



# CIA Tool presentation

MYTILUS

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# Introduction

- As part of the INTERREG project NorthSEE, we needed a tool for cumulative impact assessment and considered the existing tools Symphony and EcoImpactMapper – though, they did not meet our requirements regarding licensing and functionality
- Due to our long experience in developing modelling and simulation tools we decided to develop our own tool (MYTILUS) – providing maximum flexibility for further development
- This development continued under the BONUS BASMATI project adding more statistics and conflict/synergy analysis between maritime activities



# Uses

- MYTILUS was originally developed as a research tool within the INTERREG project NorthSEE and the BONUS BASMATI project
- MYTILUS is currently part of the toolbox for planners in the Capacity4MSP project
- The software has been used in PhD courses
- Our current efforts are directed towards a broader application of MYTILUS as a decision support tool in real world MSP processes



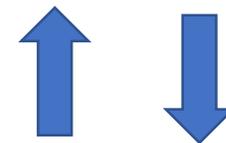
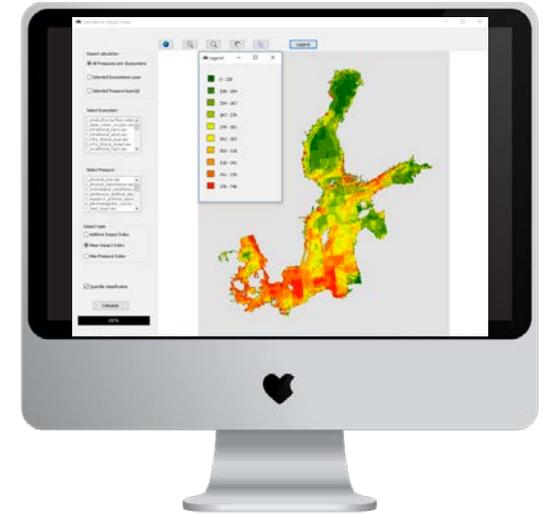
# Spatial scope

- MYTILUS is a general purpose tool for cumulative impact assessment and the spatial scope spans from local sea areas over regional seas like the Baltic Sea to global level
- It is independent of the coordinate systems chosen



# Input data

- All geographical data like pressure layers and ecosystem layers used in MYTILUS are in the open ESRI ASCII grid format facilitating easy exchange between MYTILUS and GIS software
- All pressure values normalised to (0-100)
- MYTILUS supports multi-resolution through a project organised architecture
- All layers are associated with metadata, which can be displayed within MYTILUS in order to keep track of the quality



ArcGIS / QGIS



# Resolution

- All map results are in principle in the same spatial resolution as the provided input data – showing results in a higher spatial resolution will not be correct from a quality assessment point of view
- All results can be aggregated into larger spatial units like Baltic Sea sub-basins, MPAs, Natura2000 areas or other planning units



