

Luquillo Critical Zone Observatory Activities and Accomplishments

Interim Report for Program Review

Sept 2009 to Feb 1, 2011

Overview and sampling strategy

The overarching goal of the Luquillo Critical Zone Observatory (LCZO) is to develop the infrastructure platform and information base that will allow geoscientists to address the overarching question of “*how critical zone processes differ in landscapes with contrasting lithology but similar climatic and environmental histories*”. LCZO research is conducted in paired and nested sampling areas and is guided by 7 interrelated hypothesis and a unified data management system that are designed to quantify how granodiorite (GD), volcanoclastic (VC), and hornfel (HF) lithologies are coupled and decoupled with hydrologic and geochemical cycles (<http://www.sas.upenn.edu/lczo/overview.html>). As of February 2011 we have met, or exceeded, the time line of activities and goals that was detailed in the original proposal (<http://www.sas.upenn.edu/lczo/proposals.html>). Specific accomplishments and activities are detailed below.

Personnel: 49+ individuals have directly contributed at least 160 hrs since the start of the Observatory (i.e. between 10/2009 and 2/2011)

Undergraduates: 7+

7 UPenn undergrads have directly participated in LCZO field, lab, or course work.

Additional undergraduates from the University of Puerto Rico, Penn State, UC Berkeley, and U. New Hampshire have also participated in the project.

Graduate Students: 13

Fully supported by the LCZO: 6 PhD's; partly supported by LCZO: 7 (4 PhD, 4 Masters)

Post Doctorial Researchers: 5

3 directly supported by the LCZO, 2 partly supported by the LCZO

Professional Staff: 5 FTE's

Directly supported by LCZO; 1FTE information manager, 0.5FTE Field Technician

Supported by USFS, USGS, or UPenn: 3.5FTE

Co-PI's (individuals who receive direct support from the LCZO for their research): 12

UPenn: 5, Penn State: 1, U. New Hampshire: 1, U.C. Berkley: 1; USGS: 4

Collaborators who receive direct support for data collection or field expenses: 8

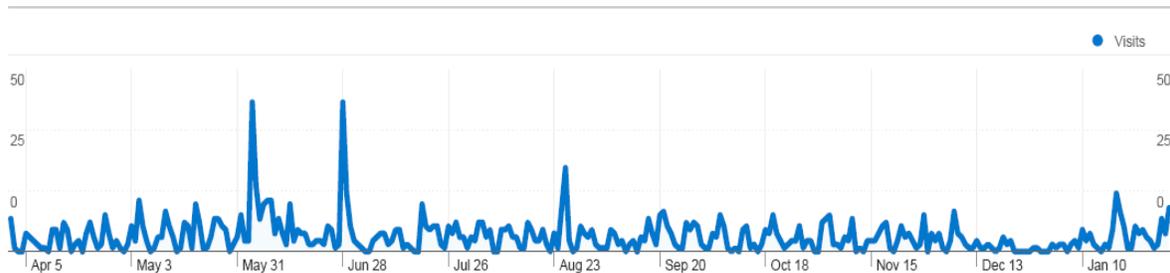
Brown University =1, Boston U. =1, U. Puerto Rico = 2; U. Southern Mississippi =1; British Geology Survey = 1; USFS = 1

Information Management

A searchable LCZO web page and data management system was established in April 2010 (<http://www.sas.upenn.edu/lczo/index.html>). A unique aspect of the system is that it allows individual investigators to update their data files and documentation. As of Feb. 23, 2011, 32 project descriptions that contain a total of 68 data files were online.

Between April 1, 2010 and Feb 2, 2011, the LCZO web page had 1310 independent visits by 516 unique visitors who came from 46 different countries (Figure 1). On average, 8.6 pages were viewed per visit.

Figure 1. Daily use of the Luquillo CZO web page, April 1, 2010 to Feb 2, 2011



The LCZO Information Manager, Miguel Leon, has developed and deployed a web-based system for generating standardized meta-data that allows the aggregation of all LCZO related data by the Spatial Information Systems Laboratory at the San Diego Supercomputer Center. By February 1, 2011, 7 LCZO data sets that contain 14 variables and 133,324 observations have been posted to the CZO Central Web Service Catalog (<http://water.sdsc.edu/czocentral/>).

