EARTHSCIENCES

Explosive volcanic eruptions from ash plume dynamics to long-term climate impacts

Primary supervisor:	Prof. Thomas Aubry, https://www.earth.ox.ac.uk/people/thomas-aubry
Co supervisor(s):	*The co-supervisory team will be bespoke to the project designed with the student. Oxford and Aubry's network of collaborators have a wide range of experts including in volcanology, remote sensing, machine learning, climate modelling and ice-core science.*
Key words:	Volcano, climate, stratospheric aerosols
Research theme(s):	• Geodesy, Tectonics, Volcanology and related hazards • Oceanography, Climate and Palaeoenvironment
Eligible courses for this project:	• MSc by Research in Earth Sciences (2-3 years) • DPhil in Earth Sciences (3-4 years) • Interdisciplinary Life and Environmental Science Landscape Award (ILESLA) • Intelligent Earth (UKRI CDT)

Overview

Explosive volcanic eruptions inject enormous quantities of ash and gas into the atmosphere which pose widespread hazard to societies and represent the most important natural driver of climate change over the last 2500 years. My group uses a wide range of techniques to understand the fundamental processes that govern volcanic impacts on climate and societies, but also how climate change could affect these processes and impacts. I am keen to work with skilled and enthusiastic postgraduate students to develop their ideas into MSc or PhD projects. Potential project directions include: as:

- Using a new laboratory experiment to better understand how wind and column collapse affect the rise of volcanic plumes and the growth rate of their umbrella cloud
- Using satellite instruments and machine learning to quantify the mass of ash produced by volcanic eruptions and initiate ash forecasts
- Develop next-generation database of eruption source parameters to evaluate and improve volcanic plume models
- Evaluate and develop the interactive stratospheric aerosol module of the UK Earth System Model, the UK flagship climate model
- Quantify the impact of small-moderate magnitude eruptions on historical climate change
- Use machine learning, satellite measurements and complex model simulations to develop a data-driven model of stratospheric aerosol forcing
- Investigate how climate change could affect proximal ash deposition for the world's most active volcanoes
- Or any idea you are keen to discuss with me around volcanoes and/or climate and/or stratospheric aerosols!

Methodology

The methodology used will depend on the project developed although it will involve for sure a large component of scientific programming and data analysis. Potential methodologies include:

- Aerosol and/or climate modelling
- Volcanic plume and/or cloud modelling
- Geophysical fluid dynamics experiment
- Satellite data analysis
- Machine learning
- Analysis/collection of volcanic deposits

Timeline

(timeline for a PhD project, it would be adjusted for a MSc by Research one)

Year 1: Acquiring of background knowledge, training in scientific programming and targeted expert skills required by the project, initiation of work for first paper(s).

Years 2 and 3: Delivery of workplan, writing of first two papers. Presentation at international workshop and conferences. Definition of final direction for the thesis.

Year 4: Delivery of workplan and writing of last paper(s). Integration of papers as a thesis and thesis completion.

Training & Skills

The student will receive intense, targeted training in any skill required by the project.

References & Further Reading

List of relevant texts formatted as follows:

Aubry, T. J., Farquharson, J.I., Rowell, C.R., Watt, S., Pinel, V., Beckett, F., Fasullo, J., Hopcroft, P.O., Pyle, D.M., Schmidt, A. and Staunton Sykes, J., Impact of climate change on volcanic processes: current understanding and future challenges. Bull Volcanol 84, 58 (2022). https://doi.org/10.1007/s00445-022-01562-8

Aubry, T. J.1 , Engwell, S.1 , Bonadonna, Mastin, L.G., C., Carazzo, Van Eaton, A.R., Jessop, D., Grainger, R.G., G., Scollo, S., Taylor, I.A., Jellinek, A.M., Schmidt, A., Biass, S., Gouhier, M (2023). New insights into the relationship between mass eruption rate and volcanic column height based on the IVESPA dataset. Geophysical Research Letters, 50. https://doi.org/10.1029/2022GL102633

Chim, M. M., Aubry, T. J., Abraham, N. L., Marshall, L., Mulcahy, J., Walton, J., & Schmidt, A. (2023). Climate projections very likely underestimate future volcanic forcing and its climatic effects. Geophysical Research Letters, 50, e2023GL103743. https://doi.org/10.1029/2023GL103743

Further Information

Contact: Thomas Aubry (thomas.aubry@earth.ox.ac.uk)