My Desktop
Prepare & Submit Proposals
Proposal Status
Proposal Functions
Awards & Reporting
Notifications & Requests
Project Reports
Submit Images/Videos
Award Functions
Manage Financials
Program Income Reporting
Grantee Cash Management Section Contacts
Administration
Lookup NSF ID

Preview of Award 1331841 - Annual Project Report

Cover |
Accomplishments |
Products |
Participants/Organizations |
Impacts |
Changes/Problems

Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1331841
Project Title:	Luquillo CZO: The role of hot spots and hot moments in tropical landscape evolution and functioning of the critical zone
PD/PI Name:	William H McDowell, Principal Investigator Grizelle Gonzalez, Co-Principal Investigator Alain F Plante, Co-Principal Investigator Whendee Silver, Co-Principal Investigator
Recipient Organization:	University of New Hampshire
Project/Grant Period:	12/01/2013 - 11/30/2018
Reporting Period:	12/01/2016 - 11/30/2017
Submitting Official (if other than PD\PI):	Alain F Plante Co-Principal Investigator
Submission Date:	11/13/2017
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Alain F Plante

Accomplishments

*** What are the major goals of the project?**

The overarching question guiding LCZO2 is: ***How do hot spots and hot moments in weathering, biogeochemical cycling, hydrologic processes, and atmospheric inputs drive landscape evolution and CZ function in a humid tropical forest?***

Our research is organized into four inter-related focal areas. Focal Area 1 explores the importance of knickpoints and different landscape positions as hot spots for weathering, soil development, and biogeochemical cycling. Focal Area 2 addresses the role of hot spots and hot moments in redox cycling that contributes to the dynamics of weathering, and to the retention and

loss of C and nutrients in soils over a range of spatial and temporal scales. Focal Area 3 determines the role of hot moments in the transport of sediment, C, and nutrients in stream flow, and hot spots that determine the distribution of material across the landscape. Focal Area 4 scales up hot spots and hot moments in time and space using climate and hydrologic modeling, and identifies the role of key atmospheric inputs in clouds and rain. Taken together, the research proposed in LCZO2 will provide a well-integrated assessment of critical zone properties and processes that scale from microsites to catenas, watersheds, landscapes, and the region, and from minutes to hours, days, months, and years. The data collected and synthesized as part of LCZO2 will contribute to our understanding of the controls on weathering, soil development, C and nutrient storage and loss, soil and sediment transport, and ultimately landscape evolution and effects of climate change. Through collaborations with local and federal agencies and educational institutions, we will conduct workshops and outreach activities to inform policy makers and other stakeholders of our research findings and the significance of the Critical Zone in the Luquillo Mountains of Puerto Rico.

Our goal is to address each of the specific hypotheses listed below. Participants responsible for each focal area and hypothesis are also included.

Focal Area 1: Hot spots and hot moments in the deep critical zone (*Brantley Focal Area Lead*)

- H1.1: The higher chemical weathering flux and depletion of rock-derived elements from soils in quartz diorite (QD) above the knickpoint results from the penetration of high-O2 waters into fractures that promote rapid weathering. Below the knickpoint, relatively low-O2 waters effectively lower reaction rates. In contrast, in the volcaniclastic (VC) rocks, O2 is consumed relatively high in the profile throughout the watersheds and deep dissolution of silicates outpaces deep Fe oxidation. As a result, VC-derived soils above and below the knickpoint show less variation than their QD-derived counterparts (*Brantley*, Comas, Buss)
- H1.2: Hot spots of rock-derived nutrient availability are best predicted from denudation rates and lithology. The transition from reaction limitation (below the knickpoint) to supply limitation (above the knickpoint) will result in much higher phosphorus and cation availability lower in the landscape (*Porder*)

Focal Area 2: Hot Spots and Hot Moments in Redox Dynamics and Associated Fe-C interactions (*Silver Focal Area Lead*)

- H2.1: Patterns in rainfall, drainage, and biological activity drive the distribution of redox environments in the critical zone (*Silver*)
- H2.2a: Rapid, high magnitude redox fluctuations create hot spots and hot moments of decomposition by stimulating Fe reduction and associated C decomposition (*Silver*, Thompson, Plante)
- H2.2b The storage and stabilization of soil organic matter in LCZO soils is controlled by hot spots of Fe-C interactions rather than the bulk mineral matrix. (*Plante*, Thompson, Silver)

Focal Area 3: Watershed scale hot spots and hot moments (*Jerolmack* Focal Area Lead)

- H3.1: Particulate carbon, fine sediment and bed material each have different characteristic transit times within a watershed. Particles with short residence times are generated at hot spots in the landscape, and particles with long residence times are eroded and transported from relatively stable parts of the landscape during hot moments. Because of differences in landscape stability, these characteristic time scales will differ with position above or below knickpoints (*Willenbring*, Jerolmack, Shanley, González)
- H3.2: Floods are hot moments that may be treated as 'impulses' that drive sediment transport. The availability of sediment is strongly variable in space due to hot spots associated with physical landscape discontinuities, mainly knickpoints. Sediment transport hysteresis curves allow estimation of time- and space-varying sediment availability. Feedbacks between transport and topography maintain hot spots. (*Jerolmack*, Willenbring)
- H3.3: Hot spots in stream chemistry are associated with recent landslides; hot moments are associated with high flow events that can dilute or enrich various solutes. Watershed lithology controls spatial and temporal variability of solute chemistry through its influence on landslides and subsurface flow paths (*McDowell*, Shanley)

Focal Area 4: Hydrologic and Atmospheric Hot Spots and Hot Moments (*McDowell* Focal Area Lead)

- H4.1: The distribution of hydrologic hot spots like sediment sources and landslides will vary with watershed soils, vegetation, and channel knickpoints; the occurrence of hot spots will vary as a function of storm intensity and frequency (hot moments) (*Bras*, Wang, González)
- H4.2: Orographic precipitation in the LM has decreased during historic times as a consequence of climatic warming. Orographic rains make a disproportionately large contribution to base flow (critical to municipal water supplies), and more

so in VC than QD. Cloud level has likewise changed, resulting in smaller cloud inputs of moisture and nutrients to the Luquillo Mountains with important biotic consequences (*Scholl*, González, Gould, Shanley)

- H4.3: Intercontinental transport of African dust alters incoming radiation and cloud formation, and provides nutrient inputs that are significant relative to those from rain events during periods without dust in the atmosphere (H4.2) (*Mayol-Bracero*, Scholl, González).

The major milestones anticipated during the course of LCZO2 are outlined in a supporting file (Accomplishments Supporting File 2).

The core research teams that comprise the LCZO2 and the tasks to meet the goals for each focal area are outlined in a supporting file (Accomplishments Supporting File 2).

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities:

The LCZO team has made great progress toward achieving our major goals. We have produced over 103 scientific publications and given over 352 presentations at scientific and public meetings over the course of the project. Over the past year, the team published 47 papers, and made 151 presentations at national and international meetings. The LCZO is actively training students and young professionals in the field. 20 of the 47 papers published were authored or co-authored by at least one post-doctoral researcher or graduate student. Nine of 14 additional papers that have been accepted, submitted, are under review, or are awaiting publication also were authored or co-authored by at least one post-doctoral researcher or graduate student. Of the total 151 presentations given during this reporting year, post-docs participated 37 times on 36 presentations (some presentations involved multiple post-docs), graduate students participated 32 times on 29 presentations. Graduate students have produced six dissertations thus far.

Integration of research among the 4 different focal areas and the coordination of efforts among all our partners and participants occurs through our executive committee and by hosting regular LCZO meetings. The executive committee consists of the PI and co-PIs, and has met regularly since it was formed in December 2013. The executive committee often meets prior to or after the LCZO webinars and communicates regularly via email. Each LCZO co-PI has had special responsibilities in the following areas, with reporting of progress and opportunities to the full Executive Committee:

- Site Management, local operations – González
- Data management, information transfer, engagement - Plante
    - Cross-site CZO activities and new research initiatives - Silver

LCZO personnel attended general LCZO meetings via web-broadcast using GoToMeeting approximately every 8 weeks. These meetings were approximately 1.5 hours in length and were structured to present results from the 4 major focal areas and encourage integration across focal areas. The 2017 LCZO annual meeting had to be canceled due to damaged facilities from Hurricane Maria. The agendas for the LCZO All-Scientist webinars are attached in the Products Supporting File 2 PDF.

LCZO personnel helped plan and coordinate the CZO all hands meeting in Arlington Virginia, June 4th-6th 2017 with McDowell serving as the Agenda Committee Chair and University of New Hampshire LCZO post-doctoral researcher Adam Wymore also participating on the Agenda Committee. LCZO collaborators Wendy Yang and Steven Hall served as breakout group leaders. The LCZO presented 8 posters and 2 scientific talks. Wymore and McDowell (along with Pam Sullivan from the University of Kansas) are drafting a white paper that summarizes the meeting including major accomplishments over the past decade from the CZ program and future directions for

both research and outreach. See Products Supporting File 3 PDF for meeting agenda and presentation slides.

The accomplishments of the LCZO from August 10, 2016 through September 15, 2017 are further described within the framework of our milestones by hypothesis and our education and outreach milestones as outlined in the LCZO management plan. These major activities are contained within the Accomplishments Supporting File 2 PDF.

Efforts to promote cross-CZO science are described in the Additional Reporting Requirements contained within the Accomplishments Supporting File 1 PDF.

Specific Objectives:

Focal Area 1

H1.1

- Investigate incipient weathering mechanisms and rates in volcaniclastic bedrock
- Analyse results from using rare earth elements (REEs) to trace mineral nutrient cycling under variable redox conditions
- Explore imaging of fracture distribution using geophysical methods and its relation to stress dynamics in the Rio Icacos watershed.
- Examine geophysical contrast between igneous and volcaniclastic sedimentary rocks and its implications for weathering
- Describe and analyse particle flux from the corestone routing zone in the subsurface in the Rio Icacos watershed.

H1.2

- Show the change in forest height along an elevation gradient
- Further elaborate the role of differences in tree type on mesoscale topography
- Complete work on N trace gas emissions across bedrock and topographic contrasts and defend PhD dissertation (PhD student Almaraz)
- Describe the effects of bedrock and topography, as well as drought, on N gas fluxes from the Luquillo Forests (PhD student Almaraz)

Focal Area 2

H2.1

- Use sensor array to identify hot spots and hot moments in redox dynamics and soil biogeochemistry.
- Use statistical modeling to identify hot spots and hot moments in soil redox and biogeochemistry from sensor array data.

- Determine the role of substrate quality in decomposition under fluctuating redox conditions
- Conduct field and lab experiments to measure changes in iron dynamics across the landscape during shifts in rainfall patterns and redox conditions.
- Determine if variation in iron cycling parameters occurs over daily or weekly timescales in the field and if it correlates with rainfall and biogeochemical dynamics.

H2.2a

- Examine how oxygen (O2) concentrations influences Fe reduction rates, Fe mineral composition and CO2 production during subsequent anoxic periods.
- Determine the role of fluctuating redox conditions on Fe-P interactions across a range of native redox conditions
- Determine the role of microbes versus minerals in P dynamics in soils from different topographic positions.
- Use redox oscillation experiments to determine the influence of variation in the length of anoxic (and oxic) hot moments on CO2 production and iron reduction rates.
- Conduct fluctuating redox experiments to determine effects on P dynamics, microbial composition shifts and mineral dynamics.

H2.2b

- Assess the role of Fe-derived soil minerals phases (e.g., amorphous, crystalline, etc.) as hot spots of soil C storage.
- Characterize soil organic matter storage and cycling, and microbial activity as a function of soil depth in two contrasting soils types in Luquillo.
- Quantify the total organic C, microbial biomass by total PLFA, microbial community composition by PLFA and sequencing, potential enzyme activities of C-, N- and P-acquiring enzymes in soil samples collected from 0-140cm in 10-cm increments from contrasting volcaniclastic- and granodiorite-derived soils.
- Perform laboratory incubations and analytical thermal analysis of soil depth profile sample sets to assess soil organic matter decomposability.
- Perform selective dissolution experiments to extract and quantify various Fe-derived soil minerals phases (e.g., amorphous, crystalline, etc.) and to quantify the amount of organic carbon associated with those mineral phases.
- Characterize the mineral composition of untreated soils and compare it to extracted residues by XRD, specific surface area, Mössbauer spectrometry and FT-ICR-MS.
- Perform dissolved organic matter batch sorption experiments using soil mineral matrices without treatment, with added SRO-Fe (ferrihydrite), and with removed Fe-minerals by selective dissolution.

Focal Area 3

H3.1

- Determine impact of knickpoints on erosion rates and hillslope form.
- Determine source areas of sediment during a flood to track which floods mobilize landslide-derived material.
- Determine the mechanism of erosion (overland flow vs. groundwater sapping) upstream of knickzones.

H3.2

- Derive theory and determine material controls on pebble abrasion in rivers, coasts and deserts due to sediment transport.
- Complete analysis of laboratory experiments to understand how material strength and collision energy control the transition from chipping (abrasion) to shattering (fragmentation) in sediment transport.
- Write up experimental results on how particle collisions give rise to intermittent bursts of sediment transport.

H3.3

- Analyze the grain size distribution and composition of fine suspended sediment sampled during a major flood.
- Determine river particulate organic carbon and particulate nitrogen yields
- Determine effects of drought and storms on suspended sediment export

Focal Area 4

H4.1

- Study the lithological controls on the hydro-geomorphic response of diverse tropical watersheds in a changing climate (objective met).
- Build on an existing physically based ecohydrological model (tRIBS-VEGGIE), develop a coupled model of Carbon-Nitrogen cycle and ecohydrological model using the concept of carbon cost economics (objective met).

H4.2

- Synthesize ceilometer, cloud camera, satellite data, meteorology, and field measurements to estimate total water contribution to the ecosystem from the clouds (deposition, transpiration suppression).
- Begin determining headwater stream response to cloud water deposition.
- Compare ceilometer aerosol measurements to satellite measurements to look for urban influence on cloud level

H4.3

- Establish continuous weekly sampling for the determination of dust concentrations and water-soluble ions in aerosol filter samples under the presence of high and low African dust levels and in the absence of African dust.
- Identify African dust inputs and other aerosol sources using back trajectory analysis, aerosol spectral coefficients, and chemical composition.

- Determine water-soluble ions and dust concentrations of cloud water samples and the cloud droplet size distributions.
- Begin to work with radiation data collected at Pico Este.

Education and Outreach

- Continue to disseminate and promote the Introduction to Critical Zone Science curriculum (Adam Wymore and colleagues from across institutions and CZOs).
- Use multiple formats including publication of peer-reviewed journal articles in Geoscience Educational journals and conference talks to discuss this unique transdisciplinary course and share results regarding student's changing perspectives regarding CZ and Environmental science.
- Host Data Jam workshop.

Significant Results:

FA1

H1.1

- Particles are emitted from between corestones in the quartz diorite of the Rio Icacos. Such subsurface particle flux has been observed in other places, but the particles are observed to be large in the Icacos watershed (hundreds of microns). Many of the particles are hornblende or biotite, which is attributed to the fact that particle formation may be related to ferrous iron oxidation.
- Geophysical surveys show that fracture zones in the quartz diorite are widely spaced but are loci of rock weathering, promoting rapid water transit and high weathering rates and formation of spheroidal corestones; while fractures in the volcaniclastic rocks are more regularly distributed, interconnecting with bedding planes.

H1.2

- Tree heights dropped significantly across the knickpoint on the quartz diorite, but across the same elevation gradient tree heights dropped only gradually on the volcaniclastic. We take this as evidence that the soil nutrient regime, driven by transient geomorphology, has measurable effects on forest communities.

