Geophysical Research Abstracts
Vol. 19, EGU2017-15883, 2017
EGU General Assembly 2017

Regional aerosol emissions and temperature response: Local and remote climate impacts of regional aerosol forcing

Anna Lewinschal (1), Annica Ekman (1), and Hans-Christen Hansson (2)

(1) Department of Meteorology, Stockholm University, Stockholm, Sweden (anna@misu.su.se), (2) Department of Environmental Science and Analytical Chemistry, Stockholm University, Stockholm, Sweden

Emissions of anthropogenic aerosols vary substantially over the globe and the short atmospheric residence time of aerosols leads to a highly uneven radiative forcing distribution, both spatially and temporally. Regional aerosol radiative forcing can, nevertheless, exert a large influence on the temperature field away from the forcing region through changes in heat transport or the atmospheric or ocean circulation. Moreover, the global temperature response distribution to aerosol forcing may vary depending on the geographical location of the forcing. In other words, the climate sensitivity in one region can vary depending on the location of the forcing.

The surface temperature distribution response to changes in sulphate aerosol forcing caused by sulphur dioxide (SO_2) emission perturbations in four different regions is investigated using the Norwegian Earth System Model (NorESM). The four regions, Europe, North America, East and South Asia, are all regions with historically high aerosol emissions and are relevant from both an air-quality and climate policy perspective. All emission perturbations are defined relative to the year 2000 emissions provided for the Coupled Model Intercomparison Project phase 5.

The global mean temperature change per unit SO_2 emission change is similar for all four regions for similar magnitudes of emissions changes. However, the global temperature change per unit SO_2 emission in simulations where regional SO_2 emission were removed is substantially higher than that obtained in simulations where regional SO_2 emissions were increased. Thus, the climate sensitivity to regional SO_2 emissions perturbations depends on the magnitude of the emission perturbation in NorESM. On regional scale, on the other hand, the emission perturbations in different geographical locations lead to different regional temperature responses, both locally and in remote regions.

The results from the model simulations are used to construct regional temperature potential (RTP) coefficients, which directly link regional aerosol or aerosol precursor emissions to the temperature response in different regions. These RTP coefficients can provide a simplified way to perform an initial evaluation of climate impacts of e.g. different emission policy pathways and pollution abatement strategies.