Biomass-Burning Aerosol Emissions from Measurement to Modeling

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Biomass burning is a seasonal phenomenon in different land ecosystems around the world. These fires, which can originate from natural or anthropogenic causes depending on region and circumstances, are estimated to consume biomass containing a total of 2-5 petagrams of carbon globally every year, generating intense heat energy, and emitting smoke plumes that comprise different species of aerosols and trace gases. Many of these fire emissions when produced in large amounts can have adverse effects on human health, air quality, and environmental processes. However, because of the inherent difficulty in quantifying these emissions in near real-time by traditional methods, it has hitherto been challenging to parameterize them accurately in models used for biosphere-atmosphere interaction studies or air-quality monitoring and forecasting. Fortunately, a series of recent studies have revealed that both the rate of biomass consumption and the rate of emission of aerosol particulate matter by open biomass burning are directly proportional to the fire radiative energy (FRE) release rate, which is fire radiative power (FRP) that is measurable from space. We have leveraged this relationship to generate a global, gridded dataset of emission coefficients (Ce) of smoke particulate matter using measurements of FRP and aerosol optical depth (AOD) from the Moderate-resolution Imaging Spectro-radiometer (MODIS) twin sensors aboard the Terra and Aqua satellites. This first version of the Fire Energetics and Emissions Research (FEER.v1) global Ce product is available at 1°x1° resolution at http://feer.gsfc.nasa.gov/. Ce is a simple coefficient to convert FRE (or FRP) to smoke aerosol emissions, in the same manner as emission factors are used to convert burned biomass to emissions. In this presentation, we demonstrate the simplicity and utility of using both the gridded Ce product and satellite measurements of FRP to derive emissions, present some comparisons of these emission products against other emissions inventories, and analyze the results of the comparative implementation of these emissions in WRF-Chem, which is a fully-coupled meteorology-chemistry-aerosol model that is used to simulate regional smoke transport and impacts.