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Surface ozone at Villum Research Station in High Arctic

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Introduction
Temperatures in the Arctic are rapidly increasing, roughly twice as fast as in the rest of the world [IPCC, 2013]; this phenomenon is known as Arctic amplification. Thirteen tipping elements, where small perturbations might change the global climate dramatically, have been identified globally; eight of which are located in polar or boreal regions [Lenton et al., 2008]. Examples of such tipping elements include the melting of sea ice, which leads to a decreased albedo, the increased thaw of permafrost, leading to increased emissions of methane, and increased numbers of boreal forest fires, leading to increased Volatile Organic Compounds (VOCs), particle and Black Carbon (BC) emissions. Ozone is a strong greenhouse gas that is photochemically formed in the troposphere from volatile organic compounds and NO_x. Specially in the Arctic, the reactions with halogen atoms are very important for the observed ozone levels [Simpson et al., 2007] that changes the seasonal pattern of ozone compared to more southern localities. In order to assess the dynamics of ozone in the high Arctic we made interpretation of based on measured halogen oxide radicals, oxidized Volatile Organic Compounds (VOCs) and meteorology.

Method
Surface ozone has been measured since 1996 using UV absorption (with a gap in data from July 2002 to April 2007) at Villum Research Station (VRS) at Station Nord in North Greenland ((81°36' N, 16°40' W) www.villumresearchstation.dk). Ozone is compared with measurements of BrO and IO, where the halogen oxide radicals are measured with max-DOAS. Finally, ozone concentrations are interpreted by comparison with (VOCs) that were measured with a Proton Transfer Reaction-Time of Flight-Mass Spectrometer.

Conclusion
Based on the measurements, the dynamics of ozone are discussed in terms of trends, seasonality, and chemical processes, as well as meteorological parameters. In particular, the role of BrO, IO, VOCs and meteorology is investigated. Climate impact of the findings is finally discussed together with an outlook on future work.

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