



**2013
ANNUAL
REPORT**

GLOBAL CHANGE AND SUSTAINABILITY CENTER

The GCSC is a faculty-led initiative to address the complex challenges of sustaining human-built and natural systems by bringing together researchers and educators from all colleges to tackle the questions of today and to train the leaders of tomorrow.

*“It is very clear to me
that the problems we face
at the international level
are just too complex to solve alone.
To address these issues,
a multidisciplinary team is essential,
and learning to work and communicate
in such environments is critical
for all fields of study.”*

Tabitha Benney

Cover Photo:

Ken Golden's research team collects ice samples via crane from the icebreaker vessel Aurora Australis.
Photo by Ken Golden

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Kristi Kirisberg Harmon, www.kristikirisberg.com

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THE UNIVERSITY OF UTAH

**GLOBAL CHANGE
& SUSTAINABILITY
CENTER**



JIM EHLERINGER
DISTINGUISHED PROFESSOR, BIOLOGY

MESSAGE FROM THE DIRECTOR

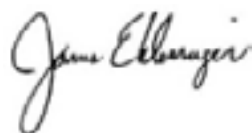
“ECOLOGICAL
SYSTEMS AND THE
ENVIRONMENTS
IN WHICH WE
LIVE AND WORK
ARE IMPACTED BY
UNPRECEDENTED
CHANGES”

Sustainability is an everyday part of our lexicon today, but we too infrequently stop to ask what research and training are critical to developing sustainable systems, how sustainable are natural and human-built systems today, and what are the short- and long-term impacts of our activities on the viability of cities, forests, and desert surroundings here in Utah. Today, from local to global scales, ecological systems and the environments in which we live and work are impacted by unprecedented changes, ranging from air quality locally to the Earth's climate globally. There is neither a single ecosystem nor a society that will not be impacted by these changes. The Global Change and Sustainability Center (GCSC) developed as a faculty-initiated effort to build a program to address these complex challenges. These faculty had the vision and interest to imagine what could be possible if we joined forces, lowered the college silos, and collaborated across disciplines.

This report details the Center's progress in developing an outstanding interdisciplinary research and training program. We helped to attract a cohort of excellent graduate students, and have provided funding to support student research and professional development. We continue to facilitate the development and funding of new projects and other new collaborations that bring faculty, students, and stakeholders together. We provided an excellent interdisciplinary speaker series and other education and training opportunities.

Much of our progress is a direct result of efforts by Drs. Brenda Bowen (Geology & Geophysics) and Steve Burian (Civil & Environmental Engineering) as Associate Directors of the GCSC. In the past year they played key roles in attracting funding to develop an undergraduate sustainability STEM program, to launch a graduate certificate and its curriculum, and to further develop our campus as a living lab through efforts such as the Red Butte Creek Project.

We are pleased to present our annual report for 2013. Here, we have not only tried to capture the breadth and significance of our affiliated faculty's contributions; we also hope to share with you the promise we see in the new generation of researchers whom these faculty are training.



Jim Ehleringer
Distinguished Professor, Biology

THE GCSC AT THE UNIVERSITY OF UTAH

WHAT IS THE GCSC?

The GCSC is composed of ~90 affiliate faculty and their students from eight colleges and over 115 different departments, unified by cross-disciplinary interests in the environment and sustainability.



Jim Ehleringer, Brenda Bowen, Steve Burian

“The GCSC is a faculty-led initiative whose mission is to encourage broad interdisciplinary research, education, and outreach on natural and human-built systems, the dynamic interactions and interconnections that exist in those systems, and the role of humans in the environment.”



Brenda Bowen and Laurie Mecham at the 2013 Research Symposium

GCSC ADMINISTRATION

Director:	Jim Ehleringer, Biology
Associate Director:	Brenda Bowen, Geology & Geophysics
Associate Director:	Steve Burian, Civil & Environmental Engineering
Program Coordinator:	Laurie Mecham
Accountant:	Ming Li
Program Assistant:	Emily Booth

WHAT DOES THE GCSC DO?

The GCSC provides opportunities for cross-college interactions among social scientists, natural scientists, engineers, and policymakers interested in the complex challenges of understanding dynamics in both natural and human-built ecosystems. The GCSC facilitates interdisciplinary research and training through multi-investigator grant proposals, student recruitment and support, and mentoring and education programs.



Brenda Bowen and Jim Ehleringer



2013 Retreat Participants

GLOBAL CHANGE AND SUSTAINABILITY CENTER

UNIVERSITY OF UTAH

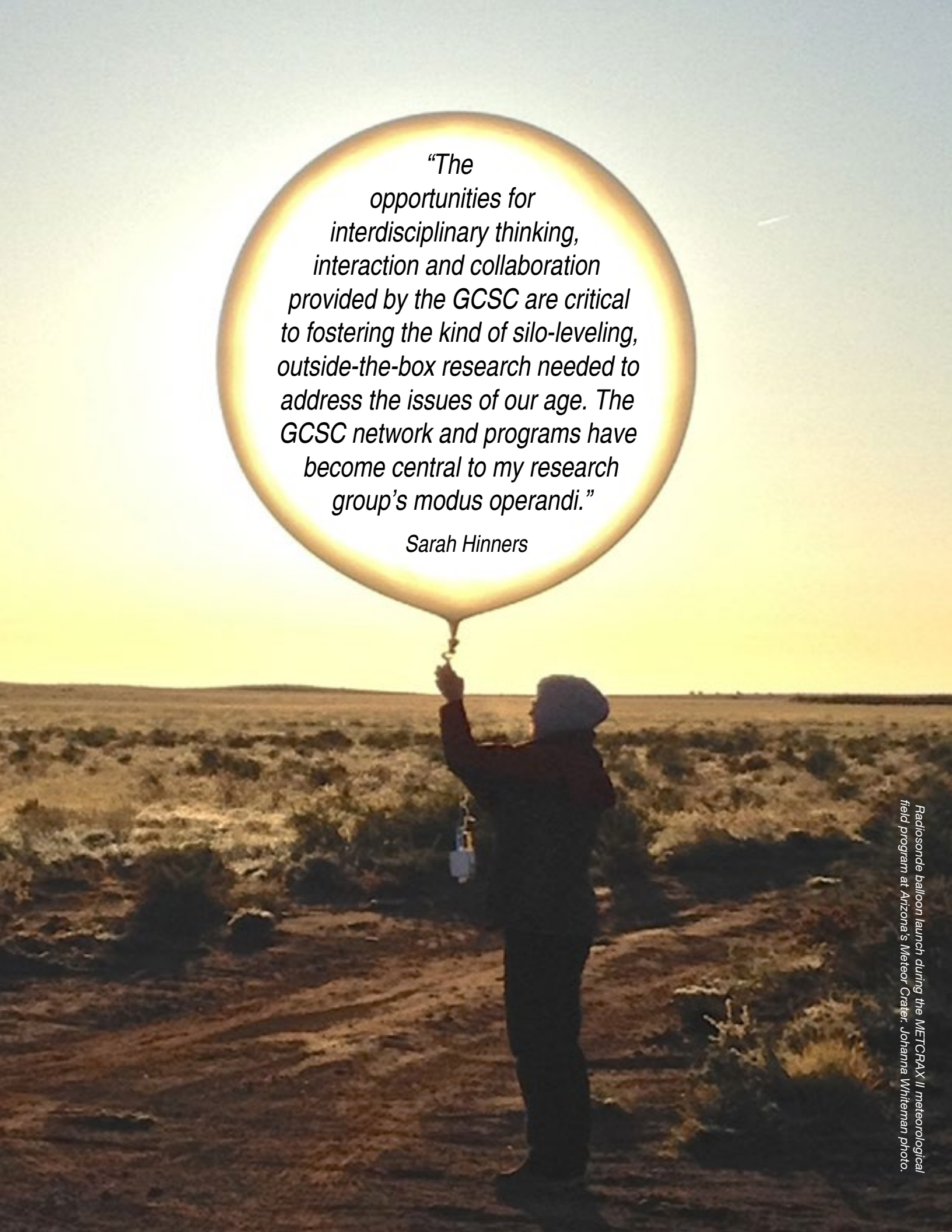
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A person in silhouette stands in a desert landscape at sunset, holding a large, glowing balloon. The balloon is filled with text. The background shows a vast, flat desert with sparse vegetation under a warm, orange sky.

“The opportunities for interdisciplinary thinking, interaction and collaboration provided by the GCSC are critical to fostering the kind of silo-leveling, outside-the-box research needed to address the issues of our age. The GCSC network and programs have become central to my research group’s modus operandi.”

Sarah Hanners

GCSC AFFILIATE FACULTY RESEARCH

NEW GCSC AFFILIATE FACULTY IN 2013

In 2013, the interdisciplinary GCSC community continued to grow with 13 new faculty affiliates from all 8 associated Colleges and 11 different departments. The breadth and excellence of these faculty can be seen in the publications listed below, and demonstrates the diverse range of opportunities linked to sustainability on campus.

ED
BARBANELL

Associate Dean, Undergraduate Studies
Associate Professor (Lecturer), Philosophy,
College of Humanities
Director, University Studies Program
Director, Integrated Certificate in Sustainability

Ed Barbanell's research and teaching interests focus on the value-theoretical aspects of the dialogue about sustainability, to identify those values that are most conducive to sustainable interactions with our environments—both cultural/political environments and physical ones—and to then find ways of inculcating those values within individuals' existing narrative structures.

The new Undergraduate Integrated Certificate in Sustainability is designed to give students the breadth and depth of knowledge, skills, and critical and creative thinking to create a more sustainable future

- Explain, discover, and imagine a worldview cognizant of our ability to live within ecological limits
- Comprehend and evaluate, at the systems level, linkages among policy, the ecosystem, social equity and environmental justice, and the built environment
- Utilize various analytical techniques including triple bottom line and life cycle analysis

(<http://ugs.utah.edu/sustainability-certificate/>)

TABITHA
BENNEY

Assistant Professor, Political Science,
College of Social & Behavioral Sciences

Tabitha uses a mixed method research design to compare emerging economies in an effort to explain how and why differing types of capitalism influence important environmental behavior and outcomes across within these states to determine if differing types of capitalism produce measurable effects on the success of carbon markets in these states. Her work investigates new and innovative ways of understanding interactions among complex socio-political and ecological systems.

- Tabitha Marie Benney & Pulver, 2013, Private-sector responses to climate change in the *Global South: Wiley Interdisciplinary Reviews: Climate Change*



Tabitha Benney at a cement company in Karnataka, India as part of an international research team studying the diffusion of the Clean Development Mechanism in India and Brazil

AMANDA BORDELON

*Assistant Professor, Civil & Environmental
Engineering, College of Engineering*

Amanda's research areas include: 1) monitoring and quantifying the effects of bacteria that has been known to grow in and erode concrete sewer pipes internally, by re-creating the same environment and using alternative pipe materials that may be resistant to such bacteria growth or erosion, 2) designing and measuring potential "self-healing" products that can absorb or consume CO₂ or CH₄ while being contained on or within concrete, 3) designing and creating a new material that can selectively aid in improved dispersion of particles

Graduate student Uma Ramasamy measures shrinkage of a piece of concrete for a study with Amanda Bordelon researching Idaho volcanic pumice as a durable and sustainable alternative to carbon-intensive manufactured cement in concrete.

in concrete, and 4) gathering cost and carbon emission information about existing manufacturing systems, products, construction, or maintenance methods in order to progress design and selection of alternative material options.



KELLEY S. BRICKER

*Associate Professor, Parks Recreation &
Tourism, College of Health*

The primary focus of Kelley's research is to understand the complex and varied nature of sustainability within nature-based tourism and recreation. Specifically, she conducts social science research in an attempt to comprehend the relationship between socio-economic, environmental, and cultural management and development factors which support or negate positive change within varying contexts (i.e., local to global) and environments. Because of

the complex and diverse nature of tourism and recreation endeavors, managers are continually confronted with a dynamic interplay of shifting challenges that are interconnected at varying scales. Hence, there is a need to understand systems and how factors of sustainability intersect and can begin to address these challenges.

- Kelley S. Bricker, 2013, Ecotourism as a Venue for Environmental and Social Justice: A Case Study of a Fijian Vanua in *Just Leisure: Things That We Believe In*, Sagamore Publishing LLC

Research team studying winter recreation and tourism at Yellowstone National Park (Kelly Bricker)



Brian's research focuses on examining human-environment interactions among small scale societies in the past and present. He is currently working on projects in Australia and North America that examine (1) the effects of paleoenvironmental change on prehistoric subsistence strategies; (2) the contemporary use of fire among indigenous populations to examine co-evolutionary interdependence between traditional burning practices and local flora and fauna; and (3) using the latter to help inform interpretations of past human-environment interactions by better understanding contemporary relationships between indigenous foraging practices, ecological variability and their material (i.e., archaeologically visible) outcomes.

- Bird, Taylor, Brian F. Coddling & Bird, 2013, Niche construction and Dreaming

logic: aboriginal patch mosaic burning and varanid lizards (*Varanus gouldii*) in Australia. Proceedings of the Royal Society B: Biological Sciences

- Brian F. Coddling & Jones, 2013, Environmental productivity predicts migration, demographic, and linguistic patterns in prehistoric California: Proceedings of the National Academy of Sciences of the United States of America

"Global patterns of ethnolinguistic diversity vary tremendously. Some regions show very little variation even across vast expanses, whereas others exhibit dense mosaics of different languages spoken alongside one another... Here we show that environmental productivity predicts both the order of migration events and the population density recorded at contact."

U of U Anthropology graduate students (Erk martin, Kate Magargal, and Peter Yaworsky) conducting field work on a prehistoric shell midden on the California coast. (Brian Coddling)





Robin is currently working on two major research projects and several related but more minor projects. The first major project is supported by a University of Utah research grant and will compare the implementation of marine spatial planning in the United States and New Zealand, focusing on each country's treatment of native peoples and national security in the marine spatial planning process. The second major project examines the potential role of a public health rationale in insulating land use planning changes for climate change adaptation from constitutional "takings" challenges. Much radical land use planning—as will be necessary to adapt to climate change—has been subject to significant claims that the new regulations take private property for public use with compensation, and many of these challenges have been successful, especially regarding attempted coastal adaptation strategies. This series of articles argues that land use practices create not only physical but public health problems in the face of climate change and that public health protection provides states and local governments with a legally stronger justification for imposing new and radical kinds of land use planning requirements on property owners in the face of climate change.

- Robin K. Craig, 2013, *Comparative Ocean Governance: Placed-Based Protections in an Era of Climate Change*, Edward Elgar Publishing
- Robin K. Craig, 2013, *Learning to Think About Complex Environmental Systems in Environmental and Natural Resources Law and Scholarship: A Twenty-Year Retrospective*: 24 *Fordham environmental Law Review*

"The environment is a complex system, and acknowledging that fact has become an increasingly important part of environmental law scholarship. However, that fact also desperately needs to become a more prominent part of environmental and natural resources law and policy. In particular, grappling with ecological complexity through new legal tools offers one of the best prospects for dealing with the impacts of climate change—i.e., engaging in climate change adaptation—in the decades to come."

- Robin K. Craig, 2013, *Hydraulic Fracturing*

("Fracking"), *Federalism, and the Water-Energy Nexus*: 49 *Idaho Law Review*

"While the actual and potential water impacts of hydraulic fracturing ("fracking") are well-known and the subject of sometimes intense scholarly debate, few discussions to date have situated fracking within the larger legal and policy conundrum known as the water-energy nexus. This nexus acknowledges that, just as water supply and energy production are mutually dependent, so water policy and energy policy should also develop in tandem."

- Robin K. Craig, 2013, *Climate Change Adaptation, the Clean Water Act, and Energy: An Application of Principled Flexibility*: *George Washington Journal of Energy & Environmental Law*
- Robin K. Craig & Benson, 2013, *Replacing Sustainability*: *Akron Law Review*

"Since at least 1992 and the United Nations Conference on Environment and Development, sustainability and sustainable development have been explicit and persistent goals for the governance and management of socio-ecological systems. However, the repeated invocation of sustainability ignores the ecological realities of the Anthropocene—biodiversity loss, increasing per capita resource consumption, and climate change."

- Robin K. Craig, 2013, *The Social and Cultural Aspects of Climate Change Winners*: 97 *Minnesota Law Review*
- Burger, Burleson, Bratspies, Robin K. Craig et al., 2013, *Rethinking Sustainability to Meet the Climate Change Challenge*: *University of Utah College of Law Research Paper*
- Robin K. Craig, 2013, *Treating Offshore Submerged Lands as Public Lands: A Historical Perspective*: 34 *Public Land & Resources Law Review*

"When President Harry Truman proclaimed federal control over the United States' continental shelf in 1945, he did so primarily to secure the energy resources—oil and gas—embedded in those submerged lands."

ZAK FANG

Professor, Metallurgical Engineering, College of Mines & Earth Sciences

Zak's research focuses on using powder metallurgy and basic principles of materials engineering to facilitate advancement in the

production, storage and use of energy in mechanized systems.

- Z. Zak Fang et al., 2013, A New, Energy-Efficient Chemical Pathway for Extracting Ti Metal from Ti Minerals: Journal of the American Chemical Society

STEPHEN GOLDSMITH

University Professor for Campus Sustainability Associate Professor, City & Metropolitan Planning, College of Architecture & Planning

Stephen is responsible for teaching Foundations of Urban Ecology, Empathic Sustainability, Ethics in Shaping Communities, Planning Workshop and Green Communities. In 2009 he led students on a Learning Abroad trip to Germany as part

of a Green Communities Seminar, and in 2012 led students to a Green Communities Seminar in Curitiba, Brazil. He teaches Sustainability and Urban Ecology tracks for Honors Scholars in the Honors College, and created an Honors Think Tank in Sustainability. He also serves as Environmental Science Track Director for the Professional Masters in Science and Technology Program in the Graduate School.

ZACHARY LUNDEEN

Assistant Research Professor, Geography, College of Social & Behavioral Sciences Station Manager at Rio Mesa Center

Zach's research focuses on understanding the drivers of hydroclimatic variability in the West, and the impacts of climate change and variability on ecosystems. His research and educational background crosses over disciplinary boundaries, incorporating elements of climatology, geochemistry, ecology, hydrology, and geography.

