

Ph.D Final Defense

EMISSION PROJECTION AND UNCERTAINTY ANALYSIS OF PRIMARY PARTICULATE MATTER (PM) FROM THE TRANSPORTATION SECTOR

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Particulate matter (PM) emissions from the transportation sector have significant impacts on climate and human health. Global projections of PM emissions are critical elements in understanding air quality impacts on large scales, because they are needed to forecast future air quality and climate change and to examine the effects of mitigation options. The purpose of this work is to develop new methods for global emission projections from transportation, analyze the uncertainty in those projections, and investigate the effectiveness of mitigation policies.

A dynamic population model of vehicle linked to emission characteristics, SPEW-Trend, is used to make the emission projections. Unlike previous models of global emissions, this model incorporates considerable detail on the technology stock, including the vehicle type and age, and the number of emitters with very high emissions (“superemitters”). These features of the vehicle fleet alter over time and respond to growth and changes in regional income. Sensitivity and Monte Carlo analyses are used to explore uncertainties.

Projections of global from on-road vehicles are estimated under four global fuel-consumption scenarios from 2010 to 2050. Common features of the projections are an emission decrease until 2035, as emission standards are implemented worldwide and older engines built to lower standards are phased out. Superemitters may contribute more than 50% of global emissions around 2020-2030. Global emissions are most sensitive to uncertainties in vehicle retirement rate. The uncertainty caused by lack of knowledge about technology composition is about the same as the uncertainty in economic pathways, especially during 2010 to 2030.

Two mitigation policies, scrappage of vehicles and retrofit to advanced control technology, are explored to examine potential PM emission reductions. Scrappage provides more emission reduction as soon as the policy begins, while retrofit reduces more emissions when very advanced technology becomes available in most regions. In the year 2030, scrappage and retrofit reduce emissions by 22-49% and 9-23%, respectively.

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3350 Newmark Lab (Yeh Center)
Public Welcome: 7:30am-8:30am