3.070 Iodide to feed the machine: a machine-learning built parameterization for sea-surface iodide using new observations, which impacts the ozone budget and iodine emissions.

Early Career Scientist

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Abstract:

Halogens (Cl, Br, I) in the troposphere have been shown to play a profound role in determining the concentrations of ozone and OH. Iodine, which is essentially oceanic in source, exerts its largest impacts on composition in both the marine boundary layer, and in the upper troposphere. This chemistry has only recently been implemented into global models and significant uncertainties remain, particularly regarding the magnitude of iodine emissions. Iodine 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). Critical for calculation of these fluxes is the sea-surface concentration of iodide, which is poorly constrained by observations.

Previous parameterizations for sea-surface iodide concentration have focused on simple regressive relationships, mostly based on sea-surface temperature. The choice of parameterization used in global models leads to differences in iodine fluxes of approximately a factor of two, and substantial differences in the modelled impact of iodine on atmospheric composition.

Here we use an expanded dataset of oceanic iodide observations that incorporates new data that has been targeted at locations that had poor coverage. This is combined with a data-driven multivariate machine learning technique using climatological products (e.g. temperature, salinity) to generate a model that better captures the observations in both coastal and open-ocean regions.

This improves estimates of the global sea surface iodide spatial distribution, with a global average magnitude (3.2x10-6 kg/m3) between to the two parameterisations most commonly used in the literature (2.3x10-6 kg/m3, 5.0x10-6 kg/m3). We then use a global chemical transport model (GEOS-Chem) to show the atmospheric impacts compared to the previously used parameterisations, including increased iodine emissions (~40%) and a modest impact of decreasing tropospheric ozone burden (~1%).