- Zachary Lundeen, Andrea Brunelle et al., 2013, A speleothem record of Holocene paleoclimate from the northern Wasatch Mountains, southeast Idaho, USA: Quaternary International

Cut open speleothem (stalagmite) from Minnetonka Cave in Idaho Quaternary International). Photo by Zachary Lundeen

RIO MESA CENTER

<http://riomesa.utah.edu>

Located along almost three miles of Dolores River in the magnificent red-rock country of southeastern Utah, The University of Utah's Rio Mesa Center provides opportunities for field-based interdisciplinary research that emphasizes ecology and the environment in the broadest sense. Rio Mesa Center is a real-world laboratory for integrated thinking about humans and their place in biologically complex, but fragile, systems. The Center promotes research, courses and professional training at the interface of history, anthropology, biology, art and human sustainability around the following themes:

- Water as the lifeblood of the West
- Human history and sustainability on the Colorado Plateau
- Solitude and inspiration



MEREDITH METZGER

Associate Professor, Mechanical Engineering, College of Engineering

Meredith's research is focused on experimental fluid dynamics, including both laboratory and field studies with an emphasis on pollutant dispersion, turbulent mixing, and high Reynolds number turbulent boundary layer physics. She is involved in development of sensors for

fundamental fluid dynamic and atmospheric measurements, and technologies for wind and wave energy harvesting.

- Guala, LeHew, Meredith Metzger & McKeon, 2013, On the structure of wall turbulence in the thermally neutral atmospheric surface layer in Coherent Flow Structures at Earth's Surface

LINDSEY NESBITT

Assistant Professor/Lecturer, Biology, College of Science

Lindsey teaches Global Change Ecology, Global Environmental Issues, and Introduction to

Environmental Science, and conducts research on the primary and secondary effects of global change on western US mountain hydro-ecological systems. She is currently involved

AMANDA SMITH

Assistant Professor, Mechanical Engineering, College of Engineering

Amanda's academic research relates to the environment through addressing air quality and water resources; to global changes by investigating how our methods for producing and using energy will change the world and how changes in the world will affect how we choose to produce and use energy; to sustainability through a focus on energy savings and better integration of renewable energy resources into power generation portfolios; and in general, this work may inform our

in research using RHESys, a hydro-ecological model, to conduct spatial/temporal simulations of Red Butte Canyon watershed.

understanding of the response of ecosystems to changes in energy systems. She is interested in utilizing mathematical system-level models, computer simulations, and case studies to look at emissions from both conventional and alternative power production systems while incorporating water system effects from different power production scenarios.

- Amanda D. Smith et al., 2013, Benefits of Thermal Energy Storage Option Combined with CHP System for Different Commercial Building Types: Sustainable Energy Technologies and Assessments

BRETT TIPPLE

Research Assistant Professor, Biology, College of Science

Brett's research interests are in the fields of isotope geochemistry, paleoclimatology, and modern and ancient plant ecology. In particular, I use stable isotope ratios and abundances of organic molecules and other organic phases to constrain modern and ancient environmental conditions of oceans, terrestrial ecosystems, and atmospheres. Some of the major foci of Brett's research are reconstructing past atmospheric CO₂ levels and isotope ratios, understanding the effects changing CO₂ concentrations on ancient terrestrial plant communities, and developing new terrestrial plant-based proxies of climate and hydrologic cycle dynamics.

- Brett J. Tipple & Pagani, 2013, Environmental control on eastern broadleaf forest species' leaf wax distributions and D/H ratios: *Geochimica et Cosmochimica Acta*

"Local climate and environment broadly affect the deuterium/hydrogen (D/H) ratios of plant materials, however the degree to which an individual plant's leaf waxes D/H ratios are affected by these parameters remains in question. Understanding these issues is particularly important in order to reconstruct past floral transitions and

changes in the paleohydrologic cycle... These findings indicate that the isotope ratio of n-alkanes from soils in Eastern North American forests and similar ecosystems likely represents a time-averaged value that smooth out the environmental influence any one plant experiences."

- Brett J. Tipple, Chau, Chesson, Diego P. Fernandez & James R. Ehleringer, 2013, Isolation of strontium pools and isotope ratios in modern human hair: *Analytica Chimica Acta*

"The elements of human hair record specific information about an individual's health, diet, and surrounding environment... The results of this study indicate that external environmental strontium signals can be distinguished from the internal signals and therefore permit the application of strontium isotope ratios of modern human hair for geospatial applications."

- Brett J. Tipple, Berke, Doman, Khachatryan & James R. Ehleringer, 2013, Leaf-wax n-alkanes record the plant-water environment at leaf flush: *Proceedings of the National Academy of Sciences of the United States of America*



The Narus Valley in Kipado National Park, Uganda, where soil and plant samples were taken for stable isotopes analysis (Kendra Chritz)

GCSC INTERDISCIPLINARY FACULTY HIRES

In 2012, with support from the central administration, the GCSC attracted three outstanding interdisciplinary Associate Professor level faculty with college-bridging research interests in global change, environment, and sustainability. These individuals have already made significant contributions to the University community, engaging across disciplines to understand and address questions of environmental import.



Gabe, John, Diane

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GABRIEL BOWEN

Associate Professor, Geology & Geophysics

- Gabriel J. Bowen, 2013, Up in smoke: A role for organic carbon feedbacks in Paleogene hyperthermals: Global and Planetary Change
“Sedimentary archives from the world’s oceans and continents indicate that as the world warmed from the mild climate conditions of the mid-Paleocene to the extreme global warmth of the Early Eocene, a series of abrupt perturbations shifted the carbon isotope budget of the ocean/atmosphere/biosphere (exogenic) system. Consideration of the rates and magnitude of carbon isotope change, along with independent evidence for ocean acidification, dictates that these “hyperthermal” events involved the transfer of thousands of petagrams of reduced carbon to the actively cycling exogenic system... the initial results suggest that organic carbon feedbacks, similar in nature to those being explored in work on modern and future Earth systems, may have played a significant role in shaping global changes at the Paleocene–Eocene boundary.”
- Cooper & Gabriel J. Bowen, 2013, Metal Armor from St. Lawrence Island: Arctic Anthropology
- Clyde, Gingerich, Wing, Röhl, Westerhold, Gabriel J. Bowen et al., 2013, Bighorn Basin Coring Project (BBCP): a continental perspective on early Paleogene hyperthermals: Scientific Drilling
- Liu, Yoshimura, Gabriel J. Bowen & Welker, 2013, Pacific North American Teleconnection Controls on Precipitation Isotopes ($\delta^{18}\text{O}$) across the Contiguous United States and Adjacent Regions: A GCM-based Analysis: Journal of Climate.
- Schneider-Mor & Gabriel J. Bowen, 2013, Coupled and decoupled responses of continental and marine organic-sedimentary systems through the Paleocene-Eocene thermal maximum, New Jersey margin, USA: Paleoceanography
“The flux of sediment and organic carbon from continents to the coastal ocean is an

ISOTOPES IN SPATIAL ECOLOGY AND BIOGEOCHEMISTRY SHORT COURSE

The inaugural offering of the “Isotopes in Spatial Ecology and Biogeochemistry” short course was held at the U from June 17-28, 2013. The graduate level course was organized as a component of the NSF-supported “Inter-university Training for Continental-scale Ecology” project, a 5-year, \$4.3M effort headed by GCSC faculty to advance next-generation, global-scale ecology and Earth science research through student training and resource development. The course enrolled 27 graduate students, postdocs, and professionals from across the USA, Canada, Africa, Asia and Australia. Lectures from 19 faculty, including 6 GCSC faculty members, provided students with background in stable isotope geochemistry, GIS, data management, and modeling and introduced a wide range of cutting-edge applications of environmental chemistry to spatial problems in fields ranging from atmospheric science to forensics. In afternoon lab sessions students developed and conducted week-long research projects involving field work, data collection, database development, and spatial and statistical modeling.

important factor governing organic burial in coastal sediments, and these systems preserve important records of environmental and biogeochemical conditions during past global change events. Burial of organic materials in coastal systems can be promoted by chemical resilience or through protection by association with mineral surfaces, but the role and influence of these processes on organic records from ancient sediments is poorly known.”

- VanDeVelde & Gabriel J. Bowen, 2013, Effects of chemical pretreatments on the hydrogen isotope composition of 2:1 clay minerals: Rapid Communications in Mass Spectrometry
- VanDeVelde, Gabriel J. Bowen, Passey & Brenda B. Bowen, 2013, Climatic and

diagenetic signals in the stable isotope geochemistry of dolomitic paleosols spanning the Paleocene–Eocene boundary: *Geochimica et Cosmochimica Acta*

“The precipitation of primary dolomite in soil is rare and controversial, and its occurrence indicates highly unusual geochemical and climatic conditions. We utilize isotopic and petrographic techniques, including clumped isotope thermometry, to evaluate diagenetic alteration and preservation of primary climatic signal in dolomitic paleosol nodules from a section spanning the Paleocene–Eocene boundary in central Utah... Soil water isotopic composition is suggestive of heightened aridity, particularly through the Paleocene–Eocene Thermal Maximum.”

2014 SPATIAL cohort



JOHN C. LIN

Associate Professor, Atmospheric Science

- John C. Lin, 2013, A fully-Lagrangian approach to solving atmospheric dynamics in Mesoscale Meteorological Modeling: Academic Press, 3rd Edition
- Kim, Millet, Hu, Mohr, Griffis, Wen, John C. Lin et al., 2013, Constraints on carbon monoxide emissions based on tall tower measurements in the US Upper Midwest: Environmental Science & Technology

“We interpret a full year of high-frequency CO measurements from a tall tower in the U.S. Upper Midwest with a time-reversed Lagrangian Particle Dispersion Model and an Eulerian chemical transport model to develop top-down constraints on U.S. CO sources in 2009.”

- Luus, Gel, John C. Lin et al., 2013, Pan-Arctic linkages between snow accumulation and growing-season air temperature, soil moisture and vegetation: Biogeosciences

DIANE PATAKI

- Luus, Kelly, John C. Lin et al., 2013, Modeling the influence of snow cover on low Arctic net ecosystem exchange: Environmental Research Letters
- Luus, John C. Lin et al., 2013, Subnivean Arctic and sub-Arctic net ecosystem exchange (NEE): Towards representing snow season processes in models of NEE using cryospheric remote sensing: Progress in Physical Geography
- Wen, John C. Lin et al., 2013, Modeling atmospheric ammonia and ammonium using a stochastic Lagrangian air quality model: Geoscientific Model Development
- Wen, Zhang, John C. Lin et al., 2013, An evaluation of ambient ammonia concentrations over southern Ontario simulated with different dry deposition schemes within STILT-Chem v0.8: Geoscientific Model Development Discussions

Associate Professor, Biology

- Diane E. Pataki, 2013, City trees: Urban greening needs better data: Nature
“To make substantive progress towards urban sustainability, city managers and researchers need to know where, when, how and which greening programmes are appropriate for urban areas.”
- Diane E. Pataki et al., 2013, A trait-based ecology of the Los Angeles urban forest: Ecosphere
- Jenerette, Miller, Buyantuev, Diane E. Pataki et al., 2013, Urban vegetation and income segregation in drylands: a synthesis of seven metropolitan regions in the southwestern United States: Environmental Research Letters
- Litvak, Bijoor & Diane E. Pataki, 2013, Adding trees to irrigated turfgrass lawns may be a water-saving measure in semi-arid environments: Ecohydrology
- Pincetl, Prabhu, Gillespie, Jenerette & Diane E. Pataki, 2013, The evolution of tree nursery offerings in Los Angeles County over the last 110 years: Landscape and Urban Planning
- Townsend-Small, Diane E. Pataki et al., 2013, Increasing summer river discharge in southern California, USA, linked to urbanization: Geophysical Research Letters

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GCSC EXECUTIVE COMMITTEE – DIRECTORS

The GCSC Directors work to create, identify, and facilitate new opportunities for interdisciplinary research, education, and outreach related to the environment and sustainability, and to promote broad participation by students and faculty across campus.

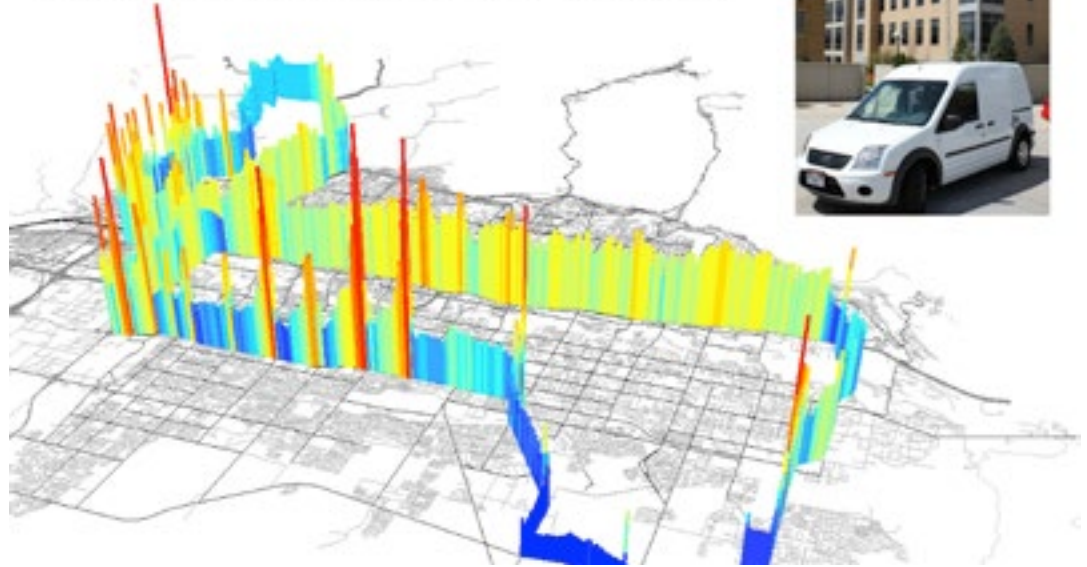
JAMES EHLERINGER

*Distinguished Professor, Biology
Director, Global Change & Sustainability Center
Director, Stable Isotope Ratio Facility for
Environmental Research (SIRFER) Lab*

The Ehleringer Lab continues to explore relationships between climate and plant responses and the ways in which biomarkers in the environment can be used to reconstruct past climates.

- Hultine, Burtch & James R. Ehleringer, 2013, Gender specific patterns of carbon uptake and water use in a dominant riparian tree species exposed to a warming climate: Global Change Biology
“Air temperatures in the arid western United States are predicted to increase over the next century. These increases will likely impact the distribution of plant species, particularly dioecious species that show a spatial segregation of the sexes across broad resource gradients... Results suggest that the spatial segregation of the sexes could shift under global warming such that female plants lose their dominance in high-resource habitats, and males increase their dominance in relatively lower-resource habitats.”
- Domingues, Martinelli & James R. Ehleringer, 2013, Seasonal patterns of leaf-level photosynthetic gas exchange in an eastern Amazonian rain forest: Plant Ecology & Diversity

Atmospheric CO₂ distributions across the Salt Lake Valley revealed by mobile observatory



Atmospheric CO₂ distributions with Nerdmobile. January 7, 2013 afternoon

BRENDA BOWEN

Associate Research Professor,
Geology & Geophysics
Associate Director, Global Change & Sustainability Center

Brenda's research is focused on understanding physical and chemical processes in sedimentary systems related to environmental change. Ongoing projects include evaluation of the feasibility and impacts of geologic CO₂ sequestration, and surface processes in modern extreme environments (e.g., acid lakes, salt systems) and anthropogenically influenced systems (e.g., urban creeks).

- Brenda B. Bowen et al., 2013, Differences in regolith weathering history at an acid and neutral saline lake on the Archean Yilgarn Craton and implications for acid brine evolution: Chemical Geology

"Many of these lakes have extreme chemistry, with pH values down to ~1.5. Previous workers have suggested that the regionally acidic groundwater that feeds these lakes has reached its unusually low pH as the result of long-term continental denudation and may be a characteristic of late-stage continental weathering and may have been important in the geologic past."

- Benison & Brenda B. Bowen, 2013, Extreme sulfur-cycling in acid brine lake environments of Western Australia: Chemical Geology

"Regional-scale extreme acid brines in southern Western Australia are an example of sulfur-rich end-member continental waters and are amongst the most physically and chemically dynamic settings in the world..."



Interdisciplinary group of geologists (Brenda Bowen and students) and microbiologists (from Westminster College) conducting field work at the Bonneville Salt Flats to understand fluid-sediment-microbial processes within the salt (October 2013).

Sulfur cycling among the lithosphere, hydrosphere, biosphere, and atmosphere in acid saline environments is dynamic. Driving forces are rock weathering, weather, and climate, which ultimately influence the water chemistry.”

- Zhang, Person, Rupp, Ellett, Celia, Gable, Brenda B. Bowen et al., 2013, Hydrogeologic controls on induced seismicity in crystalline basement rocks due to fluid injection into basal reservoirs: Groundwater

“A series of Mb 3.8-5.5 induced seismic events in the midcontinent region, United States, resulted from injection of fluid either into a basal sedimentary reservoir with no underlying confining unit or directly into the underlying crystalline basement complex... We present a suite of simulations that use a simple hydrogeologic-geomechanical model to assess what hydrogeologic conditions promote or deter induced seismic events within the crystalline basement across the midcontinent.”

STEVE BURIAN

*Professor, Civil & Environmental Engineering
Co-Director of Sustainability
Curriculum Development
Associate Director, Global Change & Sustainability Center*

Steve’s research focuses on modeling, simulation, and observation studies of (1) climate, urbanization, and air quality impacts on hydrologic response and urban water system sustainability, (2) sustainability tradeoffs of decentralized versus centralized urban water infrastructure systems, and (3) integrated modeling and simulation of natural, built, and human elements of water systems. His research is producing results guiding planning

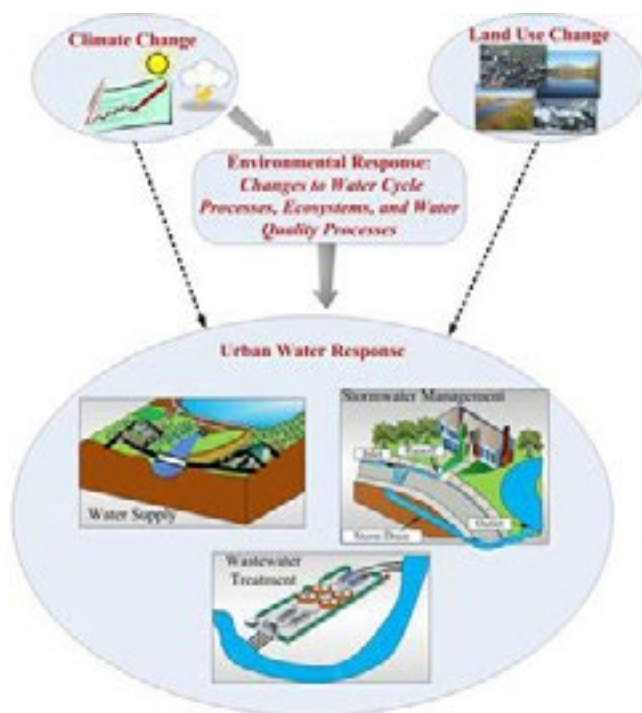
and management of urban water systems, decentralized water supply approaches, and prototyping and designing stormwater and water treatment technologies.

