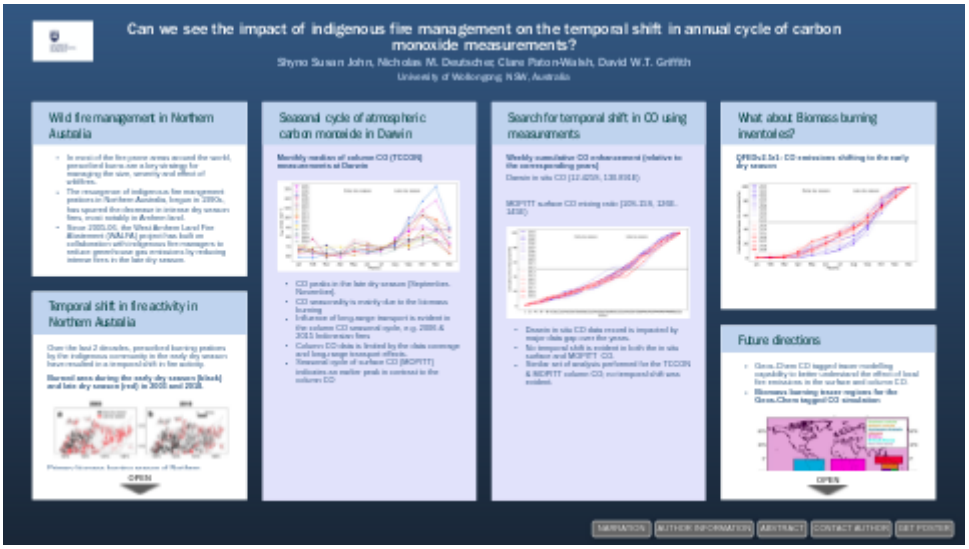
Can we see the impact of indigenous fire management on the temporal shift in annual cycle of carbon monoxide measurements?



Shyno Susan John, Nicholas M. Deutscher, Clare Paton-Walsh, David W.T. Griffith

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PRESENTED AT:

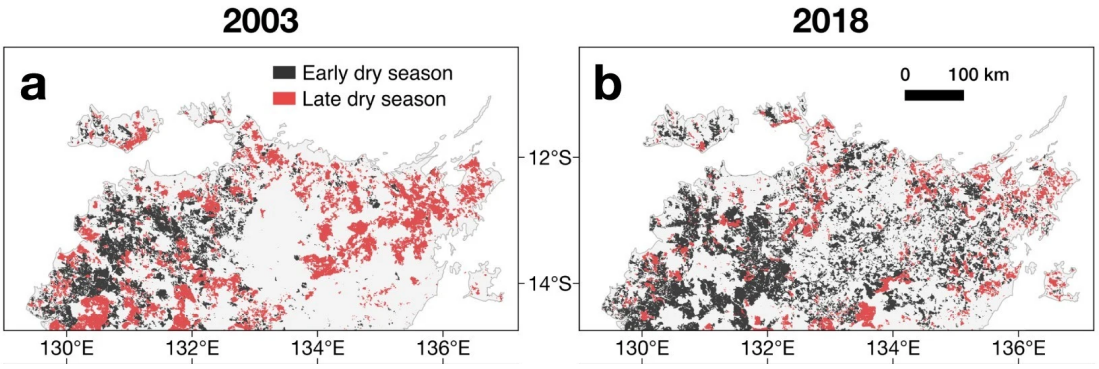
WILD FIRE MANAGEMENT IN NORTHERN AUSTRALIA

- In most of the fire prone areas around the world, prescribed burns are a key strategy for managing the size, severity and effect of wildfires.
- The resurgence of indigenous fire mangement pratices in Northern Australia, begun in 1990s, has spurred the decrease in intense dry season fires, most notably in Arnhem land.
- Since 2005-06, the West Arnhem Land Fire Abatement (WALFA) project has built on collaboration with indigenous fire managers to reduce greenhouse gas emissions by reducing intense fires in the late dry season.

