4.030 Parametric and Structural Uncertainties Related to Air Pollution and Human Health: Influence of Resolution, Chemical Mechanism, Meteorology, and Model (CESM CAM-Chem and GEOS-Chem).

Early Career Scientist

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Abstract:

By examining the differences in simulated $PM_{2.5}$ and O_3 and associated uncertainties, we quantitatively explore potential trade-offs between complex, high-resolution, short simulations and simpler, coarse-resolution, long simulations for air pollution health impacts analysis. Continuing advancements in computational power, observations, and scientific understanding allow for more complex simulations with higher spatial resolutions. This enhances our ability to assess human health hazards due to atmospheric chemistry and climate change, but also increases awareness of parametric uncertainties within models and structural uncertainties between models. Thus, analysts often face a choice between shorter or fewer runs of a complex model and longer or more runs of a simpler model. This work explores the implications of model choice for health benefits analysis using two state-of-the-art chemistry-climate models with a particular focus on O_3 and $PM_{2.5}$ exposure. We examine differences resulting from modeling decisions regarding: resolution, chemical mechanism, driving meteorological data, and model choice. Preliminary comparisons of CESM CAM-Chem simulations using standard CESM CAM-Chem and GEOS-Chem emissions show that, when normalized by their respective mean values, global O_3 shows twice as much of a difference between models than global

$PM_{2.5}$. The opposite is found over the US, where the differences between models for O_3 are half as much as differences between models for $PM_{2.5}$. We also find that CESM simulations, when comparing standard CESM CAM-Chem and GEOS-Chem emissions, result in time-series correlations that are higher globally than regionally (e.g. $PM_{2.5}$ correlations of R^2=0.99 globally, and R^2=0.43 over the US). Preliminary comparisons of simulations using chemical mechanisms with differing complexity find small differences for aerosols (~10%) and larger differences for gaseous species such as O_3. Uncertainties related to resolution and driving meteorological data may be of comparable magnitude. Finally, we assess the influence of these choices on health prediction using the BenMAP health impacts assessment software.