- Steven J. Burian et al., 2013, Climate Vulnerabilities and Adaptation of Urban Water Infrastructure Systems in Climate Vulnerability: Understanding and Addressing Threats to Essential Resources, Elsevier Inc., Academic Press,

“Urban water infrastructure systems – including water supply, stormwater management, and wastewater collection – are subject to climate and other factors that influence the water cycle. Those seeking to manage water infrastructure systems in cities begin by assessing vulnerabilities or critical features and developing mitigation and adaptation plans... Therefore, the goals of this chapter are not only to summarize climate vulnerabilities and adaptation strategies of current urban water infrastructure systems but also to identify climate vulnerabilities and adaptation potential of new green infrastructure and decentralization approaches and highlight the importance of the interdependency of urban water infrastructure and energy requirements in relation to climate.”

- Bardsley, Wood, Hobbins, Kirkham, Briefer, Niermeyer & Steven Burian, 2013, Planning for an Uncertain Future: Climate Change Sensitivity Assessment toward Adaptation Planning for Public Water Supply: Earth Interactions

“The most significant water management impacts will be earlier and reduced runoff volume, which threaten the system’s ability to maintain adequate streamflow and storage to meet late-summer water demands.”



Steve Burian’s research is producing results guiding planning and management of urban water systems and water treatment technologies

- Muleta, McMillan, Amenu & Steven J. Burian, 2013, Bayesian Approach for Uncertainty Analysis of an Urban Storm Water Model and Its Application to a Heavily Urbanized Watershed: Journal of Hydrologic Engineering
“This study applies formal Bayesian approach for uncertainty analysis of a widely used storm water management model

and illustrates the methodology using a highly urbanized watershed in the Los Angeles Basin, California... Overall, the UA methodology proved promising for sensitivity analysis, calibration, parameter uncertainty, and total predictive uncertainty analysis of urban storm water management models.”

**MYRON
WILSON**

*Director, Sustainability Resource Center,
Sustainability Office*

Myron designs, plans, and coordinates the activities in the Sustainability Resource Center and across campus. He works with Campus

Design, the Energy Efficiency group and Facilities Management to create efficiency standards and techniques to make all of our campus buildings more sustainable. Myron also works with faculty and administration to integrate sustainability into curriculum, research and operations.

GCSC EXECUTIVE COMMITTEE – COLLEGE REPRESENTATIVES (2010-2013)

The GCSC Executive Committee members are selected by the affiliate faculty from a College, and serve as the faculty liaisons between the Colleges and the Center. Executive Committee members participate in regular planning meetings and determine GCSC policies.

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COLLEGE OF ARCHITECTURE AND PLANNING

**KEITH
BARTHOLOMEW**

*Associate Professor, City &
Metropolitan Planning*

- Keith Bartholomew & Reid Ewing, 2013, Pedestrian- and Transit-Oriented Design, Urban Land Institute

**SARAH J.
HINNERS**

*Director, Ecological Planning Center
Assistant Research Professor, City &
Metropolitan Planning*

Sarah works within the realm of ecological planning, which looks for ways to incorporate ecological science and thinking into the planning of human settlements. Current

projects and initiatives include the integration of natural resources and land cover data into a scenario planning software package, Envision Tomorrow Plus, and several initiatives in collaboration with public agencies to advance green infrastructure engineering, design, planning and implementation in the Wasatch Front and elsewhere.

**A. CHRIS
NELSON**

*Director, Metropolitan Research Center
Presidential Professor, City &
Metropolitan Planning*

For the past thirty years, Chris Nelson has conducted pioneering research in growth management, urban containment, public facility finance, economic development, and metropolitan development patterns.

ERIC PARDYJAK

Associate Professor, Mechanical Engineering

- Addepalli & Eric Pardyjak, 2013, Investigation of the Flow Structure in Step-Up Street Canyons—Mean Flow and Turbulence Statistics: *Boundary-Layer Meteorology*
- Brown, Gowardhan, Nelson, Williams & Eric Pardyjak, 2013, QUIC transport and dispersion modelling of two releases from the Joint Urban 2003 field experiment: *International Journal of Environment and Pollution*
- Froidevaux, Higgins, Simeonov, Ristori, Eric Pardyjak et al., 2013, A Raman lidar to measure water vapor in the atmospheric boundary layer: *Advances in Water Resources*
- Garai, Eric Pardyjak et al., 2013, Surface Temperature and Surface-Layer Turbulence in a Convective Boundary Layer: *Boundary-Layer Meteorology*
- Higgins, Eric Pardyjak et al., 2013, Measured and Estimated Water Vapor Advection in the Atmospheric Surface Layer: *Journal of Hydrometeorology*
- Pincetl, Franco, Grimm, Hogue, Hughes, Eric Pardyjak et al., 2013, Urban Areas in Assessment of Climate Change in the Southwest United States, Island Press
- Zajic, Fernando, Brown & Eric Pardyjak, 2013, On flows in simulated urban canopies: *Environmental Fluid Mechanics*

CHRISTINE POMEROY

Assistant Professor, Civil & Environmental Engineering

- Houdeshel & Christine Pomeroy, 2013, Storm-Water Bioinfiltration as No-Irrigation Landscaping Alternative in Semiarid Climates: *Journal of Irrigation and Drainage Engineering*
- Steffen, Jensen, Christine Pomeroy & Steven J. Burian, 2013, Water Supply and Stormwater Management Benefits of Residential Rainwater Harvesting in U.S. Cities: *Journal of the American Water Resources Association*

“This article presents an analysis of the projected performance of urban residential rainwater harvesting systems in the United States (U.S.)... The results indicate that rainwater harvesting can reduce stormwater runoff volume up to 20% in semiarid regions, and less in regions receiving greater rainfall amounts for a long-term simulation.”

- Walsh, Christine Pomeroy & Steven J. Burian, 2013, Hydrologic modeling analysis of a passive, residential rainwater harvesting program in an urbanized, semi-arid watershed: *Journal of Hydrology*

ROB STOLL

Assistant Professor, Mechanical Engineering



A field experiment on the U of U campus (Rob Stoll, Mechanical Engineering)

Rob's current research seeks to understand how the transport of mass and momentum are linked to the geometries of complex canopies. His motivations for this include the transport of water vapor and heat in urban areas and the dispersion of airborne fungal pathogens in perennial agricultural canopies. To examine these transport processes his research group uses a combination of field experiments, numerical simulations, and wind tunnel studies.

- Bailey & Rob Stoll, 2013, Turbulence in Sparse, Organized Vegetative Canopies: A Large-Eddy Simulation Study: *Boundary-Layer Meteorology*
- Miller & Rob Stoll, 2013, Surface Heterogeneity Effects on Regional-Scale Fluxes in the Stable Boundary Layer: *Aerodynamic Roughness Length Transitions: Boundary-Layer Meteorology*

AMY WILDERMUTH

*Associate Vice President of Faculty
Professor, Law
Interim Chief Sustainability Officer*

Amy's scholarship agenda focuses on three themes: (1) the importance of sound ecological

science to the law on environmental issues, (2) the appropriate governance mechanisms in the administrative setting, and (3) the value of identifying and connecting to culture in order to create workable policy solutions.

LINCOLN DAVIES

Associate Professor, Law

Lincoln's research asks, do legal, policy, and other social systems mediate our interaction with the environment, namely, how do those systems promote or frustrate the building of a sustainable society?

- Lincoln L. Davies et al., 2013, Understanding barriers to commercial-scale carbon capture and sequestration in the United States: An empirical assessment: Energy Policy
- Lincoln L. Davies, 2013, Tracing US Renewable Energy Policy: Environmental Law Reporter

THURE CERLING

Distinguished Professor, Geology & Geophysics

- Thure E. Cerling, Manthi, Mbua, Leakey, Leakey, Leakey, Francis H. Brown et al., 2013, Stable isotope-based diet reconstructions of Turkana Basin hominins: Proceedings of the National Academy of Sciences
- Thure E. Cerling et al., 2013, Diet of Theropithecus from 4 to 1 Ma in Kenya: Proceedings of the National Academy of Sciences
- Sponheimer, Alemseged, Thure E. Cerling, Grine et al., 2013, Isotopic evidence of early hominin diets: Proceedings of the National Academy of Sciences

- Kimura, Jacobs, Thure E. Cerling et al., 2013, Fossil mice and rats show isotopic evidence of niche partitioning and change in dental ecomorphology related to dietary shift in late Miocene of Pakistan: PLoS one
- Uno, Quade, Fisher, Wittenmyer, Douglas-Hamilton, Andanje, Omondi, Litoroh & Thure E. Cerling, 2013, Bomb-curve radiocarbon measurement of recent biologic tissues and applications to wildlife forensics and stable isotope (paleo) ecology: Proceedings of the National Academy of Sciences

PAUL JEWELL

Associate Professor, Geology & Geophysics

Paul's research applies hydrologic principles to fundamental problems of sedimentation, geomorphic evolution, and geochemistry in surface water environments.

- Paul W. Jewell & Bruhn, 2013, Evaluation of Wasatch fault segmentation and slip rates using Lake Bonneville shorelines: Journal of Geophysical Research: Solid Earth
"Analysis of Lake Bonneville shorelines using lidar digital elevation data challenges accepted models of Wasatch fault deformation since the late Pleistocene... Shoreline analysis suggests isostatic rebound caused by a drop in lake level was concentrated during a relatively short

(~2000 year) time period following the Bonneville flood at ~16 ka."

- Paul W. Jewell et al., 2013, Rediscovering the Discovery Outcrop: The Promises and Pitfalls of Digital Elevation Models in Mineral Exploration: Society of Economic Geologists Newsletter
- Anderson, Naftz, Day-Lewis, Henderson, Rosenberry & Paul W. Jewell, 2013, Quantity and quality of groundwater discharge in a hypersaline lake environment: Journal of Hydrology
"Previous studies in Great Salt Lake (GSL) suggest that unmeasured sources of selenium (Se) may enter the lake via groundwater discharge... The modeling results suggest that under reducing conditions,

As-bearing minerals are mobilized while Se-bearing minerals will likely precipitate out of solution possibly explaining why the

shallow groundwater below the hard salt layer have low concentrations of Se (0.9-2.3 pg/L).”



Paul Jewell with a LiDAR instrument in Bryce Canyon National Park

THOMAS REICHLER

Associate Professor, Atmospheric Science

- Staten & Thomas Reichler, 2013, On the ratio between shifts in the eddy-driven jet and the Hadley cell edge: *Climate Dynamics*
- Stevens, Giorgetta, Esch, Mauritsen, Crueger, Rast, Salzmann, Schmidt, Bader,

Block, Brokopf, Fast, Kinne, Kornblueh, Lohmann, Pincus, Thomas Reichler & Roeckner, 2013, Atmospheric component of the MPI-M Earth System Model: ECHAM6: *Journal of Advances in Modeling Earth Systems*

JIM STEENBURGH

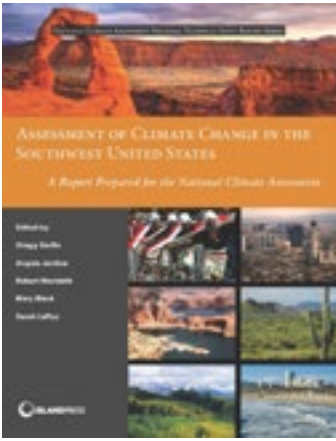
Professor, Atmospheric Sciences

Jim’s research examines the weather and climate of the western United States and other mountainous regions of the world, with emphasis on orographic and lake-effect precipitation, front-mountain interactions, and weather analysis and forecasting.

- W. James Steenburgh et al., 2013, Present Weather and Climate: Average Conditions in Assessment of Climate Change in the Southwest United States: A

Report Prepared for the National Climate Assessment, Island Press

- Alcott and W. James Steenburgh, 2013, Orographic Influences on a Great Salt Lake–Effect Snowstorm: *Monthly Weather Review*
“Although several mountain ranges surround the Great Salt Lake (GSL) of northern Utah, the extent to which orography modifies GSL-effect precipitation remains largely unknown... These results help elucidate the spectrum of lake–orographic processes that contribute to lake-effect



- events and may be broadly applicable to other regions where lake effect precipitation occurs in proximity to complex terrain.”*
- Liverman, Moser, Weiland, Dilling, Boykoff, Brown, Gordon, Greene, Holthaus, Niemeier, Pincetti & W. James Steenburgh,

Several GCSC affiliated faculty contributed to the 2013 Assessment of Climate Change in the Southwest U.S. including Jim Steenburgh, John Horel, and Eric Pardyjak

- 2013, Climate choices for a sustainable Southwest in Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment, Island Press
- Yeager, W. James Steenburgh & Alcott, 2013, Contributions of Lake-Effect Periods to the Cool-Season Hydroclimate of the Great Salt Lake Basin: Journal of Applied Meteorology and Climatology

WILLIAM JOHNSON

Professor, Geology & Geophysics

- William P. Johnson & Hilpert, 2013, Upscaling colloid transport and retention under unfavorable conditions: Linking mass transfer to pore and grain topology, Water Resources Research

This work demonstrates that the mass transfer of particles to and from surfaces in porous media is not continuous but is punctuated by the topology of the porous media and flow field such that particle transfer to surfaces occurs predominantly in forward flow stagnation zones, and transfer from surfaces back to fluid occurs predominantly in rear flow stagnation

zones. This finding changes the strategies used in pore network simulations of particle transport in porous media, which relates to water treatment, aquifer protection, remediation of subsurface contaminants, microfluidic devices and drug delivery.

- Ma, Hradisky & William P. Johnson, 2013, Extending Applicability of Correlation Equations to Predict Colloidal Retention in Porous Media at Low Fluid Velocity: Environmental Science & Technology
- “In this work, we analyzed causes for a recently noted shortcoming of filtration models, which is to predict collector efficiencies greater than unity under low fluid velocity conditions.”*



William Johnson paddling to a sampling site on the Willard Spur of Great Salt Lake



study abroad students (and William P. Johnson) collecting water quality samples in Ecuador

DENISE DEARING



Researchers weighing woodrats and collecting feces (Denise Dearing/Patrice Kurnath)

*Professor, Biology
Associate Dean, College of Science*

- Skopec, Hale, Torregrossa & M. Denise Dearing, 2013, Biotransformation enzyme expression in the nasal epithelium of woodrats: Comparative Biochemistry and Physiology. Toxicology & Pharmacology
“When herbivores come in contact with volatile plant secondary compounds that enter the nasal passages the only barrier between the nasal cavity and the brain is the nasal epithelium and the biotransformation enzymes present there.”
- Kurnath & M. Denise Dearing, 2013, Warmer ambient temperatures depress liver function in a mammalian herbivore: Biology Letters
“Diet selection in mammalian herbivores is thought to be mainly influenced by intrinsic factors such as nutrients and plant secondary compounds, yet extrinsic factors like ambient temperature may also play a role. In particular, warmer ambient temperatures could enhance the toxicity of plant defense compounds through decreased liver metabolism of herbivores...”
- Varner & M. Denise Dearing, 2013, Dietary plasticity in pikas as a strategy for atypical



Graduate student Johanna (“Pika Jo”) Varner collects vegetation from “haypiles” that Columbia River Gorge pikas build beneath rockslides to store food for winter. (Dearing)

resource landscapes: Journal of Mammology

“Mammalian habitat specialists are suffering notable population declines and localized extinctions in response to climate change... Understanding a species’ capacity to adapt its foraging strategies to new resource landscapes will be essential to assessing its vulnerability to future climate change and to developing conservation plans.”

JOHN SPERRY

Professor, Biology

- John S. Sperry, 2013, Cutting-edge research or cutting-edge artifact? An overdue control experiment complicates the xylem refilling story: Plant, Cell & Environment
- Bentley, Stegen, Savage, Smith, Allmen, John S. Sperry et al., 2013, An empirical assessment of tree branching networks and implications for plant allometric scaling models: Ecology Letters
- Lens, Tixier, Cochard, John S. Sperry et al., 2013, Embolism resistance as a key mechanism to understand adaptive plant strategies: Current Opinion in Plant Biology
- McDowell, Fisher, Xu, Domec, Hölttä, Mackay, John S. Sperry et al., 2013, Evaluating theories of drought-induced vegetation mortality using a multimodel-experiment framework: New Phytologist

DAVE BOWLING

Associate Professor, Biology

- Moyes & David R. Bowling, 2013, Interannual variation in seasonal drivers of soil respiration in a semi-arid Rocky Mountain meadow: Biogeochemistry

Dave has a new project focused on studying “Multi-scale carbon cycle observations and ecosystem process modeling at Niwot Ridge, Colorado,” funded by the U. S. Department of Energy, Terrestrial Ecosystem Science. He was also a PI with collaborators Gabe Bowen, Thure Cerling, Jim Ehleringer, and Diane Pataki, who were successful in acquiring funding for “Acquisition of an Isotope Ratio Mass Spectrometer for Tracing Human-Environment Interactions,” funded by the National Science Foundation Division of Biological Infrastructure - Major Research Instrumentation.



iUTAH researcher Dave Eriksson in the field at an EPSCoR weather station (Bowling)

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES

MITCHELL POWER

Curator of the Garrett Herbarium, Utah Museum of Natural History Assistant Professor, Geography Co-Director of Science, Rio Mesa Center

Mitch studies long-term vegetation history from the analysis of pollen and plant macrofossils preserved in sedimentary environments.

