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Evaluation of global water, energy, and carbon fluxes in ECLand and ISBA models

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Biogenic fluxes play a fundamental role in the carbon cycle and are crucial for the land-surface water and energy cycles. These three cycles, water/energy/carbon, are coupled and interact on time-scales ranging from minutes to centuries. Among different aspects of the processes involved, Land Use and Land Cover (LULC) are extremely relevant in the estimation of biogenic carbon. Moreover, the errors found in the model's representation of LULC effects on the lower troposphere have also been shown to limit the progress in weather and climate predictability. In this work we evaluate different configurations of two land surface models: the ECMWF ECLand and Meteo-France ISBA within the SURFEX modelling platform. The evaluation is focused on the surface energy, water and carbon fluxes using FLUXCOM as reference, as well as land surface temperature using LSA SAF satellite product. The surface offline simulations evaluation identified the added value of a revised land cover and Leaf Area Index (LAI) in ECLand in terms of Gross Primary Production (GPP) when combined with a model configuration using the Farquhar photosynthesis model. The results also suggest that time-varying LAI, prescribed in ECLand and via data assimilation in SURFEX are relevant to GPP estimates during large-scale extreme events. Limitations in the evaluation of Net Ecosystem Exchanges and terrestrial respiration arising from model uncertainties, as well as in the reference data used, suggests that flux adjustments are paramount to mitigate biases in global CO_2 analysis. Finally, coupled atmosphere weather forecasts with the ECMWF model show a clear improvement of the 2-meter temperature in Eurasia during spring following the revised land cover and LAI with a negative impact during summer in the tropics, which requires further developments.

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