FA2

H2.1

- Using the sensor array we found that soil oxygen dynamics are very sensitive to rainfall; the drought led to rapid and dramatic increases in soil O2 concentrations across the landscape (hot moments). The valleys are less sensitive to rainfall than the rest of the landscape (hot spots). Soil O2 was slow to recover from drought, extending the effective time of the drought by several months after the initiation of rainfall.
- We found that hot spots and hot moments had large impacts on soil greenhouse gas emissions. For CO2, 5% of the fluxes were responsible for 25% of the net efflux. For

methane, 1% of the fluxes increased the annual methane emissions by over 50%. Soil respiration increased during the drought on slopes and in valleys, and remained elevated after the initiation of rainfall; methane fluxes declined slightly during the drought and increased significantly across the landscape with the initiation of rain. Post-drought methane fluxes more than off-set the drought sink.

H2.2a

- Iron oxidation drives C oxidation in soils, although patterns with Fe reduction were more complex. Anaerobic metabolism (e.g. fermentation and Fe-reduction) was highly effective in degrading labile C from litter. Compared to SOM, litter contains more oxidized substrates such as simple organic acids that are readily reactive during Fe-reduction. Redox fluctuation, as opposed to a static anoxic state, increased soil CO2 production, but decreased litter CO2 production.
- The timing of rainfall impacts Fe dynamics in the field as evidenced by shifting ferrous iron and the potential for Fe reduction. Drought significantly decreased inorganic P availability while Fe(III) increased in valleys. Organic P increased across the landscape, likely due to the accumulation of organic matter.

H2.2b

- Absolute values of organic C, total N, microbial biomass, enzyme activity, and respiration showed exponential declines as a function of soil depth. However, when normalized to organic C concentration or microbial biomass C, enzyme activity and respiration were either constant or increased with depth. Energy concentration of SOM declined with depth, indicating that microbial populations were energy limited, which in turn may lead to soil organic matter stabilization and long-term storage.
- Fe-derived mineral phases (as quantified by selective dissolution) contribute a substantial, but not dominant, proportion of mineral surface area. Contrary to expectations, the amount of organic C released following dissolution of the Fe mineral phases was a small fraction of the total C in the soil. Adsorption capacity of soils for DOC is strongly controlled by surface area, which is driven by content of iron minerals.

FA 3

H3.1

- Results from cosmogenic techniques are better constraining long-term rates of erosion, stream sediment sources, and the impact of landscape position on erosion rates.
- Annual yields of suspended sediment, particulate organic C, and particulate N were determined for two LCZO rivers. Only ~10 large storms, producing high river discharge, dominated the suspended load export over the 18-year study period. Annually, an average of 50% of suspended sediment flux occurred over just two days a year, but these storm events only accounted for <10% of the annual runoff.

H3.2

- All coarse-grained (gravel) rivers organize their geometry to be close to threshold during floods, which blunts the impact of extreme events on landscape erosion. This was first shown at LCZO, then generalized to almost 200 rivers in the US.
- All particles that move by “bed load” - rolling, sliding and hopping along the Earth’s surface - exhibit a universal rounding as corners and edges are chipped off, regardless of the whether particles are moved by rivers, wind or waves. This result

means that particle shape alone can be used to determine the source and transport distance of sediment, and the production rate of fine particulates. The first field demonstration of theoretically-predicted universal rounding was in LCZO, which was then applied to Mars and has now been generalized across environments with our new theoretical and experimental work.

H3.3

- During storms, turbidity, a proxy for TSS, peaked only slightly before discharge, and exhibited a slight clockwise hysteresis (higher values on the rising limb than the same discharge on the falling limb). This suggests that the sediment derives primarily from proximal sources, such as the streambed itself. FDOM, a proxy for DOC, peaks well after discharge and displays counterclockwise hysteresis. This behavior suggests more distal sources and/or slow travel times to the stream.
- Convective storms were very infrequent over 2015 and stream water was sourced from ongoing orographic precipitation during the 2015 drought. The river suspended load concentration (including C and N) did not appear to be influenced by the extreme drought upon rewetting. Overall the river biogeochemistry appeared to be resistant to the effects of the 2015 drought.

FA 4

H4.1

- Disturbance of tropical watersheds may result in a net atmospheric C sink or source depending upon forest management practices.
- The relative frequency of predicted landslide magnitudes differs significantly between the Icacos and Mameyes. The simulated erosional potential did not exhibit substantial differences among various climate change scenarios.
- Simulation with downscaled climate scenarios shows a decline in NPP despite high CO2 concentration, indicating that the influence of water stress on NPP is significant. The inter-model variability in projected temperature, rainall and NPP is large.

H4.2

- Trade-wind inversion limits the cloud base altitude over the mountains and proximity to a seasonally invariant low ocean cloud layer means low clouds are consistent over the forest even during dry periods. This pattern also continued through the longer drought in 2015.
- Time-lapse photography showed cloud immersion to be present 39% and 86% of nighttime hours at 700 m and 1000 m, respectively.
- These studies clearly showed that cloud base is rarely as low as 600 m, the level reported in previous work.

H4.3

- Back trajectory analyses showed that most of the time air masses arriving to LCZO come from ENE to ESE, with most summer air masses originating in northern Africa (Sahara).
- Cloud droplets were smaller and more numerous during periods with high dust influence, suggesting dust might be acting as a CCN. The effective diameter did not show significant differences but during low-dust periods droplets reached smaller diameters than in high-dust periods.

Key outcomes or Other achievements:

FA1

For figures and more complete descriptions see supporting file 4 addendum for significant results and key outcomes

In FA1 we are exploring the implications of two discoveries: 1) the presence of deep fracture zones that crisscross the Icacos watershed but exhibit closer spacing as they approach the knickpoint; and 2) the movement of particles of unweathered rock material from the subsurface of the Icacos watershed to surface seeps. Fletcher has calculated the stress distribution around a hypothetical knickpoint and determined that the likelihood of opening of fractures perpendicular to the valley axis is higher just above the knickpoint (Fig. FA1.1). This could explain the observed deep fracture zones which may be the source of many of the corestones in the Icacos. Second, Hyojin Kim describes the particles, their fluxes, and their generation. It appears that the particles may move in the space between corestones and may be related to biotite oxidation (Fig. FA1.2). It is generally assumed that only solutes move in the subsurface and that movement of particles is driven solely by surficial processes. If relatively large particles (μm to tens of μm) move through the subsurface between corestones, this could be a very important mechanism for particle generation in some watersheds.

We investigated the geochemical effects of fracture zones on critical zone processes, specifically mineral weathering, mineral nutrient cycling, and solute exports. We have discovered that the vast majority of mineral weathering in the volcaniclastic watershed occurs over mm- to cm-scale zones at the fracture surfaces, initiated by oxidation reactions. These reactions are either oxidative dissolution of pyrite in volcaniclastic rocks that form angular corestones or oxidation of Fe(II) in pyroxene in spheroidally weathering corestones (Fig. FA1.4). Our findings indicate: i) the importance of deep CZ processes to watershed chemical budgets in highly weathered environments, ii) the dependence of the aboveground and soil ecosystem on surficial cycling of nutrients, iii) the importance of lithology in establishing the rate-limiting step in initiating bedrock weathering, the character of the rock-regolith interface, and the isotopic signature of the watershed solute exports.

FA2

FA2 has revealed a number of biogeochemical processes that lead to hot spots and hot moments of carbon cycling and storage in the soils of a humid tropical forest. Our results show for the first time how redox varies in time and space across the landscape, and we can now describe mechanistic controls that produce the observed patterns.

We documented the dramatic effects of a severe drought and a slow recovery to baseline conditions (Fig. FA2.1). The results have important implications for the future of ecosystems where increased drought is predicted to occur with worsening climate changes. We showed that predicted declines in CH4 emissions with drought were rapidly offset by large emissions immediately following the initiation of rainfall.

The high spatial and temporal resolution of our data allowed us to identify the importance of hot spots/hot moments in redox and GHG fluxes across the landscape. These data showed that a small proportion of the events accounted for 25-50% of the CO2 and CH4 fluxes over time, clearly identifying hot moments of biogeochemical fluxes. Across a catena, valleys accounted for a strong majority of total GHG fluxes, even with only 18% of the surface area.

These redox fluctuations are acting on a large pool of Fe-bearing minerals present in Luquillo soils, which represent a substantial hot spot for the long-term stabilization of SOM. Analysis of 216 quantitative pits showed that soil organic C concentrations were not significantly different between the two dominant soil types derived from contrasting parent materials. Soil depth was a significant control such that surface layers were a hot spot of C storage, while soil organic C, microbial biomass C and potential activity of several enzymes decline exponentially with soil depth.

Taken together, results from FA2 and previous CZO research highlight the importance of Fe-bearing minerals and redox cycling for carbon storage in, or conversely for GHG production from, these soils. Sensitivity of these fluxes to changes in rainfall conditions will have importantly implications for the role of soils in the global C cycle and soil C responses to disturbances such as climate change.

FA3

Our recent work shows that a tectonic perturbation occurring ~4 million years ago has imparted a change in stream form. We have explored the relationship between the erosion rates we measure by cosmogenic isotope methods and vegetation data derived by satellite and LiDAR data. We find that as the erosion rates double across the knickzone, the presence of bioavailable nutrients doubles and the height of the tree canopy doubles (Fig. FA3.1). Above the knickpoint, the erosion is driven by groundwater and is facilitated by differences in tree type. We also use a numerical landscape evolution model to show how relict areas persist over long periods of time due to the lack of ‘tools’ in streams Brocard et al. (in prep).

We use the data from sourcing of suspended sediment to look at erosion rates over the last 20,000 years to understand changes in erosion rate during El Niño events.

We have shown a fundamental distinction in the response of fine vs. coarse sediment transport following the “impulse” of a flood. Coarse sediment (pebble) transport is controlled (and can be predicted) by the integrated momentum of a flood, and this transport creates river channels that are near the threshold of motion for pebbles. The mechanisms governing the export of and channel adjustment to coarse sediment are the same in LCZO as other rivers.

Storms, thus climate, were the major driver of suspended load yields in the LCZO over the last several decades. The largest storms were the main drivers of river suspended load flux. Over the 18-year study period, we determined that 50% of the river SS and POC was transported in just 2.2 days per year with 8% of the rainfall and 6% of the runoff.

We determined the river POC and PN yields in the LCZO over the last 30 years (Table FA3.1). To do this we utilized 100s of river suspended sediment samples for carbon and nitrogen.

FA4

A modelling framework was developed to assess landslide risk in the Icacos and Mameyes watersheds. The landslide area frequency distribution, which can be approximated by a power law in both watersheds, shows that the relative frequency of predicted landslide magnitudes differs significantly between them. In Figure FA4.1a, large slides occur at the steep slopes of the Icacos, depositing soil and saprolite in the vicinity of streams. The weathered soil and saprolite from the quartz diorite in the Icacos are more susceptible to landslide, compared to the volcaniclastic landscape, leading to frequent larger landslides. In the Mameyes, multiple intermediate and small landslides and shallow soil slips occurred across the basin (Fig. FA4.1b). The contrasting lithologies appears to be the primary driver that results in the differences in landslide frequency.

The process-based and spatially explicit modelling that we have developed in this study is applicable to other CZO and Cross-CZO efforts given spatially explicit model inputs. Details on the application of the model to Calhoun CZO are discussed in Dialynas's (2017) dissertation.

The mountain tops are clearly a hot spot for moisture inputs as two studies show that cloud immersion of the forest occurs nearly every night, 18:00-6:00, all year long (Fig. FA4.2, Fig. FA4.3). With improved understanding of trade-wind atmospheric structure we are in a better position to predict the effects of climate change on the hydrological, geochemical and ecological systems, and better understand thresholds of permanent change to coastal montane environments.

*** What opportunities for training and professional development has the project provided?**

Focal Area 1

- Two Bristol PhD students successfully defended their LCZO-focused dissertations. Dr. Maria Chapela Lara has begun a postdoc at UNH with McDowell. Oliver Moore will submit corrections late summer 2017and is working as a postdoc with Buss on the UK-China CZO project SPECTRA.
- Buss taught her undergraduate 2nd year unit in Soils and the Critical Zone at the University of Bristol for the second time. This unit incorporates cross-CZO concepts and data and explicitly uses specific CZO projects as case studies.
- An FAU Master's student Mario Job is currently preparing his LCZO-based thesis. He's been a research assistant under this project for the las year, helping with the processing of data from last year's campaign and organizing logistics for this year's campaign in October.
- Dr. Hyojin Kim, a postdoctoral scholar working at Penn State, has documented the importance of subsurface particle transport at Shale Hills and at the Luquillo CZO. Particles in LCZO are much larger than those at Shale Hills. Kim is advancing from Penn State now for a job in Europe.
- PhD student Maya Almaraz (Brown) successfully defended her PhD and moved on to an NSF funded post doc at UC Davis. She has three manuscripts in preparation that relate to the LCZO project, all of which will be submitted during the next year. They explore the role of topography, soil parent material, drought and N deposition on N2 and N2O losses from Luquillo soils.

Focal Area 2

- The work on soil depth patterns of soil organic matter and microbial activity represents the PhD dissertation research of Dr. Madeline Stone, who was trained on multiple methods for characterizing microbial community composition (e.g., PLFA, DGGE, pyrosequencing), laboratory incubations, and analytical thermal analysis. Two undergraduate research assistants were trained and involved in the soil depth profile experiments.
- The work on FeC associations represents the PhD dissertation research of Dr. Elizabeth Coward, who was trained in selective dissolution experiments (including Fe, Al, Si quantification in extracts by ICP-OES), as well multiple methods for mineral characterization (e.g., XRD, SSA, Mössbauer spectrometry) and organic matter characterization (e.g., DOC quantification and FT-ICR-MS). Three undergraduate research assistants were trained and involved in the dissolution experiments.
- The work on Fe redox dynamics was the dissertation research of Dr. Jared Wilmoth (currently at Oak Ridge National Lab) and Diego Barcellos (dissertation in progress). These students and the postdocs, Drs. Chunmei Chen, Viktor Tishchenko, and Brian Ginn, were trained on performing research on Fe dynamics within this focal area including use of mineral characterization equipment (XRD, Mössbauer spectroscopy, electron microscopy, numerical modeling, trace gas analysis, and operation of field sensor equipment. Over the last four years, two high school students and four undergraduate students were trained in soil characterization methods associated with this focal area.
- The work on the redox array in the field is training a postdoctoral scholar Dr. Christine O'Connell and a technician Jordan Stark who will soon apply to graduate school. The work on Fe, C, and P interactions is part of the postdoctoral research of Yang Lin and Avner Gross. They are learning new approaches to redox biogeochemistry and also gaining some field experience.
- Omar Gutierrez del Arroyo is a PhD student exploring Fe, C, and P interactions along depth profiles. This has allowed him to learn to do field sampling, laboratory extractions, and the use of analytical instrumentation, as well as new statistical approaches. We have had two undergraduate volunteers and two high school volunteers this last year who worked with graduate students and postdocs in the lab learning about biogeochemistry.

Focal Area 3

- Emma Harrison, a PhD student Conducting cosmogenic dating studies in the LCZO, and Marisa Earll, a PhD student conducting and coordinating geodetic analyses in the LCZO, participated in field work, video conferences, group discussions and presented research at conferences and mini-symposiums. Two undergraduates, Omar Rosalez-Cortez student and Dakota Churchill, have been involved in chemistry laboratory experiments and fieldwork. Willenbring has presented this work at several universities as an Association for Women Geoscientist distinguished speaker. Collaborative work between the LTER and the LCZO resulted in a web news story published in July 2017.
- PhD students Dylan Lee and Kieran Dunne participated in field work, video conferences, group discussions and presented research at conferences. Two post doctoral researchers, Herve Guillon and Ali Seiphoori, have taken part on cross-disciplinary collaboration linking physics and chemistry of fine sediment, and another postdoc has connected mathematics to geoscience in the pebble abrasion work. Two undergraduates, Sophie Bodek and Yosef Robel have been involved in laboratory experiments.
- Dr. Kathryn Clark, Postdoctoral researcher, analyzed chemistry and isotope aspects of watershed response during the summer 2015 drought, gave an oral presentation at AGU fall meeting and poster presentation at the Chapman conference in river biogeochemistry. Presented CZ perspective and concepts in addition to postdoctoral results at several international universities in Canada, UK, New Zealand. Featured in the CZO online magazine as a highlighted researcher. Attended the All Hands Meeting in Arlington. Publication out in 2017 and another one in prep.

