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Simulating fire-induced ecological succession with the dynamically coupled fire-vegetation model, ED-SPIFTIRE

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The simulation of fire-vegetation feedbacks is crucial for determining fire-induced changes to ecosystem structure and function, and emissions of trace gases and aerosols under future climate change. A new global fire model SPITFIRE (SPread and InTensity of FIRE) has been designed to overcome many of the limitations in existing fire models set within DGVM frameworks (Thonicke et al. 2008). SPITFIRE has been applied in coupled mode globally (Thonicke et al. 2008) and northern Australia (Spessa et al. unpubl.) as part of the LPJ DGVM. It has also been driven with MODIS burnt area data applied to sub-Saharan Africa (Lehsten et al. 2008) as part of the LPJ-GUESS vegetation model (Smith et al. 2001). Recently, Spessa & Fisher (unpubl.) completed the coupling of SPIFTIRE to the Ecosystem Demography (ED) model (Moorecroft et al. 2001), which has been globalised by Dr R. Fisher as part of the development of the new land surface scheme JULES (Joint UK Environment Simulator) within the QUEST Earth System Model (http://www.quest-esm.ac.uk/).

In contrast to the LPJ DGVM, ED is a 'size and age structured' approximation of an individual based gap model. The major innovation of the ED-SPITFIRE model compared with LPJ-SPITFIRE is the categorisation of each climatic grid cell into a series of non-spatially contiguous patches which are defined by a common 'age since last disturbance'. In theory, the age-class structure of ED facilitates ecologically realistic processes of succession and re-growth to be represented. By contrast, LPJ DGVM adopts an 'area-based approach' that implicitly averages individual and patch differences across a wider area and across 'populations' of PFTs.

This presentation provides an overview of SPITFIRE, and provides preliminary results from ED-SPITFIRE applied to northern Australian savanna ecosystems which, due to spatio-temporal variation in fire disturbance, comprise a patchwork of grasses and trees at different stages of post-fire succession. Comparisons with similar simulations undertaken with LPJ-SPITFIRE are also presented.