Assessment of Climate Change Impacts on Fire Activity in the US

4 month progress report

Principle Investigator: G. James Collatz
Co-Investigator: Douglas C. Morton
NASA's GSFC
Research Associate: DongDong Wang
UMDCP

Objectives:

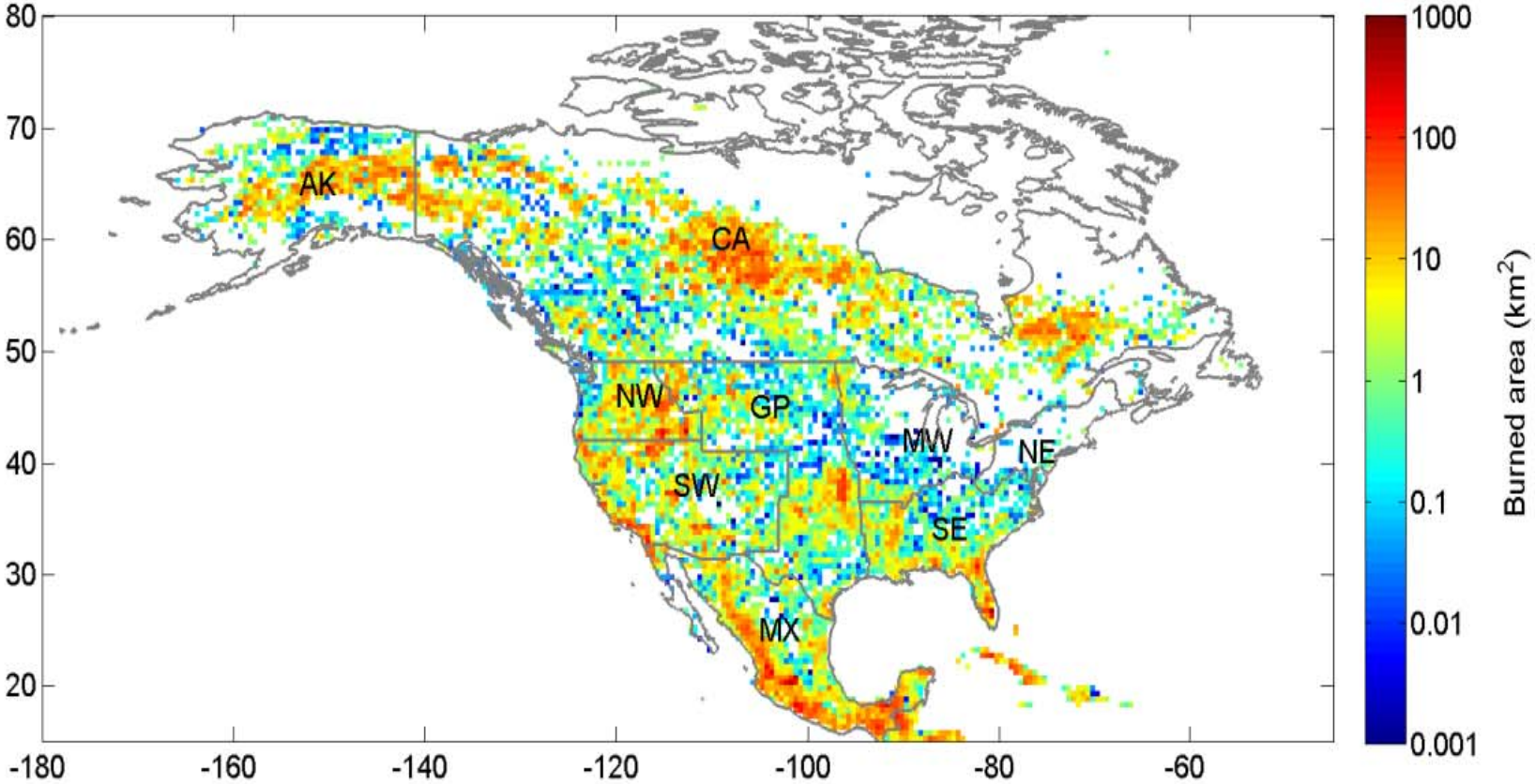
1) **Develop weather predictors of burned area and fire emissions using GFED3 products and meteorological data at ½ degree resolution for '97 – '10 and beyond for NCA regions and land cover types.**

2) Develop leading and trend climate indicators of fire activity in each region

3) Using AR5 Decadal Hindcast and Prediction simulations (10-30 years into future) scenarios forecast future fire vulnerability for each region and fuel type.

