US Trends in Wildfire Smoke Derived from Satellite and Airport Data from 2010-2020

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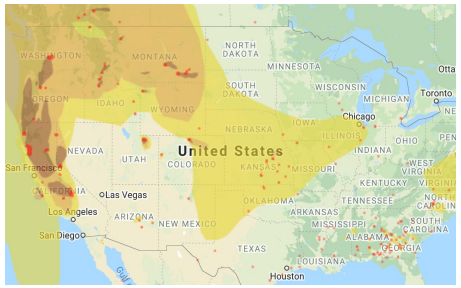
Key Questions

1. How well do satellite-derived HMS smoke days align with airport smoke days?
2. What are the **spatial and temporal patterns** associated with smoke days for NOAA HMS and ISD airport data?

Background

- To better understand recent increases in the scale of wildfire and the effects of associated smoke plumes, **NOAA's Hazard Mapping System (HMS) smoke product** can be a proxy for ground-level smoke extent and severity



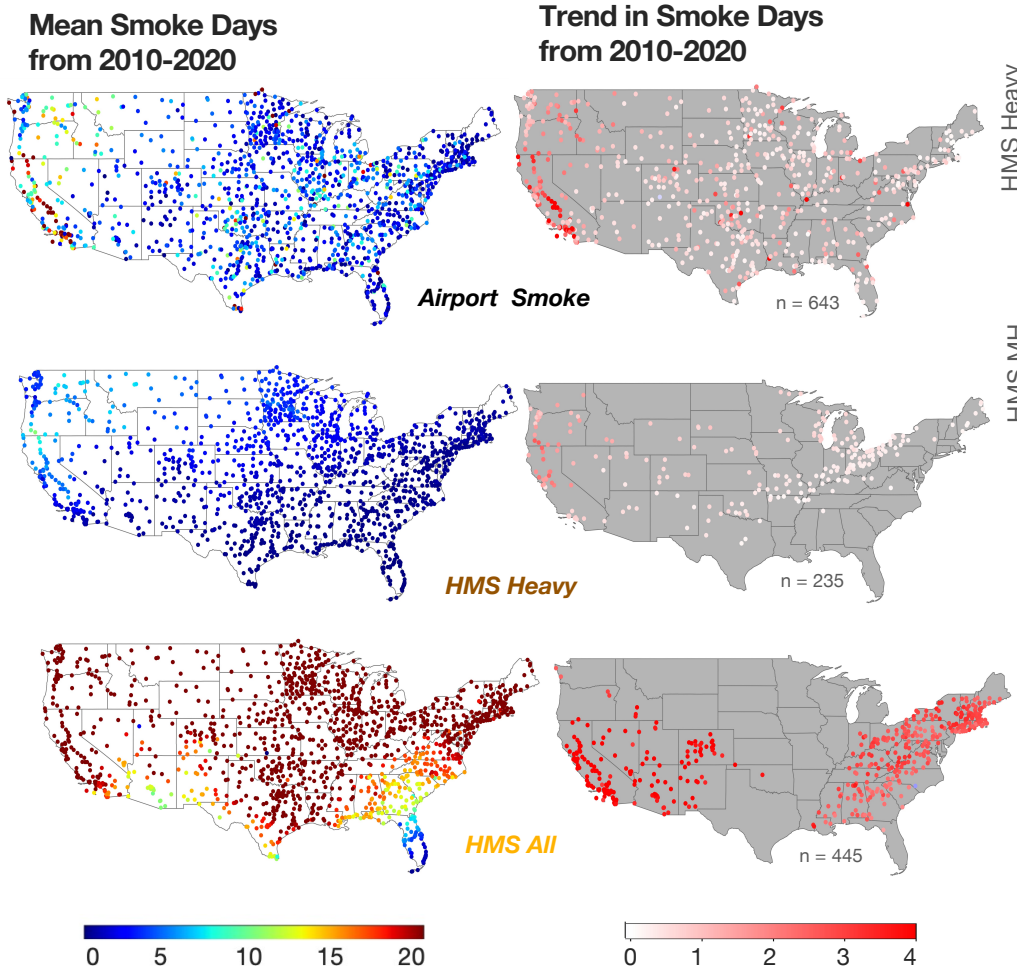
globalfires.earthengine.app/view/hms-smoke

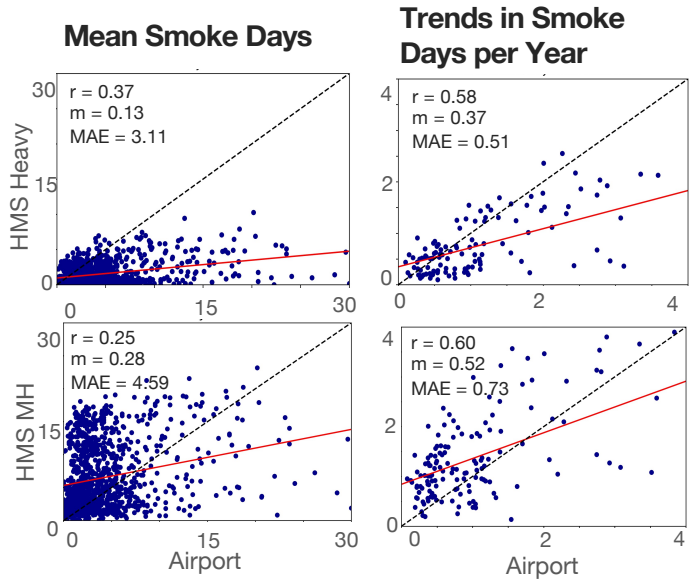
HMS is categorized into **light, medium, or heavy** smoke dependent on density

Light	(0-10 μg/m^3)
Medium	(10-21 μg/m^3)
Heavy	(21-32 μg/m^3)

- However, **NOAA HMS is unvalidated** and may not reflect smoke conditions at the surface.
- **NOAA's Integrated Surface Database (ISD)** of airport data monitors the hourly presence of smoke plumes and can act as localized sources of ground-truth data.
- We define NOAA HMS categories into **three definitions** to assess smoke plume accuracy
  1. **HMS Heavy**
  2. **HMS Heavy or Medium (HMS MH)**
  3. **HMS Heavy, Medium, or Light (HMS All)**

Results





- HMS Heavy has greater skew towards mean airport smoke days than HMS MH
- HMS MH has stronger correlation with airport data
- Greater overall average of smoke days and an increasing trend in the number of smoke days
- The number of smoke days per year increases by as much as 2-4 days at some sites
- HMS Heavy **generally underestimates** the mean smoke days over 2010-2020, while HMS All tends to **overestimate** the mean smoke days

Conclusions and Future Work

- NOAA's HMS product is **somewhat consistent** with airport smoke observations. Specific HMS categories may be more accurate for smoke day detection in some states and time periods
- The observed **increases in smoke days** in the HMS product reveal the impact of changing wildfire activity on U.S. air quality
- Future research should reconstruct smoke periods pre-2007 to provide a more holistic view of how smoke changes over time