Interreg Baltic Sea Region

Co-funded by the European Union

SUSTAINABLE WATERS

OpenRisk II

UNIVERSITY OF TARTU

GDAŃSK UNIVERSITY OF TECHNOLOGY

Overview of OpenRisk II project

Filip Zarzycki, Gdańsk University of Technology

Mission Arena 4
28-29.4.2025 Sopot, Poland

TOETAB

KYSTVERKET
NORWEGIAN COASTAL ADMINISTRATION

TRAFICOM
Finnish Transport and Communications Agency

Aalto University

NDPTL

UNIVERSITY OF HELSINKI

OpenRisk II

Better Maritime Risk Management for the Baltic Sea Region

@ Mikko Törmanen

Interreg Baltic Sea Region

Co-funded by the European Union

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OpenRisk II

Duration: November 2023 - October 2026

Total budget: 2 M EUR

Funding: Co-funded by the EU Interreg BSR programme 2021-27

Project consortium

UNIVERSITY OF TARTU 1632

GDAŃSK UNIVERSITY OF TECHNOLOGY

TRAFICOM Finnish Transport and Communications Agency

KYSTVERKET NORWEGIAN COASTAL ADMINISTRATION

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Background & OpenRisk II Project Overview

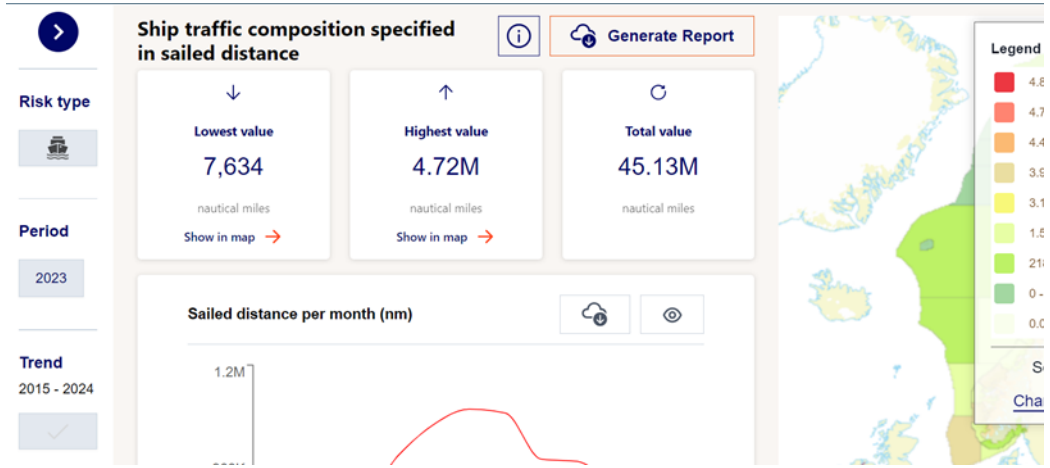
The Baltic Sea's maritime risk environment is dynamic and uncertain, necessitating innovative joint risk assessment initiatives for safety and spill response.

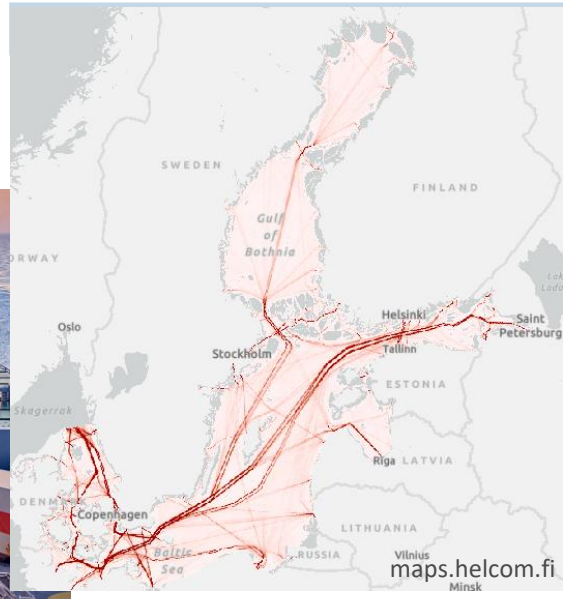
OpenRisk II delivers user-focused risk assessment and risk management tools aimed at preventing maritime accidents, minimizing their impact, and improving risk management.

These tools are designed for national maritime authorities, intergovernmental organizations, and other stakeholders.

AISyRISK Baltic together with module on ice

- **AISyRISK Baltic** presents the risk picture in the Baltic Sea through interactive maps and graphs accessible online.
- A new **risk assessment module on ice navigation** will be developed, with potential applications extending beyond the Baltic Sea Region.
- The tool is primarily designed for long-term planning and risk mitigation purposes.





EcoSensitivity tool

- **EcoSensitivity** is a web-based decision support system designed to evaluate the consequences of oil spills on the marine environment.
- It covers all stages, from defining accident specifics to modelling oil distribution and ecological impacts.
- It predicts oil spill dynamics, assesses environmental risks, and provides actionable guidance to enhance decision-making and response efficiency.

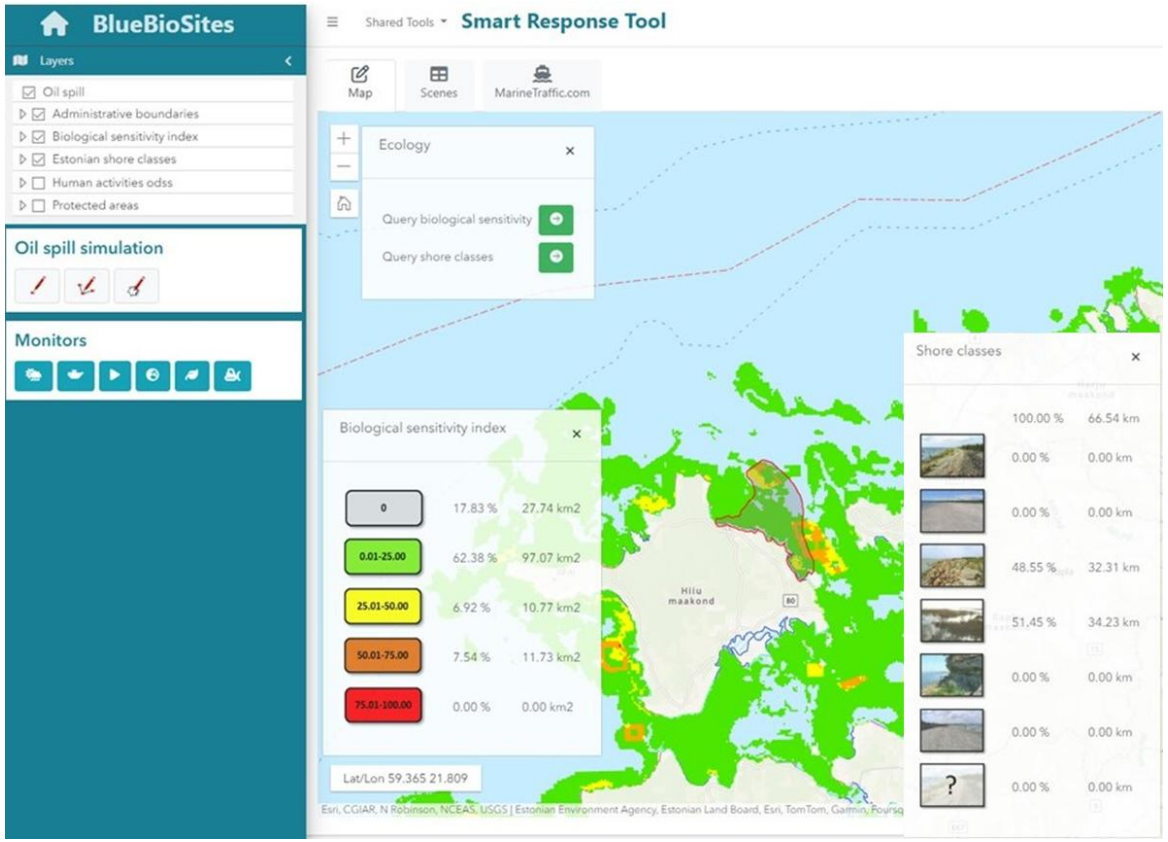
Journal of Marine Science and Engineering

MDPI

Article

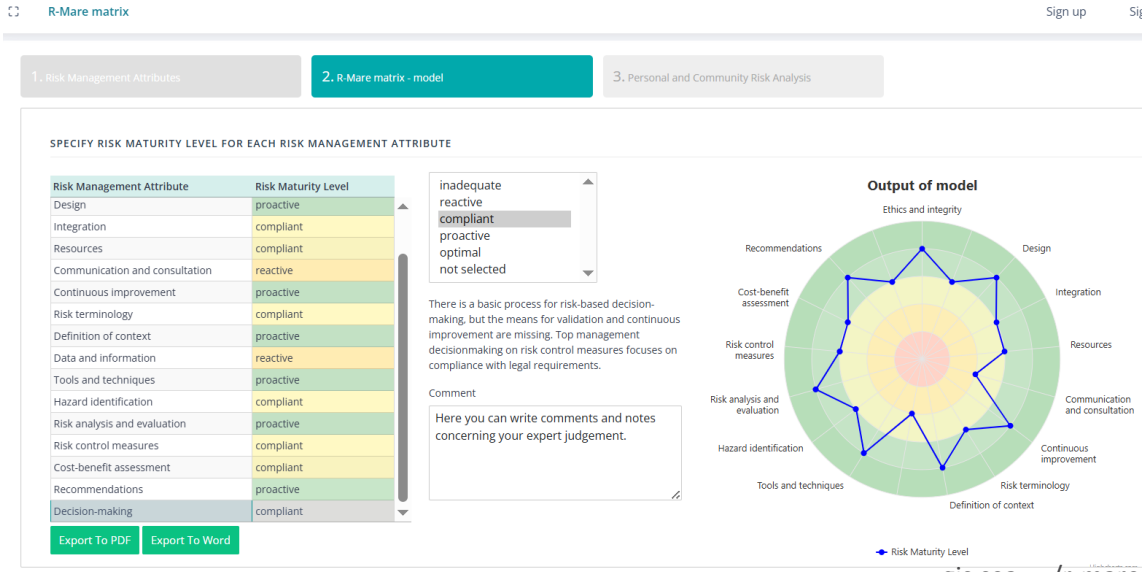
Towards Resilient Marine Ecosystems: EcoSensitivity as an Operational Model for Strategic Oil Spill Management

