My Desktop
Prepare & Submit Proposals
New! Prepare Proposals (Limited proposal types)
Prepare Proposals in FastLane
Proposal Status
Awards & Reporting
Notifications & Requests
Project Reports
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 - 11/30/2020
Reporting Period:	12/01/2018 - 11/30/2019
Submitting Official (if other than PD\PI):	William H McDowell Principal Investigator
Submission Date:	12/10/2019
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	William H McDowell

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 interrelated 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 174 scientific publications and given over 578 presentations at scientific and public meetings over the course of the project. Over the past year, the team published 36 papers, and made 65 presentations at national and international meetings. The LCZO is actively training students and young professionals in the field. Fourteen of the 26 papers published were authored or co-authored by at least one post-doctoral researcher or graduate student. Seven of 11 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 65 presentations given during this reporting year, post-docs and graduate students participated in 18 presentations. Graduate students have produced 16 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 Zoom 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, encourage integration across focal areas and discuss education and outreach activities. The annual all-hands LCZO meeting in Puerto Rico was held from June 5-8, 2019. On the first day, a joint poster session was held with the Luquillo LTER, with 20+ posters including two from K-12 student participants from the LCZO/LTER Data Jam. Four students and two teachers involved in the Data Jam attended and interacted with LCZO and LTER scientists. On Thursday the 6th, overview presentations were given by Bill McDowell on the general project and stream chemistry, geophysics by Xavier Comas, soils by Aaron Thompson and Whendee Silver, hydrology by Jamie Shanley, landform evolution by Jane Willenbring, and cloud observations and meteorology by Ashley Van Buesekom. Following this lightning talks were given by all participants, then two additional longer presentations were presented by Miguel Leon on publishing data online and Stephen Hughes of the University of Puerto Rico Mayagüez on characterizing hurricane induced landslides. In the afternoon breakout groups were organized based on integrative questions to better inform conceptual models 1) better quantification of atmospheric inputs, 2) linking hillslope processes with stream solute and greenhouse gas dynamics, 3) At what depth do surface processes and deep CZ structure interact? 4) How might we build on the NEON presence in PR? Extensive discussions in these breakout groups continued on Friday including discussion around how these integrative topics could be used to inform new proposals for the CZCN RFP. Additional presentations were given on Friday, focused on topics including linking University of Puerto Rico students to LCZO activities (Carla López Lloreda), the DOE-funded TRACE project by Tana Wood, and a discussion of using suspended sediment to assess critical zone drivers of watershed resilience to extreme events by Diana Karwan. The poster session continued through lunch, then the Advisory committee members Mattew Larsen, Jérôme Gaillardet, and Ariel Luquo presented their assessment of the LCZO and discussed synthesis work that should be completed before the end of LCZO funding. Finally the meeting concluded with two field trips, one to see the relative lack of vegetative recovery from Hurricane Maria in the Icacos watershed and another on Saturday to visit the ‘pockmarked’ landscape and coves near Rio Sabana. Sampling was done during this field trip for algae and water samples for water and gas chemistry. The agendas for the LCZO annual all-hands meeting and the LCZO All-Scientist webinars are attached in the Products Supporting File 1 PDF.

Numerous papers are in preparation that describe the impacts of Hurricanes Irma and Maria on soil carbon stocks, soil microbes, soil solution, and stream chemistry.

The accomplishments of the LCZO from September 2018 through September 2019 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

H1.1.1. Publish paper 'The effects of lithology on trace element and REE behavior during tropical weathering'.

H1.1.2. Revise and publish paper 'Incipient chemical weathering at bedrock fracture interfaces in a tropical critical zone system, Puerto Rico'.

H1.1.3. Analyze the results of Mg and Li isotope measurements to estimate the relative contribution of biological and geochemical reactions in the cycling of rock-derived nutrients.

H1.1.4. Investigate the specific minerals that impart the chemical signature of the deep critical zone fluids and the baseflow at granitic and volcaniclastic streams.

H1.1.5. Revise and publish paper "Understanding fracture distribution and its relation to knickpoint evolution in the Rio Icacos (RI) watershed (Luquillo Critical Zone Observatory, Puerto Rico) using landscape-scale hydrogeophysics"

H1.1.6. Prepare datasets for publication on the comparison of regolith distribution at the Rio Icacos and Sabana watersheds using near-surface geophysical methods.

H1.1.7. Process datasets to test the potential of GPR for understanding moisture content distribution along tree trunks for several species along topographic gradients.

H1.1.8. Revise and resubmit paper 'How fractured lithologies impact stream chemistry in the Luquillo Mountains, Puerto Rico'

H1.1.9. Write and publish paper 'Particle transport in subsurface during tropical weathering of granitoid lithologies'.

H1.1.10. Write and publish paper 'Initiation of weathering of quartz diorite in Luquillo Mountains, Puerto Rico'

H1.2

H1.2.1. Submit Harrison et al. paper 'Global Rates of Soil Production are Independent of Soil Depth' to Nature.

H1.2.2. Revise and Resubmit paper for JGR-Earth Surface: 'Dynamic Critical Zone architecture driven by subsurface flow in the Luquillo Mountains, Puerto Rico' by Harrison et al.

H1.2.3. Write and publish paper 'Worm-driven impacts on the Si-budget in the Luquillo Mountains, Puerto Rico' by Harrison et al.

H1.2.4. Write and publish paper 'Linking soil and weathering front development from coupled cosmogenic nuclide-derived soil production rates and U-series in the Luquillo Mountains, Puerto Rico' by Harrison et al.

Focal Area 2

Test the following hypotheses:

H2.1

P amendment experiment

- Phosphorus amendment will increase Fe reduction, soil respiration, and microbial C and P content under anoxic conditions, indicative of P limitation.
- Soil Fe reduction, respiration, and microbial biomass will be more sensitive to P amendment in higher elevation sites, as these soils contain less inorganic P and likely experience stronger P limitation.
- The extent of soil C loss via CO2, CH4, and DOC production will be regulated by Fe reduction rates, which in turn are affected by redox history.

Hurricane project

- Hurricane Maria would greatly increase debris deposition to the soil surface and increase microbial processing of C, P, and Fe.

H2.2a

Temperature sensitivity experiment

- Anaerobic metabolic processes such as anaerobic respiration, Fe reduction, and methanogenesis will have similar temperature sensitivity as aerobic metabolism.

Field Fe cycling experiment

- Rapid fluctuations in soil O2 availability in humid tropical forest soils drive high rates of Fe-redox cycling and associated C mineralization.

H2.2b

- The chemical composition of dissolved organic matter (DOM) extracted during selective dissolution experiments varies considerably. We hypothesize that the unextracted organic matter (which is a considerably large fraction) will have a uniform composition.
- The persistence of mineral associated organic matter depends on how the organic matter minerals associations are formed.
- Exposure to Fe(II), which is present during anaerobic conditions, will decrease the availability of the mineral associated organic matter.

Focal Area 3

H3.1

Resume high flow sampling to capture hot moments associated with Maria-induced and subsequent landslides.

H3.2

We wrote and submitted a paper on how times of high hurricane activity impacts erosion rates over the last 25 ky ago using meteoric 10Be and stable isotopes from carbon deposited in the floodplain of the Rio Fajardo.

H3.3

- Continue to collect stream samples in watersheds with contrasting lithology, the Icacos (intrusive quartz diorite), Mameyes (volcaniclastic terrain) and Sonadora (hornfels) watersheds.
- Maintain water quality sensors in the Icacos and Sonadora watersheds

- Sample 35 stream sites that vary in watershed characteristics. These sites were sampled on an annual basis since 2000 (supported by other funding sources) and are in addition to the LTER stream sites that are sampled weekly. Sampling frequency was increased to every 2-3 months following Hurricanes Irma and Maria in Fall 2017.
- Deploy an autosampler on the Sonadora to assess TSS and solute delivery to the stream following Hurricanes Irma and Maria.
- Synthesize hydrologic understanding from diverse studies, including recent geophysical work, to provide stronger hydrologic context for biogeochemical interpretation.

Focal Area 4

H4.1

- Study the impact of hurricane disturbances and subsequent recovery on carbon balance using census data from LTER (Completed)
- Study the impact of hurricane disturbances and subsequent recovery on carbon balance under IPCC climate scenarios using a terrestrial biosphere model—the Ecosystem Demographic Biosphere (ED2) models (In progress).

H4.2

- Analyze post-hurricane meteorology and cloud immersion at camera sites and ceilometer site.

H4.3

- Analyze water and nutrient deposition in cloud and rain water samples under the influence of African dust.
- Determine dust concentrations.

Education and Outreach

- Publish: Dere A. et al. Implementing and Assessing InTeGrate Critical Zone Science Materials in an Undergraduate Geoscience Program. In: Gosselin D., Egger A., Taber J. (eds) Interdisciplinary Teaching About Earth and the Environment for a Sustainable Future. AESS Interdisciplinary Environmental Studies and Sciences Series. Springer, Cham.
- Contribute to the development of the Data Jam model by supporting teachers and students in exploring, analyzing and summarizing long-term LCZO data about the environment and then creatively communicating their discoveries to non-scientific audiences.

Significant Results:

Focal Area 1

H1.1

H.1.1. Using trace elements, we found that dust inputs are the main source of a plethora of rock-derived elements to soils at both QD and VC regolith profiles. These dust inputs can be traced down to ~2 m depth at ridgetops over both lithologies. We also found significant differences in nutrient cycling processes between the VC site, where trace element behavior is controlled mainly by redox-mediated, sorption/desorption reactions, and the QD site, where pH-controlled dissolution/precipitation and sorption reactions predominate. The most noticeable difference between regolith profiles developed over the two different lithologies is in the long-term redox conditions (more variable and stratified in the VC site).

H.1.2. In this paper we show that, despite its low abundance (~0.5 vol.%), pyrite oxidation is the limiting step of weathering advance in the VC bedrock. Lowering the pH of porewater then accelerates the dissolution of silicate minerals. We also found that the vast majority of primary minerals are lost within the weathering rinds that form along fracture surfaces (mm scale).

H.1.3. Our preliminary results show that most of the rock-derived nutrients are cycled via geochemical processes, with little influence of biological processes. An additional result is that Li and Mg isotopes also show dust inputs down to 2 m depth at both QD and VC ridgetop profiles.

H.1.4. Our preliminary Li and Mg isotope results indicate that in a VC site the composition of the stream baseflow is controlled by the dissolution of chlorite in the deep critical zone (>20 m depth), whereas in a QD site it is the dissolution of plagioclase and biotite at the bedrock-saprolite transition (<7 m depth) that determine the composition of the stream baseflow.

H1.1.5. In this paper geophysical methods are used to quantify the width of fractured and weathered zones along the kickzone in RI and show an increase with proximity to the knickpoint that was attributed to dilation of sub-vertical fractures. Stress modeling confirms this hypothesis and was used in combination with geophysical datasets to hypothesize that erosion rates increase in the knickzone because of the dilation of fractures.

H1.1.6. Results confirm that soil and saprolite increase thickness in the upstream direction, and are particularly thick in slowly eroding areas when compared to areas with higher erosion rates. The study also confirms the value of multi-method geophysical approaches for imaging the critical zone at a wide array of scales of measurement (from cm to km) and resolutions (from mm to m).

H1.1.7. This study shows the potential of the method to non-invasively investigate the spatial distribution of moisture content in a variety of trees and opens the door for further measurements to include two-dimensional models of water content distribution both in space and time when expanding surveys in time-lapse mode.

H1.1.8. This paper summarizes water chemistry in three lithologies and relates differences in stream chemistry to differences in rock chemistry and fracture distributions.

H1.1.9. This new paper documents that millimeter sized particles move in the subsurface of the quartz diorite during weathering in LCZO. These particles break off the rindlets during spheroidal weathering of the quartz diorite corestones. This is important because models of subsurface transport always emphasize movement of solutes or colloids. In the dynamic environment of weathering in Luquillo, large particles move in subsurface as well.

H1.1.10. This new study is targetting how biotite affects and promotes the initiation of weathering of the quartz diorite. We are using Raman spectroscopy, scanning electron microscopy, transmission electron microscopy, and electron microprobe to complement bulk chemical analysis.

H1.2

H1.2.1. We report compiled global rates of soil production (including new rates from Luquillo) and soil depth and report a new, important finding that rates of soil production are independent of soil thickness.

H1.2.2. We show that groundwater discharge has measurable effects on erosion rates of small catchments in the relict/upland portion of the Luquillo Critical Zone Observatory.

H1.2.3. We measured the quartz size fractions in bedrock, sparolite and soil profiles and used 10Be concentrations in coarse sand and medium and fine (non-dust sized) sand to understand the transit time of particle movement of quartz in soils. We find that fine sand resides longer in soils than coarse quartz sand and provide a fining mechanism (e.g. worm digestion) and make inferences about the impact of worms on the Luquillo Mountain Si budget.

H1.2.4. We received support from a SAVI grant to analyse a transect of cores taken for U-series analysis from the knickpoint into relict topography and discovered that the weathering ages are very similar despite differences in soil erosion rates and soil thicknesses.

Focal Area 2

H2.1

- Our results show that, in contrast to our first hypothesis, anaerobic processes including Fe reduction, methanogenesis, and anaerobic soil respiration were not consistently limited by P availability in three soils along the rainfall gradient. Aerobic respiration, on the other hand, was improved by P amendment in all three soils, indicative of P limitation on microbial activity.
- Our results also do not support the second hypothesis, as anaerobic respiration, Fe reduction, and methanogenesis were most sensitive to P amendment in the soil with the lowest mean annual rainfall and highest inorganic P concentration.
- We also found that Hurricane Maria increased the concentrations of organic P and acid-extractable Fe across the rainfall gradient. Increases in organic P also led to higher soil total P after the hurricane, while the inorganic P pool was largely unaffected by hurricane.

H2.2a

- We found that soil carbon dioxide (CO_2) production increased exponentially with temperature in both oxic and anoxic mesocosms. The Q10 value of CO_2 production was significantly higher under oxic (2.20 ± 0.11) than under anoxic conditions (1.47 ± 0.10). Soil CH_4 emissions at 26 °C were comparable or somewhat higher than those at 35 °C, indicative of a weak temperature dependency. Soil samples from 8 °C had significantly lower levels of Fe(II) than those from higher temperature, and no difference was observed between the 26 and 35 °C treatments, suggesting that Fe reduction may not be sensitive to warming in this soil.
- By analyzing the regular field measurements using a variety of statistical models we find the soil moisture and precipitation was the main explanatory parameter for all parameters, including Fe(II) concentrations and the amount of rapidly reducible Fe(III). In addition, we found that depending on soil parameter considered (e.g, Fe(II), DOC, etc.) we needed to use a different length of sensor measurements (e.g., Eh or O_2 or soil moisture) to best predict the parameter. So, for instance, O_2 average concentrations over the last 48h was the best predictive time window for Fe(II) concentrations, while Eh measurements over the last 2h was the best predictive time window for DOC concentrations.

See Accomplishments Supporting file 3 for significant results for Focal Area 2.2b, Focal Area 3, Focal Area 4 and Education and Outreach.

