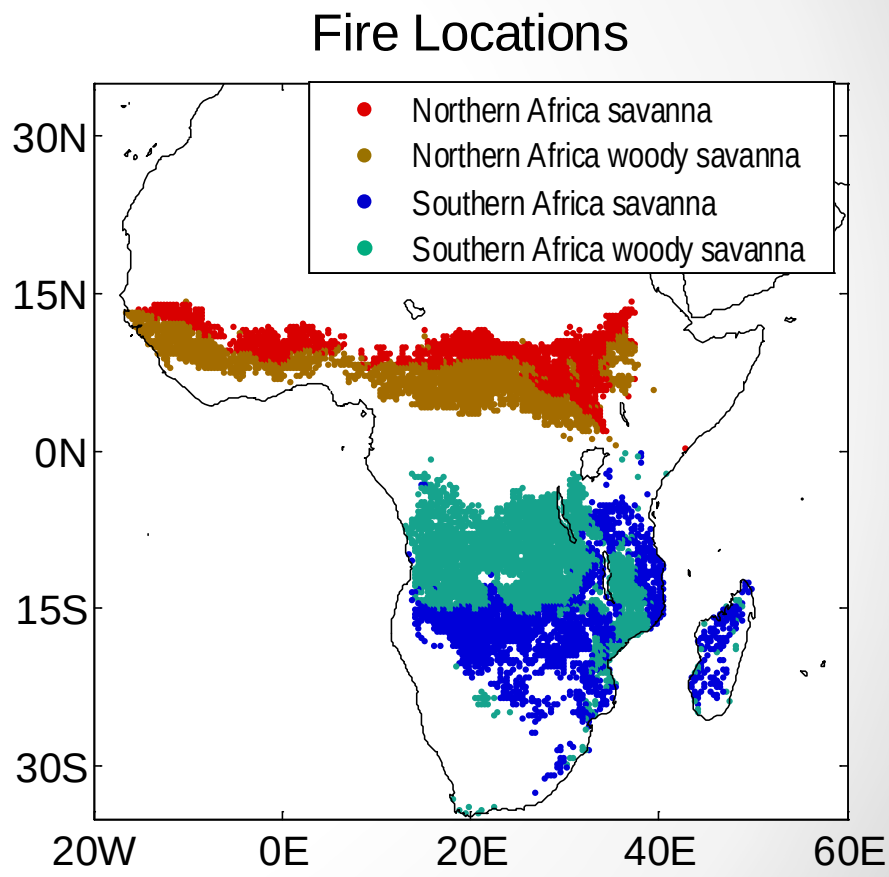
Satellite observations of a seasonal cycle in NO_x emission factors from fires in the African savanna

Anna K. Mebust and Ron C. Cohen
University of California, Berkeley
EOS-Aura Science Team Meeting
Oct 3, 2012

Biomass burning is the largest source of NO_x in Africa

Surface emissions of NO_x in Africa (year 2000)*

Source	Total emissions (Tg N yr^{-1})
Biomass burning	**3.8**
Soils	3.3
Fossil/Biofuels	0.8