Anneliis Kõivupuu [1,*], Mihhail Fetissov [1,2], Robert Aps [1], Helen Orav-Kotta [1], Valtteri Laine [3], Mirka Laurila-Pant [3], Merli Rätsep [1] and Jonne Kotta [1,2,*]

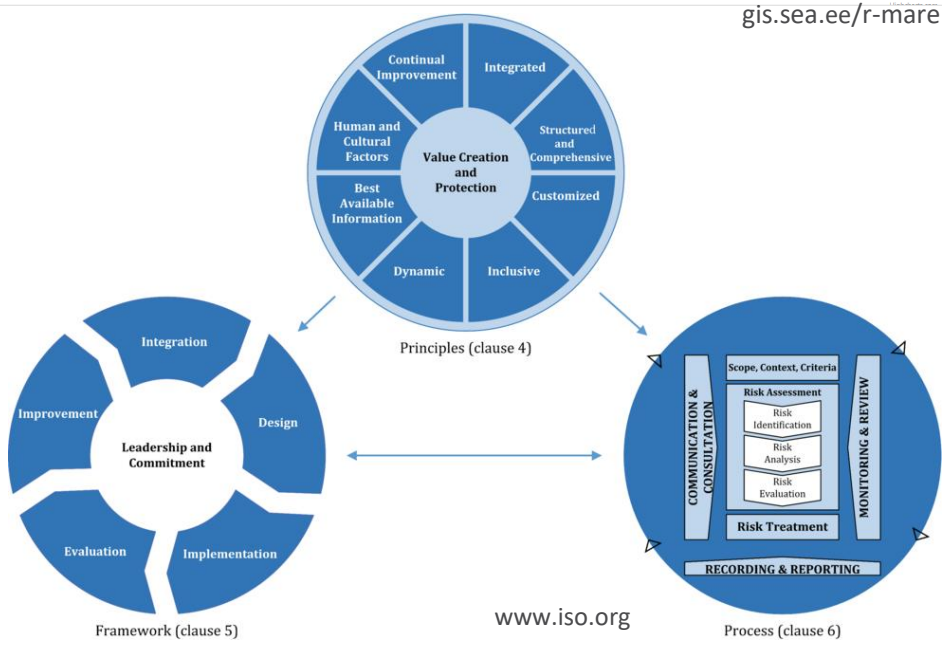


R-Mare Matrix & a risk quality method for tendering process

- **R-Mare matrix** is an online tool that enables maritime administrations to assess their current risk management performance and identify areas for improvement, guiding them towards higher maturity levels.
- **A risk quality method** for the tendering process ensuring that maritime risk studies meet high standards, delivering reliable and actionable results.



gis.sea.ee/r-mare



www.iso.org

Work plan overview and the progress

Work Package 1: Preparing Solutions	• The goal is to develop and prepare solutions to address the identified challenges.
Work Package 2: Piloting and Evaluating Solutions	• Focuses on piloting, evaluating, and refining the solutions to ensure they meet the desired objectives.
Work Package 3: Transferring Solutions	• The finalized solutions will be communicated and transferred to the target groups for implementation

The aim of the OpenRisk II workshop in Sopot

Work Package 1: Preparing Solutions

Work Package 2: Piloting and Evaluating Solutions

Work Package 3: Transferring Solutions

Current Status: Technology Testing and Validation

Engaging national and international end-users to gather valuable feedback, refine, and validate the initial versions of risk assessment and management tools.

Questions during presentations?
Please use QR code

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Aalto University

AISyRisk Baltic & Ice module

Jon-Arve Røyset, Norwegian Coastal Administration

Filip Zarzycki, Gdansk University of Technology

Mission Arena 4
28-29.4.2025 Sopot, Poland

AISyRisk a strategic risk tool

- The AISyRisk including the new ice module is a strategic planning tool for use in:
  - Maritime administration, government, research and development
    - Maritime spatial planning
    - Oil spill contingency and response planning
    - Traffic regulation
    - Evaluating the need for new measures on macro level (high level).
    - Other tools like for example IWRAP is normally used to analyse on a smaller scale.

AISyRisk, including the new Ice module, is not a tool for operational voyager planning.

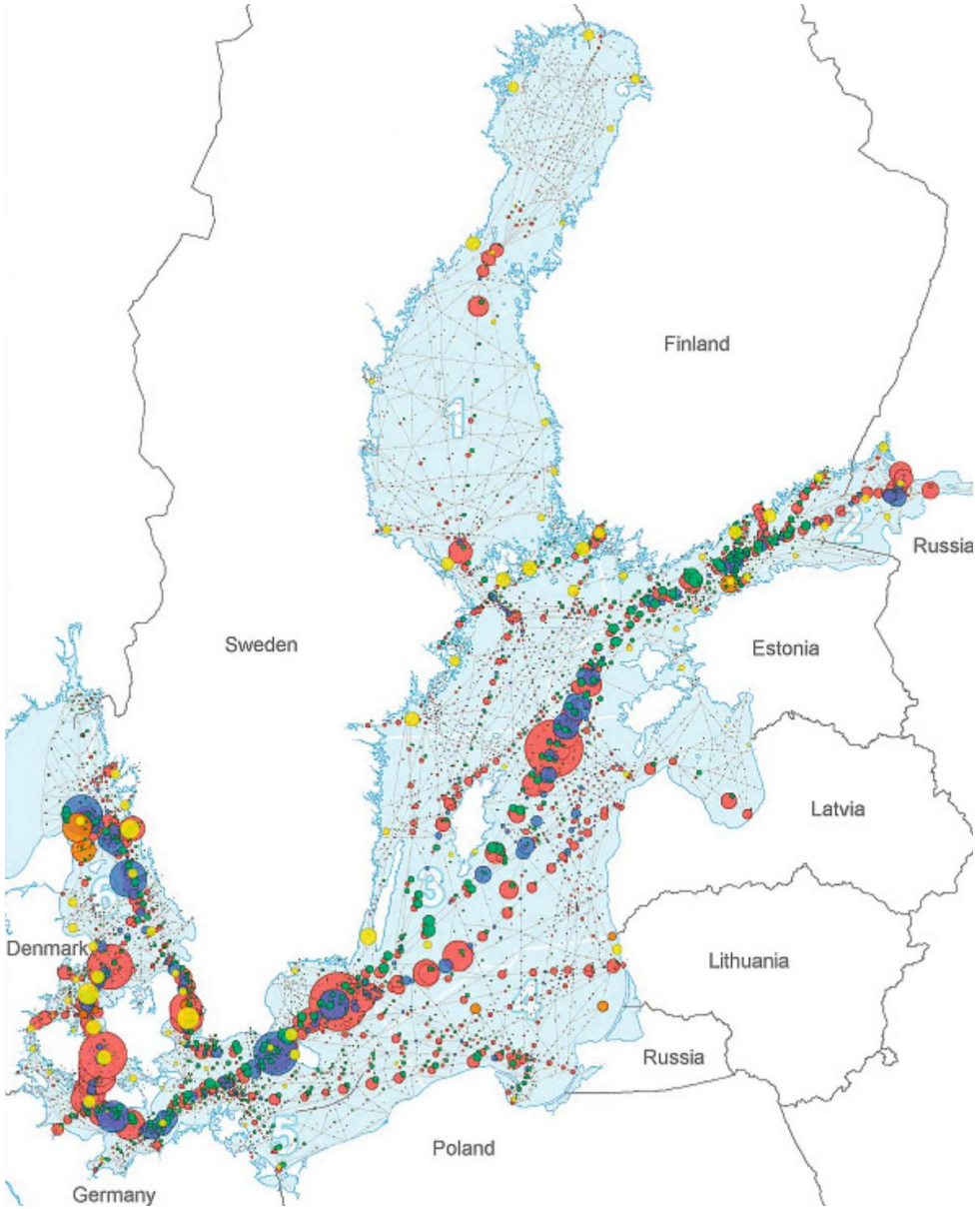
Background and objective

What is AISyRISK?

- AISyRISK is a method for automated estimation of risk. It is also a system for presenting the estimated risk in a dynamic and understandable way.

Why do we do it?

