Global Fire Prediction on Daily and Seasonal Timescales

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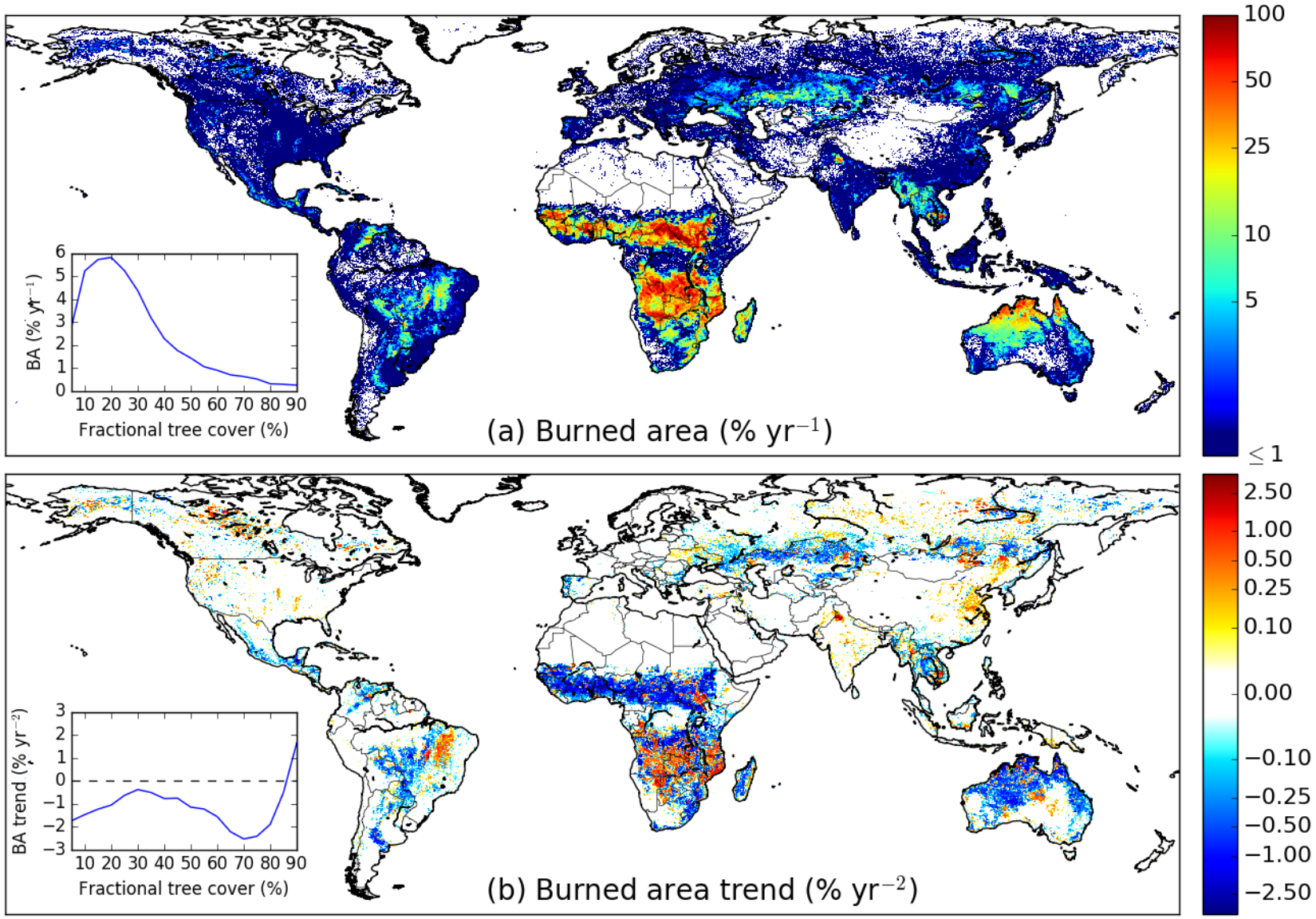
NOAA
MAPP Webinar
Fire: Modeling and Prediction Issues

