Risk and Impact assessment of scrubber water discharge

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Clean Arctic Alliance Webinar

Scrubbers: The end of an end of pipe solution?

2023-11-22

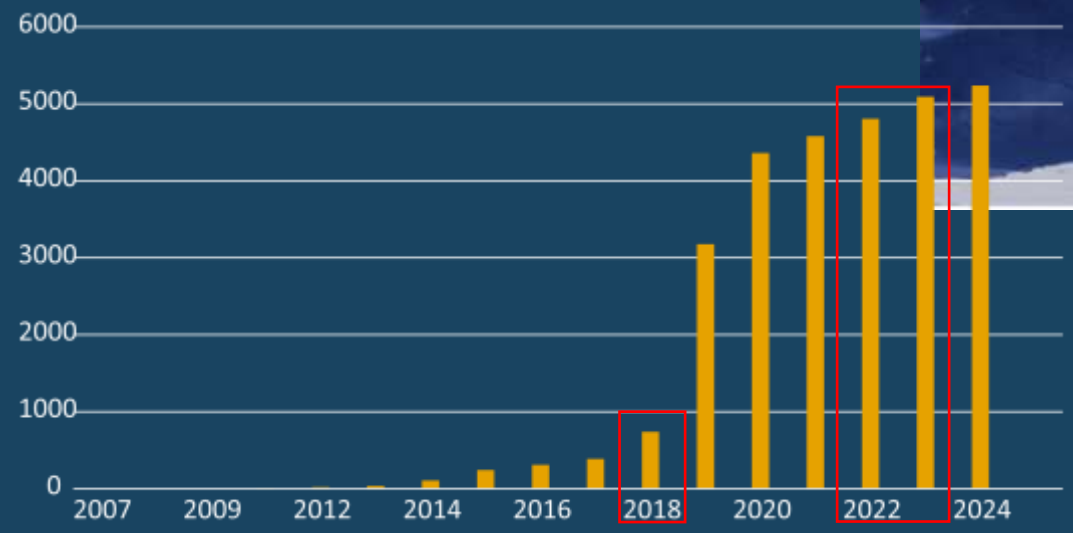
EMERGE = Evaluation, control and Mitigation of the EnviRonmental impacts of shippinG Emissions

- 18 partners from 10 European countries
- Coordinated by Jukka-Pekka Jalkanen, FMI
- 5 case study areas
- 1 onboard campaign
- Atmospheric and marine distribution of contaminants (modelling framework)
- Chemical characterisation (water & air)
- Ecotoxicological tests (5 case studies)
- Impact assessments and optimization

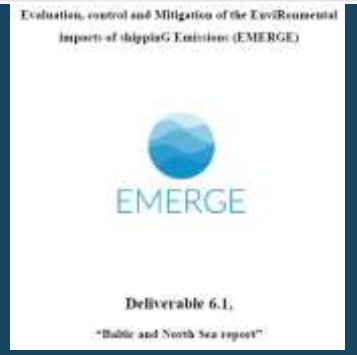
https://emerge-h2020.eu/consortium/

EMERGE synthesis in 3 reports - Deliverable 6.1

- Baltic and North Sea focus
- 2018 as baseline and 2050 scenarios
- 2018 (underestimation)



Growth of scrubber-equpped fleet: https://afi.dnv.com/statistics/



https://research.chalmers.se/publication/538393

Marine Environment Protection Committee (MEPC) guidelines

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MEPC.1/Circ.899
10 June 2022

2022 GUIDELINES FOR RISK AND IMPACT ASSESSMENTS OF THE DISCHARGE WATER FROM EXHAUST GAS CLEANING SYSTEMS

1 The Marine Environment Protection Committee, at its seventy-eighth session (6 to 10 June 2022), approved the *2022 Guidelines for risk and impact assessments of the discharge water from exhaust gas cleaning systems*, as set out in the annex.