ANDREA BRUNELLE

Associate Professor, Geography Co-Director of Research, Rio Mesa Center

- Andrea Brunelle et al., 2013, A record of Lateglacial/Holocene environmental change from a high-elevation site in the Intermountain West, USA: *Journal of Quaternary Science*
- Carter, Andrea Brunelle, Minckley, Philip E. Dennison & Mitchell J. Power, 2013, Regionalization of fire regimes in the Central Rocky Mountains, USA: *Quaternary Research*
- Morris, Andrea Brunelle & Mitchell J. Power, 2013, Holocene vegetation and disturbance

reconstructions from the transition region of the Great Basin and Colorado plateau in Utah, USA: *Quaternary International*

- Morris, le Roux, Macharia, Andrea Brunelle, Hebertson & Zachary J. Lundeen, 2013, Organic, elemental, and geochemical contributions to lake sediment deposits during severe spruce beetle disturbances: *Forest Ecology and Management*
- Nishizawa, Currey, Andrea Brunelle & Sack, 2013, Bonneville basin shoreline records of large lake during Marine Isotope Stage 3 and the Last Glacial Maximum: *Palaeogeography, Palaeoclimatology, Palaeoecology*

RICHARD FORSTER

Professor, Geography

Recent findings by Rick’s team include discovery of an aquifer system within the snow and firn of the Greenland ice sheet that persists throughout the long cold winter, storing meltwater and buffering its contribution to global sea level

rise. The aquifer system is extensive, covering an area equivalent to the size of Ireland, yet it was previously undetected until the team drilled into and then mapped it with ground-based and airborne radar. The research team also mapped ice surface velocities for nearly all glaciers in Alaska and found that a majority of their

contribution to sea level rise is dominated by shrinkage of only a few key glaciers.

- Richard R. Forster et al., 2013, Extensive liquid meltwater storage in firn within the Greenland ice sheet: *Nature Geoscience*
- Miège, Richard R. Forster et al., 2013, Southeast Greenland high accumulation

rates derived from firn cores and ground-penetrating radar: *Annals of Glaciology*

- Rennermalm, Smith, Chu, Box, Richard R. Forster et al., 2013, Evidence of meltwater retention within the Greenland ice sheet: *The Cryosphere*



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Core sample drill by sunset: researchers discovered a large reservoir of melt water that persists beneath the Greenland ice sheet. (Richard Forster)

PHILIP DENNISON

Associate Professor, Geography

Phil's research group within the Utah Remote Sensing Applications Lab has several projects examining vegetation and wildfire using airborne

and satellite image data. They are using time series data to measure vegetation recovery following wildfire, developing tools for remote assessment of fuel moisture, mapping dominant vegetation species, and exploring links between fire and climate.

- Philip E. Dennison, Thorpe, Eric R. Pardyjak et al., 2013, High spatial resolution mapping of elevated atmospheric carbon dioxide using airborne imaging spectroscopy: Radiative transfer modeling and power plant plume detection: *Remote Sensing of Environment*

"Carbon dioxide is emitted from the combustion of fossil fuels and is an important contributor to anthropogenic climate change. Multiple current and planned satellite missions are designed to quantify atmospheric carbon dioxide concentrations on a global scale, but most of these sensors do not have the spatial resolution necessary to resolve point sources such as fossil fuel power plants. Airborne imaging spectrometer data, such as those from the Airborne Visible InfraRed Im-



Graduate students from the Utah Remote Sensing Applications Lab map tree species for use with airborne hyperspectral data collected over the Sierra Nevada. (Paul Dennison)

aging Spectrometer (AVIRIS), can have multiple, contiguous bands covering shortwave infrared (SWIR) absorption features produced by carbon dioxide. Therefore, high spatial resolution data from AVIRIS-like sensors may offer a means for detecting plumes and retrieving carbon dioxide concentrations for point source emissions.”

- Fryer, Philip E. Dennison & Cova, 2013, Wildland firefighter entrapment avoidance: Modeling evacuation triggers: International Journal of Wildland Fire
“Wildland firefighters are often called on to make tactical decisions under stressful conditions in order to suppress a fire. These decisions can be hindered by human factors such as insufficient knowledge of surroundings and conditions, lack of experience, overextension of resources or loss of situational awareness.”
- Thorpe, Roberts, Bradley, Funk, Philip E. Dennison & Leifer, 2013, High resolution mapping of methane emissions from marine and terrestrial sources using a Cluster-Tuned Matched Filter technique

and imaging spectrometry: Remote Sensing of Environment

“In this study, a Cluster-Tuned Matched Filter technique was applied to data acquired by the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) over marine and terrestrial locations known to emit methane... This technique is particularly well suited for application over large areas to detect CH₄ emissions from concentrated point sources and should permit detection of additional trace gases with distinct absorption features, including carbon dioxide (CO₂) and nitrous oxide (N₂O). Thus, imaging spectrometry by an AVIRIS-like sensor has the potential to improve high resolution greenhouse gas mapping, better constraining local sources.”

- Yebra, Philip E. Dennison et al., 2013, A global review of remote sensing of live fuel moisture content for fire danger assessment: Moving towards operational products: Remote Sensing of Environment

SIMON BREWER

Assistant Professor, Geography

- Davis, Zanon, Collins, Mauri, Bakker, Barboni, Barthelmes, Beaudouin, Bjune, Bozilova, Bradshaw, Brayshay, Simon Brewer et al., 2013, The European Modern Pollen Database project: Vegetation History and Archaeobotany
“Modern pollen samples provide an invaluable research tool for helping to interpret the quaternary fossil pollen record, allowing investigation of the relationship between pollen as the proxy and the environmental parameters such as vegetation, land-use, and

climate that the pollen proxy represents.”

- Giesecke, Davis, Simon Brewer, et al., 2013, Towards mapping the late Quaternary vegetation change of Europe: Vegetation History and Archaeobotany
- Marsicek, Shuman, Simon Brewer et al., 2013, Moisture and temperature changes associated with the mid-Holocene Tsuga decline in the northeastern United States: Quaternary Science Reviews
- Saltr, Saint-Amant, Gritti, Simon Brewer et al., 2013, Climate or migration: what limited European beech post-glacial colonization?: Global Ecology and Biogeography

ANDREW JORGENSON

Professor, Sociology

- Andrew K. Jorgenson & Clark, 2013, The Relationship between National-Level Carbon Dioxide Emissions and Population Size: An Assessment of Regional and Temporal Variation, 1960–2005: PloS One
- Andrew K. Jorgenson & Givens, 2013, The emergence of new world-systems perspectives on global environmental change: Routledge International Handbook

of Social and Environmental Change

- Andrew K. Jorgenson & Givens, 2013, Economic Globalization and Environmental Concern: A Multilevel Analysis of Individuals Within 37 Nations: Environment and Behavior
- Grant, Andrew K. Jorgenson & Longhofer, 2013, Targeting electricity’s extreme polluters to reduce energy-related CO₂ emissions: Journal of Environmental Studies and Sciences



Judy Pechmann and Chris Gaili of the UU Atmospheric Sciences Department deploying a tethered meteorological balloon in Arizona's Meteor Crater as part of the METCRAX II experiment in October, 2013. Sebastian Hoch photo.

GCSC AFFILIATE FACULTY – MEMBERS SINCE 2010-2012

In the last three years, the number of faculty affiliated with the GCSC has increased significantly- from the original 34 to the 90 today. These faculty span the disciplines on campus, creating a diverse community of academic excellence focused on the complex issues surrounding sustainability.

ROBERT ADLER

*Interim Dean, S.J. Quinney College of Law
James I. Farr Chair and Distinguished
Professor of Law*

- Robert W. Adler, Robin K. Craig & Hall, 2013, Modern Water Law: Private Property, Public Rights, and Environmental Protection, Foundation Press

TARIQ BANURI

*Professor (Lecturer), City & Metropolitan
Planning & Economics*

Tariq's work combines expertise in global sustainable development policy with practical

experience in the design and implementation of development programs, building of development institutions and networks, and support and facilitation of political processes.

HAIMANTI BHATTACHARYA

Assistant Professor, Economics

Haimanti's research in the realm of 'socio-economic' sustainability focused on causes and effects of violence against women and cheating in market transactions.

- Haimanti Bhattacharya & Dugar, 2013, Contests for Ranks: Experimental Evidence: Southern Economic Journal



Haimanti Bhattacharya at the GCSC Retreat

MATTHEW BROWNLEE

*Assistant Professor, Parks Recreation
& Tourism*

Matt's interdisciplinary research links outdoor recreation and resource management, and provides information to help park and protected area managers plan for, monitor, and evaluate visitor experiences. He uses visitor surveys (internet and on-site sampling methods), GPS tracking, infrared counters, and photographic methods to help managers evaluate visitors' 1) on-site behaviors, motivations and benefits, 2) perceptions of environmental conditions, and 3) park crowding and carrying capacities. He also examines how nature-based recreationists' interactions and attachments to climate-sensitive and impacted environments influence their 1) attitudes towards sustainability initiatives, 2) visitation and recreation behavior, and 3)

opinions about global climate change.

- Matthew T. Brownlee & Hallo, 2013, Botanical garden visitors' perceptions of local climate impacts: Awareness, concern, and behavioral responses: *Managing Leisure*
- Matthew T. Brownlee & Hallo, 2013, Motivations to visit designated wilderness at Cumberland Island National Seashore: *The International Journal of Wilderness*
- Matthew T. Brownlee & Hallo, 2013, Understanding foundational processes that influence beliefs in climate change: Opportunities for environmental education research: *Environmental Education Research*
- Matthew T. Brownlee et al., 2013, Visiting a climate-influenced national park: the stability of climate change perceptions: *Environmental Management*

“Understanding perceptions of global environmental issues, such as climate change, can help inform resource management, policy development, and communication with constituents. Although a considerable amount of research doc-

uments citizens’ perceptions of climate change, few have investigated how interactions with climate-impacted parks and protected areas influence these perceptions, and consequently elements of environmental management.”

SARAH BUSH

Assistant Professor, Biology

Sarah’s research involves three major avenues of investigation faunal surveys, comparative studies, and experimental work. To understand the evolution of parasite diversity and the ecological factors influencing host-specificity we



Daniel “Leo” Gustafsson holding a Goldcrest (kinglet: *Regulus regulus*) with bird-bander Juho, who is holding a Mute Swan (*Cygnus olor*) at a field site in Sweden. (Sarah Bush)

must first understand what parasites exist, where they occur, and which hosts they infest. Bush’s team is surveying parasites that infest terrestrial vertebrates in China, the Philippines, Nordic countries, as well as local surveys in the Great Basin of the United States. They use these specimens to conduct comparative studies among species to better understand how parasites and their hosts have adapted and diversified over macroevolutionary time, and finally, use captive model systems to test hypotheses about ecological and evolutionary processes.

- Sarah E. Bush et al., 2013, Impact of forest size on parasite biodiversity: implications for conservation of hosts and parasites: Biodiversity and Conservation
- McAllister, Seville, Duszynski, Sarah E. Bush et al., 2013, Two new species of *Eimeria* Schneider, 1875 (Apicomplexa: Eimeriidae) from emerald tree skinks, *Lamprolepis smaragdina*: Systematic Parasitology

MARGIE CHAN

Professor, Geology & Geophysics

Chan’s group is currently working on a wide range of sedimentary geology projects covering authigenic minerals and fluid flow in reservoir sandstones and fractures, and paleoenvironmental records of high water tables



Students examine “zebra stripe” patterns in Jurassic sandstone of southern Nevada. (Margaret Chan)

and strong ground motion in Jurassic sandstones.

- Marjorie A. Chan, 2013, Geology as Science and Art in Geoscience Research and Education: Teaching at Universities, Springer Verlag
- Potter-McIntyre, Allen, Lee, Han, Marjorie A. Chan & McPherson, 2013, Iron precipitation in a natural CO₂ reservoir: Jurassic Navajo Sandstone in the northern San Rafael Swell, UT, USA: Geofluids

“Diagenetic iron (oxyhydr)oxide minerals are common precipitates expected in CO₂ reservoirs, and these minerals record fluid flow for application to carbon capture and sequestration (CSS)... CO₂ injection into porous and permeable, quartz arenite, saline aquifers will likely result in minor clay and abundant dolomite precipitation that will significantly decrease porosity.”

KEVIN DELUCA

Professor, Communication

Kevin Deluca’s research focuses on the ways in which communication technologies mediate

DANIELLE ENDRES

human relations with the natural world. Current foci include environmental activism in China, and

the impact of social media on the mobilization of environmental behaviors.

Associate Professor, Communications

Danielle's ongoing research projects include: *Human Dimensions of Nuclear Controversies*. Using a humanistic research approach, she is studying the rhetorical (persuasive) dynamics of controversies over high-level nuclear waste siting decisions. She is studying the different argument and persuasive strategies that various stakeholders in high-level nuclear waste siting decisions use to support their positions in the controversy. She is particularly interested in uncovering the intersecting roles of social, political, technical/scientific, and cultural factors that influence nuclear waste siting decisions.

The Strategies of Climate Change Activism. Using humanistic and qualitative research approaches, she is studying the persuasive strategies and tactics being used by climate change activists. After gathering descriptive data about how these activist groups are attempting to persuade people to take action to reduce greenhouse gas emissions and mitigate the effects of climate change, she will analyze the effectiveness of these current strategies and make practical recommendations for communication strategies that may be more effective.

The Influence of Low-Carbon Energy Technology Scientists and Engineers on the Composition of Energy Policy. This NSF-funded project examines how low-carbon energy scientists and engineers talk about the social, cultural, and political implications of their technologies and how they influence policymaking. This research seeks to discover

whether (and how) engineers and scientists blend technical and non-technical modes of reasoning and how they navigate the boundaries between science and policy.

- Danielle Endres, 2013, *Animist Intersubjectivity as Argumentation: Western Shoshone and Southern Paiute Arguments Against a Nuclear Waste Site at Yucca Mountain: Argumentation*
- Feldpausch-Parker, O'Byrne, Danielle Endres & Peterson, 2013, *The Adventures of Carbon Bond: Using a Melodramatic Game to Explain CCS as a Mitigation Strategy for Climate Change: Greenhouse Gases: Science and Technology*

"Policy options for mitigating climate change have been severely limited in the USA by the clash of competing ideologies. People who oppose policies to mitigate climate change have successfully framed climate change as existing outside the realm of fact and empirical reality. Instead, opponents frame the issue as a melodramatic struggle between good and evil... We developed an educational video game that uses this frame to teach students about climate change and carbon capture, and sequestration, to create an understanding of CO₂ as the villain and humans as heroes through participation in mitigation strategies."

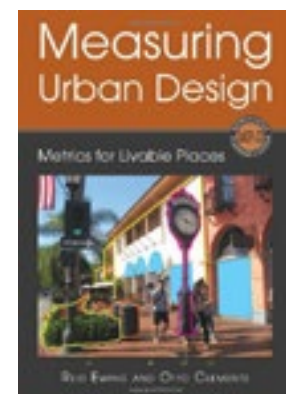
- Senda-Cook & Danielle Endres, 2013, *10 A Place of One's Own: Environmental Rhetoric and Ecologies of Place*

REID EWING

Professor, City & Metropolitan Planning Director, Metropolitan Research Center

- Ewing, Reid, & Clemente, O., 2013. *Measuring Urban Design: Metrics for Livable Places*. Island Press.
- Chen, Chen, Reid Ewing et al., 2013, *Safety countermeasures and crash reduction in New York City-Experience and lessons learned: Accident; analysis and prevention*

"Traffic fatalities and injuries constitute a major global public health problem and the United States has fallen behind other



developed countries in traffic safety... This study develops a safety framework that considers three principal axes that affect crashes: why, who, and where."

COLLEEN FARMER

Associate Professor, Biology

Research in Colleen's lab aims to understand the evolutionary sequence of events

involved in major vertebrate transitions, especially aspects of the evolution of the cardiopulmonary system and the transition from ectothermy to endothermy.

TIMOTHY GARRETT

Associate Professor, Atmospheric Sciences

Tim's research is focused in the field of cloud physics, and also includes the development

of simple physical models for understanding civilization growth.

SEBASTIAN HOCH

Research Assistant Professor, Atmospheric Sciences

Sebastian's research interests include atmospheric radiation, boundary layer processes, and surface climate.

CARI JOHNSON

Associate Professor, Geology & Geophysics

- Cari L. Johnson et al., 2013, The Effects of Scaling Cues and Interactivity on a Viewer's Ability to Estimate the Size of Features Shown on Outcrop Imagery: Journal of Geoscience Education



"The scale of features shown on outcrop photographs can be critical to geoscience interpretations, yet little is known about how well individuals estimate scale in images. This study utilizes a visualization test in which participants were asked to estimate the absolute size of several boxes shown in outcrop images using high resolution, stitched photopanoramas."

- Taylor, Webb, Cari Johnson & Heumann, 2013, The Lost South Gobi Microcontinent: Protolith Studies of Metamorphic Tectonites and Implications for the Evolution of Continental Crust in Southeastern Mongolia: Geosciences

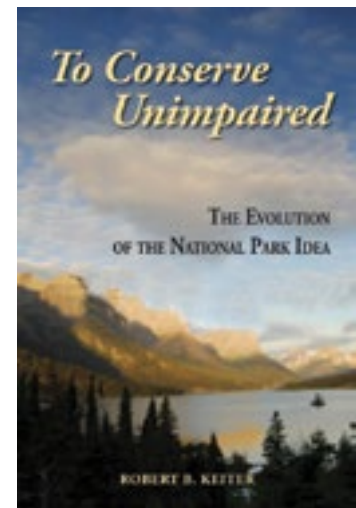
"These results yield important insights into the Paleozoic accretionary history of southern Mongolia, including the genesis of metamorphic and igneous basement during the Paleozoic, as well as implications for subsequent intracontinental reactivation."

Brenton Chentnik using a gigapan atop professor Cari Johnson's truck, capturing high resolution photopanoramas of outcrops.

ROBERT KEITER

*Distinguished Professor, Law
Director, Wallace Stegner Center for Land,
Resources, and the Environment*

- Robert B. Keiter, 2013, To Conserve Unimpaired: The Evolution of the National Park Idea, Island Press



STEVEN KRUEGER

Professor, Atmospheric Sciences

Steven's research interests include numerical simulation of cloud systems, with particular

emphasis on the interactions between large-scale and cloud-scale processes, as well as turbulence and mixing in clouds and the boundary layer, and numerical modeling of wildfires.

BARBARA NASH

Professor, Geology & Geophysics

Barbara's research interests include volcanology, tephrostratigraphy, mineralogy, geochemistry and electron beam microanalysis.

ZHAOXIA PU

Associate Professor, Atmospheric Science

Recent projects mainly emphasize the atmospheric/geophysical data assimilation and numerical weather prediction of high-impact weather systems. Here areas of interest include the interaction between landfalling hurricane and the atmospheric boundary layer, mountain terrain atmospheric modeling and observations, tropical cyclone formation and intensification and mesoscale convective system.

