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Understanding and quantifying fire-vegetation interactions through integrating satellite observation data with the Dynamic Land Ecosystem Model (DLEM)

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Fires play a critical role in global biogeochemical and hydrological cycles through influencing vegetation succession and ecosystem functioning. Observational evidence shows that fire regimes across global ecosystems have been altered by climate change and human activities. However, most fire-enabled terrestrial biosphere models (TBMs) poorly capture the spatial and temporal patterns of fire ignitions, burned area, vegetation mortality and post-fire recovery. To improve our ability in predicting fire behavior and its impacts on the ecosystem and climate, it is essential to better represent fire-vegetation interactions in TBMs. Here, we improve the fire module of the Dynamic Land Ecosystem Model (DLEM-Fire) and optimize the parameters by using the satellite observed fire ignitions, burned area and leaf area index (LAI) products. Our results show that the improved fire model can describe the magnitude, spatial patterns, and interannual variations of burned area and vegetation mortality more accurately. Moreover, the model is capable of providing robust estimations of post-fire vegetation regeneration to characterize the vegetation resistance and resilience to fire disturbances. This study emphasizes the importance of integrating terrestrial biosphere models and satellite observation data for fire monitoring and prediction.