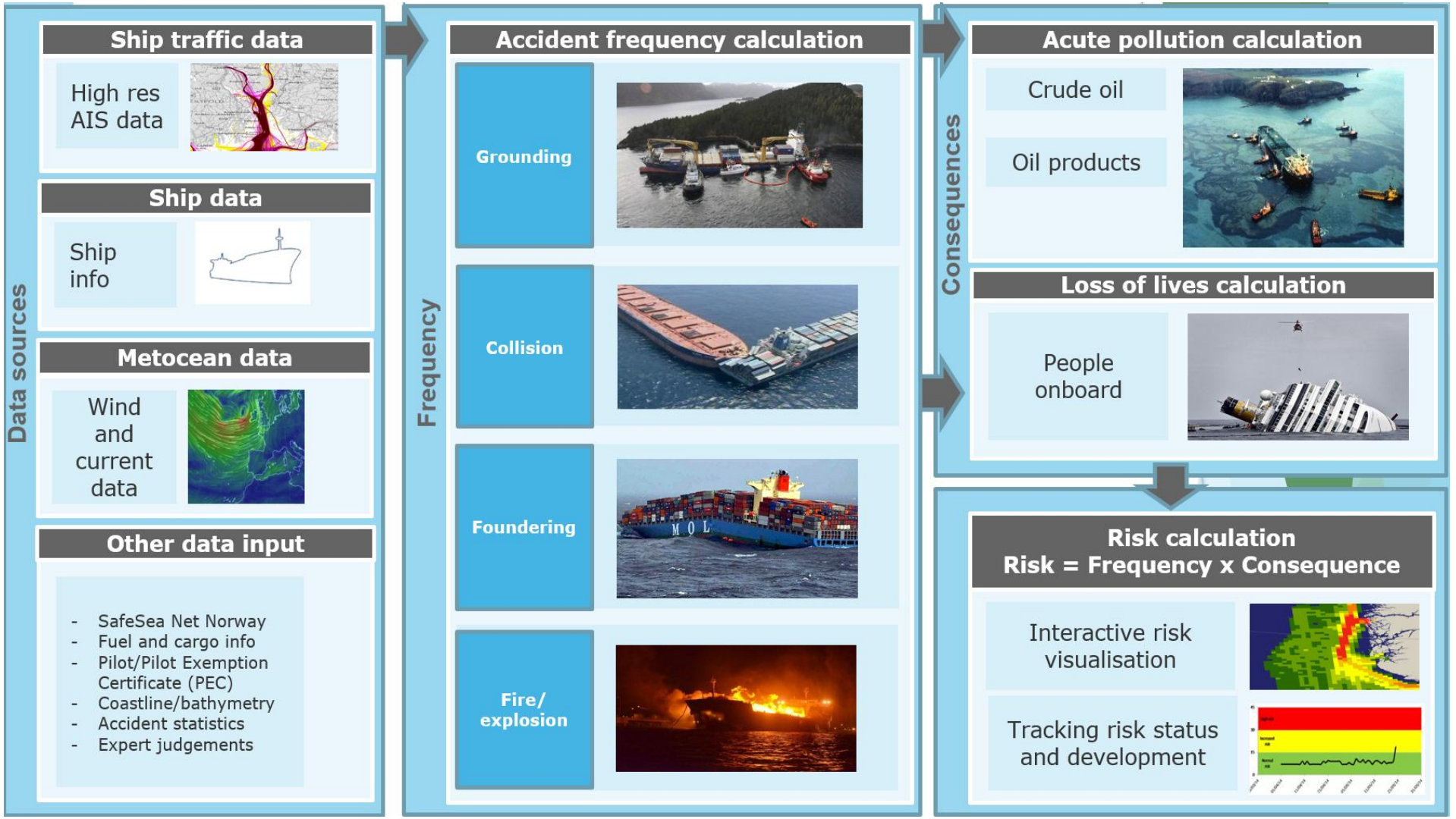
- **Objective:** The aim of the risk model is to assist the different users in their risk management activities related to maritime traffic.
  - Create an accurate and transparent system for monitoring trends related to frequency of accidents, including identifying high risk areas
  - Enable the users to regularly deliver information about risk level trends etc. for use in transport planning and risk planning processes, including risk planning processes on local and regional level



©BRISK

Risk assessment with traditional manual processing and models

AISyRISK input data at present



Existing framework developed for Norwegian Coastal Administration
3 integrated modules

AISyRisk

- Ship traffic composition
- Traffic trends
- Accident frequencies
- Spill frequencies for different oil/cargo types
- Acute oil pollution by fuel type
- Loss of lives

Eco-Sensitivity

- Mapping vulnerable environmental resources
- Oil drift modelling (Sea track web)
- Environmental consequences
- Risk index by combining frequency and environmental consequence

Response evaluation

- Mapping emergency spill response resources
- Setting performance requirements
- Gap assessment

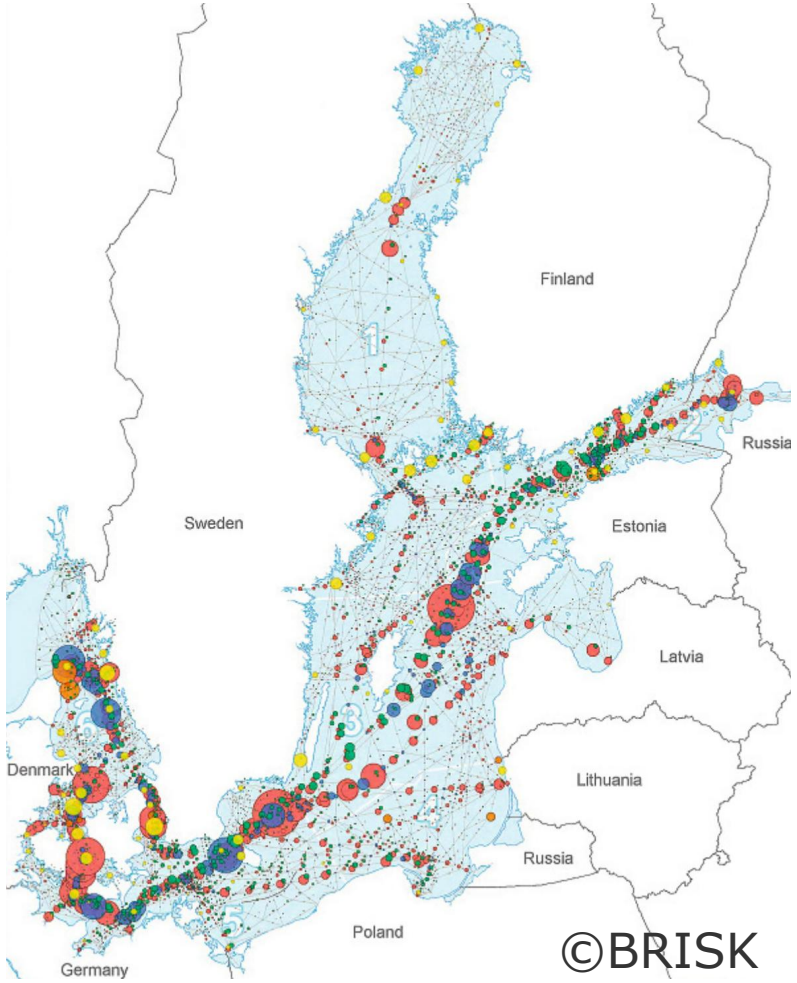
Input to decision-making processes

Risk model method

The risk model in AISyRisk considers a new methodology for the following accident types

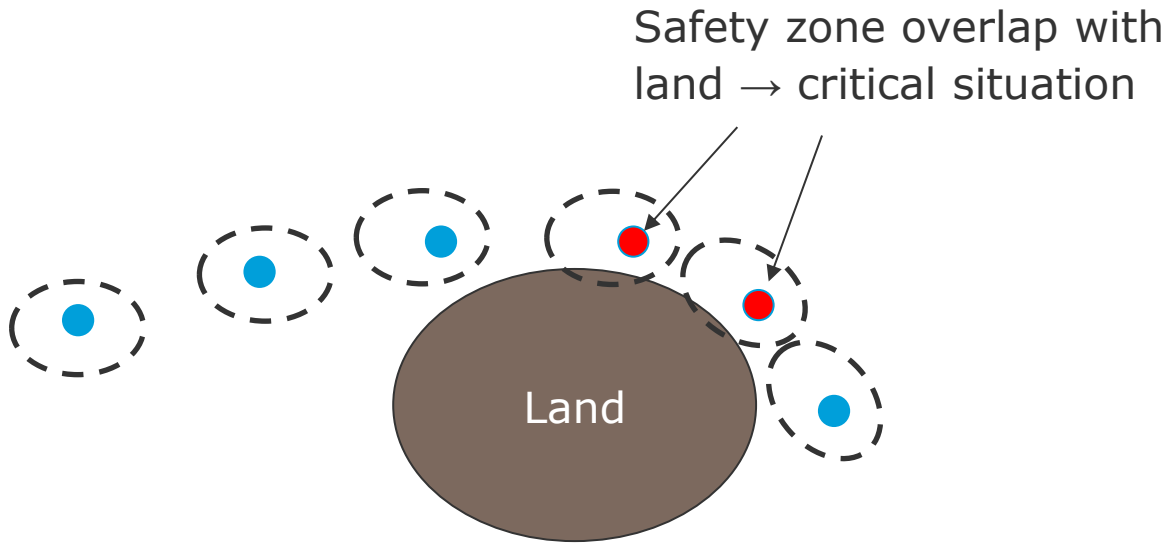
- Powered grounding
- Drifting grounding
- Collision

