# 5.130 Evaluating natural aerosol - climate interactions using long-term observations and an aerosol model .

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Abstract:

Ecosystems are a major source of atmospheric aerosols, including dust, carbonaceous particles from fires, secondary organic aerosol from biogenic emissions and sulfate from marine dimethyl-sulfide emissions. Many of these natural aerosol sources are sensitive to changes in climate, so there is a potential for important climate feedbacks. For example, increased temperature under climate change may drive an increase in biogenic emissions, increasing secondary organic aerosol. Earth System Models (ESMs) include a description of some of these natural aerosol – climate feedbacks, predicting substantial changes in natural aerosol over the coming century with global mean radiative perturbations as large as 1 W $m^{-2}$. Despite this, the sensitivity of natural aerosols simulated by ESMs to changes in climate or emissions has not been robustly tested against observations. Long-term observations of atmospheric aerosol are now available and allow us to evaluate the ability of models to simulate observed variability.
We use long-term measurements of aerosol number concentrations observed at continental mid- to high-latitude environments to explore the sensitivity of atmospheric aerosol to variability in climate and natural emissions. We use a global aerosol microphysics model to help understand this observed variability over the period 1997-2014 and evaluate the ability of the model to simulate observed variability. Using both time-varying and fixed emissions of primary aerosol and aerosol precursors, from natural sources, together with fixed and varying meteorology we quantify the contribution of these different factors to simulated variability. We then quantify for the first time the radiative perturbation through the aerosol direct and indirect effects due to variability in different natural aerosol sources. Improved understanding of the variability in natural aerosol over the observational record will help projections of how natural aerosol will change in the coming decades.