Geochemical data from Luquillo soil surveys has been posted on the CZEN.org Geochemical and Geophysical Data site (http://www.czo.psu.edu/data_agreement.html). Additional data from the 2010 survey of the entire Luquillo Mountains, and past surveys from the LCZO riparian sites will also be posted at this site in the next 2 years.

Collaborative Studies and Synergetic Activities

The following activities were not specified in the original grant or have they been completely funded by the LCZO. Instead they have developed from synergetic interactions with LCZO collaborators and PI's.

Interactions with the Luquillo LTER program: The Luquillo LTER program is entering its 5th funding cycle. Three of the LCZO collaborators (Scatena, McDowell, Silver) are also associated with that program. The central focus of the LTER program is on disturbance ecology, primarily at the El Verde Field station that is located on volcanoclastic rocks.

Ongoing efforts have been made to coordinate field and data management activities between the two programs. Specific examples of synergistic studies include:

Weekly rain and stream water sampling: The Luquillo LTER program has been collecting and analyzing weekly rain and stream water at several locations in the Luquillo Mountains for the past 2 decades. Unfortunately the LTER program never had enough funds or technician help to collect and analyze samples at the East Peak cloud forest meteorological stations, or the streams draining the granodiorite. With direct funding from the LCZO we began collecting weekly samples from these sites using the same protocol and procedures as the LTER.

Environmental Monitoring: The Luquillo LTER project has been actively involved in monitoring climate and forest dynamics in the El Verde section of the Luquillo Mountains. The USFS has been actively involved in monitoring the Bisley Experimental Watersheds while the USGS has been involved in monitoring streams draining granodiorite. While there has been informal collaboration between these groups, there has been no formal cross-site calibration or data management. Funding from the LCZO has remedied this situation by providing technician support to calibrate existing monitoring stations, purchasing standard rain gages, and supporting a integrated quality control system. Specifically, in 2010 the LCZO purchased new rain gages for 2 weather stations and hired post-doctoral researcher Dr. Holwerda to compile and analyze existing meteorological data from the upper elevations of the Luquillo Mountains.

Soil Sampling Network: The Luquillo LTER project and the USFS International Institute of Tropical Forestry have a long history of research on soil nutrients. However, both groups have done relatively little research on soil mineralogy or soil genesis. The 2010 LCZO Soil survey is adding to this knowledge base and was coordinated with previous LTER based sampling such that long-term LTER sites were sampled and others will be used to test the predictive models developed by LCZO scientists.

Graduate Student Exchanges: PhD candidate Colin Phillips is currently supported by the Luquillo LTER and UPenn to work on the impacts of urbanization on Puerto Rican streams. As part of his dissertation he is also working on the transport of tagged cobbles and boulders in Luquillo streams as part of LCZO Hypothesis 6. UC Berkeley PhD candidate Steven Hall is also conducting studies of soil gas flux at both LCZO and LTER sites. Several LCZO graduates students also stay in the LTER field station over the summer and participate in seminars that involve NSF-REU and LTER students.

USGS Mercury Contamination Studies: As a follow up to a recently published paper that documented high mercury levels in Luquillo rain and stream water (Shanley et al 2008), Cindy Nawal a UPenn Masters student surveyed historic mine sites for Mercury contamination using a hand-held XRF. This sampling fortunately indicated that the historic placer mines are not zones of elevated Mercury.

Transpiration measurements: Dr Wei Wu and 2 graduate students from the University of Southern Mississippi (Moore and Frey) instrumented 24 trees with sap-flow sensors to measure transpiration in the summer of 2010. The trees were located in the focal research areas in the volcanoclastics (Bisley) and granodiorite (Guaba). The effort has provided the first detailed measurements of transpiration in the Colorado forest type. Support for this research was provided by the University of Southern Mississippi, the USFS, and the CZO-LIDAR ground verification effort.

