NCAR | ATMOSPHERIC CHEMISTRY OBSERVATIONS & MODELING

ACOM Seminar

How Does Stratospheric Ozone Respond to Explosive Volcanic Eruptions?

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Date: Thursday, June 1st 2023, 11:00 am – 12:00 pm

Links: https://operations.ucar.edu/live-acom

ABSTRACT

The stratospheric ozone layer is essential in protecting life on Earth from harmful UV irradiation, and even small changes in ozone layer thickness can cause significant damage to human health and agriculture. Knowing the methods and causes for ozone depletion is therefore critical. As the atmospheric halogen loading moves towards pre-industrial levels in the future, the largest perturbation to the ozone layer could be caused by volcanic eruptions.

Large explosive volcanic eruptions have the potential to alter the spatiotemporal profiles of the ozone column through changes in trace gas composition and aerosol loading of the stratosphere. Along with sulfur compounds, volcanic eruptions can inject halogens or water into the stratosphere, potentially leading to sudden and dramatic ozone losses on a hemispheric to global scale. A recent example is the January 15, 2022, Hunga Tonga-Hunga Ha'apai (HTHH) volcanic eruption – the largest eruption in 30 years – injecting a significant amount of water into the stratosphere along with sulfur dioxide, SO2, peaking at a record-high >50 km above the surface.

A 3-D chemistry-climate-aerosol model – SOCOL-AERv2 model (SOCOL = modeling tools for studies of SOlar Climate Ozone Links, AER = 2D aerosol model) – has been used to determine the response of stratospheric ozone to different types of volcanic eruptions in a contemporary atmosphere: water-rich HTHH-like eruptions, eruptions injecting SO2, and eruptions co-injecting halogens into the stratosphere. The dependence on latitude, season, and halogen and water content is discussed as well as the differences in the results for hemispherical and global impacts, comparing the impact of each eruption scenario on the aerosol loading of the atmosphere and stratospheric ozone layer.

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