CARBON UPTAKE AND WATER CYCLING OVER THE AMAZON RAINFOREST

A REMOTE SENSING PERSPECTIVE

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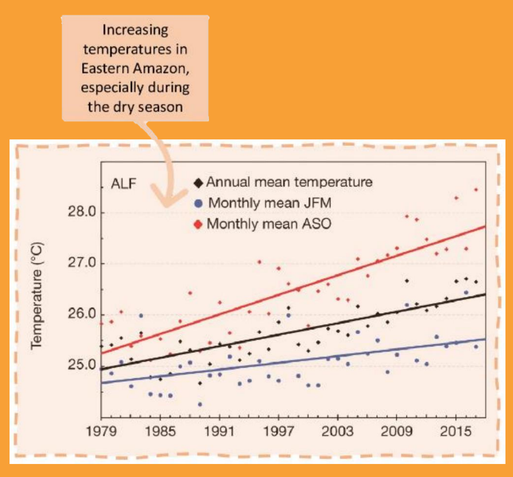
HIGHLIGHTS

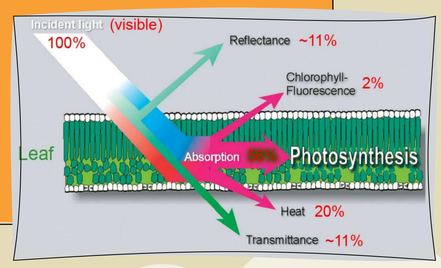
- Amazon carbon dynamics are being affected by climate change and human pressures
- New satellite capabilities allow us to investigate sub-daily carbon and water dynamics across the Amazon

MOTIVATION

The Amazon rainforest is a critical ecosystem rich in biodiversity and carbon storage, playing a vital role in the global carbon cycle. However, its carbon uptake might be declining due to climate change, leading to more droughts, and due to human pressures, such as land-use changes.

Understanding how this ecosystem reacts to these challenges is essential for assessing changes in carbon and water dynamics.

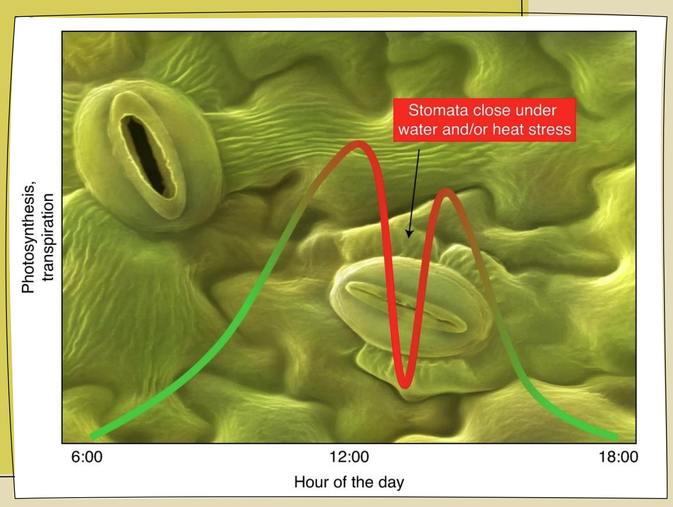




THE SIESTA STORY

The Amazon rainforest is highly productive, with plenty of light and water supporting high photosynthesis rates. However, it seems that sometimes photosynthesis decreases in the afternoon, as if the plants are taking a siesta. The stomata can close during this time primarily due to water stress. And, with climate change, more extreme droughts might occur in the Amazon rainforest…

A novelty of our study is that we create a harmonized SIF dataset using two satellites. One passes over the Amazon in the morning and the other in the afternoon, allowing us to observe photosynthesis and carbon uptake on a **sub-daily timescale** in this heterogeneous rainforest. This, for instance, enables us to explore phenomena like the afternoon "siesta".



HOW TO MEASURE REMOTE AREAS?

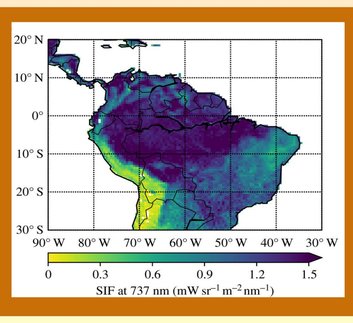
The Amazon rainforest is remote and heterogeneous, with sparse local measurements, making satellite imagery an effective research tool. Sun-Induced Fluorescence (SIF) data has proven highly effective for estimating Gross Primary Production (GPP). Fluorescence is a weak light signal emitted by plants during photosynthesis. The SIFTER retrieval algorithm, developed by KNMI for the GOME-2 satellite, captures this SIF signal and is especially well-suited for moist areas such as the Amazon; therefore, this algorithm will also be applied to the TROPOMI satellite.

GOME-2

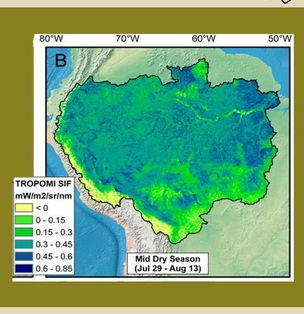
Spatial resolution of 0.5° x 0.5° in analysis by Koren et al. (2018)

Local overpass time = ~9:30

Launch date October 2006



TROPOMI



Spatial resolution of 0.05° x 0.05° in analysis by Doughty et al. (2019)

Local overpass time = ~13:30

Launch date October 2017

FURTHER PLANS: INTEGRATING CARBON, PHENOLOGY AND WATER

After retrieving the SIF signal, we will compare the photosynthesis signal to several datasets to get a comprehensive picture:

Carbon data

We will compare our harmonized SIF dataset with existing SIF products from TROPOMI, along with Eddy-Covariance (EC) data and potentially other ground-based carbon measurements.

Leaf phenology

We will explore how SIF relates to the novel photosynthesis proxy NIRv (near-infrared reflectance of vegetation), which offers insights into canopy fitness and leaf phenology.

Water Cycle

We will incorporate sub-daily evapotranspiration (ET) estimates to assess changes in the ratio of photosynthetic carbon uptake to water loss (Water Use Efficiency, WUE). These findings will be cross-referenced with WUE estimates from tree ring data.

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FEEDBACK IS WELCOME !

REFERENCES FIGURES

Gatti et al., Nature, 2021
Davidson et al., Esa Bulletin, 2003
Koren et al., Phil. Trans. R. Soc. B, 2018
Doughty et al., Proc. Natl. Acad. Sci. U.S.A., 2019
Xiao et al., Nature Plants, 2021