Key outcomes or Other achievements:

Focal Area 1

H1.1

- Atmospheric inputs are the most important source of rock-derived nutrients above the knickpoints in both lithologies, but the original properties of the bedrock (e.g., grain size, mineralogy and fracturing style) influence how rock-derived nutrients are cycled below 2 m depth and also determine the composition of the streams during baseflow.
- We have determined the specific minerals that initiate chemical weathering at the two main LCZO lithologies. This helps shape conceptual models of vegetation distribution and water pathways.

- We are synthesizing the information that different geochemical tracers provide us about the fundamental processes that shape the LCZO.

- Graduate student O. Moore, found field mineral weathering rates that are several orders of magnitude faster than previously reported in the literature, similar or even faster than laboratory dissolution rates.

- Based on an array of geophysical measurements, we have gained a better understanding of how fractures are distributed along RI and how that may result in an increase of erosion rates near the knickzone due to the dilation of fractures. Stress models show a similar distribution and correspond well with previous studies in the RI watershed, supporting enhanced, but focused, weathering near the knickpoint and along fracture zones that may control the dynamics of upstream knickpoint migration in RI. For example, open fractures could enhance access of water and in turn promote spalling, erosion, and spheroidal weathering.

- Further measurements also show the increase in soil and saprolite thickness in the upstream direction, and how that relates to erosion rates, i.e. thicker in slowly eroding areas, and how moisture content in trees could inform positioning along topographic gradients.

- The density of fractures in the three rock types (volcaniclastics, hornfels, quartz diorite) has a very large effect on the stream chemistry in the LCZO and also affects water flowpaths and soil formation.

- Particles move in the subsurface: not just solutes. This is an important new discovery and it parallels papers written at the Shale Hills CZO showing particle movement in groundwater.

H1.2

- Vegetation and biota impact the landscape in direct and indirect ways. Indirectly, worms and root systems increase flow to the subsurface which is an important mechanism for erosion and works together with overland flow and stream incision to shape the landscape.

- Tree-type patterns affect erosion rates and is one of the first examples of life-landscape linkages at the landscape meso-scale.

- We discovered an artifact in how soil production rates are measured, suggesting that the current paradigm in which soil production rates scale inversely with soil depth might be incorrect. It appears instead that soil production rates might be independent of soil depth globally.

Focal Area 2

Results from our P amendment experiment indicate that the current understanding of nutrient-C interactions in well aerated soils may not be applicable in soils experiencing frequent redox oscillations. Anaerobic processes could be less limited by P availability, as redox conditions can be the primary limiting factor of microbial activities. Our results also suggest that organic compounds are more important in supplying P to soil microbes than inorganic P, as soil with high organic P experienced less severe P limitation. This pattern is consistent with our results from the previous LCZO report where inorganic P was held tightly to the mineral phase in soils from our site. These results indicate that hurricanes can increase soil P and Fe cycling by increasing debris input, which fuels greater variability in redox as it decomposes. Results from our temperature sensitivity experiment suggest that anaerobic metabolisms including anaerobic respiration, methanogenesis, and Fe reduction may be less sensitive to temperature than aerobic respiration. Results for the field observations of iron cycling suggest that the reactivity of iron oxides can shift within days in response to variations in soil moisture and O2. Further, that soil moisture or O2 concentrations over several preceding days is more predictive of biogeochemical reaction rates than instantaneous measurements. Results from the solid phase analysis of organic

matter post-extraction have served to support the proof of principle for the application of laser desorption-ionization ultrahigh resolution mass spectrometry to the characterization of natural, soil organic matter.

Focal Area 3

- Our research highlights how and when climate does and does not impact streams and erosion in the CZO. The results from this research are wide-ranging.
- We find that periods of increased hurricane activity lead to greater basin-wide erosion rates in the first ever use of meteoric 10Be for obtaining paleoerosion rates.
- William H. McDowell was elected a 2018 Fellow of the American Association for the Advancement of Science (AAAS). This is a lifetime honor in recognition of his extraordinary achievements in advancing science. November 27, 2018. https://www.aaas.org/news/aaas-honors-accomplished-scientists-2018-elected-fellows.

Focal Area 4

H4.1

- The modelling framework that couples the capabilities of the detailed hydrologic model to describe soil moisture dynamics with the infinite slope model provides a powerful tool for the assessment of landslide risk.
- The relative frequency of predicted landslide magnitudes differs significantly between the two experimental watersheds (Icacos and Mameyes). Also, the simulated erosional potential did not exhibit substantial differences between the climate change scenarios.
- Simulations indicate that the present states of landscape equilibrium in the Mameyes and Icacos watersheds are expected to remain relatively invariant through 2099.
- From among the 36 scenarios (generated from 12 Climate models and 3 SRES scenarios) used in this study, most future scenarios show a decline in rainfall and warming of temperature. Also the inter-model variability in projected temperature and rainfall is significantly large.
- We developed an algorithm for filling missing tree diameter information based on known species-specific diameter from census data, which can be applied to similar census datasets. We studied the damages and subsequent recovery of trees after hurricane Hugo with the data filled by our algorithm which agrees with previous studies (Heartsill et al. 2010; Heartsill 2017). Hurricane Hugo had a relatively larger impact on smaller trees. The data also reflected that the stem abundance of early successional species increased quickly after the disturbance. Ten years after the hurricane, early successional plants were gradually overtaken by palm, mid, and late successional species and the total stem abundance dropped to the pre-hurricane level. We used the processed dataset and classified the trees into four different successional types (i.e., early, mid, and late successional trees, and palms) for modeling studies.

H4.2

Mountains near the coast collect moisture, with seasonal patterns influenced by complex moisture and energy balances. Hurricanes disrupt these patterns.

H4.3

- Rain water was found to be the principal mechanism for water deposition at Pico del Este, but cloud water contributed an important non-negligible amount of water and this contribution can be relatively more important in periods of low precipitation or drought.

- Cloud droplets were found to be the main mechanism of nutrient deposition.
- An enrichment of most studied species was seen in cloud and rainwater samples classified with high dust influence.

See Accomplishments Supporting file 4 for education and outreach key outcomes and other achievements.

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

Focal Area 1

H1.1

The project has trained a total of three graduate students during the summer field campaign in the use of near-surface geophysical methods for subsurface characterization, exposing the students to a wide array of geophysical methods including: GPR, terrain conductivity, seismic refraction and gravity. One of the students (Mackenzie Vecchio) continuous to use this fieldwork to develop her PhD thesis and further train on the data acquisition, processing and interpretation of geophysical datasets.

This project partially funded a postdoc (Scott Hynek) who is now working for the US Geological Survey.

This project partially funded a postdoc, Xin Gu, at Penn State who is soon to become a Research Professor.

H1.2

Emma Harrison, UC San Diego, submitted her PhD dissertation in November 2019 and plans to defend in December 2020.

Focal Area 2

- Postdoc Lin was invited to attend the Microbial Determinants of Phosphorus Transport Workshop at The Pennsylvania State University in January 2019 and presented key findings on the redox effects on microbial stoichiometry.
- In the Silver lab, the LCZO enabled the training of one undergraduate student (Nikhil Chari) on soil incubation, trace gas analysis, and microbial biomass determination.
- In the Thompson lab, PhD student Diego Barcellos graduated in August 2018; post-doctoral scholar Dr. Chunmei Chen took a faculty position at Tianjin University in September 2018.
- In the Plante lab, one undergraduate student (Staci Bell) was trained in performing thermal analyses and the subsequent data analysis. The analysis of residues by ultrahigh resolution mass spectrometry also represented a component of the dissertation research of a PhD student at Kyungpook National University (Nissa Solihat)

Focal Area 3

- Seven undergraduate and 4 graduate students were trained in water quality analysis at the UNH Water Quality Analysis Laboratory
- PI McDowell provided one-to-one and group mentoring of 4 graduate students and 2 post-doctoral researchers, Dr. Maria Chapela-Lara and Qingtao Zhou.
- The LCZO team supported and assisted an undergraduate student from Carleton College, Zoe Brown, in developing an independent research project and supported her participation in activities with the LTER REU program summer 2019.
- NEON held a data exploration workshop on September 20-22, 2019 at the University of Puerto Rico with the initial request to NEON and on-the-ground coordination led by technician Carla López Lloreda. This collaborative effort led to the participation of ~20 undergraduate Puerto Rican students in the workshop.

- Emma Harrison and Bianca Rodriguez Cardona will submit their PhDs in December 2019.

Focal Area 4

The project has supported a research engineer. Two visiting professors (Dr. Leonardo V. Noto, Dr. Chang Yao) have also participated and learned new modeling approaches.

Yannis Dialynas (Ph.D. Student) interacted with Luquillo CZO scientists and presented his doctorate research work on the development of a spatially explicit model of soil organic carbon dynamics. He received numerous comments and feedback from scientists of different fields, which significantly helped improve the quality of his effort.

One-to-one and group mentoring of a graduate student (Jiaying Zhang) and a research scientist (Dr. Mehmet Soylu).

Education and Outreach

Early career faculty Dr. Adam Wymore coauthored Dere A. et al. (2019) Implementing and Assessing InTeGrate Critical Zone Science Materials in an Undergraduate Geoscience Program. In: Gosselin D., Egger A., Taber J. (eds) Interdisciplinary Teaching About Earth and the Environment for a Sustainable Future. AESS Interdisciplinary Environmental Studies and Sciences Series. Springer, Cham.

Twenty five teachers received professional development by participating in teacher workshops and 83 middle and high school students participated in LCZO Data Jams.

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

Please refer to the Education and Outreach sections of this report, Accomplishments Supporting File 2 and Accomplishments Supporting File 3 for a more detailed description of how LCZO data and results have been disseminated to communities of interest through development of the InTegrate curriculum (E&O 1), conducting Data Jam teacher workshops (E&O 2) and data jams at the CZO-LTER Schoolyard Program Symposium (E&O 3).

In addition to the presentations and publications described in the major activities and the products sections of this report, the following dissemination activities occurred over the last year:

- The LCZO maintains a twitter feed with 414 followers and 282 tweets and retweets since early 2014. The twitter feed helps the CZO communicate information about upcoming presentations, posters and recent journal publications. The feed also helps us communicate with our members and the general public about news stories relevant to the CZO such as storms and other events impacting the region. Our feed can be found at https://twitter.com/luqczo.
- Lead PI McDowell has contributed to 39 different press releases and media interviews reaching a broad range of audiences.
- The USFS contributed to 25 press releases and media interviews on hurricane disturbance from Hurricanes Irma and Maria.
- Migeul Leon participated in the CUAHSI – Vietnam bi-lateral workshop on CUAHSI data management solutions on March 11 2019 as part of the Lower Mekong Initiative (www.lowermekong.org).
- Carla López Lloreda provided support for the LUQ LTER Schoolyard Poster Workshop on April 8, 2019 at the Forward Learning Center as part of the Data Jam project. She also lent support in developing research questions and helped with data questions. She also assisted in logistical support for the LUQ LTER Schoolyard Symposium at the University of Puerto Rico on May 17, 2019 where middle and high-school students present their Data Jam research projects.
- LCZO technician Carla López Lloreda and graduate student Bianca Rodríguez Cardona helped coordinate a LCZO seminar series at the University of Puerto Rico in fall 2019
- Miguel León presented an overview of CZ science focusing on the water cycle to a Water Resources undergraduate class (instructed by Jorge Ortiz) on 9/18/2019
- Adam Wymore gave a graduate Environmental Science seminar “The Luquillo Mountains: a critical end member for watershed and ecosystem science” on 9/19/2019

- Bianca Rodríguez Cardona presented to a Water Resources undergraduate class on 10/2/2019 and gave a graduate Environmental Science seminar on 10/3/2019
- María Chapela gave a graduate Environmental Science seminar on 10/24/2019
- Carla López Lloreda presented to a Water Resources undergraduate class on 10/22/2019

Focal Area 1

- Dr.Comas has presented in several seminars and given multiple talks. These included presentations at the Geological and Environmental Sciences Department in Western Michigan University and two first grade classes at Sunset Elementary School in Miami. Some materials were also shown at the Cargèse 2018 4th Summer School SPIC in France and presented by Kamini Signha (Professor at Colorado School of Mines)
- Willenbring presented results of her work formally in several department seminars given over the last year.
- Willenbring was filmed in the field for a documentary about her and her research as a woman in science.

Focal Area 3

McDowell served as a panelist for a workshop entitled “Pathway to Professorship” at UNH. Full professors shared their insights with Associate Professors interested putting a case forward for promotion. October 19, 2018.

Carla López Lloreda and Tatiana Barreto attended and helped coordinate the 2019 Annual LTER Science Council Meeting. This is an annual meeting of the PI and a co-PI from all 28 LTER sites in which future directions for LTER network-wide science are discussed and new cross-site projects are initiated. The CZO staff assisted with a field trip to LTER and LCZO sites, made presentations that described LCZO research and presented an LCZO overview poster. May 15, 2019.

Jamie Shanley participated in the CUAHSI workshop to envision a terrestrial modeling system to encode and formalize the knowledge from Water, Sustainability and Climate (WSC) and Innovation at the Nexus of Food, Energy and Water Systems (INFEWS) projects. Convenved by CUAHSI and jointly hosted by the Renaissance Computing Institute (RENCI) at UNC and the South Big Data Innovation Hub. March 20 - 22, 2019. Chapel Hill, North Carolina.

The workshop assembled leaders from WSC, INFEWS, and CZO projects to:

- Envision ways to capture knowledge and harvest data from these projects so that WSC and INFEWS data, models, and knowledge can be used in future integrated research in this area,
- Recommend ways that knowledge from projects, such as the CZOs, can be integrated and preserved as data and as models that are part of a terrestrial modeling system, and
- Begin to scope out the needed cyberinfrastructure for a community terrestrial modeling system to meet these needs.

Shanley provided a short position paper that described LCZO work and gave ideas related to the workshop topic. Dr. Shanley also give a “Luquillo Critical Zone Observatory” lightning talk to stimulate discussion.

Other outreach efforts also reported as products:

López Lloreda, C. and W.H. McDowell, W.H. 2018. Luquillo Critical Zone Observatory. Exploring a University of Puerto Rico-Río Piedras (UPRPR)/United States Geological Survey (USGS) Partnership to Foster Water Research. San Juan, PR. August 21, 2018.

McDowell, W.H. 2019. “Luquillo Critical Zone Observatory: Overview and response of stream chemistry to Hurricane Maria” Seminar at the 33rd Geology Symposium, Geology Department, UPR Mayaguez. February 12, 2019.

McDowell, W.H. 2019. “Luquillo Critical Zone Observatory: Overview and response of stream chemistry to Hurricane Maria” Seminar at the 33rd Geology Symposium, Geology Department, UPR Mayaguez. February 12, 2019.

McDowell, W.H. 2019. Presented a guest lecture entitled “Luquillo Critical Zone Observatory: linking spatial and temporal patterns in stream chemistry to underlying critical zone architecture” in a graduate course taught by Jorge Ortiz, Ciencias Ambientales 6115,

"Terrestrial Environment". This overview of Critical Zone science was presented in discussion format in a 3-hour class period. February 5, 2019.

