Amgen Seminar Series in Chemical Engineering

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Providing insight into relationships between air pollutant exposure and emissions using advanced modeling approaches

By

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The Computational Atmospheric Chemistry and Exposure Group, led by Dr. Kristina Wagstrom, specializes in applying computational engineering-based approaches to address problems related to air pollution and atmospheric chemistry. The work that will be presented here uses the Particulate Matter Source Apportionment Technology (PSAT) within a state-of-the-science regional chemical transport model to provide insight into the impacts of different emissions by comparing intake fractions over a variety of conditions. Chemical transport models allow researchers and policymakers to estimate spatially and temporally resolved air pollutant concentrations over a large region (from a single city to the entire globe) by explicitly accounting for the impact of gaseous reactions, particle dynamics, transport, meteorology, emissions, removal, and aqueous chemistry. The biggest advantage of these models is that they can be used to address questions and scenarios that cannot be addressed using experimental or monitoring data.

Intake fraction is simply a measure of what fraction of an emitted pollutant is ultimate inhaled by someone in the population. Estimating the inhalation intake fraction for emissions from a variety of sources provides a means by which to determine the relative impact between different emissions sources and can aide in developing efficient pollution control policies. For instance, it is likely that emissions from an elevated stack will have a lower intake fraction than ground-level emissions. In this study, we compare the ground level concentration contributions and inhalation fraction for different heights of point source emissions to those estimated using dispersion modeling approaches. We also use intake fraction as a metric by which to understand how exposure varies as you move away from an emission source region (specifically nine different cities).

In addition to estimating intake fraction of primary pollutants, as is common, we also provide estimates of the intake fraction for secondary pollutants. The intake fraction for secondary pollutants is calculated based on the commonality between the precursor and product. For instance, the intake fraction of SO_2 and particulate sulfate would actually be calculated as the intake fraction of the sulfur atom treating SO_2-sulfate as a complete system. This approach can also be applied to the NO_x-nitrate system, the ammonia-ammonium system, and similar systems of organic species. This approach provides a more thorough and complete estimation of what fraction of the original emissions are eventually inhaled by the human population, particularly as research has continued to demonstrate the importance of these secondary species to human health impacts.

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