Assessment of Climate Change Impacts on Fire Activity in the US

Principle Investigator: G. James Collatz
Co-Investigator: Douglas C. Morton
NASA's GSFC

Objectives:

1) Develop weather predictors of burned area and fire emissions using GFED3 products and meteorological data at ½ degree resolution for '97 – '10 ('11?) for each NCA region.

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.

March 1, 2012 deadline for input into NCA 2013 (objective 1), submitted (IPCC) or accepted?

CASA GFED3:

FIRE FUELS:

-LUE NPP model uses satellite data to prescribe vegetation growth

-NPP is allocated to live pools (4)

-mortality is prescribed by biome, turnover times are prescribed to each dead pool (9) and depend on temperature and precipitation.

*Fuel loads at Monthly time step, 0.5° spatial resolution, 1997-2010

FIRE EMISSIONS

-Burned Area: satellite observations of burned area and fire behavior

-Fuel Consumption: dependent on fuel type and loading (see above), current and preceding Temperature and Precipitation

*Fire emissions from forest, grassland, agriculture and peatland fires at 0.5°, sub-daily time steps, 14+ year time series.

widely used and evaluated by the atmospheric composition science community (CO2, CO, CH4, OH, and aerosols).

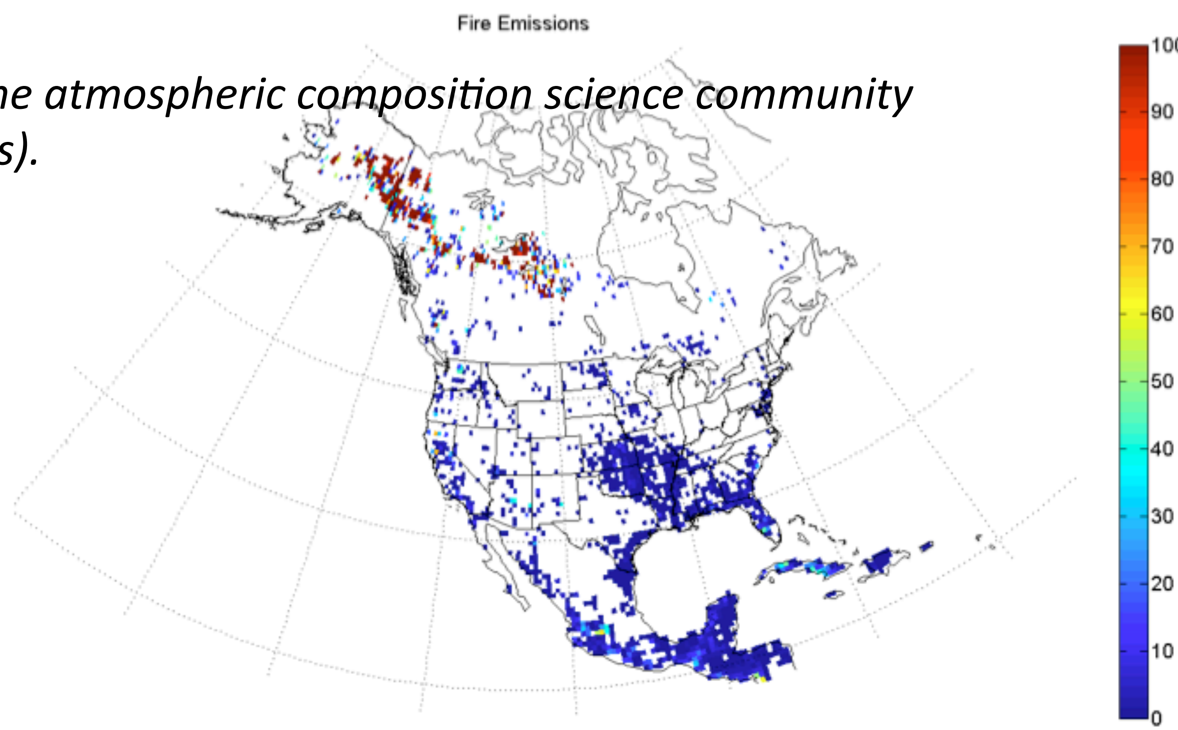


Fig 2. 1997-2009 mean annual fire emissions (gC $m^{-2} yr^{-1}$) from CASA-GFED3.

