



Identification of Remote Regions with Significant Anthropogenic Aerosol Forcing and its Climate Implications

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Numerous studies show through observational as well as modelling evidence that changes in anthropogenic aerosol emissions likely affect the Earth's radiative budget and hydrological cycle through direct (e.g. scattering, absorption) and indirect effects (e.g. acting as cloud condensation nuclei). To what degree aerosol radiative forcing can affect sea surface temperatures (SSTs) is debated. Model results suggest, for example, that anthropogenic aerosols may alter Indian Ocean SSTs, which in turn can affect precipitation patterns. Recent findings from coupled ocean-atmosphere model runs support the hypothesis that aerosol radiative forcing plays a relevant role in the North Atlantic, besides internal ocean circulation.

The aim of the present work is to advance the understanding of potential anthropogenic aerosol effects on climate (climate forcing) with emphasis on remote and fairly pristine regions such as the oceans. The radiation balance in regions with low aerosol content is sensitive to an increase in aerosol burdens, since even small amounts of aerosol induce a large relative change. We performed sensitivity experiments with the global climate model ECHAM5 combined with the interactive aerosol module HAM using prescribed sea surface temperatures (Hadley Centre), and run at a resolution of T42L19 for the years 1870-2000. We compared ensembles of simulations using transient anthropogenic aerosol emissions (from NIES, National Institute for Environmental Studies, Japan) with ensembles using pre-industrial anthropogenic aerosol emissions, i.e. emissions held constant at levels of 1870. This allows us to quantify the transport of anthropogenic aerosols to remote regions and identify regions, where the radiation balance was significantly affected by anthropogenic aerosol burdens during the last century. The aerosol transport capabilities of the model are assessed by comparing present day model results to satellite observations.

Our findings serve as basis for future modelling efforts using a coupled atmosphere-ocean modelling framework. In doing so, we aim to gauge the potential radiative impacts of anthropogenic aerosols on sea surface temperatures and the hydrological responses thereof.