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The Importance of Fire in the Earth System: Simulation Models, EO Data and Future Prospects

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Fire is a significant determinant of vegetation dynamics, biogeochemical cycling and atmospheric chemistry at global, regional and landscape scales. Earth observation data plus direct observations have shown that over recent decades, fire activity (burnt area, fire intensity) has increased markedly in many part of the world (especially the boreal and humid tropical biomes), with often negative impacts on biodiversity conservation, carbon sinks and emissions to the atmosphere. In many regions fires are an important and highly variable source of air pollutant emissions, and they thus constitute a significant if not the dominant factor controlling the inter-annual variability of the atmospheric composition.

Most methods of predicting fire risk use empirical fire danger indexes calibrated against past weather conditions and fire events. As such, they provide little information on process, and are appropriate to deal only with current climate, land use and land cover change. As such they cannot be used to predict ignition 'hotspots', burned area, carbon sinks, and pyrogenic carbon release under climate change, to name but a few applications.

The simulation of fire-vegetation feedbacks is important for investigating how fire and fire-related emissions might change with changing climate conditions, as well as vegetation and fuel dynamics. A new mechanistic model of fire ignitions, fire spread, fire intensity and emissions from biomass burning (SPITFIRE: SPread and InTensity of FIRes and Emissions), which is embedded in the LPJ DGVM, has been used to

examine the impact of fire on the terrestrial carbon cycle and the emissions of trace gases and aerosols (Thonicke, Spessa and Prentice *et al. Global Change Biology*).

This presentation provides an overview of LPJ-SPITFIRE, and illustrates its application globally and in selected regions in which model output has been evaluated using observed fire activity data from satellites. A planned future application of SPITFIRE as part of the recent NERC-funded FireMAFS project will also be presented. FireMAFS aims to forecast seasonal fire activity and emissions using SPITFIRE driven by statistically downscaled ensemble climate model fields. EO data on fires will be employed to help constrain, evaluate and improve the fire model.