Uncertainties in GFED3 products

-continue to be refined

Burned Area (Giglio et al '10)

- MODIS 500m vs. Landsat
- Regression variance

Emissions (van der Werf et al '10)

Burned Area, Fuel loads, Tree mortality, Burn depth, Combustion completeness

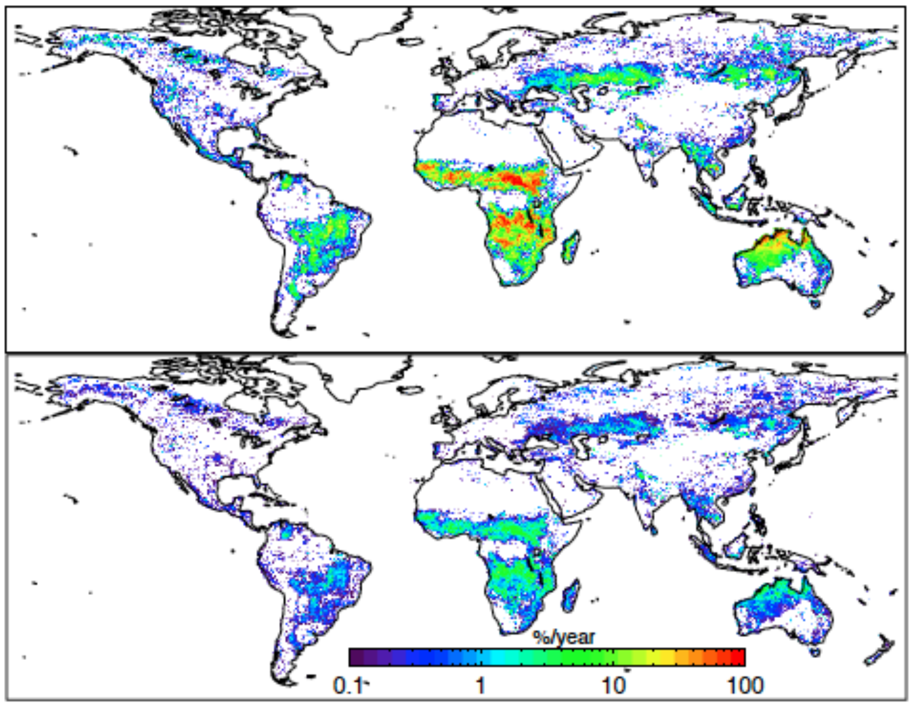


Fig. 8. 1997–2008 GFED3 mean annual burned area (top) and associated one-sigma uncertainties (bottom), expressed as the fraction of each grid cell that burns each year. One sigma uncertainties were obtained by adding the monthly, spatially-explicit uncertainty estimates (assumed to be independent and random) in quadrature.

