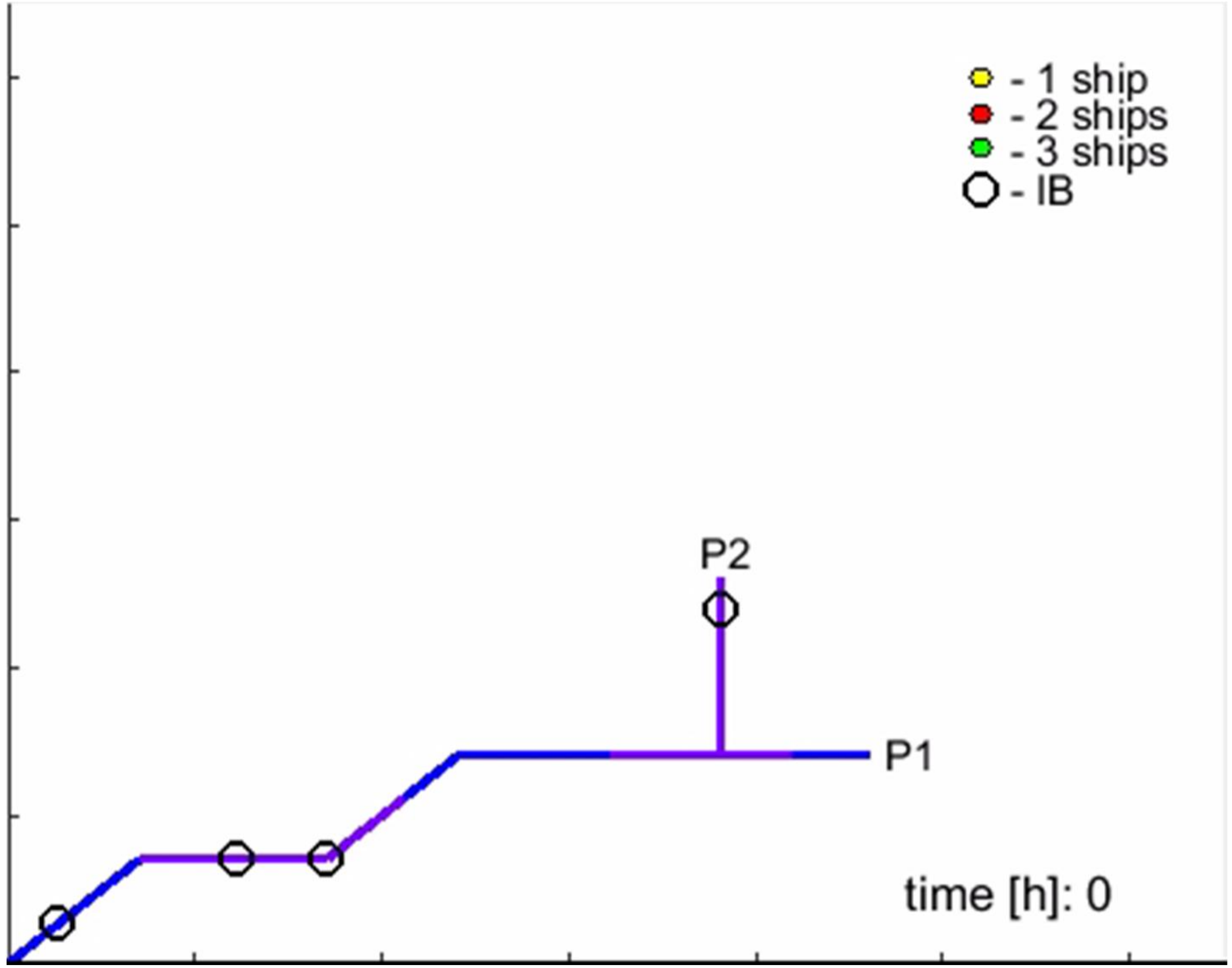


Results

- Basic structure and logic of the simulation model developed
- Outputs under comparison with actual data
- Animation used as preliminary valuation tool
  - Example sim: 4 IB areas connected (one area no icebreakers needed as no/ thin ice). 2 ports.
- Easier ways to give the input data under development (now Matlab based)

Animation



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Activity 1.3

FINNISH METEOROLOGICAL INSTITUTE

Patrick Eriksson
Product Manager / Ice Expert
Marine Services

Mikko Lensu
PhD, Senior Scientist
Marine Research

Activity 1.3

The obejctive of the activity was to generate datasets that can be used in winter navigation models.

