Vegetation-precipitation coupling in the tropics: challenges and opportunities
La Selva Biological Station, Costa Rica
March 4th-7th, 2015

Tuesday 03/03/15
Arrive in Costa Rica+Travel to La Selva

Wednesday 03/04/15

9:00 am:	Welcome and overview of workshop (Ben Lintner)
9:30-10:30 am:	Participant talks (30 minutes each) • Paolo D'Odorico • Steve Oberbauer
10:30-10:45 am:	Break
10:45 am-12:00 pm:	Morning discussion: *Key challenges in vegetation-precipitation coupling (or climate-ecosystem interactions) in the Costa Rica specifically and the tropics more generally*
12:00 pm-1:00 pm:	Lunch
1:15 pm-3:15 pm:	Participant talks (30 minutes each) • Abby Swann • Jung-Eun Lee • Pierre Gentine • Hugo Hidalgo
3:15 pm-3:30 pm:	Break
3:30 pm-5:30 pm:	After discussion: *Key challenges in vegetation-precipitation coupling (or climate-ecosystem interactions) in the Costa Rica specifically and the tropics more generally*
6:30 pm-7:30 pm:	Dinner

Thursday 03/05/15

9:00 am-9:15 am:	Day 1 recap (Ben)
9:15 am:-10:15 am:	Participant talks (30 minutes each) • Ana Maria Duran Quesada • Guido Salvucci
10:15-10:30 am:	Break
10:30-12:00 pm:	Participant Talks (30 minutes each) • Maria Uriarte • Laura Schneider • Rob Colwell
12:00 pm-1:00 pm:	Lunch
1:30 pm-3:30 pm:	Facilities tour(s), including tower climb and met station
6:30 pm-7:30 pm:	Dinner

Friday 03/06/15

5:30 am:	"Early Bird" Birdwatching tour

9:00-9:15 am:	Day 2 recap (Ben)
9:15am-10:30 am:	Morning discussion I: *Opportunities at La Selva, other OTS facilities, and elsewhere*
10:30-10:45 am:	Break
10:45-12:00 pm:	Morning discussion II: *Opportunities at La Selva, other OTS facilities, and elsewhere?*
12:00 pm-1:00 pm:	Lunch
1:00-3:00 pm:	Afternoon discussion: *What can our working group deliver? Proposals, educational opportunities, etc.*
6:30-7:30 pm:	Dinner

Saturday 03/07/15

9:00-9:15 am:	Day 3 recap (Ben)
9:15-10:30 am:	Working group synthesis I: Write-ups
10:30-10:45 am:	Break
10:45 am-12:00 pm:	Working group synthesis II: Write-ups
12:00 pm-1:00 pm:	Lunch
1:00 pm-3:00 pm:	Working group synthesis III and wrap up

Sunday 03/08/15

7:30 am: Depart La Selva for San Jose

EFTS Participant Presentations

Presenter: Rob Colwell
Title: ***The key role of precipitation information in understanding and predicting species range shifts***
Abstract: Biogeographers, macroecologists, and conservation biologists are actively striving to predict the future distributions and probable extinctions of species and their interactions under contemporary climate change. Meanwhile paleocologists and process-based modelers are looking to the past, particularly the Quaternary glacial cycles, to help to understand present and predict future spatial patterns of biodiversity. In every case, the accuracy and precision of information currently available for temperature far exceeds any corresponding information for precipitation: this generalization covers paleoclimate proxies, paleoclimate models, historical instrumental records, experimental tolerance experiments, and IPCC model predictions. I will summarize some representative studies to illustrate the importance of precipitation information in predicting species range shifts. Realistic assessment of risks urgently requires improved monitoring of precipitation, better regional precipitation models, and more research on the effects of changes in precipitation on species distributions.

Presenter: Paolo D'Odorico
Title: ***Deforestation feedbacks and the resilience of forest ecosystems***
Abstract: Forest vegetation can interact with its surrounding environment in ways that enhance conditions favorable for its own existence. Removal of forest vegetation has been shown to alter these conditions in a number of ways, and in some cases it may inhibit the reestablishment of the same community of woody plants. The effect of vegetation on an environmental variable along with vegetation susceptibility to the associated environmental conditions may imply a positive feedback. Understanding these feedbacks is important because in some cases they explain why deforestation can lead to irreversible state shifts where the forest vegetation cannot recover. I will review the different cases in which deforestation can lead to a loss of conditions necessary to sustain forest vegetation and examine the spatial and temporal scales over which these feedbacks act. Juxtaposing the spatial extent of these feedbacks with a map of deforestation enables the identification and discussion of at-risk areas to state changes following deforestation.

