ED23B-0752: Exploratory Water Budget Analysis of a Transitional Premontane Cloud Forest in Costa Rica through Undergraduate Research

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INTRODUCTION

This National Science Foundation (NSF) Research Experience for Undergraduates (REU) site hosted by Texas A&M University to allow selected undergraduate students to conduct original research on various aspects of the ecohydrology of understudied tropical pre-montane forest at the Texas A&M Soltis Center for Research and Education in Central Costa Rica (Fig. 1). The ecohydrology of transitional premontane cloud forests is not well understood. This problem is being addressed by a exploratory analysis of the water budget within a 20-ha watershed through three faculty-mentored research areas in ecohydrology, climate, and soil sciences. In order to highlight the roles of 12 undergraduate researchers from 12 different universities the goal of this study was to connect the findings in these disciplinary areas by modeling the water budget for 1 week (Fig. 2) and identifying the uncertainties in determining each parameter of the model.

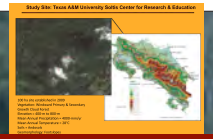

Fig. 1. Study Area

$$1.\ Q = P_n - E - T + \Delta G + \Delta S \quad 2.\ C = E + T \quad 3.\ P_n = P_g - I/\Delta I = Tf + Sf + D$$

Fig. 2. A 1 WEEK WATER BUDGET MODEL for a 20–ha watershed at the Soltis Center 3 parts (1,2, and 3) was used where Q = runoff, C = condensation, P_n = net precipitation, E = evaporation, T = transpiration, and ΔG and ΔS are change in groundwater and soil water storage, P_g = gross precipitation, I/ΔI = canopy interception or storage, Tf = throughfall, Sf = stemflow, and D = canopy drip, respectively.

METHODS

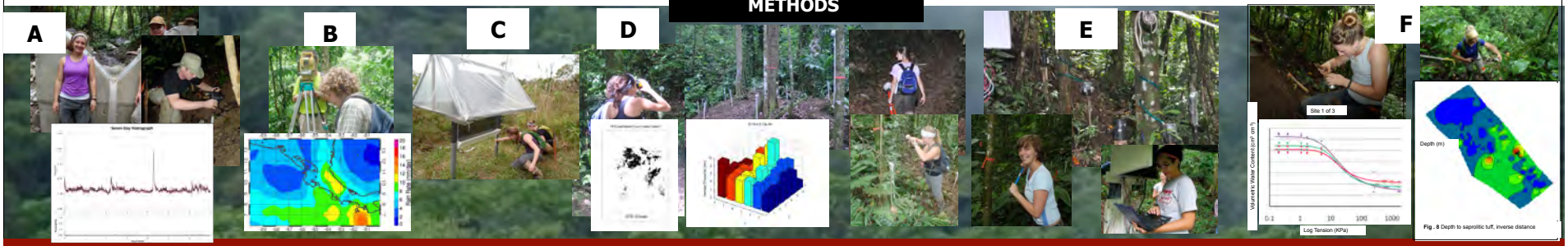

Fig. 3. Student researchers measuring and contributing different aspects of the water budget model: A: Esther Buckwalter & Nathan J. Tourtellotte using pizeometers and a weir to measure Q & ΔG, B: Alexander Peterson uses the TRMM satellite to estimate Pg, C: Ariel Dennis & Emily Guffin check a fog collector to estimate C, D: Emily Morris, Natalie G. Teale & Nicole Shibley estimate a host of parameters using terrestrial laser scanniing, a weather tower, and a 10-m X 10-m area of 36 rain guages including I, P_n, Sf, D, and Tf, E: Olivia Dodge & Graciela Orozco use sapflow sensors to measure T, a tree spiral to capture Sf, and a bucket to estimate Tf . F: Jordan Burns & Rachel Oien measure ΔS using field and lab surveys.

RESULTS

Q: 1093-m^3wk^{-1} 5.5-mm depth	$P_{g\ satellite}$ 34.0-mm	$P_{g\ tower}$ 38.1-mm	E ?	T 10.4-mm	ΔG 0.09-mm	ΔS 210-mm (Field) and 398 mm H_2O (Lab)	C ?	I/ΔI 7.2-mm	Tf + D + Sf 30.9-mm

Fig. 4. Measured or estimated water model parameters.

DISCUSSION & CONCLUSIONS

Q P_g T — P_n I/ΔI Tf Sf — ΔS ΔG D E C

WELL UNDERSTOOD

Fig. 5. The scale of uncertainty in measurements and estimated parameters of a water budget model.

RELATIVELY UNKNOWN

The 1 week measured and estimated water budget parameters are in Figure 4. Parameters are ranked and placed along a gradient of uncertainty (Figure 5). Neither E nor C were measured directly. Tf + Sf + D were estimated as the difference between rain gages inside and outside the forest. The sample size of direct measurements of Tf and Sf were not sufficient to report. However, terrestrial laser scanning is being used to separate I/ΔI into Tf, Sf and D for sample stand plots.