Impact assessment chapter Regulation 7.4 (MEPC, 2022):

…the adoption of restrictions or a ban on discharge water from EGCSs should be considered in areas where any of the following indicative criteria are fulfilled:

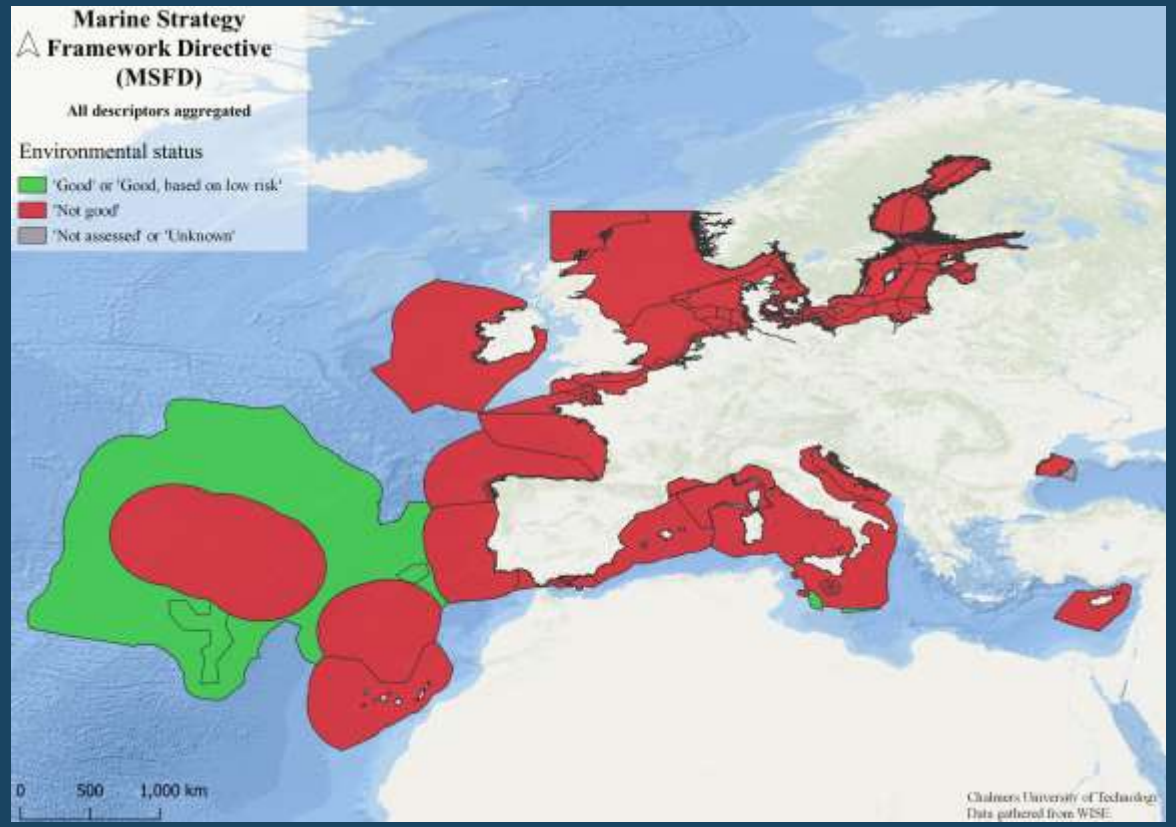
.1 environmental objectives in the areas are not met, e.g. good chemical status, good ecological status or good environmental status are not achieved under applicable legislation;

.2 the discharge of EGCS effluents represents an additional risk of deteriorating the environment and the resiliency of the climate system;