4) Test plausible mitigation strategies for responding to future fire vulnerability such as fire suppression and fuel load management.

Figure 1. Mean annual GFED burned area for North America (km^2 per ½ degree grid cell). National and sub-national study NCA study regions are outlined in black : Canada (CA), Mexico (MX), Alaska (AK), Northwest (NW), Southwest (SW), Great Plains (GP), Midwest (MW), Southeast (SE), and Northeast (NE).



Climate driven fuel conditions (moisture)

$$PE = \frac{\Delta(R_n - G) + \rho_a C_p VPD / r_a}{\Delta + \gamma}$$

Analysis is Monthly ½ degree spatial resolution for 1997-2010.

Surface Climate Data from NARR (North American Regional Reanalysis) which supports NACP modeling.

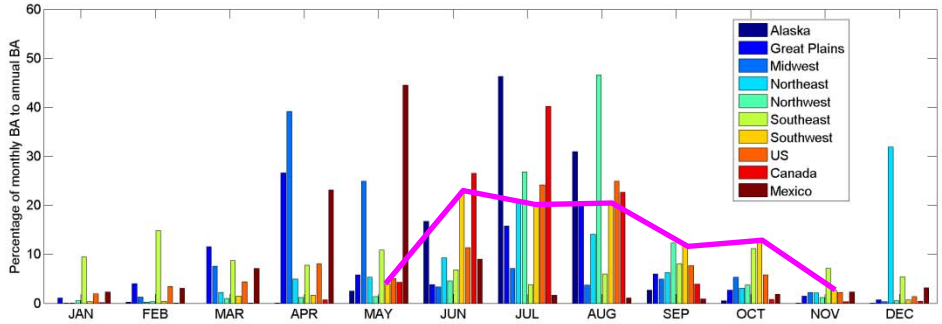
- Incident Solar Radiation
- Absolute humidity
- Temperature
- Wind speed
- Surface pressure
- LW_{net}
- Precipitation

Examine regressions between Burned Area and current and precedent PE, Precipitation, Temperature, R_n, humidity, wind speed

Future work will extend to daily analyses

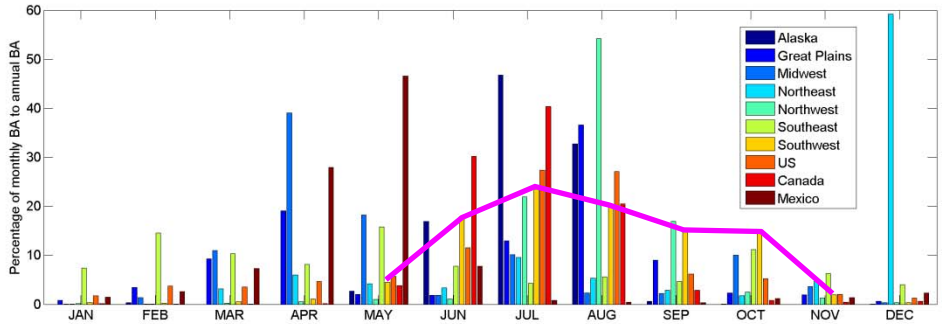
Figure 2. Seasonal distribution of burned area for each country and NCA region.

All fires:



SW

Forest fires



Herbaceous fires

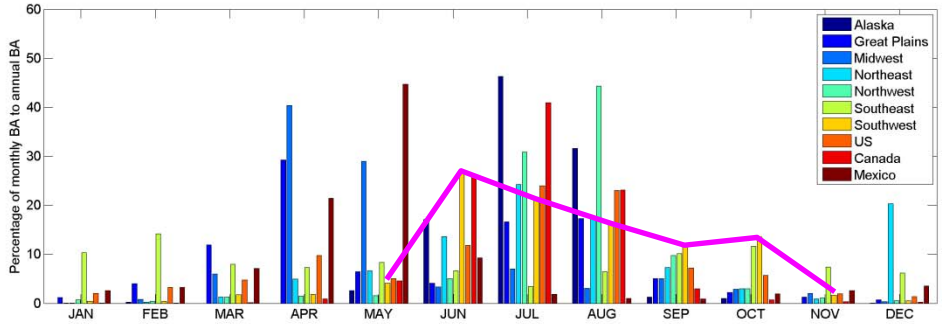
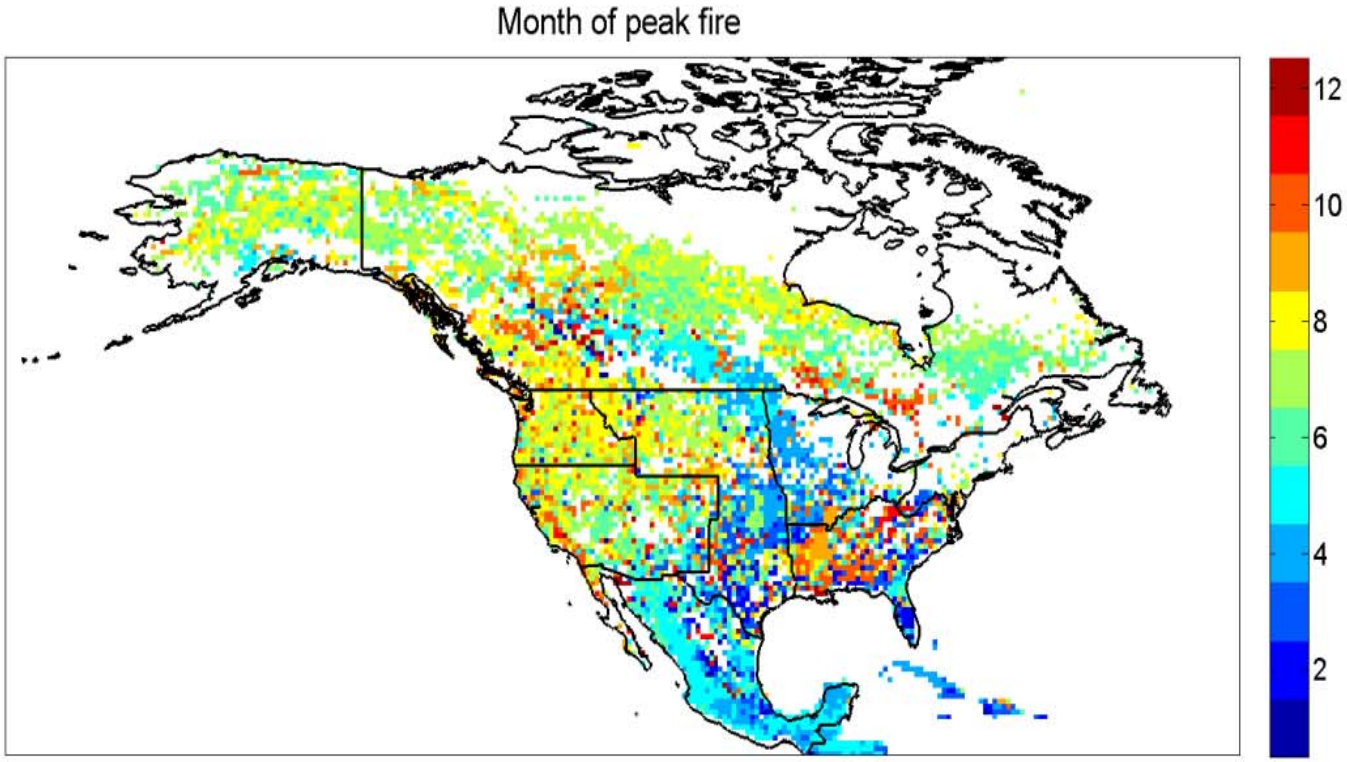
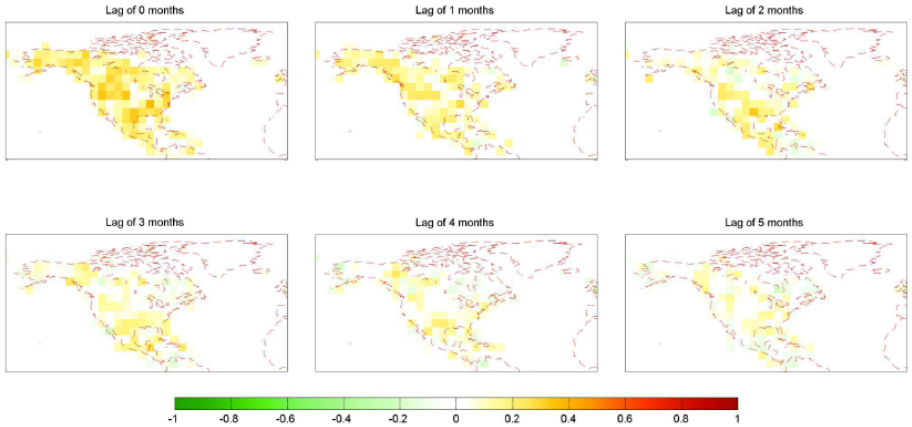


Figure 3. Month of peak fire activity based on the seasonal distribution of GFED BA 1997-2010 .

