Université de Lille

Area
Cross Disciplinary
Project Lille

Aerosol at the heaRt of the Earth/Atmosphere system

Master 2 - Research Training – 01/02 to 30/06/2026

Laboratory: Univ. Lille/Laboratoire d'Optique Atmosphérique

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AREA Work Package: Contribute to WP1, WP2 and WP3

Megafires : growth, persistence and climate impact of fire particles injected into the stratosphere

Abstract

Global warming generates an increasing occurrence of megafires on our planet that inject massive amounts of aerosols into the stratosphere. However, the microphysical properties of these particles remain poorly known, whereas they represent essential parameters to understand the impact of megafires on climate.

We have recently developed a new method to track the growth and multi-year persistence of volcanic aerosols in the stratosphere (Boichu et al. *JGR* 2023). It involves a synergistic analysis of satellite observations and ground-based photometric measurements from the international AERONET network (jointly coordinated by NASA and the French national service of observations PHOTONS/AERONET at the University of Lille in the Laboratoire d'Optique Atmosphérique). This approach, based on the new AEROMODES algorithm, provides notably constraints on the size distribution of stratospheric aerosols with a spatial and temporal resolution unequalled so far. The method was validated and has proved its performance and high sensitivity for the two last major eruptions from Hunga Tonga in 2022 (Boichu et al. *JGR* 2023) and Raikoke in 2019 (Ruyneau de St-George et al., *Nature Sci. Rep*, under review).

We propose to a motivated Master student to apply the same method to study the optical and microphysical properties of stratospheric aerosols from the most important megafires on the planet over the last years, especially those in Australia in 2019/2020 and the Pacific Northwest Event in North America in 2017. If an extreme event takes place during the internship, the student will be naturally involved in the analysis.

More broadly, the student could also participate to the automation of the method with the aim of proposing a new open access web interface for tracking the growth of aerosols, that will integrate the « Volcano Space Observatory Portal ».

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This internship is within the framework of the Horizon Europe FAIR EASE project in collaboration with DATA TERRA Research Infrastructure, AERIS/ICARE and FormaTerre National Data and Services Centres. It also contributes to the ACTRIS Research Infrastructure, the AREA Cross Disciplinary Programme of the University of Lille and the CPER ECRIN project.

Keywords: Megafire, climate, aerosol optical and microphysical properties, satellite and ground-based remote sensing, AERONET

Requirements: Background in physics, environmental sciences, computer science, data science or equivalent. Strong interest in data analysis, atmospheric and climate studies. Experience in programming (Python is preferred).

References:

Boichu M., Grandin R., Blarel L., Torres B., Derimian Y., Goloub P., Brogniez C., Chiapello I., Dubovik O., Mathurin T., Pascal N., Patou M., & Riedi J. (2023), Growth and global persistence of stratospheric sulfate aerosols from the 2022 Hunga Tonga-Hunga Ha'apai volcanic eruption. *Journal of Geophysical Research : Atmosphere*. https://doi.org/10.1029/2023JD039010

Ruyneau de Saint-George P., Boichu M., Bonnat J., Grandin R., Goloub P., Mathurin T., Pascal N., Record growth of stratospheric aerosols from 2019 Raikoke eruption with sulfate-coating of submicronic ash, *Nature Scientific Reports*, under review.

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