Developing new tools to assess aerosol impacts on convective clouds

PhD project
Space, Plasma, and Climate Community
October 2025 start, full-time.

Supervisor: Edward Gryspeerdt
(e.gryspeerdt@imperial.ac.uk)
https://profiles.imperial.ac.uk/e.gryspeerdt
http://www.cloudsandclimate.com

Clouds are a central component of the Earth system, modulating the Earth's energy budget and playing a key role in the water cycle. However, their response to human activity and to rising temperatures remains a leading uncertainty, both in the forcing and response of the climate system. Due to their multi-scale behaviour, cloud processes must be parametrised, but formulating these parametrisations is difficult and relies on accurate observations. This project involves the development of new observational techniques needed to characterise how convective clouds (such as thunderstorms) respond to human activity.

Recent studies have suggested that convective clouds might have a significant response to small particles (known as aerosols), with additional aerosols emitted from human activity increasing the amount of water in the clouds and potentially leading to more intense thunderstorms. Model studies of this process are highly dependent on the details of the simulation setup, highlighting a need for cloud-scale observations of clouds and their response to aerosol to understand and assess this effect.

This project explores new ways to measure convective cloud processes, using arrays of ground-based cameras and satellite observations to characterise cloud evolution as a function of cloud controlling factors (such as the atmospheric temperature and humidity structure). Analysing data from a recent field campaign, you will then help guide future observations, develop methods to incorporate satellite data into the analysis and help design new hardware.

Specific questions targeted in this project:

- How do aerosols and atmospheric conditions affect cloud morphology, building on observational data from recent field measurements?
- What is the best design of network of ground-based instruments to characterise the properties of cloud fields and their development?
- How can we best combine satellite and ground-based data to constrain cloud models and parametrisations?

You will join a group looking at range of cloud physics problems using a variety of techniques, from high resolution simulations, to global climate models and state-of-the-art satellite observations. This project will involve working with interdisciplinary collaborators across Imperial, nationally through the Parachute/WesCon programme and the ARIA Next-CAM project and internationally as part of the Horizon Europe CERTAINTY project. The improved knowledge of cloud processes gained through this project will not only help improve climate models, it will also address policy-relevant questions around climate mitigation.

Please contact e.gryspeerdt@imperial.ac.uk if you have any questions.

Lin et al, Volumetric Cloud Field Reconstruction (2023) *arXiv:2311.17657*
Bellouin et al, Bounding global aerosol radiative forcing of climate change (2020). *Rev. Geophys.* *doi:10.1029/2019RG000660*