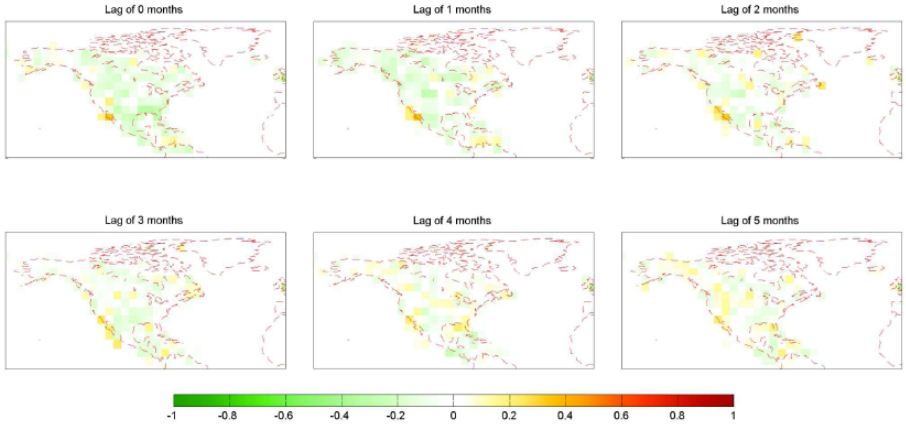


Lag Analysis

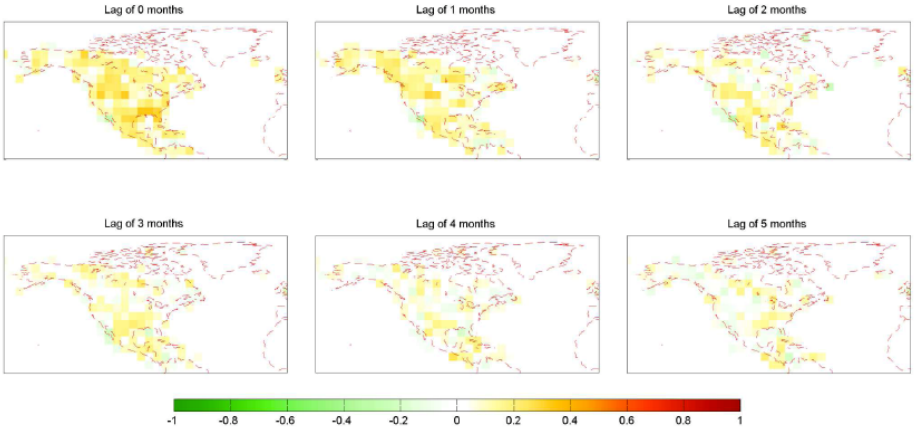
Correlation between monthly PET standardized anomaly and BA anomaly at 5 degree



Correlation between monthly precipitation standardized anomaly and BA anomaly at 5 degree



Correlation between monthly standardized anomaly of PET-precp. and BA anomaly at 5 degree



Correlation between monthly temp. standardized anomaly and BA anomaly at 5 degree