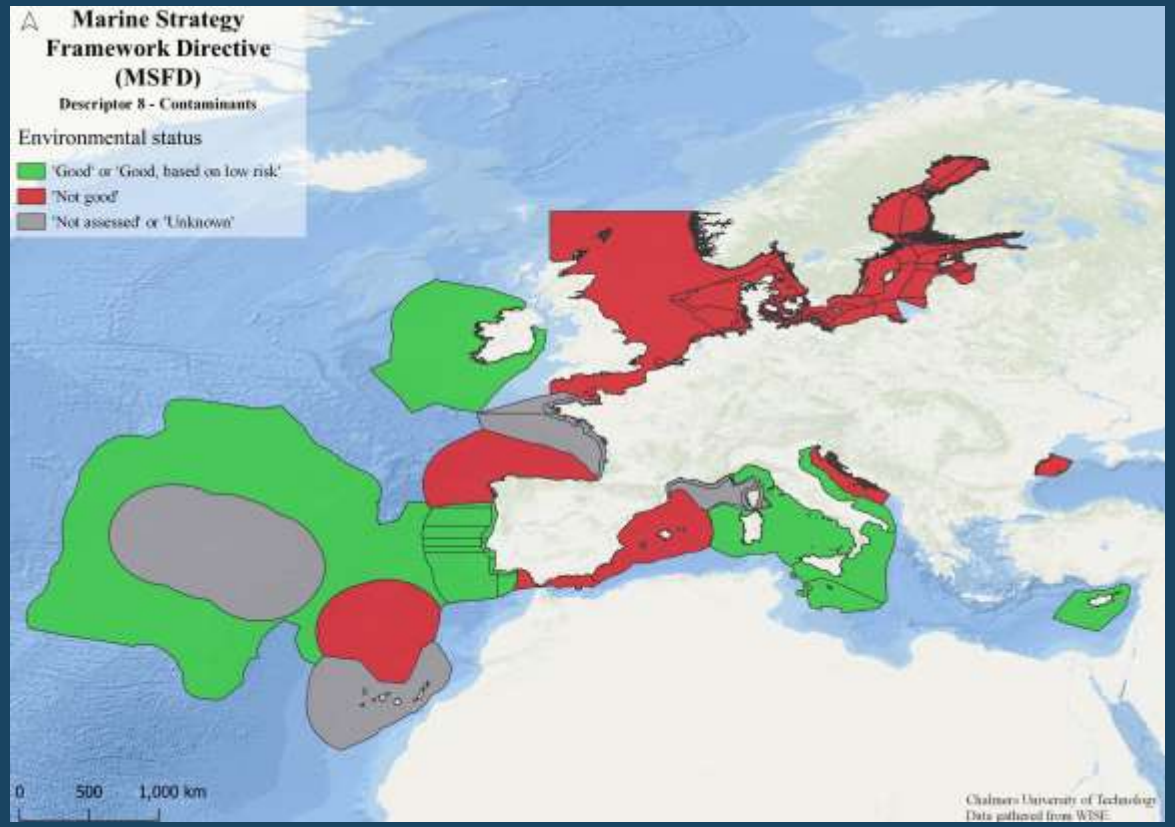
.3 the EGCS discharge water conflicts with the conventions and regulations formulated to protect the marine environment (see UNCLOS Article 195, etc.); and

.4 the EGCS discharge effluent represents an increase in the costs of management of dredged materials in ports.

EMERGE Impact assessment, following MEPC guidelines, show that a ban on discharge water from scrubbers should be considered in the entire Baltic and North Sea region



All descriptors aggregated – one out all out



Descriptor 8 – Contaminants.

Impact assessment chapter Regulation 7.4:

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7.3 Incorporation of the following steps for the specific receiving environment:

.1 a systematic review of the impacts of the discharge water;

.2 specific modelling for physical distribution and fate of the components in discharge water and comparing the PNEC and PEC considering the cumulative effects of the mixture, i.e. use the PEC/PNEC summation approach;

