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

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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

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