

Air pollution from ships

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Big questions

Shipping pollutes, but how do we

- **Know what is emitted, how is it dispersed, where the impacts occur and how to quantify them**
 - Air, Water, Noise
- **Predict what is emitted, where, when, by whom and how much**
- **Design/test regulation** which mitigates/removes the identified problems and at the same time maximises benefits and minimises damages
 - Benefits to sectors of economy? Single nations? Overall human wellbeing? Flora/fauna? Climate?
 - Avoid creating new problems → SO_x scrubbing, methane emissions, antifouling paints, **reflagging**
- **Develop methods for enforcement** of the rules which have been agreed at national, regional and international levels
 - Science of SO_x/NO_x monitoring; from local applications to satellite instruments
 - New ways for relaying information, working together

Changes in legislation affecting air emissions from ships

SOx Emission Control Area

Stepwise reduction of S in marine fuels; May 2006, July 2010, Jan 2015

NOx Emission Control Area

Gradual replacement of vessel fleet with less NOx emitting vessels: IMO Tier I-III (2000, 2010, 2016/2021)

Sulphur directive

IMO Marpol Annex VI → EU law + additional requirements for vessels in port areas, passenger vessels on regular routes within EU waters

Energy Efficiency Design Index

Gradual, mandatory improvements of vessel design with numerous exceptions, implementation in Phases 0-3 (-2015, 2015, 2020, 2025)