TEMPORAL SHIFT IN FIRE ACTIVITY IN NORTHERN AUSTRALIA

Over the last 2 decades, prescribed burning pratices 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.

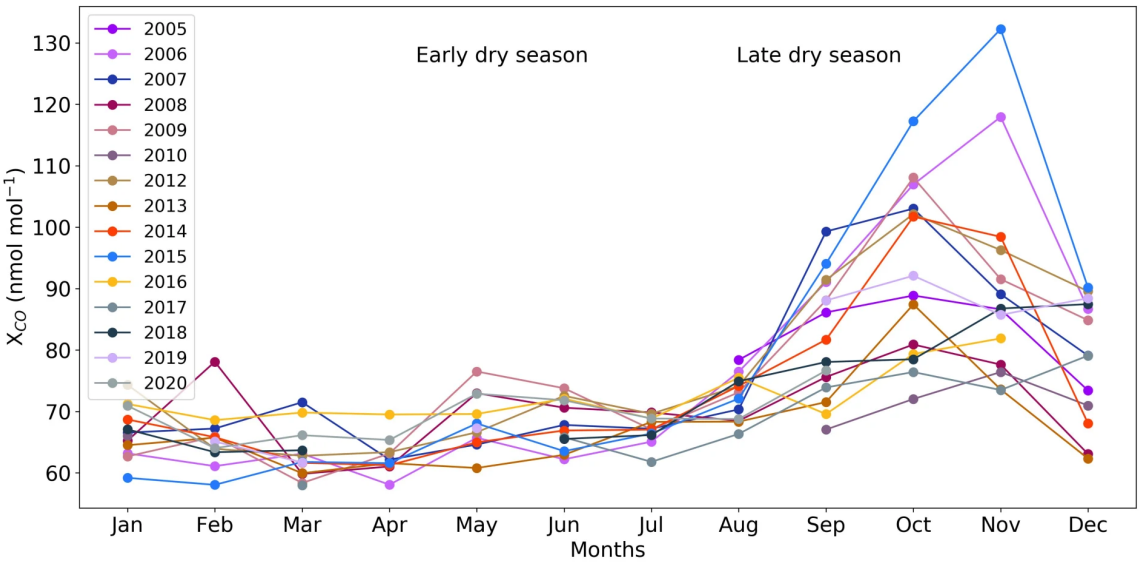


Primary biomass burning season of Northern Australia has shifted earlier - 2.41 days/yr (39 days earlier) over 2003 to 2018.

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 CYCLE OF ATMOSPHERIC CARBON MONOXIDE IN DARWIN

Monthly median of column CO (TCCON) measurements at Darwin



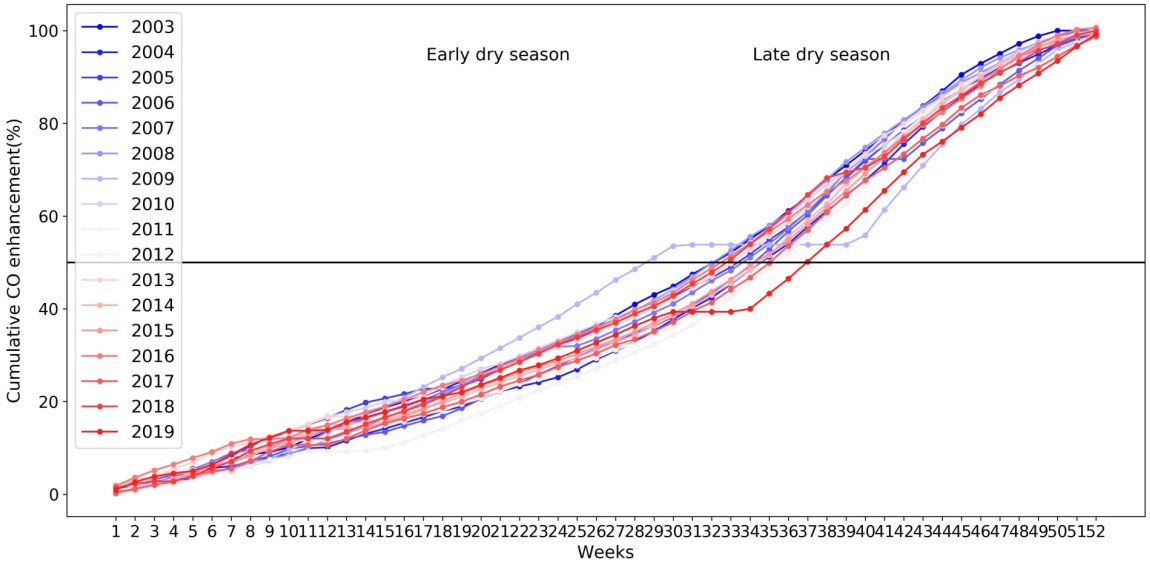
- CO peaks in the late dry season (September-November).
- CO seasonality is mainly due to the biomass burning
- Influence of long-range transport is evident in the column CO seasonal cycle, e.g. 2006 & 2015 Indonesian fires
- Column CO data is limited by the data coverage and long-range transport effects.
- Seasonal cycle of surface CO (MOPITT) indicates an earlier peak in contrast to the column CO

