Land cover and seasonality effects on biomass burning emissions observed from satellites

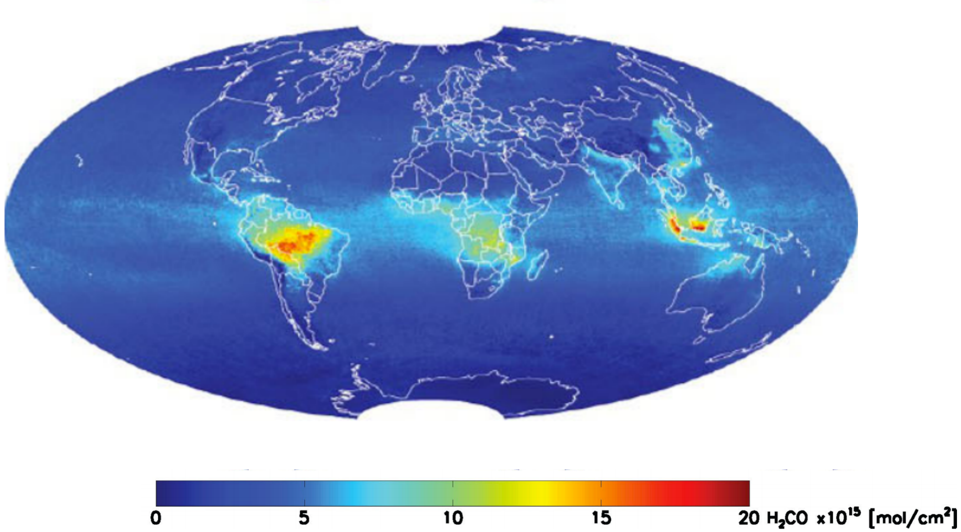
Peter Zoogman, Alicia Hoffman, Gonzalo Gonzalez Abad, Christopher Miller, Caroline Nowlan, Guanyu Huang, Xiong Liu, Kelly Chance

Aura Science Team Meeting
August 31, 2016

Satellite Measurements – OMI VOCs

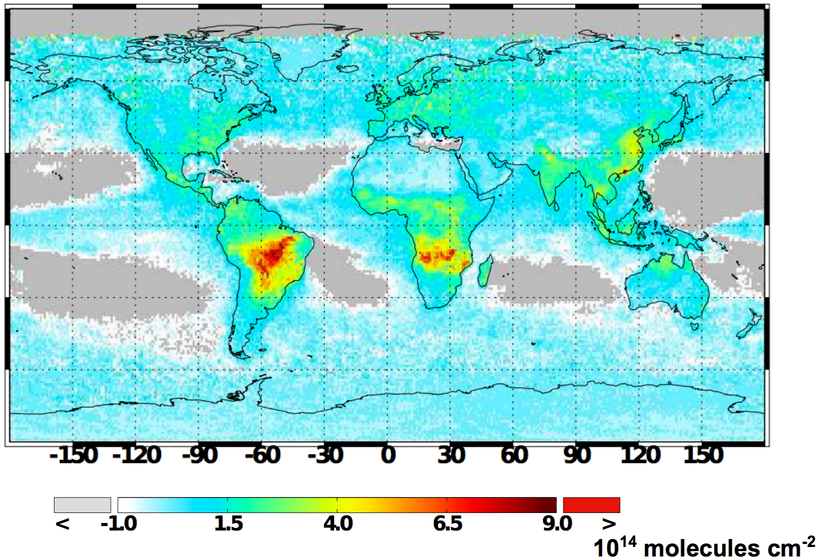
Seasonal average (Sept/Oct/Nov) column amount

Formaldehyde (HCHO)



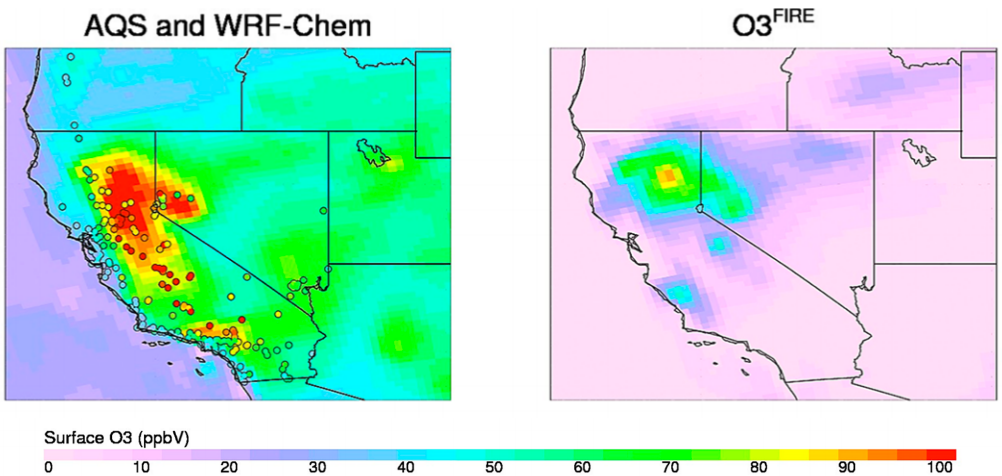
[Gonzalez Abad et al. 2015]

Glyoxal (CHOCHO)