Global sulphur reduction in ship fuels

Jan 2020 onwards, only max 0.5%S fuel is allowed

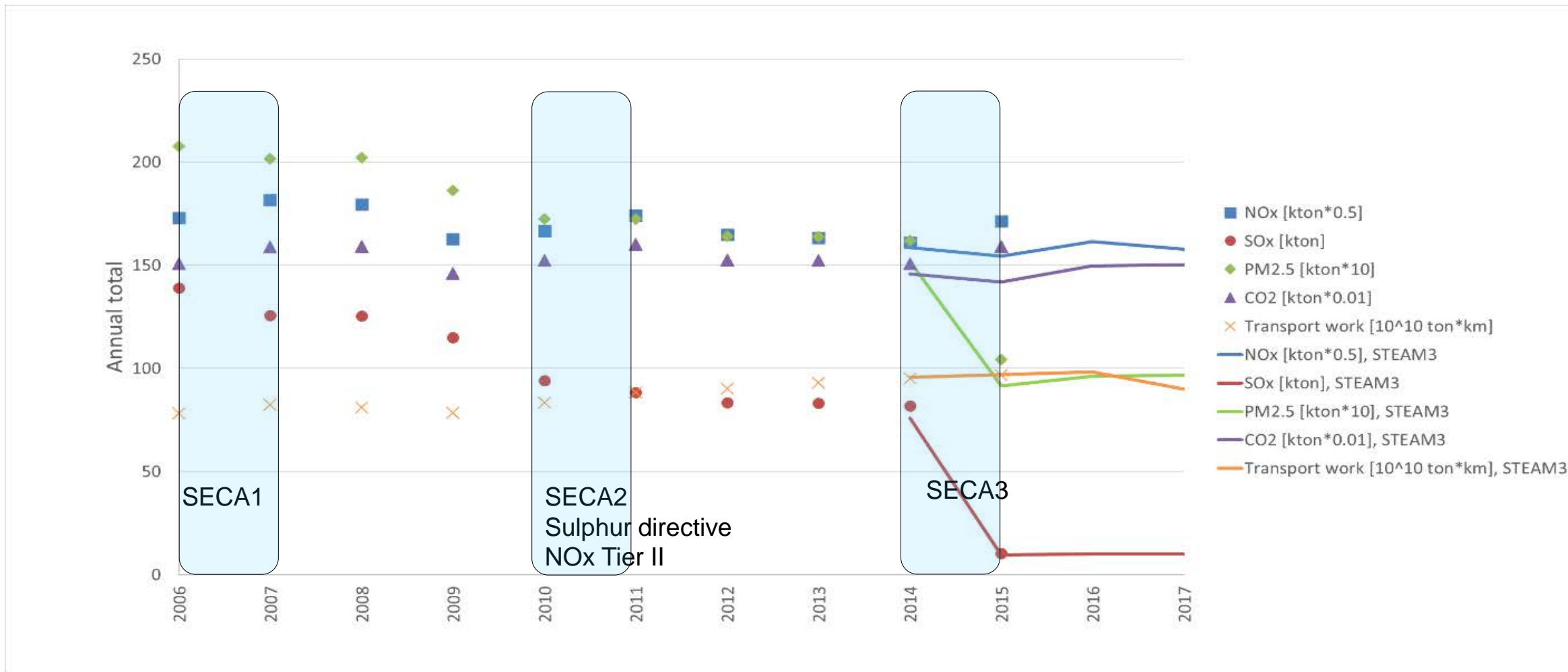
HFO ban in the Arctic discussed

Local rules in national legislation

SOx scrubber washwater (Germany, Norway, Belgium...), oily discharges to the sea (Finland), Domestic ECAs (China)

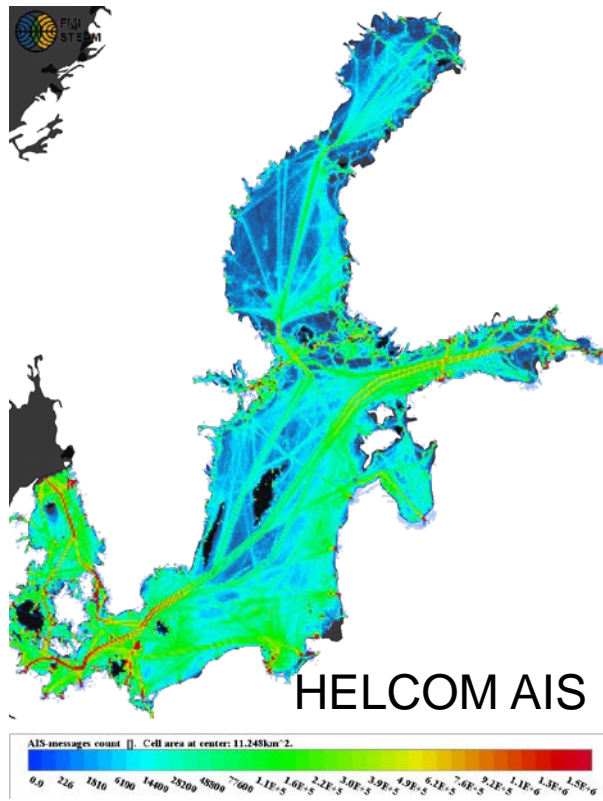
Each of these changes must be implemented in ship emissions modeling work

Air emissions, Baltic Sea



<https://portal.helcom.fi/meetings/MARITIME%2018-2018-503/MeetingDocuments/Forms/AllItems.aspx>

HELCOM Maritime18, 4-3/INF

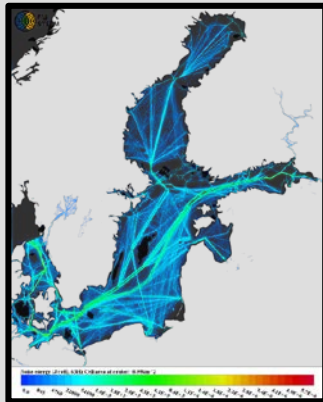


HELCOM AIS

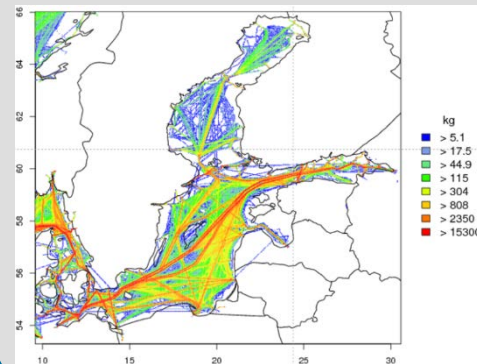
AIS messages count | Cell area at center: 11.245km².
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STEAM
Emission
model