SEARCH FOR TEMPORAL SHIFT IN CO USING MEASUREMENTS

Weekly cumulative CO enhancement (relative to the corresponding years)

Darwin in situ CO (12.425S, 130.891E)

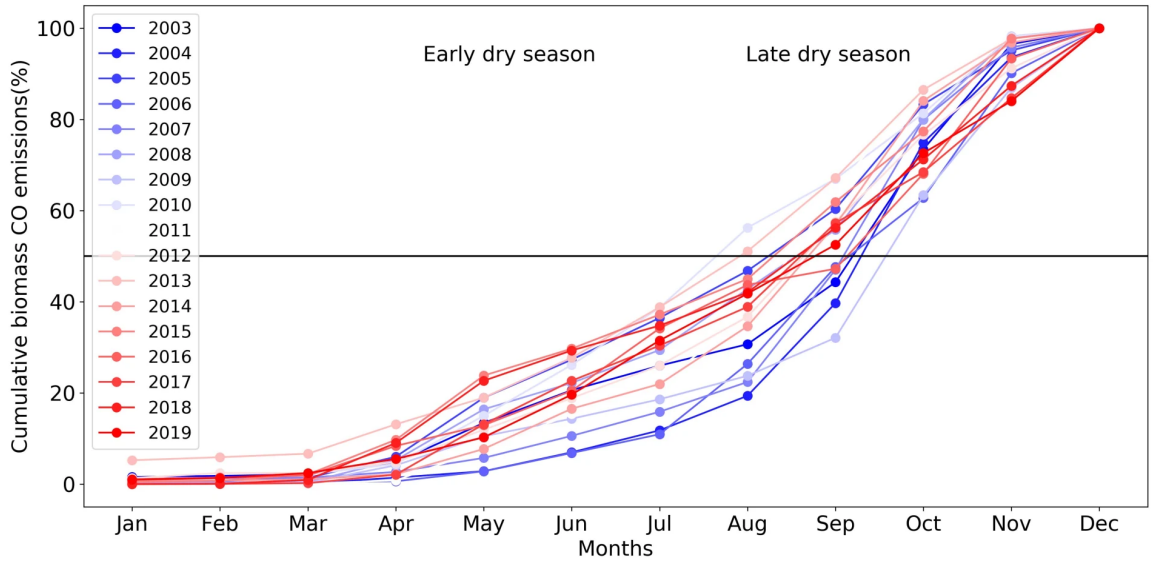
MOPITT surface CO mixing ratio (10S-15S, 126E-145E)



- Darwin in situ CO data record is impacted by major data gap over the years.
- No temporal shift is evident in both the in situ surface and MOPITT CO.
- Similar set of analysis performed for the TCCON & MOPITT column CO; no temporal shift was evident.