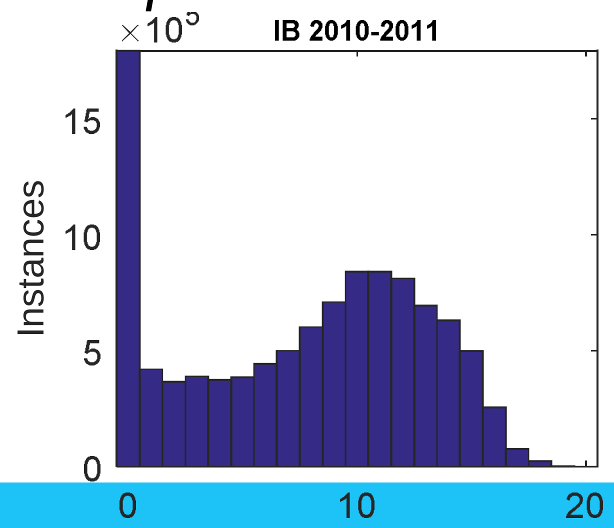
The datasets consist of AIS-retrieved navigation data combined with ice chart parameters and modeled ice conditions.

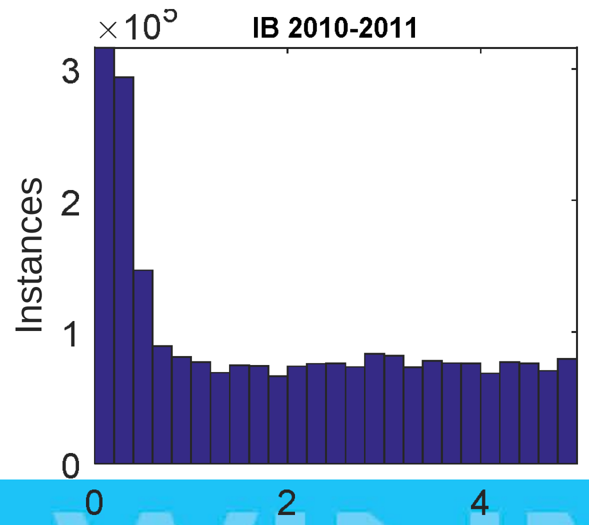
The icebreaker traffic system simulation was the main application of data

- Simulation applied archived data on the icebreaker dirways
- For each dirway ice parameters were provided as a function of dirway distance

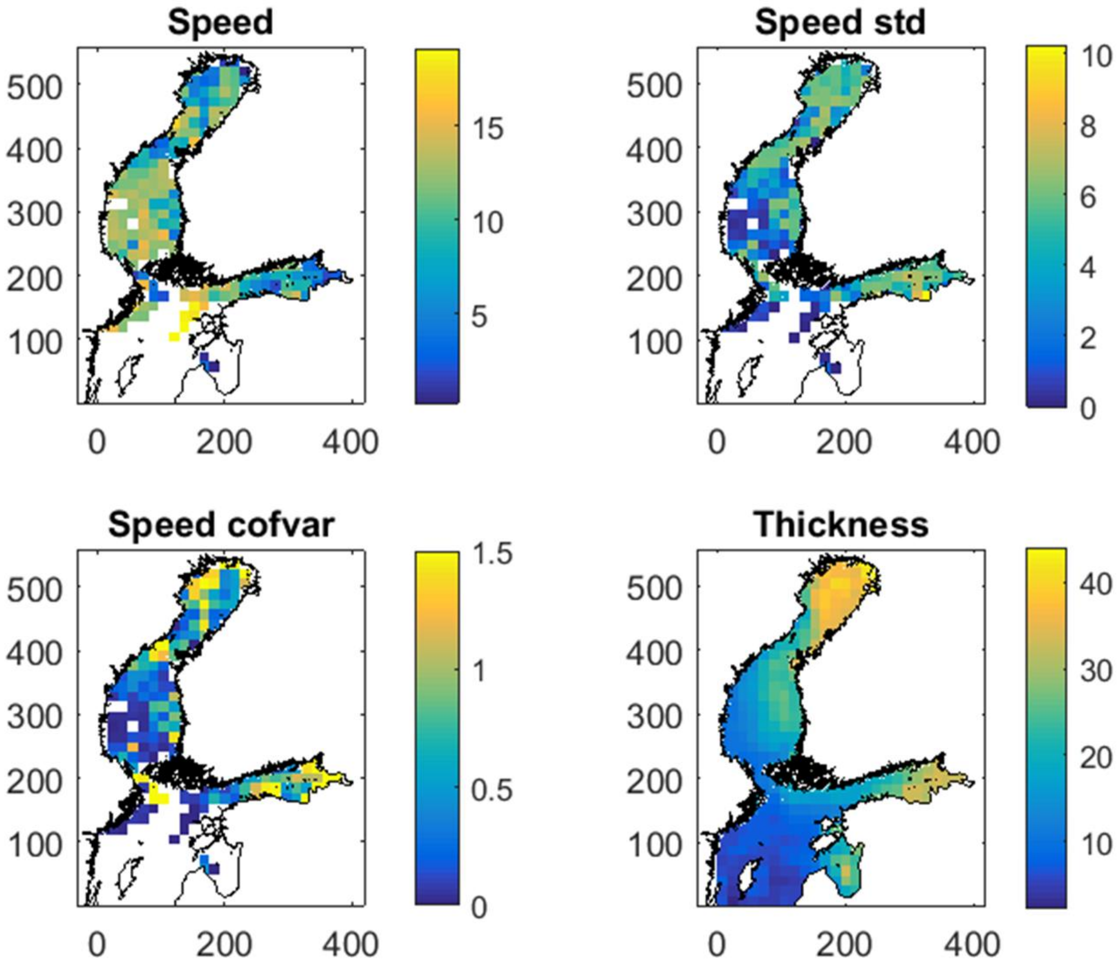
With the data it is also possible:

