Unraveling aerosol mixing state: Enhancing climate impact predictions through particle-resolved simulations

Dr. Nicole Riemer
Department of Atmospheric Sciences
and affiliate of the
Department of Civil and Environmental Engineering,
University of Illinois at Urbana-Champaign

Abstract:
Calculations of the aerosol direct effect on climate heavily rely on simulated aerosol fields. However, the accuracy of these calculations is often compromised due to the uncertainties introduced by the model representation of aerosols. These uncertainties stem from assumptions about the diversity of particle composition within the aerosol population, referred to as the aerosol mixing state. In this presentation, we aim to address the impact of simplifying the aerosol diversity on the accuracy of our estimates of aerosol optical properties. To achieve this, we employ a particle-resolved aerosol model, which represents aerosols as individual computational particles. These particles evolve in size and composition as they undergo aging processes in the atmosphere. Unlike commonly used modal or sectional aerosol models, our approach avoids limitations associated with assumptions about particle composition within specific size ranges. By leveraging particle-scale simulations, we provide compelling evidence that accurately capturing the aerosol mixing state is crucial for predicting population-level quantities such as absorption enhancement or single scattering albedo. Our findings have significant implications for remote sensing retrievals and further enable the development of parameterizations for global-scale models. In conclusion, our work underscores the importance of accounting for aerosol mixing state in climate models, and we demonstrate how particle-scale simulations can enhance our understanding of aerosol behavior, paving the way for improved parameterizations and more accurate global-scale models.

Bio:
Nicole Riemer is a Professor at the Department of Atmospheric Sciences and an Affiliate of the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign. She received her Doctorate degree in Meteorology from the University of Karlsruhe,

Germany. Her research focus is the development of computer simulations that describe how aerosol particles are created, transported, and transformed in the atmosphere. Her group uses these simulations, together with observational and satellite data, to understand how aerosol particles impact human health, weather, and climate. She has received the NSF CAREER award, the AGU Ascent Award, and the College of Liberal Arts & Sciences Dean's Award for Undergraduate Teaching. She is an editor for Aerosol Science & Technology and for the Journal of Geophysical Research.