Presenter: Ana Maria Duran Quesada
Title: ***Emerging challenges towards high resolution modeling and validation of precipitation processes affecting Central American forested regions***
Abstract: Central America is well known for being a region with a wide variety of biodiversity. In contrast, the agricultural economic development model that prevails in most of the region has, historically, motivated the change of land use. Such landscape modifications are known to have affected the ecosystems at different levels. To properly assess the impact of these changes in land use and vegetation

cover in weather and climate, it is primary to understand the mechanisms that link precipitation and vegetation. Highly variable precipitation intensity and patterns are common for this region, featured by a particular north-south seesaw in the horizontal distribution of precipitation. In the Pacific slope, the annual cycle of regional precipitation can be described in terms of the meridional migration of the Inter Tropical Convergence Zone (ITCZ), with a characteristic bimodal pattern of intra-seasonal precipitation featured by a dry spell during summer known as the Mid Summer Drought. The multiple and non linear interactions amongst different elements involved in the phase changes that lead to the occurrence of precipitation, also include the effect the development of the Western Hemisphere Warm Pool on the distribution of tropospheric heat and moisture over the tropical Americas. Regional studies often find limitations such the lack of long-term meteorological observations in the region and the coarse resolution of reanalysis products. The use of satellite retrievals is also limited by the cloudy conditions and the fact that these products cannot be always validated at the regional scale due to the lack of observations. In order to overcome these obstacles, new strategies are required to build up a new regional precipitation research paradigm. How can we start taking actions towards a high-resolution modeling and validation of precipitation processes strategy in order to improve our understanding of precipitation processes from the perspective of the vegetation coupling?

Presenter: Pierre Gentine
Title: ***Land-atmosphere interactions from daily to seasonal scales***
Abstract: TBD

Presenter: Hugo Hidalgo
Title: ***Connections between the Caribbean and the Pacific climate: are they affecting aridity in the Central America Dry Corridor?***
Abstract: Central America is located in a tropical region with low hydrologic stress in a large part of its territory. However, droughts are also frequent in another large fraction of the area. In particular, the sub-region known as "Corredor Seco Centroamericano" or "Central America Dry Corridor" (CADC) is a relatively dry zone in climatological terms, a by-product of the commonly observed drought conditions. A recent climatological study in the region found a very strong correlation between the summer latitudinal center of mass of precipitation (an indicator of the latitudinal movements of the Inter-tropical Convergence Zone) and a summer index of the Caribbean Low Level Jet, suggesting connections between Pacific and Caribbean climatic processes. The two indices are also correlated to precipitation in a large part of Central America. It is interesting to note that the correlation pattern has the strongest centers in the areas covered by the CADC. Therefore, it suggests that the climatic characteristics of this sub-region (that is mostly located in the Pacific slope) are strongly modulated by Caribbean climate conditions during the summer (the rainy season in the Pacific slope). It is important to define which are the precursors that control aridity in this sub-region, including the role of

vegetation feedbacks and other near-surface processes. Using 30 General Circulation Models, another recent study found runoff projections towards drier conditions for Central America at the end of the century (reductions of 10-30% depending on the location). More research is needed in order to determine the future characteristics of this already dry zone.

Presenter: Jung-Eun Lee
Title: ***Will forests grow back after deforestation?***
Abstract: Several modeling studies demonstrate that the length of the wet season in the eastern part of the Amazonian forests depends on transpiration during the late dry season. In this study, I explore the influence of the ice age boundary condition on the maintenance of the tropical rainforests using the GFDL climate model coupled with dynamic vegetation model. The results indicate that the eastern part of the Amazon becomes wetter under the ice age condition with decreased potential evaporation. Precipitation decreases with warming, implying that forests may not grow back after deforestation.

Presenter: Steve Oberbauer
Title: Mixed signals on the controls of tropical moist forest tree growth
Abstract: Tree stem growth represents the framework upon which all aboveground forest structure depends, and along with soil carbon represents one of the two dominant pools long-term carbon stores in forest ecosystems. Therefore, understanding what are the controls of tropical tree growth is a high priority for the structure and parameterization of earth system models, particularly for predicting the responses of trees to expected warming and drying in the tropics. However, a consensus on what are the dominant controls on tree growth in tropical moist forests has not emerged. Because aboveground wood allocation may represent less than 25% of the net carbon captured by trees, the issue is not only one of what controls how much carbon is fixed, but also how that carbon is allocated. I will review evidence for control of tree growth by light, temperature, atmospheric humidity, CO2, and soil water, as well discuss the results of a new water addition experiment recently completed at La Selva.