Probability of foundering and fire/explosion is based on existing method



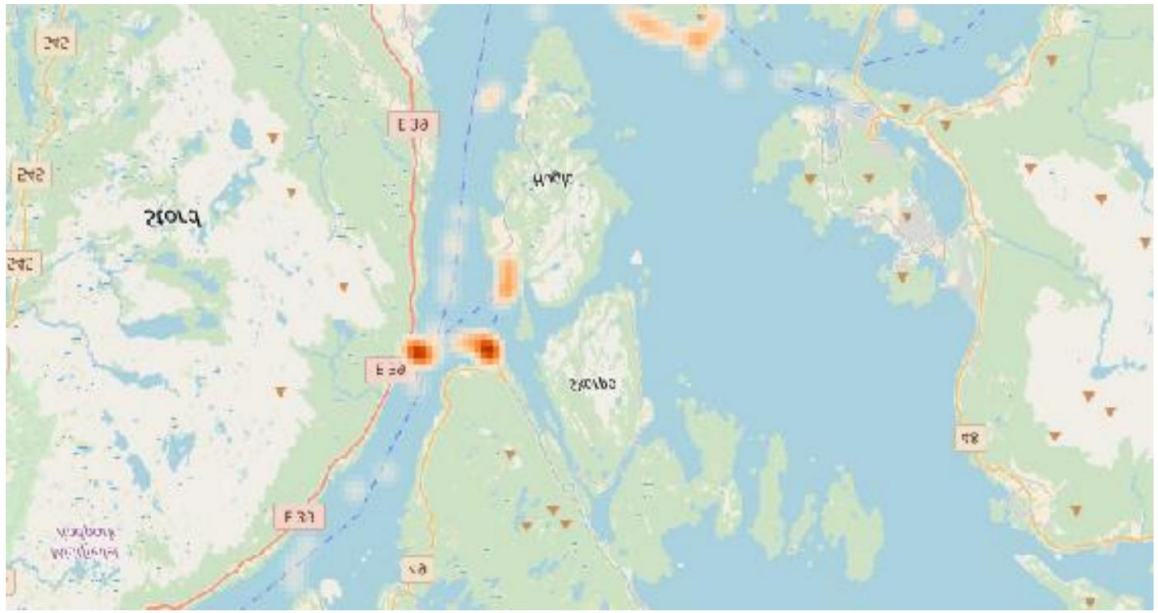
Powered grounding model – Sailing close to land

- Grounding for ships sailing very close to shore or in shallow waters
- Establishing a "safety zone" around each vessel
  - Checks for when the safety zone overlaps with land or too shallow water → critical situation
- To capture causes: *Navigational error, unmarked reefs or rocks, misconceiving position etc.*



Accidents = Number of safety zone overlaps ("accident candidates") × Causation Probability (P_C)

Clustering (gridded) of the critical turns showed on a heat map (high risk areas)



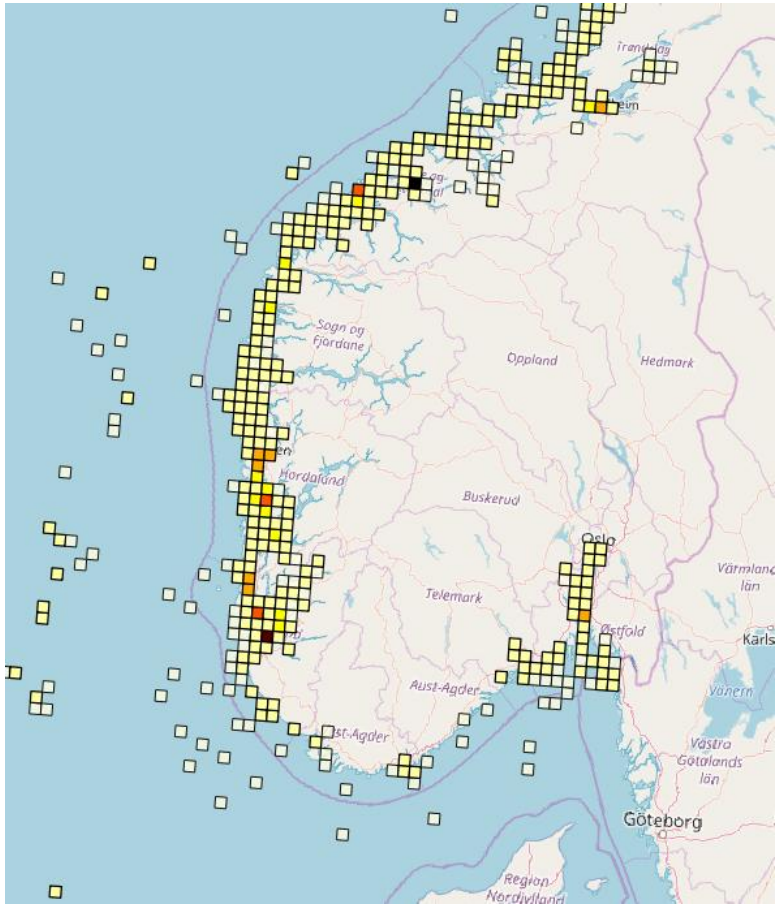
- Outputs

The outputs from the powered grounding type I candidate calculations are:

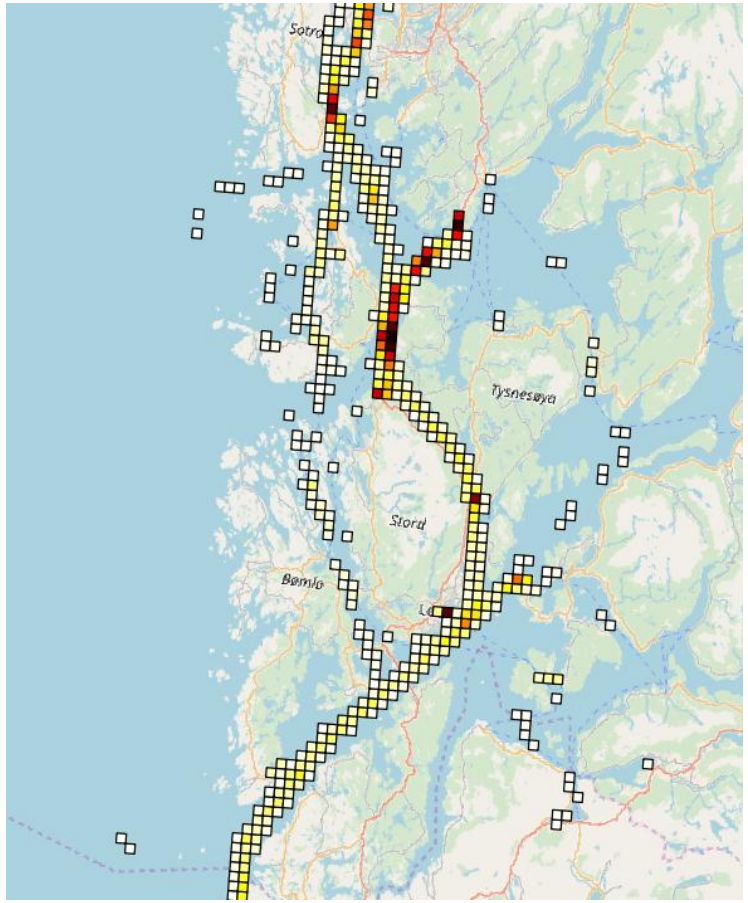
  - Number of critical ship turns.
  - Location of the critical turns (latitude and longitude of the start point of the critical turn).
  - Location of the hit point (latitude and longitude of the location for grounding).

Collision results

10x10 km grid



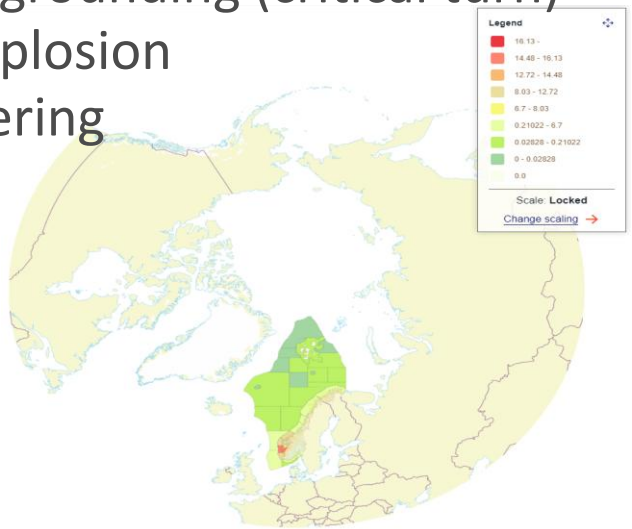
1x1 km grid



Ice module development

AISyRISK

Collision (crossing)
Collision (head on)
Collison (overtaking)
Drift grounding
Power grounding (close to shore)
Power grounding (critical turn)
Fire/explosion
Foundering



AISyRISK Ice module

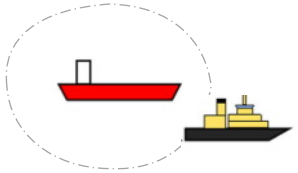
Collision (crossing)
Collision (head on)
Collison (overtaking)
Drift grounding
Power grounding (close to shore)
Power grounding (critical turn)
Fire/explosion
Foundering
Collision under assistance
Ice damage
Besetting in ice

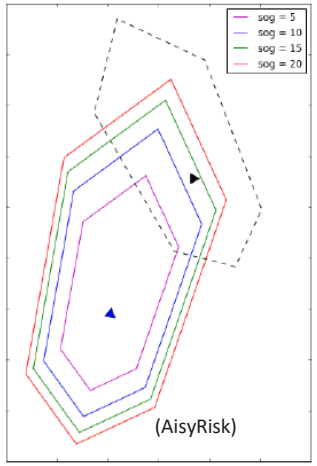
Collision under assistance

Operation modes

- Independent navigation 
- Escort 

- Convoy 

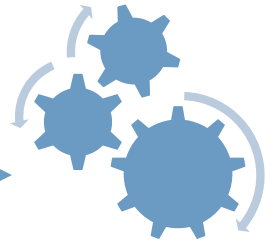
- Cutting loose 



$F = N \times P$

N – Accident candidate
P – Causation probability

Mode recognition



$F = N_m \times P_m$

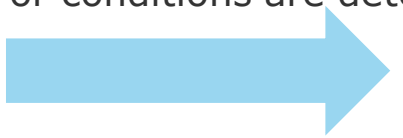
m – Operation mode
N_m – Candidate in mode m
P_m – Causation probability in mode m

What shall we calculate?

