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

Black carbon (BC) strongly absorbs visible light, though with large uncertainties (Bond et al., 2013). To better understand its climate effect requires us to develop faithful representation of the evolution of aerosol properties. One key process that needs to be captured is called the ‘aging’ process, conversion of fresh, hydrophobic black carbon into aged, hydrophilic black carbon, which directly contributes to CCN activation and wet removal. Currently, BC particles are usually characterized with an arbitrary aging timescale (1-2 days) or with mechanistic transfer rates from fresh to aged type, both are very sensitive to the choices of assumed parameters. Our previous study on particle-resolved aerosol model PartMC-MOSAIC has introduced a more precise way to estimate BC aging timescales by tracing the size and composition of individual particles, without making a priori assumptions (Riemer et al., 2010). Parameterization of BC’s aging has been found (Fierce et al., 2016), which can be applied to the output of global models to assess the accuracy of its aging criterion.

In this work, we simulated black carbon aging with the global CAMChem model, where a 4-mode modal aerosol model is applied to aerosol treatment by transferring BC from the fresh, hydrophobic mode (primary carbon mode) to the aged, hydrophilic mode (accumulation mode) after condensing a certain numbers of sulfate monolayers or through coagulation. We did sensitivity analysis of the BC burden and its direct radiative forcing to the number-of-monolayer aging criterion, and found that the simulated BC burden is very sensitive to the choices of aging criterion, where the highest absolute relative difference attains 22%. We also did process analysis on BC aging timescales by applying PartMC-MOSAIC parameterization to the model output, and then comparing the timescales with the e-folding time of BC conversion in CAMChem model. We observe that condensation of SOA and sulfate plays a dominating role in BC aging, compared with coagulation. The aging timescales in the CAMChem model range from less than one hour to several days, which are broadly consistent with the aging timescales from PartMC parameterization.