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Anthropogenic source of very short-lived halocarbons from industrial water treatment

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Through economic growth and population increase, power supply and commercial shipping are constantly increasing. Large volumes of seawater are used as cooling water for industrial power plants and as ballast water for the stabilisation of ships. To prevent bio-fouling and, in case of ballast water, the invasion of non-indigenous species, seawater is often chemically disinfected which produces a variety of halogenated compounds as disinfection by-products (DBPs). The most abundant DBP from oxidative seawater treatment is bromoform whose anthropogenic source is several times stronger than the natural production in seawater. Especially ballast water is a new source of bromoform to the environment, since the start of the Ballast Water Management Convention in September 2017. Thus, halocarbon emissions from oxidative water treatment are expected to become more significant for atmospheric chemistry in the near future.
In order to quantify anthropogenic halocarbon production in coastal waters, the oceanic concentration pathways of the treated water discharged at major industrial sites in Southeast Asia are simulated. This region is characterised by high industrial activity along the coast, located in the tropics where halocarbon emissions are most efficiently transported through the troposphere. The analysis is based on Lagrangian trajectories calculated with the high-resolution velocity fields from the NEMO-ORCA12 ocean model output. The simulations reveal major transport pathways of the anthropogenic halocarbons and their concentrations in the surface ocean. Over a period of one year, ocean surface concentrations have established that reach values similar to shelf water concentrations.
Furthermore the emissions into the atmosphere are calculated to quantify the impact of anthropogenic halocarbons on atmospheric chemistry and climate. A case study from Singapore shows that industrial waste water can regionally produce strongly enhanced bromoform emissions along the Strait of Malacca. The sea-to-air flux of anthropogenic halocarbons will be presented for Southeast Asia and compared to natural bromoform emissions.