- Zhaoxia Pu et al., 2013, Ensemble Kalman filter assimilation of near-surface observations over complex terrain: comparison with 3DVAR for short-range forecasts: Tellus A

"Surface observations are the main conventional observations for weather forecasts. However, in modern numerical weather prediction, the use of surface observations, especially those data over complex terrain, remains a unique challenge... In addition, results also suggest that caution is needed when dealing with

errors due to model terrain representation. Data rejection may cause degraded forecasts because data are sparse over complex terrain."

- Luo, Tian, Zhaoxia Pu et al., 2013, Characteristics of stratosphere-troposphere exchange during the Meiyu season: Journal of Geophysical Research: Atmospheres
- Thatcher & Zhaoxia Pu, 2013, Evaluation of tropical cyclone genesis precursors with relative operating characteristics (ROC) in high resolution ensemble forecasts: Hurricane Ernesto: Tropical Cyclone Research and Review
- Wei, Zhaoxia Pu & Wang, 2013, Numerical Simulation of the Life Cycle of a Persistent Wintertime Inversion over Salt Lake City: Boundary-Layer Meteorology
- Zhang, Zhaoxia Pu & Zhang, 2013, Examination of Errors in Near-Surface Temperature and Wind from WRF Numerical Simulations in Regions of Complex Terrain: Weather and Forecasting

JOERG RUEGEMER

Assistant Professor, Architecture

Rugemer's research focuses on the design and development of super-efficient and cost-effective buildings.

- Jörg Rügemer, 2013, Developing Super Efficient Passive Residential Buildings – First Experiences from Building Utah's Most Energy-Efficient and Cost Effective House: The International Journal of Design Principles and Practices
- Jörg Rügemer, 2013, 125 Haus, Park City, Utah: Residential Architect

The 125 Haus in Park City, Utah, which was completed in October 2011, is a research-based, post-occupancy monitored case study. Two-years of post-occupancy monitoring data between October 2011 to 2013 showed that 125 Haus is Utah's



125 Haus

most energy-efficient and cost-effective residential building, using an average of \$245 per year to heat and cool the entire 2,400 SF residential building at 7,000'

elevation. Designed to the strict Passive House standard, the building uses no renewable energy systems to achieve its efficiency.

ÇAGAN SEKERCIGLU

Professor, Biology

Cagan's research focuses on the world's threatened biodiversity and ecosystems, especially in human-dominated landscapes where he studies the co-existence of people and other species.

- Cagan H. Sekercioglu, 2013, Guineafowl, ticks and Crimean-Congo hemorrhagic fever in Turkey: the perfect storm?: Trends Parasitol
"To control ticks carrying the emerging Crimean-Congo hemorrhagic fever (CCHF) in Turkey the government is introducing thousands of exotic helmeted guinea fowl (Numida meleagris). However, not only do these birds eat negligible numbers of ticks, but they are also excellent nurseries for the young of Hyalomma marginatum ticks, the best vectors of CCHF."
- Newbold, Scharlemann, Butchart, Cagan H. Sekercioglu et al., 2013, Ecological traits affect the response of tropical forest bird

species to land-use intensity: Proceedings. Biological sciences

"Land-use change is one of the main drivers of current and likely future biodiversity loss. Therefore, understanding how species are affected by it is crucial to guide conservation decisions. Species respond differently to land-use change, possibly related to their traits. Using pan-tropical data on bird occurrence and abundance across a human land-use intensity gradient, we tested the effects of seven traits on observed responses... The finding that species responses to land use depend on their traits is important for understanding ecosystem functioning, because species' traits determine their contribution to ecosystem processes. Furthermore, the loss of species with particular traits might have implications for the delivery of ecosystem services."

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RYAN SMITH

Associate Professor, Architecture Director, Integrated Technology in Architecture Center

- Ryan E. Smith et al., 2013, OFFSITE: theory and practice of architectural production, Association of Collegiate Schools of Architecture Press

MICHAEL TIMBERLAKE

Professor, Sociology

- Michael Timberlake, 2013, Building Globalization: Transnational Architecture Production in Urban China By Xuefei Ren,

University of Chicago Press, *Social Forces*

- Ma & Michael Timberlake, 2013, World City Typologies and National City System Deterritorialization: USA, China, and Japan: Urban Studies

YEHUA DENNIS WEI

Professor, Geography

Dennis is working on understanding industrial location and land use change in the key cities of the Yangtze River Delta: Shanghai, Suzhou and Nanjing, with a focus on development zones.

- Dennis Wei, 2013, Remaking Development Models in Urban China: Beyond New Regionalism, Beyond Global Production, Routledge
- Dennis Wei, 2013, FDI Networks, R&D

Activities and the Making of Global Cities in China in Innovation and regional development in China, Taylor & Francis

- Dennis Wei & Liao, 2013, FDI Embeddedness in Production and Innovation in China: Strategic Coupling in Global Production Networks?: Habitat International
- Dennis Wei et al., 2013, Spatial Mismatch and Determinants of Foreign and Domestic Information and Communication Technology Firms in Urban China: The Professional Geographer

“Studies on foreign direct investment locations in China have been conducted mainly at interregional and interprovincial scales, and little attention has been paid to the intraurban scale where location decisions of foreign firms can differ from domestic firms... The case of Suzhou highlights the challenges that Chinese cities face in industrial upgrading and technological development through embedding transnational corporations.”

- Liefner, Dennis Wei & Zeng, 2013, The Innovativeness and Heterogeneity of

Foreign-Invested High-Tech Companies in Shanghai: Growth and Change

“China has taken a foreign direct investment-based approach toward increasing its capital and knowledge base, and developing into an innovative economy. However, little quantitative evidence exists about the factors that drive innovations of foreign-invested enterprises there. This paper uses survey data from high-technology firms in Shanghai to discuss factors affecting their innovativeness.”

CAROL WERNER

Professor, Social Psychology

Carol works at the interface between theory and application to examine the attitudinal and motivational underpinnings of proenvironmental behaviors. In contrast to the view that people are independent and behave as they wish, her work explores the idea that behavior is embedded in a

physical/social/policy environment, and the more this system supports a new behavior the more likely it is that people will change.

- Carol M. Werner, 2013, Designing interventions that encourage permanent changes in behavior in Green Organizations: Driving Change with I/O Psychology, Routledge Academic

DAVID WHITEMAN

Research Professor, Atmospheric Science

Dave’s current research is focused on the role of meteorology in the life cycle of persistent wintertime inversions that form in the Salt Lake Valley, the interaction of atmospheric circulations of different scales in complex

topography, and the meteorological causes of downslope windstorm events, which occur in mountain ranges all over the world.

- Lareau, Crosman, C. David Whiteman, John D. Horel, Sebastian W. Hoch et al., 2013, The Persistent Cold-Air Pool Study: Bulletin of the American Meteorological Society

Chris Golubieski of the National Center for Atmospheric Research is constructing an instrumented meteorological tower on the south rim of Arizona’s Meteor Crater as part of the October 2013 MET-CRAX II research program. Tim Lim photo.



ED ZIPSER

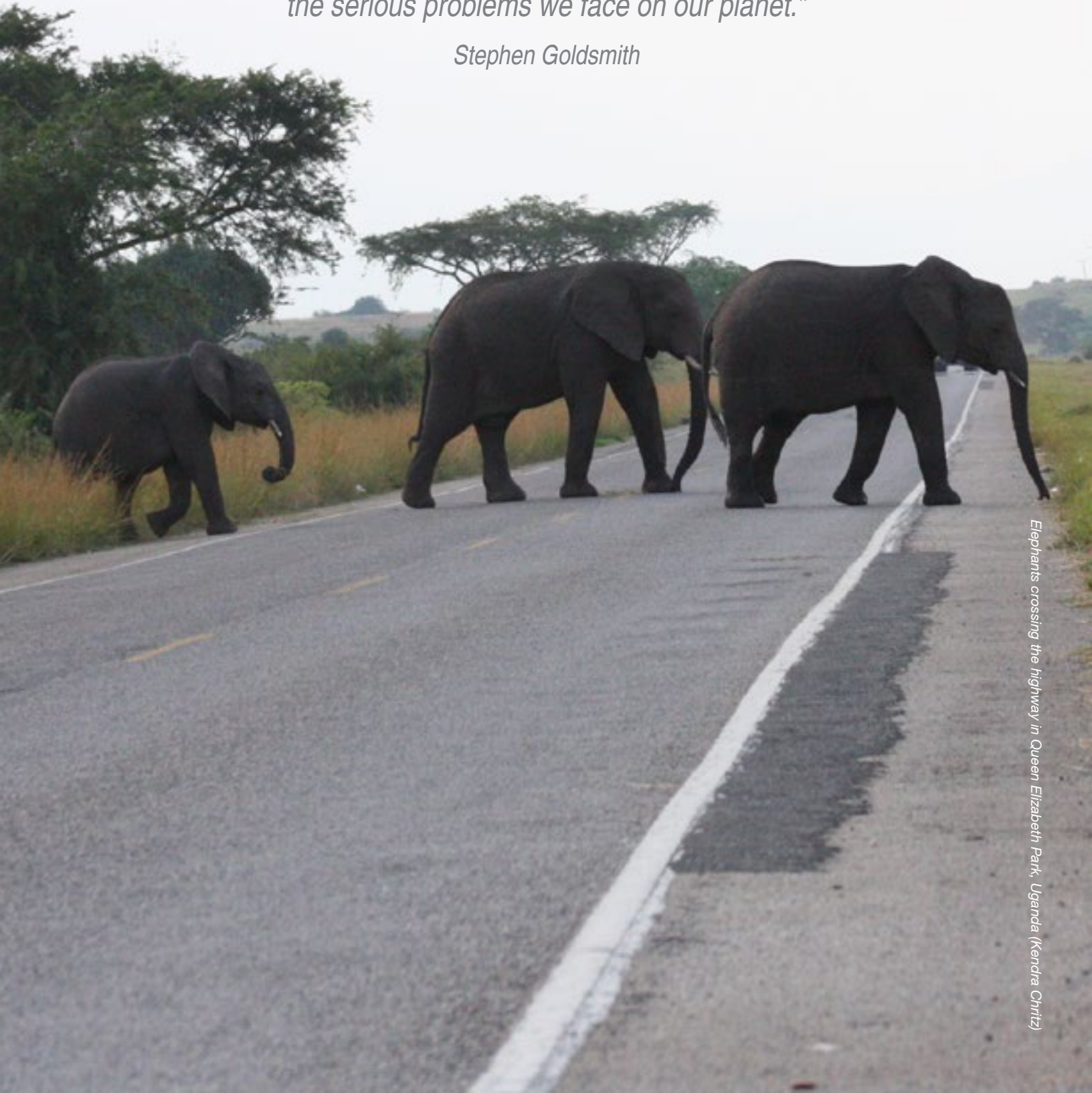
Professor, Atmospheric Science

Ed’s research interests include regional and global distribution of storms, understanding

why heavy rainfall is more frequent in the deep tropics, and helping develop improved recognition and forecasting of severe storms.

“The possibilities for bringing students together across disciplines, to encourage creative engagement using the campus and broader community as a laboratory for innovating ways to heal and repair our world, are some of the best possibilities we have to address the serious problems we face on our planet.”

Stephen Goldsmith



Elephants crossing the highway in Queen Elizabeth Park, Uganda (Kendra Chritz)

GCSC FOUNDING MEMBERS

The GCSC was founded in 2009 to focus on interdisciplinary scientific research to improve our understanding of how environmental changes impact the functions, characteristics, dynamics, and sustainability of natural and human-built ecosystems, as well as the goods and services that natural systems provide to society. In addition to the focus on research, the GCSC aims to provide an interdisciplinary environment for training future generations of researchers to address critical societal issues, and provide a rich body of knowledge to guide decisions of land-managers and policy makers in Utah and elsewhere.

COLLEGE OF SCIENCE

Fred Adler, Mathematics
David Bowling, Biology
Phyllis Coley, Biology
Dale Clayton, Biology
Denise Dearing, Biology
James Ehleringer, Biology
Donald Feener, Biology
Kenneth Golden, Mathematics
Thomas Kursar, Biology
Jon Seger, Biology
Pat Shea, Biology
John Sperry, Biology
Sylvia Torti, Biology

COLLEGE OF ENGINEERING

Steve Burian, Civil & Environmental Engineering
Eric Pardyjak, Mechanical Engineering
Christine Pomeroy, Civil & Environmental Engineering

COLLEGE OF MINES & EARTH SCIENCES

Frank Brown, Geology & Geophysics
Thure Cerling, Geology & Geophysics
Diego Fernandez, Geology & Geophysics
John Horel, Atmospheric Sciences
Randy Irmis, Geology & Geophysics
Paul Jewell, Geology & Geophysics
William Johnson, Geology & Geophysics
Daniel McCool, Political Science
Kip Solomon, Geology & Geophysics
Court Strong, Atmospheric Sciences
Thomas Reichler, Atmospheric Sciences

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES

Andrea Brunelle, Geography
Philip Dennison, Geography
Richard Forster, Geography
James O'Connell, Anthropology
Mitchell Power, Geography
Dennis O'Rourke, Anthropology

FREDRICK ADLER

Professor, Mathematics & Biology

Fred is interested in using urban ecology as a way to organize and challenge ecological theory. Do the principles and models developed



Ant survey being done by graduate student Andrew Basinski. Prof. Fred Adler's research group found 15 different species of ants on the University of Utah campus.

over the past century help us understand and predict the behavior of human-modified and human-dominated ecosystems, and how must they be expanded to do so?

- Frederick R. Adler & Tanner, 2013, *Urban Ecosystems: Ecological Principles for the Built Environment*, Cambridge University Press
"As humans have come to dominate the earth, the ideal of studying and teaching ecology in pristine ecosystems has become impossible to achieve. Our planet is now a mosaic of ecosystems ranging from the relatively undisturbed to the completely built, with the majority of people living in urban environments."
- Rowntree, Uhart, Sironi, Chirife, Di Martino, La Sala, Musmeci, Mohamed, Andrejuk, McAloose, Sala, Carribero, Rally, Franco, Fredrick R. Adler, Brownell, Jon Seger &

Rowles, et al., 2013, Unexplained recurring high mortality of southern right whale *Eubalaena australis* calves at Península Valdés, Argentina: Marine Ecology Progress Series
“Hundreds of southern right whale calves

Eubalaena australis died on their calving ground at Península Valdés, Argentina from 2003 through 2011...Here, we document the high mortality events, place them in historical context and describe ongoing efforts to identify their causes.”

FRANK BROWN

Dean, College of Mines & Earth Sciences
Distinguished Professor, Geology & Geophysics

- Francis H. Brown et al., 2013, Age Ranges of Australopithecus Species, Kenya, Ethiopia, and Tanzania in The paleobiology of Australopithecus, Springer Netherlands

- Kampf, Hughes, Marty & Francis H. Brown, 2013, Nashite, a new mineral species from the Yellow Cat Mining District, Utah and the Slick Rock Mining District, Colorado: Crystal structure and descriptive mineralogy: The Canadian Mineralogist

DALE CLAYTON

Professor, Biology

Dale’s research group continues to study the effects of invasive parasites on Darwin’s Finches in the Galapagos. He recently received a Dimensions of Biodiversity grant from the National Science Foundation to investigate the genomic basis of adaptive radiation in host specific parasites of birds.

- Knutie, Koop, French & Dale H. Clayton, 2013, Experimental test of the effect of introduced hematophagous flies on corticosterone levels of breeding Darwin’s finches: General and Comparative Endocrinology

“Parasites can negatively affect the evolutionary fitness of their hosts by eliciting physiological stress responses... We examined the effect of an invasive parasite on the corticosterone concentrations of a common species of Darwin’s finch, the medium ground finch (*Geospiza fortis*)... High stress levels could reduce the ability of females to invest in offspring, thus decreasing their reproductive success... Our results suggest that the lower reproductive success of fe-

males from parasitized nests is not mediated by a physiological stress response.”

- Koop, Owen, Knutie, Aguilar & Dale H. Clayton, 2013, Experimental demonstration of a parasite-induced immune response in wild birds: Darwin’s finches and introduced nest flies: Ecology and Evolution
- Koop, LeBohec & Dale H. Clayton, 2013, Dry year does not reduce invasive parasitic fly prevalence or abundance in Darwin’s finch nests: Reports in Parasitology
- Villa, Le Bohec, Koop, Proctor & Dale H. Clayton, 2013, Diversity of feather mites on Darwin’s finches: The Journal of Parasitology

“Feather mites are a diverse group of ectosymbionts that occur on most species of birds. Although Darwin’s finches are a well-studied group of birds, relatively little is known about their feather mites. Nearly 200 birds across 9 finch species, and from 2 locations on Santa Cruz Island, Galapagos, were dust-ruffled during the 2009 breeding season.”

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PHYLLIS COLEY

Distinguished Professor, Biology

- Phyllis D. Coley, Bixenmann & Tom A. Kursar, T. A., 2013, Developmental

Changes in Direct and Indirect Defenses in the Young Leaves of the Neotropical Tree Genus *Inga* (Fabaceae): Biotropica

DON FEENER

Professor, Biology

Don’s research interests include the ecology of direct and indirect effects in insect communities,

evolutionary and behavioral ecology of host-parasitoid interactions, and the division of labor and functional ecology of ant castes.

DIEGO FERNANDEZ

Research Assistant Professor, Geology & Geophysics

- Carling, Diaz, Ponce, Perez, Nasimba, Pazmino, Rudd, Diego P. Fernandez, Merugu, Gale & William P. Johnson, 2013, Trace element concentrations and loads in three southern Ecuador rivers impacted by artisanal gold mining in Water, Air, and Soil Pollution, Springer Netherlands
- Tasci, Manangon, Diego Fernandez, William P. Johnson & Gale, 2013, Separation

of Magnetic Nanoparticles by Cyclical Electrical Field Flow Fractionation: IEEE Transactions on Magnetics

"In this study, the potential of Cyclical Electrical Field Flow Fractionation for the separation of magnetic nanoparticles is investigated. We demonstrated for the first time that by the application of appropriate voltage waveforms, one can separate gold nanoparticles with sizes less than 50 nm."

KEN GOLDEN

Professor, Mathematics

Ken's research group uses mathematical models of composite materials and statistical physics to study key sea ice processes, and advance how sea ice is represented in climate models. This work is helping to improve projections of the fate of Earth's ice packs, and the response of polar ecosystems. They have also been conducting field experiments in the Arctic and Antarctic, to inform their models and discover new phenomena.