Focal Area 4

- PhD student Yannis Dialynas while studying the Modeling of hydro-geomorphic and biogeochemical processes, participated in field work, video conferences, group discussions and presented research at conferences. Post doctoral researcher Dr. Ashley Van Beusekom is analyzing the ceilometer and satellite data. USGS/PhD student Maoya Bassiouni co-developed image processing analysis for the cloud-camera study. Undergraduate student Gabriela Aviles was trained

in aerosol filter sampling and in the determination of the dust concentrations for those aerosol filter samples. Undergraduate student Felipe Rivera was trained on the use of the LWC and BCP as well as on aerosol filter sampling, HYSPLIT, and radiation data processing.

Education and Outreach

- Dr. Adam Wymore has received multiple opportunities to practice discussing and engaging audiences on the topic of geoscience education. This includes discussing the Introduction to CZ Science course with other educators at the 2016 AGU meeting through his poster presentation “Critical Zone Science as a Multidisciplinary Framework for Teaching Earth Science and Sustainability.”

- Twenty teachers and twenty students have participated in professional development utilizing LCZO long-term data to conduct investigations. Eight of those students also had the opportunity to present their results to LTER scientists.

*** How have the results been disseminated to communities of interest?**

- Dr. Silver gave public lectures to the following groups:
  - California Department of Food and Agriculture, Public Meeting July 2017
  - Stella Australis, Patagonia, Chile January 2017
  - University of California Sacramento Center, Sacramento, CA October 2016
  - U. C. Berkeley Homecoming Lecture, Berkeley, CA October 2016
- Dr. Thompson hosts high school students in his lab every summer and in addition to them working on a critical zone observatory project, he presents details of the CZOs at public introductory presentations to parents and students.
- Dr. Plante has given presentations on soils and the critical zone to several fourth grade classes in the Spring of 2015, 2016 and 2017 at Chestnutwold Elementary School in the Haverford School District, PA.
- A paper on ceilometer and regional cloud pattern analysis was on the Atmospheric Chemistry and Physics Journal “most downloaded paper” list for a week.
- A paper on cloud-camera method published in Agricultural and Forest Meteorology; and study results were presented at the International Conference on Fog, Fog Collection and Dew July 2016.
- Several publications were produced and presentations were made in support of disseminating education and outreach efforts, insights and student’s changing perspectives as a result of the InTeGrate course and Data Jams.
- Inamdar, S., McDowell, W.H., Shanley, J., Minor, E. and Park, J.H. 2017. Convened the AGU Chapman Conference on Extreme Climate Event Impacts on Aquatic Biogeochemical Cycles and Fluxes. San Juan Puerto Rico, USA. 22-27 January 2017.
- McDowell, W.H. and Shanley, J. 2017. Convened Long Term Impacts and Recovery of Ecosystems; Lessons from Past Extreme Events Session. AGU Chapman Conference on Extreme Climate Event Impacts on Aquatic Biogeochemical Cycles and Fluxes. San Juan Puerto Rico, USA. 22-27 January 2017.
- Minor, E. and McDowell, W.H. 2017. Convened Changes in Aquatic Ecosystem Structure, Functions, and Services session. AGU Chapman Conference on Extreme Climate Event Impacts on Aquatic Biogeochemical Cycles and Fluxes. San Juan Puerto Rico, USA. 22-27 January 2017.
- Shanley, J. and Inamdar, S. 2017. Convened Defining Extreme Climate Events (ECE) and Measuring, Recording, and Sampling Their Impacts Session. AGU Chapman Conference on Extreme Climate Event Impacts on Aquatic Biogeochemical Cycles and Fluxes. San Juan Puerto Rico, USA. 22-27 January 2017

*** What do you plan to do during the next reporting period to accomplish the goals?**

Focal Area 1

- Additional papers from M. Chapela Lara and O. Moore’s PhD theses (Buss group) will be submitted.
- A Master's thesis from Mario Job (Comas group) should be completed by next reporting year, and two more papers submitted.

- Brantley group anticipates publishing a paper entitled, “Subsurface transport of large particles cracked from rock during weathering” in the next year.
- We will continue our assessment of the transition of forest communities across the knickpoint on the quartz diorite, and begin a mechanistic exploration of why that transition exists (Porder group)

Focal Area 2

- Building on previous results from the depth profile of soil C, microbial activity and energetic signatures, we will seek to determine the composition and mechanisms of stabilization of soil organic matter at depths up to 1.4m in Oxisol soil samples from Luquillo. 13C-NMR is an excellent tool but is challenged by the low C concentrations and high Fe concentration in these samples. Special attention will be made to the method used to prepare samples for collecting usable NMR spectra to determine the chemical composition of soil organic matter at depth. Samples may also be sent out of analysis using py-GC-MS.
- Building on results from our selective dissolution and batch sorption experiments, we will seek to determine changes in chemical composition and stabilization of soil organic on the solid matrix after extraction or sorption. To date, we have characterized the chemical composition of the extracted phases and inferred changes on soil mineral surfaces by difference. Going forward, we will seek to exploit the residue solid phases and their associated organic matter. We will subject samples to analytical thermal analysis and solid phases chemical characterization (e.g., 13C-NMR and/or py-GC/MS) to determine the nature of the organic matter left behind after extraction, or accumulated during sorption.

Focal Area 3

- Finish and publish papers by Harrison et al. (in prep a; in prep b) and Earll et al. (in prep). One of these papers includes a cross-CZO comparison of topographic form.
- Revise and resubmit the Brocard et al. (submitted) paper on contribution of vegetation to the shaping of mesoscale topography in a tropical montane rainforest.
- Finish a manuscript (Brocard et al., in prep) describing a landscape evolution model applied to the LCZO landscape.
- Publish final results on theoretical, experimental and field evidence for universal rounding of particles transported by bed load.
- Publish experimental work documenting how particle collisions drive intermittent bed-load transport.
- Conduct a field campaign with cross-CZO French collaborator to measure in-situ grain size distributions of fine sediments to link to concentration and chemistry measurements.
- Publish suspended sediment, particulate organic carbon (POC) and particulate nitrogen yields paper, which also addresses the role of climate in suspended sediment transport.

Focal Area 4

- Analyze hydrological controls of hydrological hot spots and hot moments on the cycling of Carbon and Nitrogen in soil and plant system using spatially distributed dynamic eco-hydrological model.
- Analyze cloud forest ceilometer and satellite aerosol data.
- Do synthesis work on combining all the cloud works for an estimate of cloud water deposition volume in the forest and headwater stream response to cloud water deposition.
- Complete analyses of basic meteorological parameters (including radiation, visibility, and cloud properties to determine annual, seasonal, and diurnal variations at Pico Este.
- Complete chemical analyses (IC and ICP) of cloud water samples and the determination of dust concentrations on aerosol samples.
- In collaboration with M. Scholl, nutrient inputs (N, P, C) from African dust will be calculated using estimates of the atmospheric volume scavenged during rain events, derived from radar echo tops and measured airborne dust concentrations.

- In collaboration with G. Gonzalez and M. Scholl, quantification of the relative importance of dust nutrient input compared to that of rainfall (linked to H4.2).

Education and Outreach

- Dr. Adam Hoffman from the University of Dubuque will present a talk entitled, “Creating a Critical Zone Science Course to Address Environmental and Global Resource Challenges” at the Soil Science Society of American meeting this October in Tampa, Florida.
- Dr. Tim White and co-author Dr. Adam Wymore (former CZO post-doc) will present aspects of the Introduction to Critical Zone Science curriculum during a talk at the American Geophysical Union conference in December (2017) entitled “Using the transdisciplinary framework of Critical Zone science to improve climate literacy.”
- InTeGrate collaborators (White, Wymore, Dere, Hoffman) will also contribute a chapter to a book tentatively titled “Interdisciplinary Teaching about Earth and the Environment for a Sustainable Future” to be published by the Association of Environmental Sciences and Studies.

We plan to host another cycle of Data Jam in the upcoming year, including a teacher workshop, students workshop on presenting, and host students at the Annual Schoolyard Symposium.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Accomplishments Supporting File 2- Milestones and Major Activities.pdf	Milestones and Major Activities	Alain Plante	11/12/2017
Accomplishments Supporting File 3 - All Yr 5 Budgets and Justifications for NSF V2.pdf	Year 5 Budgets and Justifications	Alain Plante	11/12/2017
Accomplishments Supporting File 4 - Addendum for signifcant results and key outcomes.pdf	Addendum for significant results and key outcomes	Alain Plante	11/12/2017
Accomplishments Supporting File 1 - Special Requirements.pdf	Special Requirements	Alain Plante	11/13/2017

Products

Books

Book Chapters

Dylan Rhea-Fournier and Grizelle González (2017). Methodological Considerations in the Study of Earthworms in Forest Ecosystems. *Forest Ecology and Conservation* Chapter 3. Status = OTHER; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.5772/67769.

Inventions

Journals or Juried Conference Papers

Wolf,, and Brocard,Gilles, and Willenbring,Jane, and Porder,Stephen, and Uriarte,Maria, (2016). Abrupt change in forest height along a tropical elevation gradient detected using airborne lidar. *Remote Sensing*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes

Bassiouni, M., Scholl, M.A., Torres-Sanchez, A.J., and Murphy, S.F., (2017). Supplementary Data for Method for Quantifying Cloud Immersion in a Tropical Mountain Forest Using Time-Lapse Photography:. *U.S. Geological Survey Data Release*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.5066/F7HQ3X52.

Bassiouni, M., Scholl, M.A., Torres-Sanchez, A.J., Murphy, S.F. (2017). A method for quantifying cloud immersion in a tropical mountain forest using time-lapse photography. *Agricultural and Forest Meteorology*. . Status = PUBLISHED;

Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.agrformet.2017.04.010

Bastola,Satish, and Dialynas,Yannis, and Bras,Rafeal, and Arnone,Elisa, and Noto,L.V., (2016). Integration of a Physically based Distributed Hydrological Model with a Model of Carbon and Nitrogen Cycling. *TBD*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

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Bouskill, N. J., T. E. Wood, R. Baran, Z. Hao, Z. Ye, B. P. Bowen, H. C. Lim, P. Nico, H-Y Holman, B. Gilbert, W. L. Silver, T. R. Northen, E. L. Brodie. (2016). Belowground response to drought in a tropical forest soil. II. Change in microbial function impacts carbon composition.. *Frontiers in Microbiology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3389/fmicb.2016.00323

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Campbell AN, Bhattacharyya A, Lin Y, Tfaily M, Pasa-Tolic L, Chu R, Silver W, Nico P, and Pett-Ridge J. (2017). The impacts of redox periodicity on microbial community structure and the fate of carbon in wet, tropical forest soils.. *partially drafted manuscript*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

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Yannis G. Dialynas, Rafael L. Bras (2017). Evolution of Contrasting Tropical Landscapes and Critical Zone Response to Changing Climate.. *Earth Surface Processes and Landforms*. . Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Licenses

Other Conference Presentations / Papers

Campbell AN (2016). *"Here today, gone tomorrow' – how microbes survive the fluctuating conditions in wet tropical soils.*. LLNL First Annual Research Slam. Livermore, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Coward L.; Thompson A.; Plante A. (2017). *"Soil organic matter stabilization by Fe-C interactions in temperate and tropical soils: A cross-CZO comparison"*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2017). . *Impacts of Catastrophic Hurricanes on Stream Chemistry in Tropical Montane Forests are Long-Lasting, Context Dependent, and Vary by Critical Zone Architecture*. AGU Chapman 2017. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *A Few Geological Uses of Neutron Scattering: How Does Porosity Change as Water Enters Rocks?*. Gaithersburg, MD invited talk at the Center for High Resolution Neutron Scattering (CHRNS) NSF Site visit review at the National Institute of Standards and Technology (NIST). Gaithersburg, MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Shanley,Jamie, (2016). *A TROPICAL PARADOX - MERCURY IS HIGH IN DEPOSITION, LOW IN THE FOOD WEB IN PUERTO RICO*. PR LTER Annual Meeting June 2016. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = No

Shanley J.B.; Marvin-DiPasquale M.C.; Lane O.; Arendt W.; Hall S.J.; (2016). *A Tropical Paradox — High Mercury Deposition, but Low Mercury Bioaccumulation in Northeastern Puerto Rico*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Olga L. Mayol-Bracero (2017). *Activities in Atmospheric Chemistry in Central America and the Caribbean*. iCACGP SSC Annual Meeting. Cape Town, South Africa. Status = OTHER; Acknowledgement of Federal Support = Yes

Mayol O. (2014). *African Dust and Clouds at Pico del Este*. LCZO Cyber Seminar February 28, 2014. GoToMeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

Van Beusekom, A.E., González, G., Scholl, M.A. (2017). *Analyzing cloud base at local and regional scales to understand tropical montane cloud forest vulnerability to climate change.*. LTER Annual Meeting 2017. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Rasmussen C, Berhe AA, Blankinship JC, Crow SE, Druhan JL, Heckman KA, Keiluweit M, Lawrence CR, Marin-Spiotta E, Plante AF, Schaedel C, Schimel J, Sierra CA, Thompson AT, Wagai R and WR Wieder (2016). *Beyond clay - using selective extractions to improve predictions of soil carbon content.*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = No

Shanley J.B. (2017). *Biogeochemical response to extreme events at the five USGS WEBB watersheds*. AGU Chapman 2017. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Lee, D. (2015). *Bringing a Smart Rock to Luquillo*. LCZO Meeting 2015. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2017). *CZO common measurement network data products and a cross-czo data repository proof of concept*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Perdrial N, Clark K, Shanley JB, Plante AF and WH McDowell (2017). *Can the mineralogical signature of suspended sediments inform on the dynamics and resilience of river systems impacted by extreme climate events at Luquillo?*. AGU Chapman. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Thompson A.; (2016). *Can we predict iron reduction rates across terrestrial ecosystems?*. Telluride Summer Science Series. Telluride CO. Status = OTHER; Acknowledgement of Federal Support = Yes

G. Brocard, JK Willenbring, FN Scatena, A Johnson, K Clark, A Plante, S Porder, J Shanly, W McDowell, W Silver (2016). *Carbon storage in forested slopes of Puerto Rico:fluxes to the surrounding ocean*. Deep carbon observatory meeting, University of Sydney. Sydney, Australia. Status = OTHER; Acknowledgement of Federal Support = Yes

Silver W.L.; Smith W.K.; Parton W.J.; Wieder W.R.; DelGrosso S.; (2016). *Climate Induced Changes in Global-Scale Litter Decomposition and Long-term Relationships with Net Primary Productivity*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Gross A.; Pett-Ridge J.; Silver W.L.; (2016). *Competing for phosphorus under changing redox conditions: biological versus geochemical sinks*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

McDowell W.H.; Silver W.L.; (2016). *Conceptual models of the CZ*. LCZO Webinar series. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