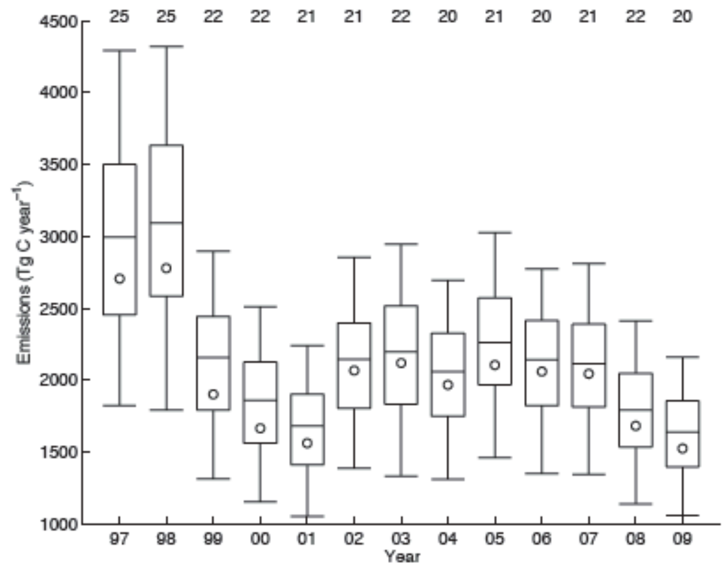


Fig. 14. Annual uncertainties expressed as the 5th, 25th, 50th, 75th, and 95th percentiles of 2000 runs from a set of Monte Carlo simulations. Circles denote the estimates reported throughout the paper, which do not necessarily align with the 50th percentiles due to truncation of several parameters in the Monte