NNH18ZDA001N-ECOSTRESS: Merging ECOSTRESS with field data in the highest uncertainty water use efficiency regions in the world

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Part 1 - Validate WUE and canopy temperature in Brazil and Ghana

Relevant Leaf Trait Measurements
- Tissue Samples (Macronutrients/Isotopes)
- Thickness and Dry Matter Content
- Specific Leaf Area
- Visible-Near Infrared Reflectance
- Stomatal Conductance
- Photosynthesis (Saturated/Maximum)
- Vcmax and Jmax
- Transpiration
- Leaf Area - Sapwood Ratio
- Venation Patterns
- Turgor Loss Point
Part 1.1 Validate WUE in tropical forests

Goldsmith et al. in prep
ECOSTRESS GPP/ET

1st Results – iWUE from Gas Exchange vs. Isotope

Next Step: Convert all WUE to $g_1$ to make it comparable per Medlyn et al. (2007)

C-13 Leaf Isotopes = WUE
Part 1.2 Validate canopy temperatures in tropical forests

- Are tropical forests near a high temperature threshold?
- Do leaf traits determine canopy temperatures?

**O-18 Leaf Isotopes = Canopy Temperature**

\[ \Delta^{18}O_{es} = \Delta^{*} + \varepsilon^k (\Delta^{18}O_v - \varepsilon^k) \frac{\varepsilon_a}{\varepsilon_i} \]

*See lightning talk by Jenna Keany*
Part 2 – Will a decrease in leaf or canopy albedo increase evaporation or canopy temperature?

- Air temperature
- +/- Photosynthesis
+ Cloud cover

= Air temperature
- Photosynthesis
? Ecosystem Impacts
Leaf traits like LMA are changing in response to climate change

- LMA is tightly correlated to leaf reflectance properties.
- We predict in a warmer world, leaf NIR albedo will decrease (tropical leaves will darken).

Doughty et al. Nature Eco/Evo 2018
Climate simulations currently predict that as albedo decreases evapotranspiration (ET) will increase

- More ET leads to more bright clouds and no net change in planetary albedo
- However, if, in contrast, canopy temperature increases we could have a drastically different future
- Empirically, we do not know how albedo impacts ET and canopy temperature in the tropics
Use Ecostress + leaf trait data to understand how changes to canopy albedo will impact Bowen ratio

• How does leaf-level albedo affect plant water use with respect to ET and WUE?

• What are the plot-level effects of contrasting albedo, but similar forest characteristics, on canopy temperature and ET measured by ECOSTRESS?

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Ghana

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Brazil
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- Air temperature
- Photosynthesis
- Cloud cover

= ET
WUE?

=? CT

+ Air temperature
- Photosynthesis

= Air temperature

=WUE?

=Ecosystem Impacts
Compare albedo to ECOSTRESS canopy temperature and ET for all Ghana and Brazil.
How will darker tropical leaves impact global climate?

- We will rerun our ESM simulations parametrized by our continental scale ECOSTRESS data.

- We will better understand how potential future albedo changes will impact global climate.
Questions?

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