

Tree water fluxes across Panama

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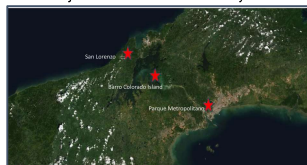


OBJECTIVE

Tree water use is the dominant terrestrial hydrologic flux globally, and has a dominant regulatory influence over the carbon cycle. Sap flow through the tree is also a useful model diagnostic for FATES-Hydro. Our objective is to quantify variation in tree water use at three sites across a rainfall gradient in Panama. Our ultimate goals are to understand the hydraulic regulation of water use and carbon uptake as a function of climate and plant traits, and to aid in improved modeling of tropical forest function.

The three sites are located within the STRI research areas (Fig. 1). We have nearly continuous data from May 2019 to the present.

Figure 1
The three sites in Panama



Approach

At this initial stage of data evaluation, we are testing the hypothesis that sap flow is a function of phenology and climate. Our eventual tests will center around determining the regulation of water use as a function of climate and physiological traits.

We measured sap flow on 11 trees at Parque Nacional Metropolitan (PNM), 10 trees at Barro Colorado Island (BCI), and 8 trees at the Bosque Protector San Lorenzo (SLZ). Mean annual precipitation is 1850, 2600, and 3421 mm per year at PNM, BCI, and SLZ, respectively. The meteorological year is divided into two parts: a pronounced dry season (approximately from mid-December to the end of April), and a wet season (May to mid-December).

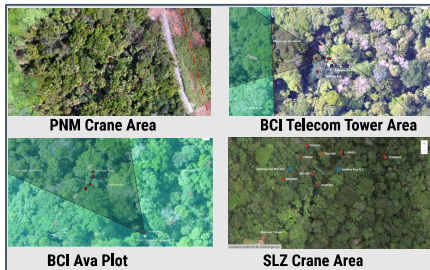


Figure 2
The sites and trees.

METHODS

We used Granier style Sap flow sensors (Figure 3; Granier 1985). These sensors use thermal dissipation to trace the velocity of water flux in the sapwood. Figure 3 shows the installed sensors before protective covering is added. The right hand image is a sap flow tree in flower. PNM has 11 monitored trees, BCI has 10, and SLZ has 8, each tree with 2 sensors.



Figure 3

RESULTS

Figure 4: Sap flow at PNM for nine trees from late March into mid-April 2022 (the end of the dry season).

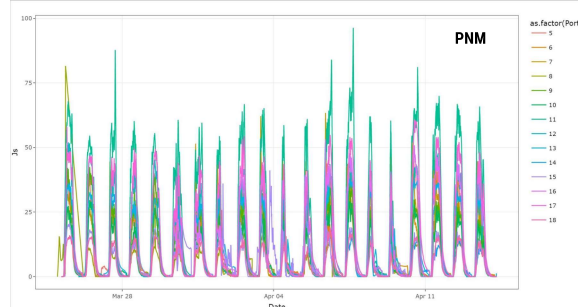


Figure 5: Sap flow at BCI from January through August 2022 for a single tree.

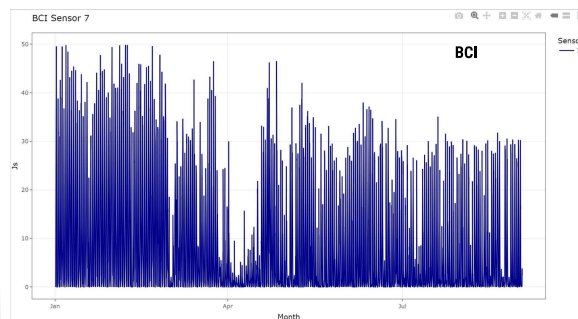


Figure 6: Sap flow at SLZ for two sensors in a single tree for eight days in August 2022.

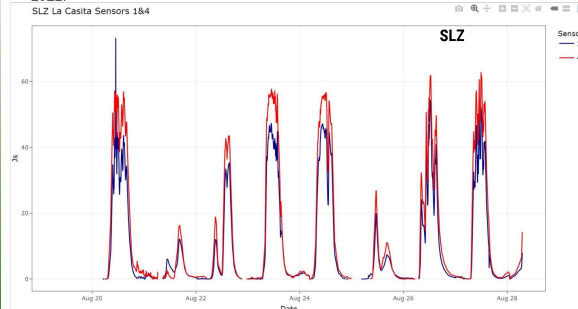
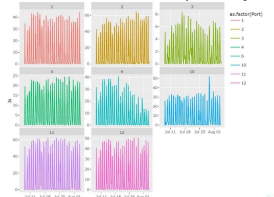
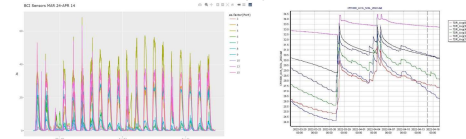


Figure 7: Sap flow at SLZ for five trees from July into August 2022 (wet season).

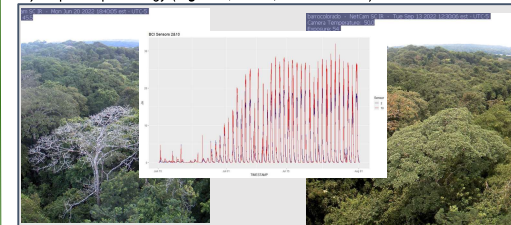


FUTURE DIRECTIONS

1) Analysing variation in sap flow and crown-conductance in relation to climate variables such as soil water content (Figure 8, below; data from BCI)



2) Sap flow phenology (Figure 9, below; data from BCI)



3) Multi-year data processing.
 4) Trait, conductance, and demographic patterns in relation to water use.
 5) MODEX applications

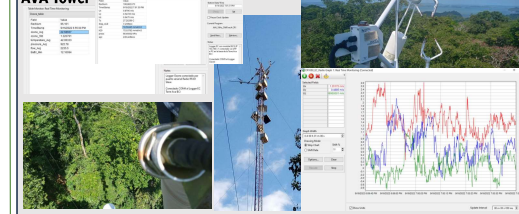
Figure 10
BCI Plots



SUMMARY

BCI: Sap flow + Infrared + Eddy Flux + Ozone + Soil Moisture + Phenocam. All these sensors are on the island, and we have data from May 2019 to date, continuously.

Figure 11
AVA Tower



REFERENCES

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