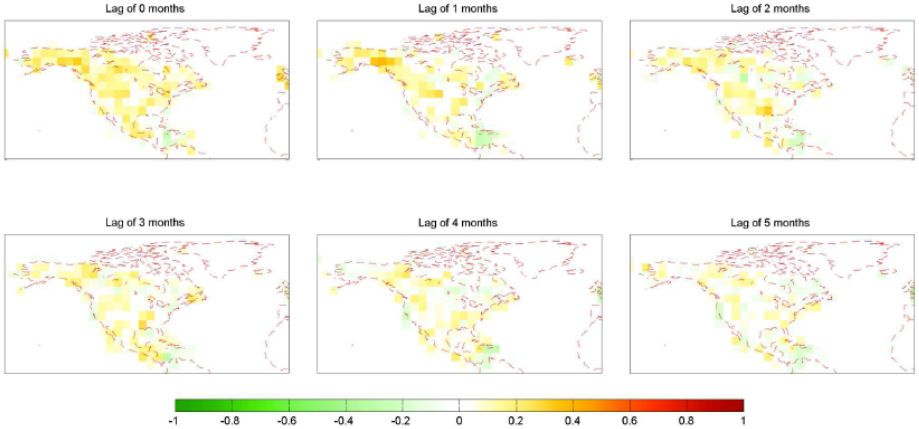
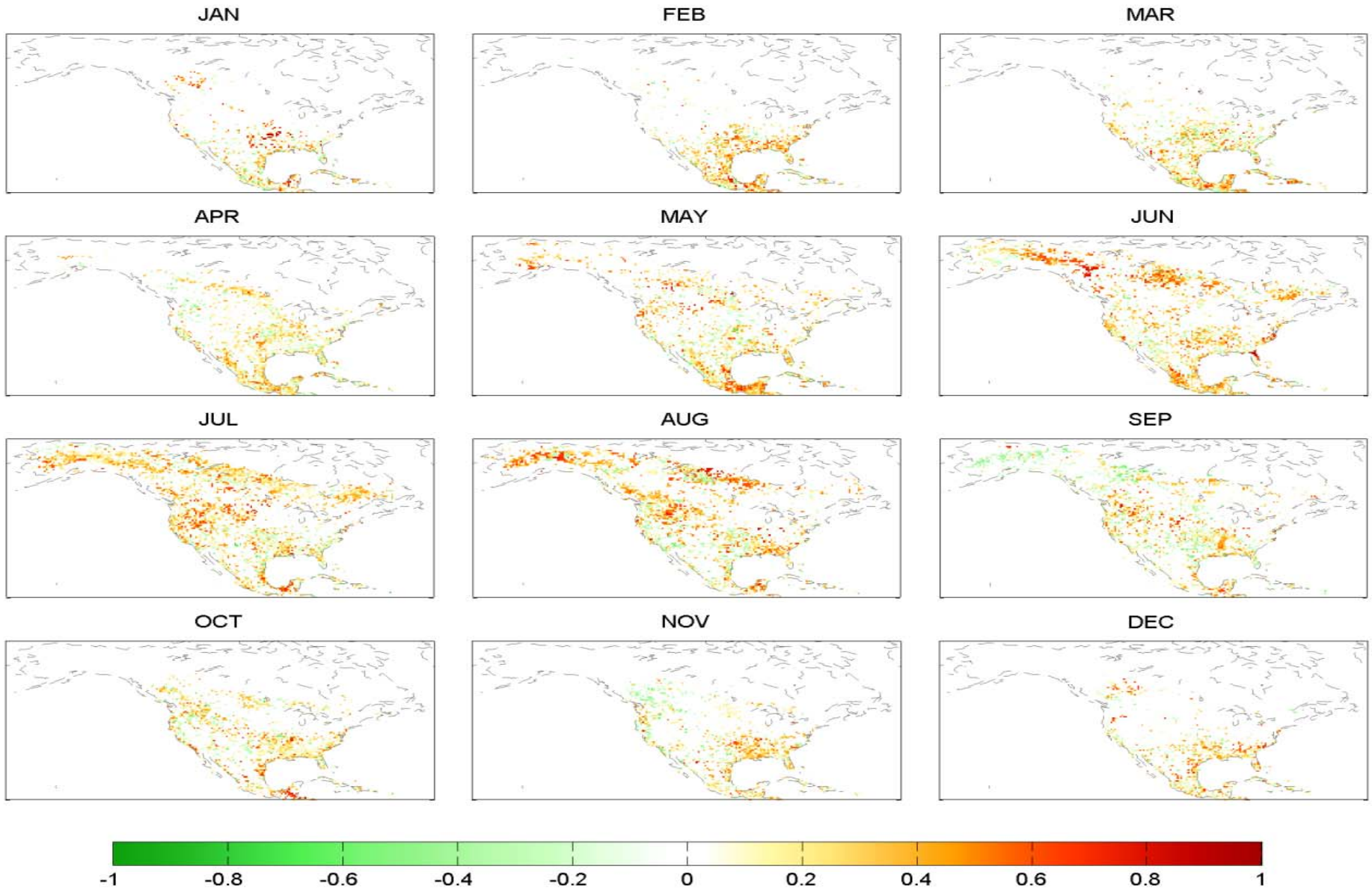