White, T.S, McDowell, W.H. and Brantley, S.L. (2016). *Critical Zone Observatories: Platforms for Collaborative Science.*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Wymore, A., White, T.S., Denton Dere, A.L., Hoffman, A., Washburne, J.C. and Conklin, M.H. (2016). *Critical Zone Science as a Multidisciplinary Framework for Teaching Earth Science and Sustainability*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Wymore, A. (2016). *Critical Zone Science: A Transformative World View.*. CZO all hands meeting.. Arlington, VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Wymore, A. (2016). *Critical Zone Science: Building the Capacity of International Critical Zone Science: An Early Career Perspective*. CZO All Hands meeting. Arlington, VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Adam Wymore (2017). *Critical zone structure controls concentration-discharge relationships and solute generation in forested tropical montane watersheds.*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Adam Wymore (2017). *Critical zone structure controls concentration-discharge relationships and solute generation in forested tropical montane watersheds.*. CZO All Hands meeting 2017; Arlington VA. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Almaraz,Maya, and Groffman,P, and Silver,Whendee, L and Hall,Steven, J and Ruan,Leilei, and Porder,Stephen, (2016). *Differential controls on dinitrogen and nitrous oxide from a wet tropical forest*. LCZO 2016. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Pett-Ridge J.P.; McFarlane K.J.; Heckman K.A.; Reed S.; Green E.A.; Nico P.S.; Tfaily M.M.; Wood T.E.; Plante A.F.; (2016). *Digging a Little Deeper: Microbial Communities, Molecular Composition and Soil Organic Matter Turnover along Tropical Forest Soil Depth Profiles*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Campbell AN, Bhattacharyya A, Lin Y, Silver W, Nico P, & Pett-Ridge J (2016). *Digging up microbial community structure and mineral-organic matter relationships under varying periodicity of redox fluxes in a tropical forest soil*. ISME16. Montreal, Canada. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2016). *Dissolved Organic Carbon (DOC) over the Decades*. Departmental Seminar. Technical University of Dresden, Germany. Status = OTHER; Acknowledgement of Federal Support = Yes

Gonzalez G.; Van Beusekom A.; Scholl M.A.; (2016). *Diurnal and Seasonal Cloud Base Patterns Highlight Small-Mountain Tropical Cloud Forest Vulnerability*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Van Beusekom, A.E., González, G., Scholl, M.A. (2016). *Diurnal and Seasonal Cloud Base Patterns Highlight Small-Mountain Tropical Cloud Forest Vulnerability*. AGU Fall Meeting 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *Drilling to Explore the Transformation of Bedrock into Soil in the Deep Critical Zone*. 2015 Willie Woltz Visiting Scientist Lecture Series, North Carolina State University, Raleigh, NC. Raleigh, NC. Status = OTHER; Acknowledgement of Federal Support = Yes

O'Connell C.; Silver W.L.; Ruan L.; (2016). *Drought drives rapid shifts in soil biogeochemistry and greenhouse gas emissions in a wet tropical forest*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Silver,Whendee, L (2016). *Drought in the Rainforest: Biogeochemical Responses and Feedbacks to Climate Change*. ESA 2016. Fort Lauderdale, FL. Status = OTHER; Acknowledgement of Federal Support = No

Dunne K. and Jerolmack D.J. (2016). *Evidence for Bi-Stable Transport States in Alluvial Rivers*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Potter, J.D., Wymore, A.S., Rodríguez-Cardona, B., Coble, A.A., López Lloreda, C., Pérez Rivera, K., De Jesús Román, A., Bernal, S., Martí, E., Krám, P., Hruška, J., Prokushkin, A. and McDowell, W.H. (2017). *Examining the role of dissolved organic nitrogen in stream ecosystems across biomes and Critical Zone gradients.*. Lamprey River Science Symposium. Durham, NH. Status = OTHER; Acknowledgement of Federal Support = Yes

Wymore, A., Rodriguez-Cardona, B., Coble, A.A., Potter, J.D., Lopez Lloreda, C., Perez Rivera, K., De Jesus Roman, A. Bernal, S., Martí Roca, E., Kram, P., Hruska, J., Stanislavovich Prokishkin, A. and McDowell, W.H. (2016). *Examining the role of dissolved organic nitrogen in stream ecosystems across biomes and Critical Zone gradients.*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Susan Brantley (2016). *Exploring the Critical Zone: Where Rock Meets Life*. Wollaston medalist acceptance speech, London Geological Society, London UK. London UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley S. (2014). *Exploring the Transformation of Bedrock into Soil in the Deep Critical Zone*. Invited talk, UC-Riverside, Apr 8, 2014. UC-Riverside. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *Exploring the Transformation of Bedrock into Soil in the Deep Critical Zone*. Departmental Seminar (invited), Dartmouth College, Hanover, NH, April 3, 2015.. Hanover, NH. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *Exploring the Transformation of Bedrock into Soil in the Deep Critical Zone*. Departmental Seminar (invited), University of New Hampshire, Durham, NH, January 29, 2015.. Durham, NH. Status = OTHER; Acknowledgement of Federal Support = Yes

Chen, C., Meile, C., Barcellos, D., & Thompson, A. (2017). *Fe and C cycling is modulated by O2 levels in redox-fluctuating environments*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Liz Coward; Hyojin Kim (2017). *Fe dynamics across the LCZO: nanometer to kilometers scale*. gotomeeting; LCZO Webinar Series. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

Steven Hall (2017). *Finding the “missing” cations: biogeochemical mechanisms that liberate occluded nutrients from highly weathered soils*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Comas X (2017). *Focal Area 1: Hot spots and hot moments in the deep critical zone*. gotomeeting; LCZO webinar series.. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell W.H.; Potter J.; McDowell W.G.; Ramirez A.; (2016). *From City to Sea: Controls on Weathering Products and Limiting Nutrients in an Urban Tropical River*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Pett-Ridge, J. (2016). *From Cradle to Grave: Using Isotopes and Imaging to Track Microbe-Mineral Interactions.*. EMSI2016. Montreal, Canada. Status = OTHER; Acknowledgement of Federal Support = Yes

O'Connell,Christine S., (2016). *Guest lecture on deforestation and climate impacts in tropical forests*. UC Santa Cruz. Santa Cruz, CA. Status = OTHER; Acknowledgement of Federal Support = No

Sheila F Murphy (2017). *High-Intensity Rain Storm Connects Hillslopes to Channels in a Steep Semi-Arid Catchment*. AGU Chapman 2017. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Silver W.L. (2017). *Hot Spots and Hot Moments in Redox Dynamics and Associated FeC interactions*. gotomeeting; LCZO webinar series. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

Diego Barcellos, Whendee Silver, Daniel Markewitz, Nadia Noor, Caitlin Hodges, Chunmei Chen, Christine O’Connell, Daniel Richter, and Aaron Thompson (2017). *Hot spots and hot moments for redox, Iron and Carbon cycling in soils across Luquillo*

and Calhoun CZOs. CZO All Hands meeting 2017; Arlington VA. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Campbell A.; Bhattacharyya A.; Lin Y.; Tfaily M.M.; Paša-Tolić L.; Chu R.K.; Silver W.L.; Nico P.S.; PettRidge J.; (2016). *How Redox Fluctuation Shapes Microbial Community Structure and Mineral-Organic Matter Relationships in a Humid Tropical Forest Soil*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Susan Brantley (2016). *How Rocks, Water, and Living Organisms Turn Rock into Soil*. 2016 Global Institute for Water Security's Annual Distinguished Lecture Series. University of Saskatchewan, Saskatoon, Canada. Status = OTHER; Acknowledgement of Federal Support = Yes

Brocard,Gilles, and Willenbring,Jane, (2015). *How Saharan Dust Slows River Knickpoints : Coupling Vegetation Canopy, Soils and the Foundation of the Critical Zone.*. AGU 2015. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Pett-Ridge, Jennifer, Aaron Thompson, Gilles Pinay, Klaus-Holger Knorr, and Marco Keiluweit (2017). *How Spatial and Temporal Redox Dynamics Shape Biogeochemistry in Soils and Sediments Across Scales*. Goldschmidt 2017. Paris, France. Status = OTHER; Acknowledgement of Federal Support = Yes

Gutierrez del Arroyo,Omar, and Silver,Whendee, L (2016). *How deep does disturbance go?*. LTER Annual Mtg. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = No

Gutiérrez del Arroyo O.; Silver W.L.; (2016). *How deep does disturbance go? The legacy of hurricanes on tropical forest soil biogeochemistry*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *How porosity increases during incipient weathering of crystalline silicate rocks.*. Pore-Scale Geochemical Processes Short Course, Prague, CZ. Prague, CZ. Status = OTHER; Acknowledgement of Federal Support = Yes

Campbell AN, Bhattacharyya A, Lin Y, Tfaily M, Pasa-Tolic L, Chu R, Silver W, Nico P, & Pett-Ridge J (2016). *How redox fluctuation shapes microbial community structure and mineral-organic matter relationships in humid tropical forest soil*. AGU 2016. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Campbell AN, Bhattacharyya A, Lin Y, Tfaily M, Pasa-Tolic L, Chu R, Silver W, Nico P, & Pett-Ridge J. (2017). *How redox fluctuation shapes microbial community structure and mineral-organic matter relationships in humid tropical forest soil.*. JGI User Meeting. Walnut Creek, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Campbell AN, Bhattacharyya A, Lin Y, Tfaily M, Pasa-Tolic L, Chu R, Silver W, Nico P, & Pett-Ridge J. (2017). *How redox fluctuation shapes microbial community structure and mineral-organic matter relationships in humid tropical forest soil.*. DOE Genomic Sciences Annual Contractors Meeting. Arlington, VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Shreeram P Inamdar (2017). *How will large storms alter particulate organic matter exports and composition and impact water quality of receiving aquatic ecosystems?*. AGU Chapman 2017. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2017). *Hydrologic and Atmospheric Hot Spots and Hot Moments*. gotomeeting; LCZO Webinar Series. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell W.H. (2017). *Impacts of Catastrophic Hurricanes on Stream Chemistry in Tropical Montane Forests are Long-Lasting, Context Dependent, and Vary by Critical Zone Architecture*. AGU CHapman 2017. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell W.H.; (2017). *Impacts of Catastrophic Hurricanes on Stream Chemistry in Tropical Montane Forests are Long-Lasting, Context Dependent, and Vary by Critical Zone Architecture*. AGU Chapman 2017. San Juan, Puerto Rico. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Clark, K. E., Shanley, J. B., Stallard, R. F., Scholl, M. A., Plante, A. F., Perdrial, J. N., Murphy, S. F., Perdrial, N., Gonzalez, G., McDowell, W. H. (2017). *Impacts of extreme climate events - drought and hurricane - on carbon and nitrogen in streams*

draining the Luquillo Mountains in Puerto Rico. AGU Chapman conference on Extreme Climate Events Impacts on Aquatic Biogeochemical Cycles and Fluxes. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Ashlee Dere, Timothy White, Adam Wymore, Adam Hoffman, James Washburne, Martha Conklin, and Robert Shuster (2017). *Implementing InTeGrate Critical Zone Science materials in an undergraduate geoscience curriculum*. Earth Educator's Rendezvous. Albuquerque, New Mexico. Status = OTHER; Acknowledgement of Federal Support = Yes

Torres-Delgado, E., C. J. Valle-Díaz, D. Baumgardner, O. L. Mayol-Bracero (2016). *Indirect effect of African dust particles on cloud microphysical and chemical properties in a tropical montane cloud forest in the Caribbean*. 32nd Meeting of the American Meteorological Society – Hurricanes and Tropical Meteorology. San Juan, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Dialynas Y.G.; Bras R.L.; (2016). *Influence of Climate Change on the Evolution of Contrasting Tropical Landscapes in the Luquillo Critical Zone*. AGU 2016. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Comas X.; Wright W.J.; Hynek S.A.; Ntarlagiannis D.; Terry N.; Whiting F.; Job M.J.; Brantley S.L.; Fletcher R.C.; (2016). *Integrated geophysical study to understand the architecture of the deep critical zone in the Luquillo Critical Zone Observatory (Puerto Rico)*. AGU 2016. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Brocard,Gilles, (2015). *Interplay of forest and topography during the growth a tropical mountain. Insights from the Luquillo CZO observatory, Puerto Rico.*. Department seminar, Tulane University. New Orleans, LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Gilles Brocard, Jane K Willenbring, Fred Scatena (2016). *Interplay of forest and topography during the growth of a tropical mountain*. University of Wollongong, Australia. Wollongong, Australia. Status = OTHER; Acknowledgement of Federal Support = Yes

Brocard,Gilles, and Willenbring,Jane, (2016). *Interplay of forest and topography in the Luquillo Critical Zone Observatory: the case of the Rio Blanco knickpoints*. Department seminar, university of Grenoble, France. university of Grenoble, France. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2017). *Interpretive talk on Bisley Experimental Watersheds*. AGU Chapman. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Pett-Ridge, J. (2016). *Into the Deep: Variability in Soil Microbial Communities and Carbon Turnover Along a Tropical Forest Soil Depth Profile*. Invited Presentation. UC Berkeley. Status = OTHER; Acknowledgement of Federal Support = Yes

Jennifer Pett-Ridge, Karis J. McFarlane; Elizabeth Green; Katherine A. Heckman; Sasha Reed; Tana E. Wood (2016). *Into the Deep: Variability in Soil Microbial Communities and Carbon Turnover Along a Tropical Forest Soil Depth Profile*. Luquillo CZO Annual Meeting. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2017). *Invited Talk: Ecological research in tropical ecosystems and impacts of extreme climate events on stream chemistry and ecology*. AGU Chapman. San Juan, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Hall S.J; Liptzin D.; Buss H.L.; DeAngelis K.; Silver W.L.; (2016). *Iron Redox Dynamics From Surface to Bedrock in a Deep Tropical Forest Soil: a New Conceptual Model*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coward E, Plante AF and AT Thompson (2017). *Iron speciation at the critical zone: Controls on organomineral complexation and soil C*. Goldschmidt 2017. Paris, France. Status = OTHER; Acknowledgement of Federal Support = Yes

Bhattacharyya, A., Campbell, A.N., Nico, P.S., Weber, P. and Pett-Ridge, J. (2017). *Iron-organic matter transformations in wet tropical soils.*. ACS Spring Meeting. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Thompson A, Meile, Wilmoth, Barcellos, Chen C, Ginn B, Tang Y, Hodges C (2017). *Key features of redox fluctuating soils that influence iron cycling*. ACS-spring 2017. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring J.K.; Brocard G.Y.; (2016). *Leaky Sinks: Should (Paleo)erosion Rates and Floodplain Sedimentation Rates Covary?*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Willenbring J.K.; (2017). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring, J.K., (2016). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. Invited talk; Montana State University. Montana State University. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring, J.K. (2017). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. Invited talk; University of California Los Angeles. University of California Los Angeles. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring, J.K. (2017). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. Invited talk; Massachusettes Institute of Technology. Massachusettes Institute of Technology. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring, J.K. (2017). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. Invited talk; University of Oregon. University of Oregon. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring, J.K. (2017). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. Invited talk; Rice University. Rice University. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring, J.K. (2017). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. Invited talk; University of Southern California. University of Southern California. Status = OTHER; Acknowledgement of Federal Support = Yes

Willenbring, J.K. (). *Life in the slow lane - Tectonic controls on soils, nutrients, and tree canopies*. Invited talk; University of Lausanne, Switzerland. University of Lausanne, Switzerland. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, William H. (2016). *Linking ILTER and Critical Zone Science: Opportunities to build a global understanding of land-water linkages*. International LTER First Open Science Meeting. Kruger National Park, South Africa. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *Lithology and chemical weathering reaction fronts, and runoff paths through hillslopes*. Departmental Seminar (invited), Purdue University, West Lafayette, IN, Nov 19, 2015.. West Lafayette, IN. Status = OTHER; Acknowledgement of Federal Support = Yes

Susan Brantley (2016). *Lithology, chemical weathering reaction fronts, and runoff paths through hills*. Distinguished Lecture Series, Dept of Geology and Geophysics, University of Wyoming, Laramie, WY. University of Wyoming, Laramie, WY. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *Lithology, chemical weathering reaction fronts, and runoff paths through hillslopes*. Gilbert Club Talk (invited), University of California at Berkeley, Berkeley, CA. California at Berkeley, Berkeley, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2016). *Lithology, chemical weathering reaction fronts, and runoff paths through hillslopes*. University of Wyoming, Laramie WY, April 2016.. Laramie WY. Status = OTHER; Acknowledgement of Federal Support = Yes

