Geophysical Research Abstracts
Vol. 16, EGU2014-11251-1, 2014
EGU General Assembly 2014

Assessing the Potential Effect of Anthropogenic Aerosol Dimming on Sea Surface Temperatures (SSTs)

Tanja Dallafior, Doris Folini, Martin Wild, and Reto Knutti
ETH Zurich, Institute for Atmospheric and Climate Sciences, Zürich, Switzerland (tanja.dallafior@env.ethz.ch)

It is beyond doubt that anthropogenic aerosols have an impact on the Earth's radiative balance and hydrological cycle through both direct and indirect effects. The focus of this presentation is the statistically robust quantification of anthropogenic aerosol dimming over oceans, using a global climate model (ECHAM5 at T42L19 resolution) combined with a detailed aerosol microphysics module (HAM, the Hamburg Aerosol Module). The long term goal is to quantify consequences of such forcing on sea surface temperatures (SSTs).

We use a series of atmosphere only experiments with prescribed observed transient SSTs covering the years 1870-2000. All experimental setups are identical except for anthropogenic aerosol emissions, which are once transient (13 ensemble members) and once held constant at pre-industrial levels (9 ensemble members). On regional scales and in recent decades, anthropogenic aerosol dimming at the sea surface can reach considerable magnitudes, exceeding 20W/m2 in the model. To quantify these findings in more detail, we assume that anthropogenic aerosols spread from the continents in plumes, and introduce identification criteria for said plumes based on statistical testing of changes in aerosol optical thickness and downward short-wave radiation (clear-sky and all-sky). Using the pre-industrial experiment data to construct a reference distribution, the above three variables are tested at each grid point for each month and decade of the transient experiment against the respective reference distribution to identify significant changes in aerosol-induced surface forcing, in the form of changes in downward clearsky shortwave radiation (direct aerosol effect) or in the form or changes of downward allsky shortwave radiation (including also indirect aerosol effects). The resulting aerosol plume regions are analysed for size, intensity and associated surface dimming, persistence, seasonality, and interdecadal trends. The sensitivity of the results towards the chosen statistical approach is presented. A first estimate of potential SST changes due to anthropogenic aerosols over oceans is presented. Additional experiments have been performed which allow to study the sensitivity of the forcing towards different SSTs, emission scenarios, and aerosol composition.