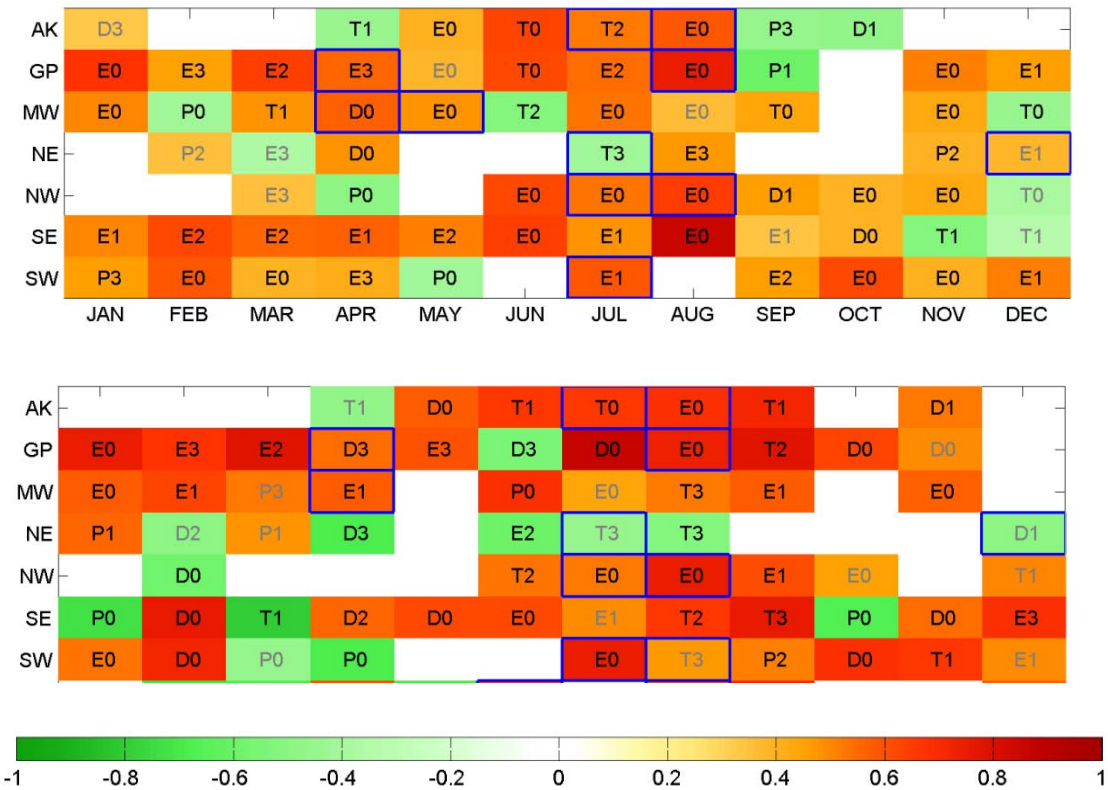
Figure 4. Map of monthly correlation coefficients between BA and PET at the zero lag.

Seasonal Progression of Fire Weather



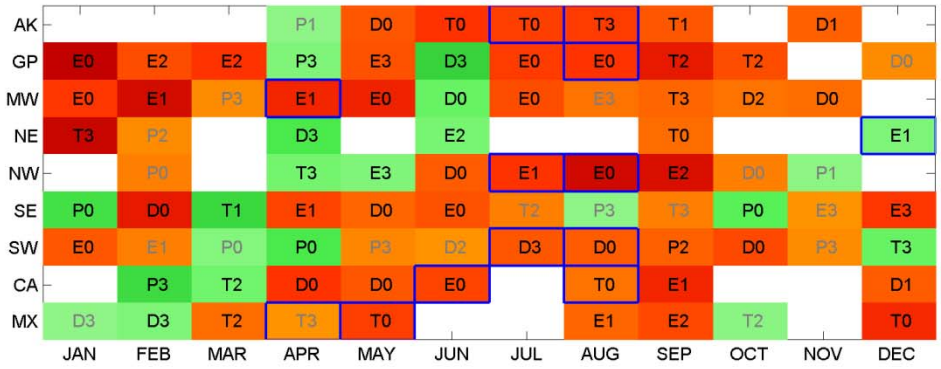
Monitoring Trends in Burn Severity (MTBS): back to 1985, Landsat/fire data base product
400 ha (West) and 200 ha (East) minimum cut off (GFED BA detection resolution ~25 ha)
USGS, USFS collaboration

