**Sensitivity of Black Carbon Aging to Modeling Assumption in CAMChem**

Black carbon (BC) aerosol strongly absorbs visible light and therefore has a warming impact on climate. Quantifying this impact requires us to develop faithful model representations of its climate-relevant properties, such as CCN activity and optical properties. One key process that needs to be captured is the BC ‘aging’ process, that is the conversion of fresh, hydrophobic black carbon into aged, hydrophilic black carbon, which directly contributes to CCN activation and wet removal and impacts black carbon’s optical properties. In current models, the BC aging timescale is either assumed to be a fixed value (1-2 days) or is determined with mechanistic transfer rates based on ad hoc aging aging criteria. Both approaches are very sensitive to the choices of assumed parameters.

The goal of this study is to explore the sensitivity of the simulated BC burden and BC radiative forcing to the aging criterion used in CAMChem, and to compare BC aging rates in CAMChem to an aging parameterization based on more detailed particle-resolved simulations with PartMC-MOSAIC. We carried out a 1-year simulation with the global CAMChem model, where a 4-mode modal aerosol model is used. BC aerosol is transferred from a fresh, hydrophobic mode (primary carbon mode) to an aged, hydrophilic mode (accumulation mode) after condensing a certain amount of secondary materials or through coagulation. Our results show that the simulated BC burden is most sensitive to the choices of the aging criterion in the high-latitude regions, with maximum differences in the annual averaged BC mixing ratio of 16% near the surface. This differences can be higher in the monthly averaged BC mixing ratio (e.g., we observe 65% relative difference at an elevation of 10km in the Arctic for March). The aging timescales in the CAMChem model range from less than one hour (South America) to several days (over the ocean) and these values are broadly consistent with the aging timescales from the PartMC-MOSAIC parameterization.