

Global biophysical effects of forest fire differ by region

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Fire is an important deforestation driver, and affects climate systems by changing biophysical characteristics of land surfaces. However, there is still a lack of understanding on how fire will affect climate at the global scale. By overlaying Landsat-derived global tree loss data with MODIS burned area, we found fire-induced forest loss consisted of $10.7 \pm 5.4\%$ (mean \pm standard deviation) of global deforestation, and peaked in northern boreal forests. Globally, fire affected much higher percentage of total forest cover ($5.85 \pm 0.67\%$) than deforestation ($1.36 \pm 0.45\%$). To assess the climate effects of forest fire, we compared land surface temperature (LST) change between burned forest with adjacent unburned forest ($\Delta LST = LST_{\text{burn}} - LST_{\text{unburn}}$) using MODIS observations. We found that the climate effect of forest fire is trivial in low latitude, and starts to emerge at mid to high latitudes. Overall, fire had a strong warming effect on annual daytime LST, and a weak cooling effect on annual nighttime LST, due to annual surface albedo (α) and evapotranspiration (ET). The annual ΔLST was mainly caused by large decrease in ΔET , rather than $\Delta \alpha$. However, fire had a strong cooling effect on both winter daytime and nighttime LST, due to large increase in α . The climate effect of forest fire also varied among different regions due to difference in fire regime, forest type, and background climate. This analysis indicates that fire is an important driver of changes in the land surface radiative budget, especially at high latitudes, and its climate effect should be included in models to accurately predict future climate.