**Boulder Creek Critical Zone Observatory**
**Annual Report, June 2008**

**People**

Senior Personnel

Suzanne Anderson *University of Colorado, Geography and INSTAAR*
Noah Fierer *University of Colorado, Ecology and Evolutionary Biology and CIRES*
Anne Sheehan *University of Colorado, Geological Sciences and CIRES*
Greg Tucker *University of Colorado, Geological Sciences and CIRES*
Robert Anderson *University of Colorado, Geological Sciences and INSTAAR*
Diane McKnight *University of Colorado, Civil, Architectural and Environmental Engineering and INSTAAR*
Mark Williams *University of Colorado, Geography and INSTAAR*
Nel Caine *University of Colorado, Geography and INSTAAR*
Cam Wobus *University of Colorado, Geological Sciences and CIRES*
Dave Dethier *Williams College, Geological Sciences*
Keith Loague *Stanford University, School of Earth Sciences*
Joerg Voelkel *Technical University of Munich, Geomorphology and Soil Science at WZW*
Matthias Leopold *Technical University of Munich, Geomorphology and Soil Science at WZW*
Sheila Murphy *U. S. Geological Survey, Boulder*
Alex Blum *U. S. Geological Survey, Boulder*

Staff

Eric Parrish *University of Colorado, INSTAAR*
Zan Frederick *University of Colorado, Geography and INSTAAR*

Consultant

Jim Waterman *BASIN*

Post-doc

Miriam Duhnforth *University of Colorado, INSTAAR*

Grad students

Susan Riggins *University of Colorado, Geography and INSTAAR*
Cary Kandel *University of Colorado, Geography and INSTAAR*
Kevin Befus *University of Colorado, Geological Sciences and CIRES*
Rachel Gabor *University of Colorado, Environmental Sciences and INSTAAR*
Kathryn Eilers, *University of Colorado, Ecology and Evolutionary Biology and CIRES*
Chris Gray *University of Colorado, Ecology and Evolutionary Biology and CIRES*
Aimee McLaughlin *University of Colorado, Environmental Sciences and INSTAAR*
Ken Hill *University of Colorado, Geography and INSTAAR*
Ashley Nielson *University of Colorado, Geography and INSTAAR*
Juliane Huber *Technical University of Munich, Geomorphology and Soil Science at WZW*
Johannes Daferner, *Technical University of Munich, Geomorphology and Soil Science at WZW*

Matt Miller *University of Colorado, Civil, Architectural and Environmental Engineering and INSTAAR*

Undergraduate students and student field assistants
Sebastian Doetterl, *Technical University of Munich, Geomorphology and Soil Science at WZW*
Eirik Buraas, *Williams College*
Evey Gannaway, *Sewanee*
Ken Nelson, *Macalester College*
Miguel Rodriguez, *Colgate University*
Mollie Pettit, *Virginia Tech*

**Partner Organizations**
United States Geological Survey: In-kind Support; Facilities; Collaborative Research; Personnel Exchanges
Alex Blum and Sheila Murphy, both USGS, are integral members of the project team. Their contributions are in soil/rock/water geochemical analysis, lab support, and outreach.

Technical University of Munich: In-kind Support; Collaborative Research; Personnel Exchanges
Two researchers (Joerg Voelkel and Matthias Leopold) of TUM are a major part of the geophysics team for the project. They conduct geophysical survey field work this summer, and are bringing several students with them. They work closely with several members of the team, including Nel Caine, Anne Sheehan, and David Dethier.

Williams College: Collaborative Research; Personnel Exchanges
David Dethier from Williams College is bringing a group of undergraduate students for summer research in the CZO this summer, and his work ties in with efforts of the geophysics, geochemical and geomorphology teams.

Stanford University: Collaborative Research
Keith Loague of Stanford is producing hydrologic simulations using the Integrated Hydrologic Model (InHM). He is currently working on a hydrologic simulation of Green Lakes Valley.

Keck Geology Consortium: Collaborative Research; Personnel Exchanges
A Keck Geology Consortium project involving 3 undergraduate students will take place at the Boulder Creek CZO this summer.

Niwot Long Term Ecological Res. (LTER): In-kind Support; Facilities; Collaborative Research; Personnel Exchanges
Boulder Creek CZO shares one field site- Green Lakes Valley- with the Niwot LTER. LTER personnel assist CZO personnel, and we are sharing some lab work. The CZO will augment instrumentation in the Niwot LTER- notably the met station in Green Lakes Valley.

