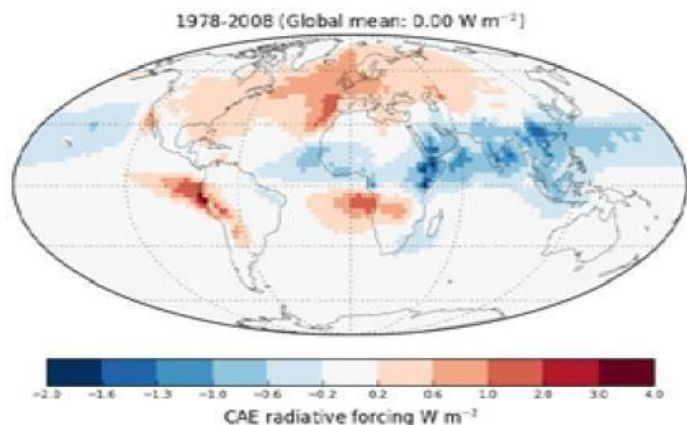


The Climatic Importance of Aerosol Uncertainty



Project

Atmospheric aerosol particles have been identified as the largest source of uncertainty in the degree to which air pollution affects clouds and climate change over the industrial era. This research utilised the N8 HPC facilities to quantify sources of uncertainty in output from the Global Model of Aerosol Processes (GLOMAP), which is used to understand the impact of aerosols on climate, air quality and weather. Thirty-one model processes and particle (aerosol) emissions were perturbed simultaneously to make a large statistical ensemble of several hundred simulations. Because aerosol and chemical concentrations are calculated on a three-dimensional grid throughout the atmosphere, creating each of these global simulations was computationally expensive. N8 HPC and the local University of Leeds HPC resources (Arc1 and Arc2) were used to run the ensemble of simulations and perform the statistical analysis of the output in over ten thousand model grid boxes.

Partners

Leighton Regayre – PhD Student, Institute for Climate and Atmospheric Science, University of Leeds

Professor Ken Carslaw – Director of the Institute for Climate and Atmospheric Science, University of Leeds

Dr Kirsty Pringle – Institute for Climate and Atmospheric Science, University of Leeds

Dr Lindsay Lee – Institute for Climate and Atmospheric Science, University of Leeds

Dr Ben B.B Booth – Met Office Hadley Centre

Testimonial

“Our research has had to push the computational limits of how global models are used to understand aerosol effects on climate. Making use of the N8 HPC and working closely with colleagues at the Met Office turned an impossible tasking into a manageable one. We have produced and analysed an ensemble of global simulations large enough to produce robust and meaningful data for input into future model development.”

- Professor Ken Carslaw, University of Leeds.

Impact

Our poor understanding of aerosol processes limits the ability to reduce uncertainty in how aerosols from human activities have affected Earth's climate. By quantifying the sources of uncertainty over century and decadal timescales, our research has identified the aerosol model processes and emissions that need to be prioritised in future research, our results show that the effect of aerosols on regional climate over recent decades could be up to four times larger than the global effect of changing greenhouse gas concentrations. With this new information, we can plan to reduce uncertainty in the key aerosol processes and emissions and thereby improve the reliability of near-term climate projections.

Success

Without access to N8 HPC the sophistication and thoroughness of the model sensitivity analysis would have been greatly reduced. The N8 HPC facility enabled the team to create a very large ensemble of simulations, in which model processes were perturbed simultaneously. This enabled the full uncertainty of the model to be quantified from one set of simulations. These results will be used to inform the design of an ensemble of global climate model simulations at the Met Office Hadley Centre, where parameters from different components of the Earth system will be perturbed. Our research helps to make this next step feasible by identifying with confidence the most important sources of aerosol model uncertainty.



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