Geophysical Research Abstracts
Vol. 18, EGU2016-15159, 2016
EGU General Assembly 2016

Effect of Aerosol and Ocean Representation on Simulated Climate Responses

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

It is still debated to what extent anthropogenic aerosols shaped 20th century surface temperatures, especially sea surface temperatures (SSTs), through alteration of surface solar radiation (SSR). SSTs, in turn, are crucial in the context of atmospheric circulation and ocean heat uptake. Uncertainty considering anthropogenic aerosol forcing thus translates into uncertainty regarding ocean heat uptake and, ultimately, climate responses towards anthropogenic influences.
We use the global climate model ECHAM to analyse the 20th century climate response towards either anthropogenic aerosols or well-mixed greenhouse gases or both with different representations of ocean and aerosols: atmosphere-only with prescribed SSTs and interactive aerosols; mixed-layer ocean and interactive or prescribed aerosols; fully coupled with prescribed aerosols. For interactive aerosols we use the Hamburg Aerosol Module (HAM).
Our results suggest that up to 15% of global ocean surfaces undergo an SSR reduction of at least -4W/m^2 in the year 2000, due to anthropogenic aerosols. The area affected depends on how aerosols are represented and whether clear sky or all sky SSR is considered. In MLO equilibria with interactive aerosols, anthropogenic aerosols clearly shape surface temperature response patterns. This is to a lesser degree the case for the transient fully coupled case. Additivity of global mean temperature responses towards single forcings – an assumption often made in the literature – is not fulfilled for the MLO experiments, but for the fully coupled experiments.
While some of these differences can be attributed to the differing ocean representation, it is implied that differing aerosol representation may play an even more relevant role. Thus, our results corroborate not only the relevance of anthropogenic aerosols for surface temperature responses, but also highlight the relevance of choice of aerosol representation.