Presenter: Guido Salvucci
Title: ***TBD***
Abstract: TBD

Presenter: Laura Schneider
Title: ***Environmental disturbances and land systems: The effect of landscape configuration on hurricane damage in Southern Yucatán, Mexico***
Abstract: Hurricanes represent a major disturbance in the greater Caribbean region, affecting landscapes and human livelihoods. Local studies of hurricane impact have shown that the level of forest damage and recovery is determined by storm intensity and species composition and structure. Less attention has been given to understanding the effect of regional variability, such as landscape

configurations, land changes and topographical variables. As step in this direction, this study explores the relationship of several regional variables and local assessments of hurricane damage in the forests of the Mesoamerican biological corridor Sian Kaan-Calakmul in Southern Yucatán which was hit by a category 5 hurricane (Dean) in August 2007. Data on forest damage was collected from 91 plots (5 m x 100 m) established across the region between May and July 2008. Structural damage was recorded for all trees with a DBH equal or higher to 5 cm according to a set of pre established categories, and an overall Damage Index was estimated for each plot based on the proportion of damaged trees per category. Hurricane damage was as well mapped using EVI-MODIS data (Rogan et al., 2011). The relationship between forest damage from both local/regional estimations and explanatory regional variables such as landscape metrics and variables associated to hurricane intensity (wind speed, topographic exposure) was investigated through two modeling approaches: an ordered least squares (OLS) linear regression and a logistic regression. Results show that storm intensity, forest contiguity (proxy for land use) and human access (roads proximity) are strong indicators of potential damage when using mapped damage as the dependent variable. Explaining plot level damage variables such as basal area, species compositions in addition to storm intensity explained most of the variability of stand level damage. These results highlight the importance of increasing meso-scale level of analysis and its linkages to landscape characteristics when trying to explain environmental disturbances such as hurricanes.

Presenter: Abigail Swann

Title: ***Ecoclimate Teleconnections: remote effects of the interactions between ecosystems and climate***

Abstract: In this talk I will show that large-scale afforestation in the northern mid latitudes warms the Northern Hemisphere and alters global circulation patterns in climate model experiments. An expansion of dark forests increases the absorption of solar energy and increases surface temperature, particularly in regions where the land surface is unable to compensate with latent heat flux due to water limitation. Atmospheric circulation re-distributes the anomalous energy absorbed in the northern hemisphere, in particular towards the south, through altering the Hadley circulation, resulting in the northward displacement of the tropical rain-bands. Precipitation decreases over parts of the Amazon basin affecting productivity and increases over the Sahel and Sahara regions in Africa with implications for the mid-Holocene Green Sahara. The magnitude of circulation response to forcing from vegetation scales linearly with area of forest cover added. Clouds decrease in the afforested latitude, but increase over lower latitudes, compensating for some of the energy imbalance between hemispheres. Mid latitude afforestation is found to have a small impact on modeled global temperatures and on global CO2, but asymmetric heating from the increase in forest cover is capable of driving unintended and undesirable changes in circulation and precipitation. The ability of vegetation to affect remote circulation has implications for strategies for climate mitigation.

Presenter: Maria Uriarte

Title: ***Influence of climate variability and landscape composition on water supply and quality in Puerto Rico and São Paulo, Brazil***

Abstract: Ensuring an adequate supply of water resources for humans and ecosystems represents a pressing environmental challenge. Any effort to ensure the sustainable use of this critical resource must take into account the compounded effects of climate variability, particularly precipitation, and human land-use dynamics on water supply and quality. Using data from dozens of water monitoring stations collected over several years, we quantified how climate variability, particularly the frequency of extreme precipitation events, the composition and configuration of the landscape (proportion of native forest, sugarcane plantations, exotic forest plantations, and urban areas), and geological substrate influence water flow and quality in the streams of nine large watersheds of the state of São Paulo, Brazil between 2000 and 2007 and dozens of watersheds in Puerto Rico between 1997 and 2011. High precipitation events were positively associated with stream water flow and turbidity, increases in the concentration of phosphorus and aluminum, and reductions in nitrogen. Relative to native forest cover, water flow was lower in Brazilian watersheds dominated by *Eucalyptus* plantations especially during dry years. Exotic plantations and sugarcane cultivation were also associated with greater turbidity and higher concentration of nitrogen and phosphorus in streams. Degradation of water quality, namely higher nitrogen and phosphorus and lower dissolved oxygen was evident in areas dominated by urban cover. The recent drought in the state of São Paulo together with predicted declines in precipitation in the Caribbean region highlight the importance of watershed management for sustainable water provision in these landscapes.