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Exploring the use of halogens as climate proxy in the inner Antarctic plateau

Content

The role of bromine and iodine in polar atmospheric chemistry has been studied intensively over the past few decades. Research has been driven by the role of bromine as a control on polar tropospheric ozone con-centrations, mainly in spring. First year sea-ice and blowing snow have been identified as key components for this heterogeneous bromine recycling in the polar boundary layer. Iodine activation in the Antarctic region is strongly linked to algal communities that inhabit sea-ice. Consequently, organic forms of iodine, such as iodocarbons, along with inorganic species, were linked to sea-ice. Biological activity primarily oc-curs on the underside of the sea-ice, therefore mechanisms for the transfer of iodine through the sea-ice to the upper surface is an essential precondition to activation and emission of iodine to the atmosphere. The understanding of polar halogen chemistry has formed the basis for investigating quantitative links between halogen concentrations in the polar atmospheric boundary layer and sea-ice presence and/or extent. The pho-tochemistry of halogens is complex due to the mixed-phase (gas and aerosol) nature of atmospheric halogen cycling. Therefore, the application of halogen records in ice cores to sea-ice reconstruction overcomes some challenges posed by existing proxies but also opens new challenges in particular for their use in remote sites away from the sea ice, such as the Antarctic plateau. Only a few studies have explored the bromine and io-dine signal in ice core from the inner Antarctic plateau and have evaluated the possibility to use them for long term (glacial\interglacial time scale) paleoclimate reconstructions. Here, we present the first ice core record of iodine and bromine, and its enrichment, from Dome C (Antarctica) covering approximatively the last 200 years. In the Dome C ice core record, iodine is linked to coastal air mass intrusions and sea spray aerosol, how-ever its preservation within the snowpack is influenced by the changes in the incoming solar UV-radiation. Contrarily, we found that bromine is preserved within the Antarctic plateau snowpack independently on the intensity of the incoming UV-radiation. To evaluate whether Br and its enrichment (Brenr) can be used as a proxy to reconstruct past sea-ice extent at Dome C, we compare our record with satellite observations of sea-ice over the last 30 years. Even though we found weak, but significant, correlations between Brenr and sea-ice extent of the Indian Ocean and Ross Sea sectors, at this stage it is not possible to fully validate Brenr as an effective proxy for past sea-ice reconstructions in Dome C mainly because of the low sea-ice variability in East Antarctica over the satellite era. Future investigations at Dome C during the satellite periods as well as over the glacial/interglacial transitions are necessary to assess whether Brenr at Dome C can be used as a qualitative sea-ice tracer over centennial or millennial time scales.

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