McDowell, W.H., J.D. Potter, C. Lopez-Lloreda. 2018. Sensors reveal new insights into controls on tropical stream chemistry after Hurricanes Irma and Maria. Nanjing Forestry University, Nanjing, China. College of Biology and the Environment. August 21, 2018

McDowell contributed to 37 press releases regarding hurricanes Irma and Maria that resulted from December 2018 AGU press release.

McDowell contributed to 4 additional press releases (2 AAAS honor, 1 PR field visit, 1 press release from Frontiers publication)

Pro-Development Committee of Maunabo, Inc. 2019. Scientist from the University of New Hampshire joins a water quality study of the Punta Tuna reservoir. W.H. McDowell was the scientist participating in the visit. https://www.facebook.com/groups/197423907131/permalink/10155790085762132?sfns=mo

Education and Outreach

The Data Jam team created two videos during the last year. One video was 1 minute 46 seconds and described the 2018 data jam experiences. This video was titled: "Luquillo LTER/CZO Schoolyard Data Jam Experiencia" and can be viewed at: https://www.youtube.com/watch?v=DF4K7UuMiV0&feature=youtu.be

The team created a second video as part of the NSF 2019 STEM for All Video Showcase (https://stemforall2019.videohall.com/). This video shows the resilience of the Luquillo Experimental forest and how the Luquillo LTER Schoolyard program strives to bring that message to youth (https://stemforall2019.videohall.com/p/1554).

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

Focal Area 1

H1.1

- Submit a paper from Chapela Lara, Buss and other LCZO collaborators using Mg isotopes to trace bio-geochemical processes in the CZ over a QD and a VC catchment.
- Submit a paper from Chapela Lara and Buss to highlight the importance of secondary minerals in producing extremely light Li isotope values.
- Submit a paper from Chapela Lara and Buss to synthesise the information from several tracers that have been applied at the LCZO (REE, Ge/Si, Si isotopes, S isotopes, Mg isotopes, Mo isotopes, Fe isotopes) to obtain an overall picture of weathering processes and biogeochemical cycling of rock-derived elements.
- Submit a paper from Comas, Brocard, Harrison, Machenzie et al on the comparison of regolith distribution at the Rio Icacos and Sabana watersheds using near-surface geophysical methods.
- Submit a paper from Mackenzie, Comas, et al on the use of GPR for understanding moisture content distribution along tree trunks for several species along topographic gradients.
- Submit a paper showing how fracture distribution and lithological chemistry affect stream chemistry.
- Submit a paper describing particle flux in the subsurface.
- Start and revise a paper describing how biotite oxidation initiates weathering of quartz diorite.

H1.2

- Submit Harrison et al. paper 'Global Rates of Soil Production are Independent of Soil Depth' to Nature.
- Revise and Resubmit paper for JGR-Earth Surface: 'Dynamic Critical Zone architecture driven by subsurface flow in the Luquillo Mountains, Puerto Rico' by Harrison et al.
- Write and publish paper 'Worm-driven impacts on the Si-budget in the Luquillo Mountains, Puerto Rico' by Harrison et al.

- Write and publish paper ‘Linking soil and weathering front development from coupled cosmogenic nuclide-derived soil production rates and U-series in the Luquillo Mountains, Puerto Rico’ by Harrison et al.

Focal Area 2

The Silver lab will continue to complete the experiments and projects listed above, analyze the data, and submit manuscripts for peer-review.

The Plante lab will continue to complete experiments on thermal and ultrahigh resolution mass spectrometry of extraction residues, analyze results, present them at national and international conferences, and prepare them for submission in peer-review manuscripts.

The Thompson lab will finalize publication of various redox oscillation experiments and iron-carbon field dynamic experiments on soils from the LCZO. In addition, we will work to synthesize data to describe linkages in Fe biogeochemistry across the two parent material types and associated stream systems. Most of the core data has been collected, but additional measurements are needed on existing samples and we will also collect limited additional samples to gap fill in order to create a CZO wide synthesis. This will involve characterizing colloidal and dissolved element mobilization via Fe reduction along a catena in the two parent materials (QD and VC).

Focal Area 3

The McDowell lab will:

- Maintain 15-minute in situ sensors in the Rio Icacos and the Quebrada Sonadora and QA/QC the data.
- Collect stream samples every 6 months from 35 stream sites that drain LCZO watersheds with varying characteristics.
- Continue to assess the response of stream chemistry to hurricanes Irma and Maria and prepare manuscripts.

Shanley and others will identify USGS stream gages across the island that maintained valid records through Hurricane Maria and/or was restored within 3 months. The percentage forest cover for each "valid" gage will be computed. Base flow hydrographs will be compared pre- and post-Maria to determine whether reduced evapotranspiration due to defoliation resulted in an increase in baseflow, and if so, the duration of that increase and whether it was proportional to the percent forest cover.

Shanley and others will prepare and submit the following papers:

1. A synthesis of the hydrology of Luquillo Experimental forest.
2. Comparing stream DOC and TSS fluxes from sensor- and sample-based approaches. This paper will compare Luquillo to the other 4 sites in the USGS WEBB small watershed program.
3. Wet and dry deposition of mercury in a Puerto Rico tropical forest.

Focal Area 4

4.1

- Parameterize the allometry of palms and calibrate and validate the ED2 model
- Generate future meteorological forcing data based on the intensity, duration, and frequency of hurricanes under different climate conditions
- Simulate the responses of the forest to projected hurricane disturbances under different plausible climate conditions using the calibrated ED2 model with the generated meteorological forcing data
- Use the modeling results to understand the consequence of disturbance and recovery on carbon balance among different successional species.

4.2

- Hurricane changes to cloud cover will be quantified, along with the length of the disruption. These results will be tied to changes measured in the atmosphere and in the forest abiotic factors.
- Produce papers and data release publications that follow previous publications that described the orographic cloud system. Future products will provide an analysis of its response to disturbance, and its importance in the ecohydrology of the Luquillo

Mountains.

H4.3

- Submit paper on cloud microphysical properties in Pico del Este and how they are affected by the presence of African dust.
- Submit paper on water and nutrient deposition in periods with and without dust influence.
- Graduate student will complete his PhD thesis this academic year.

Education and Outreach

Teachers will implement the data jam with their students. Students will attend a scientific poster preparation workshop on November 4th, 2019 and present their final Data Jam poster presentation on December 6, 2019 at the University of Puerto Rico, Rio Piedras Campus.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Accomplishments File 1 Additional Requirements.pdf	Additional reporting requirements	William Mcdowell	12/10/2019
Accomplishments File 2 LCZO Research Teams Milestones and Major Activities 2018-2019.pdf	LCZO research teams, milestones and major activities	William Mcdowell	12/10/2019
Accomplishments File 3 Significant Results.pdf	Addendum for significant results	William Mcdowell	12/10/2019
Accomplishments File 4 Key Outcomes.pdf	Addendum for key outcomes and other achievements	William Mcdowell	12/10/2019

Products

Books

Book Chapters

Ashlee Dere, Carol Engelmann, Timothy White, Adam Wymore, Adam Hoffman, James Washburne, Martha Conklin (2018). Implementing and Assessing InTeGrate Critical Zone Science Materials in an Undergraduate Geoscience Program. *Interdisciplinary Teaching about Earth and the Environment for a Sustainable Future.* David C. GosselinAnne E. EggerJ. John Taber. AESS. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes

Dere, A., Engenlmann C., White, T., Wymore A., Hoffman A., Washburne J., and Conklin M. (2018). Implementing and assessing InTeGrate Critical Zone Science materials in an undergraduate geoscience program. In: Gosselin, D., Egger A. and Taber J. (eds.) Springer, New York. *Interdisciplinary Teaching about Earth and the Environment for a Sustainable Future.* Association of Environmental Sciences and Studies. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes

Gould, W.A., E.L. Díaz, (co-leads), N.L. Álvarez-Berríos, F. Aponte-González, W. Archibald, J.H. Bowden, L. Carrubba, W. Crespo, S.J. Fain, G. González, A. Goulbourne, E. Harmsen, E. Holupchinski, A.H. Khalyani, J. Kossin, A.J. Leinberger, V.I. Marrero-Santiago, O. Martínez-Sánchez, K. McGinley, P. Méndez-Lázaro, J. Morell, M.M. Oyola, I.K. Parés-Ramos, R. Pulwarty, W.V. Sweet, A. Terando, and S. Torres-González (2018). U.S. Caribbean. *In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* 2. Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart. U.S. Global Change Research Program. . Status = PUBLISHED; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.7930/NCA4.2018.CH20.

Wymore, AS and WH McDowell. (2019). Variable response of DOC and DON to discharge across critical zone gradients. Abstract submitted to: Biogeochemistry of the Critical Zone. Eds: Wymore AS, Yang W, Silver W, Chorover J, McDowell WH. To be published

by Springer-Nature.. *Biogeochemistry of the Critical Zone* Wymore AS, Yang W, Silver W, Chorover J, McDowell WH. Springer-Nature.. . Status = OTHER; Acknowledgement of Federal Support = Yes ; Peer Reviewed = Yes

Inventions

Journals or Juried Conference Papers

Adam S. Wymore, Miguel C. Leon, James B. Shanley and William H. McDowell (2019). Hysteretic Response of Solutes and Turbidity at the Event Scale Across Forested Tropical Montane Watersheds. *Frontiers in Earth Science*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3389/feart.2019.00126

Ariel E. Lugo and Grizelle González (2019). Introduction to the Special Issue on Tropical Forests: Management and Ecology in the Anthropocene. *Forests*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/f10010048

Ashley E. Van Beusekom, Nora L. Álvarez-Berríos, William A. Gould, Maya Quiñones and Grizelle González (2018). Hurricane Maria in the U.S. Caribbean: Disturbance Forces, Variation of Effects, and Implications for Future Storms. *Remote sensing*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/rs10091386

Ashley E. Van Beusekom, Nora L. Álvarez–Berríos, William Gould, Maya Quiñones, and Grizelle González (2018). Hurricane Maria in the U.S. Caribbean: Disturbance Forces, Variation of Effects, and Implications for Future Storms. *MDPI remote sensing*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Avner Gross, Yang Lin, Peter K. Weber, Jennifer Pett-Ridge, and Whendee L. Silver (2019). The role of soil redox conditions in microbial phosphorus cycling in humid tropical forests. *Ecology*. . Status = ACCEPTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Avner Gross, Yang Lin, Whendee Silver (2019). The role of soil redox conditions in microbial phosphorus cycling in humid tropical forests. *Ecology*. . Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Bhattacharyya A, Campbell AN, Tfaily MM, Lin Y, Silver WS, Nico PS, Pett-Ridge J (2018). Redox fluctuations control the coupled cycling of iron and carbon in tropical forest soils. *Environmental Science & Technology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Brocard G., Salles T., Willebring J.K. (2018). Selective preservation of low-relief summit surfaces under low gravel fluxes. *TBD*. . Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Brocard G., Willebring J.K., Scatena F.N. (2018). Vegetation-reinforced differentiation of valleys and ridges in a tropical montane rainforest. *TBD*. . Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Brocard, G. Willenbring, J.K., Wolf, J., Uriarte, M., Scatena, F.N. (2018). Contribution of vegetation to the shaping of mesoscale topography in a tropical montane rainforest. *Nature Communications*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Brocard, G. Willenbring, J.K., Wolf,J., Uriarte, M., Scatena, F.N. (2017). Contribution of vegetation to the shaping of mesoscale topography in a tropical montane rainforest. *Nature Geoscience*. . Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Brocard, G. Y., Willenbring, J. K., Miller, T. E., and Scatena, F. N. (2016). Relict landscape resistance to dissection by upstream migrating knickpoints. *J. Geophys. Res. Earth Surf.*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/2015JF003678

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 = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Chapela Lara M., Buss H. L., Pett-Ridge J.C. (2018). The effects of lithology on trace element and REE behavior during tropical weathering. *Chemical Geology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Christine S. O'Connell and Whendee L. Silver (2018). Hot spots and hot moments have outsized influence on greenhouse gas flux dynamics in a wet tropical forest. *Global Change Biology*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Comas, X., Wright, W., Hynek, S. A., Fletcher, R. C., and Brantley, S. L. (2019). Understanding fracture distribution and its relation to knickpoint evolution in the Rio Icacos watershed (Luquillo Critical Zone Observatory, Puerto Rico) using landscape-scale

hydrogeophysics. *Earth Surf. Process. Landforms*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/esp.4540

Coward E.K.; Thompson A.; Markewitz D.; Richter D.; Plante A.F. (2018). Land use history effects on extractable iron phases and Fe-organic matter interactions at the Calhoun Critical Zone Observatory. *Soil Science Society of America Journal*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Dialynas, Y. G., Bastola, S., Bras, R. L., Marin-Spiotta, E., Silver, W. L., Arnone, E., and Noto, L. V. (2016). Impact of hydrologically driven hillslope erosion and landslide occurrence on soil organic carbon dynamics in tropical watersheds. *Water Resour. Res.*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/2016WR018925

E.K. King, A. Thompson, J.C. Pett-Ridge (2019). Underlying lithology controls trace metal mobilization during redox fluctuations. *Science of The Total Environment*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.scitotenv.2019.02.192

Elizabeth K.Coward, Aaron Thompson, Alain F. Plante (2018). Contrasting Fe speciation in two humid forest soils: Insight into organomineral associations in redox-active environments. *Geochimica et Cosmochimica Acta*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.gca.2018.07.007

Emma Jayne Harrison (2019). Dynamic architecture: restructuring subsurface flow fields in the Critical Zone of the Luquillo Mountains, Puerto Rico. *JGR: Earth Surfaces*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Forster, M., Bestelmeyer, S., Baez-Rodriguez, B., Berkowitz, A., Caplan, B., Esposito, R., Grace, E., & McGee, S. (2018). Data Jams: Promoting data literacy and science engagement while encouraging creativity.. *The Science Teacher*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Gilles Y. Brocard Tristan Salles, Jane K. Willenbring (2018). River gravel fluxes and the selective preservation of low-relief upland surfaces. *Nature Geoscience*. . Status = SUBMITTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

González, Grizelle; Lugo, Ariel E. (2019). Concluding Remarks: Moving Forward on Scientific Knowledge and Management Approaches to Tropical Forests in the Anthropocene Epoch. *Forests*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/f10070572

Gross A, J Pett-Ridge and W Silver. (2017). Competition for phosphorus between microbes and minerals drives phosphorus dynamics in humid tropical forests soils.. *fully drafted, will be submitted soon to JGR Biogeosciences*. . Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Gross, Avner, Pett-Ridge, Jennifer, Silver, Whendee L. (2018). Soil Oxygen Limits Microbial Phosphorus Utilization in Humid Tropical Forest Soils. *Soil Systems*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/soilsystems2040065

Heather Buss (2018). Linking surface and deep. *LCZO Annual Meeting 2018*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Jamie Shanley, Oksana Lane, Wayne Arendt, Mark Marvin-DiPasquale , Bill McDowell, and Steven Hall (2016). A TROPICAL PARADOX - MERCURY IS HIGH IN DEPOSITION, LOW IN THE FOOD WEB IN PUERTO RICO. *TBD*. . Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = No ; Peer Reviewed = Yes