Accident Types in Ice
Collision - Over taking Collision – Crossing) Collision - Head on
Drift Grounding
Powered Grounding (close to shore)
Powered Grounding (missed turn)
Foundering due to ice
Fire / explosion
Besetting in ice
Ice damage
Collision under assistance
= Existing accident type
= New accident type

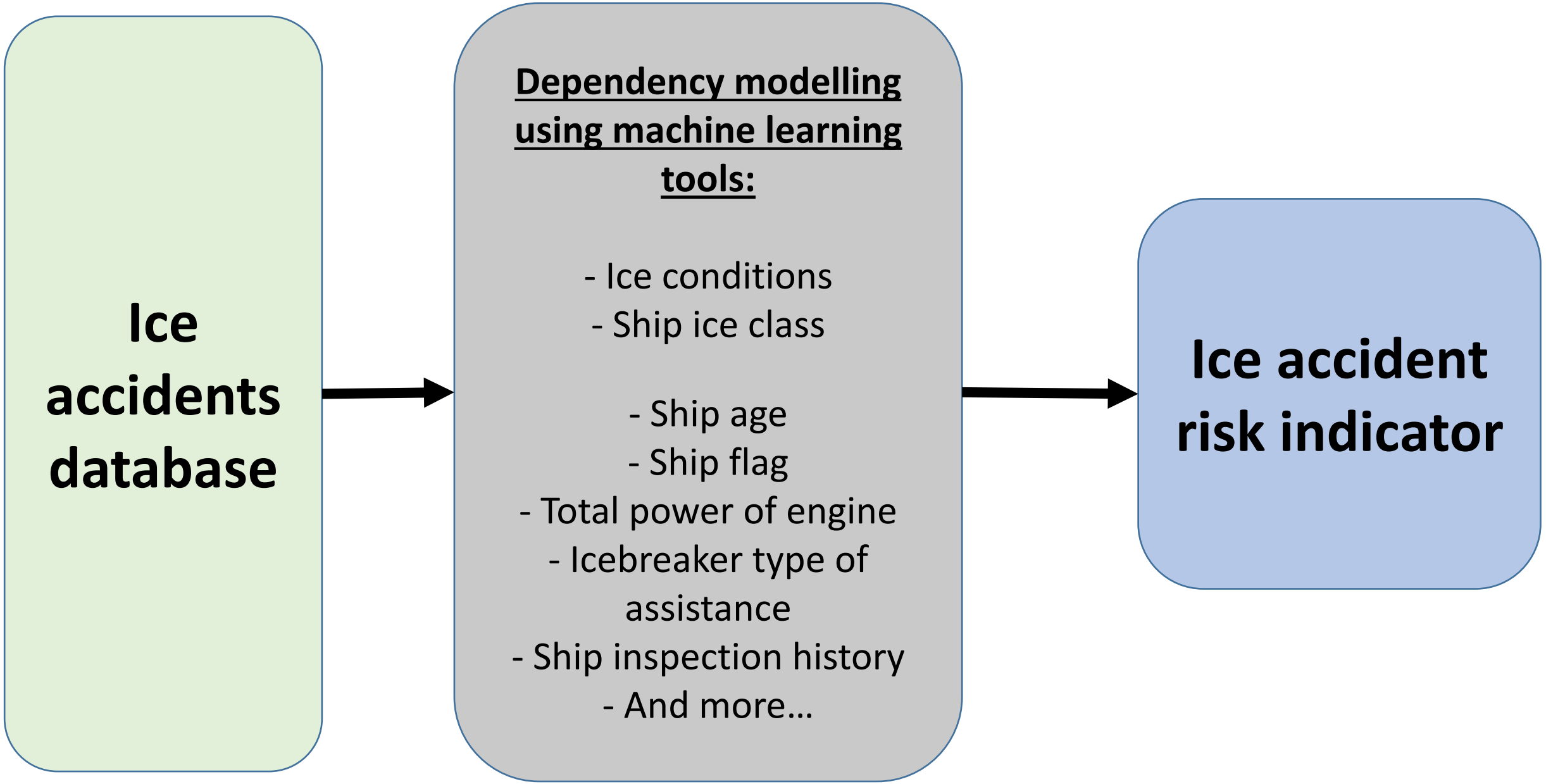
The frequency / probability of an accident occurring is dependant on the operation mode of the ship and the ice conditions the ship operates in.

I.e. the frequency needs to change if certain operations modes or conditions are detected.



Consequences
Expected Fuel Spill Volume
Expected Cargo Spill Volume
Expected Fatalities
Cost? **No**
Time lost? **No**

Operation modes (TRUE/FALSE)
1. Operating in ice
2. Independent operation in ice
3. Vessel following icebreaker
4. Vessel under tow
5. Vessel getting cut loose by icebreaker
6. Vessel sailing in convoy
7. Vessel sailing in an ice lead
8. Pressure ridges in ice regime
9. Glacier ice in ice regime
10. Vessel operating with positive Risk index
11. Vessel operating in remote areas
12. Operating in "light"/"harsh" ice conditions *Something representing the risk if ice navigation better then POLARIS. Representing the speed of the vessel through ice might be an option?*


Ice accidents database
Dependency modelling using machine learning tools:
- Ice conditions
- Ship ice class
- Ship age
- Ship flag
- Total power of engine
- Icebreaker type of assistance
- Ship inspection history
- And more…
Ice accident risk indicator

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Environmental sensitivity decision support tool