Carlo simulations. Numbers on the top of the plot indicate 1σ uncertainties in annual fire emissions in percent of the median estimate from Monte Carlo simulations, assuming a Gaussian distribution. Note that uncertainties are larger on regional and monthly scales (Fig. S6).

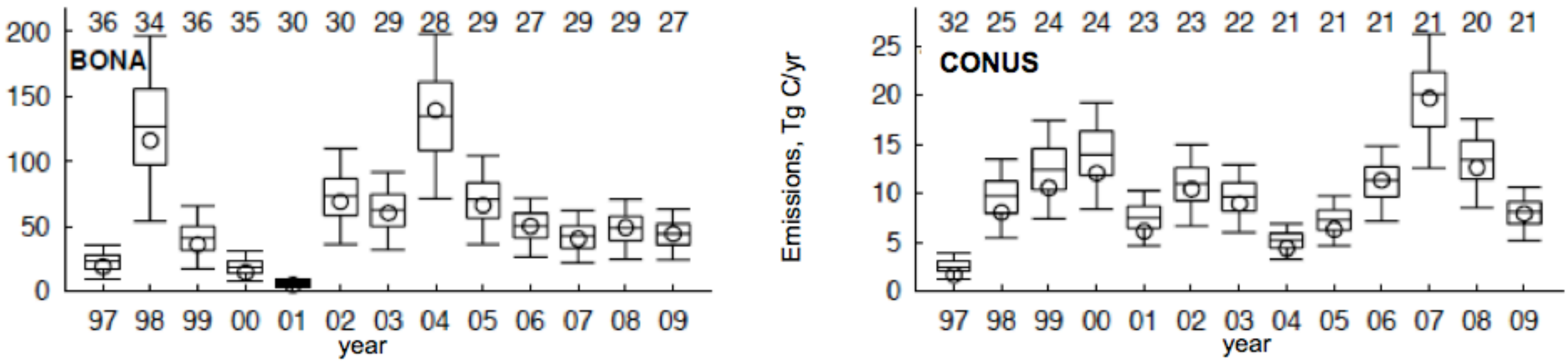
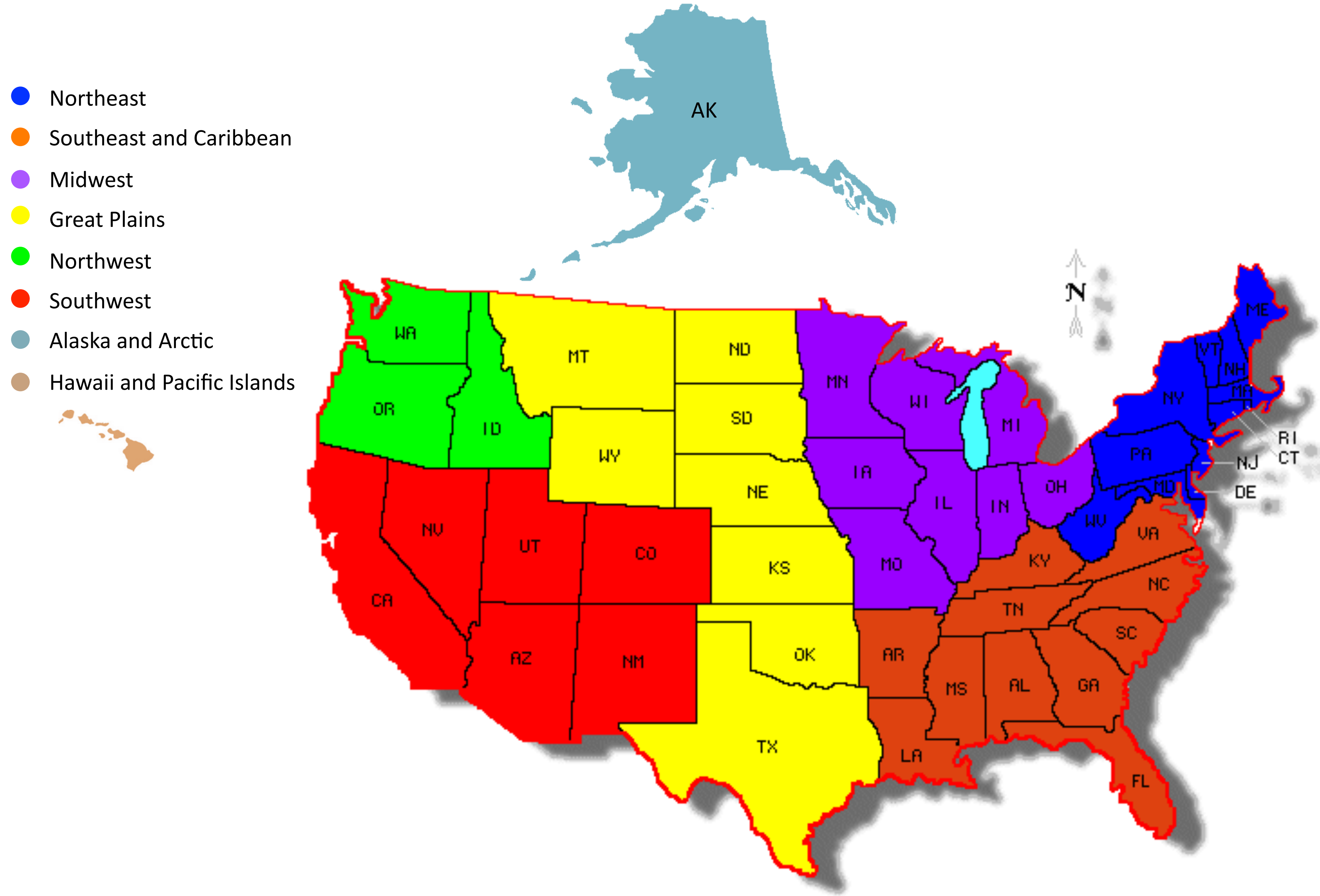