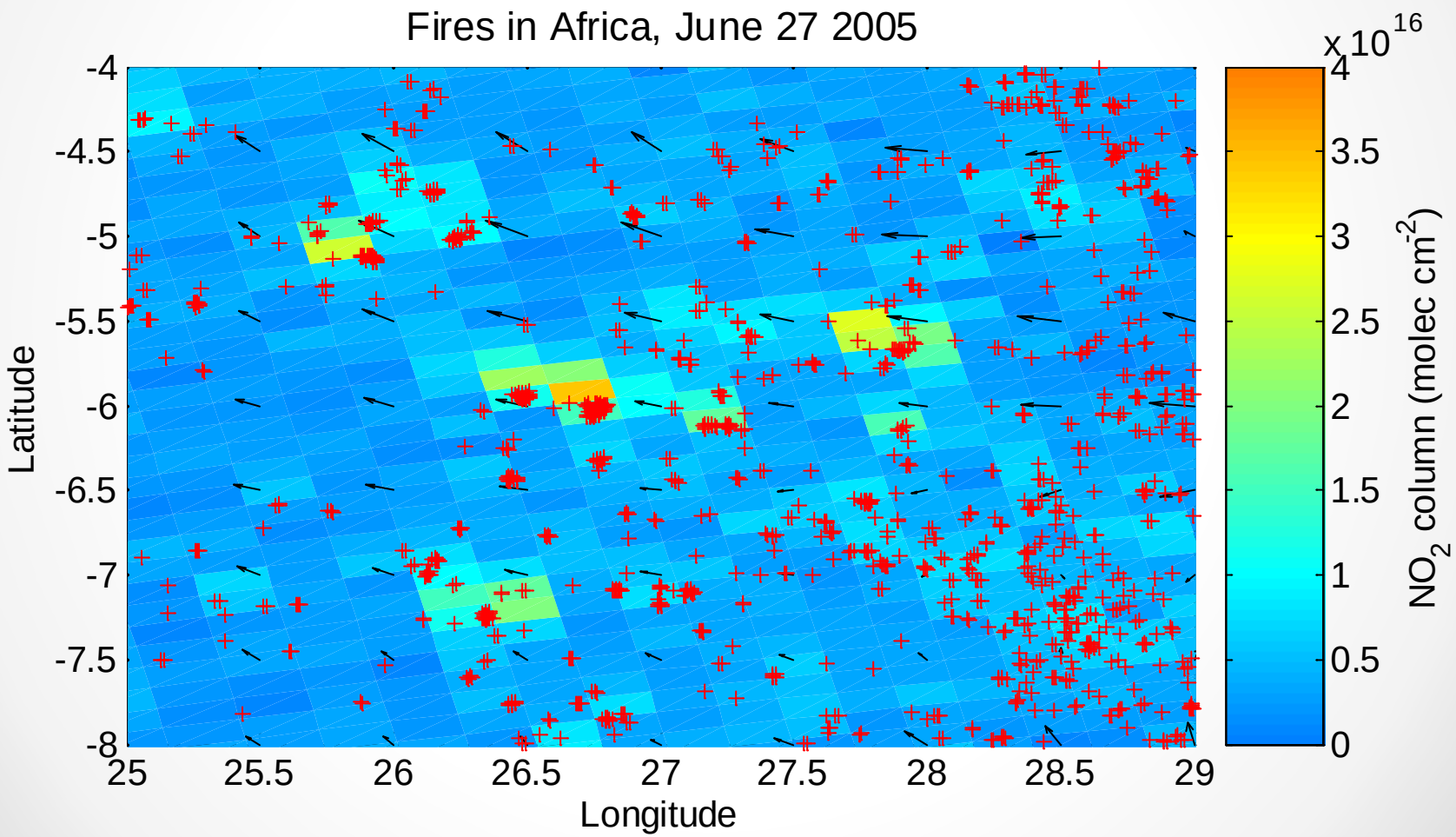


*Jaeglé et al., J. Geophys. Res., 109, D21310, 2004.