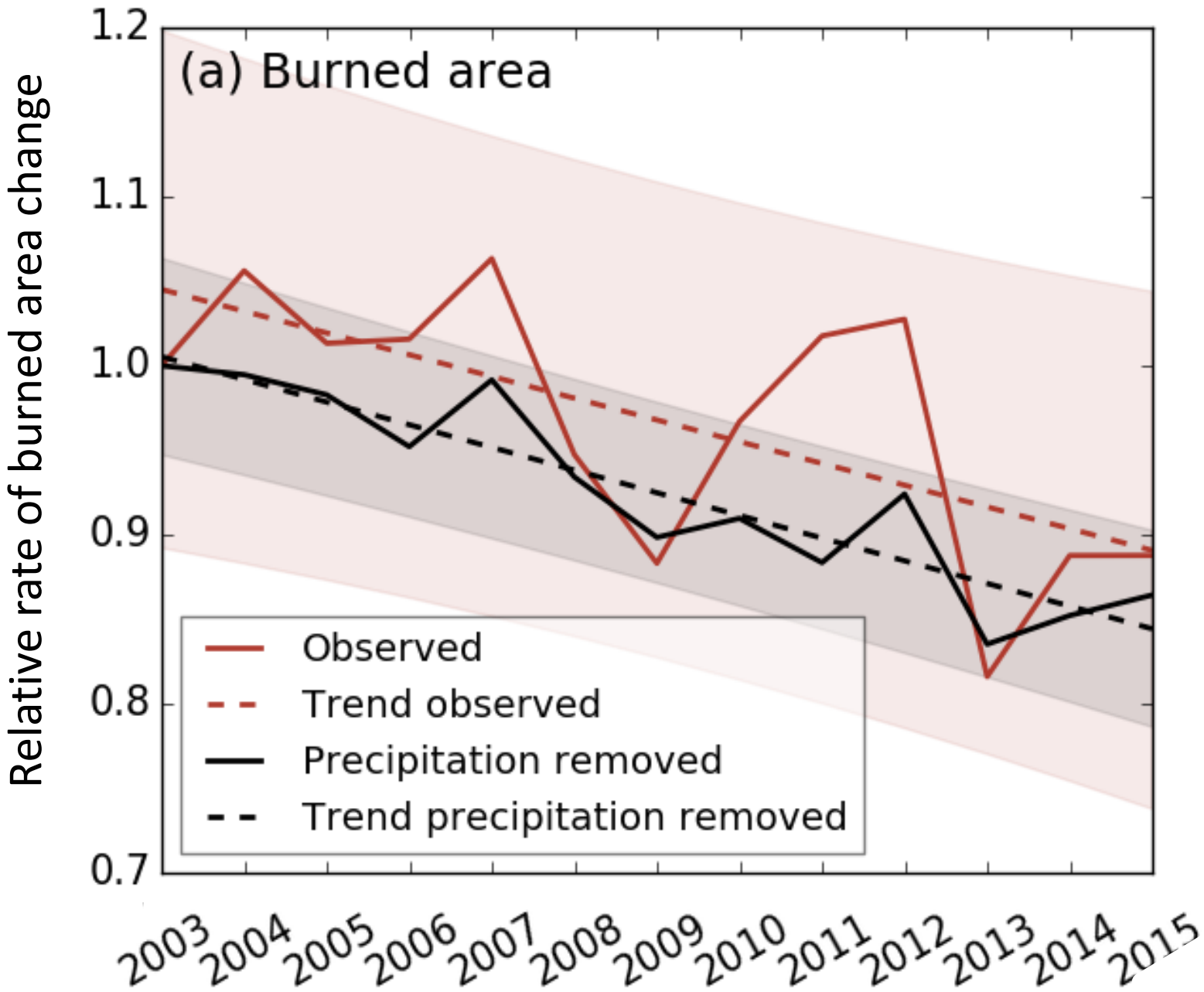
Fires are declining worldwide



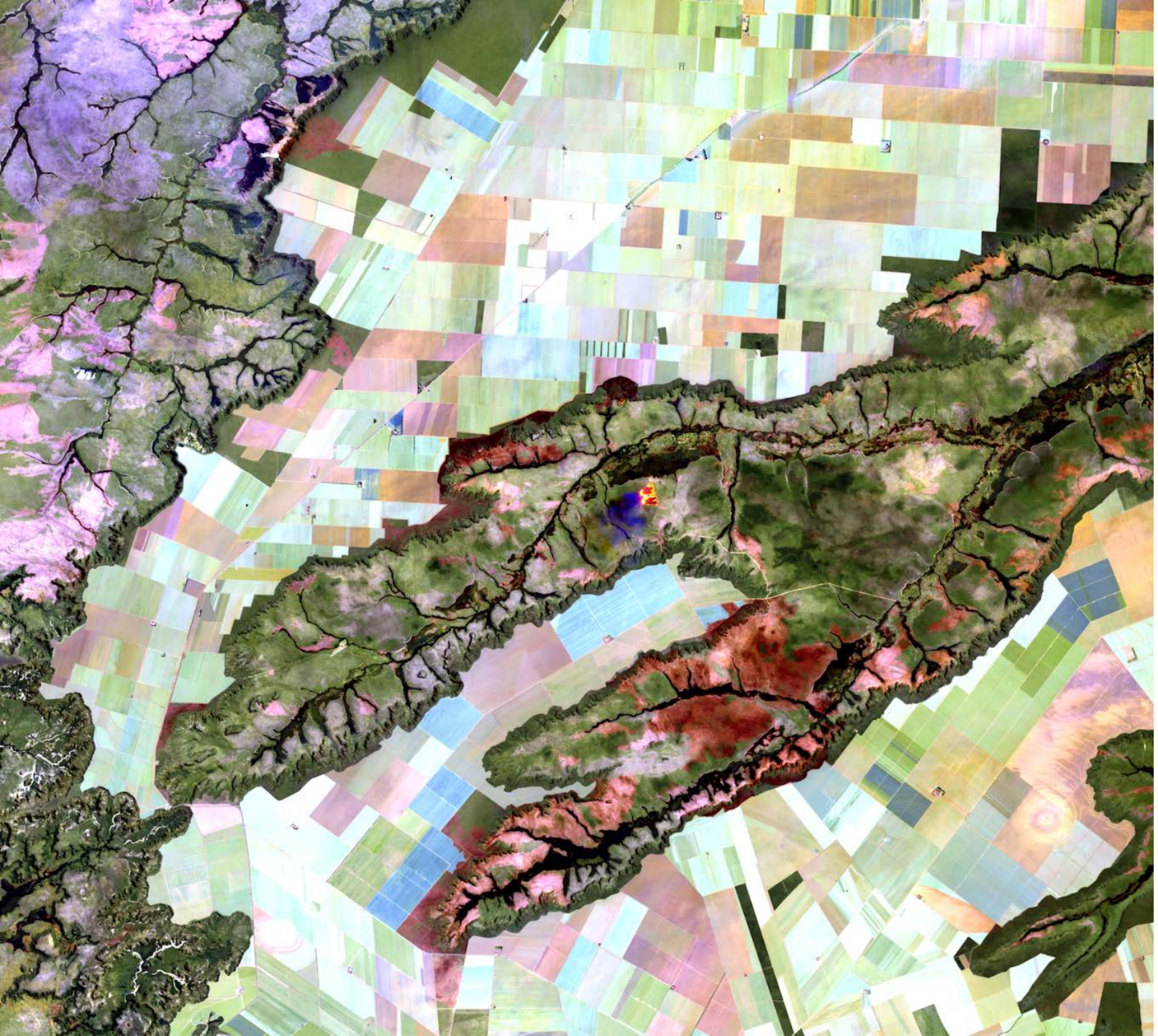
1997-2015

We have lost nearly a quarter of global burned area over two decades