- To study how the performance of ship depends on ice conditions
- Conduct analyses on the areal patterns of traffic intensity, mean speed and other traffic parameters and connect these to areal ice conditions
- Derive average statistics for ice navigation over one season or several years for areas, ship types or individual ships: *some examples follow*

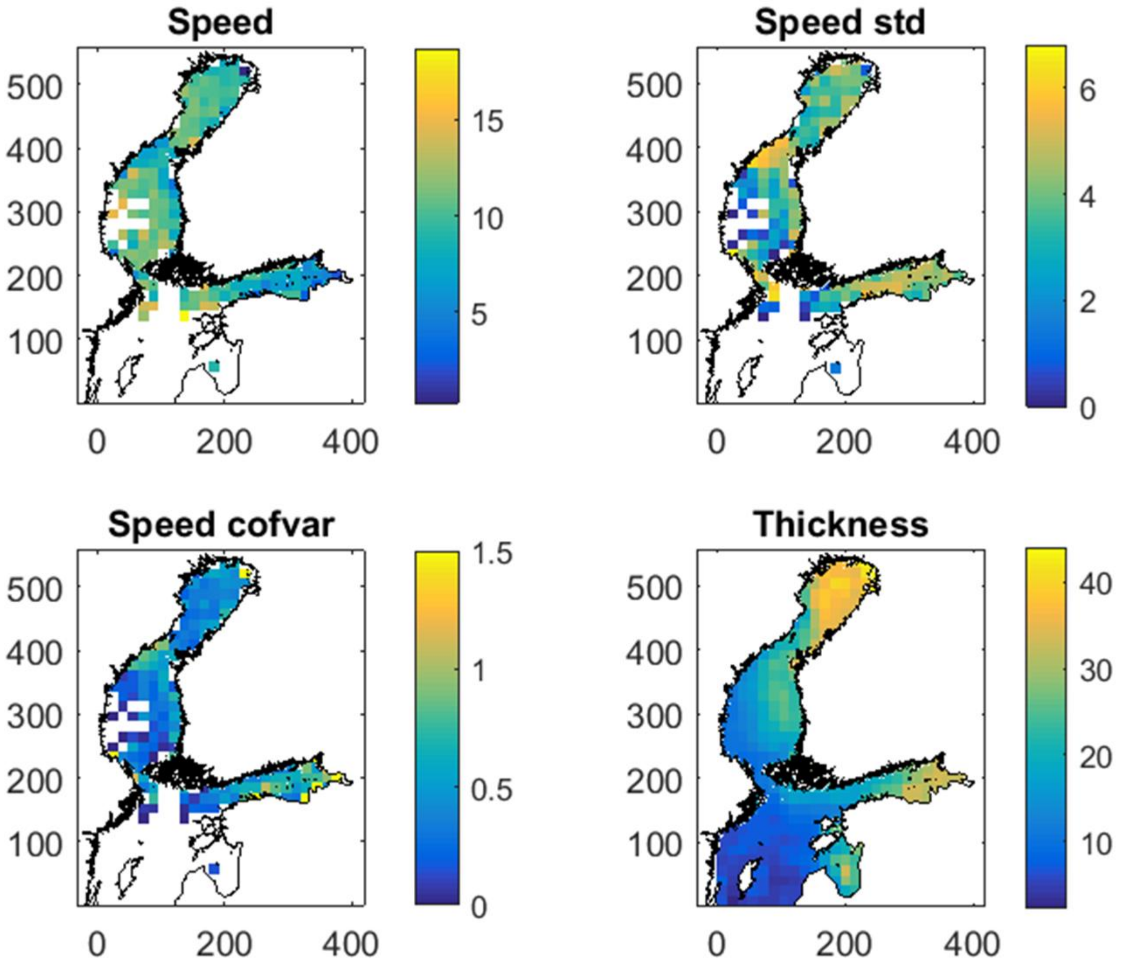




