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Stratospheric climate anomalies and ozone loss caused by the Hunga Tonga volcanic eruption

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The Hunga Tonga volcanic eruption in January 2022 injected extreme amounts of water vapor (H₂O) and a moderate amount of aerosol precursor (SO₂) into the Southern Hemisphere (SH) stratosphere. The H₂O and aerosol perturbations have persisted and resulted in large-scale SH stratospheric cooling, equatorward shift of the Antarctic polar vortex, and slowing of the Brewer-Dobson circulation associated with a substantial ozone reduction in the SH winter midlatitudes. Chemistry-climate model simulations forced by realistic HTHH inputs of H₂O and SO₂ reproduce the observed stratospheric cooling, circulation changes and ozone loss, demonstrating the observed behavior is due to the volcanic influences. Furthermore, the combination of aerosol transport to polar latitudes and a cold polar vortex enhances springtime Antarctic ozone loss, consistent with observed polar ozone behavior in 2022.