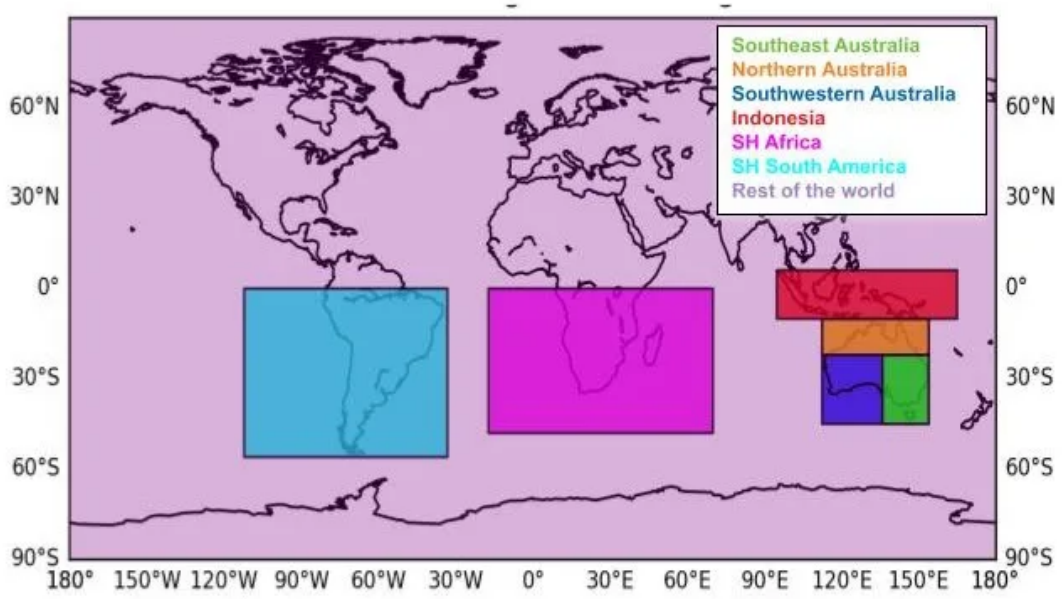
WHAT ABOUT BIOMASS BURNING INVENTORIES?

QFEDv2.5r1: CO emissions shifting to the early dry season



FUTURE DIRECTIONS

- Geos-Chem CO tagged tracer modelling capability to better understand the effect of local fire emissions in the surface and column CO.
- **Biomass burning tracer regions for the Geos-Chem tagged CO simulation**



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ABSTRACT

Fire is an essential global phenomenon that existed soon after the appearance of terrestrial plants and is vital for the regeneration of the plant species. Human activities have contributed to a changing climate and impacted fire regimes, resulting in more intense, frequent and severe fires. In particular, the 2019-20 bushfires in south-eastern Australia were unprecedented in their extent and intensity. However, human activities can also play a dominant role in regulating fire behaviour effectively through better fire management practices. In Northern Australia, indigenous fire managers use prescribed burns during the early dry season to prevent large late dry season fires, which shifts the overall temporal distribution of fire activity earlier during the primary biomass burning season. This increasing trend of prescribed burns has helped to significantly reduce the size and extent of the intense late dry season fires, indicating that such fire management practices can be effective at managing wildfires in savannas.

Biomass burning can emit many chemical species that have an impact on human health. One of the most abundant and widely measured is carbon monoxide (CO), whose long-term exposure can lead to potential human health risk. CO is also a good proxy for emissions of other shorter-lived and harder-to-measure atmospheric constituents. This study is focussed on understanding how the earlier fire season in Northern Australia impacts the temporal shift in annual cycle of CO. Column CO data from the ground-based Total Carbon Column Observing Network site in Darwin will be used together with surface measurements, complemented by the surface mixing ratio observations from MOPITT, in order to disentangle the CO emitted from the study region from that measured in the column from remote emissions coupled with long-range transport. GEOS-Chem CO tagged tracer modelling capability will be used to better understand the effect of local fire emissions on the surface and column CO.