INITIATIVE ON
Extreme Weather and Climate
COLUMBIA UNIVERSITY

PyrE, an interactive fire module within the NASA-GISS Earth System Model

Keren Mezuman
Susanne E. Bauer
Kostas Tsigaridis

Fires directly affect the composition of the atmosphere and Earth's radiation balance by emitting a suite of reactive gases and particles. Having an interactive fire module in an Earth System Model allows us to study the natural and anthropogenic drivers, feedbacks, and interactions of biomass burning in different time periods. To do so we have developed PyrE, the NASA-GISS interactive fire emissions model. PyrE uses the flammability, ignition, and suppression parameterization proposed by Pechony and Shindell (2009), and is coupled to a burned area and surface recovery parameterization. The burned area calculation follows CLM's approach (Li et al., 2012), paired with an offline recovery scheme based on Ent's Terrestrial Biosphere Model (Ent TBM) carbon pool turnover time. PyrE is driven by environmental variables calculated by climate simulations, population density data, MODIS fire counts and LAI retrievals, as well as GFED4s emissions. Since the model development required extensive use of reference datasets, in addition to comparing it to GFED4s BA, we evaluate it by studying the effect of fires on atmospheric composition and climate. Our results show good agreement globally, with some regional differences. Finally, we quantify the present day fire radiative forcing. The development of PyrE allowed us for the first time to interactively simulate climate and fire activity with GISS-ModelE3.