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Global patterns of vegetation fire seasonality

Akli Benali (1), Bernardo Mota (1), Jose M.C. Pereira (1), Duarte Oom (1), Nuno Carvalhais (2,3)

(1) Universidade Técnica Lisboa, Centro de Estudos Florestais, ISA, Tapada da Ajuda, 1349-017 Lisboa, Portugal, (2) Max-Planck-Institut fu r Biogeochemie, P.O. Box 10 01 64, 07701 Jena, Germany, (3) CENSE, Departamento de Ciências e Engenharia do Ambiente, FCT, Universidade Nova de Lisboa, Portugal

Fires exhibit a strong seasonality throughout the year, which is driven by a combination of climatic factors, ignition sources and land management practices. Despite the significant contribution of fire to atmospheric composition, global biogeochemical cycles and the Earth system in general, seasonal fire activity has not been thoroughly characterized at the global scale so far. In this work we aim to classify and investigate the patterns of fire seasonality at the global scale.

Active fire counts from the Moderate Resolution Imaging Spectrometer (MODIS) over the period 2002-2012 were aggregated to a spatial resolution of 0.5 degrees to derive the first global classification map of uni and bimodal fire seasons. We used circular statistics techniques to fit a single and a mixture of two von Mises distributions to the observed active fire counts in order to classify fire activity into uni- and bi-modal seasonal patterns. The seasonal model was determined using the Nash-Sutcliffe model efficiency index to select the best seasonal model explaining the fire activity observations. We combined annual and aggregated (2002-2012) active fire counts to produce a more detailed seasonality classification identifying the regions with unimodal and predominantly- frequently- and sporadically-bimodal seasonal patterns. We find that circa 25% of the global regions with relevant fire activity exhibited some type of bimodal fire seasonality. The most relevant clusters showing bimodal seasonality were found in northeastern regions of North America, and the southern areas of South America, as well as in Russia, Ukraine and Kazakhstan, northern India, and northeastern China. Around 40% of the bimodal regions were covered by croplands, twice as much as in unimodal areas, suggesting that most of the bimodal activity is related to land management practices. The interannual variability of the seasonal patterns is also investigated, in particular the changes in the magnitude of the main and secondary seasons in bimodal regions.

Our results emphasize the influence of land use management, in addition to vegetation phenology, and climate constraints, on the temporal patterns of global vegetation burning and atmospheric emissions. Ultimately, the current classification maps of seasonality of fire activity may present a relevant information source for future studies related to the spatio-temporal patterns of fires at a global scale.