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Diverse responses of wildfire burned area to the widespread greening of the Earth

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Satellite observations reveal widespread increases in green vegetation cover ("greening") and an increase in aboveground biomass across global land ecosystems in recent decades. The continuity of vegetation cover and the availability of fuel is a prerequisite for the occurrence and spread of wildfires and hence a strong control on burned area. However, it is unclear whether the observed greening has affected burned area and whether this impact has been sufficient to offset the influence of changes in climate and human population on burned area over recent decades. Here, we use several satellite datasets to analyse relations between greening, vegetation cover, biomass, fuel properties, and burned area, and to assess their contribution to recent trends in burned area. We use the fraction of absorbed photosynthetic active radiation (FAPAR) from optical satellites and vegetation optical depth (VOD) from microwave satellites to disentangle the relative changes of green biomass and vegetation water content or total biomass, and an empirical fire model to quantify the relative contribution of vegetation, climate, and population changes to trends in burned area.

The response to greening is heterogeneous and depends on the relative changes in green vegetation cover and biomass and on the type of vegetation: Greening supports an increase in burned area in subtropical and temperate deserts, in tropical and boreal mountain systems, and polar ecosystems. FAPAR and VOD trends are associated to increasing fuel loads in polar ecosystems, tropical deserts, and tropical shrublands. However, recent trends in burned area are not strongly correlated to vegetation trends over most of the world. In these regions, the impact of vegetation changes is offset by changes in climate and/or human activities. Our results emphasize that greening has had a predictable though non-linear impact on fire regimes, though other factors have modulated this impact in specific regions. Single-factor explanations of observed changes are over-simplistic and the challenge for making projections of wildfire activity under future climate and environmental change is to incorporate this complexity in a realistic way.

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