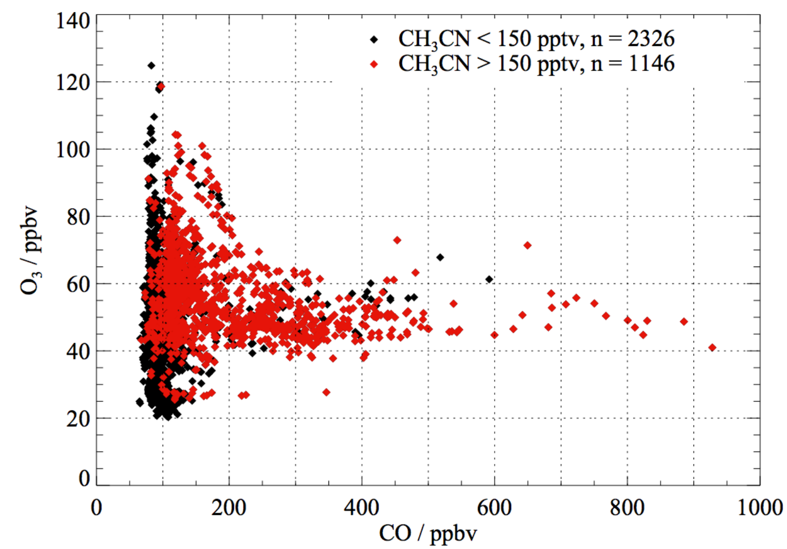


[Chan Miller et al. 2015]

Ozone Emissions from Fires?

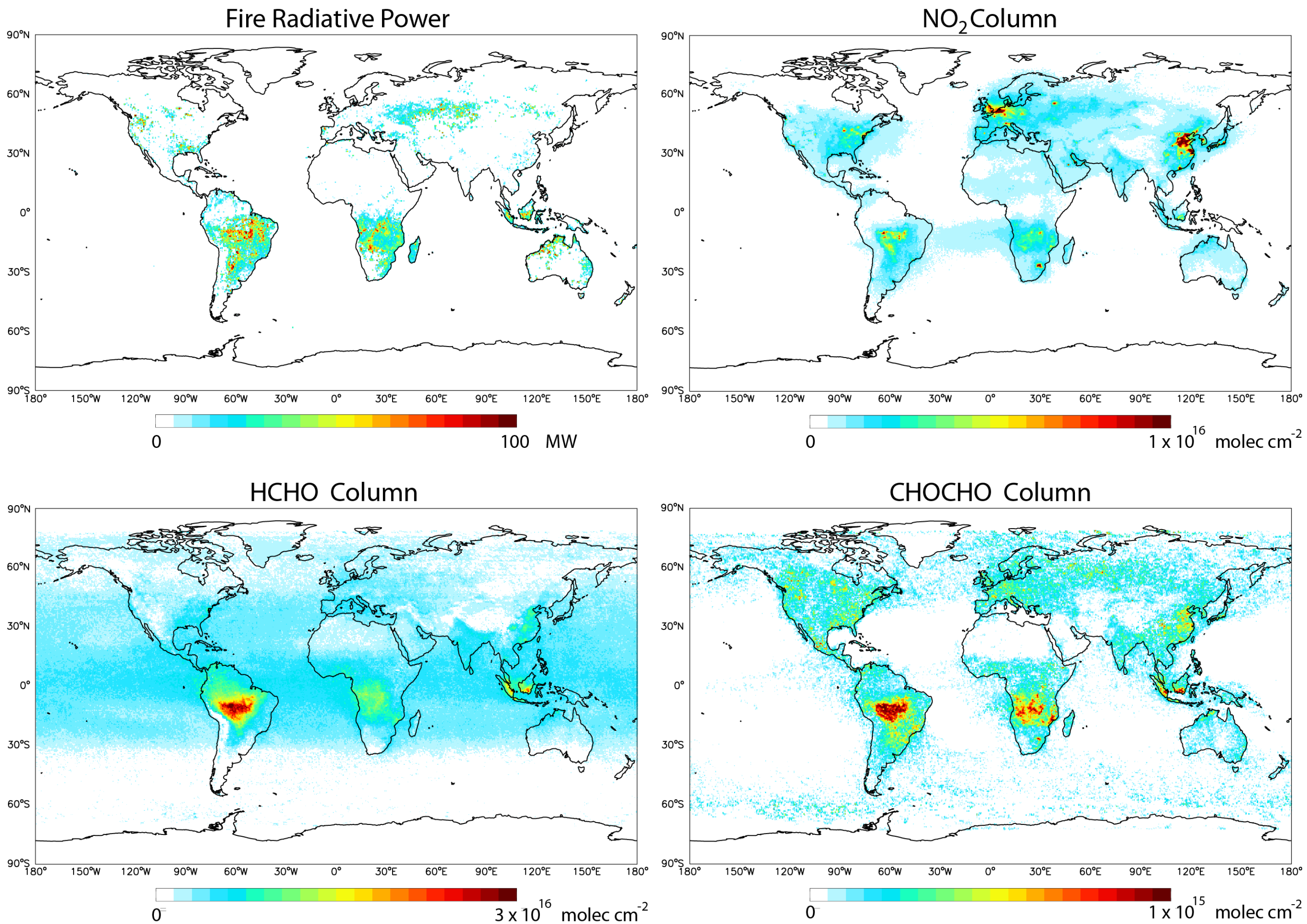


Models show ozone pollution episodes can be driven by fire emissions [Jaffe et al. 2013]



However, aircraft measurements often show no significant difference between O_3 in fire plume air and those in clean air [Parrington et al. 2013]