Icebreaker speed statistics for a season



Icebreaker speed statistics for 2010-11 season, all icebreakers and all navigation



Icebreaker speed statistics for 2010-11 season, all icebreakers, independent navigation only (no other ships within 3 NM)

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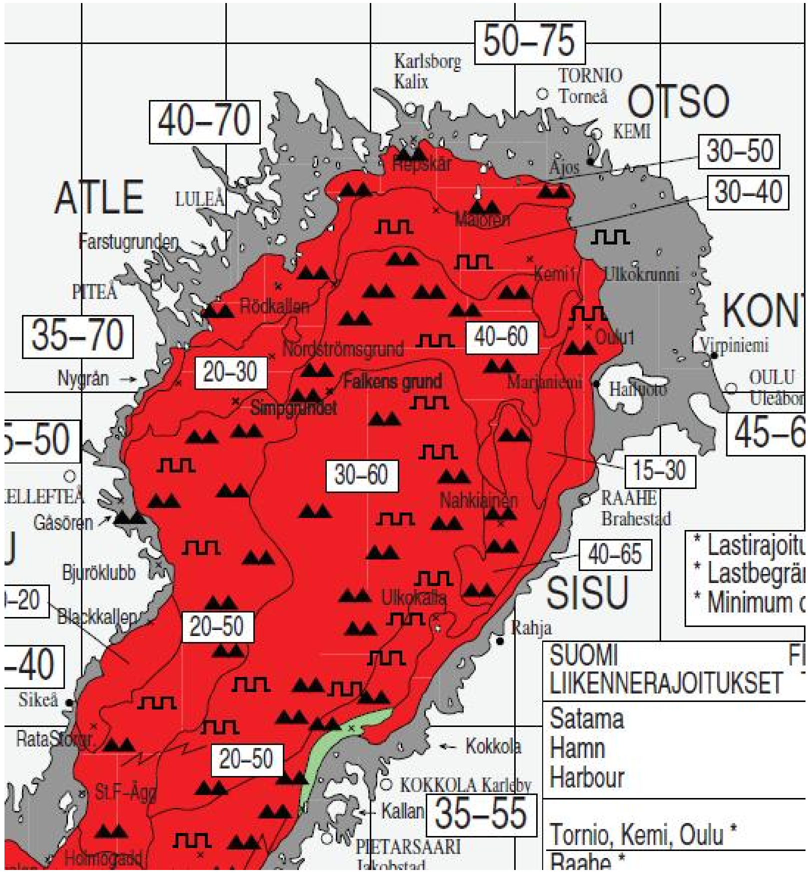
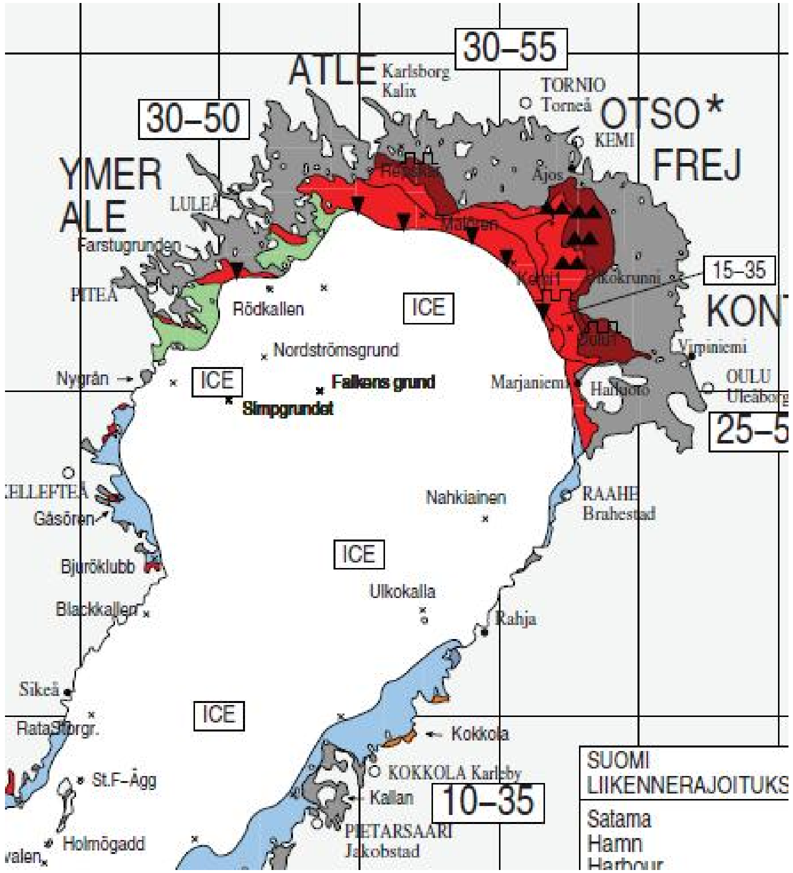
25 Feb 2011