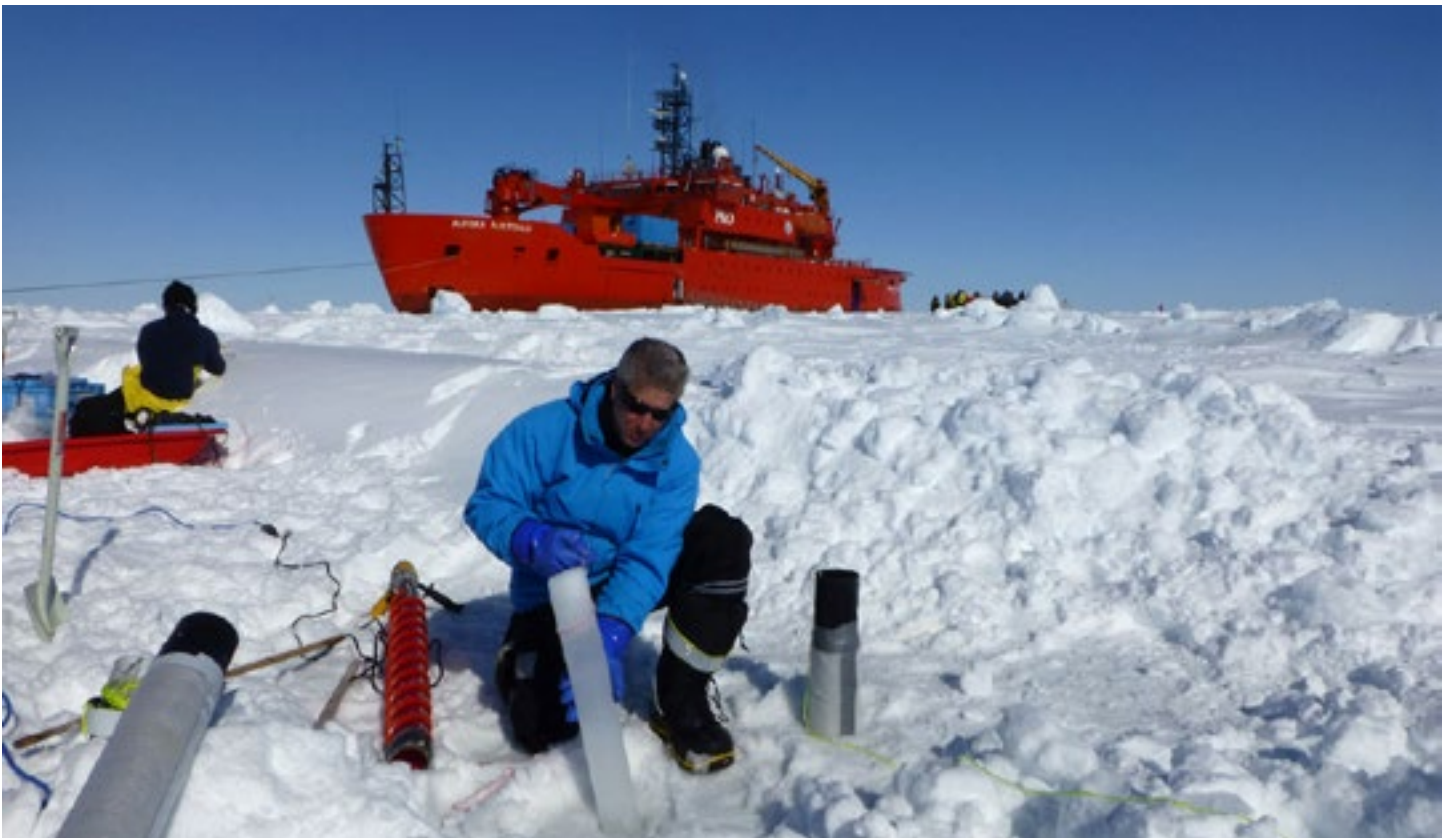
Ken gave over 20 invited lectures this year including these high profile engagements:

Invited to give the MAA-AMS-SIAM Gerald and Judith Porter Public Lecture, Joint Mathematics Meetings, San Diego (official kick-off of Mathematics of Planet Earth 2013 at the largest math meeting in the world)

Guest of Honor and Presenter, Institut des Hautes Etudes Scientifiques (IHES) Charity Gala, Theme of Mathematics of Planet Earth 2013, Pierre Hotel, New York City (honored by the French Ambassador to the United States)

Featured in: Science of the Winter Olympic Games – Science of Ice
<http://nbclearn.com/2014olympics/cuecard/68320>

Ken Golden extracts an ice core.



JOHN HOREL

Professor, Atmospheric Science

John led a team of researchers and graduate students in the Department of Atmospheric Sciences to observe and simulate the atmospheric conditions associated with wintertime high ozone concentrations in the Uintah Basin.

- Tyndall & John D. Horel, 2013, Impacts of Mesonet Observations on Meteorological Surface Analyses: Weather and Forecasting
“Given the heterogeneous equipment, maintenance and reporting practices, and siting of surface observing stations, subjective decisions that depend on the application tend to be made to use some

observations and to avoid others... When averaged over the entire 100 cases, observations with the highest impact are found within all network categories and depend strongly on their location relative to other observing sites and the amount of variability in the weather; for example, temperature observations have reduced impact in urban areas such as Los Angeles, California, where observations are plentiful and temperature departures from the background grids are small.”

- John D. Horel et al., 2013, Transforming an Atmospheric Science Curriculum to Meet Students’ Needs: Bulletin of the American Meteorological Society

RANDALL IRMIS

COLORADO PLATEAU CORING PROJECT

“This NSF-funded multi-institutional project aims to recover a continuous terrestrial sedimentary record for the early Mesozoic from 250-150 million years ago, in the form of a series of continuous rock cores. The first phase of this project was completed in November-December 2013, with a ~1700 feet long core drilled in the northern portion of Petrified Forest National Park, Arizona, recording ~245-205 million years ago. This core will allow the development of a high-resolution temporal and paleoenvironmental context for understanding how ecosystems on land responded to major changes in temperature, aridity, and high atmospheric CO₂ during a hothouse world. We also endeavor to determine whether a sudden change in plant and animal species around 215 million years ago was linked to an extraterrestrial bolide impact in Quebec at the same time.”

Assistant Professor, Geology & Geophysics

Randy’s research investigates the evolution of terrestrial ecosystems in deep time, particularly in response to climate change. Much of this work focuses on vertebrate animals from the Mesozoic hothouse world, a possible analogue to our future human-induced climate state.

- Randall B. Irmis, 2013, Crocodyliforms from the Late Cretaceous of Grand Staircase-Escalante National Monument and vicinity, southern Utah, U.S.A. in *At the Top of the Grand Staircase: The Late Cretaceous of Southern Utah*, Indiana University Press
- Randall B. Irmis et al., 2013, Early Crocodylomorpha, Geological Society of London Special Publication
- Randall B. Irmis et al., 2013, Non-biotic controls of observed diversity in the paleontologic record: An example from the Permo-Triassic Karoo Basin of South Africa: *Palaeogeography, Palaeoclimatology, Palaeoecology*



Randy Irmis, (right) & Nicky Giesler (left - from U of AZ) with conglomerate in newly drilled core

“Paleodiversity trends through geologic time can be affected by a number of geologic, taphonomic, and anthropogenic biases that obscure or prejudice paleoecological patterns in the fossil record.... We conclude that although large specimen datasets (hundreds to thousands of specimens) are robust to various potential biases, and can recover large-scale paleobiologic trends, they are still affected by many non-biotic controls, and workers should strive to improve dataset quality and understand the underlying reasons for observed paleodiversity patterns.”

- Langer, Nesbitt, Bittencourt & Randall B. Irmis, 2013, Non-dinosaurian Dinosauromorpha, Geological Society of London Special Publication
- Loewen, Randall B. Irmis et al., 2013, Tyrant Dinosaur Evolution Tracks the Rise and Fall of Late Cretaceous Oceans: PLoS ONE
- Nesbitt, Desojo & Randall B. Irmis, 2013,



Cross-section of 225 million-year-old soil horizon in newly-drilled core

Anatomy, phylogeny, and palaeobiology of early archosaurs and their kin: Geological Society of London, Special Publication

- Thomson, Randall B. Irmis & Loewen, 2013, First occurrence of a tyrannosaurid dinosaur from the Mesaverde Group of Utah: Implications for upper Campanian Laramidian biogeography: Cretaceous Research

“This area constitutes a biogeographic break between northern and southern biogeographic provinces, so any specimens

from this region are critical to understanding the origin, evolution, and limits of upper Campanian biogeographic zones on the west margin of the Western Interior Seaway... This is the first unambiguous tyrannosaurid dinosaur reported from the Mesaverde Group and represents an important biogeographic record situated between northern and southern upper Campanian vertebrate assemblages.”

Moonset at CPCP drilling site



TOM KURSAR

Professor, Biology

Tom's research interests include the role of rainfall and drought in determining distributions of

tropical rainforest plants; how tropical rainforests are defended against attack by herbivores; and linking bioprospecting, a sustainable use of biodiversity, with conservation.

DAN MCCOOL

*Professor, Political Science
Director of Environmental and Sustainability
Studies Program
Co-Director Sustainability curriculum*

Dan's research focuses on water resource development, voting rights, Indian water rights, and public lands policy.

JAMES O'CONNELL

Distinguished Professor, Anthropology

Jim's research interests include hunter-gatherer ecology and its implications for arguments about human evolution, and archaeological

method and theory. Current projects are focused on the initial human colonization of Australia (c. 46,000 yrs ago), including observations on the impact of colonization on native plant and animal communities.

DENNIS O'ROURKE

Professor, Anthropology

Dennis's work focuses on ancient DNA analyses in both prehistoric human and nonhuman populations. His primary research interests in recent years have been in the origins of the Inupiat/Inuit populations and cultures of the North American arctic, and their adaptations to the arctic environment, and the genetic evidence for the original colonization of the Americas.

- Broughton, Beck, Coltrain, Dennis H. O'Rourke & Rogers, 2013, A Late Holocene Population Bottleneck in California Tule Elk: Provisional support from ancient DNA:

Journal of Archaeological Method and Theory
"Zooarchaeological analyses have suggested a possible case of late Holocene resource depression in California tule elk. We develop and conduct a preliminary independent test of this here based on trends in genetic diversity derived from ancient DNA extracted from archaeological elk bone... The analysis has implications for our understanding of change in human behavior and biology during late Holocene of central California, the methodology of resource depression analyses, and the conservation biology of tule elk.

JON SEGER

Professor, Biology

Jon's research seeks to understand how weakly selected genetic variation interferes with ecological and social adaptation.

PATRICK SHEA

Associate Research Professor, Biology

Pat's interests lie in working with private property owners to achieve sustainable, exceptional,

conservation practices. He teaches The Biography of an Urban Stream in the Fall semester, which focuses on the complex history of Red Butte Creek.

42 KIP SOLOMON

Professor, Geology & Geophysics

- Aeschbach-Hertig & D. Kip Solomon, 2013, Noble Gas Thermometry in Groundwater Hydrology

- Robertson, Van Stempvoort, D. Kip Solomon et al., 2013, Persistence of artificial sweeteners in a 15-year-old septic system plume: Journal of Hydrology

COURT STRONG

Assistant Professor, Atmospheric Science

- Courtenay Strong & Rigor, 2013, Arctic marginal ice zone trending wider in summer and narrower in winter: Geophysical Research Letters
- Liptak & Courtenay Strong, 2013, The Winter Atmospheric Response to Sea Ice Anomalies in the Barents Sea: Journal of Climate
- Liptak & Courtenay Strong, 2013, A Model-Based Decomposition of the Sea Ice-

- Atmosphere Feedback over the Barents Sea during Winter: Journal of Climate
- Liptak & Courtenay Strong, 2013, Propagating Atmospheric Patterns Associated with Sea Ice Motion through the Fram Strait: Journal of Climate
- McCabe-Glynn, Johnson, Courtenay Strong et al., 2013, Variable North Pacific influence on drought in southwestern North America since AD 854: Nature Geoscience

SYLVIA TORTI

Dean of the Honors College Research Faculty, Biology

Sylvia is an ecologist by training currently working at the interface between science, environment, communication, and education. In her current role as Dean of the Honors College,

she is working to strengthen the interdisciplinary educational opportunities for outstanding undergraduates at the U. Her currently research focuses on coupling science with writing and communication and exploring the relationships between humans and their environment.



INTERDISCIPLINARY STUDENT TRAINING

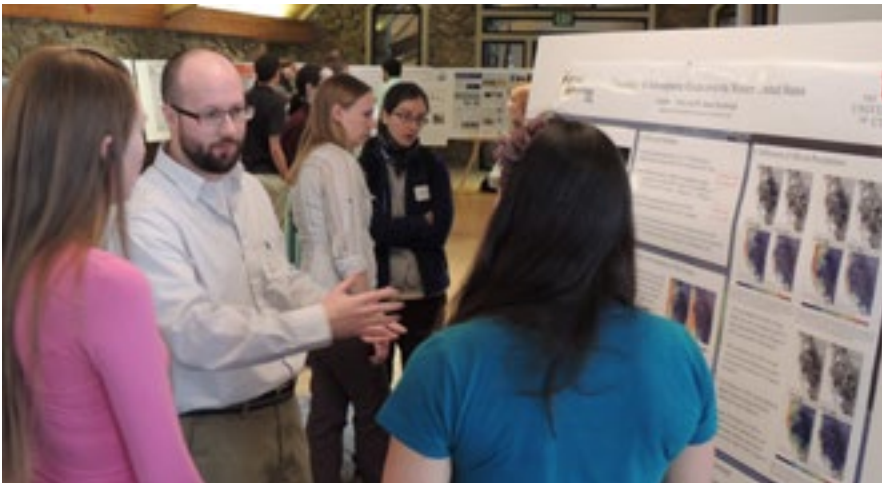
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The GCSC is committed to producing leaders who are prepared to find creative solutions to the environmental and sustainability challenges facing our planet. Toward this goal, the Center offers training, mentoring, and support for students and young researchers. The GCSC acts as a catalyst for collaboration and exploration by facilitating engagement between students and faculty across disciplines.

2013 GCSC RESEARCH SYMPOSIUM

On January 29, 2013, over 150 GCSC-affiliated faculty, students, University staff and members of the public gathered for interdisciplinary discussions about ongoing

global change research. Thirty-five graduate students, including all of those who received GCSC research and travel grants in 2012, presented their research in the interactive poster session. Presentations included research from Anthropology, Atmospheric Science, Biology, City and Metropolitan Planning, Civil and Environmental Engineering, Electrical Engineering, Geography, Geology and Geophysics, Mechanical Engineering, Parks Recreation and Tourism, and Law. There were additional presentations about the proposed Interdisciplinary Graduate Certificate in Sustainability, opportunities through the Sustainability Resource Center, Rio Mesa, and Red Butte Creek. This event earned "Green Event" certification.



2013 GCSC SEMINAR SERIES

Every other Tuesday afternoon in Fall and Spring semesters, the GCSC Seminar series presents some of the best researchers from around campus and across the country whose work sheds light on global change and sustainability. Seminars are open to all. Students who enroll in the Seminar course have additional opportunities to engage with the speakers. GCSC affiliated faculty and their students are invited to nominate speakers for future seminars (see <http://environment.utah.edu/speaker.html>).

SPRING 2013

- **Patrick Barickman**, Utah Division of Air Quality, *"Air pollution, science, and society"*
- **Stephen T. Jackson**, Southwest Climate Science Center, *"Biodiversity consequences of climate change: Forecasts from the past"*
- **Roslynn G. H. Brain**, Utah State University Sustainable Communities Extension, *"Extension Sustainability: Research, Outreach, and Communication Techniques to Foster Positive Change"*
- **Andrew K. Jorgenson**, University of Utah Department of Sociology, *"The Political Economy of Greenhouse Gas Emissions: An Overview of Research Done by Environmental Sociologists at the 'U'"*
- **Doug Jackson-Smith**, Utah State University Department of Sociology, Social Work and Anthropology, *"Beyond Cadillac Desert: Reframing the Western Water Sustainability Paradigm"*
- **Dave Schimel**, NASA Jet Propulsion Laboratory, *"Observational constraints on the climate sensitivity of global terrestrial ecosystems"*
- **David Chapman**, University of Utah Department of Geology and Geophysics, *"Global Warming: The Science is Settled (for most of us) but Climate Change Challenges Lie Ahead"*
- **Elisabeth Moyer**, University of Chicago Department of Geophysical Sciences, *"The Danger of Mismatched Assumptions in Climate Policy"*

FALL 2013

- **Robert Keiter**, University of Utah College of Law, *"The National Park Idea and the Future of the National Park System"*
- **Alexander Glazer**, University of California, Berkeley, *"Mountain Top Removal/Valley Fill: Cheap Coal at High Cost"*
- **Brain Coddling**, University of Utah Department of Anthropology, *"The Origins of Anthropogenic Fire in Arid Australia"*
- **Brenda Bowen**, University of Utah Department of Geology and Geophysics + GCSC, *"Can carbon capture and storage turn black to green?"*
- **Wallace Akerley**, Division of Medical Oncology, University of Utah School of Medicine *"Radon: A Stealthy Assassin"* (co-sponsored with the Program for Air Quality, Health, and Society)
- **Andrea Brunelle**, University of Utah Department of Geography, *"Climate driven dynamics in southwestern US desert ecosystems"*
- **Michelle Hoffman**, University of Utah School of Medicine Department of Pediatrics, *"Children and Ambient Air Pollution: 21st Century Canaries in a Coal Mine"* (cosponsored with the Program for Air Quality, Health, and Society)
- **Scott Denning**, Colorado State University Department of Atmospheric Sciences, *"I'm not a Warmist! Effective Engagement of Hostile Audiences on Climate Change"*
- **Richard Alley**, Pennsylvania State University Department of Geosciences, *"History of Abrupt Climate Change Determined from Ice Cores"*

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Pediatrician Michele Hoffman lectures at Seminar Series



2013 GCSC FALL RETREAT

The Fall Retreat brought together dozens of faculty, graduate students, and postdocs from a wide range of departments including Anthropology, Atmospheric Science, Biology, City and Metropolitan Planning, Civil and Environmental Engineering, Communications, Economics, Geography, Geology and Geophysics. Together with sustainability-focused staff, the group spent the day at the Alta Lodge exploring the challenges and opportunities associated with interdisciplinary sustainability research and training. Participants interacted with colleagues from different disciplines, developing networks through discussions and activities, including a hike through the Albion Basin and the chance to get their hands dirty planting vegetation along the eroding slopes of Little Cottonwood Canyon with the Alta Environmental Center.