Andela et al. (2017) *Science*

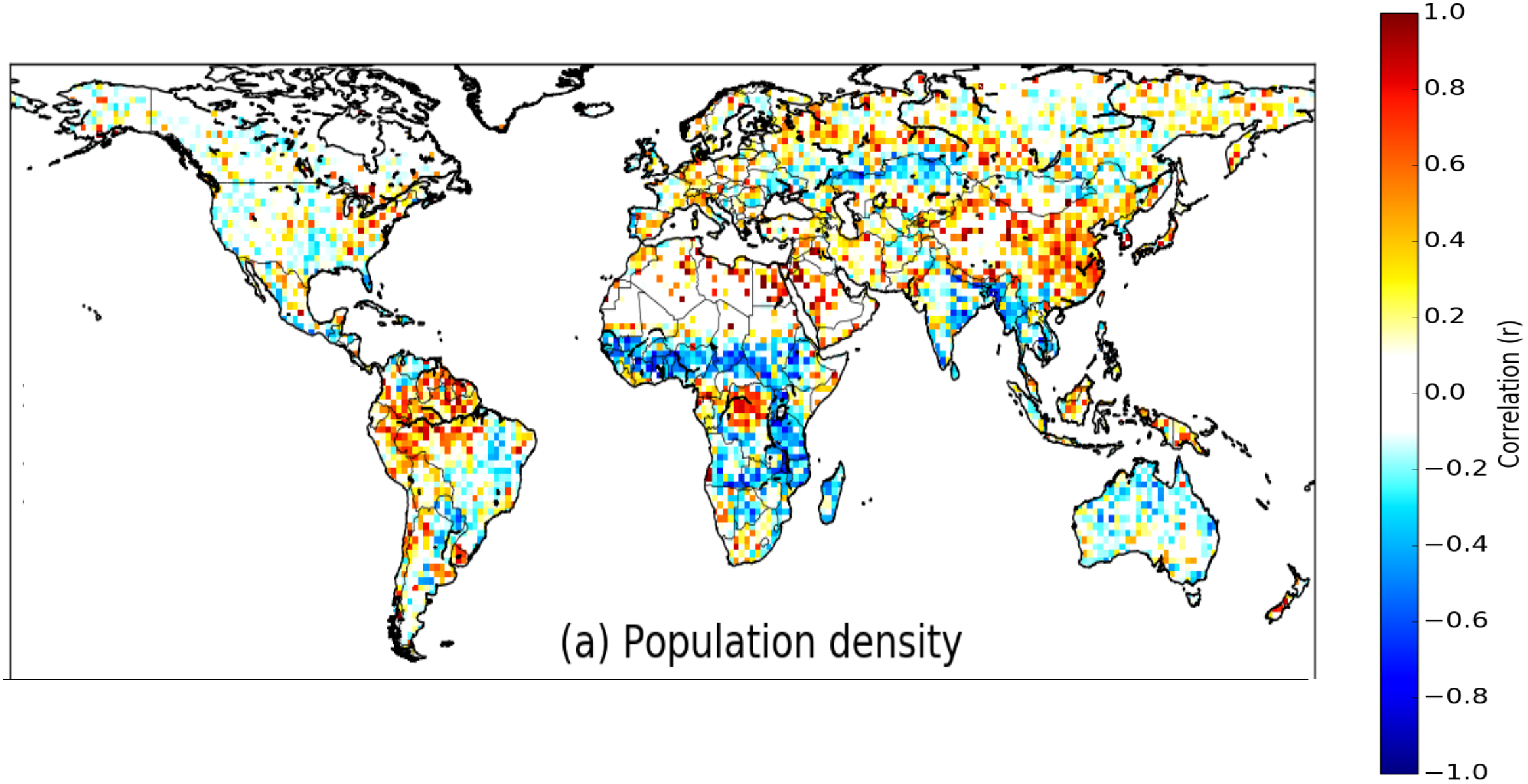


Andela et al. (2017) *Science*



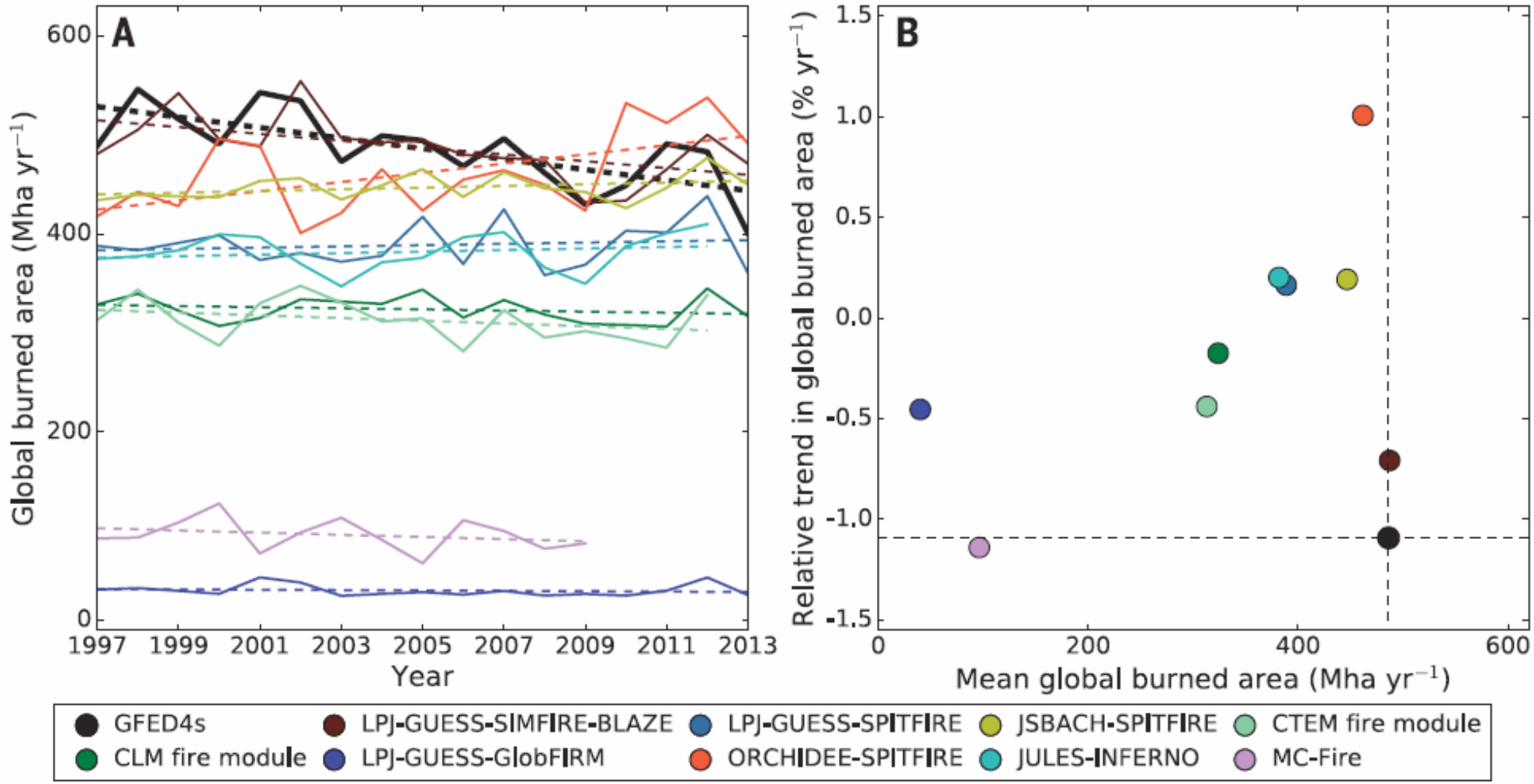
Landsat8 image from the Brazilian Cerrado (Morton, NASA)