Nutrient cycling studies: Nutrient cycling within Luquillo forests has been studied for several decades. Nevertheless, no study has explicitly focused on the role of bedrock lithology nor has there been an explicit connection been made between weathering studies and nutrient availability. The LCZO is helping to close this information gap by providing logistical support to several new studies, including:

Brown University Phosphorous cycling studies: Assistant Professor S. Porter and Post Doctoral Research Associate S. Goldsmith have separate funding from the A.J. Mellon foundation and NSF to study P cycling on granites in tropical environments. A Brown Masters student was involved in the LCZO 2010 summer soil sampling campaign. In addition, a subset of the soils, 391 samples were sent to Brown University where they are being analyzed for total and extractable phosphorous.

UC Berkeley Sulfur cycling studies: The LCZO is collecting weekly and monthly samples for UC Berkeley graduate student Simona Balan and her advisor Professor Ron Amundson separately funded studies on sulfur cycling. The LCZO is one of many sites they are comparing.

Boston University Silica cycling studies: The LCZO is assisting University of Boston graduate student Ken Takagi and his advisor Professor Andrew Kurtz studies on silica cycling under watersheds with contrasting lithology. They had done earlier studies in Luquillo granodiorites and are now conducting comparable studies on the volcanoclastic. Kakagi is expected to spend part of June 2011 collecting water samples with other LCZO graduate students.

African Dust Monitoring: The LCZO is conducting coordinated monitoring and atmospheric sampling studies with a NSF supported project “Impact of African Dust on Clouds and Precipitation in a Caribbean Tropical Montane Cloud Forest”. This study is being managed by Associate Professor Dr. Olga L. Mayol-Bracero of the Institute for Tropical Ecosystem Studies (ITES) of the University of Puerto Rico. Data from the LCZO managed weather station on East Peak is being used by the project and several LCZO scientists (Shanley, Scholl, Balan, Willenbring) will use data they collect. In addition, Scatena taught 8 UPR graduate students associated with the project a 40 hr short-course on Luquillo Climate and Critical Zone processes in May and June of 2010.

Hydrologic and Landslide Hazard Modeling: Research Associate Dr. Chiara Lepore of MIT and her advisor, Dr. Rafael Bras of Georgia Technological Institute have independent funding to develop a hydrologic model that can be used to predict the occurrence of landslides across the island of Puerto Rico. They have been using the high frequency rainfall, stream flow, and soil moisture measurements from the LCZO to calibrate their

model. Although they had initially intended to use USGS and NOAA data to calibrate their model, the LCZO data is the only data from the island they have found that could be used to calibrate their complex process-based model. In addition, the LCZO has modified our soil moisture sampling protocol in Bisley to assist their project. Because of synergetic interactions with various collaborators, the LCZO information manager, Miguel Leon is developing a real-time landslide hazard warning system based on LZCO data. This system will be added to the LCZO web page and will be come part of Mr. Leon's master project in Spatial Analytics from the UPenn School of Design, where he attends part time.

Comparative sediment transport studies in the Caribbean: UPenn Co-PI D. Jerolmack and Eric Lajeunesse of the IPGP - Université Paris Diderot are collaborating to understanding bedload and suspended load transport in Luquillo and on the Caribbean island of Guadeloupe at a French CZEN where Lajeunesse has been working. With the assistance of a travel grant from the Susquehanna/Shale Hills CZO project (EAR 07-25019), UPenn doctoral student Meredith Reitz was also able to spend the 2010 Fall semester at the Institut de Physique du Globe de Paris , Fall 2010.

Comparative Sea-Level Rise Studies in the Caribbean: Understanding local variations in sea-level rise is critical to understanding the fate of sediment and the stream channel physiography in the volcanoclastic and granodiorite landscapes of the LCZO. In addition, it is critical to understanding regional tectonics and global climate change. Fortunately, the LCZO sea-level rise studies headed by Co-PI Horton are being done in collaboration with studies in Belize, Florida, and Eastern North America. These studies are separately funded by the Smithsonian Institution, NSF and the USGS. The research involves interactions with national and international institutes including the Geodynamic Laboratory of the University of Toronto and the Coastal Research Unit of the British Geological Survey. The LCZO studies are critical to these other studies because they represent a far-field, tectonically active site.

