Recent Trend Analysis of Biomass Aerosols and Low-Cloud Distribution

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Background

Africa has long been recognized as one of the most vulnerable continents to climate change and variability (Parry et al., 2007). The responses of vegetation toward climate change have been an active subject of recent research. Grassland/savanna transition types are particularly fragile to changes in anthropogenic activity and plays an important role in land surface-atmospheric interactions (Hou et al., 2019).

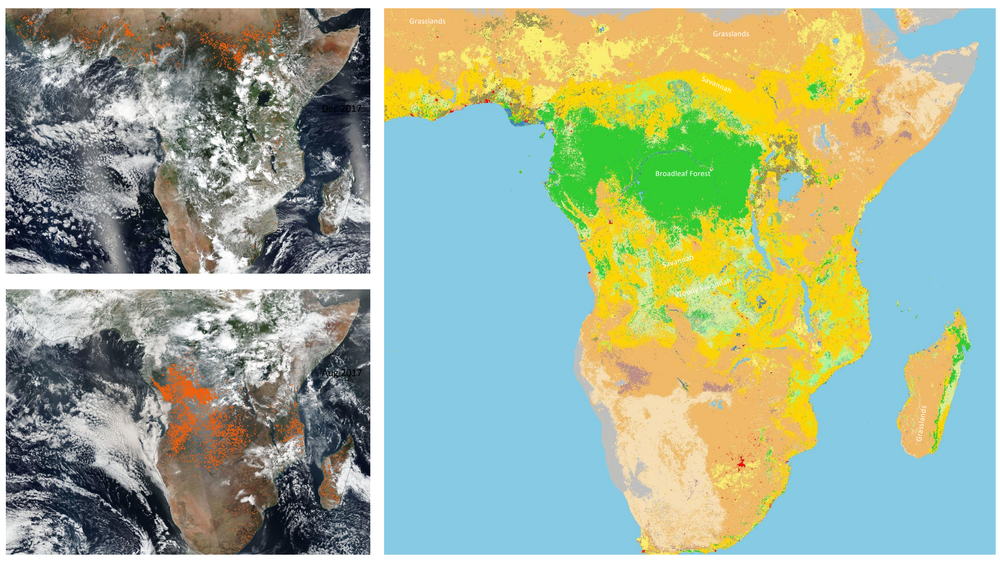

Fig 1: Small fire locations during December 2017 (upper left) and August 2017 (lower left) and vegetation cover by type (right) over continental Africa.

Data Sources

- *Modern-era Retrospective Analysis for Research and Application, Volume 2 (MERRA2) provides reanalysis data at 0.5° x 0.625° resolution*
- *CERES low-cloud colver monthly-averaged, 1 degree product,)*
- *NASA WorldView*

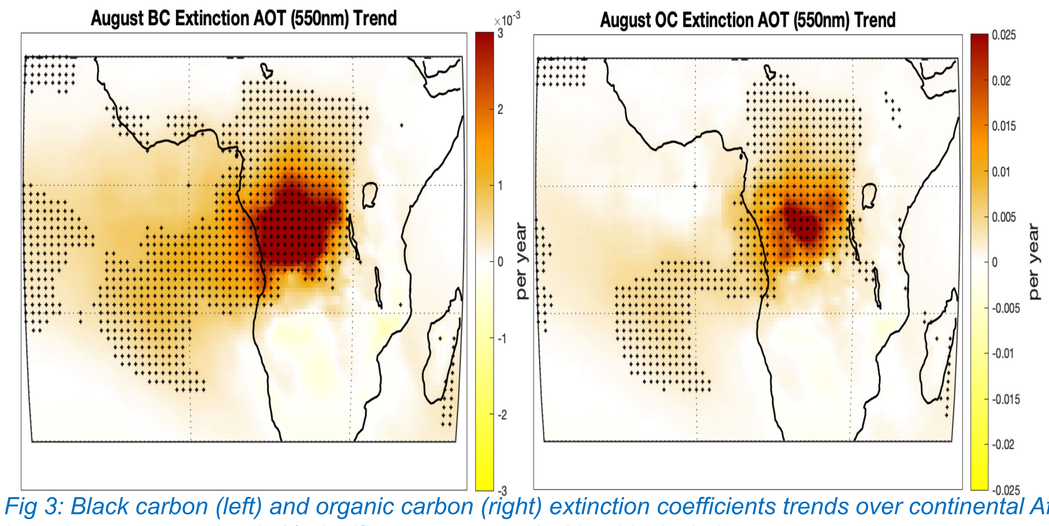

Fig 3: Black carbon (left) and organic carbon (right) extinction coefficients trends over continental Africa. Locations representing 95% significance are noted with a black circle.