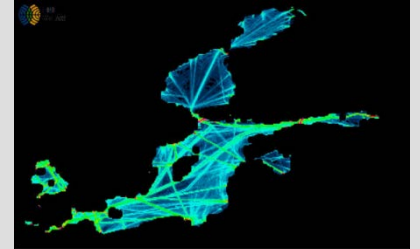
Underwater noise



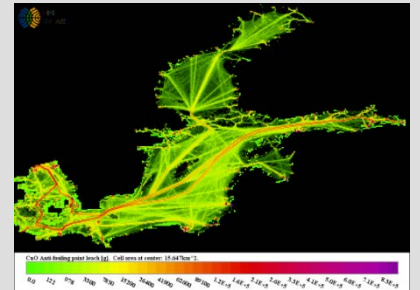
Air emissions



Water discharges

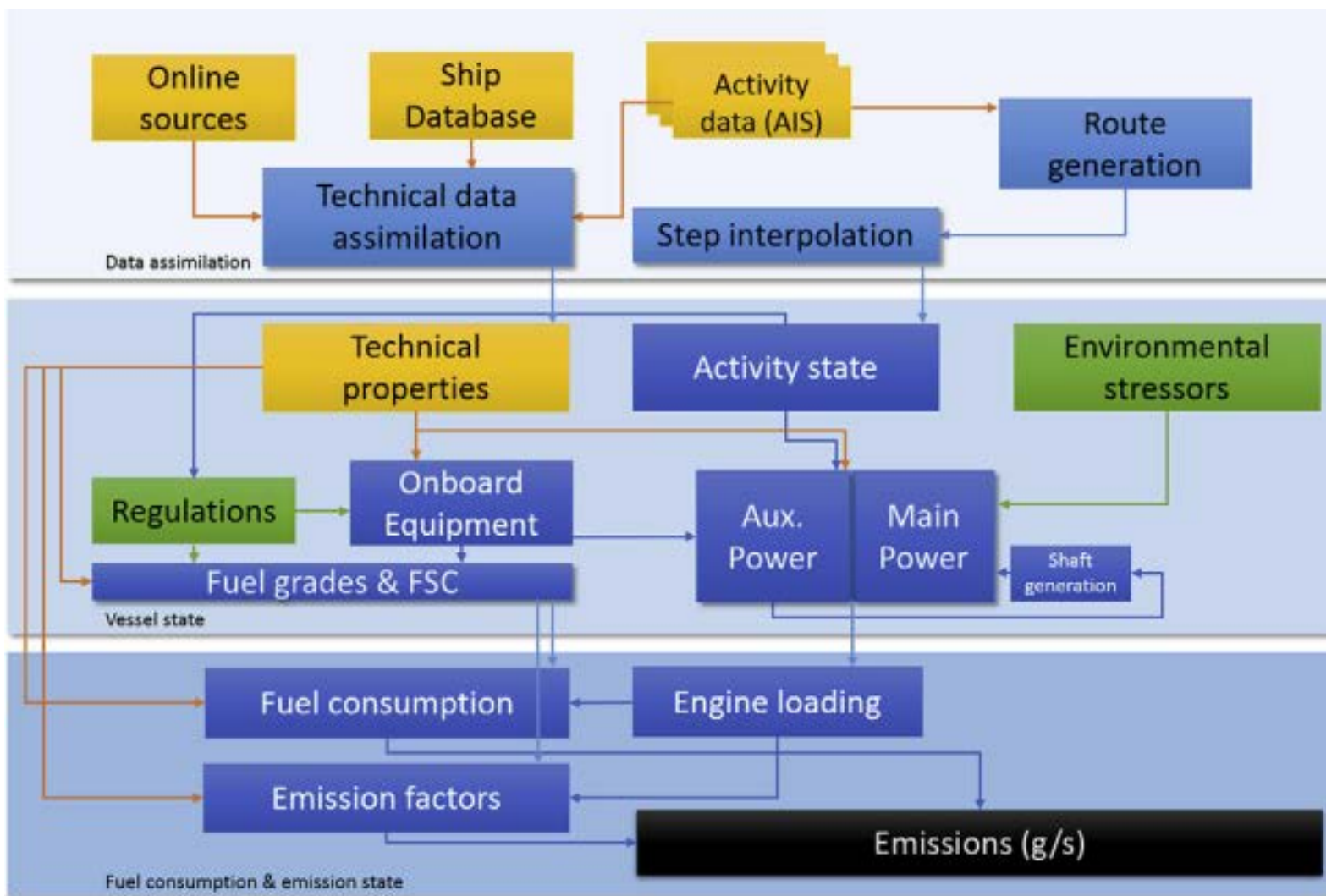


Sewage water release during year 2017 from Baltic Sea shipping

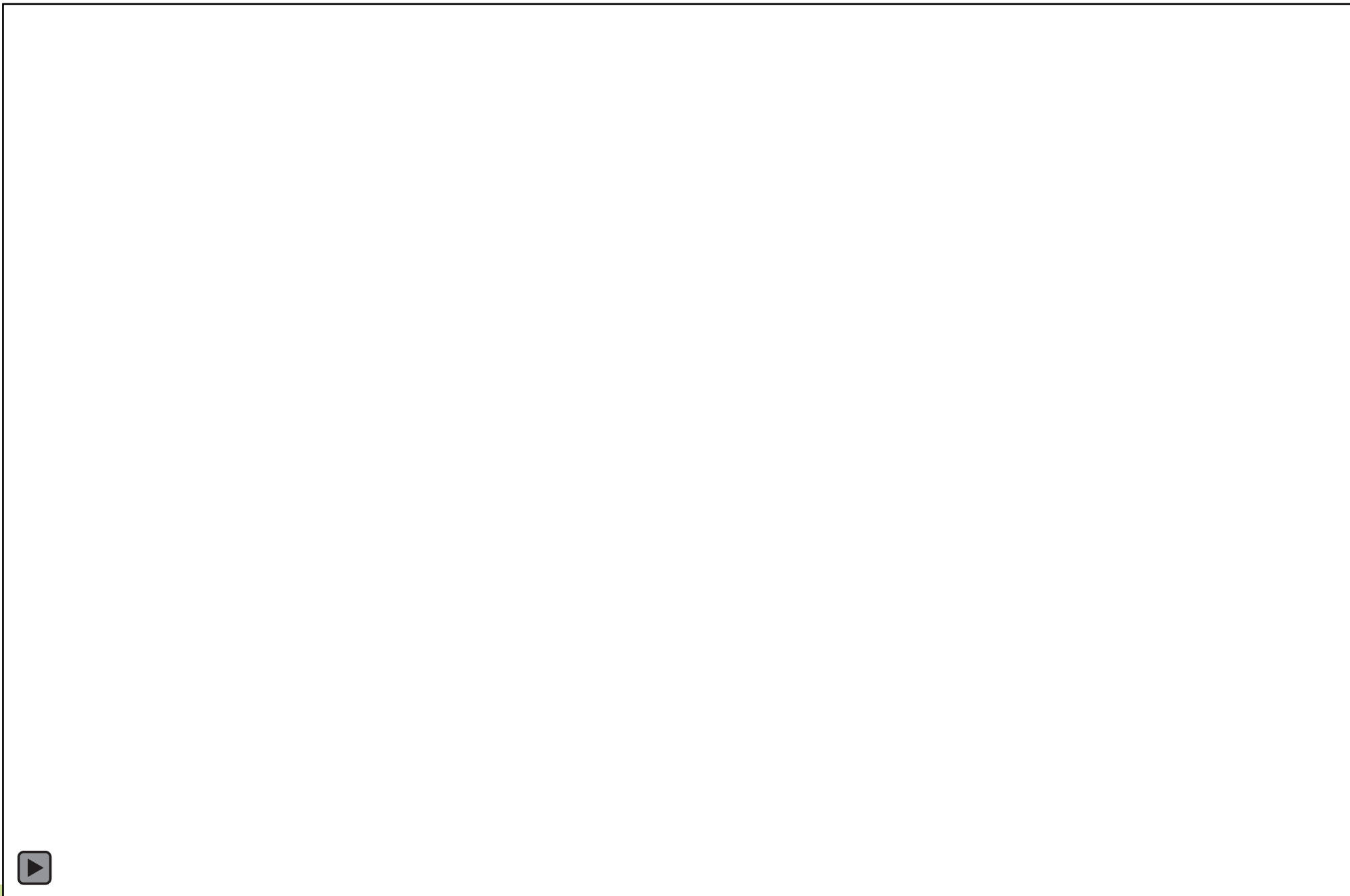


Cu(I)O from anti-fouling paints

Our approach – Ship Traffic Emission Assessment Model



Johansson et al., Atmos. Chem. Phys., 13 (2013) 11375-11389.



Some of the challenges in the horizon

GHGs, SLCFs and climate/health impacts

Black Carbon, methane, mitigation, aftertreatment, engine technology, alternative fuels, market based mechanisms

