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The Joint UK Land Environment Simulator (JULES), model description – Part 2: Carbon fluxes and vegetation dynamics

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Abstract. The Joint UK Land Environment Simulator (JULES) is a process-based model that simulates the fluxes of carbon, water, energy and momentum between the land surface and the atmosphere. Many studies have demonstrated the important role of the land surface in the functioning of the Earth System. Different versions of JULES have been employed to quantify the effects on the land carbon sink of climate change, increasing atmospheric carbon dioxide concentrations, changing atmospheric aerosols and tropospheric ozone, and the response of methane emissions from wetlands to climate change.

This paper describes the consolidation of these advances in the modelling of carbon fluxes and stores, in both the vegetation and soil, in version 2.2 of JULES. Features include a multi-layer canopy scheme for light interception, including a sunfleck penetration scheme, a coupled scheme of leaf photosynthesis and stomatal conductance, representation of the effects of ozone on leaf physiology, and a description of methane emissions from wetlands. JULES represents the carbon allocation, growth and population dynamics of five plant functional types. The turnover of carbon from living plant tissues is fed into a 4-pool soil carbon model.

The process-based descriptions of key ecological processes and trace gas fluxes in JULES mean that this community model is well-suited for use in carbon cycle, climate change and impacts studies, either in standalone mode or as the land component of a coupled Earth system model.

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