Measurements and modelling the impact of indigenous fire management on the annual cycle of carbon monoxide

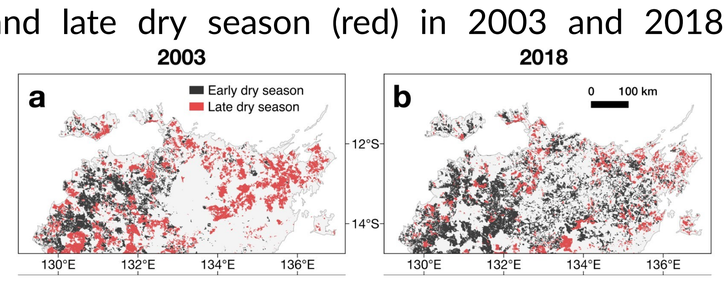
Can we see the impact of Indigenous burning practices?

Shyno Susan John, Nicholas M. Deutscher, Clare Paton-Walsh, David W.T. Griffith
University of Wollongong, NSW, Australia

Temporal shifts in fire activity in Northern Australia

Over the last 2 decades, prescribed burning practices by the Indigenous community in the early dry season have resulted in a temporal shift in fire activity.

Burned area during the early dry season (black) and late dry season (red) in 2003 and 2018



Trends in Darwin TCCON X_{CO} measurements

Months	Slope (ppb/year)	Uncertainty*
January	0.50	[-0.22,0.94]
February	-0.05	[-1.21,0.65]
March	0.07	[-0.33,0.58]
April	0.49	[-0.097,1.10]
May	0.33	[-0.80,0.99]
June	0.11	[-0.65,0.96]
July	0.05	[-0.40,0.49]
August	-0.23	[-0.97,0.51]
September	-0.55	[-1.69,0.93]
October	-0.92	[-2.87,1.24]
November	0.0083	[-1.76,1.38]
December	0.80	[-1.24,2.43]

*Lower and upper bound of the 95% confidence interval on slope.

Liu, T., Mickley, L. J. and McCarty, J. L.: Global search for temporal shifts in fire activity: potential human influence on southwest Russia and north Australia fire seasons, Environ. Res. Lett, 16(4), 44023, doi:10.1088/1748-9326/abe328, 2021.

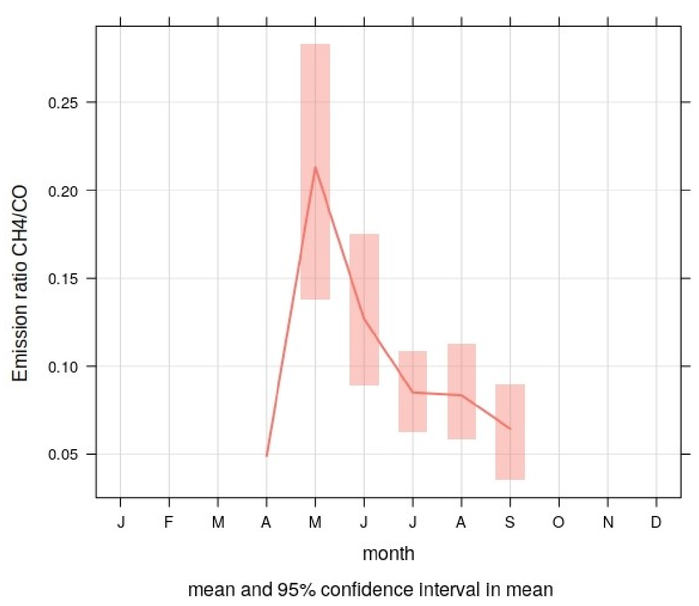
Seasonal variation of co-varying trace gas species at Darwin

One of the major objectives associated with the savanna burning projects involve avoiding the emission of methane and nitrous oxide.

CH_4 vs CO events at Darwin

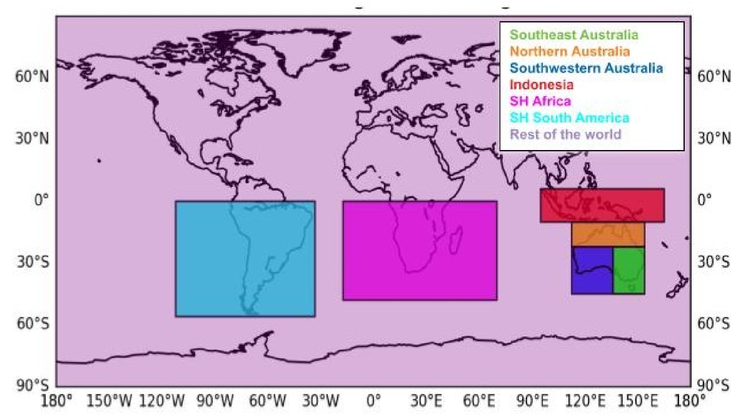
- Smokey events were filtered from the surface in situ data record, i.e. CO>850 ppb
- Linear regression performed for each of these events to obtain emission ratio of CH_4 vs CO; only events with r^2>0.5 is considered here.

Time-variation of emission ratio of CH_4 vs CO



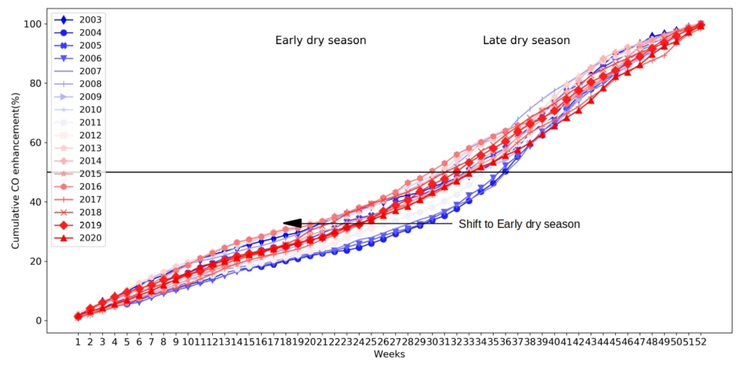
- Investigated CO vs CO_2 events at Darwin surface in situ, unlike that of CH_4, the variations in CO_2 are associated with different processes, e.g: diurnal variation.
- The shift to earlier burning results in fires that burn at cooler temperatures, reducing the amount of biomass burned (or CO_2 emitted), but increasing the proportion of fire emissions from incomplete combustion.
- We see a seasonal pattern in CH_4 :CO emissions from the fires, indicating that reductions in CO_2 might be offset by increased emissions of CH_4.

Temporal shift of modelled CO to the early dry season



Geos-Chem tagged CO tracer regions

QFED: modelled surface CO shifting to early dry season



Weekly cumulative surface CO enhancement at Darwin: Temporal shift of modelled CO the early dry season over the 18 year time period.

What's next?

- Estimate CH_4 based on the calculated emission ratio of CH_4/CO along with the CO emissions from the biomass burning inventories.
- Inter comparison of Geos-Chem CO tagged tracer modelled CO to the measurements at the Darwin site.