Wymore, A. (2016). *Looking up at the Critical Zone: When the CZ shows up in your backyard*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

McDowell, William H. (2017). *Luquillo Critical Zone Observatory: linking spatial and temporal patterns in stream chemistry to underlying critical zone architecture*. Institute of the Physics of the Globe of Paris. Paris, France. Status = OTHER; Acknowledgement of Federal Support = Yes

Shanley J.B. (2017). *Luquillo loco! Insights on hot moments from in-stream optical sensors in the Puerto Rico wet forest*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

María Chapela (2017). *Magnesium isotopes reveal a decoupling of Mg sources to the vegetation and the stream at the Luqillo CZO*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Pett-Ridge, J (2016). *Mapping Soil Carbon From Cradle To Grave: Microbe-Mineral Interfaces,*. EMSL Town Hall, AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Finstad KM, Campbell AN, Plante AF, Veldkamp E, Zhang N, McFarlane K and J Pett-Ridge (2017). *Measurements and modeling of carbon turnover rates in tropical forest soils.*. 2017 Joint NACP and Ameriflux Principal Investigators Meeting. North Bethesda, MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Finstad KM, Campbell AN, Koven C, Miller G, Pett-Ridge J, Plante AF, Veldkamp E, Zhang N, and K McFarlane (2017). *Measurements and modeling of carbon turnover rates in tropical forest soils.*. DOE Terrestrial Ecosystem Science Program Investigators Meeting. Potomac, MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Napieralski SA, Roden EE, Buss HL (2017). *Microbiological and genomic analysis of a terrestrial subsurface Fe(II)-silicate based lithotrophic microbial community.*. AbSciCon. Mesa AZ. Status = OTHER; Acknowledgement of Federal Support = No

Coward E, Plante AF, Ohno T, and AT Thompson (2017). *Mineral control of dissolved organic matter sorption in a tropical soil*. Goldschmidt 2017. Paris, France. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2017). *ODM2 Admin A Data Management Application for Observations of the Critical Zone.*. Advancing Hydrologic and Environmental Science through Cyberinfrastructure: Lessons Learned and Paths Forward. CUAHSI,. Boston MA,. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2017). *ODM2 Admin A Data Management Application for Observations of the Critical Zone.*. 3nd Annual Cross-CZO EarthCube Microbial Ecology Workshop and NEON Microbial Ecology Working Group Meeting. Portland, OR. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Miguel Leon (2017). *ODM2 Admin A Data Management Application for Observations of the Critical Zone.*. 2017 CUAHSI Conference on Hydroinformatics. Tuscaloosa, AL. Status = OTHER; Acknowledgement of Federal Support = Yes

Leon,Miguel, Carlos (2016). *ODM2 Admin: New Administrative Interface for ODM2 data model for CZO Data Managers.*. gotomeeting. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

Leon,Miguel, Carlos (2016). *ODM2 Admin: New Administrative Interface for ODM2 data model for the BigCZToolbox*. BiGCZ. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

Leon,Miguel, Carlos (2016). *ODM2 Admin: New Administrative Interface for ODM2 data model for the CZO Community.*. gotomeeting. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2016). *ODM2-Admin Data Management*. 2nd Annual Cross-CZO EarthCube Microbial Ecology Workshop and NEON Microbial Ecology Working Group Meeting. Montreal, Quebec, Canada. Status = OTHER; Acknowledgement of Federal Support = Yes

"Coward E.; Thompson A.T.; Plante A.F. " (2016). *Organomineral Complexation at the Nanoscale: Iron Speciation and Soil Carbon Stabilization*. AGU 2016. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Mayol-Bracero, O. L (2015). *Overview of Aerosol and Cloud Measurements in the neighbor-island of Puerto Rico, with focus on African Dust*. 50th Anniversary of Climate Research in Barbados. Barbados. Status = OTHER; Acknowledgement of Federal Support = Yes

Satish Bastola (2017). *Parameterization of nitrogen limitation for a dynamic ecohydrological model: a case study from the Luquillo Critical Zone Observatory*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Stone M and AF Plante (2017). *Patterns of substrates, microbes and enzymes with soil depth in the Luquillo Critical Zone Observatory*. CEREGE,. Aix-en-Provence, France. Status = OTHER; Acknowledgement of Federal Support = Yes

Perdrial,Julia N., and Rizzo,J, and Harpold,A, (2016). *Perdrial et al. 2016. Investigating controls on stream water carbon dynamics in varied climates: Luquillo as endmember of a CZO climosequence ?*. LCZO allhands meeting. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = No

McDowell, William H. (2016). *Plenary talk, International LTER First Open Science Meeting*. Brothers in earth systems research: Convergence of Critical Zone and ecosystem science as used in LTER. Kruger National Park, South Africa. Status = OTHER; Acknowledgement of Federal Support = Yes

Gonzalez,Grizelle, and Scholl,Martha A, and Shanley,Jamie, (2016). *Progress report on Hypothesis 4*. CZO Annual Meeting. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Scholl,Martha A, and Bassiouni,M, and Gonzalez,Grizelle, (2015). *Quantifying amount and variability of cloud water inputs using active-strand collector, ceilometer, dewpoint, and photographic measurements*. AGU 2015, A33H-0278. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Scholl,Martha A, and Bassiouni,M, and Gonzalez,Grizelle, (2016). *Quantifying amount and variability of cloud water inputs using active-strand collector, ceilometer, dewpoint, and photographic measurements*. LCZO Annual Mtg, presented by Torres-Sanchez A. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Lin Y, Campbell AN, Bhattacharyya A, Nico PS, Silver WS, and Pett-Ridge J (2016). *Redox-induced variations in phosphorus fractions in a humid tropical forest soil*. INTERFACE phosphorus workshop. Townsend, Tennessee, USA. Status = OTHER; Acknowledgement of Federal Support = Yes

Leon, M.C., Appling A.P., W.H. McDowell, Clark K. (2015). *Reducing bias and quantifying uncertainty in watershed flux estimates: The R package loadflex*. CZO C-Q workshop. University of New Hampshire. Status = OTHER; Acknowledgement of Federal Support = Yes

Thompson A.; Druhan J.L.; Wagai R.; Plante A.F.; Lawrence C.R.; Brehe A.A.; Sierra C.A.; Rasmussen C.; (2016). *Representation of diffusion controlled carbon stabilization in reactive transport models*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2016). *Research Opportunities at the Critical Zone Observatories*. Research Priorities to Incorporate Terrestrial-aquatic interfaces in Earth System Models. Rockville MD. Status = OTHER; Acknowledgement of Federal Support = Yes

Clark,Kathryn, (2016). *Research strategy and contribution*. University of Newcastle, UK. Newcastle, UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2017). *Research strategy and contribution*. Invited talk University of Exeter, UK. University of Exeter, UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2017). *Research strategy and contribution*. Invited talk, University of Birmingham, UK. University of Birmingham, UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2017). *Research strategy and contribution*. Invited talk, University of Winnipeg, Canada. University of Winnipeg, Canada. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2017). *Research strategy and contribution*. Invited talk, University of Victoria Wellington, New Zealand. University of Victoria Wellington, New Zealand. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2017). *Research strategy and contribution*. Invited talk, University of Canturbury, New Zealand. University of Canturbury, New Zealand. Status = OTHER; Acknowledgement of Federal Support = Yes

Clark, K. E., Stallard, R. F., Shanley, J. B., Scholl, M. A., Plante, A. F., Perdrial, J. N., Murphy, S. F., Perdrial, N., Gonzalez, G., McDowell, W. H. (2017). *River particulate load transport, drivers and yields in the Luquillo Mountains in Puerto Rico*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Clark,Kathryn, and Stallard,Robert, and Plante,Alain, (2016). *River particulate organic carbon, and nitrogen yields in the Luquillo Critical Zone Observatory*. All-CZO Annual Meeting. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Alonso-Rodriguez A.M.; Reed S.; Cavaleri M.A.; Uriarte M.; Carter K.; Bachelot B.; Wood T.E.; (2016). *Severe Drought Constrains Seedling and Sapling Growth in a Puerto Rican Tropical Rainforest*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Coward L.; Thompson A.; Plante A. (). *Soil Organic Matter Stabilization By Fe-C Interactions in Temperate and Tropical Soils: A Cross-CZO Comparison*. SSSA Meeting 2016. Madison, WI. Status = OTHER; Acknowledgement of Federal Support = Yes

Coward E.K.; Thompson A.T.; Plante A.F. (2017). *Soil organic matter stabilization by Fe-C interactions in temperate and tropical soils: A cross-CZO comparison*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Lin Y, Bhattacharyya A, Campbell AN, Nico PS, Pett-Ridge J, and Silver WS. (2016). *Soil phosphorus redistribution among iron-bearing minerals under redox fluctuation*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Susan Brantley (2016). *The effect of fractures on weathering of igneous and volcaniclastic sedimentary rocks in Puerto Rican tropical rain forest*. Water-Rock International (WRI-15) Symposium,. Evora, Portugal. Status = OTHER; Acknowledgement of Federal Support = Yes

Bhattacharyya A.; Campbell A.; Lin Y.; Nico P.S.; Silver W.L.; Pett-Ridge J.; (2016). *The effects of redox fluctuation on iron-organic matter interactions in wet tropical soils*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Willenbring,Jane, and Jerolmack,Doug, (2016). *The null hypothesis: steady rates of erosion, weathering and sediment accumulation during Late Cenozoic mountain uplift and glaciation*. AGU 2015. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Thompson A (2016). *The role of redox variability in structuring iron cycling in soils.*. Georgia Tech Seminar Series. Atlanta, GA. Status = OTHER; Acknowledgement of Federal Support = Yes

Susan Brantley (2016). *Toward a conceptual model relating chemical reaction fronts to water flow paths in hills*. Binghamton Symposium: Connectivity in Geomorphology. Colorado State University, Fort Collins, CO. Status = OTHER; Acknowledgement of Federal Support = Yes

"Clark K.E.; Shanley J.B.; Perdrial, N.; Scholl, M.A.; Perdrial J.N.; Plante A.F.; McDowell W.H.; " (2016). *Tropical river suspended load and solute dynamics in storms within an extreme drought, Luquillo Critical Zone Observatory, Puerto Rico*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Clark,Kathryn, and Shanley,Jamie, and Perdrial,Julia N., and Scholl,Martha A, (2016). *Tropical river suspended sediment and solute dynamics in storms during an extreme drought*. All-CZO Annual Meeting. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Comas X (2017). *Understanding the architecture of the deep critical zone and its relation to knickpoint evolution in the Luquillo CZO (Puerto Rico) using hydrogeophysical methods*. CZO All Hands meeting 2017;. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Comas,Xavier, and Wright,W, and Hynek,Scott, (2015). *Understanding the architecture of the deep critical zone in the Rio Icacos watershed (Luquillo Critical Zone Observatory, Puerto Rico) using a combination of hydrogeophysical methods.*. AGU 2015. San Francisco, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Jerolmack D.J.; Domokos G.; Shaw S.; Sipos A.; Szabo T.; (2016). *Universal shape evolution of particles by bed-load (Invited)*. AGU 2016. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Pett-Ridge, J. (2016). *Using isotopes and imaging to track microbe-mineral interactions in soil*. ISME Meeting. Montreal, Canada. Status = OTHER; Acknowledgement of Federal Support = Yes

Shanley J.B. (2017). *Watershed scale hot spots and hot moments*. gotomeeting; LCZO Webinar Series. gotomeeting. Status = OTHER; Acknowledgement of Federal Support = Yes

Brantley,Susan, (2015). *Weathering and Surface Processes: Major Advances in the Past 25 Years*. National Science Foundation (invited), Arlington, VA, Dec 1, 2015. Arlington, VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Silver,Whendee, L and O'Connell,Christine S., and Gutierrez del Arroyo,Omar, (2016). *What drives the distribution of phosphorus across the landscape?*. INTERFACE phosphorus workshop. INTERFACE phosphorus workshop. Status = OTHER; Acknowledgement of Federal Support = Yes

Wymore, A., D. Ibarra, R. Brereton, K. Maher, and W.H. McDowell (2017). *ritical zone structure controls concentration-discharge relationships and solute generation in forested tropical montane watersheds. "Critical Zone Science: Current Advances and Future Opportunities"*. National CZO meeting. Arlington, VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Other Products

News Article.

Can an ancient ocean shoreline set the stage for a tropical forest of today? https://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=242383&org=NSF&from=news

Authoer Cheryl Dybas

Featuring: Jane Willenbring, Gilles Brocard, Jeffery Wolf, Stephen Porder and Maria Uriarte

Other Publications

features: Kathryn Clark, written by Justin Richardson (2017). *CZO News - June 2017: Research highlight: Studying river biogeochemistry at Luquillo CZO and beyond*. Research Highlight. Status = OTHER; Acknowledgement of Federal Support = Yes

Hopewell, John. Based on article by Maddie Stone and pictures shared by LCZO. (2017). *Hurricane Maria decimated the nation's only tropical rain forest outside Hawaii*. September 29, 2017. The Washington Post. https://www.washingtonpost.com/news/capital-weather-gang/wp/2017/09/29/hurricane-maria-decimated-the-nations-only-tropical-rain-forest/?utm_term=.d226aa91d336. Status = OTHER; Acknowledgement of Federal Support = Yes

Katherine Unger Baillie (2017). *Penn Doctoral Student Probes the Secrets of Ancient Carbon in Tropical Soils*. Penn News (https://news.upenn.edu/news/penn-doctoral-student-probes-secrets-ancient-carbon-tropical-soils). Status = OTHER; Acknowledgement of Federal Support = No

Katherine Unger Baillie (2017). *Puerto Rico 'Data Jam' lets students put their spin on scientific data*. Penn News (https://penncurrent.upenn.edu/news/puerto-rico-data-jam-lets-students-put-their-spin-on-scientific-data). Status = OTHER; Acknowledgement of Federal Support = No

Stone, Maddie; based on an interview with W.H. McDowell (2017). *The Only Tropical Rainforest in the National Forest System Was Devastated by Hurricane Maria*. Earther https://earther.com/americas-only-tropical-rainforest-was-devastated-by-hur-1818827517. Status = OTHER; Acknowledgement of Federal Support = No

Patents

Technologies or Techniques

Thesis/Dissertations

Chapela Lara M.. *Controls on Mg and water fluxes in a highly weathered tropical catchment over different spatial and temporal scales.*. (2016). University of Bristol. Acknowledgement of Federal Support = Yes

Yannis G. Dialynas. *Influence of Linked Hydrologic and Geomorphic Processes on the Terrestrial Carbon Cycle.*. (2017). Georgia Institute of Technology. Acknowledgement of Federal Support = Yes

Elizabeth Coward. *Iron-Carbon Complexation at the Critical Zone: Impacts of Metal Speciation and Ligand Structure*. (2017). University of Pennslyvania. Acknowledgement of Federal Support = Yes

Almaraz, Maya. *Nitrogen Availability and Loss from Managed and Unmanaged Ecosystems*. (2016). Brown University. Acknowledgement of Federal Support = Yes

Miller K.L., Jerolmack D.J.. *The Causes and Consequences of Particle Size Change in Fluvial Systems*. (2014). University of Pennsylvania. Acknowledgement of Federal Support = Yes

Phillips, C.B., Jerolmack, D.J.. *The Control of Grain-Scale Mechanincs on Channel Form Landscape Dynamics, and Climatic Perturbations in Gravel-Bedded Rivers*. (2014). University of Pennsylvania. Acknowledgement of Federal Support = Yes

Websites
Cross CZO ODM2 Admin
https://xczo-odm2admin.ncsa.illinois.edu/XCZO/

A NCSA hosted instance of ODM2 Admin for cross-CZO use. By Miguel Leon.

