Improving simulations of biomass burning smoke and anthropogenic dust in E3SM

Xiaohong Liu[1], Zheng Lu[1], Ziming Ke[1], Allen Hu[1], Jiwen Fan[2], Kai Zhang[2], and Po-Lun Ma[2]

[1]Department of Atmospheric Sciences, Texas A&M University, College Station, TX
[2]PNNL

Natural aerosols including biomass burning smokes and dust particles play a key role in the Earth system, but their representations in Earth System Models (ESMs) are overly simplified. As ESMs approach convection-permitting scales, physically-based treatments of aerosol emissions and atmospheric processes become feasible.

This abstract presents two new developments for E3SM under the EAGLES project:

(1) Biomass burning smoke injection height. We incorporated a 1-D plume-rise model in E3SM so that the vertical profiles of biomass burning aerosol emissions can be calculated interactively as a function of fire heat release, fire size, and ambient thermodynamic conditions. We partitioned the biomass burning aerosol emissions into four categories (severe, large, moderate, and small fires) that are grouped based on fire radiative powers observed by the MODIS satellite. Vertical profiles for each fire category are merged into one as weighted by fire emission amounts. Preliminary results of biomass burning aerosol vertical profiles, burdens, and radiative effects will be presented.

(2) Anthropogenic dust from land-use. We introduced the anthropogenic dust to E3SM by modifying the soil erodibility in the dust emission scheme. The land-use data were derived from the Historical Database of the Global Environment (HYDE version 3.2). We quantified the contribution of anthropogenic dust on the global and regional scales by comparing model simulations with *in-situ* ground-based and satellite-borne observations. The climate impacts of anthropogenic dust will be presented.