

Calculating second order sensitivity coefficients for airport emissions In the continental U.S. using CMAQ-HDDM

Calvin Arter

Email: arterca@email.unc.edu

University North Carolina Chapel Hill

Institute for the Environment

130 airports in the United States are currently located in areas designated as being in nonattainment of the EPA's NAAQ standards. These standards regulate air pollutants across the country to preserve public health. The airports located in regions of nonattainment of these standards pose a risk to public health by contributing to the amount of air pollutants in the region. And as aviation continues to grow as an emission sector, with the FAA forecasting for a 2.1% increase in passenger growth per year over the next 20 years, aviation-related health impacts will heavily affect areas already in nonattainment. Atmospheric chemical transport models are used to estimate concentrations of air pollutants such as PM_{2.5} and O₃, and sensitivity analyses of these models can estimate changes in air pollutant concentrations as a result of varying emission rates. This type of analysis becomes important for looking at air pollutant concentration changes due to emissions from an individual airport, such as one of the 130 located in regions of nonattainment. Hence, we utilize the Decoupled Direct Method in three dimensions (DDM 3-D) as implemented in the Community Multiscale Air Quality Model (CMAQ) to perform these sensitivity analyses. In particular we look to quantify the sensitivity of PM_{2.5} and O₃ concentrations in nonattainment regions to emissions from individual airports. We expand the DDM 3-D analysis to first and second order changes in concentration due to changes in emissions. In this way we can capture the highly non-linear chemistry often seen with emission reduction strategies as well as the indirect effects from changing multiple emissions simultaneously. We choose six precursor emission species responsible for PM_{2.5} and O₃ formation to estimate the individual sensitivity coefficients for each of the 130 airports located in regions of nonattainment.