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## Impact of Hunga Tonga Hunga Ha'apai eruption on the global stratospheric aerosol layer in comparison with other eruptions and extreme fire events of the past decade

**Corinna Kloss**<sup>1,2</sup>, Gwenaël Berthet<sup>2</sup>, Pasquale Sellitto<sup>3,4</sup>, Bernard Legras<sup>5</sup>, Jean-Paul Vernier<sup>6,7</sup>, Jean-Baptiste Renard<sup>2</sup>, Fabrice Jégou<sup>2</sup>, Paul Konopka<sup>1</sup>, and Felix Plöger<sup>1</sup>

<sup>1</sup>Forschungszentrum Jülich, Institute for Energy and Climate Research - 7, Germany

<sup>2</sup>Laboratoire de Physique et Chimie de l'Environnement et de l'Espace (LPC2E), CNRS/Université d'Orléans, Orléans, France

<sup>3</sup>Laboratoire Interuniversitaire des Systèmes Atmosphériques, UMR CNRS 7583, Université Paris-Est Créteil, Université de Paris, Institut Pierre Simon Laplace, Créteil, France

<sup>4</sup>Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo (INGV-OE), Catania, Italy

<sup>5</sup>Laboratoire de Météorologie Dynamique, UMR8539, CNRS – École Normale Supérieure/Université Pierre et Marie Curie/École Polytechnique, Paris, France

<sup>6</sup>National Institute of Aerospace, Hampton, Virginia, USA

<sup>7</sup>NASA Langley Research Center, Hampton, Virginia, USA

Using a combination of satellite, ground-based and in-situ observations, we quantify and compare the impact of the most recent moderate volcanic eruptions and extreme fire events (volcanic eruptions: Ambae, Vanuatu in July 2018; Raikoke, Russia and Ulawun, New Guinea in June 2019; extreme fire events: Canadian fires 2017 and Australian fires 2019/2020) on the global stratospheric aerosol layer and climate.

A particular focus is set on the Hunga Tonga Hunga Ha'apai (Tonga islands) eruption of January 2022, which was exceptional especially in terms of water injection into the stratosphere. However, even the observed peak global average stratospheric aerosol optical depth exceeded that of the strongest stratospheric aerosol events of the last decade by a factor of more than 2.

Since the eruption, we performed multiple measurement campaigns with Optical Particle Counters (POPS and LOAC) to study the aerosol optical properties of the freshly injected plume and its long-term evolution in terms of microphysical properties. The fresh plume consisted mostly of small (<1  $\mu\text{m}$  in size), sulfate particles; the aged stratospheric plume 9 months after the eruption started showing the formation of a second aerosol mode of larger particles (at around 1  $\mu\text{m}$ ). The results of an additional campaign in the Southern hemisphere (February/March 2024, 2 years after the eruption) will also be presented.

Furthermore, during regular balloon borne aerosol observations we found evidence of plume transport towards the Northern Hemisphere with in situ observations in Europe.