National Aeronautics and Space Administration
Jet Propulsion Laboratory
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Contrasting carbon cycle responses of the tropical continents to the 2015–2016 El Niño

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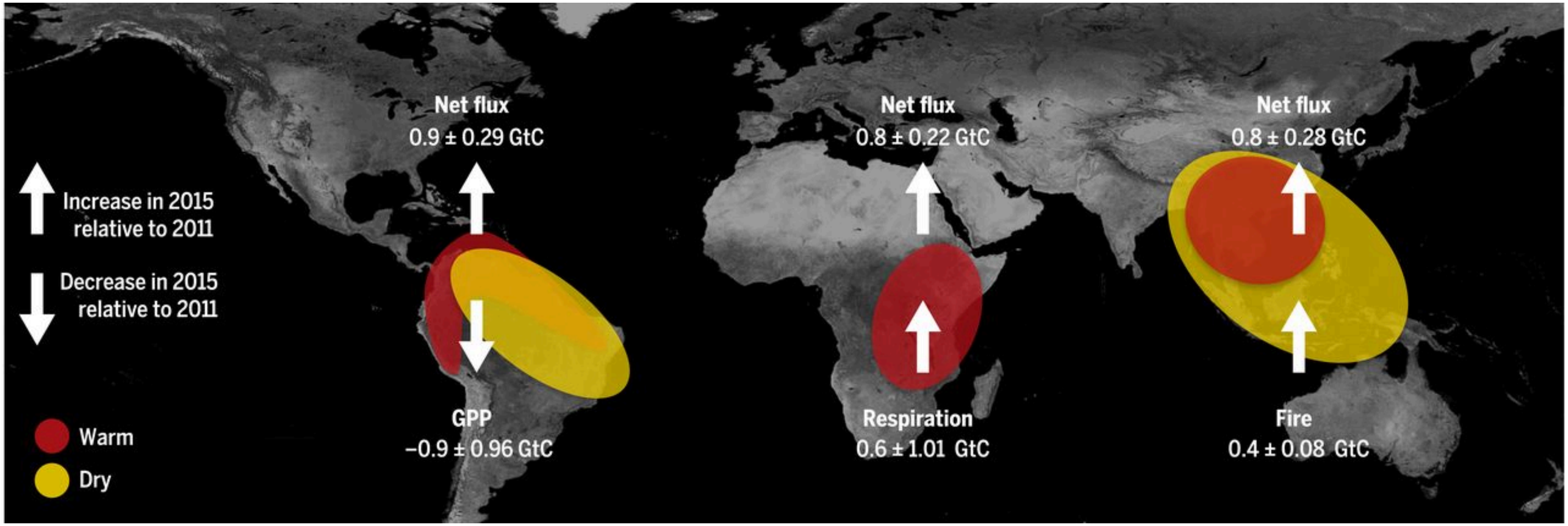

Science Question: The growth rate of atmospheric CO_2 was the largest on record during 2015-2016 El Niño. It was long suspected that the El Niño-induced variability in carbon cycle was primarily due to tropical continents. However, due to dearth of observations in the tropics, tropical carbon fluxes have been poorly quantified.

Data & Results: 1) With column CO_2 observations from OCO-2, we quantified that the tropical continents were the driver for the large atmospheric CO_2 growth during 2015-2016 El Niño. 2) The three tropical continents had comparable contribution to the large atmospheric CO_2 growth, but temperature (T) and rainfall changed in different ways, and the carbon cycle responded to these T and rainfall anomalies in very different ways.

Significance: Challenge previous studies that suggested that a single dominant process determines carbon cycle interannual variability.

Liu, J., et al., Contrasting carbon cycle responses of the tropical continents to the 2015–2016 El Niño. Science 358, eaam5690 (2017)

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Data Sources:

The data used for this study is available at https://cmsflux.jpl.nasa.gov/DS-Science.aspx.

Technical Description of Figure:

Diverse climate driver anomalies and carbon cycle responses to the 2015–2016 El Niño over the three tropical continents.

Scientific significance, societal relevance, and relationships to future missions:

Our study challenges previous studies that suggested that a single dominant process determines carbon cycle interannual variability. Our results indicate that more CO_2 may remain in the atmosphere if drought and heat events become more frequent in the future, and further warm up the planet.

We showed how multiple satellite observations can be used to quantify net carbon exchange and its component fluxes including gross primary production, fire, and respiration in a data assimilation framework, and understand the interactions and feedbacks between climate and carbon cycle in regional scales. This study provides a pathway to use observations from OCO-3, GeoCARB, and TROPOMI to understand carbon cycle.