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Response of fine particulate matter to changes of emissions in Europe

Athanasios G. Megaritis (1,2), Christos Fountoukis (2), Spyros N. Pandis (1,2,3)

(1) Department of Chemical Engineering, University of Patras, 26500, Patras, Greece, (2) Institute of Chemical Engineering & High Temperature Chemical Processes, Foundation for Research & Technology-Hellas (FORTH), 26504, Patras, Greece, (3) Department of Chemical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA

Abstract

Ozone, particulate matter less than 2.5 μm in size ($PM_{2.5}$) and other pollutants either organic or inorganic are subjected to a complex series of common emissions, physical and chemical transformations. Consequently improving air quality requires understanding of how the emissions reductions of one pollutant can lead to changes in the concentration of other pollutants. Three-dimensional chemical transport models that can accurately and efficiently describe the physical and chemical transformations of gas and aerosol species can estimate these source-receptor relations.

PMCAMx-2008 [1, 2, 3], a detailed 3-D chemical transport model (CTM), was applied to Europe in order to simulate the mass concentration and chemical composition of particulate matter during May 2008 and February 2009. The model includes a state-of-the-art organic aerosol module which is based on the volatility basis set framework [4, 5] treating both primary and secondary organic components to be semivolatile and photochemically reactive. The model performance was evaluated against high time resolution aerosol mass spectrometer (AMS) measurements taken from various sites in Europe during the EUCAARI intensive periods [6]. The ability of PMCAMx to predict hourly average concentrations of the major $PM_{2.5}$components against AMS measurements in Europe is encouraging.

Sensitivity analyses were conducted in order to quantify the changes in fine aerosol ($PM_{2.5}$) mass concentrations in response to different emission reductions. Five separate emissions scenarios were applied and the effects of 50% reduction of gaseous emissions (sulfur dioxide (SO_2), ammonia (NH_3), oxides of nitrogen (NO_x), anthropogenic volatile organic compounds (VOCs)), as well as 50% decrease of anthropogenic primary OA emissions on the concentration of the major $PM_{2.5}$ components (sulfate, ammonium, nitrate, and organics) was investigated.

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