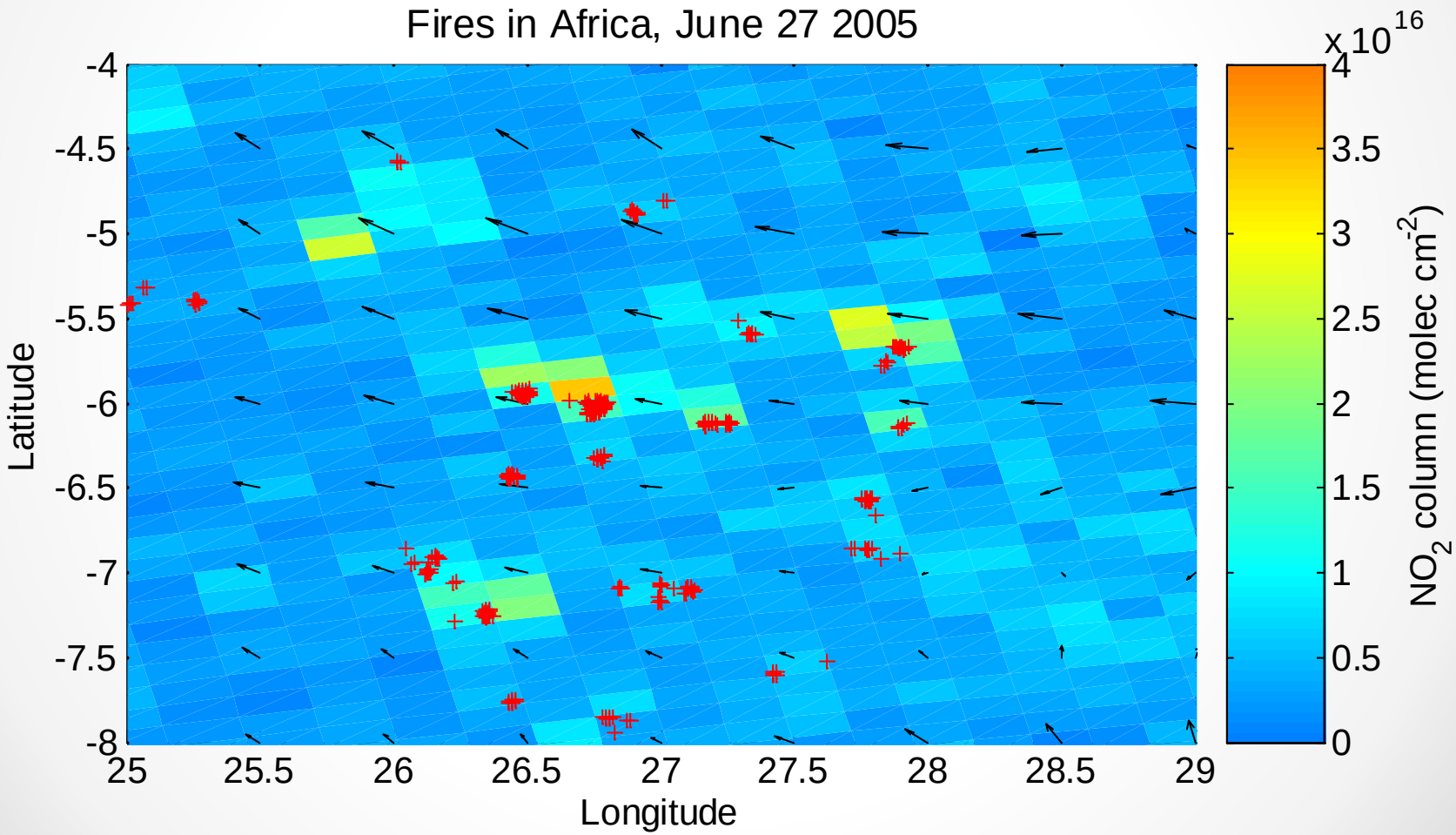
Emissions are estimated using an emission factor and biomass burned

