

Title: Anthropogenic Sectoral Contributions to Poor Air Quality Days

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Abstract: Two problem pollutants remaining in the U.S. are fine particulate matter (PM_{2.5}) and ozone (O₃). PM_{2.5} are liquids and solids suspended in the atmosphere that are directly emitted (primary) as well as formed from chemical reactions (secondary). O₃, a secondary pollutant, is formed from photochemical oxidation reactions in the presence of heat and sunlight. These pollutants can have detrimental impacts on human health, contributing to respiratory and cardiovascular diseases. Energy-intensive sectors that contribute to PM_{2.5} and O₃ in the eastern U.S. are on-road transportation and electricity generating units (EGUs). On-road vehicles, prevalent in the highly populated northeast, largely emit nitrogen oxides (NO_x), which contribute to summertime O₃ formation via reactions with volatile organic compounds (VOCs). EGUs, especially coal-fired power plants predominant in the Tennessee River Valley, are strong emitters of sulfur dioxide (SO₂), a gaseous chemical that can oxidize to form particulate sulfate (SO₄²⁻), a large component of summertime PM_{2.5}. However, the relationship between emissions and ambient surface concentrations is highly non-linear. Using the U.S. Environmental Protection Agency (EPA) Community Multi-scale Air Quality (CMAQ) Model at a 12 km by 12 km resolution over the eastern U.S., we examine how two anthropogenic emission sectors contribute to ground-level concentrations of PM_{2.5} and O₃ for July 2007. Our goal is to assess the changes sector contributions on “dirty” pollution days, when concentrations exceed the EPA National Ambient Air Quality Standards (NAAQS). In New York City, concentrations of O₃ and PM_{2.5} on average are 78.2 ppb and 17.2 µg/m³ respectively, and on dirty days are 98.3 ppb and 22.4 µg/m³. Average on-road (EGUs) emissions contribute 14.2% (3.2%) of O₃ and 24.5% (30.8%) of PM_{2.5}. During polluted conditions, contributions from on-road (EGUs) increase to 17.2% (3.9%) for O₃ and 29.4% (31.3%) for PM_{2.5}. Enhanced pollution in New York City is just slightly more so the result of emissions from on-road vehicles than EGUs, however increases in energy sector contributions to O₃ and PM_{2.5} between average and polluted conditions are slight.