MTBS

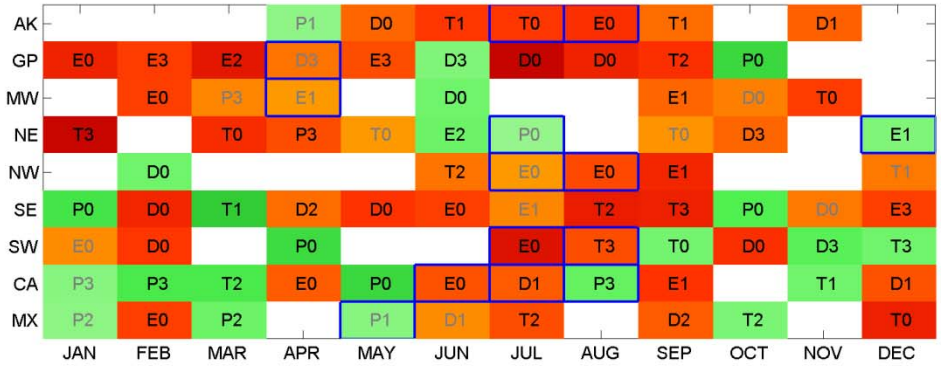


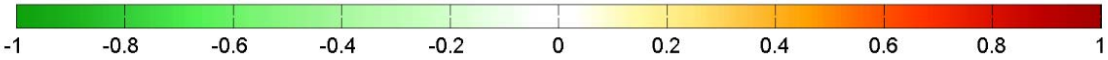
GFED 14 year time series corresponds in response and magnitude to ~25 year MTBS data.

Forest Fires:



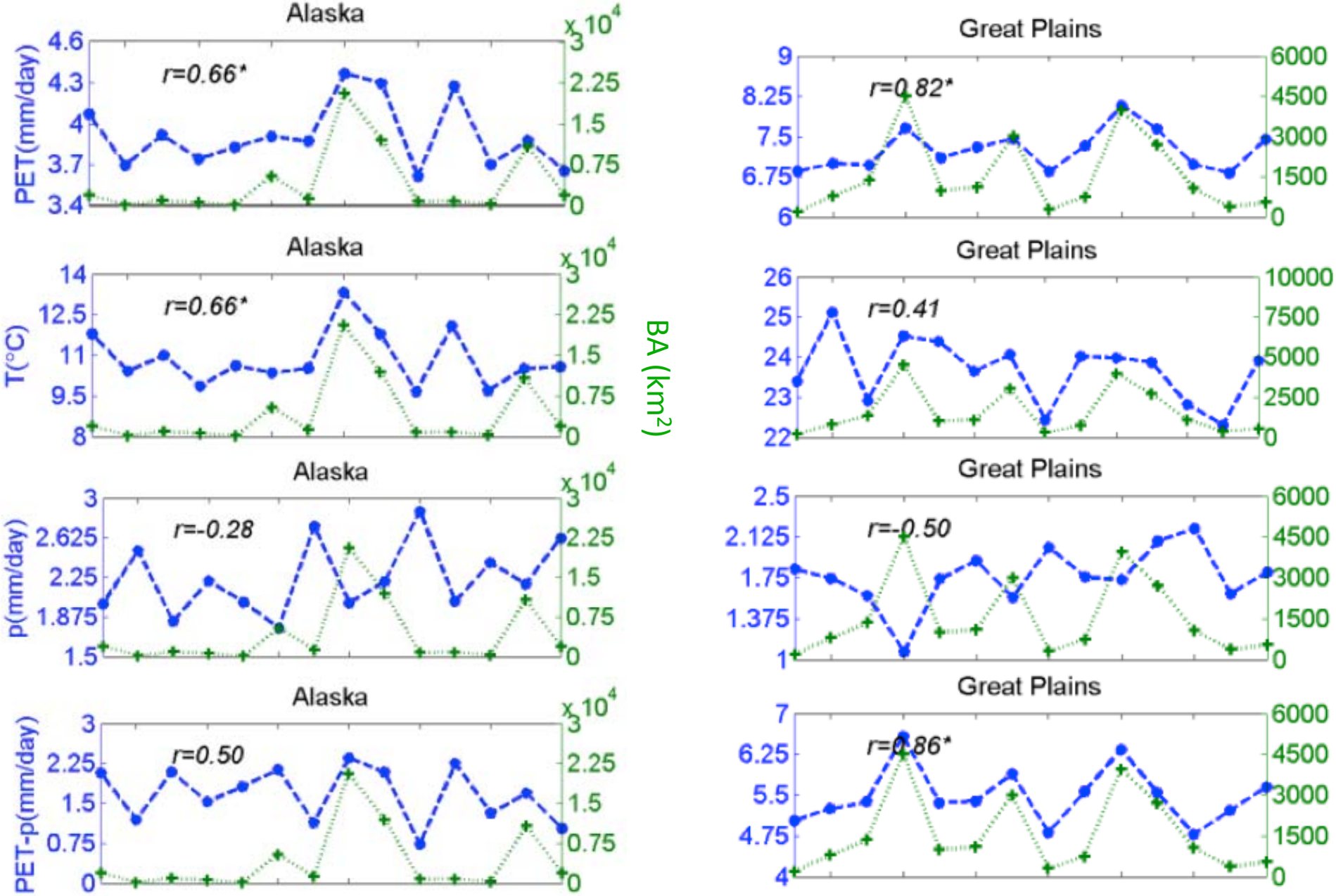
Herbaceous fires:





