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Present and future tropical fire risks associated with compound events

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Complex interactions between climate and land-use are altering the course of the fire regimes across the tropics. In Brazil, many recent peaks of burned area have co-occurred with extreme climate events, high deforestation rates and agricultural expansion. Particularly during compound dry and hot years, widespread fires have become increasingly common, and an intensification of the fire activity due to climate change may be already underway.

Based on a compound-event-oriented framework to assess fire risk, we provide evidence on the extent to which fire activity and the associated impacts could be constrained if anthropogenic global warming is limited. Here we quantify the nonlinear relationships between compound climate drivers and burned area across two main Brazilian biocultural heritage sites (Xingu and Pantanal) and estimate compound-event-related fire risks in terms of the occurrences of compound drivers beyond which the fire response becomes extreme.

Our results show that the exponential response of burned area to climate is well explained by compound events characterized by air dryness and precipitation deficits (high VPD and low precipitation) and that climate-change induced fire risks will increase due to the co-occurrence of drier and warmer climatic conditions under global warming. However, if global warming is constrained to +1.5°C instead of +3°C, the likelihood of fire risk can be reduced by ~11% in the case of the most prominent fire types (forest fires in Xingu and grassland fires in the Pantanal). We thus conclude that if we slow down the rate of warming and follow more sustainable uses of land, we might be able to prevent the crossing of tipping points and the consequent downward spiral of socio-environmental impacts that threatens these regions.