

Global ozone depletion and increase of UV radiation caused by pre-industrial tropical volcanic eruptions

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Large explosive tropical volcanic eruptions inject significant amounts of gases into the stratosphere, where they disperse globally through the large-scale meridional circulation. Halogens from tropical eruptions have been thought to be negligible based on observations of the largest eruptions of the satellite era, and thus most studies focus on sulfuric acid aerosols. More recent observations and plume modeling indicate that explosive volcanism can be a big source of halogens to the stratosphere. Here, we present the first study, based on observations, of sulfur, chlorine and bromine releases from tropical volcanic eruptions from the Central American Volcanic Arc over the last 200 ka combined with state-of-the-art coupled chemistry climate model simulations using CESM1(WACCM). The simulations reveal global, long-lasting impact on the ozone layer affecting atmospheric composition and circulation for a decade. Column ozone drops below 220 DU (ozone hole conditions) in the tropics, Arctic and Antarctica, increasing biologically active UV by 80 to 400%. Given the current decline in anthropogenic chlorine, halogen and sulfur rich explosive tropical eruptions may become the major threat to the future ozone layer.