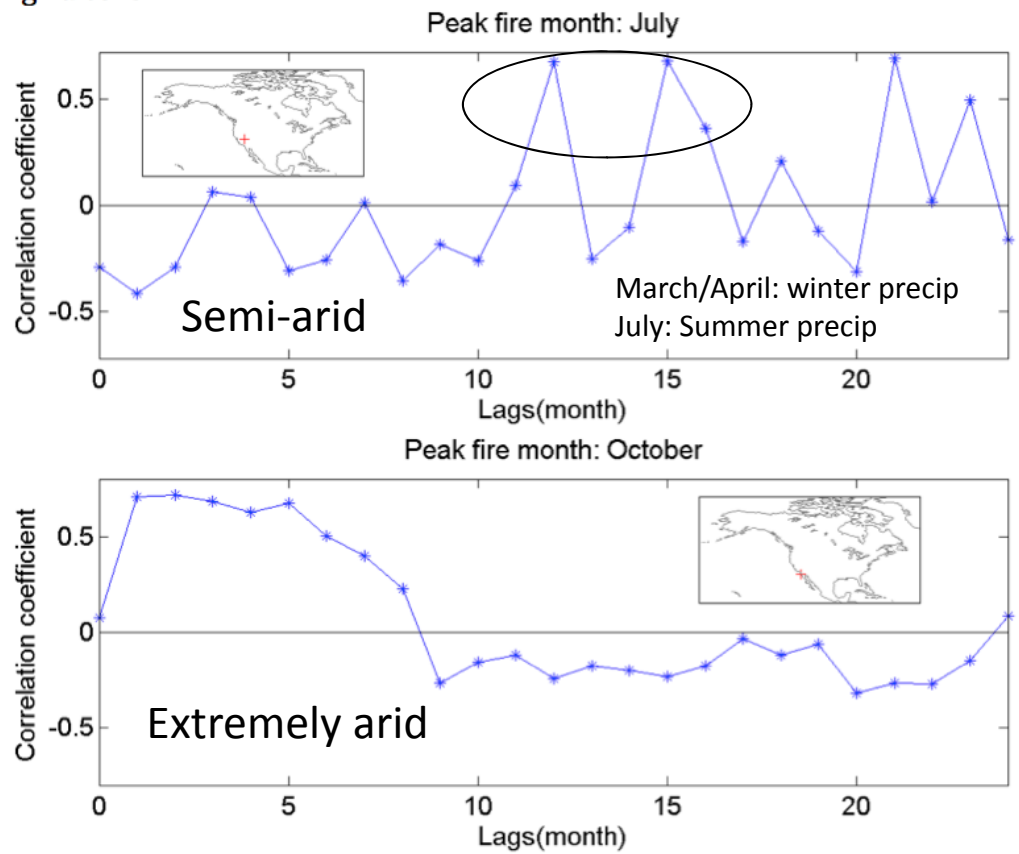
PE driven largely by temperature

Sensitive to both PET and PET-P



In fuel limited systems (low productivity) positive correlations with precedent Precipitation

Figure 9. Monthly correlation coefficients between GFED BA and precipitation 5° grid cells.



Region Specific, Climate Driven Fire Vulnerability

Temperature (e.g. Alaska)
Integrated Drying Potential (e.g. Great Plains)
Water Deficit (e.g. SE)
Precipitation (e.g. SW)

Unexplained Variability

Management
Ignition sources
Driver data and Burned Area errors