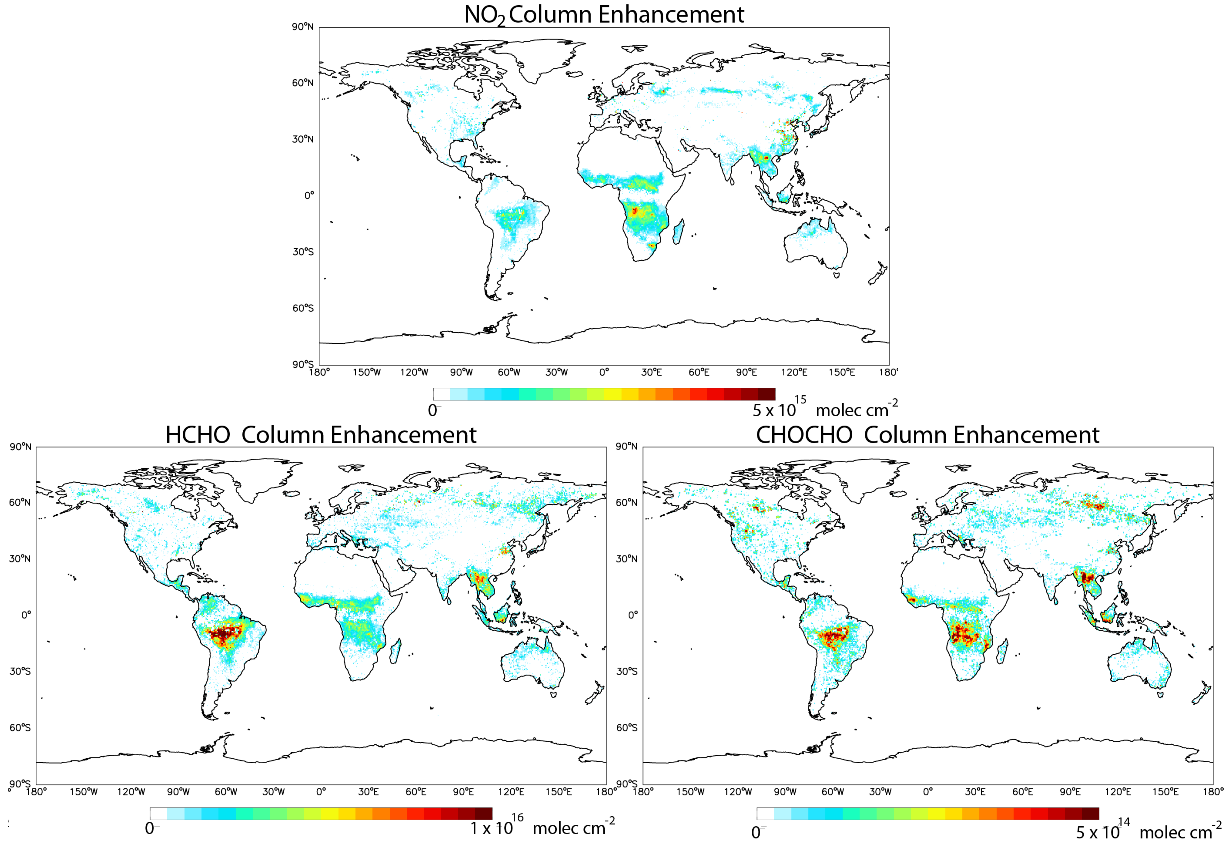
Global Distributions of Fire Products



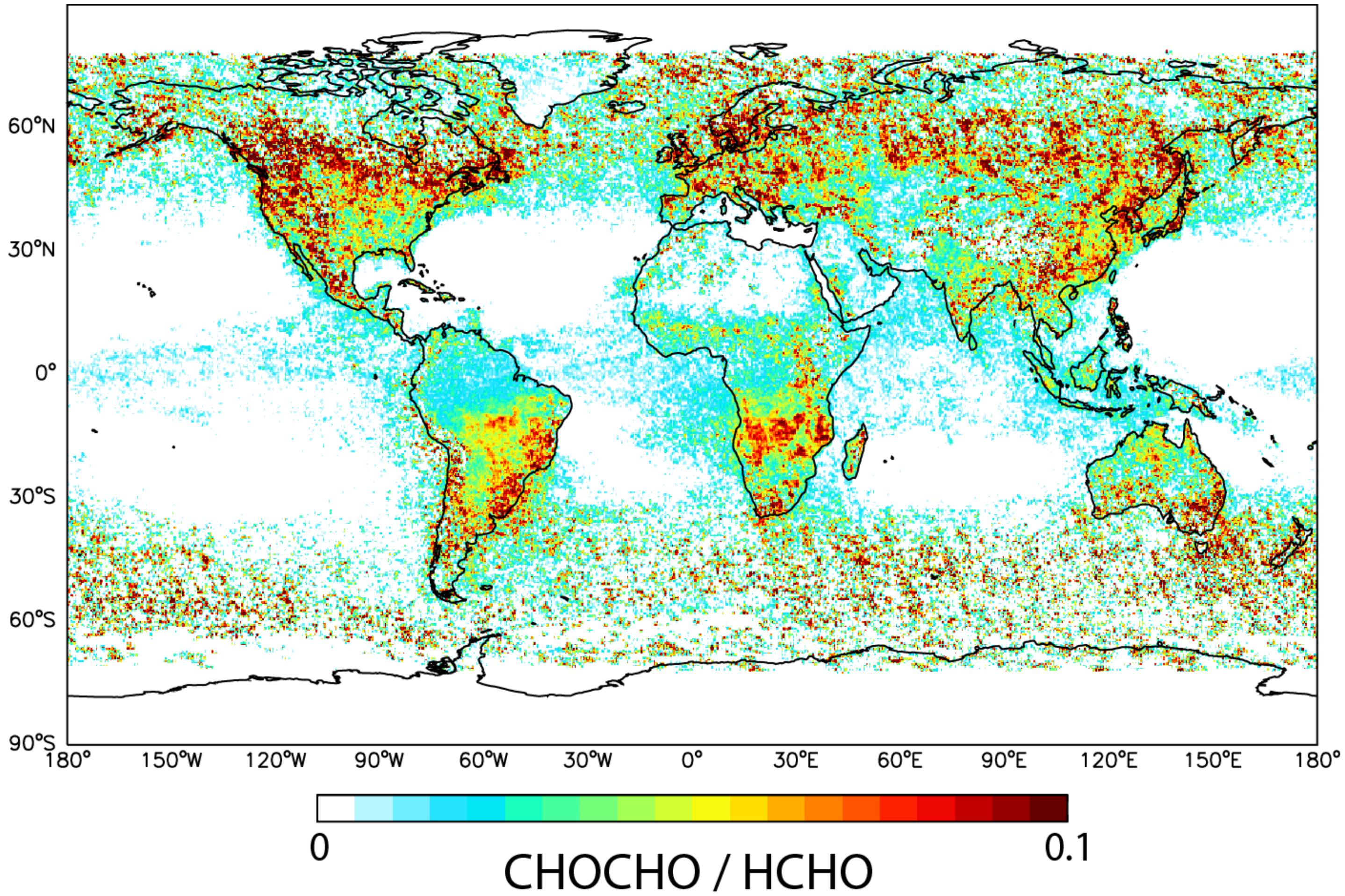
September 2006 of fire activity as observed from MODIS (top left) and the global tropospheric columns of NO2, HCHO, and CHOCHO (all from OMI). Both VOC compounds show strong enhancements from fire activity.

