Seasonal to sub-seasonal predictions of understory fire risk in Amazon forests

Douglas Morton
Yang Chen
Niels Andela
Praveen Noojipady
James Randerson

In drought years, understory fires burn millions of hectares of Amazon forest. Recent Amazon droughts follow warm anomalies in tropical Atlantic and Pacific sea surface temperatures (SSTs), with distinct regional sensitivity to the Atlantic Mutli-decadal Oscillation (AMO) and El Niño Southern Oscilliation (ENSO). Seasonal fire forecasts for the Amazon use the long lead time between SST changes and drought conditions to predict interannual variability in climate-driven fire risk 3-6 months before peak fire activity in the southern Amazon. Moving from seasonal to sub-seasonal time scales of fire prediction for the Amazon region remains a challenge, however, as the mechansims that govern large-scale rainfall redistribution offer little insight regarding the timing of wildfire events during drought years. Here, we combine annual maps of understory fire damages (1999-2016), satellite-based observations of daily climate indicators and fire activity, and in situ measurements to track the evolution of fire weather conditions in years with large-scale fire damages. Our analysis compares indicators of fire weather in drought years linked to AMO (1999, 2005, 2010) and ENSO (2002-2003, 2009-2010, 2015-2016) to identify candidate variables for sub-seasonal prediction of understory forest fire risk on 1-4 week time scales. Given tradeoffs between the spatial and temporal resolution of indicator variables, we present a two-factor methodology for sub-seasonal fire prediction using climate observations and new, higher-resolution active fire detections to monitor understory fire risk in Amazon forests.