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## Recent evolution of stratospheric aerosol load from ground-based lidars and satellites: impact of volcanic eruptions and wildfires.

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During the last 2 years (2018-2019) a series of volcanic eruptions led to remarkable enhancements in stratospheric aerosol load. These are eruptions of **Ambae** (July 2018, Vanuatu), **Raikoke** (June 2019, Russia) and **Ulawun** (July 2019, Papua New Guinea). In this study we examine the evolution of the stratospheric aerosol bulk optical properties following these events in consideration of large-scale stratospheric circulation. We use long-term aerosol records by **ground-based lidars** in both hemispheres together with global observations by various satellite missions (**OMPS-LP**, **SAGE III**, **OSIRIS**, **CALIOP**) and discuss the consistency between these datasets. In addition, we evaluate the preliminary lower stratosphere aerosol product by ESA **Aeolus** mission through intercomparison with ground-based lidars.

The 28-yr Observatoire de Haute Provence (**OHP**) **lidar record** shows that **Raikoke eruption has led to the strongest enhancement of stratospheric aerosol optical depth (SAOD) in the northern extratropics since Pinatubo eruption**. Satellite observations suggest that the stratospheric plume of Raikoke has dispersed throughout the entire Northern hemisphere and ascended up to 27 km altitude. The eruption of Ulawun in the tropics has further boosted the stratospheric aerosol load and by Fall 2019, the **global mean SAOD was a factor of 2.5 higher than its background level**.

At the turn of the year 2020, while both Raikoke and Ulawun aerosols were still present in the stratosphere, a dramatic bushfire event accompanied by vigorous fire-induced thunderstorms (PyroCb) in eastern Australia caused a massive injection of smoke into the stratosphere. The early detections of stratospheric smoke by OMPS-LP suggest that the zonal-mean SAOD perturbation caused by this event **exceeds the previous record-breaking PyroCb-related perturbation** after the British Columbia fires in August 2017. We use satellite observations of aerosol and trace gases (H<sub>2</sub>O, CO) to characterize the stratospheric impact of the wildfires and contrast it with that of volcanic eruptions.