Andela et al. (2017) *Science*



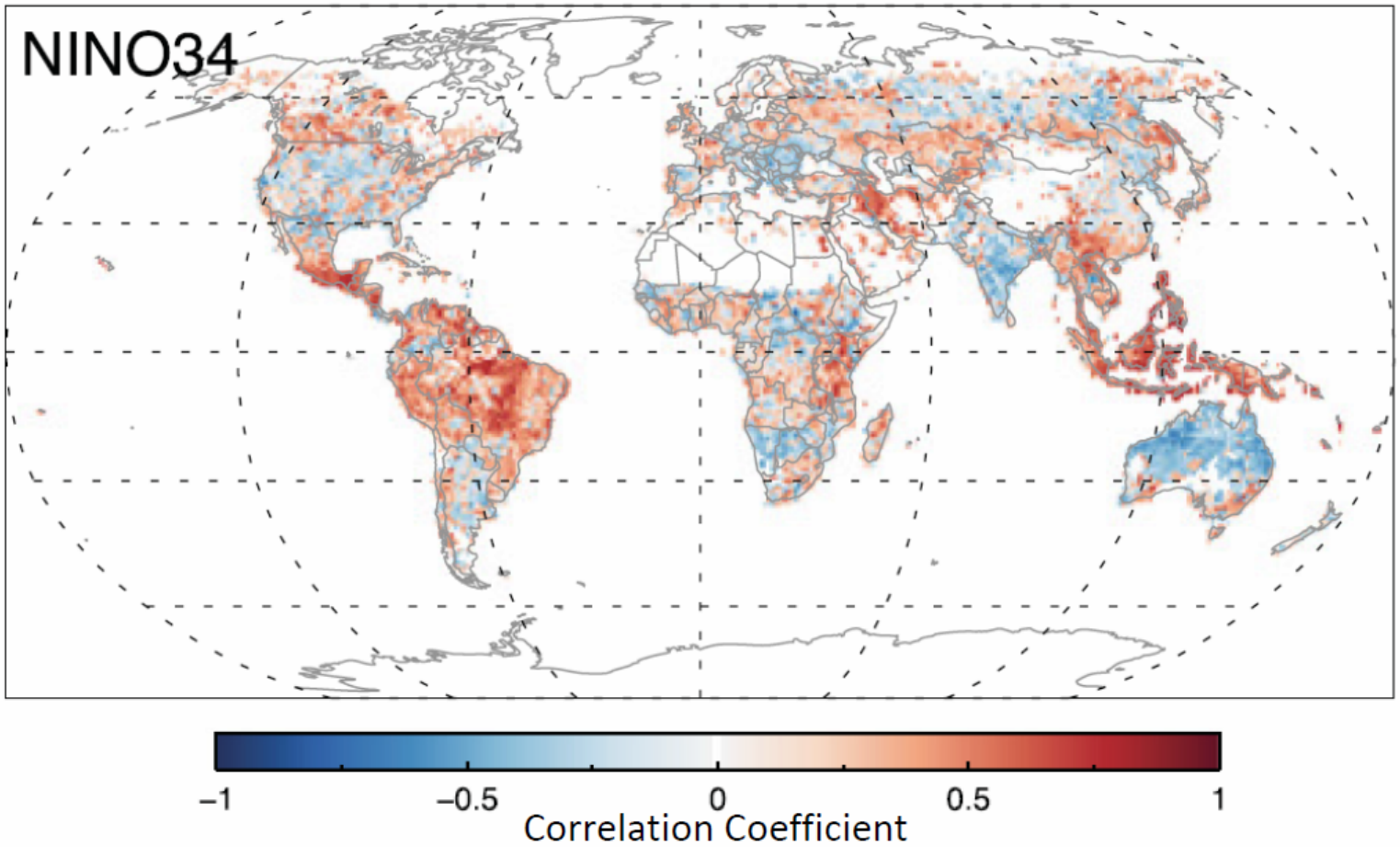
Andela et al. (2017) *Science*

Decadal prediction of fires remains challenging