Environmental Sensor Exchanges: LCZO Co-PI W. Silver has been instrumental in using Apogee oxygen probes to quantify redox processes in surface soils within the LCZO. A synergistic and unplanned collaboration between Silver and Brantley has resulted in emplacement of the same sensors in the Shale Hills CZO where they will be used to measure attributes of weathering. Conversations are also ongoing between Brantley and Aufdenkampe about the possibility of emplacing the same sensors in the Delaware CZO.

External Fellowships: The following LCZO scientists and graduate students have received the following fellowships to conduct LCZO related research:

LCZO Co-PI Dr. Heather Buss received a Marie Curie Incoming International Fellowship from the European EU to study Mg and Li isotopes at the LCZO.

With travel support for extended laboratory visits to European institutions from the Shale Hills CZO project (EAR 07-25019), LCZO graduate students have spent extended time at the British Geology Survey conducting isotopic analysis on LCZO sediments, and the

Institut de Physique du Globe de Paris conducting sediment transport modeling experiments.

The following items summarize the ongoing accomplishments and activities of the LCZO that were outlined in the original proposal.

LCZO Surface Soil Studies and Soil Network Infrastructure

In accordance with Hypothesis 2 of the proposal, a soil sampling network has been established across the LCZO. In July 2010 eight students, plus UPenn Professor Art Johnson and Post-Doctoral Researcher John Clark spent 5 weeks establishing and sampling a network of soil pits. The sampling of the network was completed in January 2011. The students who participated in the entire 6 day per week-5 week dig in July 2010 included; 2 UPenn-Masters of Applied Geosciences students, 2 UPENN Undergraduates; 1 Brown University Masters Student; and 1 University of Southern Mississippi Masters Student. Additional participants included 2 UPenn Professors, 2 UPenn PhD students and 1 Research Associate from Franklin and Marshall College.

A total of 212 quantitative soil pits were sampled using a stratified random design that can be used to compare soil forming factors by bedrock geology (granodiorite, volcanoclastic), forest type (Tabonuco, Colorado, Palm), elevation/climate, and topographic position (i.e. ridge, slope, valley). These 212 soil pits sampled 72 hillslope catena's at 24 different locations. At each pit, 4 samples were collected (forest floor, 0-20 cm, 20-50 cm, 50-80 cm) resulting in a total of 800 samples. In total, over 800 pounds of soils were collected and are currently being processed and archived for further use by collaborators. The collected soils are already being analyzed as part of a Master's thesis at Brown University, a master's project at UPenn, 2 UPenn PhD dissertations, and a UPenn post-doctoral project.

Since the samples arrived at UPenn in September 2010, they have been dried, weighed, ground, and archived. In addition, bulk density, Carbon and Nitrogen concentrations have been measured on all 800 samples. Grain size and light and heavy fractions of soil carbon have been measured on a subset of soils. In addition, a subset of the soils, 391 samples were sent to Brown University where they are being analyzed for total and extractable phosphorous.

In accordance with Hypothesis 4 of the proposal, 24 Prenart Super Quartz tension lysimeters and accompanying soil oxygen probes were installed at various locations in the LCZO. After an initial calibration period, surface soil redox conditions will be manipulated and the response of greenhouse fluxes and soil solution chemistry will be quantified. This project is part of a PhD thesis by Stephen Hall of UC Berkeley that is being supervised by Professor Silver. The samples will be analyzed at the Water Quality Laboratory of the University of New Hampshire under the supervision of Professor W. McDowell, who is an external advisor to the Mr. Hall. Mr. Hall also gave a oral presentation, entitled "Minerals Masquerading As Enzymes: Abiotic Oxidation of Soil Organic Matter in an Iron-Rich Humid Tropical Forest Soil" on this initial results at the Fall AGU meeting.

