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Strong control of effective radiative forcing and precipitation by the spatial pattern of absorbing aerosol

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The spatial pattern of anthropogenic aerosol has changed markedly over the historical period and is expected to continue evolving in the coming decades. Additionally, the global composition of anthropogenic aerosol is expected to become relatively more absorbing because policy measures often target sources of scattering and absorbing aerosols differently. However, despite these historical and future changes, relatively little attention has been given to the potential climatic impacts of the evolving spatial pattern of absorbing aerosol.

In this talk, we will present results from a large ensemble of idealised aerosol absorption experiments with a state-of-the-art climate model to show that the global-mean effective radiative forcing (ERF) from absorbing aerosol strongly depends on their location, driven by rapid adjustments of clouds and circulation. Furthermore, by viewing absorbing aerosol as a localised diabatic heating source we will provide an explanation for this location-dependence of ERF in terms of simple atmospheric dynamics. We will also demonstrate how this approach can be used to understand the sensitivity of local and global precipitation to realistic and idealised changes in the spatial pattern of absorbing aerosol.

Our results have implications for understanding the climatic impacts of regional aerosol absorption and demonstrate the utility of an ensemble approach to understanding the impacts of variations in the spatial pattern of aerosol.