Geophysical Research Abstracts
Vol. 14, EGU2012-6544, 2012
EGU General Assembly 2012

Investigation of aerosol-precipitation interactions in North-Eastern North America

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In this paper, we report an investigation of the effects of changes in aerosols on clouds and precipitation patterns in North America. The online meteorology/chemistry Weather, Research and Forecasting model (WRF-Chem) version 3.2 is used in the simulation. The domain of our study covers the Eastern parts of Canada and U.S. with a 12-km grid resolution. The purpose of the study is to asses the effects on meteorology (especially clouds and precipitation) of changes in aerosols that may occur due to future changes in population and emissions regulations. The first task is the creation of a series of emission scenarios reflecting the expected changes in these parameters. In order to prepare the anthropogenic and biogenic hourly emissions for the WRF-Chem simulations, we began with the annual, state or county wide total emission inventories for area, point and mobile sources in 2008, which are available from the U.S. EPA website and the corresponding Canadian emission inventories for year 2006, provided by Environment Canada. Surrogate files for the allocation of emissions from area and mobile sources were generated by processing a set of GIS shape files using the Surrogate Generator Tool. The raw emission inventories were then processed using the Sparse Matrix Operator Kernel Emissions (SMOKE) system version 2.7 to generate the speciated, gridded and hourly emission data needed for the WRF-Chem simulation.
Several one-month simulations were conducted to investigate the performance of the model, followed by preliminary studies of the effects of anthropogenic and biogenic aerosols on precipitation patterns. For these initial studies, scenarios were carried out assuming zero emissions, biogenic-only emissions and biogenic plus anthropogenic emissions. The results of these studies will be discussed in this report, along with their implications for the design of the more detailed scenarios to follow. In the latter, we will address the effect of changes in aerosols due to specific population and regulatory changes on precipitation in North America.