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Climate and human drivers of fires in the boreal forests: Data constrained design of a fire prognostic model

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Boreal regions are important for the global carbon cycle because it is the largest forested area on earth and there are large belowground carbon pools (∼1000 PgC). It is also a region where largest warming trends on the globe over the last decades have been observed and changes of the land ecosystems have already started. A major factor that determines the structure and carbon dynamics of the boreal forest is fire. As fire frequency depends strongly on climate, increased fire occurrence and related losses to the atmosphere are likely, and have already been reported. In order to predict with more confidence the occurrence and effect of fire on forest ecosystems in the boreal region, we have developed a fire model that takes advantage of the large on-ground, remote sensing and climate data from Canada, Alaska and Siberia.

This prognostic model estimates the monthly burned area in a grid cell of 2 by 2.5 degrees, from four climate (air temperature, air relative humidity, precipitation and soil water content) and one human-related (road density) variables. Parameters are estimated using a Markov Chain Monte Carlo method applied to a dataset of observed burned area for Canada.

The model is able to reproduce the seasonality of fire, the interannual variability, as well as the location of fire events, not only for Canada (on which data the model is based), but also for Siberia, for which the results compare well with remote sensing observation, and are in the range of various current estimations of burned area. The fire model is being implemented in LM3V, the new vegetation model of GFDL earth system model, in order to make prediction of future fire behavior in boreal regions,

and the related disturbance of the vegetation and carbon emissions.