GCSC POSTDOCTORAL MENTORING PROGRAM

An interdisciplinary GCSC Postdoctoral Mentoring program was initiated in 2013 to build an important training component that expands beyond the traditional research experiences that a postdoc will typically obtain in an individual faculty lab. Postdoctoral fellows whose mentors are GCSC faculty affiliates are encouraged to participate in our cross-college mentoring program. Dave Bowling and John Lin are currently leading this effort, the goals of which are to:

- facilitate stronger interdisciplinary connections among postdocs and between postdocs and faculty,
- provide professional development in preparation for academic or private industry career opportunities,
- provide guidance to training on research ethics and research responsibilities,
- draw on the knowledge and experience of a broad range of faculty members, providing guidance on developing independent careers, working in multi-investigator projects, and developing the balance between professional and personal obligations,
- provide guidance and training on data management, data archiving, and producing data sets that are shareable with peers and the broader scientific community,
- provide opportunities to learn more about science communications with peers as well as outreach to K-12 students and the general public, and
- facilitate communication about opportunities, resources, and professional experiences.

POSTDOCS

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2013

Meghan Avolio, Biology, Diane Pataki
Jennifer Cotton, Geology and Geophysics, Thure Cerling
Erik Crosman, Atmospheric Science, John Horel
Stephen Good, Geology and Geophysics, Gabe Bowen
Rebecca Hale, Biology, Diane Pataki
Steven Hall, Biology, Dave Bowling
Dasch Houdeshel, CEE, Steve Burian
Vigneshwaran Kulandaivelu, Mechanical Engineering,
Eric Pardyjak

Manuela Lehner, Atmospheric Science, Dave Whiteman
Aaron Miller, Biology, Denise Dearing
Logan Mitchell, Jim Ehleringer and John Lin
Katharina Schramm, Biology, Denise Dearing
Tara Trammell, Biology, Diane Pataki
Hanna Vander Zanden, Geology and Geophysics,
Gabe Bowen

2013 GCSC STUDENT RESEARCH GRANTS

In support of interdisciplinary student training, the GCSC offers research grants to eligible graduate students. These funds (up to \$3,000) are to be used for thesis-related research that broadens a disciplinary focus into a new interdisciplinary direction.

Conservation Agriculture: A Study of Birds, Ecosystem Services, and the Ecology of Ethiopian Coffee Farms

Evan Buechley & Cagan Sekercioglu, Biology

We are studying birds in primary forest and shade coffee farms in Ethiopia to determine the status and distribution of little-studied bird populations and to evaluate the value of shade coffee farms for avian conservation in

the Eastern Afromontane Biodiversity Hotspot. Coffee is the most traded tropical agricultural good and is often grown in areas that are biodiversity hotspots around the world, so understanding how to integrate economic production and biological conservation in this agriculture habitat is of utmost importance.



Evan Buechley, *Sekeleloglu Lab 2013, sekeleloglu.org*
 Evan Buechley, bird-banding in Ethiopia. An important aspect of this work is engagement and outreach with local communities.

Forest Disturbance Regimes in the Uinta Mountains

Vachel Carter & Andrea Brunelle, Geography

The goal of this project is to study the interconnections between forest disturbances and land cover change in response to climate change by reconstructing the fire, vegetation and climate history for a pond on the north slope of the Uinta Mountains, Utah.

Uncovering Isotopic Indicators of Monsoon-Induced Terrestrial Ecosystem Change in Eastern Africa

Kendra Chritz & Thure Cerling, Biology + Geology & Geophysics

My project involves stable isotope analysis of fossil and modern tooth enamel and plant leaf waxes in order to

Kendra Chritz Sampling a hippo tusk by kerosene lantern light



A fossil bovid tooth from an ancient pastoralist site SE Kenya, taken at the National Museums of Kenya in Nairobi (Kendra Chritz)

understand how changes in monsoon strength restructure ecosystems. My work focuses on tropical ecosystems and the connection between changing environment.

Study of Stormwater Volume Capture and Evapotranspiration using a Small Automated Lysimeter Constructed on the University of Utah Marriott Library Green Roof

Youcan Feng & Steve Burian, Civil & Environmental Engineering

I have made a green roof weighing lysimeter on the roof garden of Natural History Museum of Utah to measure the water budget of the green roof in semi-arid climate. Weight changes of a replica of the existing green roof are automatically measured by a weighing scale to quantify the water budget components of the green roof.

Impact of Anthropogenic Activities on the Carbon Budget of the Great Salt Lake, Utah

Yusuf Jameel & Gabe Bowen, Geology & Geophysics

The radiocarbon reservoir age of the Great Salt Lake has changed from >1500 years to ~400 years in the recent years. By measuring the carbon budget of the input source into the Great Salt Lake we plan to analyze the main cause of the change in the radiocarbon reservoir age.

Green roof weighing lysimeter on the roof garden of Natural History Museum of Utah (Youcan Feng)



Modeling Basketmaker II Diets Through Stable Isotope Analysis of Modern Indigenous Flora

Michael Lewis & James O'Connell, Anthropology

This project builds a collection of archaeologically and ethnographically attested plant species from Cedar Mesa, Southern Utah, for future stable carbon and nitrogen isotope analysis. This dataset will compliment existing isotopic analyses of Basketmaker II burials, providing a more precise reconstruction of diets which will demonstrate the behavioral causes of observed gender and age based differences in the isotopic composition of Cedar Mesa Basketmaker II burials.

Holocene Climate Controls on Fire and Vegetation in Neotropical Cerrado Savanna Ecosystems

Yoshi (Shira) Tracy Maezumi & Mitch Power, Geography

The GCSC funding from 2013 was used for stable isotope analysis and phytolith analysis on sediment cores from my research study site in the Bolivian Amazon. These data are



Yoshi Maezumi processes phytolith samples at the University of Exeter

used to determine the influence of climate change on the disturbance regimes in these savanna ecosystems.

- Also received travel grant to present this work at the American Geophysical Union

Assessing the Environmental Impacts of Red Butte Garden

Zachary Magdol & Christine Pomeroy, Civil & Environmental Engineering

This research investigates the interactions between Red Butte Garden and Red Butte Creek. Specifically, water quality, natural abundance of ^{15}N , and sediment transport experiments are underway to determine potential environmental benefits and impacts.

- Zachary also received a travel grant to present this work at the World Environmental and Water Resource Congress

Enhanced Atmospheric Turbulence Measurement System

Tim Price & Eric Pardyjak, Mechanical Engineering

A novel low-cost concept for measuring surface layer atmospheric turbulence was prototyped and tested in the field. An acoustical noise canceling algorithm was also implemented to improve signal quality and to determine the quality of the turbulence data collected.



Tim Price tests the turbulence measurement system during the MATERHORN field experiment on the salt flats at the Dugway Proving Grounds. (Images approved and released by the US Army)

Ozone in Rainforest Airsheds: Are Maritime NOx Emissions from the Panama Canal Shipping Ozone into Nearby Forests?

Gerald Schneider & Phylis Coley and Tom Kursar

I monitored ozone levels in two tropical forests in the vicinity of anthropogenic precursor emissions to determine whether the flora may be exposed to oxidative stress. I used a portable ozone meter to measure ozone concentrations at canopy level, in the understory, and in clearings of two protected forests in Panama.



Jerry Schneider deploys an ozone monitor in the forest canopy, Parque Nacional San Lorenzo, Panamá (photo by Christian Ziegler)

Travelers' Philanthropy: Understanding Tourists' Motivations to Financially Donate at Sweetwater Chimpanzee Sanctuary

Hilary Sgalitzer & Matthew Brownlee, Parks Recreation and Tourism

GCSC funds were used to travel to Ol Pejeta Conservancy, Kenya, Africa in order to collect data for a Masters' thesis study.

The purpose of the study was to gain a better understanding about the internal factors that motivate tourists' to donate to protected areas and conservation efforts. Results were used to inform Ol Pejeta's conservation funding initiatives, advance understanding about travelers' philanthropy programs, and enhance the role of ecotourism in parks and protected areas.



Chimpanzee relaxes in the sun at Sweetwater Chimpanzee Sanctuary. The sanctuary has been a refuge for abused chimpanzees from all over West and Central Africa. (Hilary Sgaltzer)

Barrier Complexes in the Deep Creek Mountains, UT as G.K. Gilbert's "Intermediate Shorelines" of Pleistocene Lake Bonneville

Paul Thomas & Paul Jewell, Geology & Geophysics

We are studying the geomorphology of the Deep Creek Range of western Utah related to the transgression and regression of Lake Bonneville.

High Frequency Monitoring of Stream Water Isotopes in Red Butte Creek

Crystal Tulley-Cordova & Gabe Bowen, Geology & Geophysics

From October 2012 to October 2013, daily stable isotopic samples were collected at two different sites on Red Butte Creek; one just above the University campus at Red Butte Gardens (relatively pristine site) and the other just below campus near Sunnyside Park (urbanized site). During the same time period, precipitation samples were collected at the Frederick Albert Sutton Building on campus. All collected samples were analyzed for oxygen and deuterium concentrations using cavity ring down spectroscopy.

- Crystal also received travel grant to present this work at the American Geophysical Union

2013 GCSC STUDENT TRAVEL GRANTS

The GCSC supports student participation in professional meetings, opening the door to a number of important benefits. Grants are awarded for \$250-500. Students have the opportunity to present their research to peers and professionals in the field. Networking at professional meetings can not only lead to potential collaborations and other professional opportunities, but students are also likely to gain an expanded view of the discipline, its culture, and how their research interests fit into the broader landscape.

Development and Testing of a Spatially Resolved Urban Land Surface Model Utilizing Parallel Computing on Graphic Processing Units (GPUs)

Daniel Alexander & Eric Pardyjak, Mechanical Engineering
American Meteorological Society's 11th Symposium on the Urban Environment

The Green Environmental Urban Simulations for Sustainabil-

ity (GEnUSiS) Project was organized to create a high-performance, building-resolving small-scale meteorological simulation tool for urban environments. More specifically, the simulation tool is targeted at urban planning groups for use in urban design for reduced energy consumption, optimal pollutant dispersion, and improved human comfort.

Perceptions of Climate Change on the Island of Providencia

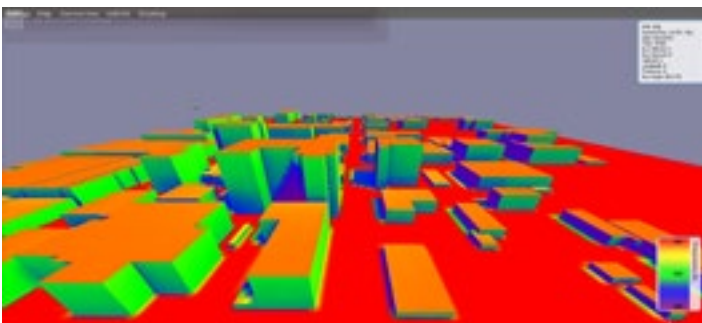
Benjamin Altschuler & Matthew Brownlee, Parks Recreation & Tourism

International Symposium on Society and Resource Management

Climate change is a global phenomenon, but its impacts are generally felt at a local level. This project recorded and analyzed local climate change perspectives on the island of Providencia, Colombia to better inform local vulnerability assessments.

The Carbon Isotopic Composition of Soil Respiration in the Decade Following Disturbance by Bark Beetle or Stem Girdling

Allison Chan & Dave Bowling, Biology
American Geophysical Union



Temperature distributions of Salt Lake City, UT simulations run at a 4-meter resolution at 1:00 PM MST. These results were obtained through coupling a heat and moisture diffusion model to the OptiX ray-tracing radiation model in QUIC-Energy to model the energy budget within the urban environment.

This project investigated if there was an isotopic effect associated with disturbance by the mountain pine beetle in Colorado. Our preliminary results suggest that mycorrhizal biomass is consumed in the first few years following major disturbance to their plant hosts.

Idealized Simulations of Canyon Exit Jets in Utah

Allison Charland, Dave Whiteman, Atmospheric Sciences

International Conference on Alpine Meteorology

Simulations of the valley exit jet at Weber, Canyon, UT, were made using an atmospheric numerical model. On clear, undisturbed days a 15-20 m/s jet-shaped wind speed profile forms about an hour after sunset with peak speeds about 50-100 m above the ground; it persists all night and decays slowly after sunrise.

Concurrent Sr/Ca Ratios and Bomb Test 14C Records from a Porites evermanni Colony on Kure Atoll: SST, Climate Change, Ocean Circulation and Management Applications

Stephanie Covarrubias & Jim Ehleringer, Biology

American Geophysical Union

The project involved the use of a *Porites evermanni* coral core taken from Kure Atoll. We used previously published equations that relate Sr/Ca ratios with sea surface temperature to reconstruct a time series that spans the length of the core (~62 years). We then tied our temperature/time graph with 14C testing of the core for conservation and circulation applications for the North Pacific region.



Navy Twin Otter taking measurements near Granite Mountain, UT

Green Roof Water Budget Measurements Using Weighing Lysimeters in Salt Lake City, Utah, and Water Demand and Stormwater Management Tradeoffs of Green Infrastructure Use in Semi-Arid Cities

Youcan Feng & Steve Burian Civil and Environmental Engineering,

World Environmental and Water Resource Congress

Measuring Nature-Based Recreationists' Beliefs in Climate Change: Occurrence and Anthropogenic Causation

Rose Gochenaur & Matthew Brownlee, Parks Recreation & Tourism

International Symposium on Society and Resource Management

Infiltration and Potential Groundwater Recharge Performance of Stormwater Bioretention Designed for Semiarid Climates

John Heiberger & Christine Pomeroy, Civil & Environmental Engineering,

World Environmental and Water Resource Congress

John studied the infiltration performance of a bioretention

garden located on the University of Utah campus.

Nitrogen Removal in Three Bioretention Systems Over One Year in a Semi-arid Climate

Dasch Houdeshel & Christine Pomeroy, Civil and Environmental Engineering

World Environmental and Water Resource Congress

Rain gardens are traditionally planted with wetland vegetation in mesic climates, however, this is not sustainable in semi-arid climates. This research has shown that while irrigated wetlands do remove more nitrogen from stormwater, upland vegetation can be used in stormwater treatment gardens to reduce nitrogen loading to urban streams in semi-arid climates.

Physical Characteristics and Biogeochemistry of Southern Lake Michigan River Plumes

Yusuf Jameel & Gabe Bowen, Geology and Geophysics

American Geophysical Union Ocean Science Meeting

Rivers are a major source of nutrients to the Great Lakes and may help control and structure ecological and biogeochemical processes within the lakes. Comparison of river water mixing ratios with water quality data allows us to identify and quantify rates of nutrient losses within the plume environment, which shows strong seasonal variability and which we infer is dominated by export to sediments via particle settling.

The Mountain Terrain Atmospheric Modeling and Observations (MATERHORN) Program: Observations and Results

Matthew Jeglum & Sebastian Hoch, Atmospheric Science

American Meteorological

Society 15th Conference on Mesoscale Processes

The MATERHORN Project involved a very large field campaign that gathered a large amount of in-situ and remotely sensed data around a mountain range in Western Utah. This data is being used to improve our theoretical understanding of how the atmosphere interacts with complex terrain as well as the ability of numerical models to simulate it.

Assessing the Validity of Monin-Obukhov Similarity Theory Over Mountainous Desert Terrain

Derek Jensen & Eric Pardyjak, Mechanical Engineering

American Geophysical Union

Derek presented a poster regarding the evaluation of the most accepted turbulent parameterization for atmospheric flows in the atmospheric surface layer.

Does Diet Influence Reproductive Success of Southern Right Whales at Península Valdés, Argentina?

Carina Maron & Jon Seger, Biology

Annual Meeting of the North Atlantic Right Whale



Measuring atmospheric flows in the desert (Jensen)

Consortium

Low food abundance driven by climate change may be influencing the large numbers of southern right whale calves that have died at Península Valdés, Argentina, since 2005 (more than 600 dead calves). My project integrates blubber thickness measurements, fatty acid and stable isotope analyses to assess whether dead calves show signs of malnutrition.

Sensitivity of Near-Surface Temperature Forecasts to Soil Properties over a Dryland Region in Complex Terrain

Jeffrey Massey & Jim Steenburgh, Atmospheric Sciences

American Geophysical Union

This project is part of the MATERHORN field program, the goal of which was to improve numerical weather prediction over areas of complex terrain.

Assessing the Cost of Haemosporidian Infection Through Flight Performance in Rock Pigeons (*Columba livia*)

Sabrina McNew & Dale Clayton, Biology

International Conference on Malaria and Related Haemosporidian Parasites of Wildlife



Cari Marón prepares a sample

While birds around the world are hosts to a diverse group of blood parasites (*Haemosporidia*), the cost of parasitic infection on the host isn't always clear. I am using homing ability in feral pigeons (*Columba livia*) as an assay to test the effect of *Haemoproteus columbae* infection on the host. While this project is still in its beginning stages, I hope that this method will provide greater insight into the ways that blood parasites affect bird physiology and behavior.

Plant Performance Considerations for Semi-Arid Bioretention and Bioinfiltration System Design

Austin Orr & Christine Pomeroy, Civil & Environmental Engineering

World Environmental and Water Resource Congress

Austin studied transpiration performance of various vegetative cover types in experimental bioretention gardens.

Colloid and Nanoparticles: New Filtration Theory

Eddy Pazmino & Bill Johnson, Geology & Geophysics

American Geophysical Union

My research is focused in understanding the interactions be-



Jeff Massey and undergraduate Kyle Neumuller prepare to launch a weather balloon and fly a tethered balloon over the salt flats in northwest Utah.



Yi Qi takes spectral measurement over the canopy

tween colloids (bacteria virus and nanoparticles) and filtering surfaces in natural and engineer scenarios like riverbed and water treatment filtration. Understanding how colloids interact with real surfaces, which can be represented modeling surface physical and chemical heterogeneity in micro to nanoscale, is of key importance to develop a filtration theory that integrates these interactions in larger scale (filter, aquifer) in order to predict the extent of contamination and accurately implement remediation techniques in environmental systems, and also to improve the design of water treatment filtration systems.

Using the Real Estate Market to Establish Light Rail Station Catchment Areas

Susan Petheram & A. Chris Nelson, City & Metropolitan Planning, Transportation Research Board

While considerable research reports the price effects of light rail transit accessibility on owner-occupied residential properties, few evaluate the effect on rental apartment building values. Controlling for structural, neighborhood, and location characteristics, we find a positive relationship between TRAX station proximity and rental apartment building values out to one and one-quarter miles, which extends beyond the conventional half-mile circle used in transit-oriented development planning.

