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Global Patterns of Interannual Fire-Climate Relationships

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Most global empirical climate-fire models use spatial relationships thereby explicitly ignoring interannual climate drivers of wildfire. Limited temporal records of global fire activity have limited interannual climate-fire relationships at meaningful geographic scales. With approximately 20 years of fire activity from remotely sensed observation from the Global Fire Emissions Database and 16 years of data from MODIS Collection 6 we can begin to establish interannual climate-fire relationships across global land surfaces. We examined linear correlations between a suite of climate variables including temperature, precipitation, water-balance and fuel aridity metrics and the logarithm of burned area for forests, grasslands, and shrublands at ecoregion scales. Secondly, we developed simple linear models for burned area as a function of a single antecedent climate variable and single concurrent climate variable. Climate explained over a third of the interannual burned area for most forested ecoregions globally, with measures of fuel aridity during the fire season being the leading predictor. Conversely, antecedent cumulative precipitation the year prior to the fire season correlated strongly with burned area in grasslands at ecoregion scales, with climate variability explaining over a third of the interannual variability in most ecoregions. We explore how the strength and direction of climate-fire relationships vary across ecoregions, how well these relate to climatological and vegetation metrics as well as land-use. Finally, the robustness of climate-fire relationships with these short time series is examined by comparing relationships to those developed from longer temporal records for several ecoregions where longer high-quality fire records exist.