$$M_{total} \times EF = M_{NOx}$$

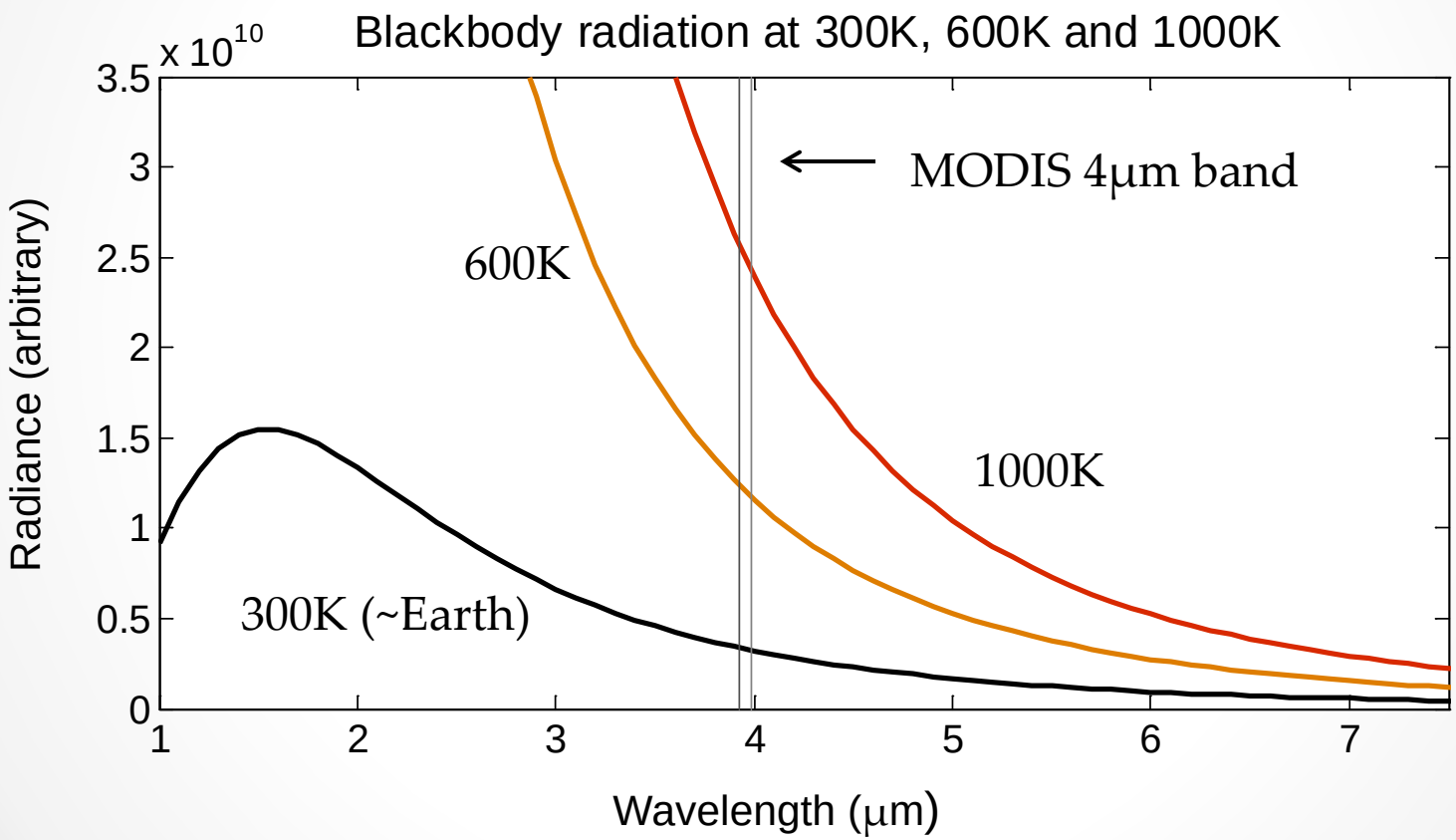
Satellite instruments are capable of observing fire properties