Environmental Risk Assessment

Chemical fate/distribution models

Ecotoxicity tests

PEC
Predicted Environmental Concentrations

PNEC
Predicted No Effect Concentrations

Risk characterisation ratio

$$RCR_i = \frac{PEC_i}{PNEC_i}$$

$$RCR_{sum} = \sum_{i=1}^{n} \frac{PEC_i}{PNEC_i}$$

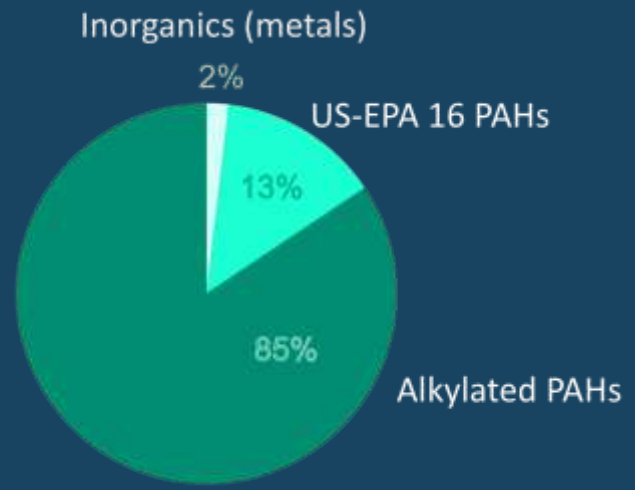
RCR < 1
Acceptable environmental risk

RCR > 1
Unacceptable environmental risk

ERA can be performed on single substances found in scrubber water, e.g. PAHs and metals.

Over 60 substances has been identified in scrubber discharge water

- very time consuming to derive PECs for all substances
- PNECs are lacking for the vast majority of the substances



Relative contribution to the average cumulative risk quotient, calculated for open loop scrubber water from the EMERGE onboard campaign. The RCRsum was 13342

Environmental Risk Assessment using whole effluent testing

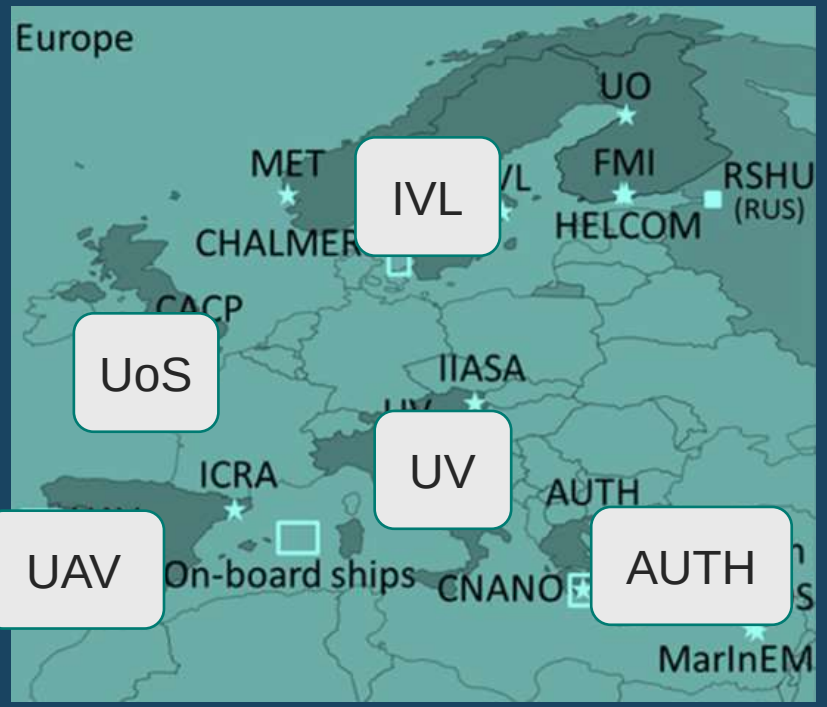
2022 GUIDELINES FOR RISK AND IMPACT ASSESSMENTS OF THE DISCHARGE WATER FROM EXHAUST GAS CLEANING SYSTEMS