Jared Lee Wilmoth, Mary Ann Moran, Aaron Thompson (2018). Transient O2 pulses direct Fe crystallinity and Fe(III)-reducer gene expression within a soil microbiome. *Microbiome*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s40168-018-0574-5

King, E.K., Thommpson, A.T., and Pett-Ridge, J.C. (2018). Underlying lithology controls trace metal mobilization during redox fluctuations. *Science of the Total Environment*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

King, Elizabeth K. and Pett-Ridge, Julie, C. (2018). Reassessing the dissolved molybdenum isotopuc composition of ocean inputs: The effect of chemical weathering and groundwater. *Geology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1130/G45124.1

Lin Y, Bhattacharyya A, Campbell AN, Nico PS, Pett-Ridge J, and Silver WS (2018). Phosphorus fractionation responds to dynamic redox conditions in a humid tropical forest soil.. *Journal of Geophysical Research: Biogeosciences*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1029/2018JG004420

Lin Y, Bhattacharyya A, Campbell AN, Nico PS, Silver WS and Pett-Ridge J. (2017). Iron transformation regulates soil phosphorus fractionation under dynamic redox conditions.. *TBD; pending submission*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Lin Y, Gross A, Silver WS (2018). Rainfall control on phosphorus fractions in wet tropical forest soils. *Global Change Biology*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

M. R. Willig, L. Woolbright, S. J. Presley, T. D. Schowalter, R. B. Waide, T. Heartsill Scalley, J. K. Zimmerman, G. González, and A. E. Lugo (2019). Populations are not declining and food webs are not collapsing at the Luquillo Experimental Forest. *Proceedings of the National Academy of Sciences*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1820456116

M.A. McClintock, G. Brocard, J. Willenbring, C. Tamayo, S. Porder, J.C. Pett-Ridge (2015). Spatial variability of African dust in soils in a montane tropical landscape in Puerto Rico. *Chemical Geology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.chemgeo.2015.06.032

M.A. McClintock, W.H. McDowell, G. González, Michael Schulz, J.C. Pett-Ridge (2019). African dust deposition in Puerto Rico: Analysis of a 20-year rainfall chemistry record and comparison with models. *Atmospheric Environment*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.atmosenv.2019.116907

María Chapela Lara, Heather L. Buss, Julie C. Pett-Ridge (2018). The effects of lithology on trace element and REE behavior during tropical weathering. *Chemical Geology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.chemgeo.2018.09.024

María Chapela Lara, Heather L. Buss, Julie C. Pett-Ridge (2018). The effects of lithology on trace element and REE behavior during tropical weathering. *Chemical Geology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.chemgeo.2018.09.024

María Chapela Lara, Heather L.Buss, Philip A.E.Pogge von Strandmann, Jan A.Schuessler, Oliver W.Moore (2017). The influence of critical zone processes on the Mg isotope budget in a tropical, highly weathered andesitic catchment. *Geochimica et Cosmochimica Acta*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.gca.2016.12.032

Moore OW, Buss HL, Dosseto A. (2018). Incipient Chemical Weathering at Bedrock Fracture Interfaces in the Luquillo Critical Zone Observatory, Puerto Rico. *Geochimica et Cosmochimica Acta*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.gca.2019.02.028

Nick Hayes, Heather L Buss, Oliver W Moore, Pavel Kram, Richard D Pancost (). Controls on granitic weathering fronts in contrasting climates. *Chemical Geology*. . Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Paul Miller, Thomas Mote, Craig Ramseyer, Ashley E. Van Beusekom, Martha Scholl, and Grizelle González (2018). A 42-yr Inference of Cloud Base Height Trends in the Luquillo Mountains of Northeastern Puerto Rico. *Climate Research*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3354/cr01529

Pett-Ridge J, K McFarlane, E Green, A Campbell, K Heckman, S Reed, A Plante, T Wood. (2017). Into the Deep: Variability in Soil Microbial Communities and Carbon Turnover Along a Tropical Forest Soil Depth Profile. Data collected, manuscript partially drafted.. *TBD; partially drafted manuscript*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Richardson, Justin B., Arnulfo A. Aguirre, Heather L. Buss, A. Toby O'Geen, Xin Gu, Daniella M. Rempe, and Daniel deB. Richter (2018). Mercury sourcing and sequestration in weathering profiles at six Critical Zone Observatories. *Global Biogeochemical Cycles*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1029/2018GB005974

Steven J. Hall . Asmeret A. Berhe . Aaron Thompson (2018). Order from disorder: do soil organic matter composition and turnover co-vary with iron phase crystallinity?. *Biogeochemistry*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Stone MM, W Hockaday and AF Plante (2017). Using 13C NMR to evaluate the chemical nature of organic matter throughout tropical soil profiles.. *In Prep; Geoderma*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Tana E. Wood, Grizelle González, Whendee L. Silver, Sasha C. Reed and Molly A. Cavaleri (2019). On the Shoulders of Giants: Continuing the Legacy of Large-Scale Ecosystem Manipulation Experiments in Puerto Rico. *Forests*. . Status = PUBLISHED;

Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/f10030210

Wei Huang, Xianbin Liu, Grizelle González & Xiaoming Zou (2019). Late Holocene fire history and charcoal decay in subtropical dry forests of Puerto Rico. *Fire Ecology*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1186/s42408-019-0033-0

Wenjuan Huang, Kenneth Hammel, Jialong Hao, Aaron Thompson, Vitaliy Timokhin, Steven Hall (2019). Enrichment of lignin-derived carbon in mineral-associated soil organic matter. *Environ Sci Technol.*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1021/acs.est.9b01834

William H. McDowell, William G. McDowell, Jody D. Potter, Alonso Ramírez (2018). Nutrient export and elemental stoichiometry in an urban tropical river. *Ecological Applications*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/eap.1839

Wood, Tana; González, Grizelle; Silver, Whendee; Reed, Sasha; Cavaleri, Molly (2019). On the Shoulders of Giants: Continuing the Legacy of Large-Scale Ecosystem Manipulation Experiments in Puerto Rico. *Forests*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.3390/f10030210

Wymore, AS, PL Sullivan, RL Brereton, and WH McDowell. (2017). Expanding the biosphere: merging ecosystem ecology and critical zone science.. *Frontiers in Ecology and the Environment*. . Status = OTHER; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Xavier Comas, William J Wright, Scott A Hynek, Raymond C Fletcher, Susan Brantley (2018). Understanding fracture distribution and its relation to knickpoint evolution in the Rio Icacos watershed (Luquillo Critical Zone Observatory, Puerto Rico) using landscape-scale hydrogeophysics. *Earth Surface Processes and Landforms.*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/esp.4540

Yang Lin, Avner Gross, Christine O'Connell, Whendee Silver (2019). Anoxic conditions maintained high phosphorus sorption in humid tropical forest soils. *Biogeosciences*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.5194/bg-2019-62

Yannis G. Dialynas, Rafael L. Bras (2017). Hydro-geomorphic behavior of contrasting tropical landscapes and critical zone response to changing climate. *Earth Surface Processes and Landforms*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/esp.4503

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

Ashley Van Beusekom, Grizelle González, Sarah Stankavich, Jess Zimmerman, and Alonso Ramírez (2017). *"Understanding Tropical Forest Abiotic Responses to Canopy Loss and Biomass Deposition from an Experimental Hurricane Manipulation"*. AGU 2017. New Orleans, LA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Wymore, A., A. Helton, R. Barnes, J. Brookshire, S. Kaushal, E. Bernhardt, W.K. Dodds, P. Johnes, S. Johnson, P. Kortelainen, W.H. McDowell, R. Spencer, B. Rodriguez-Cardona, A. Argerich, A. Coble, C. Lopez-Lloreda, P. Sullivan, S. Haq, M. Shattuck. (2018). *(De)-coupling of dissolved organic carbon and dissolved organic nitrogen across stream ecosystems.*. Society for Freshwater Science, Detroit, MI May 2018.. Detroit, MI. 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

Erickson, H.E.; González, G. (2017). *A 27-Years Chronology of Litter Production in a Puerto Rican Moist Tropical Forest*. Ecological Society of America Annual Meeting 2017.. Portland Oregon. 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

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

Coward E, Plante AF, Ohno T, and AT Thompson (2018). *Adsorption and molecular fractionation of dissolved organic matter on iron-bearing mineral matrices of varying crystallinity*. ACS National Meeting. Washington, D.C.. 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

McDowell, W.H, Lopez-Lloreda, C., Potter, J. (2018). *Aquatic Sensors Provide New Insights into the Aquatic-Terrestrial Linkages that Govern Watershed Response to Major Hurricanes in a Tropical Montane Forest*. AGU 2018. Washington, DC. Status = OTHER; Acknowledgement of Federal Support = Yes

Robinson Juarez (2018). *Assessment of hurricane-induced tree mortality: The impact of hurricane Maria to Puerto Rico Forests*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Nadia Noor , Aaron Thompson, Zhe Zhou, Drew E. Latta, Michelle M. Scherer, Alain Plante, Thomas Borch (2019). *Bioavailability of carbon in ferrihydrite-organic matter coprecipitates transformed by Fe (II)-catalyzed recrystalization*. Soil Science Society of America. San Diego, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

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

Carla López Lloreda (2019). *Building bridges: better linking UPR students and LCZO activities*. LCZO annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Anthony Castronova, Liza Brazil, Miguel Leon, Jeff Horsburgh, David Tarboton (2018). *CUAHSI Tools and Services for Managing Research Data*. CUAHSI Biennial colloquium.. Shepherdstown, WV. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2019). *CUAHSI – Vietnam bi-lateral workshop on CUAHSI data management solutions with NSF funded CZ software with Lower Mekong Initiative (www.lowermekong.org).*. CUAHSI – Vietnam bi-lateral workshop. Boston, MA. 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

Shanley, J.B. (2018). *Capturing sources and dynamics of stream sediments and solutes*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Rodríguez-Cardona, B. (2018). *Carbon and nitrogen dynamics in streams across biomes.*. Seminar at the Centre d'Estudis Avançats de Blanes (CEAB), in Blanes, Spain. March 22, 2018.. Blanes, Spain. 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

Ashley Van Beusekom (2019). *Changes seen in Land-Atmosphere Interaction after a Large Hurricane*. LCZO Annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Wymore, AS, S Bernal, E Martí, B Rodríguez-Cardona, and WH McDowell (2017). *Changing perspectives on the biogeochemistry and ecology of dissolved organic nitrogen*. Association for the Sciences of Limnology and Oceanography. Honolulu, Hawaii. 1 March 2017. Honolulu, Hawaii. Status = OTHER; Acknowledgement of Federal Support = Yes

Heather Buss (2016). *Chemical weathering fluxes: the role of deep critical zone hotspots*. Invited talk: Univ of Durham, UK, Physical Geography Seminar, Oct 2016. Durham, UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Heather Buss (2017). *Chemical weathering fluxes: the role of deep critical zone hotspots*. Invited talk: Univ of Exeter, UK, Dept of Geography Seminar, Jan 2017. Exeter, UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2018). *Collaborative RAPID: using Hydroshare to present integrated datasets from Hurricanes Maria and Irma*. LCZO Annual meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Zhou, Q., Wymore, A. and McDowell, W.H. (2019). *Comparing the impacts of two simulated hurricanes on soil nitrate concentrations: a multiple quantitative approach*. ASLO 2019 Aquatic Sciences Meeting. San Juan, PR. 23 February - 2 March 2019. San Juan, PR. Status = OTHER; 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

Yang Lin, Avner Gross, Whendee Silver (2018). *Coupling of soil carbon, organic phosphorus, and amorphous minerals along wet tropical forest rainfall gradient*. AGU 2018. Washington, DC. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Heather Buss (2017). *Creating the critical zone: dissolving, fracturing, and eating rocks*. Invited talk: West of England Geologists Association, Nov 2017. UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Christopher Wilson, Miguel Leon (2018). *Critical Zone Observatory Data Management*. CUAHSI Biennial colloquium.. Shepherdstown, WV. Status = OTHER; 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

White, T, Wymore, A, Dere AL, Richardson J (2018). *Critical Zone Science: A transdisciplinary approach to environmental science*. Science Education Resource Center: Carleton College. webinar. 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. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

Wymore, A., D. Ibarra, R. Brereton, K. Maher, and W.H. McDowell (2017). *Critical 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

Miguel Leon, David Lubinski (2018). *Data Resources and Accessibility*. Using observation networks to advance Earth system understanding. NEON Charette #3. Webinar.. webinar. Status = OTHER; Acknowledgement of Federal Support = Yes

Plante AF, Lawrence CR and J Blankinship (2019). *Data and Models for Managing Carbon in Soils*. SSSA International Meeting. San Antonio, TX;. Status = OTHER; Acknowledgement of Federal Support = Yes

Chapela Lara, Maria; Schuessler, J.A.; Buss, H.L.; McDowell, W. (2018). *Decoupling of shallow and deep sources of inorganic nutrients at the late stages of weathering: insights from traditional and non-traditional tracers at the LCZO*. Goldschmidt Conference, Boston, MA. Boston, MA. 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

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

Lopez-Lloreda, C., McDowell, W.H. and Potter, J.D. (2018). *Dissolved greenhouse gases in streams and their response to Hurricanes Irma and María in a tropical forest in Puerto Rico*. AGU 2018. Washington, DC. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2019). *Disturbance and response: understanding the effects of extreme events on aquatic biogeochemistry*. ASLO 2019 Aquatic Sciences Meeting. San Juan, PR. 23 February - 2 March 2019. San Juan, PR. Status = OTHER; 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

McDowell, W.H., C. Lopez-Lloreda, and J.D. Potter (2017). *Drivers of N2O flux from streams and rivers: searching for a better predictive model of N2O concentrations in inland waters.*. International Workshop on N2O Emissions in Various Ecosystems: Site-Based Research and Global Synthesis, November 29, 2017, Taichung, Taiwan.. Taichung, Taiwan. Status = OTHER; Acknowledgement of Federal Support = Yes

Emma Jayne Harrison (2019). *Dynamic architecture: restructuring subsurface flow fields in the Critical Zone of the Luquillo Mountains, Puerto Rico*. LCZO Annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Emma Jayne Harrison (2019). *Dynamic architecture: restructuring subsurface flow fields in the Critical Zone of the Luquillo Mountains, Puerto Rico*. Southern California Geomorphology Symposium. . Status = OTHER; Acknowledgement of Federal Support = Yes

Emma Jayne Harrison (2019). *Dynamic architecture: restructuring subsurface flow fields in the Critical Zone of the Luquillo Mountains, Puerto Rico*. Gordon Research Conferences: Catchment Science. . Status = OTHER; Acknowledgement of Federal Support = Yes

