# Methyl iodide: atmospheric budget and use as a tracer of marine convection in global models

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# Abstract

Methyl iodide ($CH_3I$) is mainly emitted to the atmosphere from the oceans, and photolyzes with a lifetime of 4 days in the tropics. It is of interest in the atmosphere as a tracer of marine convection and a source of iodine radicals. We present a global model simulation of oceanic and atmospheric $CH_3I$ using a box model of the oceanic mixed layer coupled to a global three-dimensional model of atmospheric transport driven by assimilated meterological observations from the Goddard Earth Observing System (GEOS) of the NASA Data Assimilation Office (DAO). In the oceanic mixed layer model, seawater $CH_3I(aq)$ is controlled by dissolved organic carbon (DOC) driven photochemical production, reaction with $Cl^-$, and exchange with the atmosphere. The resulting net oceanic emission of $CH_3I$ to the atmosphere is 214 Gg $yr^{-1}$. Terrestrial emissions from rice paddies (71 Gg $yr^{-1}$), biomass burning (12 Gg $yr^{-1}$), wetlands (7 Gg $yr^{-1}$) and wood fuel (3 Gg $yr^{-1}$) are also included in the model. A global compilation of atmospheric and oceanic data for $CH_3I(aq)$ concentrations is used to constrain and evaluate the simulation. The model captures 40% of the variance in the observed seawater $CH_3I(aq)$ concentrations. Simulated concentrations at midlatitudes in summer are too high, perhaps because of a biological sink of $CH_3I(aq)$ missing from the model. There is also evidence from atmospheric observations in Asian outflow that the assumed $CH_3I$ source from rice paddies may be too high. Simulated and observed vertical profiles of $CH_3I$ in the tropical marine atmosphere indicate a gradual decrease up to the trade wind inversion (TWI) at 2 - 3 km, a sharp transition across the TWI, and little vertical gradient through the rest of the troposphere reflecting convective outflow at all altitudes. We define a quantitative index of marine convection index as the ratio of upper tropospheric (8 - 12 km) over lower tropospheric (0 - 2.5 km) $CH_3I$ concentrations averaged over coherent oceanic regions. This index in the observations ranges from 0.11 over strongly subsiding regions (southeastern subtropical Pacific) to 0.40 over strongly upwelling regions (western equatorial Pacific). The model reproduces the observed index with little global bias (+ 11%); it captures qualitatively most of the observed spatial gradients and seasonal variations in the index but accounts for only 15% of its overall variance.

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**The full text of this paper is available as a** ps file