The role of anthropogenic aerosol in near-future Asian climate change

Laura Wilcox*, Liang Guo, Ross Herbert, Manoj Joshi, and Dave Frame

1National Centre for Atmospheric Science, University of Reading – Department of Meteorology, University of Reading, PO Box 243, Earley Gate, Reading RG6 6BB, United Kingdom
2National Centre for Atmospheric Science, University of Reading – Department of Meteorology, University of Reading, PO Box 243, Earley Gate, Reading RG6 6BB, United Kingdom
3Department of Physics, University of Oxford – Department of Physics, University of Oxford, Oxford, OX1 3PU, United Kingdom
4Climatic Research Unit, University of East Anglia – Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, NR4 7TJ, United Kingdom
5New Zealand Climate Change Research Institute, University of Wellington – New Zealand Climate Change Research Institute, University of Wellington, PO Box 600, New Zealand

Abstract

Increases in anthropogenic aerosol emissions during the second half of the twentieth century played a leading role in the weakening of the Asian summer monsoon. However, there are still many uncertainties around the role they might play in changes in Asian climate over the coming 30 years. In particular, there are large uncertainties in local emission scenarios, and in the regional response to these emission pathways. We quantify changes in Asian summer monsoon precipitation, and changes in the East Asian winter monsoon circulation related to haze events, in the Shared Socioeconomic Pathways (SSPs) using the CMIP6 ensemble. In both cases, there is an important role for aerosol changes on decadal timescales, even when greenhouse gases changes are the dominant driver on centennial timescales. With a focus on the summer monsoon, we also use a circulation/climate model to demonstrate that the sum of Asian summer monsoon response to emission reductions in South and East Asia is very different to the response to simultaneous reductions in both regions. As aerosol emissions in these regions are already following different pathways to those explored in the SSPs, this nonlinearity represents a new source of uncertainty in near-future Asian climate.

Keywords: Anthropogenic aerosol, nonlinearity, climate hazards, large, scale circulation

*Speaker