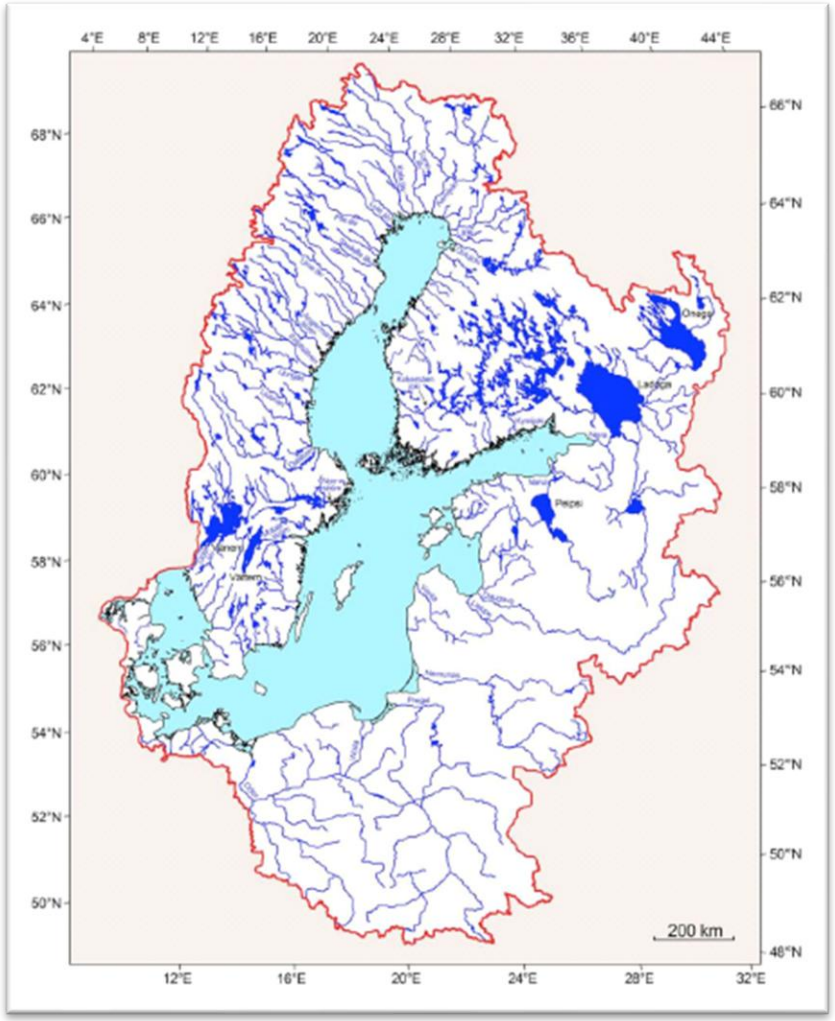
Anneliis Kõivupuu, University of Tartu

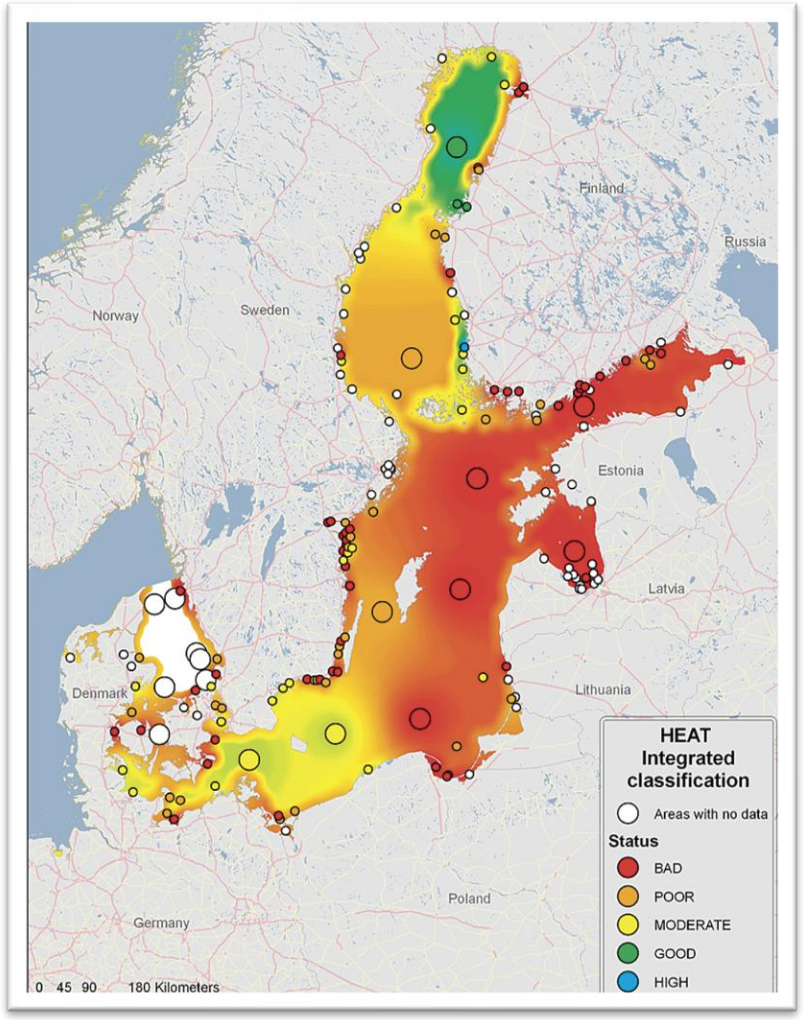
Annaleena Vaher, University of Tartu

Mission Arena 4

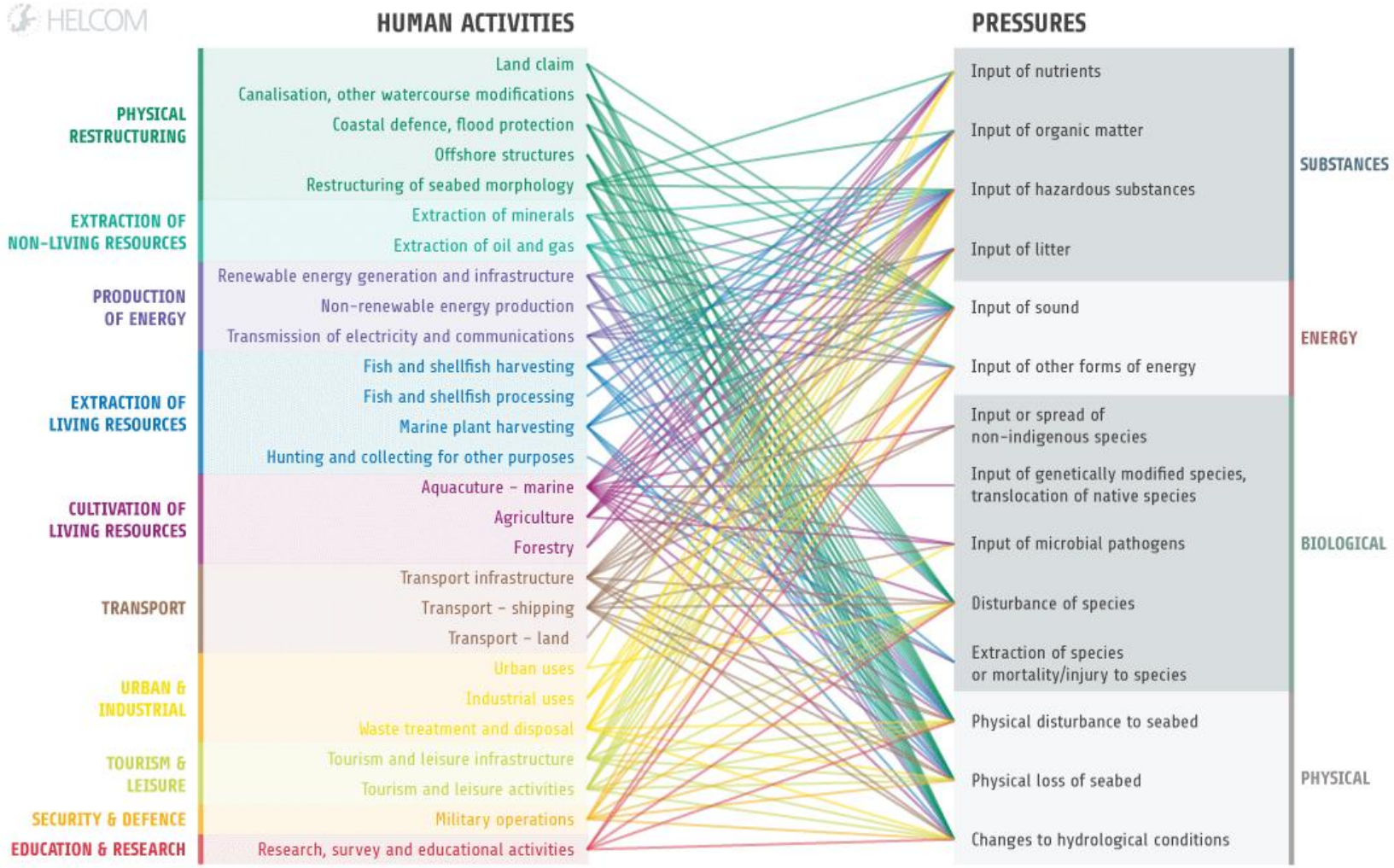
28-29.4.2025 Sopot, Poland

Baltic Sea is a transboundary ecosystem with large watershed area





Complex system: human activities and related pressures in the Baltic Sea

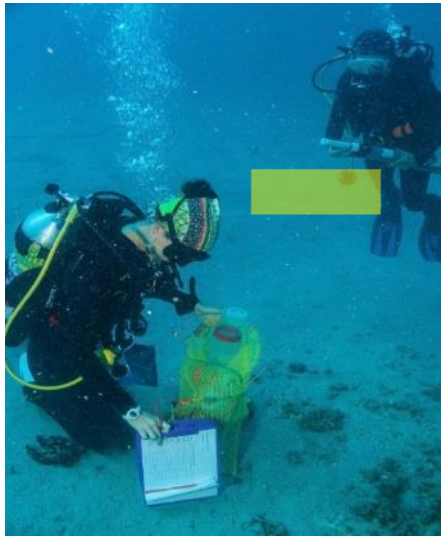


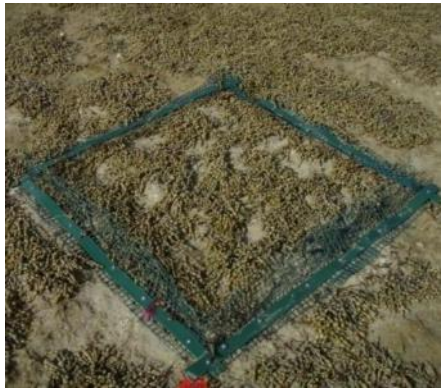
Cumulative impacts: Impacts on the environment that result from pressures of several human activities acting together, as caused by past, present or any possible foreseeable future actions.

ANALYSIS AND COMMUNICATION CHALLENGE

Need for **data and analysis** demanding assessment schemes

There are **disconnections of** flow from **science** (too specific) to **policy** (too large scale).