ODM2 Admin is an open source Django web application available for download from GitHub and DockerHub.It provides tools for data ingestion, QA/QC, data visualization, mapping and documentation of equipment deployment, methods, and citations. Additional features include the ability to generate derived data values, automatically or manually create data annotations and create datasets from arbitrary groupings of results. Over 22 million time series values for more than 600 time series are being managed with ODM2 Admin as well as more than 12,00 soil profile and other measurements. ODM2 Admin links with external identifier systems through DOIs, ORCiDs and IGSNs, so cited works, details about researchers and SESAR earth sample meta-data can be accessed directly from ODM2 Admin. This application is part of a growing open source ODM2 application ecosystem under active development. ODM2 Admin can be deployed along side such tools as ODM2API, and WOFpy which provide access to ODM2 Admin data through a Python API and Water One Flow web services.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Products Supporting File 1.pdf	Meeting Agendas	Alain Plante	11/12/2017
Products Supporting File 2 - LCZO meetings 2016-2017.pdf	LCZO meetings 2016-2017	Alain Plante	11/12/2017
Products Supporting File 3 - CZO all hands meeting.pdf	CZO all hands meeting slides and agenda	Alain Plante	11/12/2017

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
McDowell, William	PD/PI	1
Gonzalez, Grizelle	Co PD/PI	1
Plante, Alain	Co PD/PI	1
Silver, Whendee	Co PD/PI	1
Bastola, Satish	Co-Investigator	6
Brantley, Susan	Co-Investigator	1
Bras, Rafael	Co-Investigator	1
Buss, Heather	Co-Investigator	2
Comas, Xavier	Co-Investigator	1

Name	Most Senior Project Role	Nearest Person Month Worked
Crowl, Todd	Co-Investigator	1
Jerolmack, Doug	Co-Investigator	0
Mayol, Olga	Co-Investigator	2
Porder, Stephen	Co-Investigator	0
Thompson, Aaron	Co-Investigator	2
Willenbring, Jane	Co-Investigator	1
Fernandez, Denny	Faculty	1
Hall, Steven	Faculty	2
Job, Mario	Faculty	1
Marin-Spiotta, Erika	Faculty	0
McGee, Steven	Faculty	1
Ntarlaginannis, Dimitrios	Faculty	1
Perdrial, Julia	Faculty	1
Perdrial, Nicolas	Faculty	1
Pett-Ridge, Julie	Faculty	1
Wang, Jingfeng	Faculty	1
Yang, Wendy	Faculty	1
Arnone, Elisa	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Brocard, Gilles	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Chen, Chunmei	Postdoctoral (scholar, fellow or other postdoctoral position)	4
Clark, Kathryn	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Gross, Avner	Postdoctoral (scholar, fellow or other postdoctoral position)	12

Name	Most Senior Project Role	Nearest Person Month Worked
Guillon, Herve	Postdoctoral (scholar, fellow or other postdoctoral position)	2
Hynek, Scott	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Hyojin, Kim	Postdoctoral (scholar, fellow or other postdoctoral position)	4
Lin, Yang	Postdoctoral (scholar, fellow or other postdoctoral position)	2
O'Connell, Christine	Postdoctoral (scholar, fellow or other postdoctoral position)	9
Ruan, Leilei	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Seiphoori, Ali	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Szabo, Timea	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Van Bueusekom, Ashley	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Wymore, Adam	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Baez Rodriguez, Noelia	Other Professional	1
Brown, Josh	Other Professional	0
Jimenez, Rafael	Other Professional	0
Leon, Miguel	Other Professional	10
Potter, Jody	Other Professional	1
Shattuck, Michelle	Other Professional	3
Bosiak, Matt	Technician	1
Diazgranados, Jorge	Technician	1
Gomez, Nicolas	Technician	1

Name	Most Senior Project Role	Nearest Person Month Worked
Lopez, Carla	Technician	12
Salazar Ortiz, Monica	Technician	0
Sallady, Ryan	Technician	12
Schwaner, Geoff	Technician	0
Snyder, Lisle	Technician	1
Swan, Katherine	Technician	1
Torres, Angel	Technician	0
Yudkin, Brian	Technician	3
Gould, William	Staff Scientist (doctoral level)	0
Martinuzzi, Sebastian	Staff Scientist (doctoral level)	0
Murphy, Sheila	Staff Scientist (doctoral level)	2
Scholl, Martha	Staff Scientist (doctoral level)	2
Shanley, Jamie	Staff Scientist (doctoral level)	2
Stallard, Robert	Staff Scientist (doctoral level)	1
Wood, Tana	Staff Scientist (doctoral level)	1
Almaraz, Maya	Graduate Student (research assistant)	9
Barcellos, Diego	Graduate Student (research assistant)	6
Brereton, Rich	Graduate Student (research assistant)	8
Chapela Lara, Maria	Graduate Student (research assistant)	12
Coward, Elizabeth	Graduate Student (research assistant)	9
Cyle, Taylor	Graduate Student (research assistant)	0
Dialynas, Yannis	Graduate Student (research assistant)	9
Dunne, Kieran	Graduate Student (research assistant)	3
Earll, Marisa	Graduate Student (research assistant)	12

Name	Most Senior Project Role	Nearest Person Month Worked
Gutiérrez del Arroyo, Omar	Graduate Student (research assistant)	12
Harrison, Emma	Graduate Student (research assistant)	12
Hodges, Caitlin	Graduate Student (research assistant)	0
Hoyt, Virginia	Graduate Student (research assistant)	4
King, Elizabeth	Graduate Student (research assistant)	3
Koenig, Lauren	Graduate Student (research assistant)	3
Lee, Dylan	Graduate Student (research assistant)	1
Litwin-Miller, Kim	Graduate Student (research assistant)	0
McClintock, Matthew	Graduate Student (research assistant)	0
Moore, Oliver	Graduate Student (research assistant)	9
Noor, Nadia	Graduate Student (research assistant)	1
Orlando, Joe	Graduate Student (research assistant)	0
Phillips, Colin	Graduate Student (research assistant)	0
Rodriguez, Josely	Graduate Student (research assistant)	0
Santos, Gilmarie	Graduate Student (research assistant)	1
Stone, Maddie	Graduate Student (research assistant)	0
Torres, Elvis	Graduate Student (research assistant)	8
Whiting, Finn	Graduate Student (research assistant)	1
Wilmoth, Jared	Graduate Student (research assistant)	0
Wright, William	Graduate Student (research assistant)	1
Ardington, Emma	Undergraduate Student	1
Aviles, Gabriela	Undergraduate Student	2
Bell-Rosof, Madison	Undergraduate Student	3
Bodek, Sophie	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Casey, James	Undergraduate Student	0
Chang, Bowen	Undergraduate Student	0
Ciaburri, John	Undergraduate Student	0
Crespo, Ashley	Undergraduate Student	0
Earwood, Racheal	Undergraduate Student	1
Gondak, Geneva	Undergraduate Student	0
Kovalovitch, Aria	Undergraduate Student	0
McGrath, Casey	Undergraduate Student	0
Mcharo, Light	Undergraduate Student	1
Mroz, Christina	Undergraduate Student	0
Nunez, Mayra	Undergraduate Student	0
Osota, Elizabeth	Undergraduate Student	3
Pereira, Michelle	Undergraduate Student	0
Phillips, Margaret	Undergraduate Student	0
Rivera, Felipe	Undergraduate Student	2
Rogers, David	Undergraduate Student	3
Rosales, Omar	Undergraduate Student	3
Sanders, Hannah	Undergraduate Student	4
Seawards, Kyle	Undergraduate Student	1
Sherman, Justin	Undergraduate Student	1
Silver, Heather	Undergraduate Student	0
Stien, Rebekah	Undergraduate Student	0
Sullivan, Conor	Undergraduate Student	0
Tamayo, Cooper	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Terry, Neil	Undergraduate Student	1
Tilyou, Mary	Undergraduate Student	1
Traxler, Emily	Undergraduate Student	0
Waldron, Liam	Undergraduate Student	1
Yamamoto, Kana	Undergraduate Student	3
Villanueva, Roberto	High School Student	1
Morales, Flavia	Consultant	0
De Jesus Roman, Albertyadir	Research Experience for Undergraduates (REU) Participant	0
Perez Rivera, Katherine	Research Experience for Undergraduates (REU) Participant	0

Full details of individuals who have worked on the project:

William H McDowell
Email: bill.mcdowell@unh.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Executive Committee Member, responsible for intellectual project integration and stream sensor network

Funding Support: UNH

International Collaboration: No
International Travel: No

Grizelle Gonzalez
Email: ggonzalez@fs.fed.us
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Monitoring of climate and hydrological data, ceilometer data interpretation

Funding Support: USDA FS

International Collaboration: No
International Travel: No

Alain F Plante
Email: aplante@sas.upenn.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Oversees research in soil carbon quality and dynamics. Supervises 1 PhD student, 2 undergraduate students, and co-supervises 1 post-doc. Has established cross-CZO working group in organic matter research.

Funding Support: UPenn

International Collaboration: No
International Travel: No

Whendee Silver
Email: wsilver@berkeley.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Soil Trace Gases, Iron Redox. Oversees post-docs and graduate students.

Funding Support: Univsersity of California Berkely

International Collaboration: No
International Travel: No

Satish Bastola
Email: Satish.bastola@ce.gatech.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 6

Contribution to the Project: Hydrologic modeling; landslide modeling.

Funding Support: Georgia Tech

International Collaboration: No
International Travel: No

Susan L Brantley
Email: brantley@eesi.psu.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Investigates chemical and physical processes associated with the circulation of aqueous fluids in shallow hydrogeologic settings. Supervises a Post-Doc and Masters student.

Funding Support: Penn State

International Collaboration: No
International Travel: No

Rafael Bras
Email: rlbras@gatech.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Hydrologic modeling; landslide modeling.

Funding Support: Georgia Tech

International Collaboration: No
International Travel: No

Heather Buss
Email: h.buss@bristol.ac.uk
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 2

Contribution to the Project: Consulted on borehole drilling, analysis of borehole samples, measurement and analysis of weathering profiles through deep CZ

Funding Support: University of Bristol, LCZO

International Collaboration: Yes, United Kingdom
International Travel: No

Xavier Comas
Email: xcomas@fau.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Work on GPR, deep critical zone science.

Funding Support: Florida Atlantic University

International Collaboration: No
International Travel: No

Todd Crowl
Email: crowl@fiu.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Local coordination and facilities management.

Funding Support: FIU

International Collaboration: No
International Travel: No

Doug Jerolmack
Email: sediment@sas.upenn.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 0

Contribution to the Project: Oversees research related to sediment transport and fluvial processes. Established 3 sediment transport monitoring stations, supervises one PhD student and co-supervises one PhD student.

Funding Support: UPenn

International Collaboration: No
International Travel: No

Olga Mayol
Email: omayol@ites.upr.edu

Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 2

Contribution to the Project: Impacts of African dust on cloud chemical composition and microphysics at Pico Este. Impacts of African dust on radiation. Determination of dust concentrations

Funding Support: UPR

International Collaboration: No
International Travel: No

Stephen Porder
Email: stephen_porder@brown.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 0

Contribution to the Project: Nitrogen and Phosphorus Cycling and limitation

Funding Support: Brown

International Collaboration: No
International Travel: No

Aaron Thompson
Email: AaronT@uga.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 2

Contribution to the Project: Oversees research in soil carbon quality and dynamics. Supervises students and postdocs.

Funding Support: UGA

International Collaboration: No
International Travel: No

Jane Willenbring
Email: erosion@sas.upenn.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 1

Contribution to the Project: Conducting and coordinating all cosmogenic dating studies in the LCZO; Large scale geomorphology.

Funding Support: UCSD

International Collaboration: No
International Travel: No

Denny Fernandez
Email: dsfernandez@gmail.com
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Impacts of African dust on radiation.

Funding Support: UPR-Humacao

International Collaboration: No
International Travel: No

Steven Hall
Email: stevenjh@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Iron redox and soil carbon dynamics

Funding Support: Iowa State University

International Collaboration: No
International Travel: No

Mario Job
Email: mjob@fau.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Support with geophysical surveys

Funding Support: FAU

International Collaboration: No
International Travel: No

Erika Marin-Spiotta
Email: marinspiotta@wisc.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 0

Contribution to the Project: Mechanisms of soil organic matter stabilization Hydrologic controls on carbon & nutrient transport

Funding Support: University of Wisconsin

International Collaboration: No
International Travel: No

Steven McGee
Email: mcgee@lponline.net
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Responsible for K-12 curricula development

Funding Support: Northwestern University and The Learning Partnership

International Collaboration: No
International Travel: No

Dimitrios Ntarlaginannis
Email: dimntar@scarletmail.rutgers.edu

Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Work on electrical resistivity

Funding Support: FAU + Rutgers

International Collaboration: No
International Travel: No

Julia Perdrial
Email: julia.perdrial@uvm.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: DOM (sample and data) analysis of storm Erika samples

Funding Support: University of Vermont

International Collaboration: No
International Travel: No

Nicolas Perdrial
Email: nicolas.perdrial@uvm.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Particulate mineral analsysis of storm Erika samples

Funding Support: UVM

International Collaboration: No
International Travel: No

Julie Pett-Ridge
Email: Julie.Pett-Ridge@oregonstate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Chemical weathering, soil formation, and biogeochemical cycling

Funding Support: Oregon State

International Collaboration: No
International Travel: No

Jingfeng Wang
Email: jingfeng.wang@ce.gatech.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Hydrologic modeling; landslide modeling.

Funding Support: Georgia Tech

International Collaboration: No
International Travel: No

Wendy Yang
Email: wyang@life.illinois.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Iron Redox

Funding Support: University of Illinois

International Collaboration: No
International Travel: No

Elisa Arnone
Email: elisa.arnone@gmail.com
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: Hydrologic modeling; landslide modeling.

Funding Support: Government of Italy

International Collaboration: Yes, Italy
International Travel: No

Gilles Brocard
Email: gbrocard@sas.upenn.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: Conducting cosmogenic dating studies in the LCZO and operating the UPenn cosmogenic lab.

Funding Support: grant

International Collaboration: Yes, Australia
International Travel: No

Chunmei Chen
Email: cmchen@uga.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 4

Contribution to the Project: Conducting research on iron redox processes in LCZO soils.

Funding Support: UGA

International Collaboration: No
International Travel: No

Kathryn Clark
Email: kathryn.clark@ouce.ox.ac.uk

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Synthesis postdoc working on dynamics and properties of fine sediment transport in LCZO streams.

Funding Support: UPenn LCZO

International Collaboration: No
International Travel: No

Avner Gross
Email: avner.gross@berkeley.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 12

Contribution to the Project: redox, Fe, P, C interactions

Funding Support: Israel, LLNL

International Collaboration: No
International Travel: No

Herve Guillon
Email: herve.guillon@univ-grenoble-alpes.fr
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Determining size distribution of fine sediments to determine their source

Funding Support: France

International Collaboration: No
International Travel: No

Scott Hynek
Email: scott.hynek@gmail.com
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: geochronology, geochemical tracers, and isotope geochemistry to understand processes and pathways in modern environments.

Funding Support: USGS

International Collaboration: No
International Travel: No

Kim Hyojin
Email: hxk31@psu.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 4

Contribution to the Project: Post-doc working on geochronology, geochemical tracers, and isotope geochemistry to understand processes and pathways in modern environments.

Funding Support: Penn State

International Collaboration: No
International Travel: No

Yang Lin
Email: yanglin@berkeley.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2

Contribution to the Project: Iron Redox

Funding Support: UC-Berkeley

International Collaboration: No
International Travel: No

Christine Sierra O'Connell
Email: coconn@berkeley.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 9

Contribution to the Project: Redox and greenhouse gas controls

Funding Support: UC-Berkeley

International Collaboration: No
International Travel: No

Leilei Ruan
Email: ruanleil@msu.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: Iron Redox

Funding Support: UC-Berkeley

International Collaboration: No
International Travel: No

Ali Seiphoori
Email: aliseiph@sas.upenn.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Examining composition of suspended sediment sampled from storms

Funding Support: Jerolmack - NIH grant

International Collaboration: No
International Travel: No

Timea Szabo
Email: tszabo.hu@gmail.com

Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 0

Contribution to the Project: Field and theoretical investigations of pebble abrasion

Funding Support: Hungarian Gov.

