

# E3SM wildfire fire surrogate model based on machine learning

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## **Abstract**

Wildfires modify land surface characteristics, such as vegetation composition, soil carbon, surface runoff, and albedo, with significant consequences for regional carbon, water, and energy cycles. Particularly, over Africa and South America, where more than 80% of global burn area occurs, wildfires emit  $\sim 1.4$  Pg carbon per year into the atmosphere together with dust and aerosols that greatly alter regional climate through biogeophysical and biogeochemical processes. In this study, we present a surrogate wildfire model for E3SM based on machine learning techniques. We explored the long leading time predictability of wildfire activities using long-term memory of local climatic, ecosystem, and socioeconomic conditions. We found that burn area could be accurately forecasted a maximum of 6-8 months ahead of time before prediction skill declined, while adding ocean dynamics marginally improve prediction skill. This study developed an alternative wildfire model for E3SM that accurately simulated grid cell level burn area. The modeling framework could also be used as an early warning system for global wildfire activities with a relatively long leading time, and thus is valuable for developing fire mitigation strategies and management policies ahead of the fire season.