

Motivational Letter

This summer school on Effective HPC for Climate and Weather offers a great opportunity to develop the essential skills and network for my research career. I use HPC to investigate major challenges in climate and air quality. My research involves high-resolution model simulations, post-processing and visualization of satellite and in-situ observations, dealing with modern storage data format, machine learning and big data analysis. I often struggle with the technical nature of the tools, big data analysis and effective use of HPC environments. The topics of this summer school address my greatest research needs directly, and the organization of the programme will help me build my own scientific network. The topics will help me greatly advance my contributions to climate science. Based on my background and the skills I am keen to learn, I propose the following tentative idea of a project as part of the Academic Group Projects. It brings different aspects of the course together and I will encourage deeper interpretation of our results with respect to climate impacts based on individual expertise. This project will allow us to improve our skills in effectively using HPC, big data analysis, and code development. These key skills help us to overcome the gap between climate science and computational technology, allowing us to use HPC and big datasets in better ways and develop deeper insights into the impacts of aerosol on climate change in future.

Project: Aerosol is the largest uncertainty in climate assessment, according to IPCC report. Modern satellite observations provide global coverage of aerosol optical depth (AOD) which can help constrain radiative forcing estimates, but downloading, post-processing and deep analysis of these huge datasets are challenging. We will build a workflow with Python and shell language to perform analysis automatically. This workflow will: 1) download satellite AOD datasets, post-processing and visualizing the NetCDF or HDF data; 2) re-compile data as inputs to radiative transfer models which calculate radiative forcing; 3) perturb the AOD and other parameters to permit large ensembles of radiative transfer simulations using HPC to assess the uncertainty in radiative forcing, comparing results with global models; and 4) use machine learning and big data analysis to perform deep analysis of the relationship between radiative forcing and surface temperature or extreme weather events. This project would nicely combine the key foci and essential topics of the summer school.

Key Words: Climate, Aerosol, Satellite, Radiative forcing, Surface temperature