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Estimating parameters of a global aerosol transport model using an ensemble smoother

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We describe a Local Ensemble Transform Kalman filter that we have implemented and validated for use with the global aerosol transport model SPRINTARS. SPRINTARS models the emission, transport and dry and wet removal of four major aerosol species (carbon, sulfate, sea salt and dust). The filter accepts observations of aerosol optical thickness and Angstrom exponent from a variety of data sources (AERONET, MODIS, SKYNET, CSHNET) and uses the flow-dependent covariant information present in the ensemble to improve the model calculation. Recently this filter was further developed into a smoother to allow estimation of certain model parameters, in particular aerosol emission maps.

We will discuss the validation of the ensemble Kalman filter and its robustness under various assumptions. The advantages of a smoother are briefly mentioned. We will discuss observational data screening methods and observational error estimates. The construction of the model ensemble and the methodology for inversion of model parameters will also be explained.

We will present results for emission inversion experiments in which we attempt to improve the original emission maps of SPRINTARS. We will show that the results are robust and do not depend greatly on various assumptions, in particular which original emission map is used. Partial validation is done by comparison to the offical IPCC emission maps, although this is by no means a sufficient test. Various limitations of the inversion (such as spatial and temporal resolution of the resulting maps) will also be discussed.