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Climate and the inter-annual variability of fire in southern Africa: a meta-analysis using long-term field data and satellite-derived burned area data

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This study investigates the extent to which fire regimes in southern Africa are influenced by climatic drivers. We compare data from long-term field sites across the region with remotely-sensed burned area data to test whether it is possible to develop a general model. Linear mixed effects models were used to determine the effect of rainfall, seasonality, and fire weather in driving variation in fire extent between years, and to test whether the effect of these variables changes across the sub-continent, and in areas more and less impacted by human activities.

A simple model including rainfall and seasonality explained 40% of the variance in burnt area between years across 10 different protected areas on the sub-continent, but this model, when applied regionally, indicated that climate had less impact on year-to-year variation in burnt area than would be expected. It was possible to demonstrate that the relative importance of rainfall and seasonality changed as one moved from dry to wetter systems, but most noticeable was the reduction in climatically-driven variability of fire outside protected areas. Inter-annual variability is associated with the occurrence of large fires, and large fires are only found in areas with low human impact.

This research gives the first data-driven analysis of fire-climate interactions in southern Africa. The regional analysis shows that human impact on fire regimes is substantial and acts to limit the effect of climate in driving variation between years. This is in contrast to patterns in protected areas, where variation in accumulated rainfall and the length of the dry season influence the annual area burned. Global models which assume strong links between fire and climate need to be re-assessed in systems with high human impact.