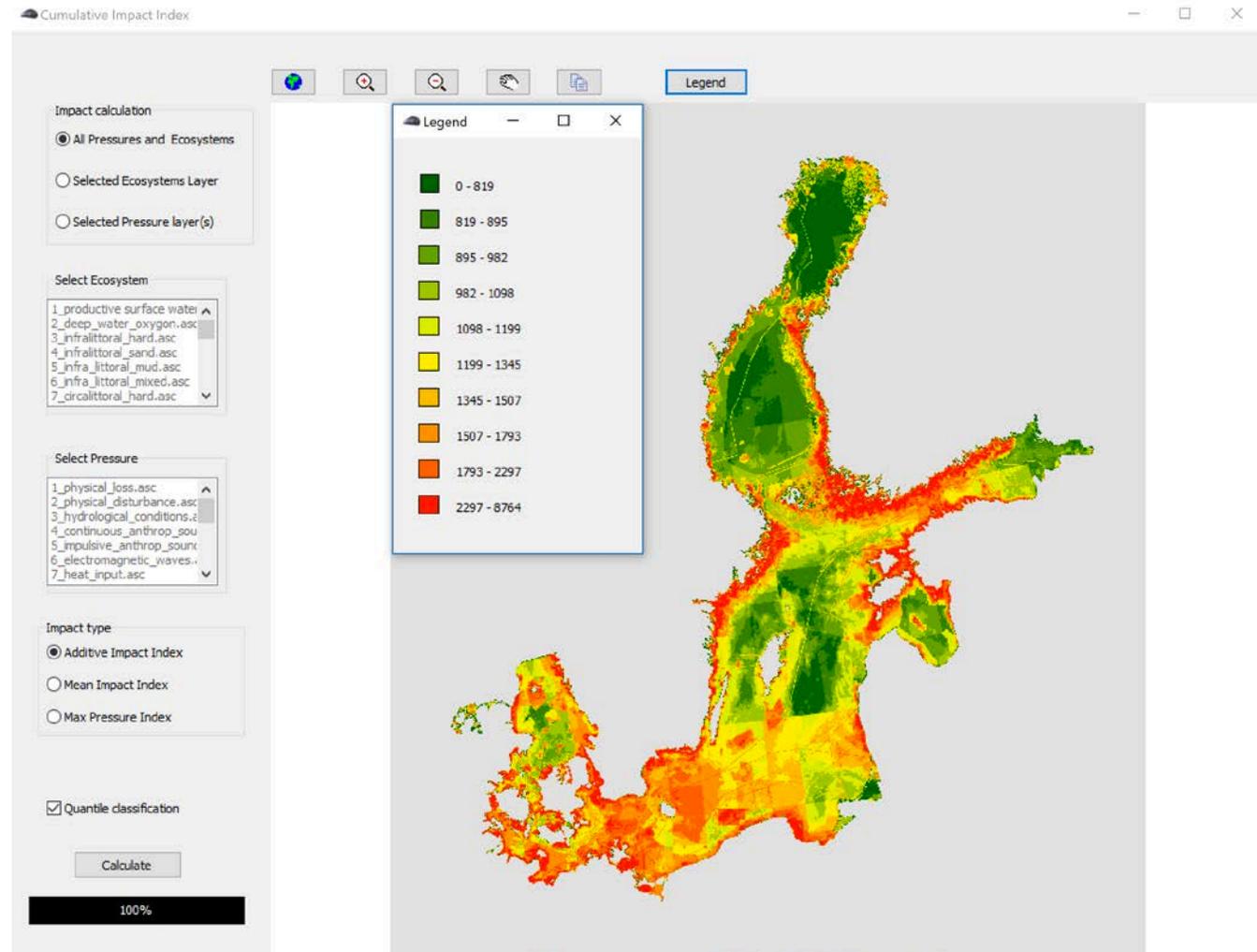
# Confidence/uncertainties

- The Halpern et al. formula for Cumulative Impact Assessment generates two types of uncertainty – the data quality of the pressure and ecosystems layers and the values in the sensitivity matrix
- The HELCOM pressure layers are of very different origins and the quality/uncertainty is difficult to assess and handle in the software
- Uncertainty estimates regarding the values in the sensitivity matrix are handled by MonteCarlo simulation – running the CIA 100 times by adding/subtracting a random number to the weights in the sensitivity matrix thus facilitating mean and variance calculations



