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Wildfires and Their Contribution to Climate Change[1]

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Aerosols emitted from wildfires and agricultural burns, collectively referred to as biomass burning aerosols (BBA), perturb Earth's climate through "direct" effects (scattering and absorption of incoming shortwave radiation), "semi-direct" effects (evaporation of cloud drops and modification of atmospheric dynamics), and "indirect" effects (influencing cloud formation and precipitation). These events are an important source of emitted primary and secondary aerosol particles providing an estimated 50% of anthropogenically-influenced fine carbonaceous particles and ˜40% of the global atmospheric inventory of black carbon (BC) – a warming agent second only to CO_2. Additionally, these events generate light-absorbing organic compounds, known as brown carbon (BrC). The overall effect of these BBA emissions on the atmospheric radiation balance, either forcing the atmosphere to heat or cool, depends on their abundance, cloud-forming activity, and complex refractive index. Their climate forcing impacts are governed by these particle properties and their temporal and spatial extents during their lifecycle. By combining aircraft observations on the near-source evolution (<5 hrs) of BBA particles with measurements on very aged (1-2 weeks) BBA plumes that have been transported 1000's of kilometers across oceans to other continents, we can, for the first time, begin to examine how biomass burn aerosols change throughout their lifecycle. The lifecycle of BB aerosols from near-source to near-global extents will be discussed, focusing on the evolution of their chemical, microphysical, and optical properties. Primarily utilizing measurements of black carbon containing particles, we track observed changes in BBA particle properties that provide insights into the processes affecting them as their environments change from local emission through long range transport. I will first introduce the importance and associated complexities of biomass burning. Next I will briefly discuss how measurements of these events are conducted and how uniquely combining different measurements can provide new insights into how atmospheric processing can alter the compositional, microphysical and optical properties of BBA particles. Finally, I will give an overview of the lifecycle of BBA particles and their properties.

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