Gutierrez-Fonseca, P.E., Ramirez, A., Pringle, C.M., Torres, P.J., Covich, A., Crowl, T.A., McDowell, W.H., Ballantyne, F. and Perez-Reyes, O. (2019). *Ecological response of stream ecosystems to extreme climate events in Puerto Rico*. ASLO 2019 Aquatic Sciences Meeting. San Juan, PR. 23 February - 2 March 2019. San Juan, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Steven McGee (2018). *Education and Outreach*. LCZO Annual meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Mayol-Bracero, O. L.; Torres-Delgado, E. (2018). *Effects of African dust particles in the nutrient, radiation, and water budget of a tropical forest*. School of Atmospheric Measurements in Latin America and the Caribbean: Atmospheric Particles and Reactive Gases (SAMLAC). . Status = OTHER; Acknowledgement of Federal Support = Yes

Mayol-Bracero, O. L.; Torres-Delgado, E. (2019). *Effects of African dust particles in the nutrient, radiation, and water budget of a tropical forest*. American Association of Hispanics in Higher Education 14th Annual Conference. . Status = OTHER; Acknowledgement of Federal Support = Yes

Vaughan, E., D.F. Cusack, W.H. McDowell, E. Marin-Spiotta (2017). *Effects of nitrogen enrichment on soil organic matter in tropical forests with different ambient nutrient status*. 2017 Fall Meeting, AGU, New Orleans, LA, 11-15 Dec.. New Orleans, LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Vaughan, E., D.F. Cusack, W.H. McDowell, E. Marin-Spiotta (2017). *Effects of nitrogen enrichment on soil organic matter in tropical forests with different ambient nutrient status*. 2017 Fall Meeting, AGU, New Orleans, LA, 11-15 Dec.. New Orleans, LA. Status = OTHER; Acknowledgement of Federal Support = No

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

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

Susan L. Brantley (2017). *Exploring the Effects on Regolith of Fractures, Water Flow, and Biogeochemical Reactions Inside Hills*. 2017 Goldschmidt Conference. Paris, France. 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

Zhou, Q., Wymore, A. and McDowell, W.H. (2018). *Exploring the drivers that affect nitrate in soil solution at Luquillo Experimental Forest, Puerto Rico*. AGU Fall meeting 2018. Washington, DC. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Wymore, A., Krueger, S., Van Der Hout, J. and McDowell, W.H. (2019). *Exploring the ecological duality of dissolved organic nitrogen with field based experimental evidence*. ASLO 2019 Aquatic Sciences Meeting. San Juan, PR. 23 February - 2 March 2019. San Juan, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Maria Chapela Lara, H. L. Buss, J.A. Shcuessler, M. J. Henehan, W.H. McDowell (2018). *Extreme Li and Mg isotope fractionation during tropical weathering: from dust to minerals (and everything in between)*. AGU Fall meeting 2018. Washington, DC. Status = PUBLISHED; 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

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

Wymore, AS. (2018). *Global patterns in stream energy and nutrient cycling.*. LTER Webinar. March 2018. (https://www.youtube.com/watch?v=suEFjtltbEE). webinar. Status = OTHER; Acknowledgement of Federal Support = Yes

Whendee Silver (2018). *Greenhouse gas fluxes from soil*. LCZO Annual Meeting 2018. Luquillo, PR. 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

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

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

Thompson, A. (2018). *How ferrous iron oxidation serves to structure iron reduction and other anaerobic processes in redox fluctuating environments*. Fe Biogeochemistry Workshop, Lech, Austria. Lech, Austria. Status = OTHER; 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. (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

Meaghan Shaw (2019). *Hurricane Influence on Redox-Active Metals in the Luquillo CZO, Puerto Rico*. LCZO annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Ashley Van Beusekom (2018). *Hurricane Maria Damage: Cause, Effect, and Variations for the Future*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Ashley E. Van Beusekom, Nora L. Álvarez–Berríos, William Gould, Maya Quiñones, and Grizelle González (2018). *Hurricane Maria in the U.S. Caribbean: Disturbance Forces, Variation of Effects, and Implications for Future Storms*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Scholl, M.A., Torres-Sanchez, A.J., Van Beusekom, A.E., Shanley, J.B., Bassiouni, M., Gonzalez, G., 2018. (2018). *Hurricane defoliation effects on water cycle processes in the Luquillo Experimental Forest, Puerto Rico*. AGU 2018. Washington, D.C.. Status = OTHER; Acknowledgement of Federal Support = Yes

Gutiérrez-Fonseca, P.E., A. Ramirez, C. Pringle, P.J. Torres, A. Covich, W.H. McDowell T. Crowl, O.Perez. (2018). *Hurricane impacts to a tropical stream ecosystem in the mountains of Puerto Rico.*. Society for Freshwater Science, Detroit, MI May 2018.. Detroit, MI. Status = OTHER; Acknowledgement of Federal Support = No

Carla López Lloreda (2018). *Hurricanes Irma and Maria drove a pulse of salts through soils and streams of a tropical watershed*. LCZO Annual meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Carla López Lloreda (2019). *Hurricanes Irma and María drove a pulse of salts through soils and streams of a tropical watershed*. LCZO annual meeting 2019. Luquillo, 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

López Lloreda, C. and W.H. McDowell, W.H. (2018). *Hydrology and biogeochemistry in the Luquillo Critical Zone Observatory*. El Verde Field Station, El Verde, PR. October 22, 2018. El Verde, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Wymore, A., Leon, M., Shanley, J. B., McDowell, W.H. (2018). *Hysteresis and response to storm events in a tropical landscape: Luquillo Mountains, Puerto Rico*. AGU 2018. Washington, DC. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Mayol-Bracero, O. L.; Bolaños-Rosero, B.; Santos-Figueroa, G. (2018). *Impact of African Dust incursions to fungal content and aerosol composition at the Caribbean region*. School of Atmospheric Measurements in Latin America and the Caribbean: Atmospheric Particles and Reactive Gases (SAMLAC). . 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

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

McDowell, W.H. (2018). *In the eye of the storm: Long-term nitrogen dynamics in hurricane-dominated tropical montane ecosystems.*. Peking University, Beijing, 17 April 2018. Beijing, China. 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

Filley T, Hall SJ, Hou T, Plante AF and MN Weintraub (2018). *Influence of past soil erosion and burial on the reactivity of deep carbon*. AGU 2018. Washington, DC. Status = OTHER; Acknowledgement of Federal Support = Yes

Xavier Comas (2018). *Integrating near-surface geophysical methods into critical zone research at the Luquillo CZO*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Song, C., E. Garcia, A. Argerich, M. Whiles, W.K. Dodds, K. Gido, W.H. McDowell, J.S. Kominoski, D. McMaster, M.B. Flinn, M.T. Trentman, J. Rüegg, S.P. Parker, T. Harms, A D. Rosemond, W.B. Bowden, K. Sheehan, L. Koenig, W. Wollheim, K. Farrell, C. Baker, J. Jones, M. Douglas, F. Ballantyne, A. Helton, S. Jia. (2017). *Interaction between physiology and environmental heterogeneity determines discrepancy in stream metabolism across spatial scales.*. Society for Freshwater Science meeting, Raleigh, NC. June 4-9, 2017.. Raleigh, NC. 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

Jennifer Pett-Ridge (2018). *Into the Deep: Variability in Soil Microbial Communities and Carbon Turnover Along a Tropical Forest Soil Depth Profile*. LCZO Annual Meeting 2018. 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

McDowell, W.H. (2018). *Invited participant and presenter at Parallel session 1C, "Optimizing the use and outcomes of national Research Infrastructures through international participation"*. International Conference on Research Infrastructures, ICRI, September 12-14, 2018. Vienna, Austria.. Vienna, Austria.. 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

Thompson, A., Meile, C, Wilmoth, J., Barcellos, D., Chen, C., Ginn, B., . . . Hodges, C. (2017). *Key features of redox fluctuating soils that influence iron cycling*. American Chemical Society Annual Meeting (Fall). Washington, D.C.. Status = OTHER; Acknowledgement of Federal Support = Yes

Aaron Thompson, Whendee Silver (2019). *LCZO Soils update; Field Iron And Biogeochemical Measurements*. LCZO Annual Meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Chapela Lara, Maria (2018). *La zona crítica como moduladora de los flujos de elementos en la superficie terrestre: evidencia de isótopos de Mg en estados de intemperismo avanzado*. Invited presentation; Universidad Nacional Autonoma de Mexico. Mexico City. Status = OTHER; 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, W.H. (2019). *Lightning talk: Ecosystem Responses to Hurricane Stressors.*. Ecosystem Responses to Hurricanes – Synthesis Workshop. Corpus Christi, TX.. 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

Xavier Comas, Gilles Brocard Emma Harrison Matt Sirianni Joe Becker Mackenzie Vecchio William Wright Susan L. Brantley William H. McDowell (2019). *Linking erosion rates and critical zone architecture using geophysical surveys at multiple spatial scales (Luquillo CZO, PR)*. AGU 2019. San Francisco, CA. Status = SUBMITTED; Acknowledgement of Federal Support = Yes

Jane K Willenbring (2017). *Linking life, landscapes, and the legacy of transience*. Gilbert Club. New Orleans, LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Jane K Willenbring (2018). *Linking life, landscapes, and the legacy of transience*. Invited seminar. University of Texas, Austin. Status = OTHER; Acknowledgement of Federal Support = Yes

Jane K Willenbring (2018). *Linking life, landscapes, and the legacy of transience*. Invited seminar. Stanford University. 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

Heather L Buss (2018). *Location, Location, Location! Chemical weathering fronts with depth in the critical zone and implications for solute exports*. Hutton Club Seminar, University of Edinburgh, UK. University of Edinburgh, UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Heather Buss (2017). *Location, Location, Location! Chemical weathering mechanisms with depth in the Critical Zone and implications for weathering exports*. Invited talk: The Greenhouse Earth System workshop, Bristol, UK, May 2017. Bristol, UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Mayol-Bracero, O. L.; Santos-Figueroa, G.; Avilés-Piñeiro, G. (2018). *Long-term monitoring of mineral "African Dust concentrations in Puerto Rico during Summer 2017*. School of Atmospheric Measurements in Latin America and the Caribbean: Atmospheric Particles and Reactive Gases (SAMLAC). . Status = OTHER; Acknowledgement of Federal Support = Yes

Rodriguez-Cardona, B., Wymore, A., Kortelainen, P., Argerich, A., Johnson, S. and McDowell, W.H. (2019). *Long-term trends in dissolved organic carbon from fluvial systems across biomes*. ASLO 2019 Aquatic Sciences Meeting. San Juan, PR. 23 February - 2 March 2019. San Juan, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

López Lloreda, C. and Barreto, T (2019). *Luquillo Critical Zone Observatory overview poster.*. Annual LTER Science Council Meeting. Rio Grande, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2019). *Luquillo Critical Zone Observatory: Overview and response of stream chemistry to Hurricane Maria*. Seminar at the 33rd Geology Symposium, Geology Department, UPR Mayaguez. February 12, 2019.. Mayaguez, PR. Status = OTHER; 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

Gilles Brocard (2018). *Luquillo Mountains evolution over 10^4-10^6 yrs timescales: impact on forest soils and plants, and geological archives of past forest changes*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Martha Scholl (2018). *Luquillo Mountains hydrology: The precipitation-atmosphere-forest system*. LCZO Annual Meeting 2018. Luquillo, PR. 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

James B Shanley (2018). *Luquillo loco! Insights on hot moments from in-stream optical sensors in the Puerto Rico wet forest*. LCZO Annual Meeting 2018. Luquillo, PR. 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

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

Miguel Leon (2019). *Migrating CZO data to HydroShare*. LCZO annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

MIguel Leon, Louis Derry, Jerad Bales, David Lubinski, Collin Bode, Christian Camacho Colon (2018). *Migrating CZO data to Hydroshare*. CUAHSI Biennial colloquium.. Shepherdstown, WV. Status = OTHER; Acknowledgement of Federal Support = Yes

Jiaying Zhang (2019). *Modeling and characterization of the Luquillo experimental forest recovery after hurricane disturbances*. LCZO Annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Alain Plante (2018). *Molecular fractionation of dissolved organic matter during soprtion on iron-bearing mineral matrices in LCZO soils*. LCZO Annual meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Jeffrey Q. Chambers, Robinson I. Negrón Juárez (2018). *NGEE-Tropics*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Xavier Comas, Gilles Brocard, Emma Harrison, Matt Sirianni, Chase Cornett, Mackenzie Vecchio, William Wright, Susan L. Brantley, William H. McDowell (2018). *Near-surface geophysical methods at multiple scales of measurement to understand variation in erosion rates and water storage in the Luquillo CZO, Puerto Rico*. AGU 2018. Washington, D.C.. Status = OTHER; Acknowledgement of Federal Support = Yes

Xavier Comas (2019). *Near-surface geophysical methods at the Luquillo CZO using multiple scales of measurement: from watershed dynamics to tree root extent*. LCZO Annual Meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Jane K Willenbring (2018). *Nevertheless, they persisted: understanding the resiliency of evolving landscapes*. Invited seminar. Rice University. Status = OTHER; Acknowledgement of Federal Support = Yes

Jeffrey Q. Chambers (2018). *Next Generation Ecosystem Experiments- Tropics*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Michelle Shattuck (2018). *Nutrient chemistry across a range of watersheds in a tropical forest ecosystem: The impacts of hurricanes Irma and Maria*. LCZO Annual meeting 2018. Luquillo, PR. 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.*. 2017 CUAHSI Conference on Hydroinformatics. Tuscaloosa, AL. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon, Tony Castronova (2019). *ODM2 Admin and CUAHSI sfotware*. Cross-CZO EarthCube CZIMEA Toolkit Workshop. Riverside, CA. 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

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

Ashley Van Beusekom, Grizelle González (2019). *Overview of other ongoing data collection efforts such as cloud observations, meteorology, soil moisture, and others*. LCZO Annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H. (2019). *Overview: Luquillo CZO and stream chemistry.*. LCZO annual meeting 2019. Luquillo, Puerto Rico. 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

Susan L. Brantley (2017). *Perspectives on CZ Science (Invited Plenary Address)*. National Critical Zone Science Workshop. Arlington VA. Status = OTHER; Acknowledgement of Federal Support = Yes

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

Miguel Leon (2019). *Publishing your LCZO data online*. LCZO annual meeting 2019. Luquillo, Puerto Rico. 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

Yang Lin, Avner Gross, Whendee Silver (2019). *Redox effects on microbial P uptake in humid tropical soils*. Microbial Determinants of Phosphorus Transport Workshop. Washington, DC. 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

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

Kathryn Clark (2018). *Research strategy and contribution*. Lectureship interview in biogeochemical cycles in physical geography. Liverpool UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2018). *Research strategy and contribution*. Academic fellowship interview. Manchester UK. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2017). *Research strategy and contribution*. lectureship interview in biogeochemical cycles. St. Andrew's University, Department of Earth Scien. Status = OTHER; Acknowledgement of Federal Support = Yes

Kathryn Clark (2018). *Research strategy and contribution*. NERC Chair II (research position) natural hazards. Simon Fraser University, Department of earth and e. Status = OTHER; Acknowledgement of Federal Support = Yes