Satellite instruments are capable of observing fire properties



MODIS quantifies fire radiative power from 4μm spectral radiance



600K = 3.5x increase

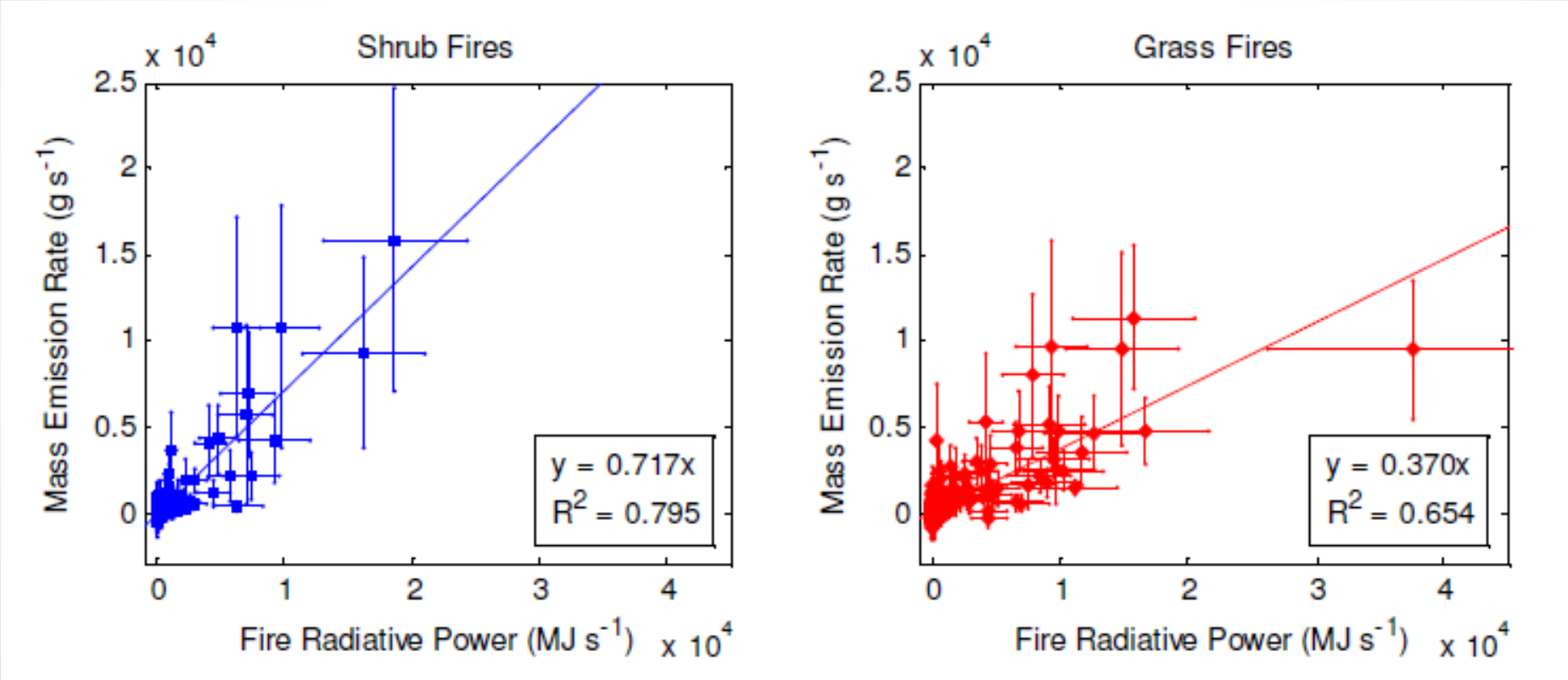
1000K = 7.5x increase

We can use satellite observations to measure fire emissions

$$R_{total} \times EC = M_{NOx}$$

$$\mathbf{EC \propto EF}$$

Satellite measurements of NO_x and energy are correlated



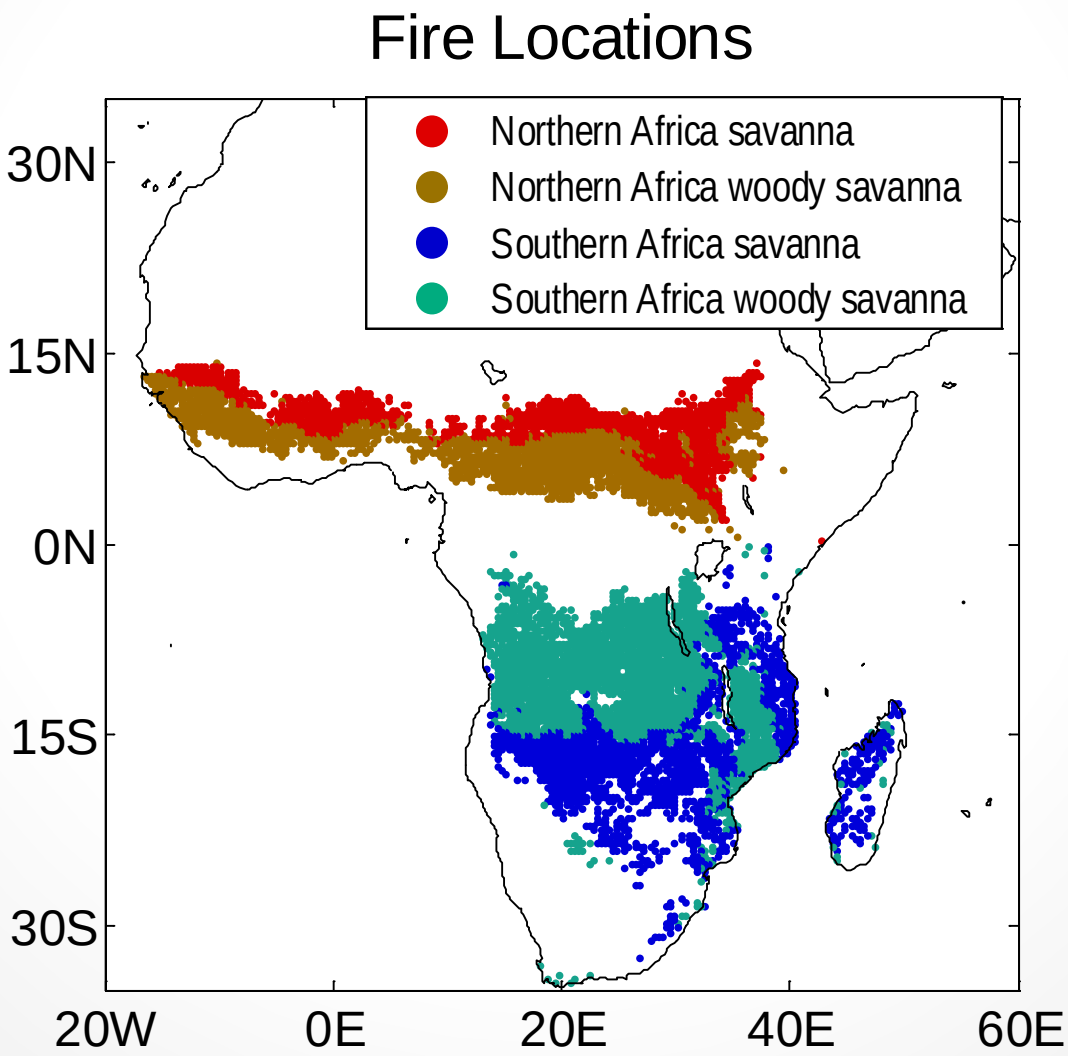
Mebust, A. K. et al. *Atmos. Chem. Phys.*, 11, 5839-5851, 2011.