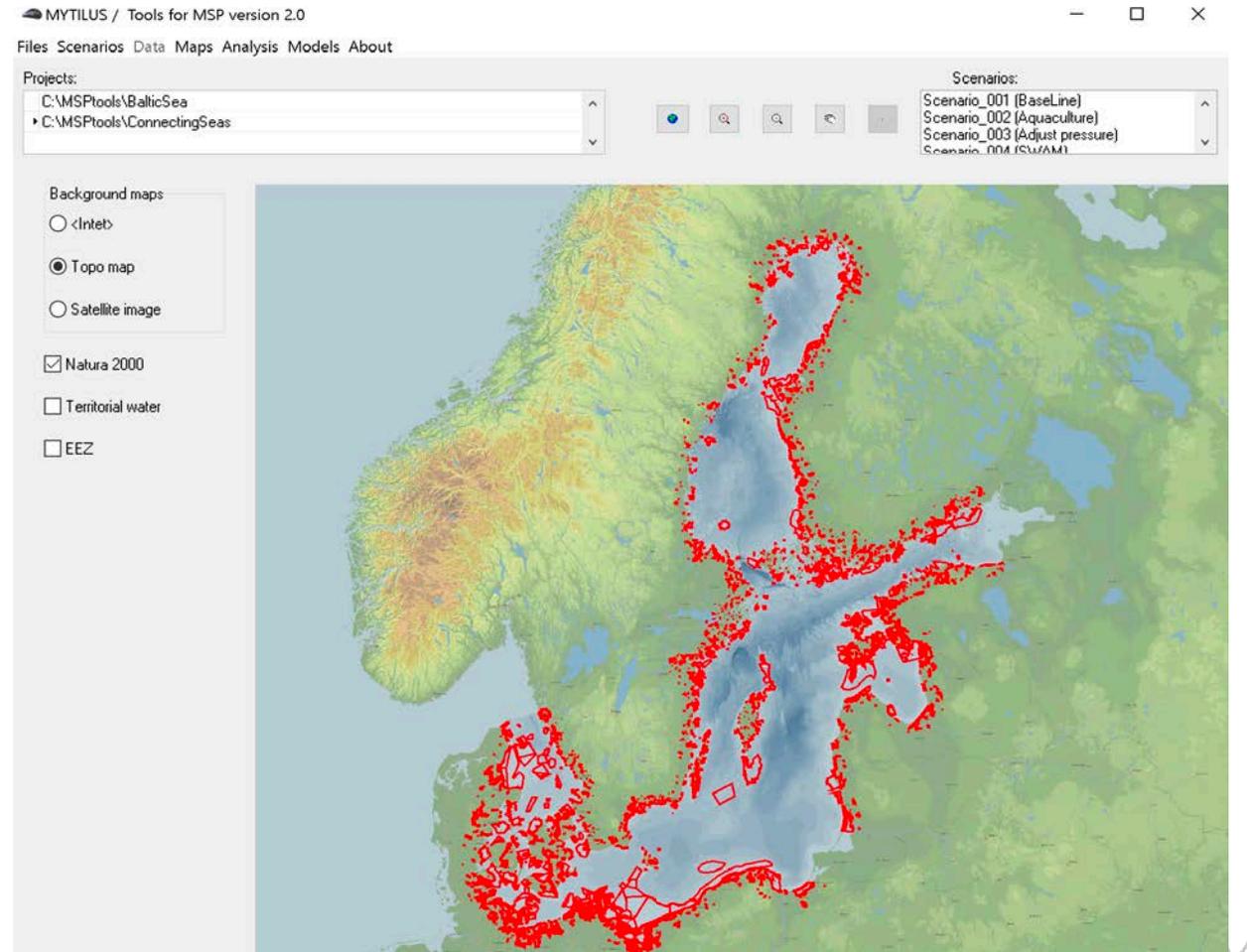
# Calculation principle

- The CIA is estimated using the formula by Halpern et al. but extended with mean impact index, eco-diversity index, weighted and unweighted pressure index, and maximum pressure index
- Due to the calculations principles in MYTILUS new indices can easily be added



# Platform

- MYTILUS is an independent desktop application running under Windows 10 – and requires no additional licenses
- Installation is very simple



# Ownership

- The MYTILUS software is fully free and open source
- It is developed fully at Aalborg University, Institute of Planning by the research team on *Ocean & Coastal Management*
- This ensures a continuous development of MYTILUS



# Strengths

- MYTILUS is free and open source
- Easy extensible to cope with new ideas and requirements
- Scenario-based approach for comparing different future developments
- Project-based approach to support multi-resolution in one case area or to handle different case areas
- Extremely fast – can calculate the CIA for the whole Baltic Sea using HELCOM data in less than 10 seconds



# Weaknesses

- MYTILUS has not yet been used in a real world Maritime Spatial Planning context



# Proportional values

- The data structure behind MYTILUS is based on data cubes storing all information about each pressure's impact on the ecosystems for each cell or aggregated into other spatial units
- Therefore MYTILUS is already now able to present proportional values of impact for different pressures?
- This can also be presented in maps
- The current version of MYTILUS cannot link proportional impact back to the source activity but through further development (in less than one year) this may be possible although. But the challenge is that there is no always a 1-to-1 relationship between activities and pressures



# Indirect and direct pressures

- The current version of MYTILUS does not differentiate between direct and indirect pressures
- ... but this is realistic to implement within less than 1 year
- You can easily represent the results of direct and indirect on two different maps – but in one map – I don't think so



