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Evaluation of the SPITFIRE algorithm within the MPI-ESM land surface model JSBACH

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Fire is an important Earth system process, which impacts climate through changes in aerosol concentrations, land surface properties and the carbon cycle. At the same time fires are controlled by climate and the frequency of fires is expected to increase with future climate change. The net effect of fires on the climate system remains unclear as depending on the process fires can cool (e.g. increased snow exposure) or warm (e.g. increased greenhouse gas emissions) the Earth system. A quantitative analysis of this contribution requires Earth system models that include the coupled climate carbon cycle and take into account fire-climate interactions.

The MPI-ESM couples atmosphere, ocean and land surface through the exchange of energy, momentum, water and important trace gases and offers a framework to quantify the net effects of fire within the Earth system. As a first step we implemented the SPITFIRE algorithm into JSBACH, which is the land surface component of the MPI-ESM. SPITFIRE is a process-based fire regime model. It interacts with the land surface model through the usage of the meteorological and carbon stock related parameters and provides in return the burned area and fire carbon emissions on a daily time scale. Here, we evaluate the SPITFIRE-JSBACH model using the GFEDv3 satellite based observational dataset with respect to burned area and carbon emissions for present day conditions. For the carbon emissions during the 20th century we compare our results with a composite of reconstruction data. We analyze global sums, spatial patterns, intra- and interannual variations of the two target variables. As climate and land use change are the two main drivers during the 20th century, we assess the sensitivity of the model with respect to driving data by using different meteorological datasets (CRUNCEP and WATCH) and different datasets for land use change (Hurtt et al. 2011, Pongratz et al. 2008).