Satellite ECs reproduce EF differences with land type

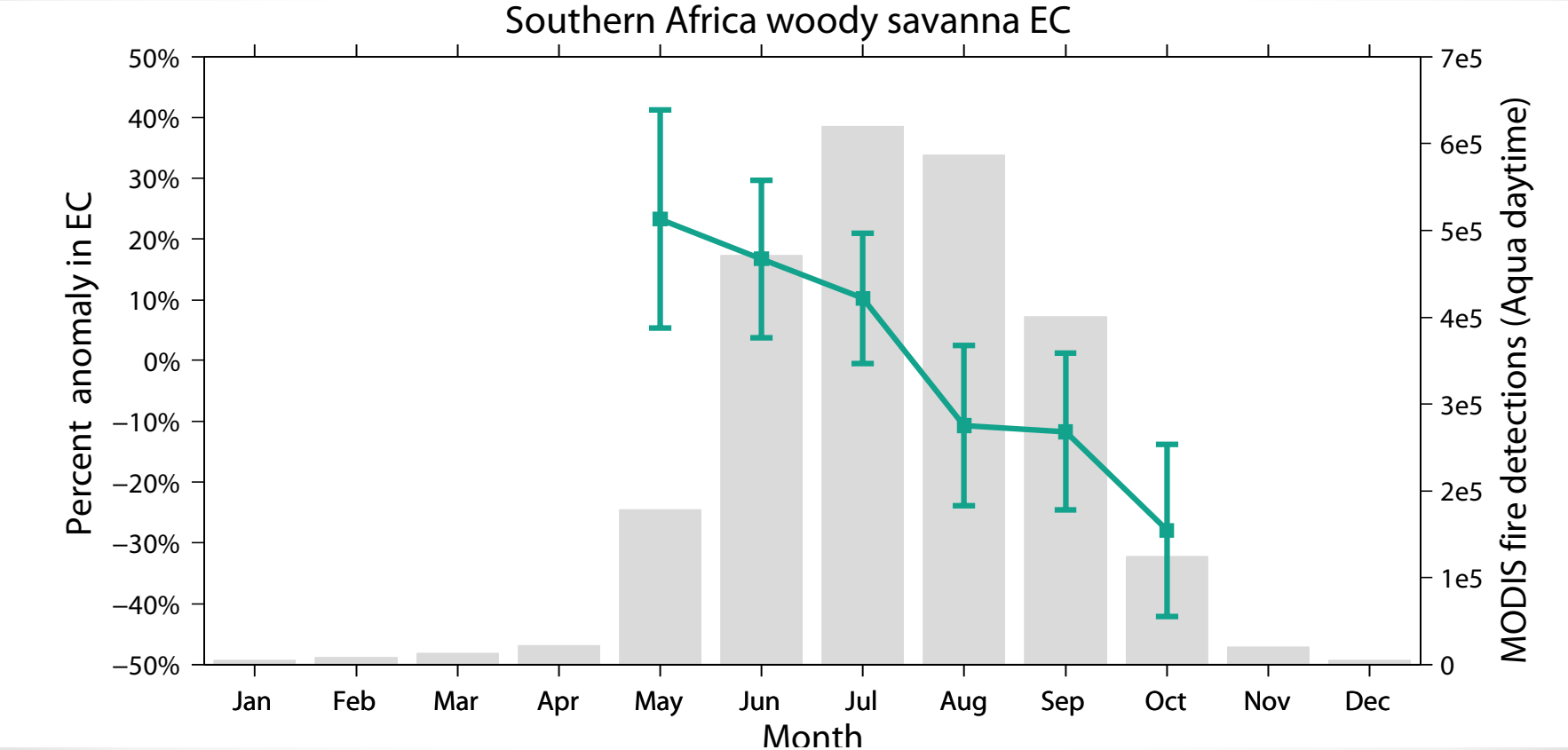
	OMI/MODIS	EPA
Land Type	EC (normalized)	EF (normalized)
Forest	**1.00 ± 0.28** (28%)	1.00 ± 0.48 (48%)
Grass	**1.23 ± 0.19** (15%)	1.40 ± 0.36 (26%)
Shrub	**2.49 ± 0.32** (13%)	2.6 ± 1.1 (42%)

Mebust, A. K. et al. *Atmos. Chem. Phys.*, 11, 5839-5851, 2011.

