

Enhanced formation of atmospheric iodine species in ice media and its impacts on Antarctica

The active halogen species play significant roles in global environmental system. Halogen chemistry especially iodine compounds are related to the depletion of tropospheric and stratospheric ozone, perturbation of HOx/NOx cycle, generation of cloud condensation nuclei(CCN), and depletion of gaseous elemental mercury (Hg^0) by oxidation to reactive gaseous mercury (Hg^{2+}) in polar regions. The chemical processes of halogen compounds in water have been intensively studied, whereas those in frozen environments have been rarely investigated. In this work, we investigated iodide(I^-) oxidation to tri-iodide(I_3^-) in frozen solution in the presence and absence of irradiation. The oxidation of iodide to tri-iodide in water, which is very slow process, was significantly enhanced in frozen water even in the absence of irradiation. We explained that the accelerated oxidation of iodide in ice phase is owing to the freeze concentration of the existed iodides, protons, and oxygen molecules in ice grain boundaries upon freezing. The outdoor experiments conducted under natural conditions in King George Island, Antarctica(, $62^\circ 13'S$ $58^\circ 47'W$, sea level) also confirmed that the tri-iodide formation by iodide oxidation is accelerated in natural ice media such as snow and glacier regardless of irradiation. The observed results imply that the generation of active iodine species such as tri-iodide might be accelerated in frozen environment and then released to the atmosphere when the ice media melt.