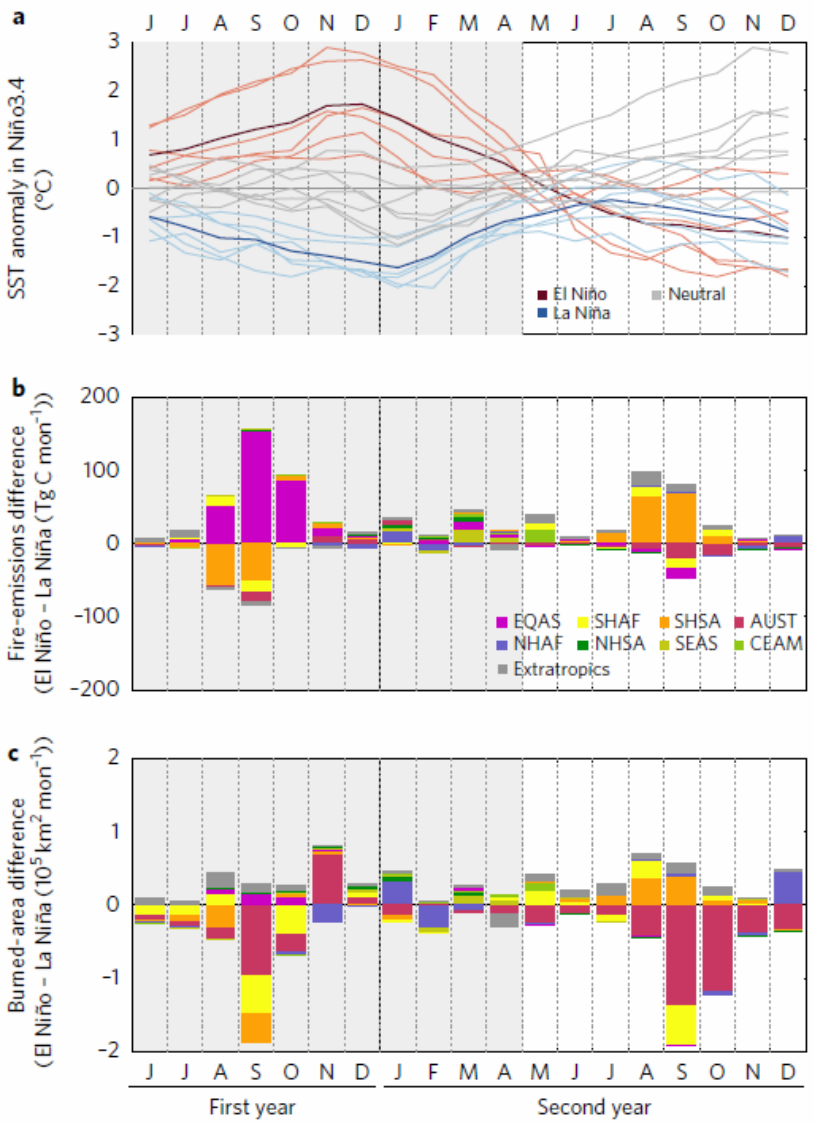
Andela et al. (2017) *Science*

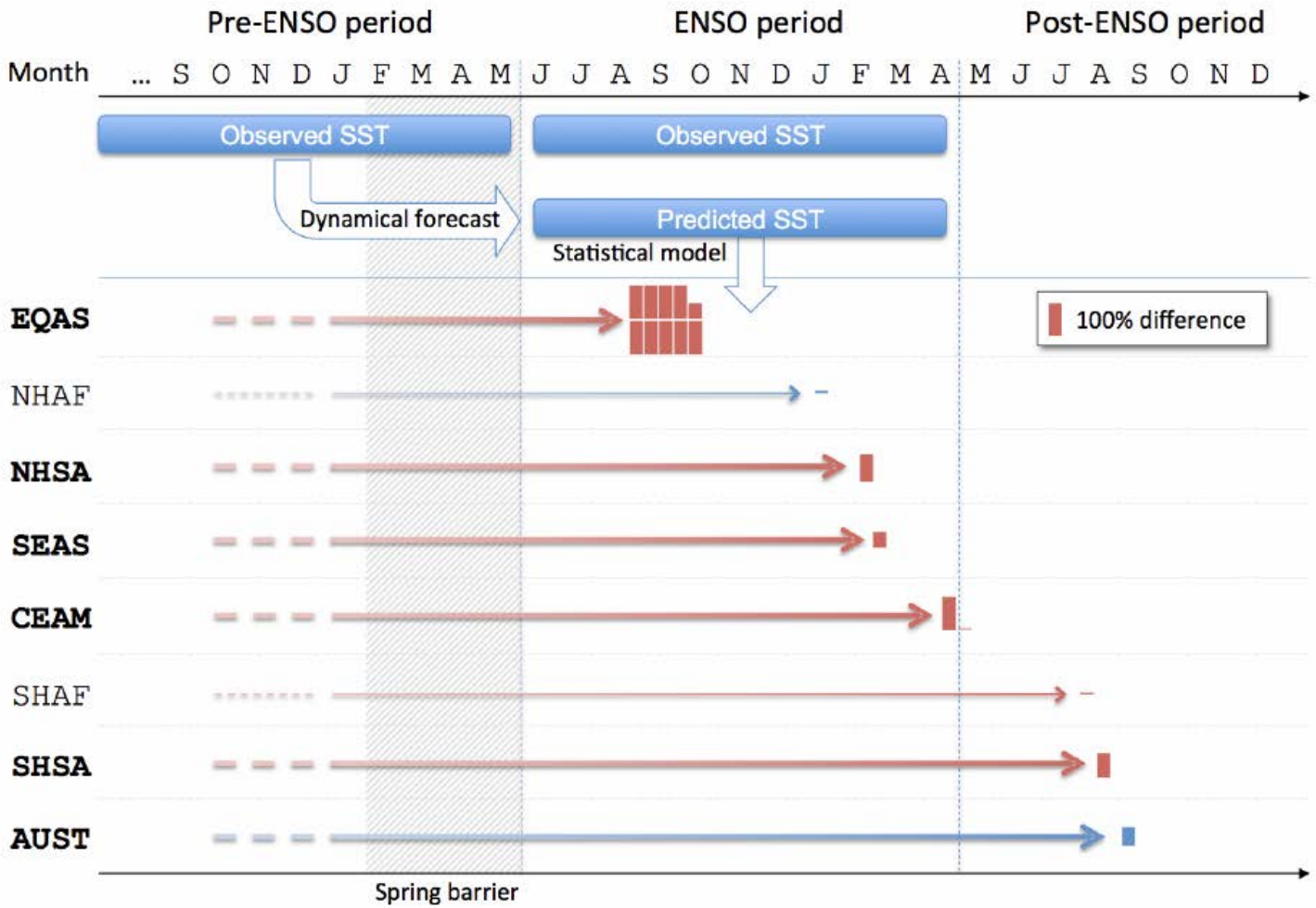
El Niño exerts a strong influence on the global pattern of fire emissions



