Climate Change and Coffee Adaptation: Developing Dendroclimatological Records In the Southern Volcanic Chain of Guatemala.

LASG Field Study Awards 2015.
Report of fieldwork activities.
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My main objective was to collect several dendrochronological samples from the southern slope of the volcanic chain in Guatemala in sites above 2,500 m ASL. I worked with increment core samples from *Abies guatemalensis* Rehder (Guatemalan Fir) in order to reconstruct the climatic signal of precipitation for the region. This species has proven to be sensitive to the late dry season rainfall and negatively correlated with growing season temperature as well as negatively correlated with eastern tropical Pacific SST anomalies. The absence of long-term instrumental records represents a challenge for coffee growers in the region in terms of understanding and adapting to climate changes. Coffee still represents one of the main sources of income to the Guatemalan economy and it has been historically affected by variability of precipitation patterns, leading to several coffee crises in the country. With the chronologies derived from the field trip partially covered with funds from LASG Field Study Award, I intend to improve the overall understanding of the climate variability of the region. Following my stated objectives, I spend about two months is Guatemala for the purpose of collecting dendrochronological samples from the southern slopes of Guatemala's volcanic chain. I visited the forest known as "Kanchej" located in Cantel, Quetzaltenango (14°46'21.47"N 91°26'35.56"W) at 10,200 ft. Several samples were collected during an intense fieldtrip to these Guatemalan highlands within the Samalá River upper watershed (figure 1).

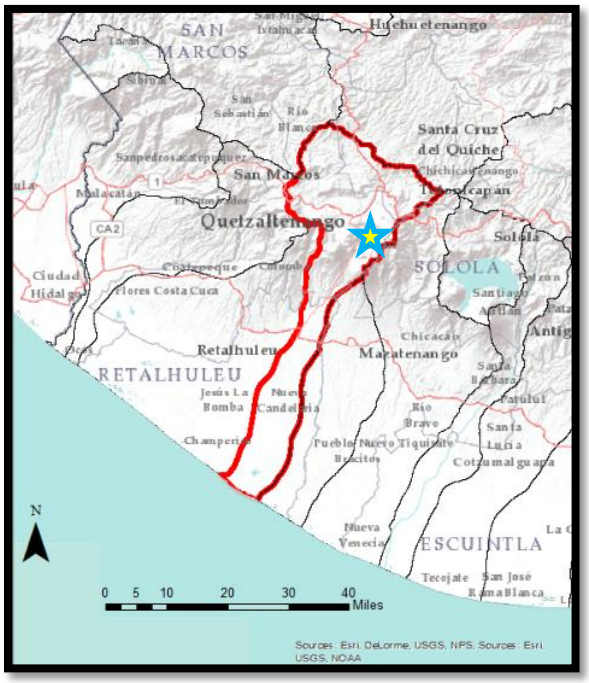

Figure 1. Site of collection of dendrochronological samples at the Samalá River watershed in the southern slope of Guatemala's volcanic chain.

With the help of an undergraduate student involved in the project, I developed an exploratory study in which samples from *Abies guatemalensis* were used to reconstruct the climatic signal of precipitation in the region. In 2015, we extracted around 60 increment cores from 30 trees in Kanchej, a forest located in the volcanic chain of Guatemala close to Quetzaltenango in a community–owned forest. We selected a subset of 18 cores to evaluate dating and climate signal at this site. For processing the samples, we followed the procedure described in methods. The preliminary chronology was compared to local instrumental data available in Quetzaltenango going back to 1980 for precipitation and 1991 for maximum, minimum, and average temperatures (www.insivumeh.gob.gt/meteorologia.html). We obtained a series intercorrelation of 0.402 and a mean average sensitivity of 0.293 suggesting that crossdating is possible in the region and that a climate signal is present. This has been established as a prerequisite to performing climatic analysis and estimating past precipitation or temperature anomalies from tree-ring proxies. Another important component of the chronology is the total length of the series, which is essential to catch low to medium frequency events. Although, the mean length of our series goes back only 90 years, some of the series go back as far as 1720. This suggests that the collection of additional samples could further extend the chronology into the past making it possible to reconstruct the ENSO variability for the region on a robust master chronology. Our preliminary chronology was compared against the one published by Anchukaitis *et al* (2013) from northwestern Guatemala. We found correlations between the chronologies, suggesting teleconnections at regional and sub-regional scales, but also with significant local signals (figure 2).

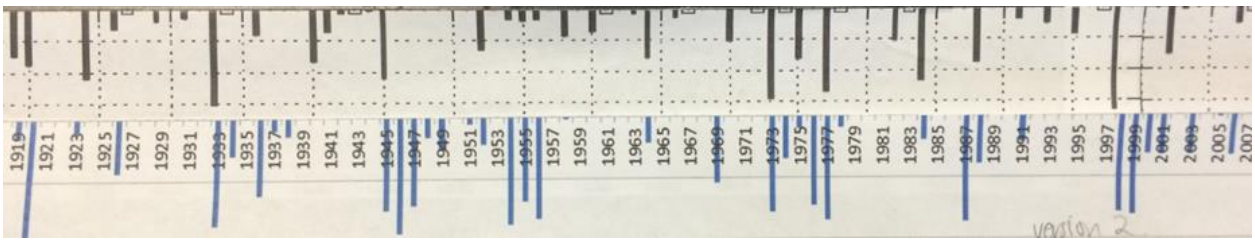

Figure 2. Visual inspection of time series from Anchukaitis et al 2013 (on top) and reconstruction from the present study (bottom). Drought reconstructions seem to relate at a regional scale but also display some local variability. More samples could improve the overall strength of the reconstruction and extend the period back to 1720.

Thanks LASG for the opportunity of improving my fieldtrip collections!

ANCHUKAITIS, K.J., M.J. Taylor, J. Martin-Fernandez, D. Pons, M. Dell, C. Chop and E. Castellanos. 2013. Annual chronology and climate response in Abies guatemalensis rehder (pinaceae) in Central America. (2013). The Holocene, 23(2), 270-277.