Tropospheric Column Enhancements

Mean tropospheric column amounts of NO_2, HCHO, and CHOCHO in the presence of fires minus in the absence of fires. NO_2 and HCHO data are from 2006-2010, CHOCHO data are from 2006-2007.

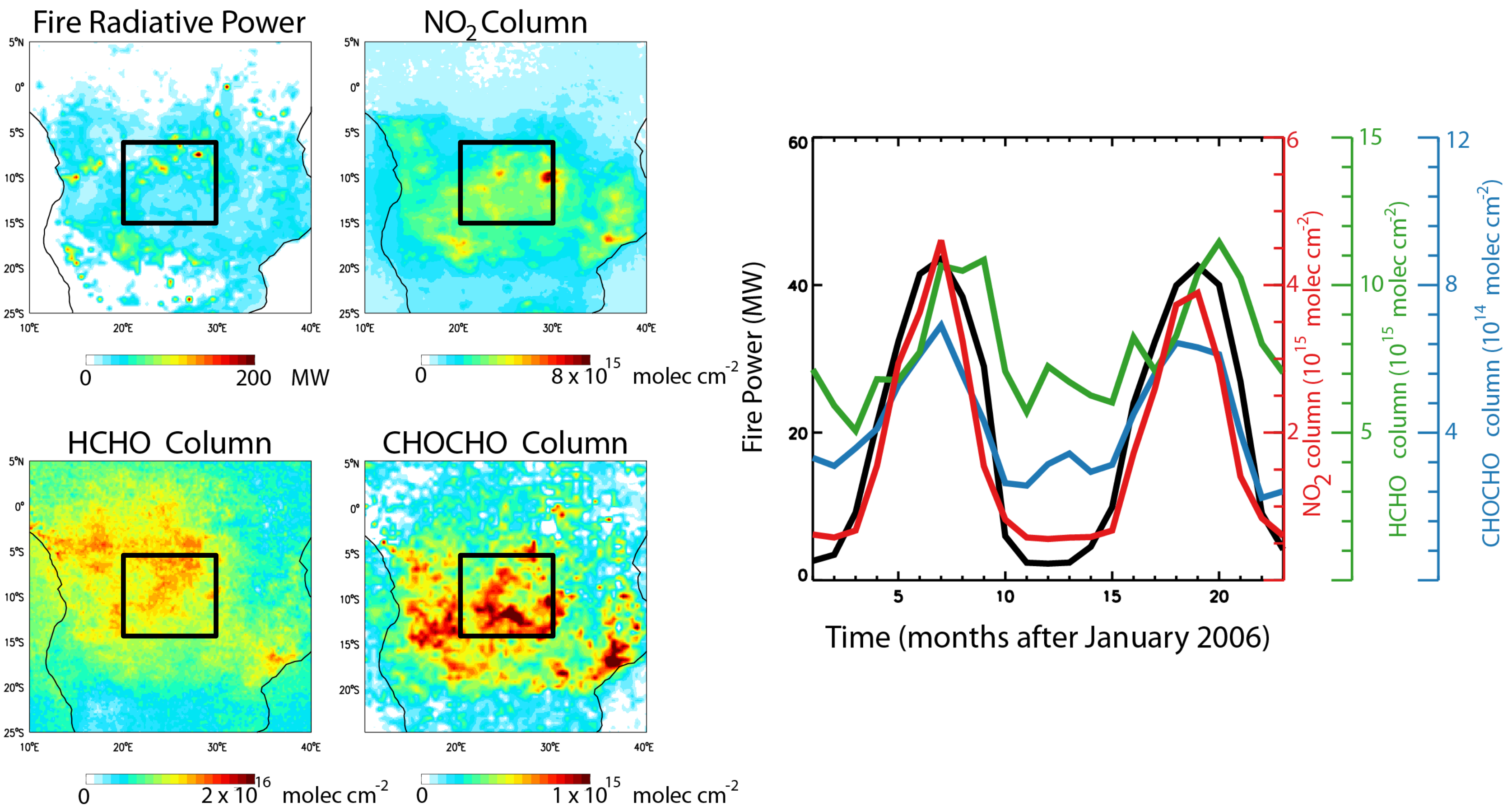


Glyoxal:Formaldehyde Ratios



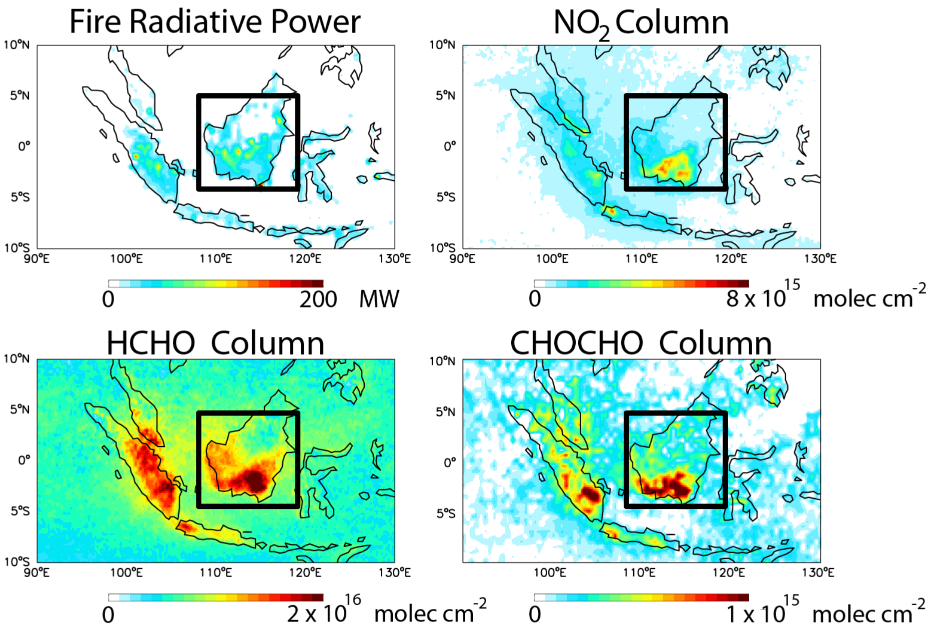
Global map of the ratio of CHOCHO / HCHO for September 2006. The ratio is highest over regions of biomass burning and boreal forests. The ratio tends to be lower over regions with large isoprene emissions.

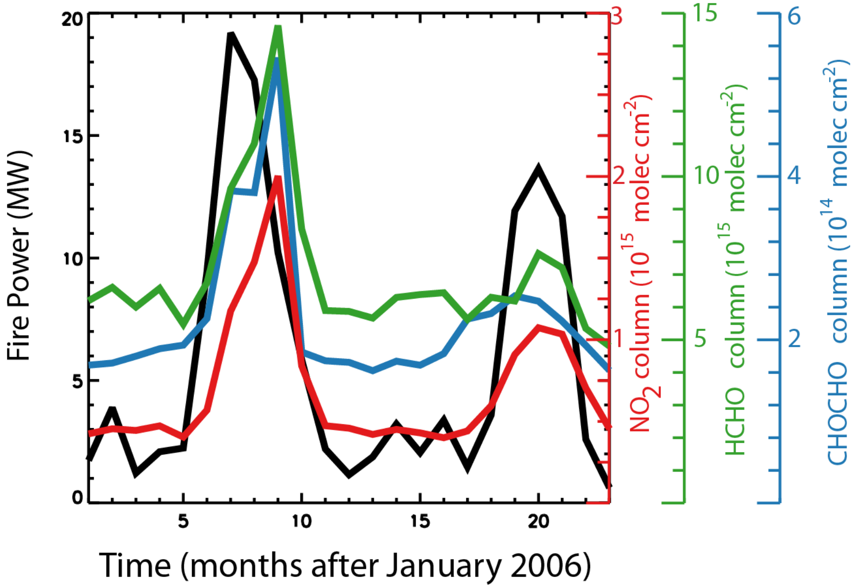
Case Study: Central Africa



Distribution for September 2006 of fire power and tropospheric columns of NO2, HCHO, and CHOCHO over central Africa. The monthly timeseries of these values averaged over the box inset shows a potential lag in HCHO emissions.

