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Stratospheric composition changes due to extreme events: insights from satellite limb and nadir observations

Extreme events such as explosive volcanic eruptions and major wildfire outbreaks can produce persistent perturbations of stratospheric aerosol and gaseous composition. Volcanic eruptions, injecting ash and sulphuric aerosol precursors into the stratosphere, have historically been recognized as the primary source of large-scale perturbations of stratospheric aerosol load. An emerging source of stratospheric aerosols is wildfires and associated pyroCbs, which are increasing in frequency and intensity in a warming climate and have proven capable of altering stratospheric composition, dynamics, and ozone chemistry on annual timescales. In the last three decades, the most significant events in terms of their stratospheric impact are the Australian New Year (ANY) "Black Summer"wildfire outbreak in 2019/20 that produced the largest-ever Smoke-Charged Vortex (SCV) rising up to 35 km and the eruption of Hunga submarine volcano in January 2022 that led to an unprecedented hydration of the global stratosphere. Each of them provided unique natural testbeds for studies of climate sensitivity to strong change in stratospheric gaseous and particulate composition.

Here we use a combination of limb scattering/sensing (OSIRIS, OMPS-LP, MLS), solar/stellar occultation (SAGE II/III, ACE-FTS, GOMOS) and active nadir sounding (CALIOP, Aeolus, EarthCARE) observations to review the character and the magnitude of stratospheric perturbations induced by the most significant events in the XXI century.

Topic

Aerosols and clouds

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