Satellite-based assessment of climate controls on US Burned area

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Objectives:

- This study was designed to conduct the first national assessment of climate controls on US fire activity using two satellite-based estimates of monthly burned area (BA).
- To do this, the Global Fire Emissions Database (GRDED 1997-2010) and Monitoring Trends in Burn Severity (MTBS, 1984-2009 products were used.
- Climate data were derived from the National Centers for Environmental Prediction (NCEP) North American Regional Reanalysis (NARR) dataset, using eleven climate variables: air temperature at 2 m, u/v wind speeds at 10 m, precipitation, snow depth, relative humidity, surface pressure, albedo, surface downward shortwave radiation, and surface upward and downward radiation.
- In additional to individual NARR climatic variables, monthly PE, calculated at 0.5 resolution using reanalysis climate data, was used to integrate the influence of temperature, humidity and other climate factors that influence monthly fire weather.

New Science:

- US Fire activity increased over the past 25 years, with statistically significant increases in MTBS BA for the entire US.
- Monthly PE was strongly correlated with US fire activity, yet the climate driver of PE varied regionally.
- Fire season PE increased from the 1980s – 2000s, enhancing climate-driven fire risk in the southern and western US where PE – BA correlations were the strongest.
- The use of PE in this study represents a methodological advance over previous studies. The equation used mechanistically combines the interactions between temperature, solar radiation, humidity and wind into a single variable for fuel drying potential.
- The spatial distribution of US BA was similar for the GFED and MTBS products. Differences were attributed to areas with small fires, or fires on private land such as agricultural fires.
- Across the US, PE anomalies explained more variance in GFED BA than anomalies in mean monthly temperature, precipitation, VPD or incoming shortwave radiation.
- Fire season PE values increased for all US regions between the 1990s – 2000s with statistically significant PE increases in the Alaska, Northern Pacific, Midwest and Northeast regions.

Significance

- Climate driven changes in fire activity are one motivating factor for the focus of the forest carbon stocks in international climate negotiations.
- Understanding the dynamics of contemporary climate-fire relationships at national and sub-national scales is critical to assess the likelihood of changes in future fire activity and the potential options for mitigation and adaptation.
- A strengthening relationship between climate and fire activity is one potential driver of recent increases in US wildfires.
- National assessments of fire activity and climate-fire interactions are needed to connect the science and policy objections at a common scale.
- The authors also discuss five methodological limitations in this study, and suggest how they can be addressed in further research.

