

Impact of Vegetation Fires on the Composition and Circulation of the Atmosphere

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Vegetation fires are a significant source for atmospheric trace gases and aerosol particles (APs) on both local and global scale. The biomass burning APs affect cloud formation as well as microphysical and chemical processes in clouds. They influence the radiation budget directly and via altered cloud properties. Finally, this results in changes of the atmospheric energy budgets and circulation. The joint research project EFEU addressed these topics with a combined experimental and numerical approach of eight different research groups. Three series of experiments were carried out at the laboratory oven facility at MPI Mainz. Characteristic vegetation from different burning regions was investigated, e.g., Musasa (Africa), Aleppo pine (Mediterranean), spruce (boreal) and peat (Indonesia). Trace gases and a wide range of AP parameters were measured, including size distributions as well as morphological, chemical, hygroscopic and radiative properties. Experimental results indicate that hygroscopic properties and drop nucleating abilities are rather similar for APs from burns of different types of hard wood but different to APs from other burning material such as maize or peat. Generally, the soluble fraction of the APs is quite small and their EC content fairly high. Radiative properties (single scattering albedo) are well correlated with the burn conditions (flaming/smoldering). For the numerical studies of the complex impact of biomass burning emissions on the atmosphere a suite of independent models was employed. Ranging from the microscale to the regional scale they complement each other in terms of spatial and temporal resolution as well as complexity of the processes described. Modelling efforts covered a detailed description of the microphysics including the ice phase, the evolution of individual biomass burning plumes, effects of radiative transport on chemistry and dynamics as well as regional atmospheric budgets of trace constituents, water and energy. Main results are: Precipitation is initiated only via the ice phase in the clouds explored. The dilution of an individual plume was predicted successfully and realistic heating and photolysis rates were simulated. Total particulate matter was correctly calculated for the Indonesian case study using emission factors and sizes of the burning areas.

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