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Production of molecular iodine and triiodide from the photooxidation of frozen iodide-containing solutions

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Halogen species play an important role in the polar atmospheric chemistry such as ozone(O_3) and mercury(Hg) depletion events, oxidizing capacity, and DMS(dimethylsulfide) oxidation to form cloud condensation nuclei. However, the plausible source and emission mechanism of inorganic iodine in polar boundary layer are poorly understood. Here, we shows that the oxidative formation of triiodide (I3-) from iodide-containing solution, which is inactive in aqueous solution, was dramatically accelerated by freezing process – both in the presence and absence of light illumination. Field experiments carried out using the frozen solutions of iodide (in distilled water) and the refrozen solutions of molten snow/glacier (spiked with iodide) in Antarctic region (King George Island, 62°13′N, 58°47′E) and confirmed that the laboratory results. . The emission of gaseous iodine molecule(I2) from the irradiated frozen solution of iodide to the gas phase was monitored by using CRDS(cavity ring down spectroscopy), which was observed both in the frozen state at 253 K and after melting the ice samples at 298 K. The modeling works done with simulating the environmentally relevant condition confirmed that the proposed iodide oxidation process in frozen state can be important in the polar atmospheric environment. In this presentation, we will show the experimental results for the oxidation of iodide to form I3- and I2 in frozen solution, which is even more enhanced under simulated solar irradiation. The effects of various experimental parameters on the freezing-enhanced iodide oxidation were systematically investigated to understand this anomalous chemical process. A modeling study was also carried out to reproduce the experimental results. This finding proposes a previously unrecognized source of gaseous I2 through abiotic process in the polar frozen environment.