EGU2020-21948
https://doi.org/10.5194/egusphere-egu2020-21948
EGU General Assembly 2020

Constraining the model representation of the aerosol life cycle in relation to sources and sinks.

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Global climate model (GCM) ensembles still produce a significant spread of estimates for the future of climate change which hinders our ability to influence policymakers. The range of these estimates can only partly be explained by structural differences and varying choice of parameterisation schemes between GCMs. GCM representation of cloud and aerosol processes, more specifically aerosol microphysical properties, remain a key source of uncertainty contributing to the wide spread of climate change estimates. The radiative effect of aerosol is directly linked to the microphysical properties and these are in turn controlled by aerosol source and sink processes during transport as well as meteorological conditions.

A Lagrangian, trajectory-based GCM evaluation framework, using spatially and temporally collocated aerosol diagnostics, has been applied to over a dozen GCMs via the AeroCom initiative. This framework is designed to isolate the source and sink processes that occur during the aerosol life cycle in order to improve the understanding of the impact of these processes on the simulated aerosol burden. Measurement station observations linked to reanalysis trajectories are then used to evaluate each GCM with respect to a quasi-observational standard to assess GCM skill. The AeroCom trajectory experiment specifies strict guidelines for modelling groups; all simulations have wind fields nudged to ERA-Interim reanalysis and all simulations use emissions from the same inventories. This ensures that the discrepancies between GCM parameterisations are emphasised and differences due to large scale transport patterns, emissions and other external factors are minimised.

Preliminary results from the AeroCom trajectory experiment will be presented and discussed, some of which are summarised now. A comparison of GCM aerosol particle number size distributions against observations made by measurement stations in different environments will be shown, highlighting the difficulties that GCMs have at reproducing observed aerosol concentrations across all size ranges in pristine environments. The impact of precipitation during transport on aerosol microphysical properties in each GCM will be shown and the implications this has on resulting aerosol forcing estimates will be discussed. Results demonstrating the trajectory collocation framework will highlight its ability to give more accurate estimates of the key aerosol sources in GCMs and the importance of these sources in influencing modelled aerosol-cloud effects. In summary, it will be shown that this analysis approach enables us to better understand the drivers behind inter-model and model-observation discrepancies.