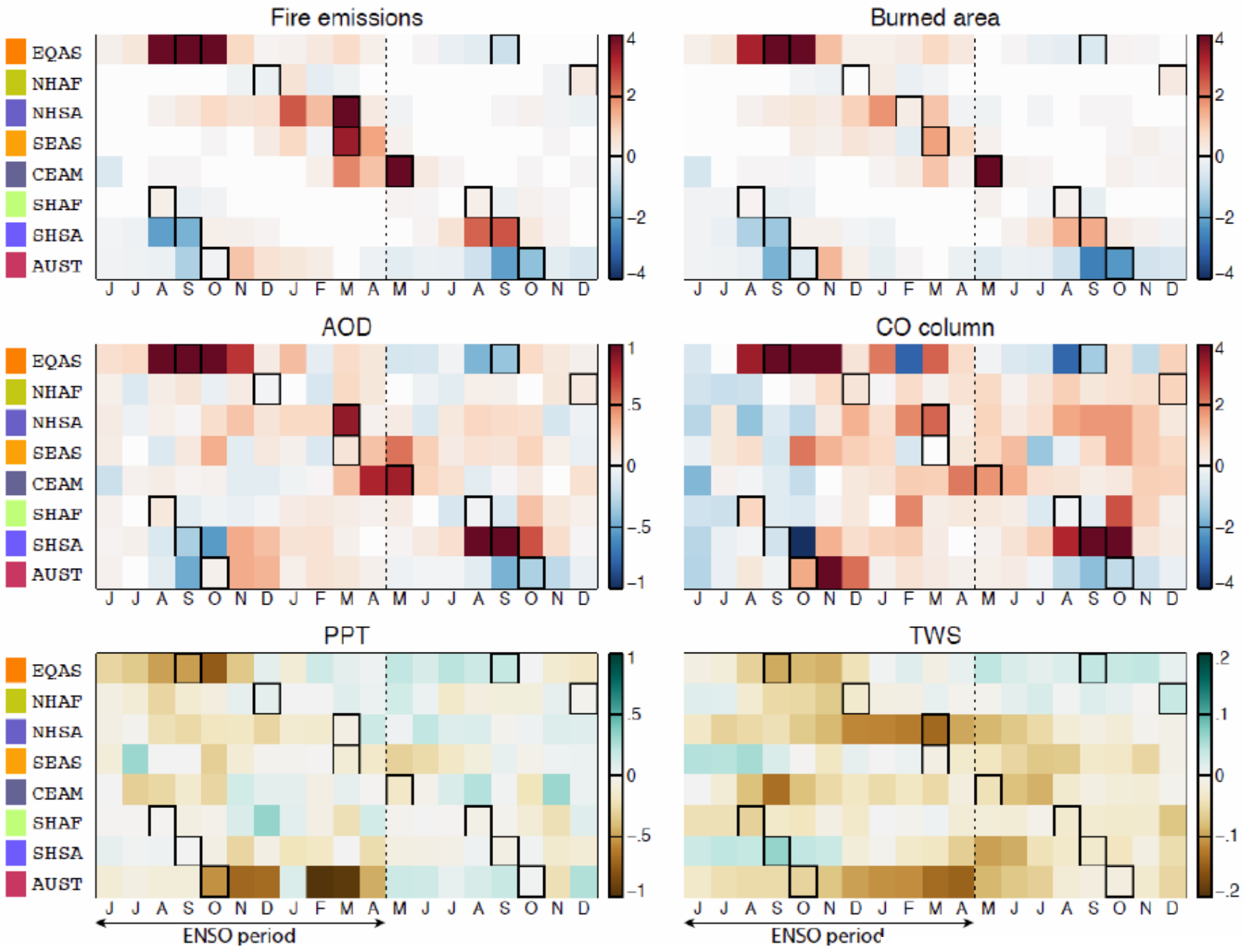
Chen, Y., N. Andela, L. Giglio, D.C. Morton, and J.T. Randerson. 2016. How much global burned area can be forecast on seasonal time scales using sea surface temperatures? Environmental Research Letters. 11: 045001.