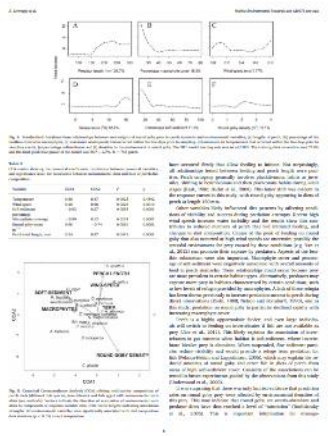





FEATURE ARTICLE

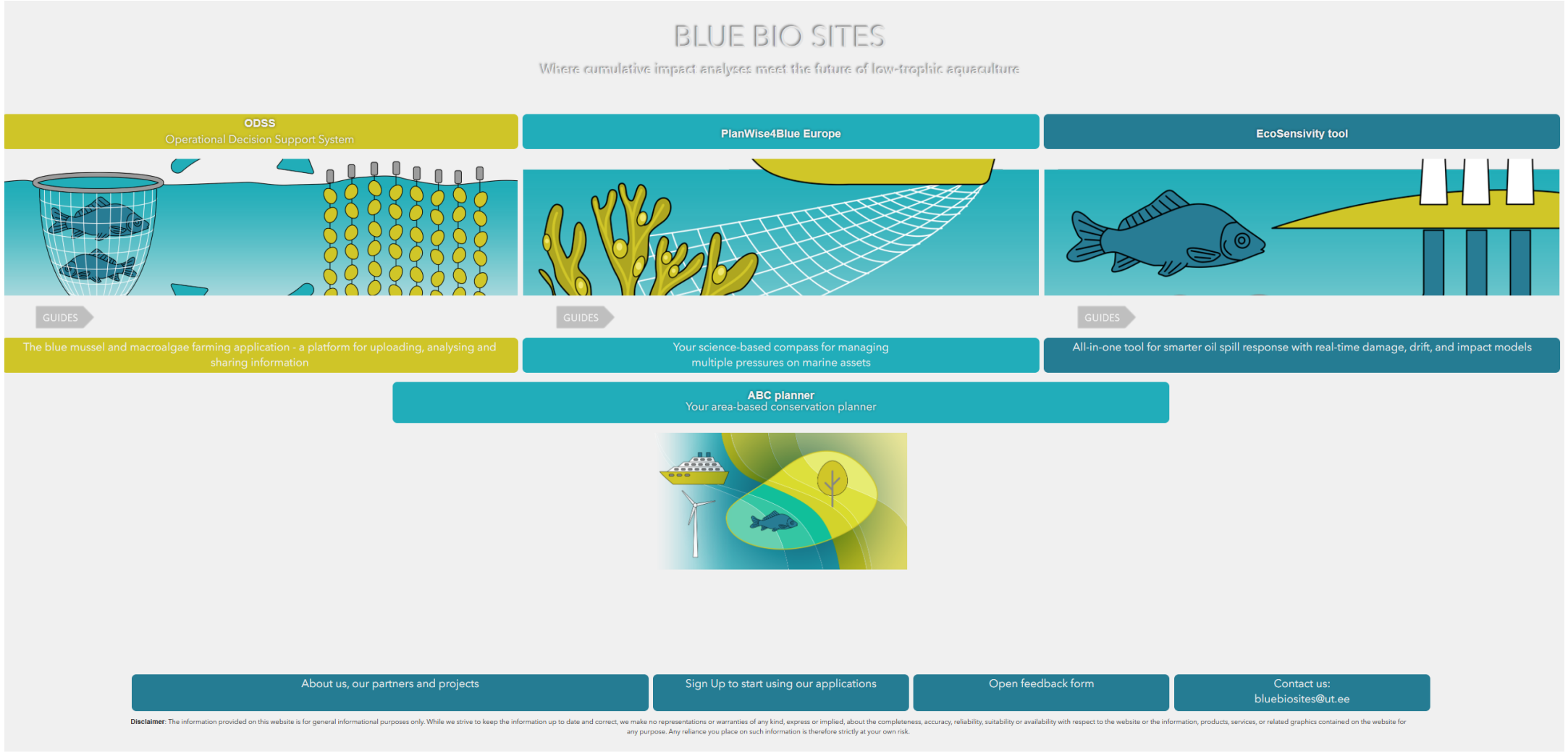
Gradients of disturbance to an algal canopy and the modification of an intertidal community

David R. Schiel*, Stacie A. Lilley



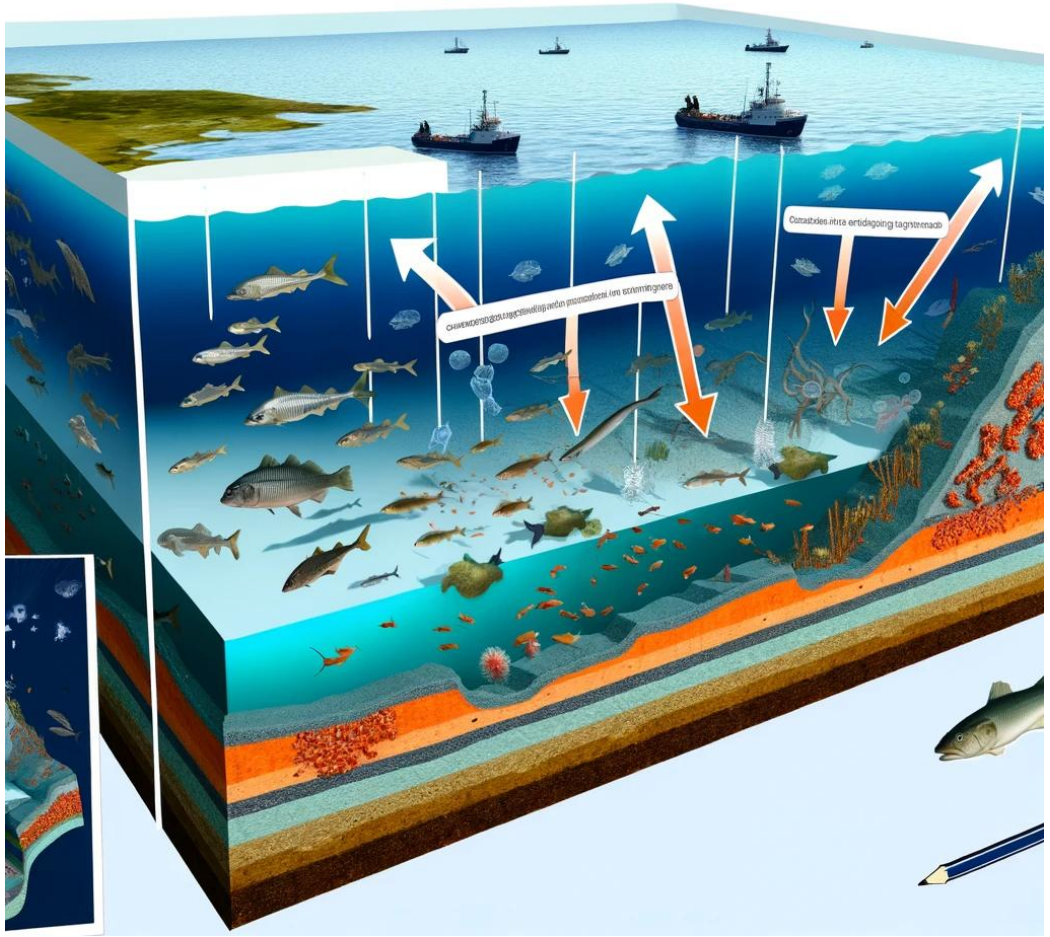
PW4B: Simple-to-use web tool

The PlanWise4Blue tool quantifies cumulative human impacts on key ecosystem elements at 1 km2 spatial scale.

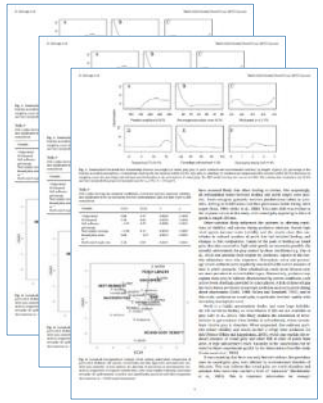


Key building blocks of the tool

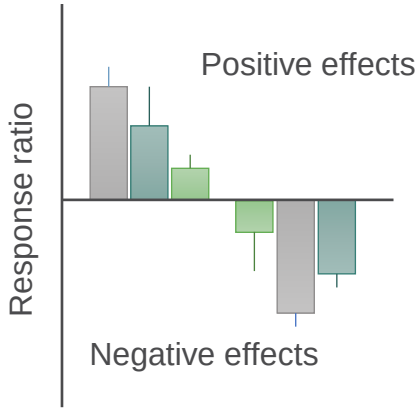
- Updated maps of nature assets
- Any scenario involving a combination of human activities
- Innovative algorithm predicting environmental impacts



Knowledge inventory: solid data and expert assessment



Extract data from relevant publications



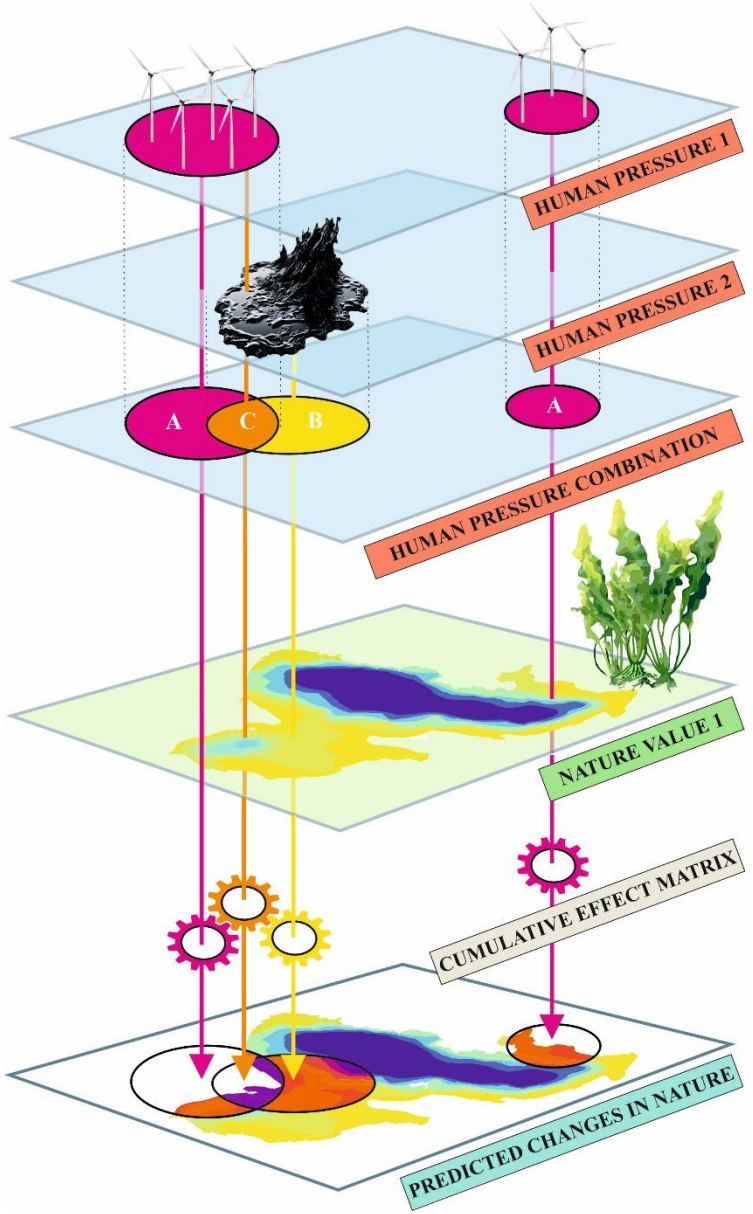
Meta-analyses and calculation of effect sizes

