M.S. Defense Announcement
Emily Ramnarine
Thursday, August 16 at 10:00am

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Defense
ATS West Seminar Room (121 ATS West)

Post Defense Meeting
ATS Main Conference Room (209 ATS)

Committee:
Jeffrey Pierce (Advisor)
Sonia Kreidenweis
Shantanu Jathar (Mechanical Engineering)

Effects of Near-Source Coagulation of Biomass Burning Particles on Global Predictions of Aerosol Size Distributions and Implications for Aerosol Radiative Effects

Globally, biomass burning burns approximately 3.7 million square kilometers per year. This burning is a significant global source of aerosol number and mass. By interacting with shortwave radiation and affecting cloud properties, biomass burning aerosol can impact the climate system. In fresh biomass burning plumes, aerosol coagulation reduces aerosol number and increases particle sizes, greatly impacting the aerosol size distributions and radiative effects. Near-source biomass burning aerosol coagulation occurs at spatial scales much smaller than the grid boxes of global and many regional models. To date, these models ignore sub-grid coagulation and instantly mix fresh biomass burning emissions into coarse grid boxes. A previous study found that the rate of growth by coagulation within an individual smoke plume can be approximated intuitively using fire properties, initial size distribution parameters, and meteorology. By using this parameterization of sub-grid coagulation in a global aerosol microphysics model, we are able to quantify the impacts on global aerosol size distributions, the direct radiative effect, and the cloud-albedo aerosol indirect effect.

Overall, we find that the inclusion of biomass burning sub-grid coagulation reduces the biomass burning impact on the number concentration of particles, including those larger than 80 nm (a proxy for CCN-sized particles). This CCN reduction causes our estimated global biomass burning cloud-albedo aerosol indirect effect to decrease in magnitude. Because sub-grid coagulation moves mass to sizes with more efficient scattering, including it increases the magnitude of our estimated biomass burning all-sky direct radiative effect. These findings are consistent across sensitivity studies.