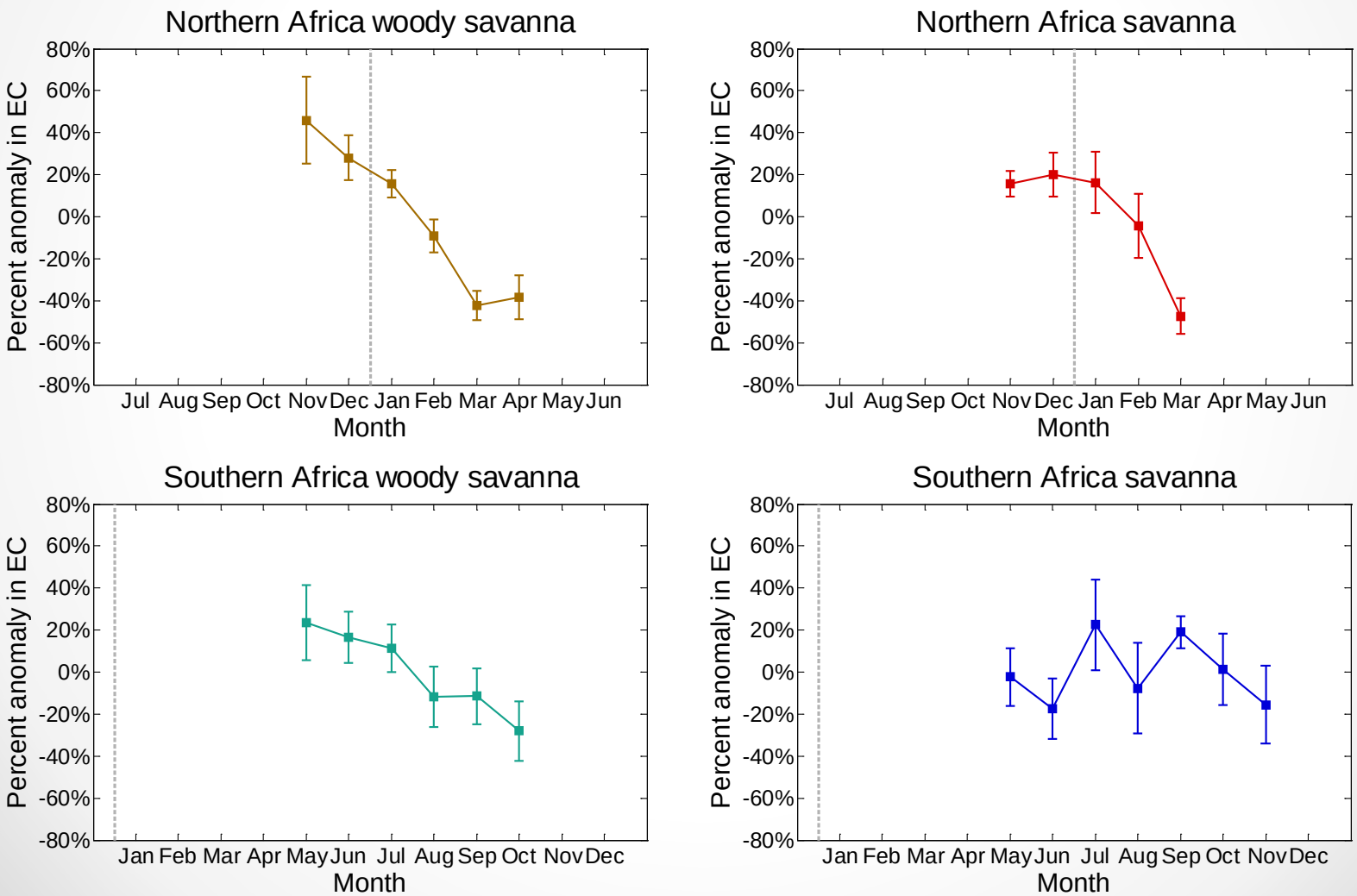
African savanna fires are globally significant and burn predictably