International Collaboration: Yes, Hungary
International Travel: No

Ashley Van Bueusekom
Email: ashley.vanbeusekom@gmail.com
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 12

Contribution to the Project: responsible for work on cloud ceiling and its effects on forest ecosystems.

Funding Support: USDA FS

International Collaboration: Yes, United Kingdom
International Travel: No

Adam Wymore
Email: Adam.Wymore@unh.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 3

Contribution to the Project: Stream Solutes

Funding Support: UNH

International Collaboration: No
International Travel: No

Noelia Baez Rodriguez
Email: nbaez@ites.upr.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Data Jam organizer

Funding Support: Luquillo LTER

International Collaboration: No
International Travel: No

Josh Brown
Email: luquillo.czo@mail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 0

Contribution to the Project: Assists all LCZO personnel in field work and sample processing in Puerto Rico.

Funding Support: None

International Collaboration: No
International Travel: No

Rafael Jimenez
Email: ajz@sas.upenn.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 0

Contribution to the Project: Conducting research on decadal-scale changes in cloud base.

Funding Support: None

International Collaboration: No
International Travel: No

Miguel Leon
Email: leonmi@sas.upenn.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 10

Contribution to the Project: data manager, responsible for expanding datasets online, working with other CZO managers to ensure comparability of datasets, communications, field work scheduling, and work on data products

Funding Support: UPenn LCZO

International Collaboration: No
International Travel: No

Jody Potter
Email: jody.potter@unh.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: lab manager, responsible for training UNH graduate students in laboratory analyses, and providing ongoing QA/QC of all analytical work for which UNH has responsibility

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Michelle Shattuck
Email: michelle.shattuck@unh.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: assists with grant and sub-contract management including reporting

Funding Support: UNH

International Collaboration: No
International Travel: No

Matt Bosiak
Email: mwz28@wildcats.unh.edu

Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Technician in the UNH Water Quality Analysis Labratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Jorge Diazgranados
Email: jorge.diazgranados@upr.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Impacts of African dust on cloud chemical composition and microphysics at Pico Este. Impacts of African dust on radiation. Determination of dust concentrations

Funding Support: UPR-RP

International Collaboration: No
International Travel: No

Nicolas Gomez
Email: nicolas.x.gomez@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Impacts of African dust on cloud chemical composition and microphysics at Pico Este. Impacts of African dust on radiation. Determination of dust concentrations

Funding Support: UPR-RP

International Collaboration: No
International Travel: No

Carla Lopez
Email: carla.lpez09@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 12

Contribution to the Project: Technician responsible for conducting nutrient addition experiments in streams and assisting with other LCZO field and lab work, recently graduated from UPR

Funding Support: UNH

International Collaboration: No
International Travel: No

Monica Salazar Ortiz
Email: monica.salazar@upr.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: Field Technician

Funding Support: LCZO

International Collaboration: No
International Travel: No

Ryan Sallady
Email: rsalladay@berkeley.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 12

Contribution to the Project: Instrument installation

Funding Support: UC-Berkeley

International Collaboration: No
International Travel: No

Geoff Schwaner
Email: gwj4@wildcats.unh.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: Responsible for field sampling in Puerto Rico in support of all CZO projects

Funding Support: None

International Collaboration: No
International Travel: No

Lisle Snyder
Email: Lisle.Snyder@unh.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Assists with aquatic sensor deployment and maintenance; assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH, NSF

International Collaboration: No
International Travel: No

Katherine Swan
Email: Katherine.Swan@unh.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 1

Contribution to the Project: Technician in the UNH Water Quality Analysis Labratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Angel Torres
Email: ajtorres@usgs.gov
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

Contribution to the Project: Field Technician, collects samples.

Funding Support: USGS

International Collaboration: No
International Travel: No

Brian Yudkin
Email: bay2zh@virginia.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 3

Contribution to the Project: TRACE and LCZO technician

Funding Support: DOE-TRACE

International Collaboration: No
International Travel: No

William Gould
Email: wgould@fs.fed.us
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 0

Contribution to the Project: Planning, data collection, analyses, presentation, and publication of results

Funding Support: USDA FS

International Collaboration: No
International Travel: No

Sebastian Martinuzzi
Email: sebamartinuzzi@gmail.com
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 0

Contribution to the Project: LiDAR analyses and interpretation

Funding Support: University of Wisconsin

International Collaboration: No
International Travel: No

Sheila Murphy
Email: sfmurphy@usgs.gov
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 2

Contribution to the Project: USGS Collaborator on rivers.

Funding Support: USGS

International Collaboration: No
International Travel: No

Martha Scholl
Email: mascholl@usgs.gov
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 2

Contribution to the Project: Isotope Hydrology

Funding Support: USGS

International Collaboration: No
International Travel: No

Jamie Shanley
Email: jshanley@usgs.gov
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 2

Contribution to the Project: Mercury and Carbon Biogeochemistry

Funding Support: USGS

International Collaboration: No
International Travel: No

Robert Stallard
Email: stallard@usgs.gov
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 1

Contribution to the Project: River carbon biogeochemistry

Funding Support: USGS

International Collaboration: No
International Travel: No

Tana Wood
Email: wood.tana@gmail.com
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 1

Contribution to the Project: Warming experiment

Funding Support: USDA FS

International Collaboration: No
International Travel: No

Maya Almaraz
Email: maya_almaraz@brown.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Nitrogen Cycling

Funding Support: Brown

International Collaboration: No
International Travel: No

Diego Barcellos
Email: diego.barcellos@yahoo.com.br
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Conducting research on iron redox processes in LCZO soils.

Funding Support: UGA

International Collaboration: No
International Travel: No

Rich Brereton
Email: rich.brereton@unh.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 8

Contribution to the Project: work describing how riparian flow paths affect stream chemistry

Funding Support: UNH

International Collaboration: No
International Travel: No

Maria Chapela Lara
Email: m.chapelalara@bristol.ac.uk
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Mg isotope analysis, analysis of decoupling of surface and deep nutrient cycles

Funding Support: CONACYT (Mexico) PhD Scholarship; LCZO UNH

International Collaboration: Yes, United Kingdom
International Travel: No

Elizabeth Coward
Email: ecoward@sas.upenn.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Conducting research on iron-organic matter interactions in LCZO soils.

Funding Support: UPenn Ben Franklin Grad Fellowship

International Collaboration: No
International Travel: No

Taylor Cyle
Email: unkown@notsure.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: dissolved organic carbon measurements. Worked to optimize the methodology for the unique extract matrices.

Funding Support: UC- Berkeley

International Collaboration: No
International Travel: No

Yannis Dialynas
Email: ydialynas@gatech.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Hydrologic modeling; landslide modeling.

Funding Support: Georgia Tech, 2006T95, 2006V31

International Collaboration: No
International Travel: No

Kieran Dunne
Email: kdunne@sas.upenn.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Examining controls of river-bank cohesion on challen geometry

Funding Support: UPenn Ben Franklin Grad Fellowship

International Collaboration: No
International Travel: No

Marisa Earll
Email: mearll@ucsd.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Conducting and coordinating geodetic analyses in the LCZO; Large scale hydrology

Funding Support: UCSD

International Collaboration: No
International Travel: No

Omar Gutiérrez del Arroyo
Email: omar.gutierrezdela@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Soil carbon and nutrient cycling controls (i.e., depth, climate)

Funding Support: UC-Berkeley

International Collaboration: No
International Travel: No

Emma Harrison
Email: haem@sas.upenn.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Conducting cosmogenic dating studies in the LCZO and operating the cosmogenic lab.

Funding Support: UCSD

International Collaboration: No
International Travel: No

Caitlin Hodges
Email: chodges@uga.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: conducting field-level assessments of iron reduction potential.

Funding Support: University of Georgia

International Collaboration: No
International Travel: No

Virginia Hoyt
Email: ah1208@wildcats.unh.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 4

Contribution to the Project: Stream Solutes

Funding Support: LCZO

International Collaboration: No
International Travel: No

Elizabeth King
Email: eking@coas.oregonstate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Chemical weathering, soil formation, and biogeochemical cycling

Funding Support: Oregon State, SAVI

International Collaboration: No
International Travel: No

Lauren Koenig
Email: Lauren.Koenig@unh.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Stream Solutes

Funding Support: NSF Fellowship

International Collaboration: No
International Travel: No

Dylan Lee
Email: dylanlee@sas.upenn.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Developing smart rocks for bedload transport analysis

Funding Support: UPenn

International Collaboration: No
International Travel: No

Kim Litwin-Miller
Email: klitwin@sas.upenn.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Conducting research on sediment transport in the LCZO.

Funding Support: UPenn

International Collaboration: No
International Travel: No

Matthew McClintock
Email: mmcclintock316@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Chemical weathering, soil formation, and biogeochemical cycling

Funding Support: Oregon State

International Collaboration: No
International Travel: No

Oliver Moore
Email: oliver.moore@bristol.ac.uk
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Analysis of deep CZ weathering: reactive transport modelling, traditional and synchrotron spectroscopies

Funding Support: NERC (UK) PhD Fellowship

International Collaboration: Yes, United Kingdom
International Travel: No

Nadia Noor
Email: nadia.noor25@uga.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Conducting research on iron redox processes in LCZO soils.

Funding Support: UGA

International Collaboration: No
International Travel: No

Joe Orlando
Email: jjo167@psu.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Research on deep CZO geochronology, tracers.

Funding Support: Penn State

International Collaboration: No
International Travel: No

Colin Phillips
Email: colinp@sas.upenn.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Conducting research on sediment transport and exports of Luquillo streams.

Funding Support: UPenn

International Collaboration: No
International Travel: No

Josely Rodriguez
Email: josely_rodriguez313@hotmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: African Dust Inputs

Funding Support: PRLSAMP fellowship

International Collaboration: No
International Travel: No

Gilmarie Santos
Email: gilmarie17@hotmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Sampling and determination of dust concentrations

Funding Support: UPR

International Collaboration: No
International Travel: No

Maddie Stone
Email: mmstone83@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Conducting research on microbial ecology and organic matter characterization in LCZO soils.

Funding Support: NSF-GRF

International Collaboration: No
International Travel: No

Elvis Torres
Email: elvis.torres810@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 8

Contribution to the Project: Impacts of African dust on cloud chemical composition and microphysics at Pico Este. Impacts of African dust on radiation. Determination of dust concentrations

Funding Support: UPR

International Collaboration: No
International Travel: No

Finn Whiting
Email: unknown@dontknow.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Support with geophysical surveys

Funding Support: FAU

International Collaboration: No
International Travel: No

Jared Wilmoth
Email: jared.wilmoth@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Conducting research on iron redox processes in LCZO soils. PhD student Jared Wilmoth completed his dissertation and secured a postdoc at Oak Ridge National Lab.

Funding Support: UGA

International Collaboration: No
International Travel: No

William Wright
Email: wwrigh19@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Support with geophysical surveys

Funding Support: FAU

International Collaboration: No
International Travel: No

Emma Ardington
Email: eca47061@uga.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with the analysis of soil samples in the lab

Funding Support: UGA

International Collaboration: No
International Travel: No

Gabriela Aviles
Email: gabrielamarie.aviles@upr.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Impacts of African dust on cloud chemical composition and microphysics at Pico Este. Impacts of African dust on radiation. Determination of dust concentrations

Funding Support: UPR-RP

International Collaboration: No
International Travel: No

Madison Bell-Rosof
Email: bemad@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: UPenn LCZO

Funding Support: Assisting with laboratory experiments on organic matter characterization in LCZO soils.

International Collaboration: No
International Travel: No

Sophie Bodek
Email: sopbodek@sas.upenn.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Conducting research on sediment transport and exports of Luquillo streams.

Funding Support: UPenn-PURM Fellowship

International Collaboration: No
International Travel: No

James Casey
Email: jdf74@wildcats.unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Bowen Chang
Email: bchang@sas.upennedu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisting PhD student on nutrients and topography participated in fieldwork with Willenbring

Funding Support: PURM fellowship

International Collaboration: No
International Travel: No

John Ciaburri
Email: jvk29@wildcats.unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Ashley Crespo
Email: acrespo@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisting with laboratory experiments on organic matter characterization in LCZO soils.

Funding Support: None

International Collaboration: No
International Travel: No

Racheal Earwood
Email: rachel.earwood25@uga.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with the analysis of soil samples in the lab

Funding Support: UGA, NSF

International Collaboration: No
International Travel: No

Geneva Gondak
Email: ggondak@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Undergrad research assistant for geomorph group

Funding Support: UPenn LCZO

International Collaboration: No
International Travel: No

Aria Kovalovitch
Email: ariakov@sas.penn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisting PhD student usign experiments on wormholes and soils and participated in fieldwork with Willenbring

Funding Support: PURM fellowship

International Collaboration: No
International Travel: No

Casey McGrath
Email: crm12@wildcats.unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Light Mcharo
Email: cal1037@wildcats.unh.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Christina Mroz
Email: notknown@unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Mayra Nunez
Email: mnunez@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisting with laboratory experiments on organic matter characterization in LCZO soils.

Funding Support: UPenn LCZO

International Collaboration: No
International Travel: No

Elizabeth Osota
Email: elizabeth.osota25@uga.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Field work in Puerto Rico and assistance in the lab analyzing samples

Funding Support: UGA

International Collaboration: No
International Travel: No

Michelle Pereira
Email: pereiram@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisting with laboratory experiments on fine sediment characterization in LCZO streams.

Funding Support: UPenn

International Collaboration: No
International Travel: No

Margaret Phillips
Email: mp1060@wildcats.unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Felipe Rivera
Email: felipe.rivera08@hotmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Impacts of African dust on cloud chemical composition and microphysics at Pico Este. Impacts of African dust on radiation. African dust and radiation

Funding Support: UPR-RP

International Collaboration: No
International Travel: No

David Rogers
Email: davrog@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Development of R scripts for color and thermal analyses of soils

Funding Support: UPenn LCZO

International Collaboration: No
International Travel: No

Omar Rosales
Email: omarrosalescortez@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Undergrad REU student working with Willenbring

Funding Support: SURF REU

International Collaboration: No
International Travel: No

Hannah Sanders
Email: hansan@sas.upenn.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 4

Contribution to the Project: Assisting with laboratory experiments on organic matter characterization in LCZO soils.

Funding Support: UPenn LCZO, Penn CURF

International Collaboration: No
International Travel: No

Kyle Seawards
Email: kgs2010@wildcats.unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Justin Sherman
Email: jsherman7732@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Heather Silver
Email: silverh@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisting with laboratory experiments on organic matter characterization in LCZO soils.

Funding Support: UPenn

International Collaboration: No
International Travel: No

Rebekah Stien
Email: unknown@notsure.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Nitrogen Cycling

Funding Support: Brown

International Collaboration: No
International Travel: No

Conor Sullivan
Email: unknown2@notsure.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Nitrogen and Phosphorus limitation

Funding Support: Brown

International Collaboration: No
International Travel: No

Cooper Tamayo
Email: unknown3@notsure.com3
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: nutrient cycling

Funding Support: Brown

International Collaboration: No
International Travel: No

Neil Terry
Email: nterry@usgs.gov
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Work on electrical resistivity

Funding Support: CZO Savi Summer intern + FAU

International Collaboration: No
International Travel: No

Mary Tilyou
Email: mtilyou@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisting with laboratory experiments on organic matter characterization in LCZO soils.

Funding Support: UPenn Velay Fellowship

International Collaboration: No
International Travel: No

Emily Traxler
Email: etraxler@purdue.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

Contribution to the Project: Assisting with laboratory experiments on organic matter characterization in LCZO soils.