Brantley, McDowell, and Silver are researching the utility of placing Apogee sensor oxygen probes in the floodplain area of the Rio Icacos to investigate issues related to oxic and suboxic weathering. Silver has been instrumental in using these sensors and has already placed them in the Bisley watershed, in an ongoing collaboration between Silver and Buss. This collaboration has also resulted in emplacement of the same sensors in the Shale Hills CZO to measure similar attributes of weathering. Conversations are also ongoing between Brantley and Aufdenkampe about the possibility of emplacing the same sensors in the Delaware CZO

LCZO Weathering Studies and Deep Observation Wells

In accordance with Hypothesis 1 of the proposal, and with additional financial support of the USGS WEBB program, three deep observation wells were drilled and sampled in the LCZO during July-August 2010. The primary goal of the project is to answer longstanding questions about lithology, bedrock fracture networks, and the bedrock-regolith interface in previously inaccessible subsurface areas. The subsurface lithology of all wells was sampled and one is currently being equipped with a water sampling system. One well was drilled to 37 m, the second to 27 m, and the third to 10 m. Four USGS Scientists (Buss, White, Johnson, Rodriguez) and 1 UPenn Masters student (Jimenez) were directly involved with the drilling and logging of the wells. The most surprising observation to date is that highly weathered saprolite extends to a depth of 37m in some areas. Previous work along roadsides indicated that the saprolite only extended up to 20m in most areas.

As of February 2010, the wells have been logged and the initial geochemical analysis has begun at the USGS and at Penn State under the guidance of Buss and Brantley. In January 2011 a Penn State PhD candidate also joined the project and has begun to analyze the existing cores. In January 2011 he also installed a 30 ft well in the metamorphic hornfel complex of the Luquillo Mountains. Samples from this well are being analyzed now and the well will be fully instrumented in June 2011.

Fluvial Studies

In accordance with the objectives of Hypothesis 6 of the proposal, 4 stream reach research sites where cobbles to boulders were tagged with electronic tracers were established in early June of 2010. A total of 425 rocks were tagged and surveyed. Sites were re-surveyed to detect movement 2 to 3 times during the summer of 2010. These sites will be surveyed annual and become part of at least 2 UPenn PhD thesis. The initial survey indicated that head size boulders can move as far as 60 m in a moderate size storm.

In accordance with hypothesis 3 of the proposal, the LCZO started weekly sampling of water from climate and stream nodes for different isotopic studies being conducted by Research Hydrologist M. Scholl of the USGS, Graduate student Simona Balan of the University of California at Berkeley, and Post-doctoral Researcher Steven Goldsmith of Brown University.

An automated water conductivity probe was installed on the Icacos stream gage in July 2010. In addition, new data loggers and conductivity and temperature sensors were purchased and are currently being installed and calibrated in the Bisley watersheds. A LCZO wide stream water sampling effort is being planned for June 2011.

Coastal and Sea Level Rise Studies

In accordance with the objectives of Hypothesis 7 in the proposal, two UPenn Graduate students, 1 UPenn post-doctoral researcher, 1 UPenn undergraduate, Dr. Ben Horton of UPenn and Dr. Chris Vane of the British Geological Service establish sampling transects in coastal mangroves of watersheds that drain volcanoclastic and granodiorite bedrock. During late May of 2010, the team conducted detailed topographic surveys of the coastal zone and collected a total of 214 samples (92 core samples, 73 surface sediment samples, 15 litter bag samples, and 34 vegetation samples). During the summer all the samples were prepped and analyzed for stable carbon isotopes ($\delta^{13}\text{C}$) and C:N ratios at the Kingsley Dunham Centre of the British Geological Survey. Analysis of all sediment samples for microfossils (foraminifera) has begun. Samples have also been sent for Cs-137 and Pb-210 dating to establish an age-depth model for core stratigraphy. A presentation on the initial work was also given to Nicole Khan, the UPenn graduate student responsible for the research. Her dissertation proposal defense is planned for April 2011.

