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Improvements of land-surface models to account for fire-climate feedbacks in the Amazon region

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Improved dynamic global vegetation models are needed to evaluate the synergistic effects of changes in climate and fire activity in Amazonia. For example, coupling of land-surface modules to Earth System Models can be applied to evaluate the vulnerability of Amazon rainforest to more frequent and severe droughts, either through a direct effect on tree mortality or indirectly via increased occurrence of vegetation fires. To this end, we are working on improving a land-surface module that can be applied globally with enhanced performance for representing biosphere-atmosphere interactions over South American biomes. In one activity to improve the model, a fire dynamics sub-model is being implemented for evaluating fire occurrence and impacts. The fire sub-model is also designed to be appropriated for global applications with emphasis in the ecosystems of South America and Brazil, considering major natural and anthropogenic factors. Fire equations are currently based on methods already tested in global dynamic vegetation models, and their initial re-parametrization lead to reasonable representation of major spatial and temporal features of the global fire occurrence. In summary, at large-scale there is correct representation of time and location for most of the burned area reported in datasets based on remote sensing. However, important under- and over-estimation of the model results occur at relatively small scales, in part explained by simple equations and current parametrization based on spatial and temporal averages of fire observations. We next plan to enhance the precision of the fire model and to implement equations for representing fire effects on vegetation characteristics and atmospheric composition. These tools will then be prepared for evaluating regional fire-climate feedbacks in the Amazon region.