# Scalable spatial presentation

- MYTILUS can now scale **up** to whatever resolution based on resolution of the input data. This just require a raster layer with the new resolution.
- Scaling **down** is not possible because such a process will provide a fake view of the inherent data quality / resolution
- MYTILUS can handle higher resolution for some pressures but now a mixture of pressures.
- However you can have two different projects applying different resolutions and compare the result



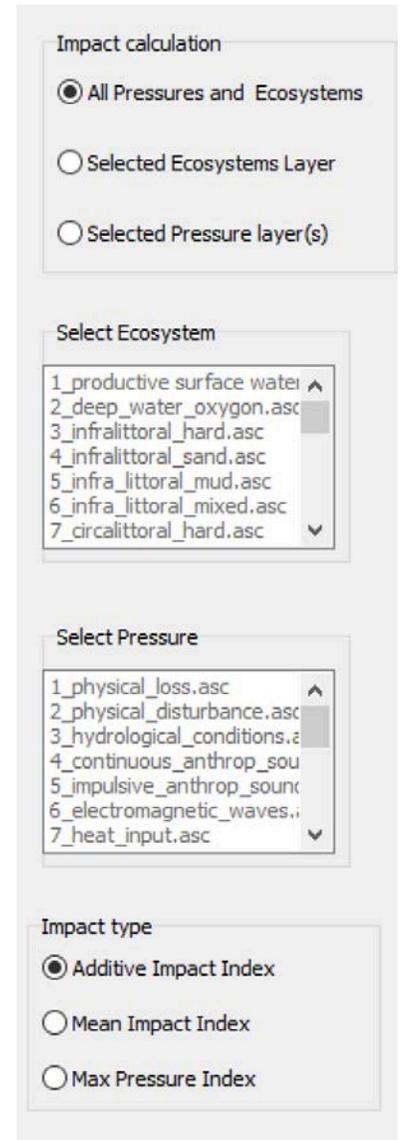
# Pressure-effect response

- YES – MYTILUS is open and flexible and can incorporate non-linear pressure-effect responses – if needed and agreed upon
- We believe that the main challenge will be to agree upon which pressure-effect responses should be handled in a non-linear fashion and how.
- Linear responses are straightforward – but non-linearity can be defined in many different ways



# Aggregations and constellation analyses

- The current version of MYTILUS can calculate impact
  - From a specific pressure or group of pressures
  - On specific ecosystems or group of ecosystems



Impact calculation

All Pressures and Ecosystems

Selected Ecosystems Layer

Selected Pressure layer(s)

Select Ecosystem

1\_productive surface water ▲

2\_deep\_water\_oxygen.asc

3\_infralittoral\_hard.asc

4\_infralittoral\_sand.asc

5\_infra\_littoral\_mud.asc

6\_infra\_littoral\_mixed.asc

7\_circalittoral\_hard.asc ▼

Select Pressure

1\_physical\_loss.asc ▲

2\_physical\_disturbance.asc

3\_hydrological\_conditions.a

4\_continuous\_anthrop\_sou

5\_impulsive\_anthrop\_sou

6\_electromagnetic\_waves.i

7\_heat\_input.asc ▼

Impact type

Additive Impact Index

Mean Impact Index

Max Pressure Index



# Uses for ecosystem based management (EBM)

- CIA can be used as a basis/tool for implementing holistic management (Ecosystem Based Management (EBM)).
- - CIA can be used for environmental management (e.g. for conservation purposes).
- - CIA can be used to inform the planning and implementation of measures
  - CIA can be used for prioritising management activities
  - *CIA can be used to support Maritime Spatial Planning*



# Climate change

- This depends what you mean with climate change.
- MYTILUS can handle climate change as a pressure affection the ecosystems. This just requires that the sensitivity matrix contain the values describing the effect on the ecosystems of climate change
- ... and we believe that current effects of climate change should be part of HOLAS III



# Forecasting/projections

- MYTILUS is already prepared for handling projections – the main challenge is to get the needed changes in pressures over time
- Projections in the MYTILUS tool will be handled by reading pressures and calculate CIA for future years within a loop
- This is straight forward and does not require much further development to implement
- The challenge is to



# Thank you!

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