"Emma Jayne Harrison, Gilles Y Brocard, Jane K. Willenbring " (2017). *Resisting Self Arrest: the Soil Production Function in Relict Landscapes.*. AGU 2017. New Orleans, LA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Jane K Willenbring (2018). *Resisting Self-Arrest: the Soil Production Function in Relict Landscapes*. Invited seminar. Caltech University. Status = OTHER; Acknowledgement of Federal Support = Yes

Jane K Willenbring (2017). *Resisting Self-Arrest: the Soil Production Function in Relict Landscapes*. American Geophysical Union Annual Meeting. New Orleans, LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Jennifer Pett-Ridge (2018). *Results from the Great Redox Experiment: How Redox Fluctuations Control Coupled Iron-Carbon Cycling and Microbial Communities in LEF soils*. LCZO Annual Meeting 2018. Luquillo, PR. 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

Gilles Brocard, Jane Willenbring (2019). *Rocks, Regolith, Rain And Rivers: The Dynamic Interaction Of Life And Landscape*. LCZO Annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H., J.D. Potter and C. Lopez-Lloreda (2018). *Sensors reveal flipping of biogeochemical behavior in a small tropical river after major hurricanes.*. International Association of Limnology meeting. Nanjing, China. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H., J.D. Potter, C. Lopez-Lloreda. (2018). *Sensors reveal new insights into controls on tropical stream chemistry after Hurricanes Irma and Maria*. Nanjing Forestry University, Nanjing, China. College of Biology and the Environment. August 21, 2018. Nanjing, China. Status = OTHER; Acknowledgement of Federal Support = Yes

Aaron Thompson (2019). *Short-range-ordered (SRO) iron minerals are dynamic, emergent representations of recent environmental conditions in soils*. AGU 2019. San Francisco, CA. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Aaron Thompson (2018). *Short-range-ordered (SRO) iron minerals are dynamic, emergent representations of recent environmental conditions in soils*. World Congress of Soil Science. Rio de Janeiro, Brazil. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H., J. Potter, and C. Lopez-Lloreda. (2018). *Short-term impacts of Hurricanes Irma and Maria on tropical stream chemistry as measured by in-situ sensors.*. Society for Freshwater Science. Detroit, M. Status = OTHER; Acknowledgement of Federal Support = Yes

McDowell, W.H., J. Potter, and C. Lopez-Lloreda. (2018). *Short-term impacts of Hurricanes Irma and Maria on tropical stream chemistry as measured by in-situ sensors.*. Society for Freshwater Science, Detroit, MI May 2018.. Detroit, MI. Status = OTHER; Acknowledgement of Federal Support = Yes

Christine S. O'Connell, Omar Gutiérrez del Arroyo, Whendee L. Silver (2018). *Short-term response and long-term trajectory of hurricane disturbance: Impacts of Hurricane Maria on forest biogeochemistry in Puerto Rico*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Christine S. O'Connell, Omar Gutiérrez del Arroyo, Whendee L. Silver (2018). *Short-term response and long-term trajectory of hurricane disturbance: Impacts of Hurricane Maria on forest biogeochemistry in Puerto Rico*. ESA 2018. New Orleans, LA. Status = OTHER; Acknowledgement of Federal Support = Yes

Coward L.; Thompson A.; Plante A. (2016). *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

Travis Clow (2019). *Soil Soundscapes from Seismic Arrays: Monitoring Bioturbation in the LCZO*. LCZO Annual meeting 2019. Luquillo, Puerto Rico. 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

Chapela Lara, Maria (2018). *Sources of mineral nutrients to soils and streams at the late stages of weathering: insights from Mg isotopes at the LCZO*. Invited presentation. German Research Centre for Geosciences (GFZ),. Potsdam, Germany. Status = OTHER; Acknowledgement of Federal Support = Yes

Heather Buss (2018). *Spheroidal and non-spheroidal weathering of the volcaniclastic rocks in the Bisley watersheds*. LCZO Annual Meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Christine S. O'Connell (2018). *Terrestrial landscapes in a changing world: Global change impacts on ecosystem ecology*. Invited seminar. Macalester College, St. Paul MN. Status = OTHER; Acknowledgement of Federal Support = Yes

Christine S. O'Connell (2018). *Terrestrial landscapes in a changing world: Global change impacts on ecosystem ecology*. Invited seminar. Sam Houston State University, Huntsville, TX. Status = OTHER; 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

Maria Chapela Lara (2019). *The effect of lithology in Mg cycling at late stages of weathering: insights from the Luquillo Critical Zone Observatory*. LCZO annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; Acknowledgement of Federal Support = Yes

Omar Gutierrez del Arroyo, Whendee Silver (2018). *The response of soil biogeochemistry to drought and hurricanes in a wet tropical forest in Puerto Rico*. ESA 2018. New Orleans, LA. 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

Shanley, J.B., Sebestyen, S. D., McDowell, W.H., Kram, P., Oulehle, F. (2018). *The scientific and societal value of long-term watershed research (Invited)*. AGU 2018. Washington, DC. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Susan L. Brantley (2017). *Toward a Conceptual Model Relating Reaction Fronts to Water Flow Paths in Hillslopes (Invited)*. 2017 Catchment Science: Interactions of Hydrology, Biology & Geochemistry Gordon Research Conference. Lewiston, ME. 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

Tana Wood (2019). *Tropical Responses to Altered Climate Experiment (TRACE) update*. LCZO Annual meeting 2019. Luquillo, Puerto Rico. Status = OTHER; 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

Miguel Leon (2018). *Updates on CZO & LCZO Data Management*. LCZO Annual meeting 2018. Luquillo, PR. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2019). *Using JupyterNotebooks and ArcGISOnline to analyze synthesized Ecosystem Responses to Hurricanes data.*. Ecosystem Responses to Hurricanes – Synthesis Workshop. Corpus Christi, TX.. Status = OTHER; Acknowledgement of Federal Support = Yes

Miguel Leon (2019). *Using NEON API and Hydroshare API to compare data across NEON and CZO sites.*. Explore NEON Workshop - University of Puerto Rico. Rio Piedras, PR. Status = OTHER; 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

Wymore, AS. (2018). *Using long-term observational data to better understand carbon: nitrogen ratios in stream ecosystems.*. Departmental seminar. University of New Hampshire. April 2018.. Durham, NH. Status = OTHER; Acknowledgement of Federal Support = Yes

Song, C., W. Dodds, J. Ruegg, A. Argerich, C. Baker,W.B. Bowden, M. Douglas, K. Farrell, M.B. Flinn, E.Garcia, A. Helton, T. Harms, J. Shufang,, J. Jones, L. Koenig, J.S. Kominoski, W.H. McDowell, D. McMaster, S.P. Damien;Parker, A.D. Rosemond, C. Ruffing, K. Sheehan, M.T. Trentman, M. Whiles, W. Wollheim, F. Ballantyne. (2018). *Warming induces asymmetric convergence of stream metabolic balance.*. Society for Freshwater Science, Detroit, MI May 2018. Detroit, MI. Status = OTHER; Acknowledgement of Federal Support = No

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

Gutiérrez-Fonseca, P.E., A. Ramirez, C. Pringle, P. Torres, A. Covich, T. Crowl, W.H. McDowell, O. Perez-Reyes (2017). *When the rainforest dries up: Impacts of severe drought in a tropical stream.*. Society for Freshwater Science meeting, Raleigh, NC. June 4-9, 2017.. Raleigh, NC. Status = OTHER; Acknowledgement of Federal Support = Yes

Other Products

Audio or Video Products.

Hurricanes Yield "Fundamental Change" In Puerto Rico's Watershed.

NPR / CONNECTICUT PUBLIC RADIO

2018 radio interview

Educational aids or Curricula.

Luquillo Critical Zone Observatory: linking spatial and temporal patterns in stream chemistry to underlying critical zone architecture

Graduate course taught by Jorge Ortiz, Ciencias Ambientales 6115, “Terrestrial Environment”. This overview of Critical Zone science was presented in discussion format in a 3-hour class period. February 5, 2019.

Author: McDowell, W.H.

Educational aids or Curricula.

As part of outreach effort, Miguel Leon presented on CZO concepts and data at University of Puerto Rico - Rio Piedras to undergraduate water resources class.

News.

2019. Hurricane Maria and Puerto Rico's Watersheds. WBUR-FM. 1/1/2019. 0101hurricaneresearch.wav

News.

Camero, K. 2018. UNH researchers find high levels of nitrate in Puerto Rico streams after storms. Boston Globe Online. 12/17/2018. https://www.bostonglobe.com/metro/2018/12/17/unh-researchers-find-high-levels-nitrate-puerto-rico-streams-after-storms-see-climate-change-link/CKOc8an0jxHzmxu17UdiqL/story.html

News.

Dybas, C. 2018. UNH researchers find unexpected impact of hurricanes on Puerto Rico's watershed. National Science Foundation News From the Field. 12/14/2018. Quoted William H. McDowell. https://nsf.gov/news/news_summ.jsp?cntn_id=297488&org=NSF&from=news

News.

Eurasia Review. 2018. Maria's Far-Reaching Effects On Puerto Rico's Watersheds And Forests. Eurasia Review. 12/12/2018. Quoted William H. McDowell. http://www.eurasiareview.com/13122018-marias-far-reaching-effects-on-puerto-ricos-watersheds-and-forests/

News.

Health Medicine Network. 2018. Maria's far-reaching effects on Puerto Rico's watersheds and forests. Health Medicine Network. 12/13/2018. Quoted William H. McDowell. http://healthmedicinet.com/marias-far-reaching-effects-on-puerto-ricos-watersheds-and-forests/

News.

Ives, J. 2018. High levels of nitrate detected on Puerto Rico's watershed after major hurricanes. News-Medical. 12/11/2018. Quoted William H. McDowell. https://www.news-medical.net/news/20181211/High-levels-of-nitrate-detected-on-Puerto-Ricoe28099s-watershed-after-major-hurricanes.aspx

News.

Kalaugher, L. 2018. Hurricane Maria: a haircut, resilient palms and NASA’s Black Marble. Physics World. 12/12/2018. Quoted William H. McDowell. https://physicsworld.com/a/hurricane-maria-a-haircut-resilient-palms-and-nasas-black-marble/

News.

Krajick, K. 2018. American Geophysical Union 2018: Key Events from the Earth Institute. The Earth Institute at Columbia University. 12/3/2018. https://blogs.ei.columbia.edu/2018/12/03/american-geophysical-union-2018-key-events-from-the-earth-institute/

News.

National Science Foundation (NSF). 2018. After the Hurricane: Maria's Far-Reaching Effects On Puerto Rico's Watersheds And Forests. Water Online. December 10, 2018. Quoted William H. McDowell. https://www.wateronline.com/doc/after-hurricane-marias-reaching-effects-puerto-ricos-watersheds-forests-0001

News.

National Science Foundation. 2018. Maria's far-reaching effects on Puerto Rico's watersheds and forests. BrightSurf.com. 12/12/2018. Quoted William H. McDowell. https://www.brightsurf.com/news/article/121218472281/marias-far-reaching-effects-on-puerto-ricos-watersheds-and-forests.html

News.

National Science Foundation. 2018. Maria's far-reaching effects on Puerto Rico's watersheds and forests. Scienmag. 12/12/2018. https://scienmag.com/marias-far-reaching-effects-on-puerto-ricos-watersheds-and-forests/

News.

National Science Foundation. 2018. Maria's far-reaching effects on Puerto Rico's watersheds and forests. Scienmag. 12/12/2018. https://scienmag.com/marias-far-reaching-effects-on-puerto-ricos-watersheds-and-forests/

News.

National Science Foundation. 2018. Tree species and stream and forest nutrients altered, with ecosystem-wide consequences. ScienceDaily. 12/13/2018. Quoted William H. McDowell. https://www.sciencedaily.com/releases/2018/12/181212160106.htm

News.

Pro-Development Committee of Maunabo, Inc. 2019. Scientist from the University of New Hampshire joins a water quality study of the Punta Tuna reservoir. W.H. McDowell was the scientist participating in the visit. https://www.facebook.com/groups/197423907131/permalink/10155790085762132?sfns=mo

News.

Ray, R. 2018. Environmental science professor William McDowell named AAAS fellow. UNH Today. November 26, 2018. https://www.unh.edu/unhtoday/2018/11/aaas-honor

News.

Ray, R. 2018. Hurricane Double-Shot - UNH research finds Hurricanes Irma, Maria had lasting impact on Puerto Rico's streams. UNH Today. December 10, 2018. Quoted Bill McDowell. https://www.unh.edu/unhtoday/2018/12/hurricane-double-shot

News.

Ray, R. 2018. UNH Professor Awarded the Honor of 2018 AAAS Fellow. UNH Newsroom. November 27, 2018. https://www.unh.edu/unhtoday/news/release/2018/11/27/unh-professor-awarded-honor-2018-aaas-fellow

News.

Ray, R. 2018. UNH Researchers Find Unexpected Impact of Hurricanes on Puerto Rico’s Watershed. UNH Today. December 10, 2018. Interviewed Bill McDowell. https://www.unh.edu/unhtoday/news/release/2018/12/10/unh-researchers-find-unexpected-impact-hurricanes-puerto-ricos-watershed

News.

Rodriguez-Cardona, B., Wymore, A., McDowell, W.H. 2019. Carbon availability enhances nitrate removal in tropical montane streams. 2019 Society for Freshwater Science Annual Meeting. Salt Lake City, UT. May 19-23, 2019.

News.

ScienceDaily. 2018. Maria's far-reaching effects on Puerto Rico's watersheds and forests. LongRoom.com. 12/13/2018. Quoted William H. McDowell. https://www.longroom.com/discussion/1290799/marias-far-reaching-effects-on-puerto-ricos-watersheds-and-forests

News.

ScienceDaily. 2018. Maria's far-reaching effects on Puerto Rico's watersheds and forests. Times of News Russia. 12/13/2018. Quoted William H. McDowell. https://russia.timesofnews.com/marias-far-reaching-effects-on-puerto-ricos-watersheds-and-forests/

News.

ScienceDaily. 2018. Unexpected impact of hurricanes on Puerto Rico s watershed. NewsCaf. 12/10/2018. Quoted William H. McDowell. http://www.newscaf.com/science/unexpected-impact-of-hurricanes-on-puerto-rico-s-watershed_1023955.html

News.

Shepherd, M. 2018. The Startling Thing Hurricanes Are Doing To Puerto Rico Watersheds. Forbes. December 10, 2018. Quoted Bill McDowell. https://www.forbes.com/sites/marshallshepherd/2018/12/10/the-startling-thing-hurricanes-are-doing-to-puerto-rico-watersheds/#22b1c92c6604

News.

Skahill, P. 2018. Hurricanes Yield "Fundamental Change" In Puerto Rico's Watershed. Connecticut Public Radio. All Things Considered. December 11, 2018. Interviewed William H. McDowell. https://www.wnpr.org/post/hurricanes-yield-fundamental-change-puerto-ricos-watershed

News.