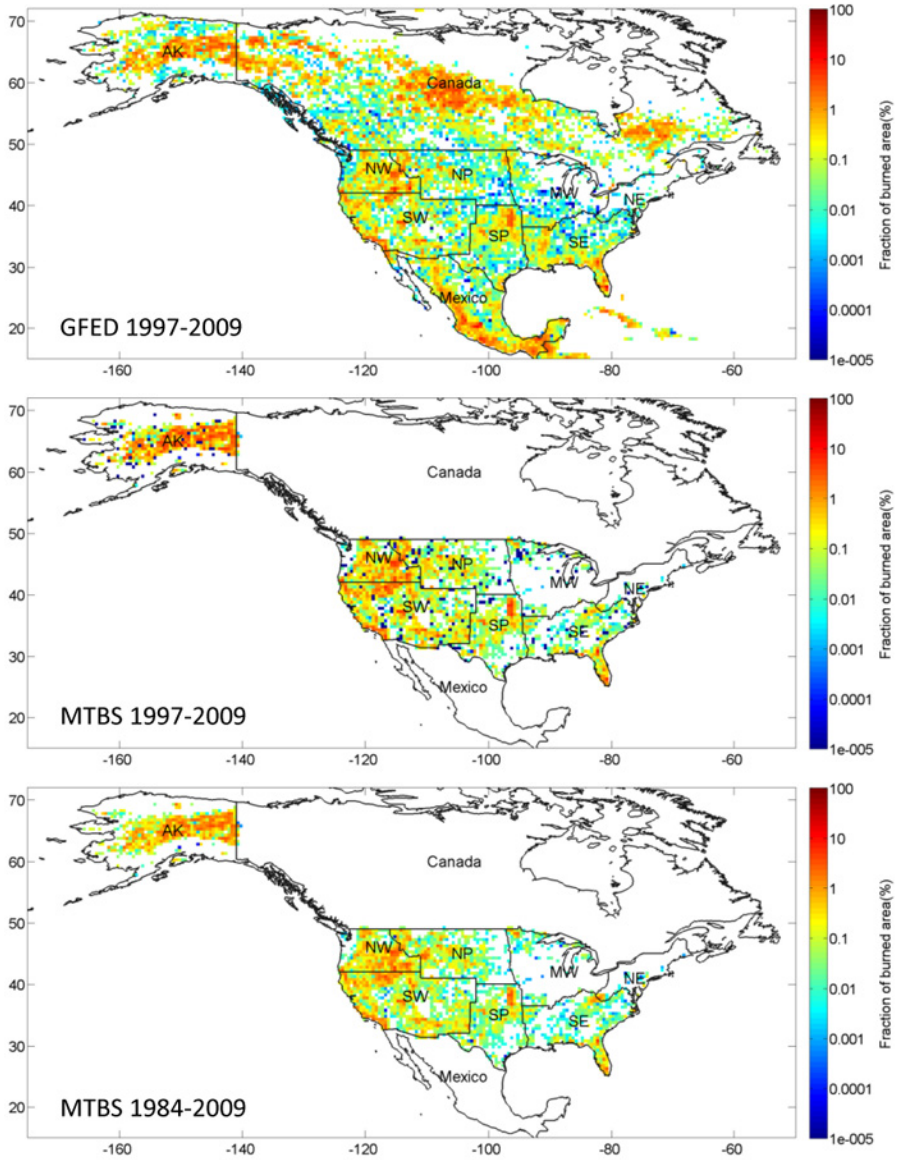

Fig. 1. Mean annual GFED BA (1997–2009, top) and MTBS BA (1997-2009, middle; 1984-2009, bottom) shown as the burned fraction of each 0.5 grid cell. Sub-national study regions are outlined in black: Alaska and Arctic (AK), Northwest (NW), Southwest (SW), Northern Plains (NP), Southern Plains (SP), Midwest (MW) and Northeast (NE).

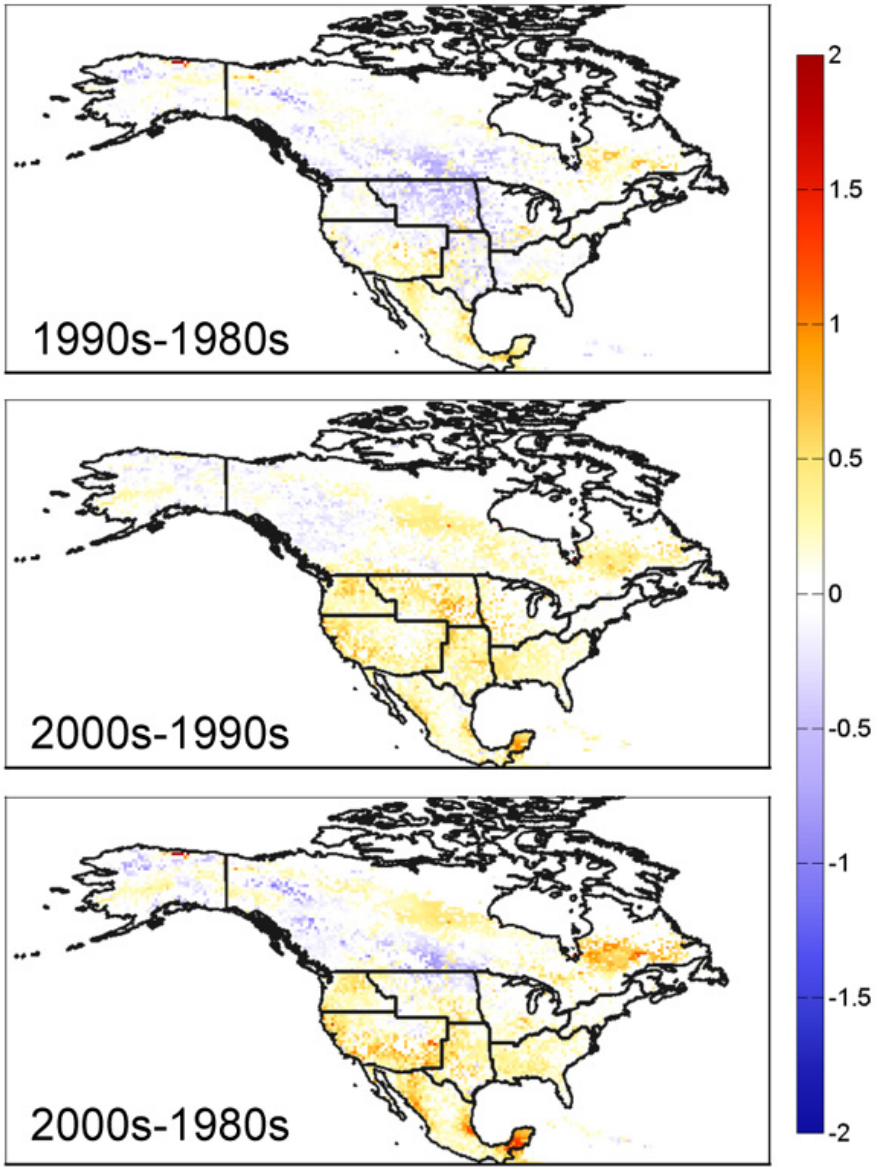

Fig. 12. Difference in decadal mean fire season PE for the 1980s, 1990s, and 2000s (mm day−1). Cells without GFED BA area in any year (1997–2010) appear white.