An El Niño cascade may improve global fire prediction





Chen et al. (2017) *Nature Climate Change*

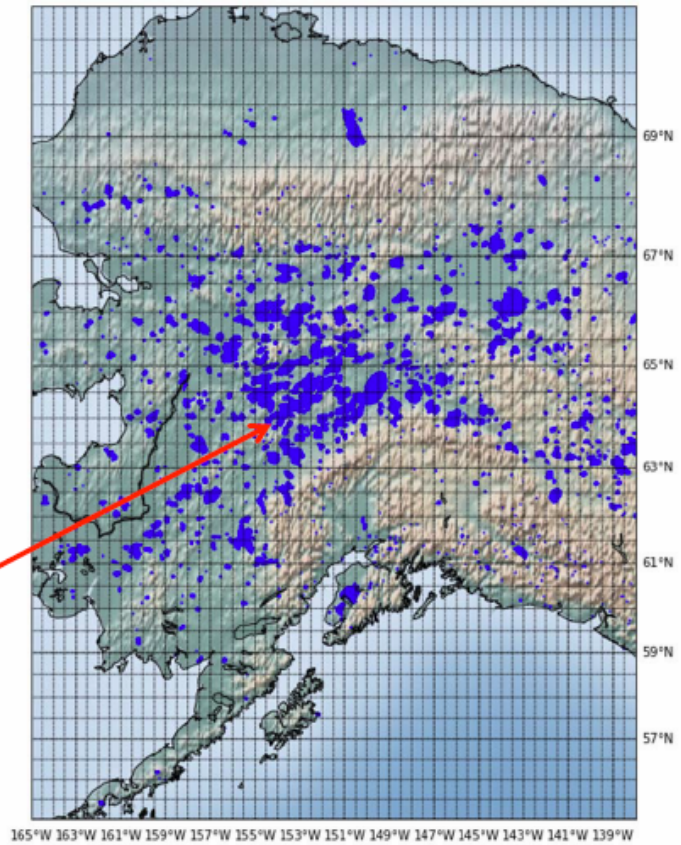


Chen et al. (2017) *Nature Climate Change*

Improving emissions estimates for smoke forecasts

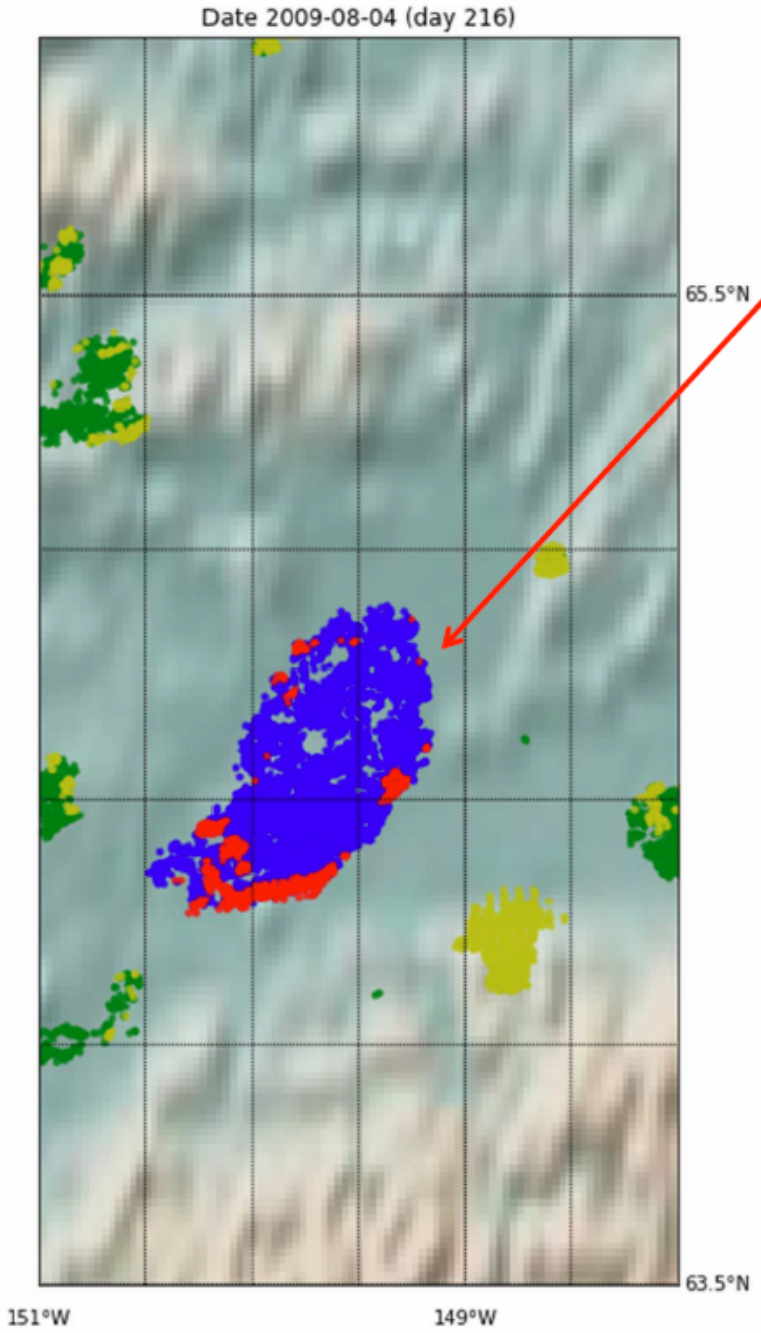
- Emissions prediction can be separated into a part associated with new ignitions and the spread of existing fires:
- $A_s(x,y, t+k) = A_I(x,y, t+k) + A_E(x,y, t+k)$
- Emissions from new ignitions likely dominant in savanna and agricultural ecosystems
- Emissions from existing fires likely a dominant term in western and boreal North American ecosystems

MODIS active fires 2007-2015



Smoke forecasting methodology – Existing fires

1. Assign active fires on day t to existing and new clusters
2. Extract climate information from analysis and forecasts at each cluster centroid
3. Predict active fires on day t + k in the future using the number of active fires at day t, and weather information
4. Use active fires to estimate emissions
5. Use emissions to estimate atmospheric composition at the next forecasting time step



Example Fire Cluster:

Current fire detections – red

Past active fires – blue

Other fire clusters – yellow a green

Climate Extraction:

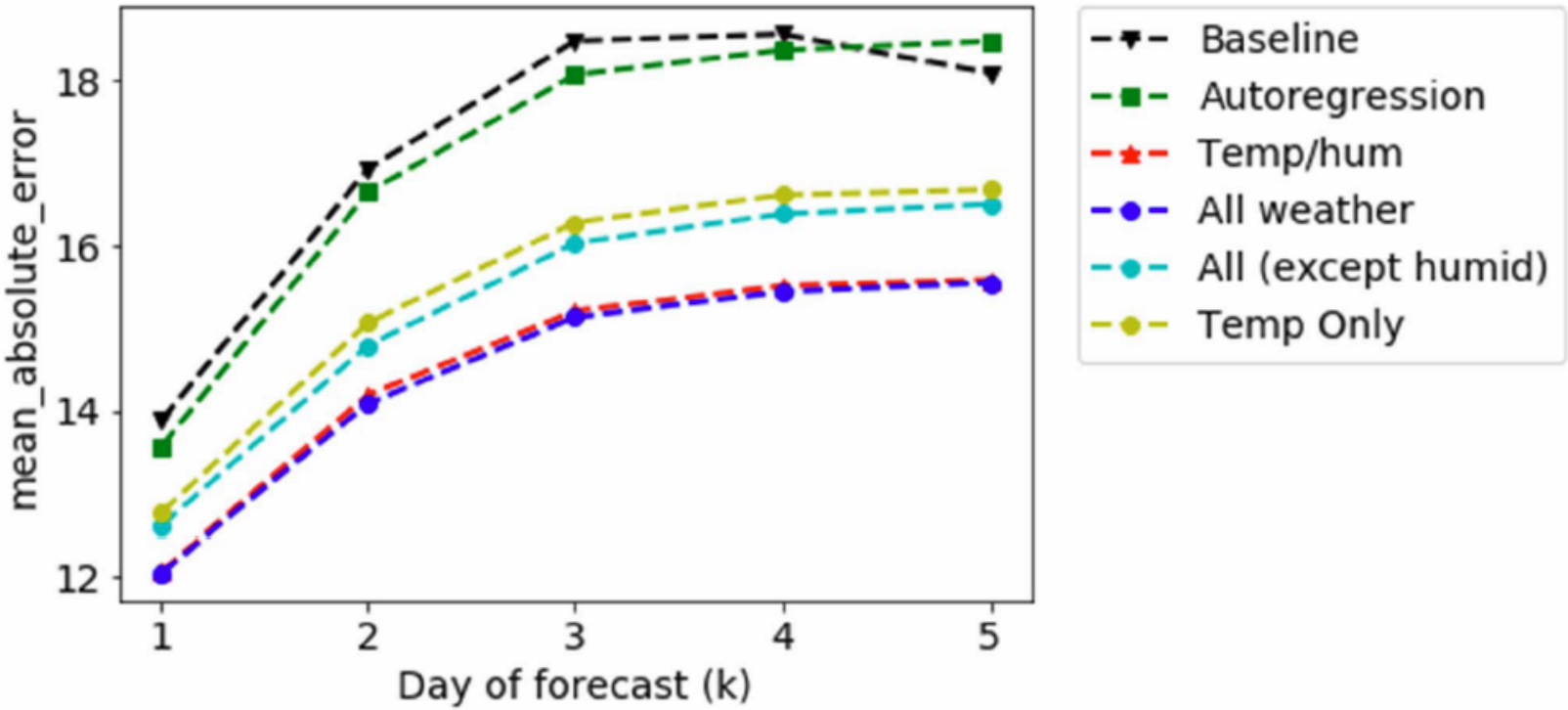
NOAA Global Forecasting System Analysis product

- Surface Air Temperature
- Relative Humidity
- Precipitation
- Wind speed

$$\log(\, E[y^i_{t+k}]\,) = B_0 + B_y \log\left(y^i_t + 1\right) + \sum_w B_w x^i_{t+k,w}$$

Graff et al. (in prep.)

Active fire model prediction improves with use of climate data



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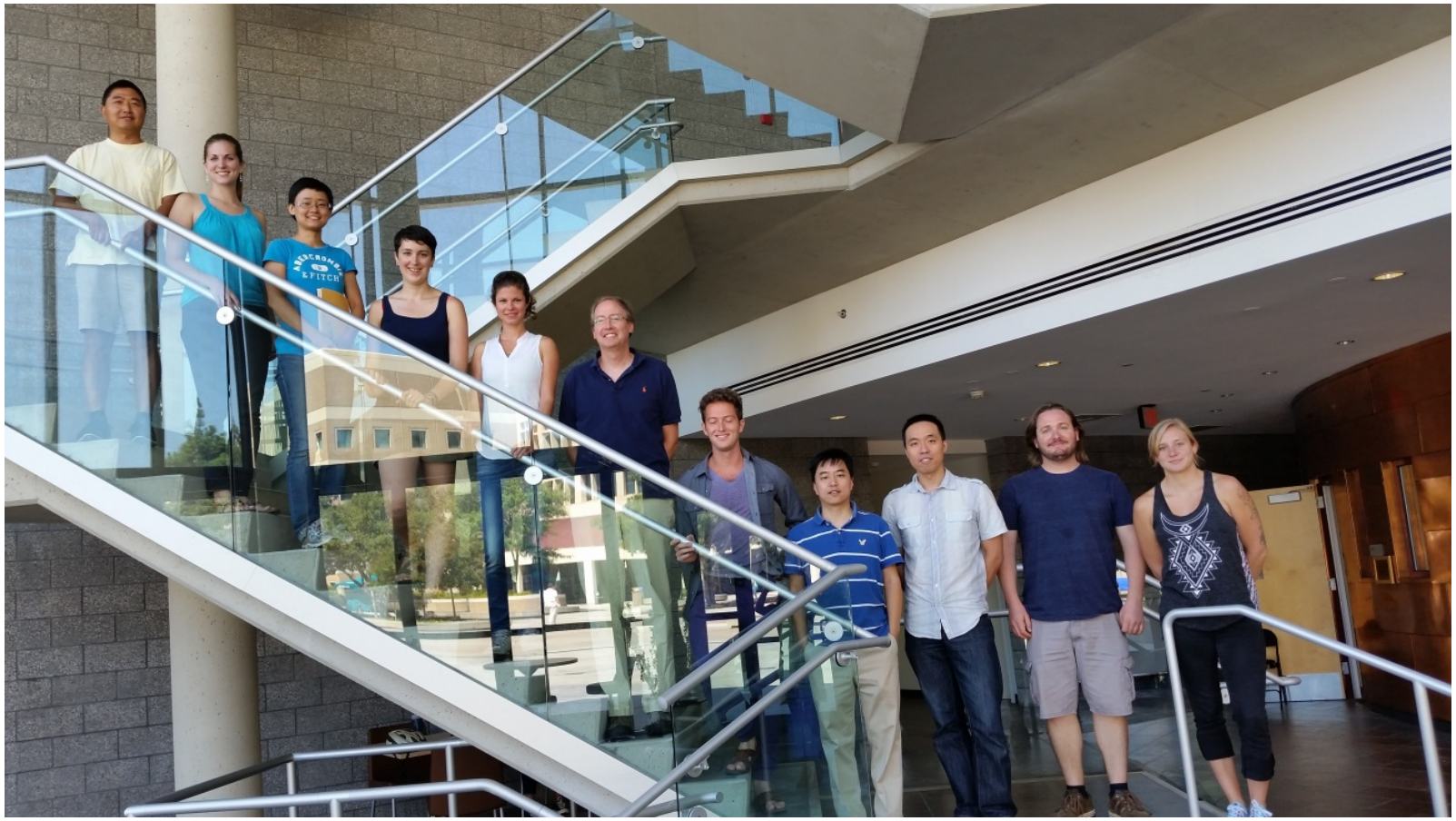
http://sites.uci.edu/randersonlab/