Skahill, P. 2018. Hurricanes Yield "Fundamental Change" In Puerto Rico's Watershed. New England Public Radio 12/11/2018. Quoted William H. McDowell. http://www.nepr.net/post/hurricanes-yield-fundamental-change-puerto-ricos-watershed

News.

Skahill, P. 2018. Hurricanes Yield "Fundamental Change" In Puerto Rico's Watershed. WSHU-AM Online. 12/12/2018. Quoted William H. McDowell. http://www.wshu.org/post/hurricanes-yield-fundamental-change-puerto-ricos-watershed

News.

Skahill, P. 2018. Researchers in Puerto Rico say hurricanes Irma and María made long-lasting and ongoing impacts to forest and coastal ecosystems. The Beaker - WNPR-FM. Quoted William H. McDowell. 12/12/2018. http://thebeaker.org/post/181044743269.

News.

TodayChan. 2018. Researchers discover surprising impression of hurricanes on Puerto Rico's watershed. TodayChan. 12/10/2018. http://www.todaychan.com/2018/12/10/researchers-find-unexpected-impact-of-hurricanes-on-puerto-ricos-watershed/

News.

University of New Hampshire. 2018. Researchers find unexpected impact of hurricanes on Puerto Rico's watershed. Phys.org. 12/10/2018. Quoted William H. McDowell. https://phys.org/news/2018-12-unexpected-impact-hurricanes-puerto-rico.html

News.

University of New Hampshire. 2018. Researchers find unexpected impact of hurricanes on Puerto Rico`s watershed. WorldNews. 12/11/2018. Quoted William H. McDowell. https://article.wn.com/view/2018/12/11/Researchers_find_unexpected_impact_of_hurricanes_on_Puerto_R/

News.

University of New Hampshire. 2018. UNH Researchers Find Unexpected Impact of Hurricanes on Puerto Rico's Watershed. Caribbean Business Online. 12/11/2018. Quoted William H. McDowell. https://caribbeanbusiness.com/unh-researchers-find-unexpected-impact-of-hurricanes-on-puerto-ricos-watershed/

News.

University of New Hampshire. 2018. UNH researchers find unexpected impact of hurricanes on Puerto Rico’s watershed. EnvironmentGuru. 12/13/2018. Quoted William H. McDowell.

News.

University of New Hampshire. 2018. UNH researchers find unexpected impact of hurricanes on Puerto Rico's watershed. 12/10/2018. BrightSurf.com. Quoted William H. McDowell. https://www.brightsurf.com/news/article/121018471978/unh-researchers-find-unexpected-impact-of-hurricanes-on-puerto-ricos-watershed.html.

News.

University of New Hampshire. 2018. UNH researchers find unexpected impact of hurricanes on Puerto Rico's watershed. Bioengineer. 12/10/2018. https://bioengineer.org/unh-researchers-find-unexpected-impact-of-hurricanes-on-puerto-ricos-watershed/

News.

University of New Hampshire. 2018. UNH researchers find unexpected impact of hurricanes on Puerto Rico's watershed. Jersey Tribune. 12/10/2018. Quoted William H. McDowell. http://jerseytribune.com/2018/12/10/unh-researchers-find-unexpected-impact-of-hurricanes-on-puerto-ricos-watershed/

News.

University of New Hampshire. 2018. UNH researchers find unexpected impact of hurricanes on Puerto Rico's watershed. Sciencecodex.com. 12/11/2018. Quoted William H. McDowell. https://www.sciencecodex.com/unh-researchers-find-unexpected-impact-hurricanes-puerto-ricos-watershed-624125

News.

University of New Hampshire. 2018. UNH researchers find unexpected impact of hurricanes on Puerto Rico's watershed. Scienmag. 12/10/2018 Quoted William H. McDowell. https://scienmag.com/unh-researchers-find-unexpected-impact-of-hurricanes-on-puerto-ricos-watershed/.

News.

University of New Hampshire. 2018. Unexpected impact of hurricanes on Puerto Rico's watershed. ScienceDaily. ScienceDaily, 10 December 2018. Quoted William H. McDowell. https://www.sciencedaily.com/releases/2018/12/181210115759.htm

News.

University of New Hampshire. 2018. University of New Hampshire Researchers Find Unexpected Impact of Hurricanes on Puerto Rico's Watershed. Seed Today Online. 12/13/2018. Quoted William H. McDowell. http://www.seedtoday.com/article/159831/university-of-new-hampshire-researchers-find-unexpected-impact-of-hurricanes-on-puerto-ricos-watershed

News.

Wright, L. 2019. UNH Researchers Study Puerto Rico Hurricane to Understand Impact of New England Storms on Watersheds. September 3, 2019. https://colsa.unh.edu/nhaes/article/2019/09/maria. Interviewed Adam Wymore.

News Release.

Dybas, C. 2018. After the hurricane: Maria's far-reaching effects on Puerto Rico's watersheds and forests. NSF News Release December 10, 2018. Quoted Bill McDowell. https://nsf.gov/news/news_summ.jsp?cntn_id=297288

Newsletter.

01/10/2019 - January eNews from CUAHSI

CUAHSI's Data Down-low: Data and R scripts for: Nutrient export and elemental stoichiometry in an urban tropical river

A new hydroshare resource with has been published for a new publication in Ecological Applications 'Nutrient export and elemental stoichiometry in an urban tropical river' it is available here https://www.hydroshare.org/resource/142c59757ed54de1816777828c9716e7/. This resource includes Jupyter Notebooks for calculating nutrient fluxes and concentrations in tropical rivers using the USGS R package Loadflex (https://github.com/USGS-R/loadflex). Loadflex integrates USGS rloadest with native R regression models and implements the composite method for computing fluxes and concentrations (Appling et al., 2015). The Jupyter Notebooks are presented alongside source data and instructions. Fluxes and concentrations for both inorganic nutrients such as dissolved silica, nitrogen and phosphorus and organic matter are presented. For questions about this resource please contact leonmi@sas.upenn.edu.

https://us3.campaign-archive.com/?u=aad7e9257f329c1a46ebbd412&id=f78a2f8c67

Radio Interview.

Brown, L. and Nalpathanchil, L. 2018. NPR's Adrian Florido On More Than A Year On The Ground In Puerto Rico. Connecticut Public Radio. Where We Live. December 18, 2018. Interviewed William H. McDowell. https://www.wnpr.org/post/nprs-adrian-florido-more-year-ground-puerto-rico

Workshop organization.

Shibata, H. and McDowell, W.H. 2019. Organized the "Challenges for global assessment of nitrogen impacts to human and environments" workshop at the 2nd International L Open Science Meeting. Leipzig, Germany. September 2-6, 2019.

Other Publications

Douglas J Jerolmack (2018). *By river, ocean, or wind, rocks round the same way*. Penn Today citing. Status = OTHER; Acknowledgement of Federal Support = Yes

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

Henry Fountain (2018). *Forests Protect the Climate. A Future with more storms would mean trouble.*. The New York Times citing Maria Uriarte. 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

Oliver W Moore. *Chemical weathering of volcanic rocks in the tropics: Using small scale studies to determine the mechanisms, rates and impacts of perturbations*. (2017). University of Bristol, UK. Acknowledgement of Federal Support = Yes

Chapela Lara M.. *Controls on Mg and water fluxes in a highly weathered tropical catchment over different spatial and temporal scales.*. (2017). 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

King, E.K.. *Understanding Molybdenum Isotope Dynamics in Terrestrial Environments*. (2017). Oregon State University. Acknowledgement of Federal Support = Yes

Websites

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Products File 1 LCZO advisory committee report-annual meeting webinar agendas.pdf	Luquillo CZO advisory committee report following the 2019 annual meeting; LCZO Annual Meeting and Webinar Agendas for 2018-2019	William Mcdowell	12/10/2019
Products File 2 LCZO Annual Meeting Presentations 2019 part 1.pdf	LCZO annual meeting presentations Day 1 (McDowell, Comas, Thompson and Shanley)	William Mcdowell	12/10/2019
Products File 3 LCZO Annual Meeting Lightning Slides.pdf	LCZO annual meeting lightning talks from all participants	William Mcdowell	12/10/2019
Products File 4 LCZO Annual Meeting Presentations 2019 part 2.pdf	LCZO annual meeting presentations Day 2 (Brocard, Silver, Van Beusekom, Gonzalez, Lopez, Wood, Karwan)	William Mcdowell	12/10/2019

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

Name	Most Senior Project Role	Nearest Person Month Worked
Bastola, Satish	Co-Investigator	3
Brantley, Susan	Co-Investigator	0
Bras, Rafael	Co-Investigator	1
Buss, Heather	Co-Investigator	2
Comas, Xavier	Co-Investigator	1
Crowl, Todd	Co-Investigator	1
Jerolmack, Doug	Co-Investigator	0
Mayol, Olga	Co-Investigator	1
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	0
Marin-Spiotta, Erika	Faculty	0
McGee, Steven	Faculty	1
Ntarlaginannis, Dimitrios	Faculty	1
O'Connell, Christine	Faculty	1
Perdrial, Julia	Faculty	1
Perdrial, Nicolas	Faculty	1
Pett-Ridge, Julie	Faculty	1
Wang, Jingfeng	Faculty	1
Yang, Wendy	Faculty	0
Arnone, Elisa	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Brocard, Gilles	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Chen, Chunmei	Postdoctoral (scholar, fellow or other postdoctoral position)	1

Name	Most Senior Project Role	Nearest Person Month Worked
Clark, Kathryn	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Gross, Avner	Postdoctoral (scholar, fellow or other postdoctoral position)	12
Gu, Xin	Postdoctoral (scholar, fellow or other postdoctoral position)	3
Guillon, Herve	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Hynek, Scott	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Hyojin, Kim	Postdoctoral (scholar, fellow or other postdoctoral position)	0
Lin, Yang	Postdoctoral (scholar, fellow or other postdoctoral position)	2
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
Zhou, Qingtao	Postdoctoral (scholar, fellow or other postdoctoral position)	1
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
Barreto, Tatiana	Technician	8
Bosiak, Matt	Technician	0
Diazgranados, Jorge	Technician	0
Gomez, Nicolas	Technician	5
Gonzalez, Gisela	Technician	8
Lopez, Carla	Technician	6
Salazar Ortiz, Monica	Technician	0

Name	Most Senior Project Role	Nearest Person Month Worked
Sallady, Ryan	Technician	0
Schwaner, Geoff	Technician	0
Snyder, Lisle	Technician	1
Swan, Katherine	Technician	1
Torres, Angel	Technician	0
Yudkin, Brian	Technician	0
Gould, William	Staff Scientist (doctoral level)	0
Martinuzzi, Sebastian	Staff Scientist (doctoral level)	0
Murphy, Sheila	Staff Scientist (doctoral level)	1
Scholl, Martha	Staff Scientist (doctoral level)	3
Shanley, Jamie	Staff Scientist (doctoral level)	0
Soylu, Mehmet	Staff Scientist (doctoral level)	1
Stallard, Robert	Staff Scientist (doctoral level)	1
Wood, Tana	Staff Scientist (doctoral level)	1
Almaraz, Maya	Graduate Student (research assistant)	0
Barcellos, Diego	Graduate Student (research assistant)	0
Becker, Joseph	Graduate Student (research assistant)	1
Brereton, Rich	Graduate Student (research assistant)	0
Chapela Lara, Maria	Graduate Student (research assistant)	12
Cornett, Chase	Graduate Student (research assistant)	0
Coward, Elizabeth	Graduate Student (research assistant)	0
Cyle, Taylor	Graduate Student (research assistant)	0
Dialynas, Yannis	Graduate Student (research assistant)	0
Dunne, Kieran	Graduate Student (research assistant)	1
Earll, Marisa	Graduate Student (research assistant)	12
Gutiérrez del Arroyo, Omar	Graduate Student (research assistant)	12

Name	Most Senior Project Role	Nearest Person Month Worked
Harrison, Emma	Graduate Student (research assistant)	12
Hodges, Caitlin	Graduate Student (research assistant)	0
Hoyt, Virginia	Graduate Student (research assistant)	0
Jiaying, Zhang	Graduate Student (research assistant)	6
King, Elizabeth	Graduate Student (research assistant)	1
Koenig, Lauren	Graduate Student (research assistant)	0
Lee, Dylan	Graduate Student (research assistant)	0
Litwin-Miller, Kim	Graduate Student (research assistant)	0
McClintock, Matthew	Graduate Student (research assistant)	0
Moore, Oliver	Graduate Student (research assistant)	1
Noor, Nadia	Graduate Student (research assistant)	1
Orlando, Joe	Graduate Student (research assistant)	0
Perez, Katherine	Graduate Student (research assistant)	1
Phillips, Colin	Graduate Student (research assistant)	0
Rodriguez, Josely	Graduate Student (research assistant)	0
Saccardi, Brian	Graduate Student (research assistant)	0
Santos, Gilmarie	Graduate Student (research assistant)	1
Shaw, Meaghan	Graduate Student (research assistant)	1
Sirianni, Matt	Graduate Student (research assistant)	1
Stone, Maddie	Graduate Student (research assistant)	0
Torres, Elvis	Graduate Student (research assistant)	8
Veccio, Mackenzie	Graduate Student (research assistant)	1
Whiting, Finn	Graduate Student (research assistant)	0
Wilmoth, Jared	Graduate Student (research assistant)	0
Wright, William	Graduate Student (research assistant)	1
Ardington, Emma	Undergraduate Student	1

Name	Most Senior Project Role	Nearest Person Month Worked
Aviles, Gabriela	Undergraduate Student	2
Bell, Staci	Undergraduate Student	3
Bell-Rosof, Madison	Undergraduate Student	0
Benitez, Gabriel	Undergraduate Student	0
Bodek, Sophie	Undergraduate Student	3
Casey, James	Undergraduate Student	1
Chancey, Danielle	Undergraduate Student	1
Chang, Bowen	Undergraduate Student	0
Chari, Nikhil	Undergraduate Student	2
Ciaburri, John	Undergraduate Student	0
Crespo, Ashley	Undergraduate Student	0
Earwood, Racheal	Undergraduate Student	0
Gauthier, Brook	Undergraduate Student	0
Gondak, Geneva	Undergraduate Student	0
Kovalovitch, Aria	Undergraduate Student	0
McGinn, Alexis	Undergraduate Student	1
McGrath, Casey	Undergraduate Student	0
Mcharo, Light	Undergraduate Student	1
Mroz, Christina	Undergraduate Student	0
Nunez, Mayra	Undergraduate Student	0
Osota, Elizabeth	Undergraduate Student	0
Phillips, Margaret	Undergraduate Student	0
Rivera, Felipe	Undergraduate Student	2
Rogers, David	Undergraduate Student	0
Rosales, Omar	Undergraduate Student	0
Sanders, Hannah	Undergraduate Student	0