Nature value ID	env_layer_name	dredging	windpark	fish farming	shipping	underwater cable	commercial fishi	harbours
1	Bird - Benthos feeders	1	1	1	0.9	1	1	0.9
2	Bird - Fish feeders	0.75	1	0.9	0.9	1	0.9	0.9
3	Bird - Migration routes	1	0.75	1	0.9	1	1	1
4	Bird - Wintering areas	1	0.75	0.9	0.9	1	1	0.9
5	Bird - Herbivores	0.7	0.85	0.7	0.9	1	1	0.8
6	Fish - Herring spawning areas	0.75	1	0.9	1	1	1	0.9
7	Fish - Pikeperch spawning areas	0.75	0.9	0.9	1	1	1	0.9
8	Fish - Whitefish spawning areas	0.75	1	0.75	1	1	1	0.9
9	Habitat - Charophytes	0.5	1	0.5	1	0.9	1	0.75
10	Habitat - Fucus	0.9	1	0.9	1	1	1	0.9
11	Habitat - Furcellaria	0.75	1	0.75	1	1	1	0.9
12	Habitat - Higher plants	0.9	1	0.9	1	1	1	0.9
13	Habitat - Richness flora and fauna	0.5	1	0.9	1	1	1	0.9
14	Habitat - Suspension feeders	1	1.25	1	1	1	1	0.9
15	Habitat - Zostera	0.75	1	0.75	1	1	1	0.9
16	Seals - All species	0.9	0.75	0.9	0.9	1	0.9	0.9
17	HD - Sandbanks	0.66	1	0.76	1	0.98	1	0.86
18	HD - Mudflats and sandflats	0.63	1.06	0.89	1	1	1	0.9
19	HD - Reefs	0.79	1.06	0.89	1	1	1	0.9

Matrix of effects

The tool **integrates current empirical evidence through meta-analysis to quantify the effects** of human pressures on nature assets.

Innovative algorithm: GIS perspective



Reading scenario (spatial distribution of pressures)

Reading nature values

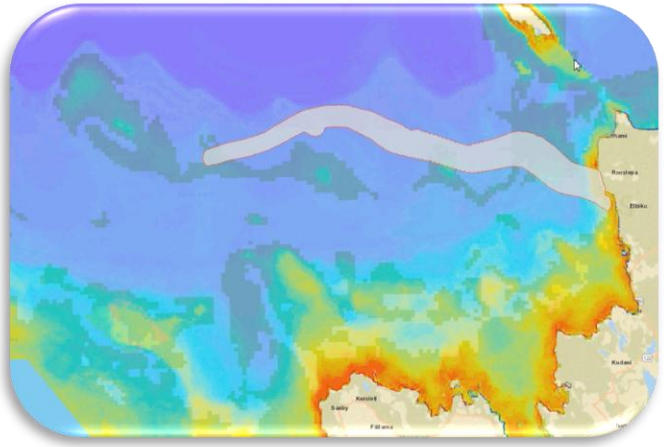
Running GIS modelling

Publishing maps on impacts

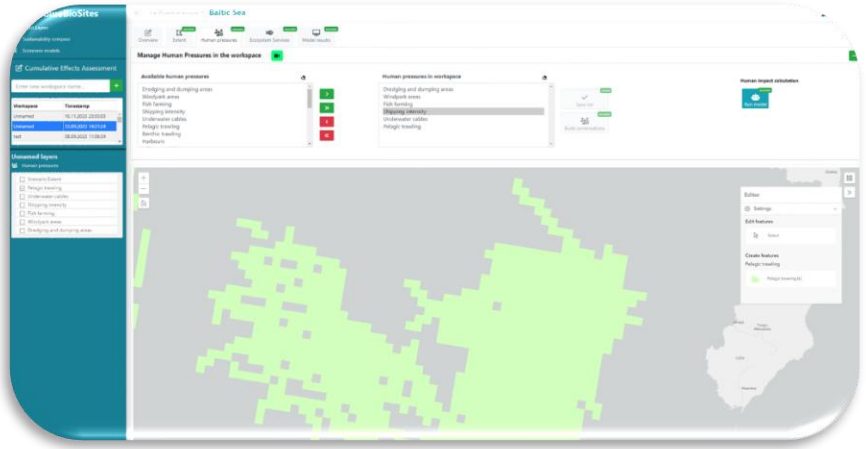
Addressing the Complexity of Oil Spill Impacts

- Oil Spills Are Highly Specific Events:
  - Vary by location, oil type, spill volume, and environmental conditions.
  - Require real-time response to minimize immediate damage.
  - Have long-term cumulative effects on marine ecosystems.
- Need for Integrated Response & Impact Assessment:
  - Existing models often lack real-time specificity and cumulative impact analysis.
  - Decision-makers need fast, data-driven tools for effective spill management.
- EcoSensitivity – A New Web Tool:
  - Combines oil spill dynamics with cumulative impact assessments.
  - Integrates real-time spill data, drift modeling, and ecosystem vulnerability.
  - Helps authorities prioritize response actions and long-term restoration.

Seatrack Web



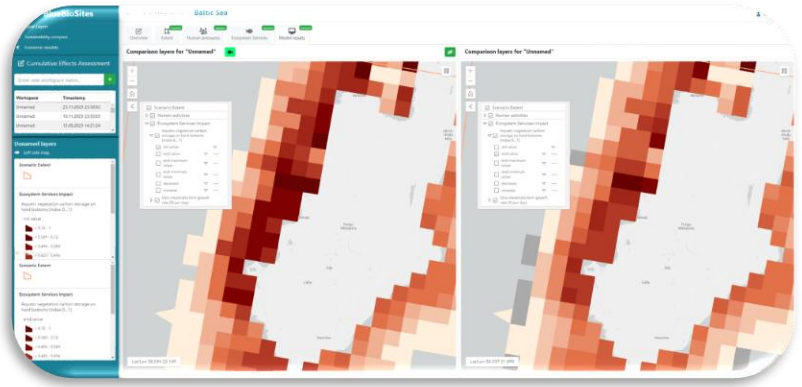
PlanWise4Blue: human pressures (oil spill)



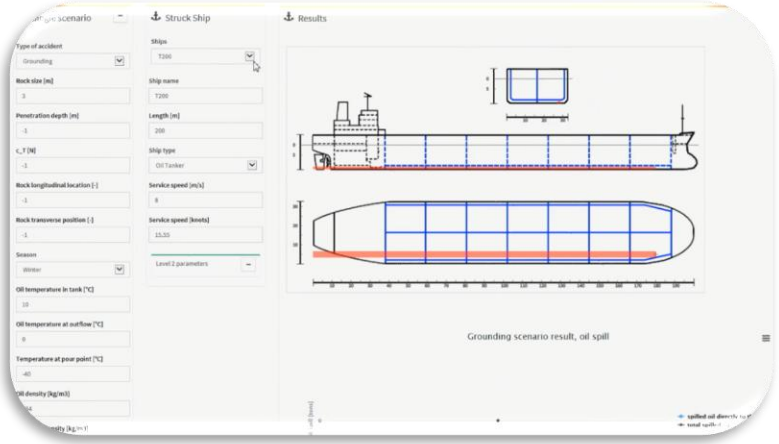
Selection of nature assets

PW4B: Calculating impacts

(Environmental Sensitivity Index)



ADSAM module



EcoSensitivity tool

Oil spill

Let’s see the EcoSensitivity tool closer:

Link to the video: https://www.youtube.com/watch?v=oCdQv6eIabY

Link to the online tool: https://gis.sea.ee/bluebiosites/

Future actions

- Advancing knowledge on new fuel types (Ultra Low Sulfur Fuel Oil, ULSFO) and their environmental behavior.
    - Developing predictive models for fuel dispersal and impact assessment.
- Other elements critical to response actions should be incorporated.
    - Engaging stakeholders to identify specific requirements.

Questions or comments?
Raise your hand or write

Action points

- **Conduct targeted research and regional training programs** to improve understanding of low-sulphur fuel spill behaviour and integrate this knowledge into operational protocols and response strategies across the South Baltic region

- **Strengthen regional cooperation frameworks** by enhancing the use and integration of risk assessment tools into national maritime safety protocols, ensuring harmonized responses to both environmental threats and security challenges

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