Submission Title:

Disruption of the 2022-2023 stratospheric circulation by the Hunga Tonga-Hunga Ha'apai volcano

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Abstract

In January 2022 the Hunga Tonga-Hunga Ha'apai (HTHH) volcano erupted, injecting an unprecedented amount of water vapor into the stratosphere that increased the total stratospheric water burden by ~10%. As the initial plume of water vapor spread throughout the stratosphere, radiative heating and cooling anomalies affected the stratospheric circulation altering the climatological mean residual circulation. Here we compare the 1980-2021 MERRA-2 (Modern Era Reanalysis for Research and Applications, Version 2) mean residual circulation climatology to the years 2022-2023 to identify stratospheric circulation changes associated with the anomalous water vapor. The HTHH water vapor is explicitly tracked using the M2-SCREAM (MERRA-2 Stratospheric Composition Reanalysis of Aura Microwave Limb Sounder) water vapor analysis. Anomalies in temperature, jet location, polar vortex strength and ozone advection in response to the HTHH water vapor anomaly are also documented. These results reveal details of the evolution of the HTHH induced stratospheric circulation anomalies with special emphasis on how these circulation anomalies affected the 2023 ozone hole.