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Atmospheric impacts of improved sea-surface iodide fields

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Halogens (Cl, Br, I) have been shown to play a profound role in determining the concentrations of ozone and OH in the troposphere. Iodine, which is essentially oceanic in source, exerts its largest atmospheric impacts in the marine boundary layer, and in the upper troposphere. This chemistry has only recently been implemented into global models and significant uncertainties remain. The magnitude of emissions of iodine compounds from the oceans is, and the associated ozone sink, are particularly uncertain. These emissions are dominated by the inorganic oxidation of iodide in the sea surface by ozone, which leads to release of gaseous inorganic iodine (HOI, I2) and both processes contribute to the loss of ozone. Critical for calculation of these fluxes is the sea-surface concentration of iodide, which is poorly constrained by observations.

Here we explore the impact of sea-surface iodide on atmospheric composition, through gas-phase iodine chemistry. We use new spatially and temporally resolved distribution fields for present-day and pre-industrial concentrations. We use a present-day iodide field predicted by a multivariate and nonparametric parameterization (Sherwen et al, 2019), built using a machine learning approach which exploits observations of sea-surface iodide and existing sea-surface climatological products (e.g. temperature, salinity, nitrate, depth). We also look at atmospheric impacts from a new sea-surface iodide output from a new process-based ocean model for both present-day and pre-industrial. The present-day sea-surface iodide fields better compare against a recently expanded dataset of observations (Chance et al 2019), than existing parameterisations used by atmospheric models (Chance et al 2014, MacDonald et al 2014).

We assess the atmospheric impacts of these new fields within the GEOS-Chem global chemical transport model, which includes atmospheric halogen (Cl, Br, I) chemistry. In the present-day, we show modest changes on the tropospheric ozone burden compared to the generally used iodide fields from MacDonald et al (2014), but large increases in iodine emissions. Historical constraints on modelled impacts of iodine have been from the gas-phase observations, however, this work takes a new perspective of constraining iodine's impacts on atmospheric chemistry by using sea-surface iodide observations (Chance et al 2019).

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