Funding Support: None

International Collaboration: No
International Travel: No

Liam Waldron
Email: lkw1003@wildcats.unh.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assists with analyses at the UNH Water Quality Analysis Laboratory where stream and groundwater samples are analyzed

Funding Support: UNH WQAL

International Collaboration: No
International Travel: No

Kana Yamamoto
Email: kyamamoto95@berkeley.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Redox and litter decomposition

Funding Support: UC-Berkeley

International Collaboration: No
International Travel: No

Roberto Villanueva
Email: roberto.villanueva@uga.edu
Most Senior Project Role: High School Student
Nearest Person Month Worked: 1

Contribution to the Project: Assisted with the analysis of soil samples in the lab

Funding Support: UGA

International Collaboration: No
International Travel: No

Flavia Morales
Email: fmorales.upr@gmail.com
Most Senior Project Role: Consultant
Nearest Person Month Worked: 0

Contribution to the Project: Determination of dust concentrations

Funding Support: UNH

International Collaboration: No
International Travel: No

Albertyadir De Jesus Roman
Email: albertyadir@yahoo.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 0

Contribution to the Project: REU student from UPR conducting nutrient addition experiments in streams

Funding Support: UNH

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: University of Puerto Rico
Government fiscal year(s) was this REU participant supported: 2016

Katherine Perez Rivera
Email: kathxpr.027@live.com
Most Senior Project Role: Research Experience for Undergraduates (REU) Participant
Nearest Person Month Worked: 0

Contribution to the Project: REU student from UPR conducting nutrient addition experiments in streams

Funding Support: UNH

International Collaboration: No
International Travel: No
Year of schooling completed: Junior
Home Institution: University of Puerto Rico
Government fiscal year(s) was this REU participant supported: 2016

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Budapest University of Technology and Economics	Academic Institution	Budapest, Hungary
Columbia University	Academic Institution	New York, NY
Università degli Studi di Palermo	Academic Institution	Palermo (PA), Italy
Hebrew University of Jerusalem, Israel	Academic Institution	Jerusalem, Israel
Oregon State University	Academic Institution	Corvallis, OR
University of Grenoble	Academic Institution	Grenoble, France
University of Maine	Academic Institution	Orono, ME
University of Miami	Academic Institution	Miami, Florida
University of Puerto Rico at Mayagüez	Academic Institution	Mayagüez, Puerto Rico
University of Puerto Rico – Humacao	Academic Institution	Humacao, Puerto Rico

Name	Type of Partner Organization	Location
University of Wollongong	Academic Institution	Wollongong, Australia

Full details of organizations that have been involved as partners:

Budapest University of Technology and Economics

Organization Type: Academic Institution
Organization Location: Budapest, Hungary

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Collaborator Domokos serves as mentor and external advisor to LCZO PhD student Litwin, and Domokos' PhD student has performed research at LCZO.

Columbia University

Organization Type: Academic Institution
Organization Location: New York, NY

Partner's Contribution to the Project:
In-Kind Support
Collaborative Research

More Detail on Partner and Contribution: Maria Uriarte from Columbia University has a postdoc who just started (May 2015) and is interested in working with the CZO LiDAR data. Their interests are primarily in quantifying vegetation structure (e.g., biomass, LAI) and examining underlying drivers (e.g., topography, elevation, etc). LiDAR-derived vegetation metrics will be used for models.

Hebrew University of Jerusalem, Israel

Organization Type: Academic Institution
Organization Location: Jerusalem, Israel

Partner's Contribution to the Project:
Facilities

More Detail on Partner and Contribution: Dr. Alon Angert, Hebrew University of Jerusalem, Israel, is an expert on phosphorus in dust and he and his group are collaborating with H4.3 to identify airborne sources of phosphorus using stable isotopes of dust aerosol samples.

Oregon State University

Organization Type: Academic Institution
Organization Location: Corvallis, OR

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

University of Grenoble

Organization Type: Academic Institution
Organization Location: Grenoble, France

Partner's Contribution to the Project:
In-Kind Support
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution: Herve Guillon has planning a field campaign with us to measure grain size distribution of fine sediments, using technology developed by critical zone researchers in France.

University of Maine

Organization Type: Academic Institution
Organization Location: Orono, ME

Partner's Contribution to the Project:
Facilities
Collaborative Research

More Detail on Partner and Contribution: Dr. Stom Ohno, at the University of Maine, is a key collaborator on the characterization of DOM samples by FT-ICR-MS. Through his collaboration, we were able to submit samples to Dr. Pat Hatcher's lab. Dr. Ohno also provided expertise in the analysis and interpretation of the FT-ICR-MS, and will be a co-author on a pending publication.

University of Miami

Organization Type: Academic Institution
Organization Location: Miami, Florida

Partner's Contribution to the Project:
Facilities
Collaborative Research

More Detail on Partner and Contribution: Dr. Prospero's group from the University of Miami is collaborating with H4.3 for the determination of the dust concentrations.

University of Puerto Rico at Mayagüez

Organization Type: Academic Institution
Organization Location: Mayagüez, Puerto Rico

Partner's Contribution to the Project:
Collaborative Research
Other: Led part of the annual meeting field trip to introduce meeting participants to the caves.

More Detail on Partner and Contribution:

University of Puerto Rico – Humacao

Organization Type: Academic Institution
Organization Location: Humacao, Puerto Rico

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution: Dr. Denny Fernandez, from the University of Puerto Rico – Humacao is collaborating with H4.3 on the impact of African dust on radiation at Pico del Este.

University of Wollongong

Organization Type: Academic Institution
Organization Location: Wollongong, Australia

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Università degli Studi di Palermo

Organization Type: Academic Institution
Organization Location: Palermo (PA), Italy

Partner's Contribution to the Project:
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution:

What other collaborators or contacts have been involved?

Focal Area 1

Eric Roden (University of Wisconsin) – deep critical zone microbial processes

Raymond Fletcher (Penn State): stress modeling.

Dimitrios Ntarlagiannis (Rutgers University, Newark) - electrical resistivity and induced polarization (IP) measurements

Neil Terry (currently USGS) - electrical resistivity measurements

Maria Uriarte (Luquillo LTER scientist Columbia University) - airborne imagery

Focal Area 2

We have collaborated with scientists at Lawrence Livermore National Lab (Jennifer Pett-Ridge) and Lawrence Berkeley National Lab (Peter Nico)

Gabor Domokos - a Hungarian mathematician who has developed the geometric theory for how pebbles round.

Focal Area 4

Dr. Leonardo V. Noto and Dr. Elisa Arnone from Università degli Studi di Palermo, have collaborated from home Organization with suggestions, reviews and writing papers.

Paul Miller University of Georgia

Education and Outreach

the CZ InTeGrate course team includes:

Tim White (National Office and Penn State)

Ashlee Dere (University of Nebraska, Omaha, SSHCZO alum)

Adam Hoffman (University of Dubuque)

Martha Conklin (UC Merced, Southern Sierra CZO)

James Washburne (University of Arizona, CJ CZO)

Impacts

What is the impact on the development of the principal discipline(s) of the project?

Focal Area 1

- Geophysical surveys in Luquillo show the potential for better understanding critical zone dynamics non-invasively and at multiple scales of measurement. The use of geophysical methods specifically designed to make data acquisition more efficient, shows how large scale surveys (at the km scale) can be collected very efficiently in just a few hours. These surveys are particularly relevant and powerful when combined with other direct methods (i.e. geochemical measurements, direct coring).
- Our work is providing a basis for understanding the importance of the deep CZ to surface processes and issues, including hydrologic and nutrient fluxes and soil fertility and security, or fracture distribution and development.

Focal Area 2

- Collaborating with geochemists, soil scientists, and watershed hydrologists the LCZO has produced some of the most detailed integrated assessments of biogeochemistry of the tropical critical zone. The work is establishing a new understanding of the controls on C and nutrient cycling, water and nutrient export, and how physical factors contribute to the patterns observed. Specifically, our work has demonstrated patterns in redox across the landscape identifying hot spots and hot moments in biogeochemical cycling, redox controls on Fe-C interactions across different mineralogies, how microbial enzyme activities varies through the critical zone and contribute to C and nutrient mineralization, and how patterns in redox in space and time impact Fe phases and associated C, nutrient, and greenhouse gas fluxes.

Focal Area 3

- We have shown novel connections between atmospheric inputs, soils, biota and landscape in Puerto Rico.
- We have shown that the topographic form of the mountains are a legacy of a past geologic history that sets the pace of landscape change.
- We have shown that extreme events should have only limited impact on landscape erosion. The influence of extreme events on landscapes is a hotly debated topic.
- We have demonstrated that pebble shape contains information to determine abrasion rate and sediment provenance, adding a new tool to the community for addressing these questions.
- We have shown how to relate pebble transport to flood momentum, developing a framework that researchers can use to interpret and determine bed-load flux from widely used “radio rocks”.

Focal Area 4

Characterization of hydrologic feedbacks to hot spots and hot moments in landslide occurrence and sediment transport and cycling of nutrient in soil and plant system are the most important aspect of this work. The distributed hydro-geomorphic model and dynamic ecohydrological model as used in this project resolves important physical processes in both space and time, at scales relevant to landslide occurrence and to the balance of carbon in plant and soil system. The model is also the integrator of carbon dynamics and nutrient cycling at watershed scale. The process based models are advantageous over empirical approaches as they represent underlying physical laws of soil dynamics, nutrient cycling and hydrologic processes in data scarce spatially complex built terrains. The analysis spans a range of scales, capturing the small scale complexity of sediment transport and nutrient cycling in assessing the watershed integrated response in terms of soil organic carbon fluxes.

With increasing availability of high resolution topography, geological and biogeochemical datasets, the models developed in this work are able to reproduce spatiotemporal distributions of sediment transport, primary productivity, and of soil organic carbon content at different soil profiles. The coupled spatially-explicit formulations can be used in landslide studies and landslide warning systems. The models are applied to simulate the topsoil erosion and landslide occurrence for the two climatic scenarios (2016-2099). The model is also applied to simulate net primary productivity for the 36 plausible future climate scenarios for the Mameyes watershed. The dynamic eco-hydrological model developed in this project has the potential to assist the installation of biogeochemical observatories at landscape scale.

What is the impact on other disciplines?

- Better understanding of the deep critical zone and feedbacks between the deep critical zone and the surface environment (vegetation, shallow soil, atmosphere) is contributing to better understanding of paleoclimate records and paleoclimate models. Dr. Heather Buss is involved in an EU-funded paleoclimate project in which LCZO insights are directly contributing.
- The biogeochemists and geochemists have collaborated with watershed modelers to scale up our work.
- Our results linking life and landscape are transformative and illustrate the importance of the subsurface when considering biota and community structure. These results have demonstrated impact for geoscientists but also to highlight the critical nature of the subsurface for biologists and ecologists.
- We are showing the ways in which climate does and does not influence the style and pace of landscape erosion, and the export of particles and solutes that influence ecosystem function and water quality.
- The LCZO has the potential to impact the field of education research. Little is known about student development of informal statistical reasoning. The Data Jam provides a rich context for exploring this area of research. Students have been successful at developing basic graphical displays of data and interpreting the visual displays. There are no opportunities to investigate how to support students in applying mathematical thinking practices to conduct statistical comparisons.

What is the impact on the development of human resources?

- McDowell, W.H. 2017. Received the 2017 Distinguished Professor Award. The purpose of this award is to identify and honor longstanding members of the faculty. This singular university-wide award will be given each year to the faculty member whose overall record of excellent teaching, caring about students, devotion to the university community and substantial record of scholarly achievement exemplifies what we would call a ‘distinguished career’
- At Bristol, over the past 2 years, 57 undergraduates have taken a course in Soils and the Critical Zone, and now know about CZO networks, the concept of critical zone science, and the questions and processes involved in the study of the CZ.
- Also at Bristol, Oliver Moore has defended his PhD focusing on the LCZO and PhD student Nick Hayes is using cross-CZO deep critical zone weathering profiles to inform palaeoclimate models.
- At FAU more than 100 students over the past two years have taken either graduate or undergraduate classes showing datasets that exemplify the potential of near surface geophysics for understanding critical zone processes. Many of those students are therefore now more familiar with the concept of critical zone and some of its processes.
- At Brown one PhD student (Almaraz, a Hispanic woman now working on an NSF funded post doc), one MS student (Susanna Mage), and three undergraduates (Rebecca Stein, Harmony Lu, Jesse Bateman) have worked in the CZO sites. Bateman (an African American) pursued graduate school and recently completed his PhD in Earth System Science at Stanford.

- The project has supported a doctoral student. A research engineer and a visiting professor have also participated and learned new modeling approaches.
- PhD student Elvis Torres (UPRRP – Mayol) presented his results on African dust as a source of nutrients to Pico Este cloud forest at the Science Conference of the International Global Atmospheric Chemistry (IGAC) program 2016.
- PhD student Gilmarie Santos-Figuaroa – lead author on one presentation at AGU 2016 (G. Santos, O.L. Mayol-Bracero)
- Undergraduate students Gabriela Aviles y Felipe Rivera were trained in aerosol and/or cloud sampling and analyses, and on how to present their scientific results in oral and poster presentations
- The LZCO is providing rich access to environmental datasets to Hispanic students throughout the island of Puerto Rico. In addition, the Data Jam students benefit from direct access to LCZO scientists. The combination of access to authentic datasets and scientists provides the ingredients for enabling students to pursue STEM college degrees.

What is the impact on physical resources that form infrastructure?
Nothing to report.

What is the impact on institutional resources that form infrastructure?
Nothing to report.

What is the impact on information resources that form infrastructure?

LCZO data manager, Miguel Leon, has led a cross-CZO effort to develop network level data products presented on cricitalzone.org. Network data products for weather stations, LiDAR, discharge, stream chemistry are now available. Network data products for vegetation, soil carbon, precipitation, Soil CO2 and O2, Flux Tower and Soil Chemistry are being developed.

What is the impact on technology transfer?

We have continued to advance our data management platform ‘ODM2 Admin’ (https://github.com/ODM2/ODM2-Admin) based on ODM2 and now an official part of the ODM2 software ecosystem (https://github.com/ODM2). We have established a partnership with CUAHSI and deployed ODM2 Admin as part of the CZIMEA (critical zone integrative microbial ecology activity project, the Catalina-Jemez CZO with additional deployments to the Dry Creek Experimental Watershed managed by Boise State and the Michigan State Hydrogeology lab. ODM2 Admin has been presented at two workshops and a conference with additional presentations planned at AGU 2017 and the BiG CZ workshop November 2017. As part of our collaboration with CUAHSI data managed in ODM2 Admin will be publishable through data.cuahsi.org and able to receive DOIs through Hydroshare linking these systems into a common computing platform.

Landsliding is the source of extraordinary infrastructure damage, land degradation and loss of lives. Carbon capture and release is a key component of the climate equation. The tools developed here can be used for planning, prediction and prevention and to develop management practices to control landslides and increase carbon capture. Furthermore, the ecohydrological model developed in this study can aid in developing comprehensive biogeochemical observational system at land scape scale.

What is the impact on society beyond science and technology?
Nothing to report.

Changes/Problems

Changes in approach and reason for change

The Jerolmack group has collaborated significantly with Gabor Domokos, a Hungarian mathematician who has developed the geometric theory for how pebbles round. A chance contact was then leveraged by LCZO into a field collaboration to test his theory, and has led to all of our work on rounding and abrasion of grains during sediment transport.

A French postdoc Herve Guillon initiated contact following a presentation of LCZO work by Jerolmack in the UK. This has led to a collaboration to translate technology from France to LCZO to perform in-situ measurements of fine-particle size distribution which is a major challenge and blind spot in our assessment of fine-sediment dynamics.

Actual or Anticipated problems or delays and actions or plans to resolve them
Nothing to report.

Changes that have a significant impact on expenditures
Nothing to report.

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.