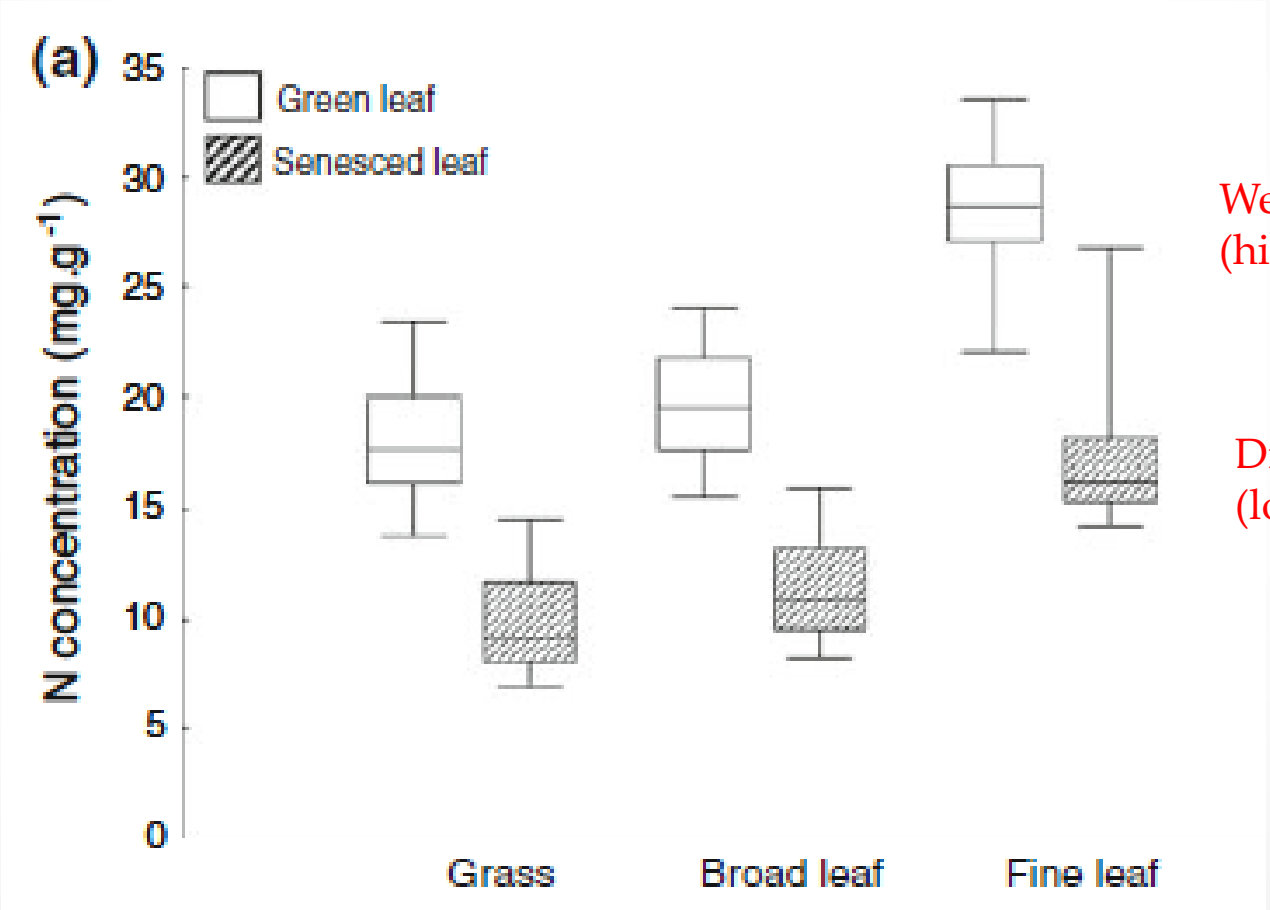
We observe a seasonal cycle in NO_x ECs in African savannas



This cycle is observed across several categories of savannas



The cycle may be due to nutrient reallocation by savanna plants



Wet season (high EC)

Dry season (low EC)

Ratnam, J. et al. *Oecologia*, 157, 141-151, 2008.

Summary

We observe a previously unmeasured seasonal cycle in NO_x ECs (and thus EFs) in African savannas that is most likely due to nitrogen resorption by savanna plants

Acknowledgements

- Ron Cohen
- Ashley Russell, Luke Valin, Rynda Hudman
- NASA grant NNX08AE566
- DOE Office of Science Graduate Fellowship