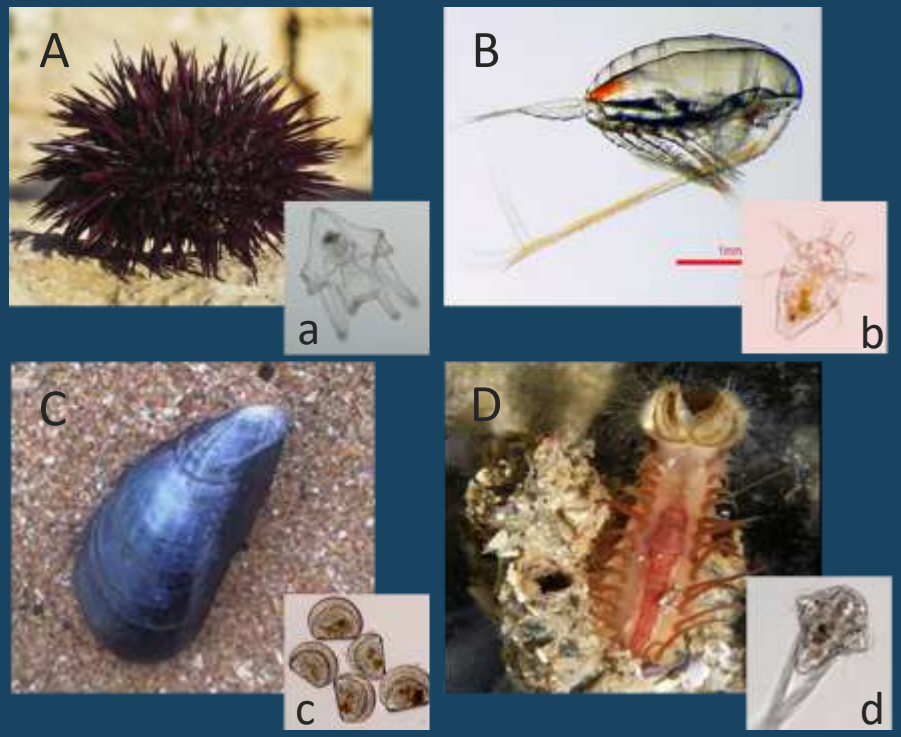
6 RISK CHARACTERIZATION

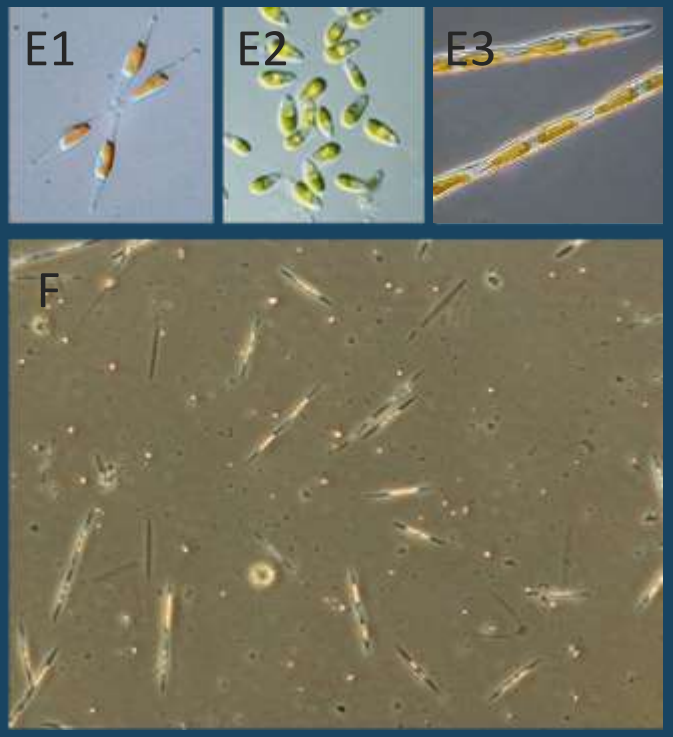
6.7.12 From the long-term viewpoints, the ratio between the resulting dilution ratio from the long-term calculation of PECs and the $PNEC_{general}$ from chronic WET tests should be calculated, and where the result is below 1, the assumption is that no unacceptable risk will result from exposure to the aggregated ecotoxicity of the discharge water from EGCS.

