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The marine iodine cycle within the Earth system and its recent perturbation by human activities

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The reaction of iodide with ozone at the sea surface plays a critical role in controlling the chemical composition of the lower troposphere. This process directly controls the rate of ozone deposition to the oceans and is the dominant source of reactive iodine to the atmosphere, which also leads to significant chemical loss of tropospheric ozone. This ozone -iodide interaction is likely a negative biogeochemical feedback on tropospheric ozone and oxidants. Its dependence on ozone itself suggests that significant changes in its magnitude will have occurred from the turn of the 20th century, and its dependence on ocean iodide suggests changes over longer timescales, for example as a result of changes in ocean circulation, acidification, and biological productivity.

Iodine cycling is now being incorporated into chemical transport and air quality models but major uncertainties remain. Our team has recently collaborated on a project to better understand the marine iodide cycle including: the critical biological, physical and chemical controls of surface ocean iodide; the global spatial distribution of ocean iodide and how it affects our understanding of ozone deposition and of tropospheric gas phase ozone loss; and iodine emissions to the atmosphere. Our results reduce some of the major uncertainties that exist in the marine iodine flux and the associated ozone sink. This talk will also present evidence that growth in tropospheric ozone caused marine iodine emissions to increase over the 20th century, and that expected changes in marine nitrification in response to ocean acidification may result in further increased iodine emissions in the future.