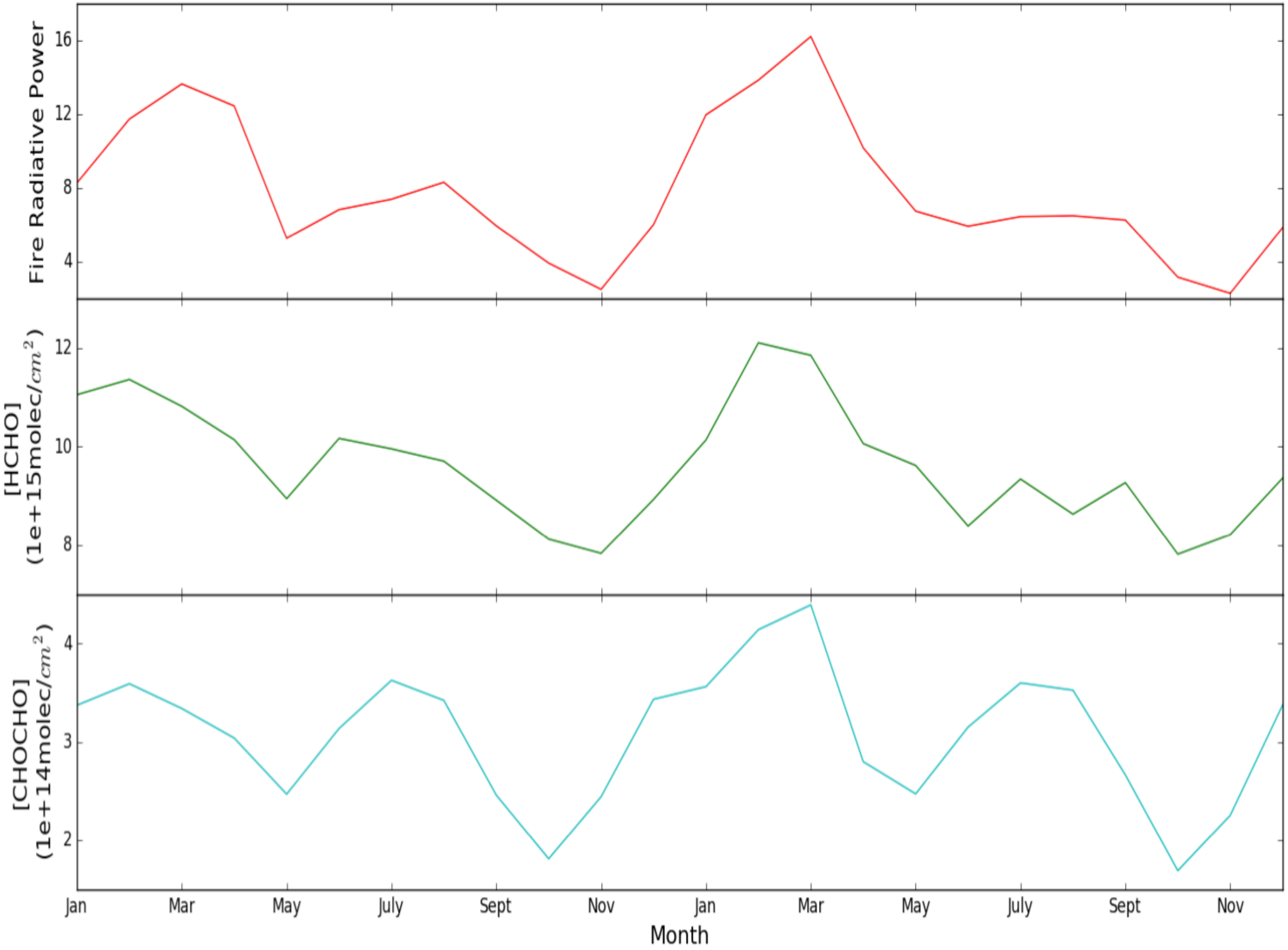
Case Study: Indonesia

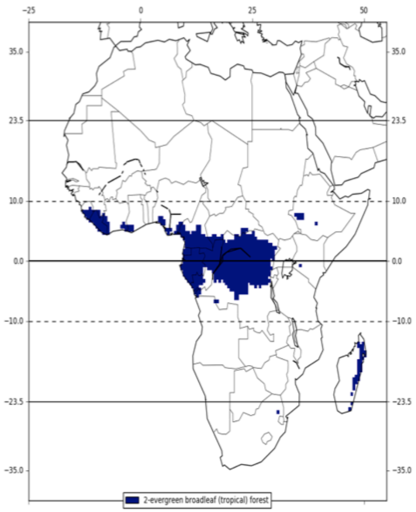




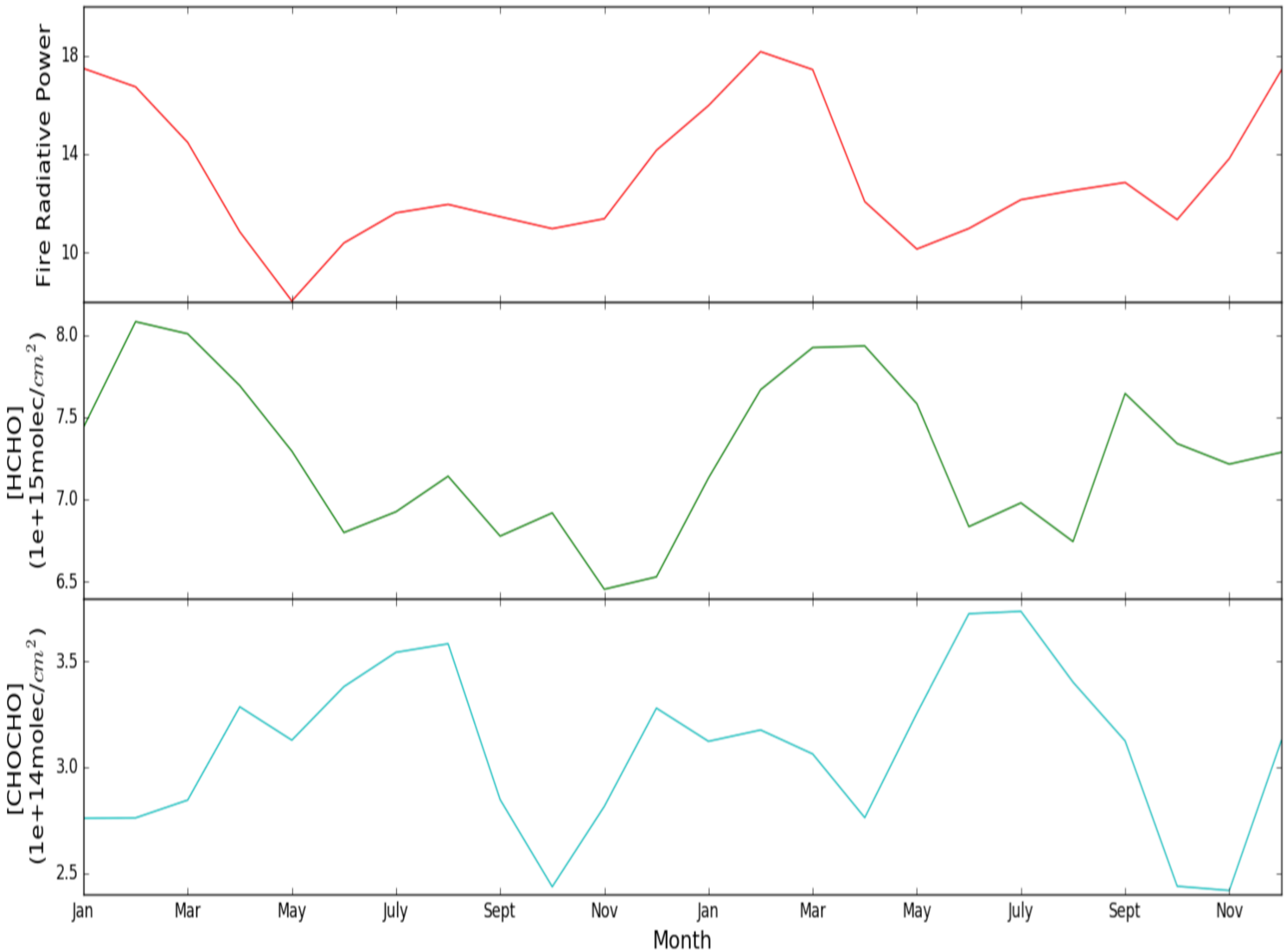
We again see lag in potential fire emissions over Indonesia, this time including NO_2 in addition to the VOCs.

