Halocarbons in Southeast Asia

Anthropogenic halocarbons in a regional ocean model

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In Short

- Oceanic Very Short-Lived Halocarbons (VSLH) are expected to increase due to anthropogenic activities
- Regional biogeochemical ocean modelling (ROMS PISCES) of the Southeast Asia and China region
- Quantifying VSLH emissions into the atmosphere from various natural and anthropogenic sources

The stratospheric ozone layer protects the Earth from most of the sun's harmful ultraviolet (UV) radiation. The depletion of stratospheric ozone in response to anthropogenic emissions of long-lived chlorofluorocarbons (CFCs), used as refrigerants or aerosol spray propellants, has been one of the major environmental issues of the last decades. Emissions of CFCs have been strongly reduced following the Montreal Protocol of 1987. As a consequence, their atmospheric abundance will decline during the 21st century and a gradual recovery of the ozone layer over the next decades is expected [1].

Emissions of Very Short-Lived Halocarbons (VSLH), which also have the potential to destroy ozone, are, on the other hand, expected to increase due to new technologies. In particular, increasing aquaculture in form of macro algae farming [2] and increasing oxidative water treatment of ship ballast water [3] are suspected to impact the marine biogeochemical systems and to drastically enhance the production of VSLH. In addition to their damaging effect on the ozone layer, increasing VSLH will also impact the radiative forcing and the oxidizing capacity of the atmosphere, i.e. the capacity of the atmosphere to ultimately remove many species emitted from natural and anthropogenic sources.

While anthropogenic activities in harbour and coastal waters threaten to multiply the current natural oceanic production, it is currently unclear how far the man-made VSLH will be distributed into the open ocean and how they will change the natural VSLH distribution and emissions. Southeast Asia and the coastline of China show a particularly high density of large harbours and widespread macro algae farming and will be a centre of anthropogenic VSLH production. Existing VSLH emission estimates for this region are highly uncertain and do not take anthropogenic sources into account [4]. High-resolution modelling of the transport and degradation of anthropogenic VSLH in sea water is necessary to capture the locally confined processes and to derive realistic estimates of the release of anthropogenic VSLH into the atmosphere.

The present work aims at quantifying the current and future impact of anthropogenic forcing on the oceanic VSLH budget. Based on prescribed sources of anthropogenic VSLH from oxidative water treatment and seaweed farming activities, VSLH transport and degradation in coastal and marine water will be investigated with the Regional Ocean Modelling System (ROMS) [5]. Background VSLH production and loss processes will be included by coupling a VSLH module to biogeochemical model (PISCES).

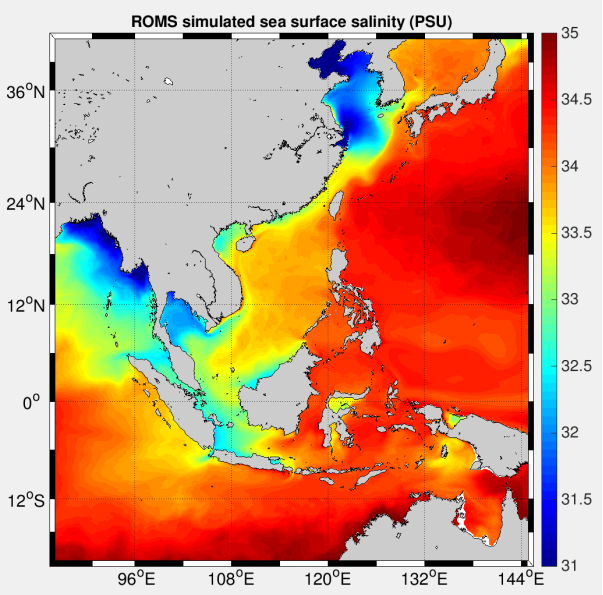

***Figure 1:** Example of sea surface salinity simulated by ROMS model.*

A high resolution ROMS configuration of Southeast Asia, the Philippine Sea, East China Sea, Yellow Sea and parts of the Indian Ocean and Northwest Pacific ocean has been implemented (see Figure 1 for exact model domain) and the full physical and biogeochemical dynamics will be analysed. VSLH sources and sinks are included step-by-step during the planned experiments following different levels of complexity. This approach allows us to quantify the full VSLH emissions into the atmosphere, but to also separate coastal from open ocean as well as anthropogenic from natural sources. Results from this study will feed into the research conducted within the DFG Emmy Noether group

AVeSH, which combines oceanic and atmospheric modelling in order to quantify the impact of anthropogenic VSLH on the stratospheric ozone.

More Information

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[4] Hossaini, R., et al.,: Evaluating global emission inventories of biogenic bromocarbons, *Atmos. Chem. Phys.*,**13**, 11819-11838, 2013.doi: 10.5194/acp-13-11819-2013

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