Ecotoxicological tests derive PNEC

- Scrubber water exposure in different concentrations (0.0001%-40%)
- Different species and life stages (sea urchin, copepod, mussel and microalgae)
- Mesocosm studies – species distribution
- Effect at lowest tested concentration (0.0001%) in developmental stages
- Derive $PNEC_{general}$ (deterministic approach) and determine LOEC





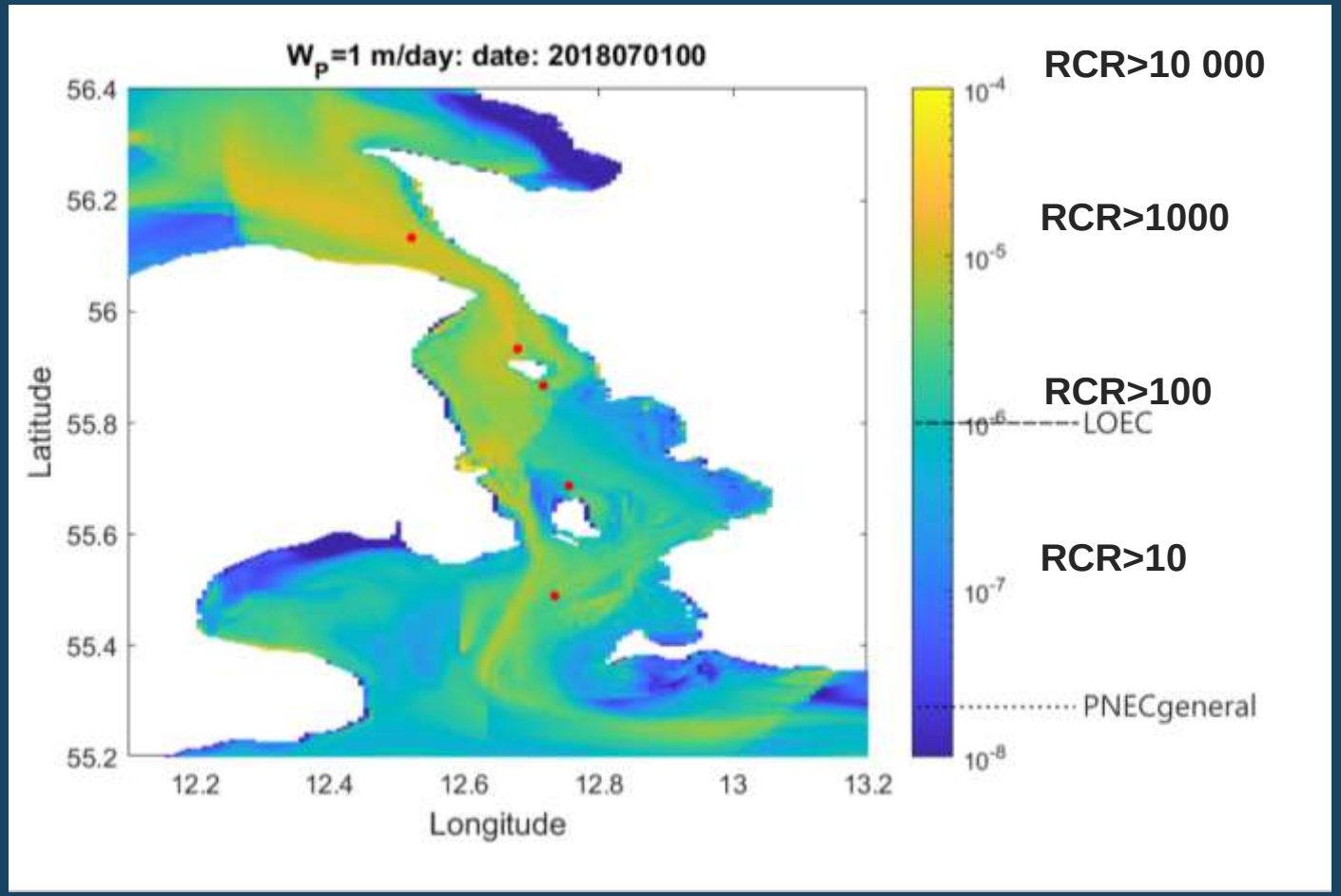


Source: EMERGE Deliverable 2.3.
https://www.ivl.se/download/18.5ae47fd818530c6f06024d0a/1676036161374/D2.3.%20%E2%80%9CReport%20on%20scrubber%20water%20whole%20effluent%20toxicity%20testing,%20at%20different%20geographical%20regions%E2%80%9D.pdf

