Brown Carbon Simulations and Impact on Radiative Forcing

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Abstract

Understanding the intricate role of aerosols in Earth's climate, especially their influence on radiative forcing, remains a significant challenge. One particular area of uncertainty pertains to the radiative effect of Organic Aerosol (OA). Typically, models depict OA as scattering agents or weakly absorbing, yet a subset of OA known as Brown Carbon (BrC) can absorb solar radiation, sometimes exceeding Black Carbon (BC) in efficiency, thus contributing to atmospheric warming. Our recent study integrated new tracers for BrC into the global Earth System Model EC-Earth3. We computed BrC emissions from biomass burning and biofuel, determining their refractive indices based on established methods. We treated BrC as exclusively absorbing, while OA was handled solely as scattering. Additionally, we considered BrC bleaching through its reaction with OH radicals, resulting in photobleached BrC with reduced absorption efficiency. To evaluate BrC climate impact, we conducted simulations with different model configurations: one with all OA slightly absorbing, another with OA solely scattering without BrC, and a third with OA scattering and BrC absorbing. Our findings revealed peak Absorption Aerosol Optical Depth due to BrC (AAOD_BrC) at 440nm in regions like central Africa, East Asia, and the Amazon, where biomass burning prevails and significant contribution to AAOD globally. BrC impact on absorbing radiation at the Top of the Atmosphere was most pronounced in central Africa and eastern Asia.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

CCMi: Chemistry Climate Model Initiative