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Changes of $PM_{2.5}$ concentrations and their sources in the US from 1990 to 2010

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Quantification of the spatial and temporal variations in the sources of air pollutants, especially $PM_{2.5}$, can inform control strategies and, potentially, the understanding of $PM_{2.5}$ health effects. Three-dimensional chemical transport models (CTMs) are well suited to help address this problem, since they simulate all the major processes that impact $PM_{2.5}$ concentrations and transport. In this study we quantify the changes in the concentration, exposure, composition, and sources of $PM_{2.5}$ in the US from the early 1990s to the early 2010s. Significant reductions of emissions of SO_2, NO_x, VOCs and primary PM have taken place in the US during the last 20 years. We evaluate our understanding of the links between these emissions and concentration changes combining a chemical transport model (PMCAMx) with the Particle Source Apportionment Algorithm (PSAT) (Skyllakou et al., 2017). Results for 1990, 2001 and 2010 are presented. The reductions in SO_2 emissions (64% mainly from electrical generation units) during these 20 years have dominated the reductions in $PM_{2.5}$ leading to a 45% reduction of the sulfate levels. The predicted sulfate reductions were in excellent agreement with the available measurements. Also, the reductions in elemental carbon (EC) emissions (mainly from transportation) have led to a 30% reduction of EC concentrations. The most important source of OA through the years according to PMCAMx is biomass burning followed by biogenic SOA. OA from on-road transport has been reduced by more than a factor of 3, on the other hand changes in biomass burning OA and biogenic SOA have been modest. In 1990 90% of the US population was exposed to $PM_{2.5}$ concentrations to equal and higher than the suggested annual mean by the WHO (10 μg m^{-3}), but this reduced to 70% in 2010. Also, the predicted changes in concentrations were evaluated against the observed changes for 1990, 2001 and 2010, in order to understand if the model represents well the changes through the years.

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