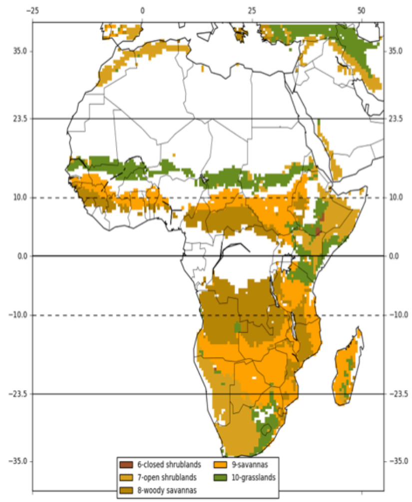
African tropical forests 10˚N-10˚S



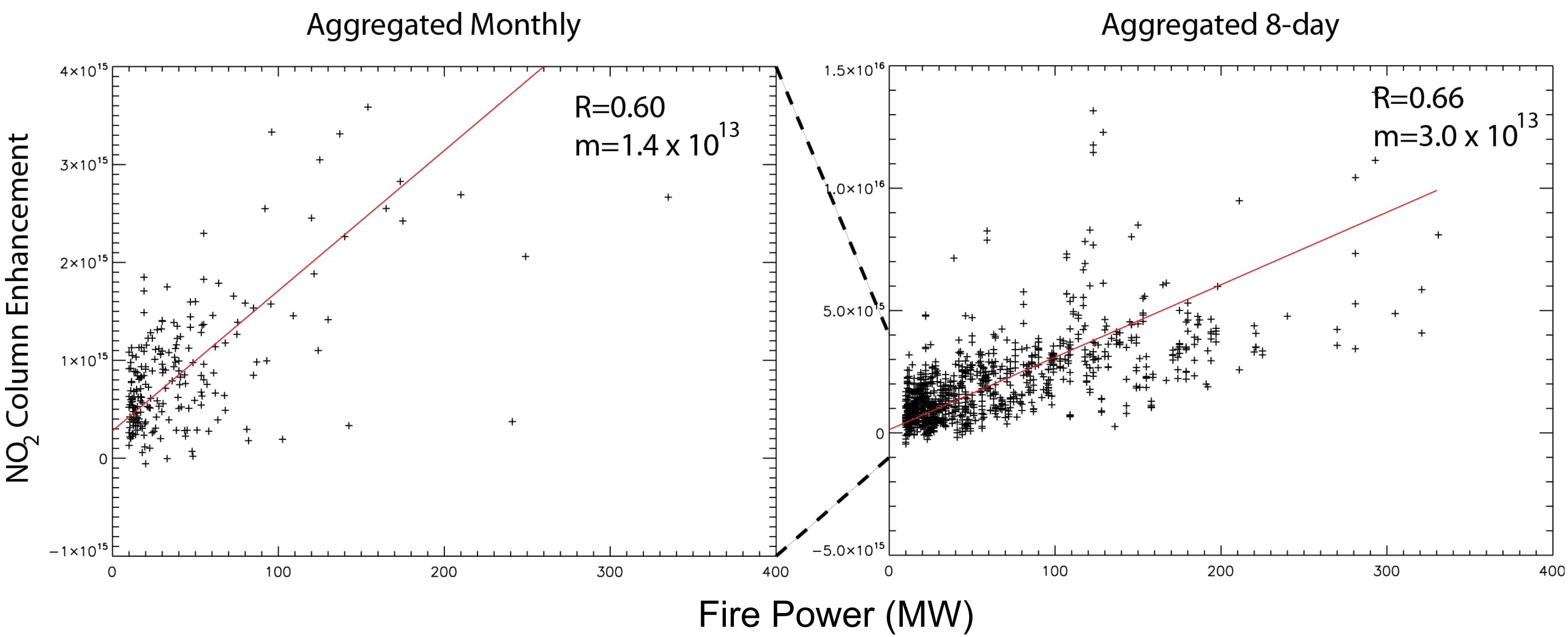


African savanna 10˚N-10˚S



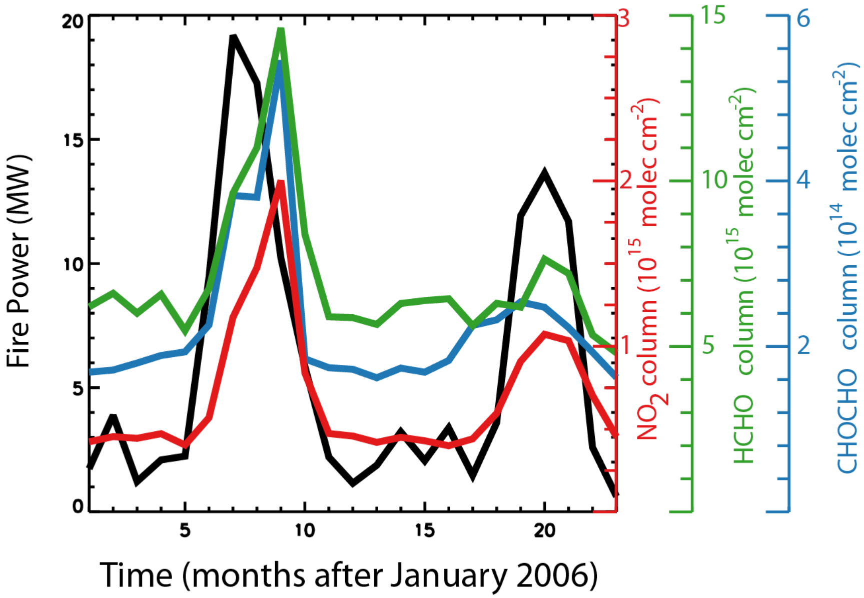


NO_x Enhancements – Temporal Effects

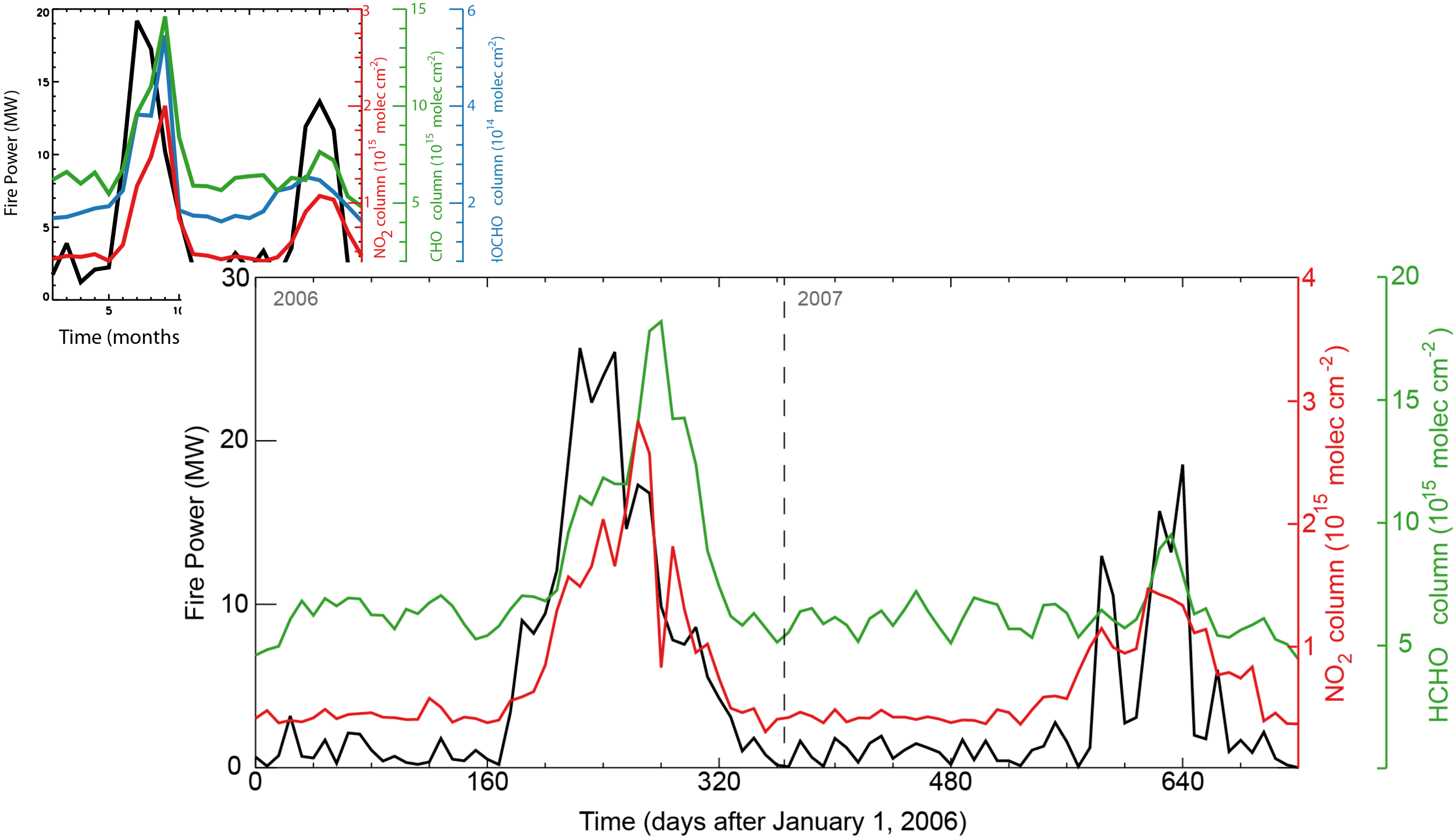


Column enhancement of NO_2 (OMI) versus fire activity (MODIS) over the African sub-region. Results are aggregated on monthly (left) and 8-day (right) timescales. The correlation between NO_2 enhancement and fire activity is similar at these two timescales. Larger NO_2 enhancements are captured by the higher temporal resolution.

Seasonal Variability – Temporal Effects



Seasonal Variability – Temporal Effects



HCHO data at ~1 week timescale is usable and may give additional insight into lag of fire enhancements

Conclusions and Future Work

- Formaldehyde (HCHO) and glyoxal (CHOCHO) observations from space show tropospheric column enhancements associated with fire activity.

- The seasonal signal for these enhancements can differ for different species or years

- Land type burned can strongly influence the timing of these enhancements

- Consideration of issues concerning temporal sampling necessary for drawing useful conclusions from OMI VOC measurements

- Want to combine measurements of VOCs and NO_2 with other AURA measurements (e.g. O_3, CO, HCN, PAN) to explore factors controlling ozone production.