Discharges to the sea

Scrubbers; open vs closed loop, impacts
 Antifouling paints; Copper releases
 Ballast water; Same risk area concept

Underwater noise

Propagation, response reaction, species habitat mapping, mitigation methods, impacts, monitoring, anthro/natural sources...

Compliance monitoring; SOx, NOx, methane, formaldehyde

Quality assurance work

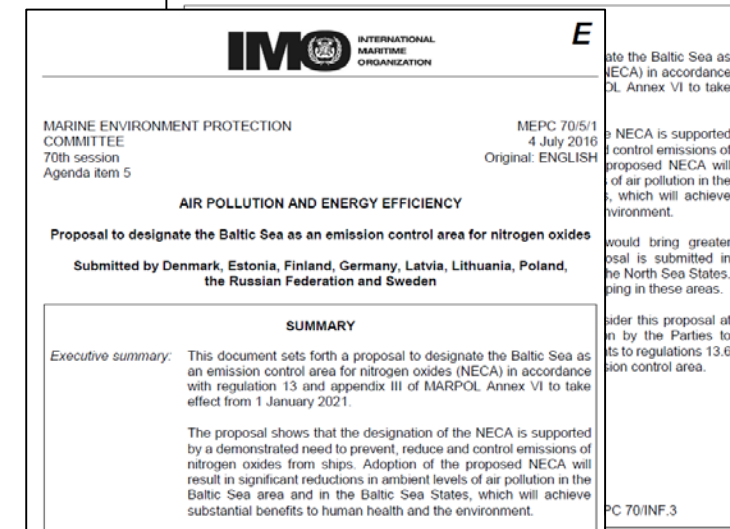
Satellites, sniffing, onboard stack measurements
 Fuel data collection done for EU MRV, IMO DCS, sensors

Recreational boating

Air/water emissions, noise

...

Policy support at all levels concerning maritime topics



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MARITIME 18-2018

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Reference	

Key points

- **A lot has been achieved, but new topics arise**
- **Problem solving approach with project clustering is worth the while**
 - No reason to reinvent the wheel
- **Need interfaces between science/policy/industry**
 - Starts by talking to the stakeholders + showcasing capabilities
- **Timing is one of the most difficult things to accomplish**
 - Policy support does not follow project schedules