08 Mar 2015



Despite large differences in ”ice winter severity”, extremely difficult assisting conditions may still occur.

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Thank you !

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Ilmatieteen laitos
Erik Palménin aukio 1,
00560 Helsinki
PL 503, 00101 Helsinki,
puh. 029 539 1000

Meteorologiska institutet
Erik Palméns plats 1,
00560 Helsingfors
PB 503, 00101 Helsingfors
tel. 029 539 1000

Finnish Meteorological Institute
Erik Palménin aukio 1,
FI-00560 Helsinki
P.O.Box 503, FI-00101 Helsinki
tel. +358 29 539 1000

>> www.fmi.fi >> Twitter: @meteorologit ja @IlmaTiede >> Facebook: FMIBeta

Total cost of winter navigation

- First attempt to calculate overall costs of winternavigation in WINMOS Act 1 economy model, including additional investments to merchant vessels ice-class and extra fuel costs.

- Model will be used to evaluate and support decision making for future fairway due legislation, service level decisions, icebreaking capacity and icebreaking service-production model.
- Economic cash-flow model, made by Inspira Ltd, audited by Rebelgroup Ltd

Holistic operational model
Holistic economic cash-flow model

Operational model

Variables and feed

- Traffic volumes and routes
- Different merchant vessels
- Different Icebreakers
- Changing ice-conditions

Output to economy model and system performance

- Merchant vessel added fuel consumption
- Icebreaker fuel consumption
- Merchant vessel waiting and slowdown times

Economy model

Variables and feed

- Different merchant vessel types and investment costs
- Different icebreaker investment and business solutions
- Different fuel options
- Icebreaker fuel consumption cost
- Merchant vessel additional yearly fuel consumption and ice related additional consumption

Output

- Total costs of winternavigation
- Individual costs of icebreakers

Collecting data of merchant vessels for holistic model

Generally method and sources of required data is assured but collecting it is laborious. New processing resources are applied during this summer

Test case

Kemi traffic during 12/12 - 05/13

- additional investment cost (steel hull strengthening) up to 150 MEUR for test case fleet
- additional engine power, cost estimate requires more detailed analysis
- additional fuel cost due to larger consumption (extra weight, not optimal load, ice conditions) up to 35% for test case

EEDI effects to Winter navigation system
Study by Aker Arctic

- "Predicted impact on the present and future merchant fleet's independent ice going capacity will be estimated, with reference Energy Efficiency Design Index, EEDI".
- The study was limited to one ship type and size.
- The examined ship concept is a LNG carrier Δ = 18500 ton, B =25m, T=7.20m and LWL = 141-145m.
- The required installed power have been estimated based on: speed 15 knots, MCR 85%, sea margin 15%.
- The icegoing performance of three different bow forms were evaluated: EEDI type of bow form, traditional icebreaking bow and semi bow.