Atmospheric and climate studies

LCZO weather stations have been installed, upgraded and improved. Specifically, a rain gage designed for windy conditions was purchased and installed in the upper Bisley tower, the East Peak weather station was mounted on a new tower changed and upgraded with new sensors, with the assistance of USFS technicians. The LCZO also began collecting weekly bulk rain chemistry samples for cation and isotopic analysis at the East Peak research site.

Research Associate Dr. Friso Holwerda was hired on a temporary basis to compile and quality check all the available data from the East Peak climate site. Nearly 20 years of data have been compiled creating one of the longest recorded from a tropical montane location. A UPenn Masters student has begun analyzing this data in relation to sea-surface temperature data as part of a capstone project.

Improvements to physical infrastructure:

In addition to the infrastructure improvements discussed above, the LCZO has been directly involved in providing the following infrastructure improvements:

Meteorological Stations: All LCZO meteorological stations have been upgraded with new sensors, a tri-pod tower was replaced at East Peak and independent safety inspections were conducted on the 2 Bisley walk-up towers where water samples are collected. Their guy wires were replaced and both towers were deemed safe by the USFS Safety officer.

Stream gage upgrades: The LCZO has purchased and is installing upgraded data loggers, new water level sensors, new conductivity sensors, and soil water probes for 2 of the Bisley Watersheds. In addition, the USGS has purchased a similar conductivity probe for one of the streams draining the granodiorite.

Equipment Purchases: The LCZO has purchased a range of equipment and instruments for the used of all LCZO researchers, including 2 portable water quality sensors (i.e. Hydrolabs), Trimble GPS units, electronic tracking equipment to record boulder movement in streams, soil coring and sampling equipment, and field scales.

Renovation of Sabana Field Station and Research Access Roads: With direct financial support of the USFS, renovations of the laboratory and office spaces used by LCZO researchers were completed in August 2010. Building of the new sleeping quarters was initiated in August and is planned for completion by June 2011. These renovations were paid for by the USFS-IITF and will result in a significant cost savings for LCZO researchers working in the area. With the financial support of the USFS, access roads to the LCZO research areas on volcanoclastic and grandiorites were re-opened and improved the following a landslide generating storm in April 2010.

LCZO Publications and abstracts (Sept 2009 to Feb 1, 2011).

Peer-Reviewed Journal Publications:

Brantley S.L., Megonigal J.P., Scatena F.N. et al 2010. Twelve testable hypotheses on the Geobiology of weathering. *Geobiology*. DOI: 10.1111/j.1472-4669.2010.00264.x

Bruijnzeel L.A., Mulligan M., Scatena F.N., 2010 Hydrometeorology of tropical montane cloud forests: emerging patterns. *Hydrological Processes* Wileyonlinelibrary.com DOI: 10.1002/hyp.7974

Buss H.L., Mathur R., White A.F., and Brantley S.L. 2010. Iron and phosphorus cycling in deep saprolite, Luquillo Mountains, Puerto Rico. *Chem. Geol.*, 269, 52-61.

Holwerda F., Bruijnzeel L.A., Oord A.L., Scatena F.N., 2010. Fog interception in a Puerto Rican elfin cloud forest: a wet-canopy water budget approach. Chapter 29 in Bruijnzeel L.A., Scatena F.N., Hamilton L. 2010. Editors *Tropical Montane Cloud Forests: Science for Conservation and Management*. Cambridge University Press. ISBN 978-0-521-76035-5.

Holwerda F., Bruijnzeel L.A., Scatena F.N., Vugts H.F., Meesters A.G.C.A 2011. Wet canopy evaporation from a Puerto Rican lower montane rain forest: the importance of realistically estimated aerodynamic conductance. In review Journal of Hydrology

Minyard M.L., Bruns M.A., Liermann L.J., Buss H.L., Brantley S.L., 2010 Bacterial Associations with Weathered Minerals in Deep Tropical Saprolite Formed from Quartz Diorite. Submitted to Geobiology

Minyard, M.L., M.A. Bruns, C.E. Martinez, L.J. Liermann, S.L. Brantley. (2010 in press). Occurrence of halloysite nanotubes and bacteria at the interface between saprolite and quartz diorite bedrock, Rio Icacos Watershed, Puerto Rico. Soil Science Society of America Journal