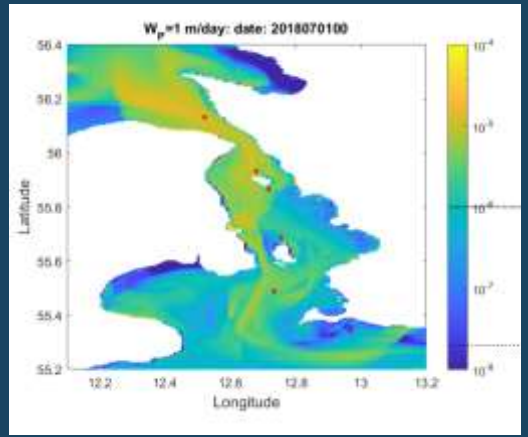
2023-11-22

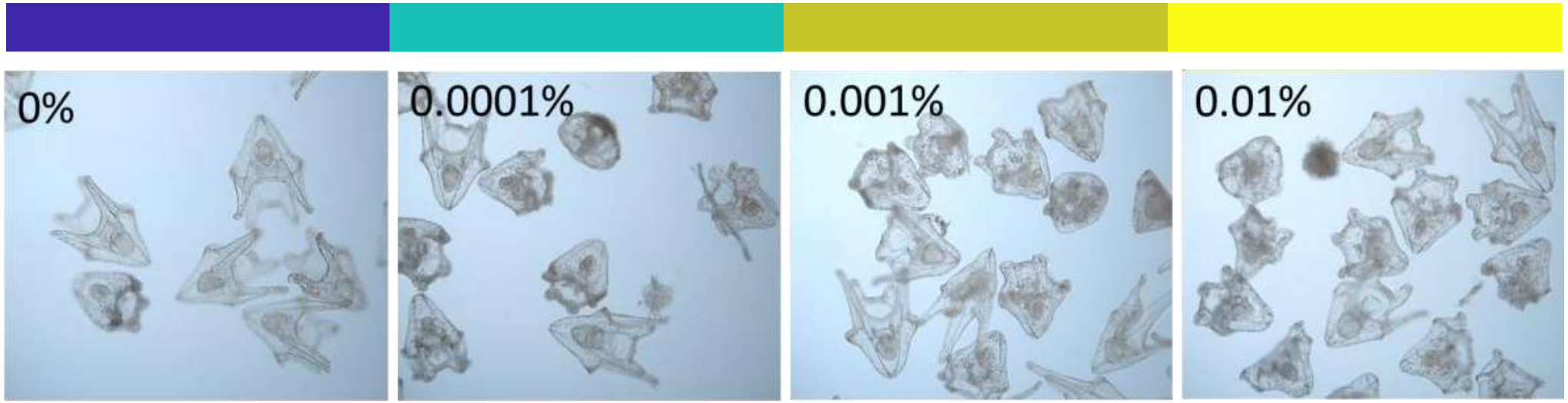
EMERGE environmental risk assessment show unacceptable risks of using open loop scrubbers

- Open loop scrubber water discharge in July 2018 (ship activity data from STEAM)
- Öresund case study
- Surface water concentration as dilution (PEC)
- PEC exceed LOEC and PNEC by 100-10000 times



Effects at the lowest tested concentrations





Larval morphology on day 10 in the exposures of different scrubber water dilutions, from 0% (control) to 0.01% scrubber water. C.Y. Chen, K. Magnusson, S. Dupont, R. Pfeiffer & M.E. Granberg (manuscript in prep.)

