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Spatio-temporal representation of biomass burning in a global fire model. Comparison to satellite data and assessment of the fire-driving assumptions.

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Biomass burning is an important terrestrial process with a strong influence on vegetation and atmospheric composition. It generates carbon emissions estimated to reach on average half of the annual fossil fuel combustion, with significant inter-annual variability. Global fire models have been developed to make projections of future fire patterns under climate change conditions. The anthropogenic footprint on fire activity, relations between climate and fire, and other factors driving global fire patterns are not well validated, limiting the usefulness of these future assessments.

Thanks to newly available remote sensing products, global fire models can now be evaluated for fire activity over the last decade. We present a validation study of the daily time-step SEVER Dynamic Global Vegetation Model fire module (SEVER-Fire) [1], at global and regional scale, over the 1997-2006 period. Burned areas and emissions are validated using the Global Fire Emission Database (GFED, [2]), derived from satellite observations:

1- Validation of the predicted spatial and temporal patterns, focusing on fire incidence, seasonality and inter-annual variability.

2- Improvement of our understanding of fire driving parameters, including climatic and anthropogenic drivers, as well as the type and amount of vegetation.

Overall, SEVER-Fire predicted an average global burned area of 4.6M km2 (GFED:

3.4M km2), and 6616 TgC emissions (GFED: 2424 TgC). The mean annual correlation of burned area estimates between SEVER-Fire and GFED is 0.11, with important spatial variability. SEVER-Fire satisfyingly represents strong climate-driven patterns, i.e. fire season timing and the 1997-98 El Niño fire events, which had huge ecological and atmospheric impact. However, the spatial pattern of fire incidence shows important discrepancies, and we here analyse and discuss the implication of precipitation, fuel availability and human influence. Inaccuracies in vegetation type mapping in the model is shown to be responsible for a substantial bias. The representation of human induced fires, through ignition, extinction and modification of vegetation also needs to be improved, given its primary impact. We discuss possible directions for further progress on these shortcomings, to enable such models to project future fire activity from satisfying assumptions.

References:

[1] S. Venevsky and S. Maksyutov, 2007, *Environmental Modelling and Software*, 22, 104-109.

[2] G. van der Werf *et al*., 2006, *Atmospheric Chemistry and Physics*, 6, 3423-3441.