The power requirements used in the analysis

phase 1	EEDi allowed power			Required power			Installed
	1A Super	1A	1B	1A Super	1A	1B	
Ice bow	6200	5300	5000	6434	4768	3311	6300
Semi bow	6200	5300	5000	7264	4537	3029	5500
EEDI bow	6200	5300	5000	9885	8505	4461	5400

phase 3	EEDi allowed power			Required power			Installed
	1A Super	1A	1B	1A Super	1A	1B	
Ice bow	4900	4000	3700	6434	4768	3311	6300
Semi bow	4900	4000	3700	7264	4537	3029	5500
EEDI bow	4900	4000	3700	9885	8505	4461	5400

EEDi allowed power in Phase 1 and 3, required power based on FSIR and estimated installed open water power in kW.

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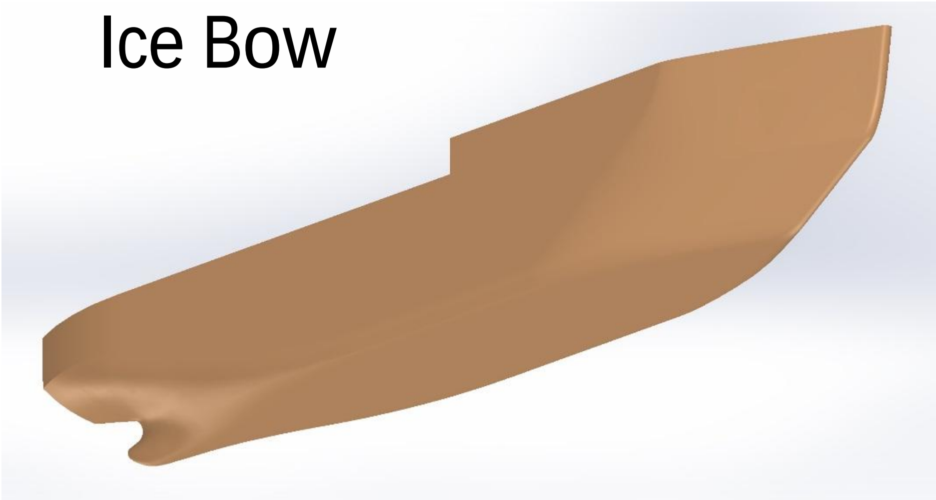
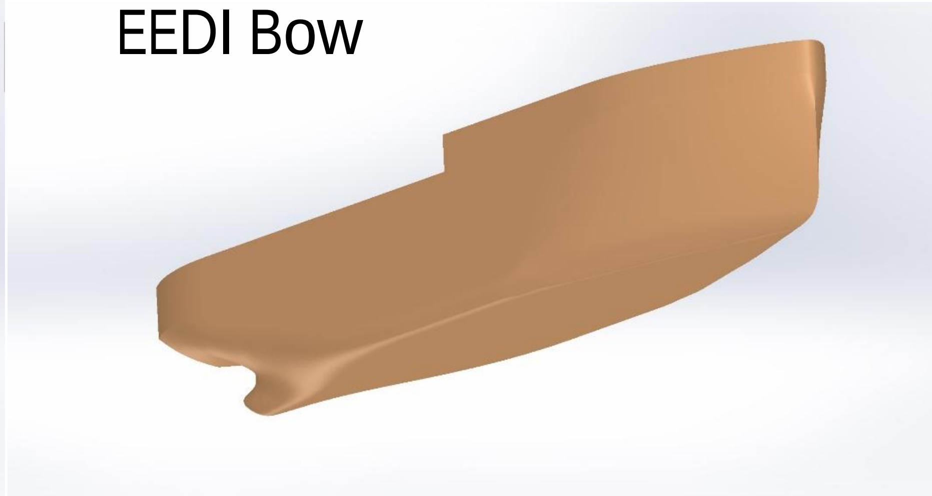
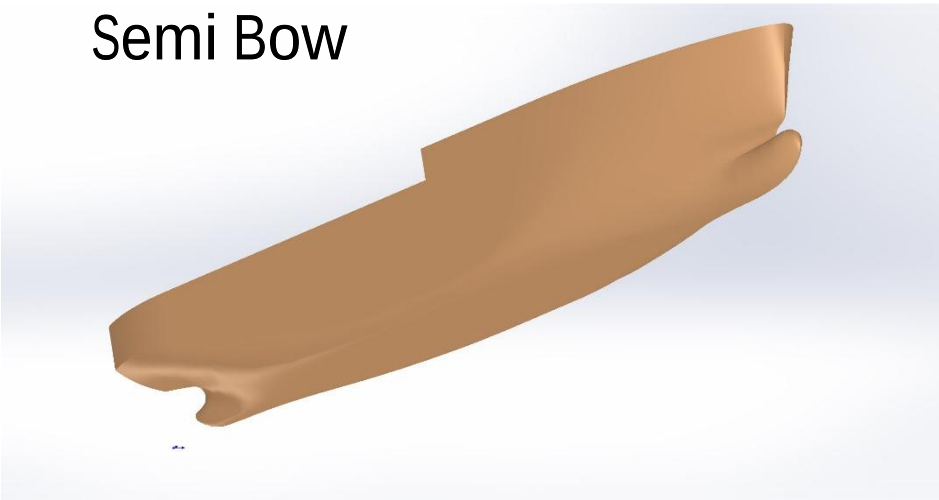