A Neighborhood-Scale Model for Understanding Heat Island Effects of New Development

David Proffitt & Reid Ewing, City & Metropolitan Planning, Salzburg Congress on Urban Planning and Development

The paper outlines a simplified method to predict how changes in land use will affect the urban heat island. It's designed to help planners, city officials, and other decision-makers mitigate the urban heat island through better planning.

Spectroscopic Analysis of Temporal Changes in Leaf Moisture and Dry Matter Content

Yi Qi & Phil Dennison, Geography

2013 HypsIRI Science and Application Workshop in Jet Propulsion Lab

My research studied the seasonal trends and spectral signature of live fuel moisture and dry matter. This information is useful in fire danger prediction and fire behavior modeling.

Green Infrastructure Design for Red Butte Creek at the University of Utah

Kristianne Sandoval & Christine Pomeroy, Civil & Environmental Engineering

World Environmental & Water Resources Congress

I presented a green infrastructure design created for the EPA's Campus RainWorks Challenge within the context of stormwater green infrastructure and low impact development research being completed at the University of Utah. The RainWorks design was created by an interdisciplinary student team that was led by myself, with Dr. Pomeroy as our faculty advisor.

Team: Jake Anderson, Max Stiefel (Environmental Studies), Jacob Andra, English, Steven Arhart, Travis Christensen, John Heiberger, Dasch Houdeshel, Zachary Magdol, Lindsay Minck, Austin Orr, Kristianne Sandoval, Jen Steffen, Thomas Walsh (Civil & Environmental Engineering), Melissa Fryer (Urban & Land Planning), Carolina Gomez-Navarro (Biology), Marian Hubbard (Political Science, Olivia Miller, David Wheatley (Geology), Philip Stoker (City & Metropolitan Planning), Carolyn Stwertka (Atmospheric Sciences).

Coherence Between Great Basin Precipitation and Low Frequency Pacific Ocean Variability in CMIP5

Kimberly Smith & Court Strong, Atmospheric Science, American Geophysical Union

Prior observational studies have shown connectivity between Great Basin (GB) precipitation and Pacific sea surface temperatures (SSTs) on quasi-decadal to multidecadal time scales. We evaluated the performance of 20 models from the CMIP5 archive on this quasi-decadal to multidecadal precipitation-SST connectivity, and the results will be used to force a nonstationary daily stochastic weather generator to assist hydrology and ecosystem impact studies out to year 2100.

Comparing Green and Gray Infrastructure Solutions for the Toledo Combined Sewer System in terms of Stormwater Runoff Control and Life Cycle Environmental Impact

Hassan Tavakol-Devani & Steve Burian, Civil & Environmental Engineering,

World Environmental and Water Resource Congress

My project is about analyzing the financial and environmental benefits of Green Infrastructures in urban areas. It specifically focuses on rain water harvesting systems to supply water locally in order to decrease the resultant Green House gases emission from the traditional centralized infrastructures (it's interdisciplinary between Water Engineering, Economics and Environment Science).

Reading the Surface Heterogeneity Responsible for Colloid Deposition in the Presence of an Energy Barrier

Jacob Trauscht & Bill Johnson, Geology & Geophysics, American Geophysical Union

The motivations for this research are to better understand the surface and solution conditions responsible for colloid deposi-

tion in natural systems in which an energy barrier theoretically prevents zero deposition. This research will help better characterize bacterial filtration in natural groundwater systems.



American Pika

Too Hot to Trot? Effects of wildfire disturbance on pika-relevant microclimates.

Johanna Varner & Denise Dearing, Biology
Ecological Society of America

American Pikas (*Ochotona princeps*) are small mammals that have already exhibited marked declines and local extinctions in response to climate change. My research focuses on identifying ecological factors that promote pika persistence in marginal habitats. Ultimately, this research may allow us to define practical conservation targets for pikas and other sensitive mammals.

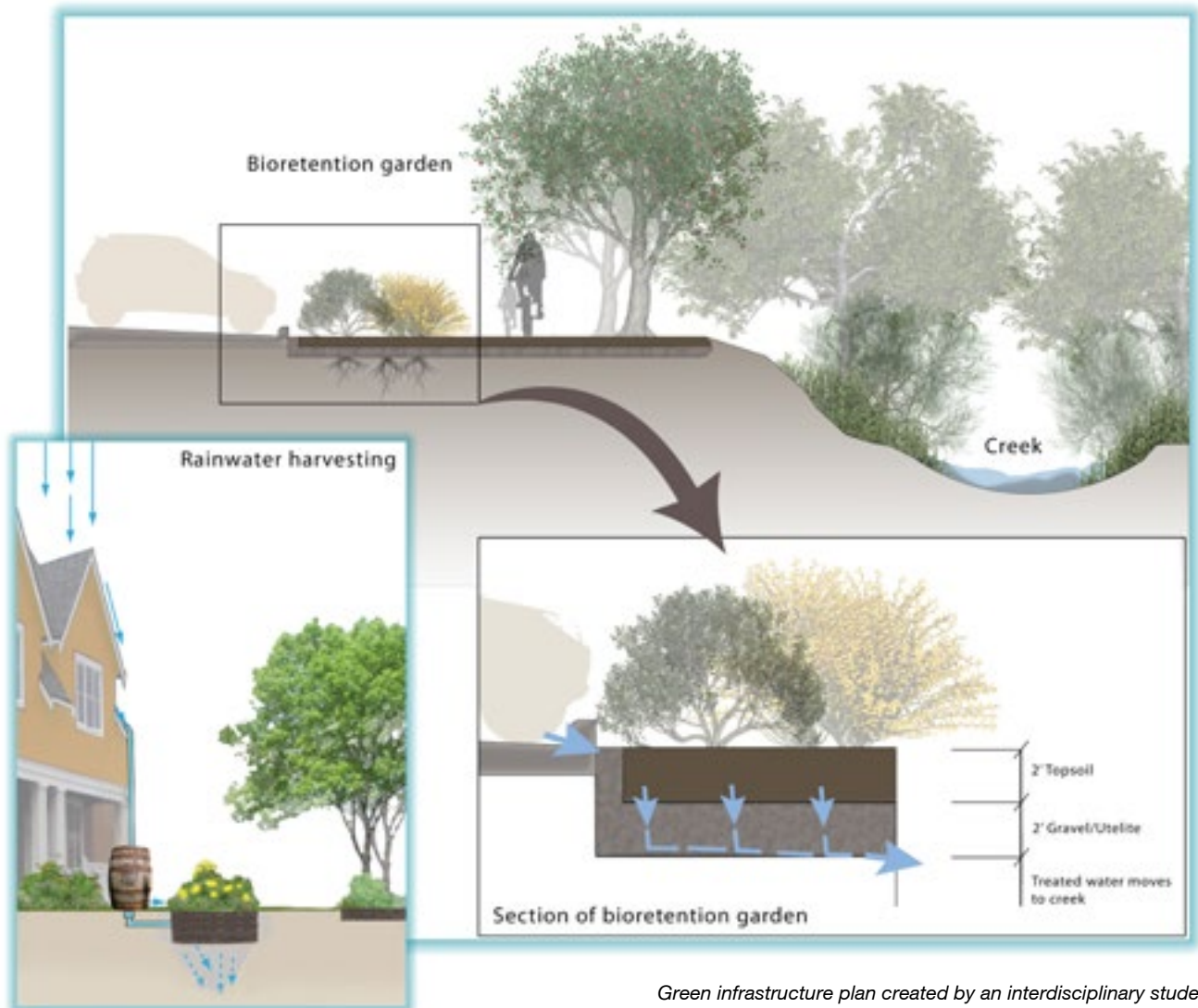
Investigation of a novel approach to projecting decentralized stormwater management networks via fractals

Thomas Walsh & Christine Pomeroy, Civil & Environmental Engineering

World Environmental and Water Resource Congress

This preliminary research was focused on the assessment of whether a fractal relationship could be extracted between

various scales of watershed analysis (individual parcel, neighborhood, and watershed). The results of this analysis proved inconclusive for the study area (Chollas Creek Watershed, San Diego, California), requiring further investigation of scaling methods.



Green infrastructure plan created by an interdisciplinary student team



*Long exposure shot of a fire on a Lake Bonneville aged lagoon deposit.
Railroad sign placed there by local jokesters? (Paul Thomas)*

2013-2014 GCSC GRADUATE FELLOWS

The GCSC first year Fellowship program is aimed at recruiting outstanding and diverse graduate students to the University of Utah; scholars who are interested in an interdisciplinary graduate training and research experience around the broad themes of the environment and sustainability.



LA'SHAYE ERVIN

Biology
Advisor: Diane Pataki

La'Shaye is from Brooklyn, New York and received her B.A. degree from Bowdoin College where she had a double major in Biology and Africana Studies and a minor in English. She has a very strong passion for the great outdoors and is interested in how people in cities connect to nature. Her research explores impacts of urbanization as a mechanism of global change. More specifically, she has been analyzing the effects of human sociodemographics on urban biogeochemical cycling. La'Shaye plans to use nitrogen and carbon stable isotopes as indicators of change in the Los Angeles Metropolitan Area and Salt Lake Valley.



LOGAN FREDERICK

Geology & Geophysics
Advisor: Bill Johnson

Logan is from Arlington, Virginia and received her B.A. degree from Skidmore College where she majored in Geoscience, minored in Mathematics, played varsity basketball, and worked as a volunteer firefighter. Her research is focused on surface groundwater interactions. She is currently working on a project under the Center for Disease Control in partnership with representatives from the College of Public Health and Family Planning on a project to try and determine the likelihood of Arsenic, Uranium, and Nitrate in unmonitored private wells across the United States.

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DEREK JENSEN

Mechanical Engineering
Advisor: Eric Pardyjak

Derek is from Sandy, Utah and received his B.S. degree in Mechanical Engineering with a minor in Mathematics from Brigham Young University. He is interested in interdisciplinary environmental fluid dynamics. His current research involves the parameterization of turbulent transport of momentum, heat, and scalars over rough and mountainous terrain. He is using data acquired during the Mountain Terrain Atmospheric Modeling and Observations Program (MATERHORN) to evaluate current parameterizations and to explore alternatives. MATERHORN is a large, multi-institution, cross-discipline study centered on a field experiment that took place in Utah's West Desert at Dugway Proving Ground in the fall of 2012 and the spring of 2013.



ZACHARIA LEVINE

City and Metropolitan Planning
Advisor: Sarah Hinners

Zacharia received a B.S. in Industrial Engineering and operations research from the University of California, Berkeley. Zacharia identifies as a transdisciplinary thinker operating from a systems worldview, with an interest in the interdependence of people, place, and design. His research utilizes mixed methods to explore quality of life outcomes in different human environments. In particular, Zacharia is interested in how climate change impacts mental health and well-being, and how cities of the 21st century will adapt to design healthy places for human and non-human alike. He is a founding member of the Ecological Planning Center and the Metropolitan Water Lab, and currently working on participatory modeling and stakeholder engagement within the iUTAH project (Innovative Urban Transitions and Aridregion Hydro-sustainability- iutahepscor.org).



EMILY NICOLOSI

Geography
Advisor: Andrea Brunelle

Emily is originally from the New York metropolitan area and studied Anthropology and Studio Art as an undergraduate at the University of Vermont. As an Anthropology student, she focused on environmental problems and globalization, particularly looking at conflicts involving indigenous communities. Her current research is focused on climate change science and policy. She is interested in investigating how the science of climate change can be communicated in a way that promotes climate change mitigating efforts.

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EMILY SCHULZE

Biology
Advisor: Dave Bowling

Emily is originally from Indiana, and grew up in Los Alamos, New Mexico. She graduated with a B.S. in Biology from Colorado Mesa University in Grand Junction, Colorado and traveled back to New Mexico for a post-baccalaureate position at Los Alamos National Laboratory focused on groundwater monitoring and environmental remediation. Her current research is focusing on exploring ecohydrology of riparian trees and hydrogeology. She is particularly interested in the soil/plant and water interface, and the cycling of nutrients and energy between these systems. Emily is currently characterizing the stable isotope dynamics of snowfall and the snowpack, and will be observing the winter/spring transition and snowmelt in the coming months.



MEGAN WALSH

Civil and Environmental Engineering
Advisor: Christine Pomeroy

Megan is from Pittsburgh, Pennsylvania. She attended Penn State University, where she earned her B.S. degree in Civil Engineering and M.S. degree in Environmental Pollution Control. She has worked in both the public and private sectors and has research interests in sediment transport, fluvial geomorphology, and stormwater runoff. Her current research is focused on exploring the impacts of oil and gas production on water quality, sediment transport, and geomorphology of receiving streams. Recently, she has been reviewing literature concerning the effects of the oil and gas industry on the nation's surface waters and stormwater permitting requirements. Megan has also been performing a spatial analysis of oil and gas wells with respect to receiving streams in the Uinta Basin.

Core sample drill by sunset: researchers discovered a large reservoir of melt water that persists beneath the Greenland ice sheet. (Richard Forster)



GLOBAL CHANGES AND SOCIETY COURSE

This interdisciplinary, project-based course engages first-year GCSC Fellows and other interested students in critical analysis of complex social, economic, and natural system interconnections through diverse perspectives. Students develop collaborative approaches to imagine and implement sustainable practices and values through the translation of knowledge of sustainability into action. The 2013 class focused on the sustainability of Red Butte Creek and urban streams.

FRIENDS OF RED BUTTE CREEK

Through the Global Changes and Society course, students determined to promote awareness and stewardship of the Red Butte Creek system, from the headwaters in Red Butte Canyon to its confluence with the Jordan River. Friends of Red Butte Creek (FoRBC) is a student-led community of those interested in supporting resilience of the Creek system. The group aims to better understand the natural processes of Red Butte Creek system and the impact we have on it. In May 2013, FoRBC hosted a kick-off event at the Red Butte Garden Rose House, adjacent to the creek, to engage stakeholders of Red Butte Creek in a conversation about the past, present, and future of the creek. The event showcased a variety of research projects involving the creek, shared images of the watershed, displayed

information about the creek's history, and discussed opportunities for involvement and shaping the vision of what the Friends of Red Butte Creek can become.

Since the conclusion of the Spring 2013 Global Changes and Society course, the FoRBC group has continued to develop, as follows:

- Established ASUU FoRBC student group – currently with 35 student members and growing
- Worked with the University Riparian Corridor Steering Committee to integrate Red Butte Creek into campus planning
- Partnered with the GCSC and the Salt Lake County Watershed Planning and Restoration Program and to provide Mini-Grants for Red Butte Creek related research, outreach, and education projects.



With the help of David Wheatley, kids get hands-on experience with water flow at Friends of Red Butte Creek event



Red Butte Creek at the transition from the Wasatch Mountains to Research Park at the University of Utah (3D image created by Kenneth Dudley)

RED BUTTE CREEK MINI-GRANTS

How do Neighborhood Residents Use and Value Red Butte Creek?

Philip Stoker, *City & Metropolitan Planning*

Residential attitudes, use, and values related to RBC will be assessed for households along the urban RBC corridor with an established social science questionnaire that builds from and links to state-wide iUTAH survey instruments.

Elementary Science Club Student Field Trips to RBC to Learn About Conducting a Scientific Research Project, Urban Streams, and Water Issues in an Urban Environment

Olivia Miller & Brittany Dame, *Geology & Geophysics*

Local elementary (grades 5 and 6) Science Club students will conduct field and lab based projects focused on RBC in connection with relationships established through the Think Globally Learn Locally (TGLL) program.

Exploring Traditional Ecological Knowledge for Red Butte Creek held by Utah Native American Tribes

Gavin Noyes, *Political Science*

This project will explore ties between Native Americans and the Red Butte watershed through 1) interviews with elders from Utah's Native American Tribes, 2) consultation with archaeologists, and 3) conversations with organizations interested in advancing education and outreach around Red Butte Creek and Utah's Native American cultures

Examining the Role of Storm Runoff as a Source of Pollutants to RBC

Crystal Tulley-Cordova & Yusuf Jameel, *Geology & Geophysics*

The impact of urbanization on RBC water quality will be examined in collaboration with iUTAH via measurement of nitrogen and ammonium concentration and evaluation of nitrogen isotope variations in water and particulate organic matter during 2014 precipitation events.

Red Butte Creek Sediment Transport Model

Zachary Magdol, *Civil & Environmental Engineering*

This project will support evaluation of the impact of land management practices on bank stabilization and sediment transport along the urban stretch of RBC.

Nitrogen in Stormwater Runoff

Dasch Houdeshel, *Civil & Environmental Engineering*

This project will evaluate whether nitrogen inputs from stormwater runoff to RBC are deposited via precipitation or by entrainment as stormwater is conveyed across engineered flow paths.

Enhancing Habitat Quality for Seasonal Mule Deer Movement Within the Red Butte Riparian Corridor

William Newmark & Eric Rickart, *Natural History Museum of Utah*

This project will identify landscape features that promote or hinder mule deer movement along the RBC riparian corridor by mapping snow trail networks during the winter of 2014.

Estimating Density of Large Mammals in Red Butte Canyon

Blake Hethmon, *Biology*

Faunal populations occupying the Red Butte riparian corridor will be surveyed using non-invasive camera traps during the spring of 2014.

Integrating science, environmental education, public outreach, conservation, and capacity-building through hands-on bird ecology research in the Red Butte Creek riparian corridor

Evan Buechley, *Biology*

This project will investigate the community ecology of understory birds with the RBC riparian corridor.

LOOKING AHEAD IN 2014

Sustainability at the University of Utah

The GCSC has developed a strong foundation which will allow the Center to continue to grow and to dynamically serve the University of Utah as well as the broader community. The University is moving forward to institutionalize sustainability at the U, and the GCSC will continue to play an important part in promoting, coordinating, and conducting local to global environmental- and sustainability-related research and training.

U-S²TEM Scholars Program

In partnership with the Center for Science and Math Education (CSME), the GCSC will coordinate a new Undergraduate Sustainability Science Technology Engineering and Math (U-S²TEM) Scholars Program to provide academically talented, financially challenged, and diverse undergraduate students with unique educational and research opportunities.

Interdisciplinary Graduate Certificate in Sustainability

The GCSC is in the process of gaining approval for an Interdisciplinary Graduate Certificate in Sustainability. This will be a collaborative, interdisciplinary program which will give students the necessary grounding in the overlap between science, society and policy that will prepare them to address complex problems facing our planet that are beyond the scope of any single discipline.



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