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Heat waves impacts in fire incidence during the 2005 drought in Amazon forest

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Climate and weather extremes, such as droughts and heat-waves (HWs) are projected to increase under global warming, leading to significant, sometimes devastating, ecological and health impacts. Droughts (heat-waves) are characterized by the occurrence of an extended period - months (days) - of excessively dry conditions (high temperatures) often associated with the persistence of favorable (atmospheric circulation) patterns. Recent studies show that these two phenomena interact and provide positive feedback, i.e. prolonged droughts tend to increase the likelihood, duration and the induced thermal-stress conditions of HWs. Therefore, an increment in fire occurrence and intensity is expected under this context, as droughts affect long-term flammability characteristics and HWs being able to equally affect fuel characteristics, inducing to significant effects on fire weather risk. Currently, there are numerous studies evaluating wildfire causes and impacts for the Northern Hemisphere, in light of the observed increase in severe droughts and HWs frequency and future climate predictions that show a potential for recurring fire-prone conditions. However, there are fewer assessments South America, and in particular over Brazil, despite its large spatial extent and numerous biodiversity and population potentially affected. Therefore, the present study aims to fill a gap in regional studies on ecological impacts of two climate extreme phenomena in Amazonia, including how HWs are increasingly associated with droughts. A comprehensive multi-disciplinary approach was applied, including meteorological fields from reanalysis, several remote sensing platforms and in-situ data in order to understand the impacts of fire activity through the synergy of different temporal and spatial scales. Heat waves events during the 2005 drought year were assessed by analyzing the associated synoptic patterns using ERA-INTERIM reanalysis and its indexes based on temperature data from surface meteorological stations, from 1961 to 2014. Fire radiative power (FPR) and active fires counts (AF) from the 6th collection of MODIS aboard AQUA and TERRA satellites from 2003 to 2017 were also used for fire pattern evaluation. Results show an exacerbation of HW occurrence during extreme droughts, in particular, seven HWs were detected from July to September of 2005 in the Amazon region. The assessment of the impact revealed an average increase in both the active fire counts and FRP circa 130% above what was expected for the same period. In general, the excessive occurrence of fire events was clearly associated with drought-induced soil-atmosphere feedback mechanisms for the HW development. This study provides a novel and synergic assessment of drought, HWs, and associated fire occurrence in Amazon region and may serve to understand better, forecast and prevent the impacts of extreme events in the region.

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