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Obtaining a Pragmatic Representation of Fire Disturbance in Dynamic Vegetation Models by Assimilating Earth Observation Data

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Fire constitutes a violent and unpredictable pathway of carbon from the terrestrial biosphere into the atmosphere. Despite fire emissions being in many biomes of similar magnitude to that of Net Ecosystem Exchange, even the most complex Dynamic Vegetation Models (DVMs) embedded in IPCC General Circulation Models poorly represent fire behavior and dynamics, a fact which still remains understated. As DVMs operate on a deterministic, grid cell-by-grid cell basis they are unable to describe a host of important fire characteristics such as its propagation, magnitude of area burned and stochastic nature. Here we address these issues by describing a model-independent methodology which assimilates Earth Observation (EO) data by employing image analysis techniques and algorithms to offer a realistic fire disturbance regime in a DVM. This novel approach, with minimum model restructuring, manages to retain the Fire Return Interval produced by the model whilst assigning pragmatic characteristics to its fire outputs thus allowing realistic simulations of fire-related processes such as carbon injection into the atmosphere and permafrost degradation. We focus our simulations in the Arctic and specifically Canada and Russia and we offer a snippet of how this approach permits models to engage in post-fire dynamics hitherto absent from any other model regardless of complexity.