Scatena F.N., Gupta A., 2011. Streams of the Montane Humid Tropics. Treatise on Geomorphology. Editors E. Wohl. Academic Press, San Diego Ca. Vol 9. in press

Shanley, J.B., W.H. McDowell, and R.F. Stallard. 2010 Long-Term Patterns and Short-Term Dynamics of Solute and Sediment Export from a Rapidly Weathering Tropical Watershed. Submitted to WRR

Dissertations and Thesis

Nawal, C. 2011. Exploration of the Geological Formations of the Luquillo Mountain Range of North Eastern Puerto Rico using X-ray Florescence. UPenn Masters of Applied Geoscience Final project, 45 pages. Available at <http://www.sas.upenn.edu/lczo/index.html>

Minyard M.L., 2010 Microbe-Mineral Associations in Tropical Saprolite and Saprock formed from weathered quartz diorite. PhD Dissertation. Department of Crop and Soil Science, Pennsylvania State University, 165 pages

Poster and Oral presentations at Professional Societies:

Bedison J.E., Scatena F.N., Plante A., Gonzales G., 2010. Spatial controls on carbon quality along an elevation gradient in northeastern Puerto Rico. Poster 2010 Goldschmidt Conference

Buss H.L., Dessert C., White A.F., Vivit D., Blum A.E., Sak P.B., and Gaillardet J. Mineral nutrient profiles on differing lithologies at three tropical critical zone sites. Goldschmidt (Oral), Knoxville, TN, USA.

Hall H. "Minerals Masquerading As Enzymes: Abiotic Oxidation Of Soil Organic Matter In An Iron-Rich Humid Tropical Forest Soil." Fall AGU 2010 meeting in San Francisco

Holwerda F., Bruijnzeel L.A., Scatena F.N., Vugts H.F., Meesters A.G.C.A 2011. Wet canopy evaporation from a Puerto Rican lower montane rain forest: the importance of realistically estimated aerodynamic conductance. Fall AGU 2010 meeting in San Francisco

Jerolmack D., Martin R., Paola; M. D. Reitz; R. Schumer, "Linking stochastic sediment transport to physical processes" Fall AGU 2010 meeting in San Francisco

Lepore C. ; *E. Arnone; G. Sivandran; L. V. Noto; R. L. Bras.* "Modelling of Rainfall Induced Landslides in Puerto Rico" Fall AGU 2010 meeting in San Francisco

Martin R.L., Jerolmack D.L., Kasserman C.T., "Physical basis for anomalous sediment dispersion" Fall AGU 2010 meeting in San Francisco

McDowell W.H., Scatena F.N., Lugo AE, 2010 Impacts of Hurricanes on Elemental Cycles: Separating short-term and long-term effects on Stream Chemistry. Presentation International Association of Limnology meeting in Cape Town, South Africa, Fall 2010

Phillips, C., Scatena F.N. 2010. Flashiness indices for urban and rural streams in Puerto Rico. Proceedings of the Tropical Hydrology Specialty Conference of the American Water Resource Association. Rio Mar Puerto Rico, August 29, 2010

Plante AF. "Soil organic matter quality: Definition, quantification and implications for modeling" Fall AGU 2010 meeting in San Francisco

Scholl M. A. Coplen T.B., Correlation Between Stable Isotope Composition and Cloud Altitude (Radar Echo Tops) in Tropical Rainfall: Puerto Rico and Hawaii Fall AGU 2010 meeting in San Francisco

Silver W.; Seasonality of carbon fluxes in an aseasonal environment: controls on litterfall and soil respiration in a tropical forest Fall AGU 2010 meeting in San Francisco

Stone M., "Using soil enzymes to explain observed differences in the response of soil decomposition to nitrogen fertilization" Fall AGU 2010 meeting in San Francisco

Willenbring J., "Soil Production from Above and Below: Implications for Cosmogenic Nuclide Denudation Rate Estimates" Fall AGU 2010 meeting in San Francisco