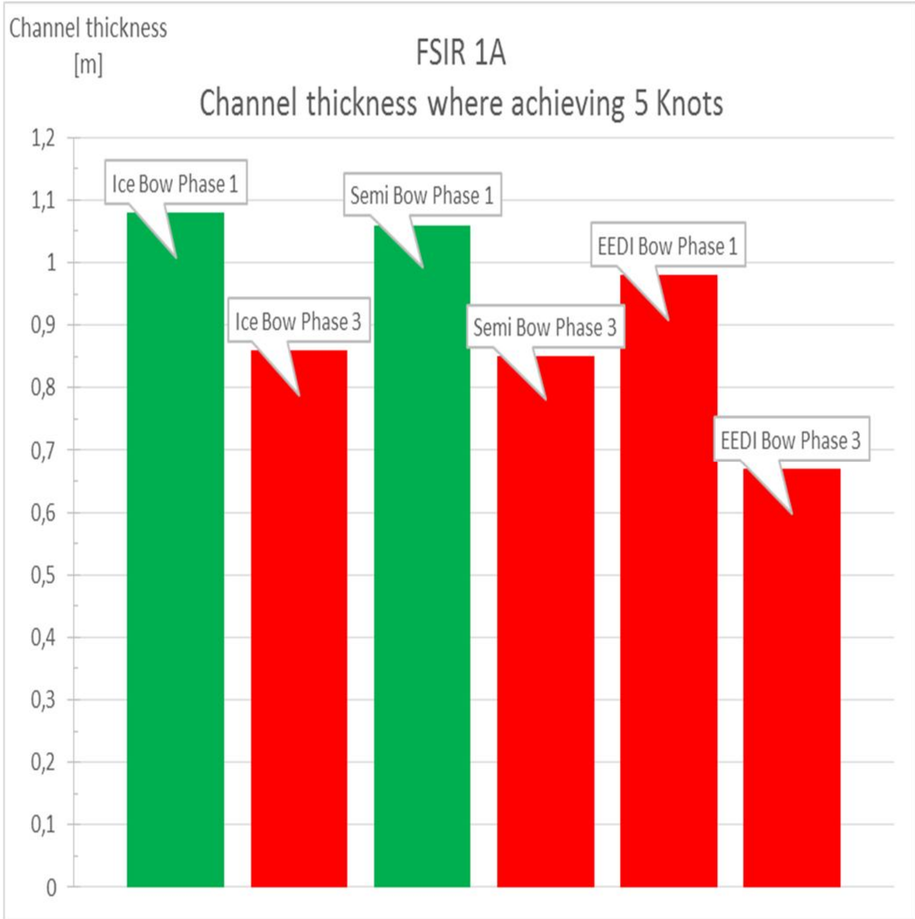




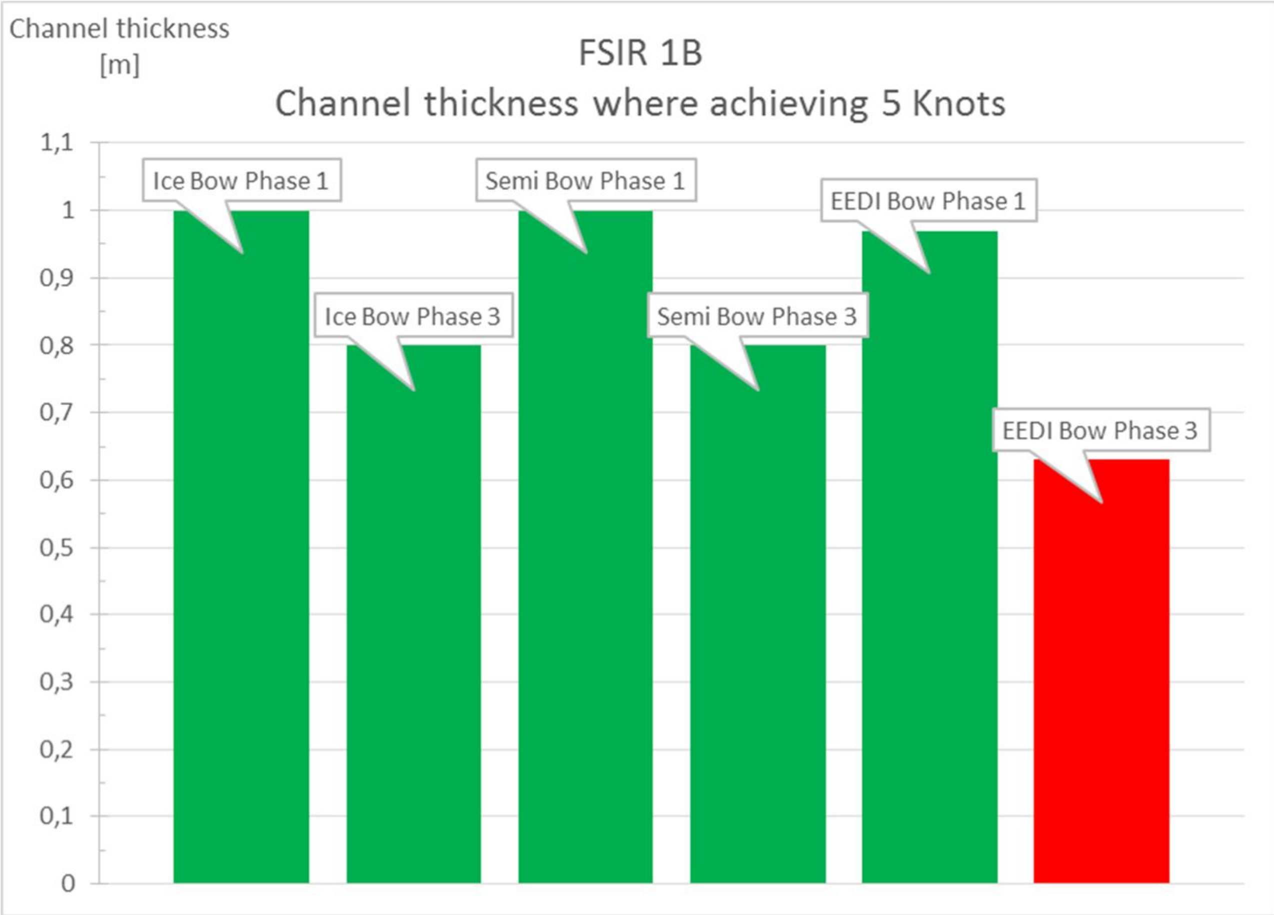
Hyvin jäissä kulkeva keula lisää avovesivastusta ja siten polttoaineenkulutusta

Säännöllisessä Tornio-Rotterdam liikenteessä oleva laiva vain noin 5% liikkeellä olo ajastaan jäissä jotka vaikuttavat sen kulkuun

EEDI allowed power for ice class 1A super:
6200 kW (phase 1), 4900 kW (phase 3)



EEDI allowed power for ice class 1A:
5300 kW (phase 1), 4000 kW (phase 3)



EEDI allowed power for ice class 1B:
5000 kW (phase 1), 3700 kW (phase 3)