Lower Tropospheric heating

Here, we see a weakening in the meridional temperature gradient responsible for the low-level monsoon flow. As a result, there is a weakening in the monsoon flow. This vertical cross section serves as the reasoning behind looking at the 900mb spatial temperature plot. Furthermore, the location of this warming over the Gulf of Guinea match's the location of increased CO trend.

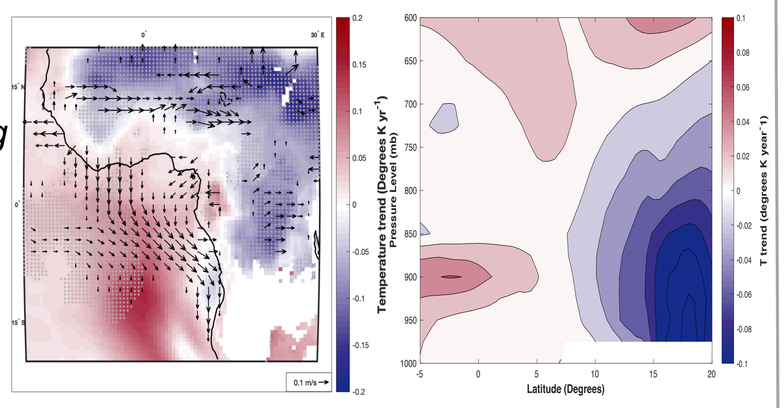

Fig 2: 900mb temperature trend with wind trends overlain (left) and zonal-average temperature cross section (right). Values are averaged between 10W and 10E. Locations representing 95% significance are noted with a silver asterisk.

Low-Cloud Changes

BC and OC are often produced from biomass burning events. Here, we look at extinction coefficients corresponding with each. Positive trends are noticeable within the Congo Basin in addition of offshore transport heading toward the Gulf of Guinea. The positive values shown here reflect the possibility of shortwave radiation absorption.

All together, there has been an increasing trend in carbonaceous aerosol extinction, lower-tropospheric heating while a decreasing trend occurs in low-cloud cover. The increased aerosol transport and corresponding heating can possibly be linked with decreasing precipitation trends (not shown) over southern West Africa. These results will aid the current ARM proposal study conducted by PI Ajoku.

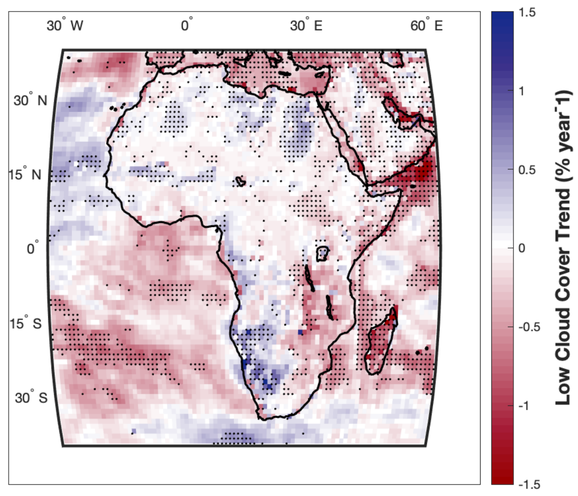

Fig 4: Low-cloud cover trends over continental Africa. Locations representing 95% significance are noted with a black circle.

Acknowledgments

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References

Hou, J., Du, L., Liu, K., Hu, Y., & Zhu, Y. (2019). Characteristics of vegetation activity and its responses to climate change in desert/grassland biome transition zones in the last 30 years based on GIMMS3g. Theoretical and Applied Climatology, 136(3), 915-928.

Parry, M. L., Canziani, O., Palutikof, J., Van der Linden, P., & Hanson, C. (Eds.). (2007). Climate change 2007-impacts, adaptation and vulnerability: Working group II contribution to the fourth assessment report of the IPCC (Vol. 4). Cambridge University Press.

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