Name	Most Senior Project Role	Nearest Person Month Worked
Seawards, Kyle	Undergraduate Student	0
Sherman, Justin	Undergraduate Student	0
Silver, Heather	Undergraduate Student	0
Sims, Alexis	Undergraduate Student	1
Stien, Rebekah	Undergraduate Student	0
Sullivan, Conor	Undergraduate Student	0
Tamayo, Cooper	Undergraduate Student	0
Terry, Neil	Undergraduate Student	0
Tilyou, Mary	Undergraduate Student	0
Traxler, Emily	Undergraduate Student	0
Waldron, Liam	Undergraduate Student	0
Yamamoto, Kana	Undergraduate Student	0
Villanueva, Roberto	High School Student	1
Wu, Yiyu	High School Student	0
Morales, Flavia	Consultant	0
De Jesus Roman, Albertyadir	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: USFS

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: UC-Berkeley

International Collaboration: No
International Travel: No

Satish Bastola
Email: Satish.bastola@ce.gatech.edu
Most Senior Project Role: Co-Investigator
Nearest Person Month Worked: 3

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: 0

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: 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

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: 0

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

Christine Sierra O'Connell
Email: coconnell@macalester.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Redox and greenhouse gas controls

Funding Support: UC-Berkeley

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: 0

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: Gilles.Brocard1@univ-grenoble-alpes.fr
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

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

Funding Support: grant

International Collaboration: Yes, France
International Travel: No

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

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

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

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: Yes, Israel
International Travel: No

Xin Gu
Email: xug102@psu.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 3

Contribution to the Project: Postdoc working on particle movement in groundwater

Funding Support: LCZO and DOE

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: 0

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

Funding Support: France

International Collaboration: Yes, France
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: 0

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

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: No
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

Qingtao Zhou
Email: Qingtao.Zhou@unh.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: Soil processes and stream solutes

Funding Support: UNH AES

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: miguel.leon@unh.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: CZO

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

Tatiana Barreto
Email: tbarr057@fiu.edu

Most Senior Project Role: Technician
Nearest Person Month Worked: 8

Contribution to the Project: LCZO technician

Funding Support: LTER, CZO

International Collaboration: No
International Travel: No

Matt Bosiak
Email: mwz28@wildcats.unh.edu
Most Senior Project Role: Technician
Nearest Person Month Worked: 0

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: 0

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: 5

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

Gisela Gonzalez
Email: gisela.gonzalez688@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 8

Contribution to the Project: Field support

Funding Support: UC-Berkeley

International Collaboration: No
International Travel: No

Carla Lopez
Email: carla.lpez09@gmail.com
Most Senior Project Role: Technician
Nearest Person Month Worked: 6

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: 0

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: 0

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: 1

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: 3

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: 0

Contribution to the Project: Mercury and Carbon Biogeochemistry

Funding Support: USGS

International Collaboration: No
International Travel: No

Mehmet Soylu
Email: msoylu3@gatech.edu
Most Senior Project Role: Staff Scientist (doctoral level)
Nearest Person Month Worked: 1

Contribution to the Project: Terrresterial biosphere modeling; Forest distrubance and recovery

Funding Support: Gerogia Tech

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: 0

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: 0

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

Funding Support: UGA

International Collaboration: No
International Travel: No

Joseph Becker
Email: jbecker2015@fau.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Support with geophysical surveys (graduate assistant)

Funding Support: FAU

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: 0

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: UNH-LCZO, SAVI

International Collaboration: No
International Travel: No

Chase Cornett
Email: ccornet1@fau.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: "Support with geophysical surveys (graduate assistant)"

Funding Support: FAU

International Collaboration: No
International Travel: No

Elizabeth Coward
Email: ecoward@sas.upenn.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

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: 0

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: 1

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 Jayne Harrison
Email: ejharris@ucsd.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: 0

Contribution to the Project: Stream Solutes

Funding Support: LCZO

International Collaboration: No
International Travel: No

Zhang Jiaying
Email: jiaying.zhang@gatech.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Terrresterial biosphere modeling; Forest distrubance and recovery

Funding Support: Gerogia Tech

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: 1

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: 0

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: 0

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: 1

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

Katherine Perez
Email: kxp1000@wildcats.unh.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Stream Solutes

Funding Support: LTER

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

Brian Saccardi
Email: bek36@wildcats.unh.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

Contribution to the Project: Stream Solutes

Funding Support: UNH

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

Meaghan Shaw
Email: mes1109@wildcats.unh.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Stream Solutes

Funding Support: UNH

International Collaboration: No
International Travel: No

Matt Sirianni
Email: matt.sirianni@icloud.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

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

Mackenzie Veccio
Email: vecchio647@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

Finn Whiting
Email: unknown@dontknow.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 0

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

Staci Bell
Email: bstaci@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Analysis of experimental data on organic matter characteirzation in LCZO soils

Funding Support: UPenn LCZO

International Collaboration: No
International Travel: No

Madison Bell-Rosof
Email: bemad@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

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

Gabriel Benitez
Email: benit036@umn.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

Sophie Bodek
Email: sopbodek@sas.upenn.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

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: 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

Danielle Chancey
Email: ddc1004@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

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

Nikhil Chari
Email: nikhilrchari@berkeley.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Redox and organic matter decomposition

Funding Support: UC-Berkeley

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: 0

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

Funding Support: UGA, NSF

International Collaboration: No
International Travel: No

Brook Gauthier
Email: beg1007@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

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

Alexis McGinn
Email: ajm1028@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

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: 0

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

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: 0

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: 0

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: 0

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: 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

Justin Sherman
Email: jsherman7732@gmail.com
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

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

Alexis Sims
Email: as1254@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

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: 0

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: 0

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: 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

Kana Yamamoto
Email: kyamamoto95@berkeley.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 0

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

Yiyu Wu
Email: ywu-19@peddie.org
Most Senior Project Role: High School Student
Nearest Person Month Worked: 0

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

Funding Support: Volunteer

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

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
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

María Chapela Lara, W.H. McDowell and M. Scholl are collaborating with Mark Torres (Assistant Professor Rice University DEEPS) on dO and dH rain data.

Scott Hynek (USGS)

Xin Gu (postdoc, Penn State)

Focal Area 2

The Plante lab collaborated with Sunghwan Kim and Nissa Solihat from Kyungpook National University to conduct a pilot experiment testing the viability of solid-phase high resolution mass spectrometry using laser desorption-ionization.

Focal Area 3

Amy Marcarelli, Associate Professor, Department of Biological Sciences, Michigan Technological University, sampled LCZO streams in February 2019 as part of a cross-biome comparison of N-fixation/denitrification rates (CAREER award).

Dawn Cardace, University of Rhode Island and Amanda Olsen, University of Maine, interested in serpentine watersheds in Puerto Rico began initial field work in February 2019 with PI McDowell.

Lin Ma, University of Texas at El Paso, began collaborating with the McDowell lab group to document changes in stream chemistry following Hurricane Maria.

Focal Area 4

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

Impacts

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

Focal Area 1

Our work is highlighting the importance of fracture distribution on stream chemistry.

Geochemists and geomorphologists generally ignore transport of particles in the subsurface (in groundwater). We have documented the importance of this transport pathway in Luquillo.

We are documenting how oxygen reactions at depth open up porosity and permeability.

Focal Area 2

Proof-of-principle and method development work on LDI-FT-ICR-MS:

Current methods for the molecular characterization of natural organic matter by ultrahigh resolution mass spectrometry typically require a solution-phase sample, which requires extensive pre-treatment that may generate artefacts or loss of sample fidelity by fractionation. Colleagues at Kyungpook National University in South Korea have been developing a method to analyze solid phase samples by fixing materials to a metal plate and subjecting them to laser desorption. Preliminary results of a proof-of-principle for soil organic matter characterization in reference soil by LDI-FT-ICR-MS was published in Solihat et al. (2019, Anal. Chem.). Now, the method is being further tested through a collaboration with LCZO by seeking differences in residual organic matter composition after selective dissolution experiments targeting different organo-metal complexes in Luquillo soils. Solution-phase analyses were previously published in Coward et al. (2018, EST), but the current experiments represent a novel and important advance in our ability to chemically characterize the molecular composition of natural organic matter in solid soils samples. If successful, highly sensitive, direct, molecular level analysis of solid-phase natural organic matter from unprocessed soil samples and minimum sample preparation will be possible.

Focal Area 3

Our work has highlighted new roles of climate on surface processes - particularly in the areas of the landscape and stream response to climate forcing.

Focal Area 4

4.1

Characterization of hydrologic feedbacks to hot spots and hot moments in landslide occurrence and sediment transport and cycling of nutrients in soil and plant systems 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 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.

Regeneration of forest after disturbance is an important ecological process that influences forest and climate-ecosystem interaction. Forest disturbance from hurricanes can result in terrestrial carbon sink by affecting the structure and function of forests. Apart from the landslide, the forest ecosystem of Luquillo, the site of this study, is significantly disturbed by hurricane events. Understanding of recovery rates and responses of tropical forest to natural disturbance is an important aspect of this ongoing effort, which will improve quantitative and predictive understanding of critical zone processes.

4.2

Understanding the cloud moisture inputs to the cloud forest and how the inputs are affected by hurricanes will help with our understanding of the resilience of cloud forests under projections of more intense hurricanes.

H4.3

We study atmospheric particles (e.g., African dust), and the impacts these can have on clouds, precipitation and the hydrologic cycle. Atmospheric particles are important because they impact health, climate, visibility, and ecosystems. They also affect cloud formation and precipitation processes. Understanding aerosol-cloud interactions, and their impact on precipitation, is one of the areas of greatest uncertainty both in climate change research, and in our understanding of the hydrologic cycle.

What is the impact on other disciplines?
Nothing to report.

What is the impact on the development of human resources?

There were 11 undergraduate students, 17 graduate students and 9 post-doctoral researchers involved in the LCZO in year 6 (please refer to the participants section for more detailed information). Students and post-doctoral researchers received one-to-one and group mentoring by LCZO PIs and other senior personnel. Because the project includes collaborators at the national and international levels, it provides opportunities for graduate and undergraduate students to interact with collaborators/researchers from different institutions, background training, and field of expertise. These interactions create foundations for better scientific critical analyses and communication that are the basis for research, education, and networking for all people involved.

The Data Jam project contributes to student training by exposing middle and high school students to LCZO long-term datasets. As a result, students increased their familiarity and interest in environmental science as well as increased their confidence in working with long-term data and presenting results in a creative way.

For additional impacts on the development of human resources, see the opportunities for training and professional development in the accomplishments section.

What is the impact on physical resources that form infrastructure?

- Soil sensor networks and stream sensor networks have been established through a collaboration with CZO, DOE, and the Stream PULSE Macrosystems Biology project.
- A storm-proof steel container to house instrumentation was constructed and installed at Pico del Este.
- Instruments that were destroyed by hurricane Maria have been purchased and, some of them, have been installed in the modified steel shipping container. Others are been tested in the laboratory. All will be run once power issues at Pico del Este have been resolved.

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, is helping lead a cross-CZO effort to migrate CZO datasets from CZO institution hosted web servers and criticalzone.org to Hydroshare. This will result in improved accessibility of CZO data through better search and web services. The migration also provides a single hosting solution for CZO data reducing the CZO programs exposure to data loss that might occur with the shutdown of information systems at CZO host institution or the withdrawal of funding from a CZO. The migration was completed with a soft launch on 11-19-2019, further communication and promotion about the completion of this work will continue in early 2020.

The LCZO work collaborating with CUAHSI lead to the promotion of an LCZO data resources on HydroShare via the CUAHSI newsletter. Particularly of note is the use of JupyterNotebooks to demonstrate reusable code for reproducible science. This effort was documented in the CUAHSI newsletter 'CUAHSI's Data Down-low: Data and R scripts for: Nutrient export and elemental stoichiometry in an urban tropical river' in February 2019. Also as part of this collaboration, LCZO data manager, Miguel Leon, met with a visiting group of researchers from Vietnam in January 2019 as part of the US State Department 'Lower Mekong Initiative' to discuss ODM2 based research software, including the CZ Manager software the LCZO has lead development on this was also promoted via the CUAHSI newsletter.

What is the impact on technology transfer?
Nothing to report.

What is the impact on society beyond science and technology?

Focal Area 1

Our discovery that oxygen causes oxidation of biotite deep within granitoid rocks has implications for finding potable water at depth. Our discovery that particles move the subsurface in groundwater (as a result of the oxidation) has implications for understanding weathering and creation of flowpaths of potable water in the subsurface.

Focal Area 4

H4.1

Landslides are a source of extraordinary infrastructure damage, land degradation and loss of lives. Carbon capture and release (e.g., from forest disturbance and recovery, sedimentation) 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 landscape scale.

4.2

The clouds in the forest are a familiar part of the forest for the public. Understanding cloud importance and possible futures improves public knowledge for a very visible aspect of the forest.

H4.3

Understanding water and nutrient deposition helps to better understand how the ecosystem works and gives insights into which management practices could benefit the ecosystem in periods of stress.

Changes/Problems

Changes in approach and reason for change

The passage of Hurricanes Irma and Maria caused a significant disturbance to the Luquillo Experimental Forest. Hurricane Irma was a category 5 hurricane passing to the north of Puerto Rico on 6 September 2017 resulting in tropical storm force winds on the island. Hurricane Maria was a category 4 hurricane that directly struck Puerto Rico on 20 September 2017.

This major disturbance offered several new research opportunities to study the response of Luquillo Mountain hydrology, biogeochemistry, and critical zone function to these extreme events. We now have the opportunity to study our hypotheses from a hurricane simulation experiment in reality, and to expand the results to include satellite results and results on the land-atmospheric interaction that we weren't able to previously study with the smaller scale hurricane simulation. We also have the opportunity to study the hydrologic and biogeochemical response of streams draining watersheds with different lithologies.

H4.2

Recent efforts to quantify the moisture contribution of clouds to the forest water budget have been superseded by the importance of quantifying the hurricane effects. We will come back to the effort of moisture contribution quantities after publishing on the hurricane.

Actual or Anticipated problems or delays and actions or plans to resolve them

Focal Area 1

Scott Hynek wrote the paper we have been working on for this hypothesis 1.1.8 but he started at USGS before finishing the paper. The paper was submitted to GSA Bulletin but was sent back for major revision. Brantley has revised the paper but Hynek has not been able to find the time to finish the paper.

Focal Area 4

A significant setback was caused by the shutdown of the federal government. The US Forest Service was not able to finalize their special use permit authorizing us to operate inside El Yunque National Forest when the modified shipping container that was ready to be installed on-site. We have operated there since 2004 but a special revision of permits was put into effect after the passing of the hurricane. Another setback has been the difficulty in securing adequate electric power to the site. In the past (before hurricane Maria), FAA provided electricity to the station, but post-hurricane they have used generators exclusively used for their aviation radar. The PR Electric Power Authority (PREPA) has planned supplying grid power to the site, but in the meantime, we had to improvise a solution. We secured four generators donated by FAA and fuel and maintenance support from UPR for short-term use.

With the impact of hurricane Maria, we lost samples that were at Pico del Este and that needed to be analyzed for the determination of Total Organic Carbon and Dissolved Organic Carbon. However, samples from two previous summers were analyzed by this technique.

The study of how African dust affects radiation at Pico del Este was not possible. The instruments that measure radiation did not have the necessary resolution for this analysis. Another instrument with better resolution was planned to be used for this purpose, but it was not working properly.

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.