EGU2020-13840
https://doi.org/10.5194/egusphere-egu2020-13840
EGU General Assembly 2020
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The role of plant traits in shaping fire regimes in different ecosystems across the world

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Fire is an important disturbance process, having significant socio-economic consequences on the one hand, while fulfilling a vital ecological role on the other. Across fire-prone ecosystems, different fire regimes can be found, reflecting a combination of climatic factors and of different plant species characteristics. Ecosystem flammability and fuel load are the most evident and well-studied aspects of fire regime, with only recently attention being devoted to plant traits associated with fire adaptation and post-fire response. The aim of this research is to understand the role that plant traits have in driving fire regimes in different fire-prone ecosystems across the world. A mathematical, mechanistic model was developed representing vegetation dynamics, including stochastic fires and different plant fire-responses. We observe that differences in combinations of plant traits are an important factor in determining alternative ecological states. This is driven by differences in how plants determine fire occurrence and in relation to competition between plant species. Differing plant communities under the same climatic conditions can occur when the most competitive plant types do not have a strong resistance to fires, leading to different ecological and fire regime states for example in some tropical savannas and forests, or in Boreal forests. Conversely, when the dominant plant type has a very strong, post-fire response (at individual level), as e.g. in Mediterranean forests, only one ecological state is possible. This research can help improving understanding of changes in fire regime in the future to assist in fire management efforts, and underlines the importance of including plant fire-responses when modelling fire ecosystems under climate-change scenarios.