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A data-based method to determine the regional impact of agriculture on fire seasonality

B.I. Magi (1), S. Rabin (2), E. Shevliakova (2,3), and S. Pacala (2)

(1) University of North Carolina at Charlotte, Department of Geography & Earth Sciences: Charlotte, NC, USA, (2) Princeton University, Department of Ecology & Evolutionary Biology: Princeton, NJ, USA, (3) National Oceanographic & Atmospheric Administration, Geophysical Fluid Dynamics Laboratory: Princeton, NJ, USA

Anthropological work and studies of satellite-observed fire occurrence have shown that the timing of human burning practices in many regions does not correspond with what would be expected based on indices of fire weather and fuel load alone. To date, large-scale observed differences in fire seasonality between agricultural land (i.e. cropland or pasture) and non-agricultural land have not been fully quantified. This will be necessary if fire modules in the next generation of dynamic global vegetation models (DGVMs) are to take advantage of those models' ability to keep track of different types of land cover and land use. The work described in this paper compares observed fire seasonality on agricultural and non-agricultural land in 14 world regions, using a statistical method to separate burning on the two different land types. Active fire detections from the NASA Moderate Resolution Imaging Spectroradiometer (MODIS) sensors and burned area estimates from the Global Fire Emissions Database (GFED, version 3.1) serve as observations of fire activity for the years 2000-2009. Global estimates of the areal extent of cropland and pasture are provided by the History Database of the Global Environment (HYDE) database (version 3). We use the TIMESAT analysis program, which is designed to estimate seasonality in remote-sensed data, to determine the length and timing of the fire season. We find quantitative differences in fire seasonality between agricultural and non-agricultural land in many regions. The agricultural fire season in northern hemisphere Africa, for example, begins 1-2 months before the fire season on non-agricultural land. Attributable to a preference for early-season burning on managed land, this pattern is not captured by current global fire models that do not consider land use. Qualitative differences in the number of peaks in fire occurrence are also apparent in several regions – for example, South America north of the equator shows two peaks in non-agricultural land but only one for cropland/pasture. Our results illustrate a method to integrate global fire and land-use data to separate region-specific agricultural burning practices from non-agricultural burning. DGVMs with interactive fire models would benefit from the methods and results presented in this study.