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Impact of Very Short-live Halogens on Stratospheric Ozone Abundance (and UV radiation) in a Geo-engineered Atmosphere

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In this study we used the Whole Atmosphere Community Climate Model (WACCM) to explore the impact of very short-lived (VSL) bromocarbons on stratospheric ozone abundance and surface UV radiation under the influence of geoengineered aerosols. VSL bromocarbons have by definition a chemical lifetime of less than 0.5 years (WMO, 2006). In contrast to long-lived bromocarbons (e.g., CH3Br plus halons), these VSL bromocarbons have natural sources (e.g., oceanic emissions) and their abundance will therefore not decrease in the future due to international protocols. They are eventually oxidized via reactions with OH and photolysis to form inorganic bromine product gases and get transported into the stratosphere. Observations suggest that VSL bromocarbons add an additional 4-10 pptv volume mixing ratios to the total stratospheric inorganic bromine abundance. Since inorganic bromine is $\sim$60 times more efficient (relative to inorganic chlorine) at catalytic destroying ozone, this additional inorganic bromine loading could significantly affect stratospheric ozone. This is especially true in the Arctic, where the coupled BrO/ClO catalytic ozone loss cycle is as important as the ClO dimer ozone loss cycle. The chemical activation of chlorine is highly dependent on the amount of sulfate aerosol and VSL bromine provides a reaction partner for activated chlorine, resulting in a significant increase of ozone depletion in a geo-engineered aerosol environment in high latitudes. An additional impact of short-lived bromocarbons on the ozone abundance is expected and was not considered in earlier studies.