Fig 4. GFED3 annual uncertainties in fire emissions for boreal North America (BONA) and CONUS expressed as 5th, 25th, 50th, 75th, and 95th percentiles of 2,000 Monte Carlo runs. Numbers at the top indicate the 1 σ uncertainties (expressed as % of the 50th percentile)

Fig 1. Suggested NCA 2013 regions of interest



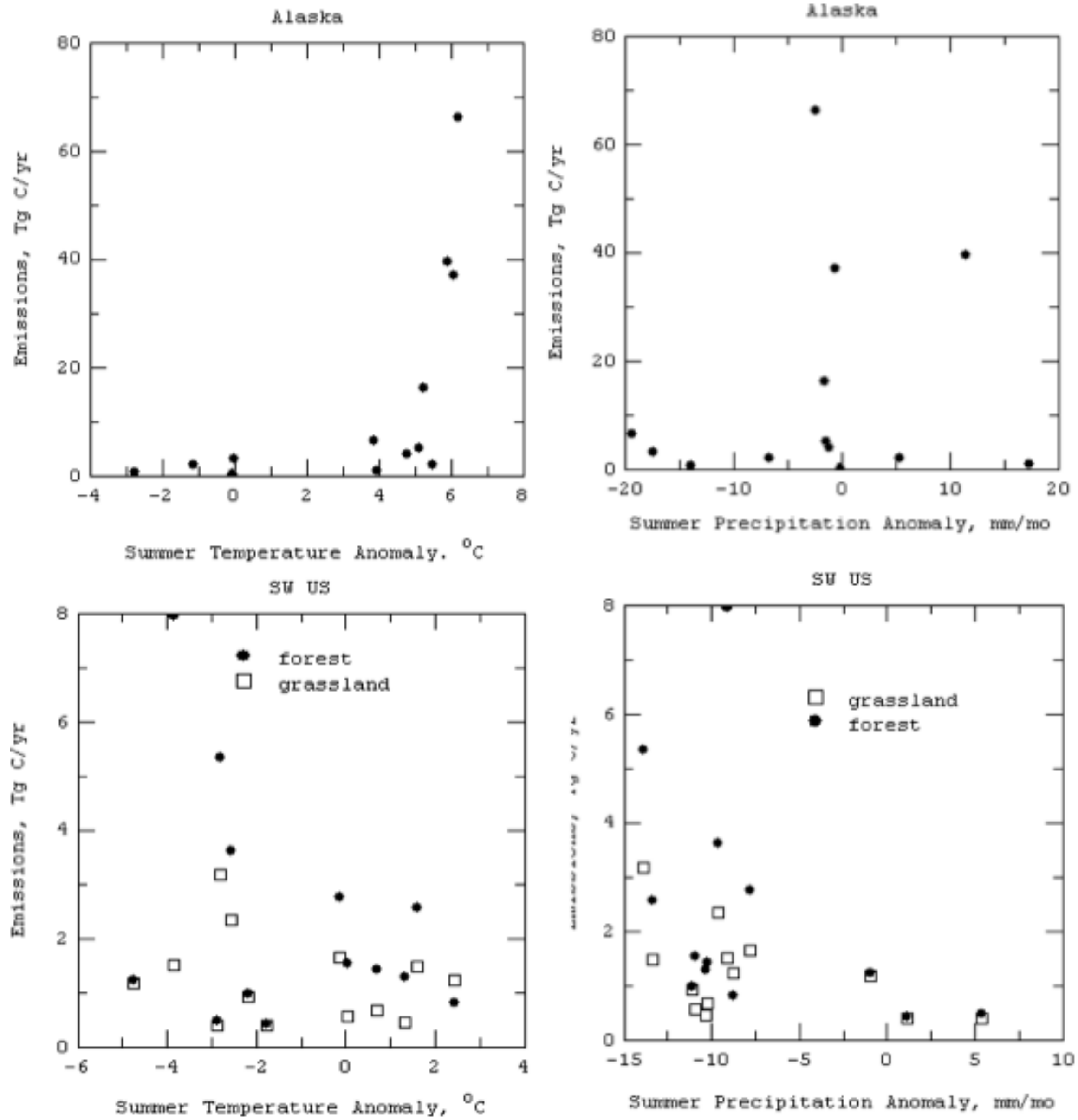


Fig 3. The relationship between summer temperatures and precipitation and fire emissions for Alaska and SW US. Each point is a year ('97-'09). Alaska emissions are more correlated with summer temperatures while SW US fires are more correlated with summer precipitation.

Meteorological variables:

- Mean monthly temperature, precipitation, solar radiation
- Daily temperature, precipitation, humidity, wind speed (NARR, 0.3^o, ’79-’10)

Approaches:

- Step-wise linear regression on meteorological variables, drying indices (e.g. PET)
- Canadian Fire Weather Index type approaches

Future:

Can we make a contribution to NCA 2013?

Evaluating the IPCC AR5 climates in terms of effects on burned area and emissions

Prediction of fire activity from SSTs

Test mitigation strategies to cope with increases in fire activity (e.g. fire suppression, fuel load management).