Conclusions

…the adoption of restrictions or a ban on discharge water from EGCSs should be considered in areas where any of the following indicative criteria are fulfilled:

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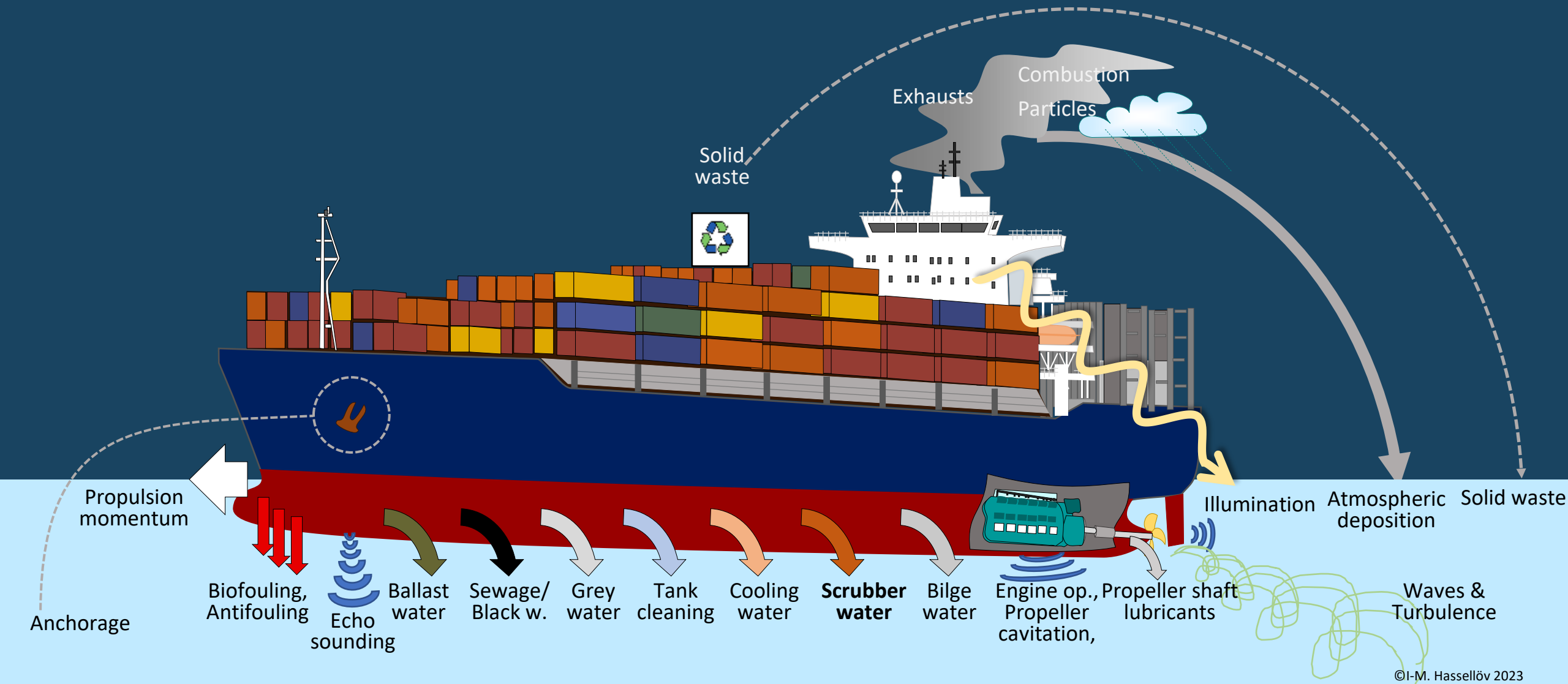
.3 the EGCS discharge water conflicts with the conventions and regulations formulated to protect the marine environment (see UNCLOS Article 195, etc.); and

.4 the EGCS discharge effluent represents an increase in the costs of management of dredged materials in ports.

One ship – many waste streams



Selection of references

- EMERGE deliverable D6.1 Baltic and North Sea report. https://research.chalmers.se/publication/538393
- EMERGE deliverable D2.3 Report on scrubber water whole effluent toxicity testing, at different geographical regions. https://www.ivl.se/download/18.5ae47fd818530c6f06024d0a/1676036161374/D2.3.%20%E2%80%9CReport%20on%20scrubber%20water%20whole%20effluent%20toxicity%20testing,%20at%20different%20geographical%20regions%E2%80%9D.pdf
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- C.Y. Chen, K. Magnusson, S. Dupont, R. Pfeiffer & M.E. Granberg (manuscript in prep.)