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## Chemical interactions between ship-originated air pollutants and ocean-emitted halogens

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Ocean-going ships supply products from one region to another and contribute to the world's economy. Ship exhaust contains many air pollutants and results in significant changes in marine atmospheric composition. The role of Reactive Halogen Species (RHS) in the troposphere has received increasing recognition and oceans are the largest contributors to their atmospheric burden. However, the impact of shipping emissions on RHS and that of RHS on ship-originated air pollutants have not been studied in detail. Here, an updated WRF-Chem model is utilized to explore the chemical interactions between ship emissions and oceanic RHS over the East Asia seas in summer. The emissions and resulting chemical transformations from shipping activities increase the level of NO and NO<sub>2</sub> at the surface, increase O<sub>3</sub> in the South China Sea, but decrease O<sub>3</sub> in the East China Sea. Such changes in pollutants result in remarkable changes in the levels of RHS as well as in their partitioning. The abundant RHS, in turn, reshape the loadings of air pollutants and those of the oxidants with marked patterns along the ship tracks. We, therefore, suggest that these important chemical interactions of ship-originated emissions with RHS should be considered in the environmental policy assessments of the role of shipping emissions in air quality and climate.