**Collaborators**
Iggy Litaor, Tel-Hai Academic College, Tel Aviv, Israel
Prof. Dennis Harry, Colorado State University
USFS
Boulder County Open Space
City of Boulder

**Project Activities**

*Goals and objectives*
The Boulder Creek CZO is designed to study how weathering and erosion processes together form the critical zone and affect its structure. Three focus field sites are situated in crystalline bedrock regions within the Boulder Creek watershed, each representing different erosional rates and histories. The CZO will undertake activities to understand the differences across these sites in CZ architecture, erosion rates, and in hydrologic-geochemical-ecological function. This understanding will be built into models of landscape evolution, hydrology and geochemical processes. We also seek to build cross-disciplinary bridges in Critical Zone study, and to engage a broad community participation in working and thinking about the CZ in this way.

*Graduate student recruitment*
Because we are building a new program, we focused in year 1 on recruiting graduate students into the project. We have had success in this effort: 5 new students are joining us, either in summer 2008 or fall 2008. Two additional students will work on CZO projects, but funded from other sources. The students are in 4 different departments. All of these students (as well as others interested in the topic) will take a graduate course in Fall 2008 on the Critical Zone, and will all undertake research projects associated with the project.

*Establishment of hydrological and meteorological monitoring in focus sites*
The aim for year 1 is to begin site characterization and establish monitoring systems in each focus site. We have established relationships with the landowners in all of our field sites (USFS, City of Boulder, County of Boulder). We are in the process of building meteorological stations and stream gages for all three sites. Snow surveys were conducted in two of the three sites in late spring. The third site does not have a continuous winter snowpack. Runoff sampling has begun on a weekly basis at each location.

*Modeling*
Landscape modeling: In order to investigate the long-term evolution of the catchment, a preliminary set of numerical experiments has been set up using the CHILD landscape evolution model. These calculations address the formation of the topography at the scale of the basin and the adjoining plains. They are designed to shed light on the long term

evolution of the basin, and test the plausibility of alternative hypotheses for the generation of knickpoints along Boulder Creek and other bedrock streams draining the eastern flank of the Colorado Front Range. One goal in particular is to assess the feasibility of scenarios in which climate change triggers knickpoint formation by driving accelerated exhumation in the weak sedimentary rocks east of the range front.

Glacial modeling: We have tuned a 2D glacial model to work in catchments akin to the Green Lakes Valley. The algorithms are now in place to allow careful interpretation of $^{10}$Be concentrations from samples we intend to collect over the summer 2008 within the Green Lakes catchment. These algorithms include the 2D field of cosmogenic radionuclide production rates at all sites in the valley. The results produce a first order history of the ELA in the catchment immediately to the south. We are beginning to run models of glacial occupation of the upper CZO site using the history of ELA from the Middle Boulder Creek valley, with the intent of constraining 1) the history of deglaciation, 2) evaluating the conditions required to account for the duration of occupation of the LGM moraine complex and its ponding of Lake Devlin being documented by others in the CZO.

Physics-based simulation of surface / near-surface hydrologic response: The development of a conceptual geologic model and corresponding boundary-value problem for the Green Lakes Valley catchment are both underway at Stanford (Keith Loague) for use in InHM (Integrated Hydrology Model) driven concept-development simulations. Available LiDAR topography and historical meteorological and streamflow data have been provided to Keith Loague by Suzanne Anderson.

*Model dissemination*

A working MATLAB 2D glacial code that simulates deglaciation history in valleys, and can incorporate constraints from cosmogenic surface age dates, has been delivered to the staff of the NSF-funded Community Surface Dynamics Modeling System (CSDMS) for translation and incorporation in their library of available codes.

*Summer field work (2008)*

Activities planned for summer 2008 include the following:

Soil sampling for mineralogy, nutrient analysis and microbial analysis.
Geophysical surveying in Green Lakes Valley and Betasso.
Identification of sites for deep coring in 2009.
Sampling for CRN dating.
Water sampling in series of sites within Boulder Creek to understand controls on the invasive diatom *Didymosphenia geminata*.

*Collaboration/communication/education*

-Website: czo.colorado.edu is under construction.
-Working with BASIN (Boulder Area Sustainability Information Network) website stakeholders to define how it should evolve and incorporate CZO outreach.
-Collaboration with Iggy Litaor (Tel Aviv), who will visit Green Lakes Valley in August to resample his soil pit sites from the 1980s. This retrospective sampling will assess how

20 years of increasing inorganic nitrogen in wetfall may have changed the chemistry of soils and soil solution.
-Collaboration with Dennis Harry (Colorado State Univ), associated with Hydrologic Measurement Facility (HMF)- Geophysics, on geophysical surveying methods.
-First group of undergraduate student researchers from Keck Geology Consortium project work in CZO in July-August.
-In August 2008, we will hold our first all-hands annual science meeting. The meeting is timed to occur when team members from Germany and Williams College and the Keck Geology Consortium undergraduate students are present. We plan to invite local researchers (mostly associated with the Niwot LTER) to join us to expand our connectivity.
-Submitted supplement request to support activities of a national Steering Committee for all three CZOs.
-Conferred with David Maidment (CUASHI- HIS) and with Michael Hofmockel (CZEN) on data management and communication.
- Collaboration with a German Research Foundation (DFG) sponsored project led by Voelkel. Their work yielded geophysical and geomorphological data on the deglaciation of North Boulder Creek, and will be shared with the Boulder Creek CZO project.
-Supported proposal writing efforts:

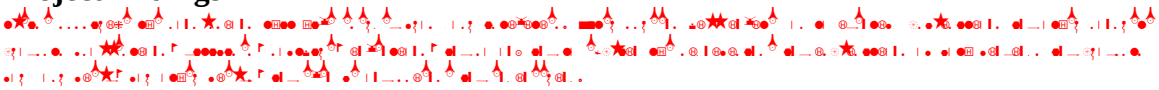
COSMOS proposal from Univ. of Arizona to NSF Medium Scale Infrastructure (MSI) program.

DataNet proposal from Purdue to NSF Office of Cyberinfrastructure

Peter Raymond (Yale) proposal to NSF-EAR instrumentation to develop an automated DIC/DOC/$CO_2$ instrument for field deployment

Eve-Lyn Hinckley (Stanford) for an NSF Earth Science Post-doctoral Fellowship to work on nitrogen fluxes and hydrology in the Boulder CZO.

**Project findings**



*Theses*

Two MA theses completed under direction of Mark Williams on hydrochemistry in Green Lakes Valley. Ken Hill found increasing contributions from subsurface flowpaths to runoff over a 26-year record of discharge and water chemistry in Green Lakes Valley. The deeper flowpaths were particularly significant during periods of drought (decreased precipitation) from 1995-2006. Evidence suggests that permafrost degradation is contributing to baseflow in warm, dry years. Ashley Nielson showed that an alpine wetland in Green Lakes Valley had a fairly flashy hydrologic response to water inputs from snowmelt and rain. The wetland impacted chemistry of waters flowing through it, and appeared to be a biogeochemical hotspot within Green Lakes Valley.

Matt Miller completed a PhD dissertation under the direction of Diane McKnight on interactions of dissolved organic matter, algae and hydrology in the headwaters of Boulder Creek. Fulvic acids are involved in rapid electron-transfer reactions in and near the headwater stream, and three pools of dissolved organic matter in the alpine lakes in the headwaters are controlled by hydrology and biologic productivity in the system.

Flood events appeared to be important in controlling growth of *Didymosphenia geminata*, a nuisance freshwater diatom.

*Snow surveys*:
First snow survey of Gordon Gulch catchment was conducted in early April 2008. Mean snow depth of 45.7 cm (n= 509), and density of 33.3 kg/m3, yields 14914 m3 water in the 0.98 km2 basin. A similar survey was conducted in Green Lakes Valley in early May.

*Glacial history of headwaters:*
We use cosmogenic radionuclide (CRN) exposure ages from polished, striated bedrock to constrain numerical simulations of deglaciation in the Middle Boulder Creek valley, Colorado Front Range, and the Animas River valley, San Juan Mountains, Colorado. In both valleys, the cosmogenic ages suggest initiation of deglaciation ca. 20 ka and ongoing retreat until 12-13 ka. While the first-order trend in CRN concentrations in each valley suggests a monotonic glacial retreat, we evaluate other retreat scenarios with different implications for post-LGM regional climate. The results of a 2D glacial model and the spatial pattern of measured concentrations in bedrock constrain the range of equilibrium line altitude (ELA) histories that reproduce the CRN pattern in each valley. In the Animas River valley, the exposure ages are well-explained by a linear ELA rise from full glacial to deglacial conditions. Ages in Middle Boulder Creek valley are best explained by a deglaciation history including a stillstand or partial readvance between 16 and 14 ka, followed by rapid retreat.

In North Boulder Creek valley a combination of optically stimulated luminescence in ice-dammed lake sediments, radiocarbon ages of bog and kettle sediments, and CRN concentrations in polished bedrock have been collected to begin a reconstruction of deglaciation. These data suggest that glacial lake (Lake Devlin) outburst around 16 ka, followed by a possible re-advance of the ice and re-blocking the outlet with a final outburst around 14 ka. This documented history is consistent with the CRN-constrained modeling of the adjacent Middle Boulder Creek valley.

These histories of glacial occupation in the Middle Boulder Creek valley and lower North Boulder Creek valley should be directly relevant to the adjacent upper CZO focus site (Green Lakes Valley), providing 1$^{st}$ order constraint on the timing of deglaciation from this valley.

*Incision of the High Plains:*
Incision of sediments covering the High Plains is the erosion event that rejuvenated the lowest focus site in the Boulder CZO, but the timing and cause of this event are poorly constrained. Results of simple long profile models of the rivers draining across the High Plains allow us to contrast the patterns of incision driven by climatically-induced changes in hydrology and sediment flux with those driven by tectonically-induced changes in baselevel. Based on these results, we suggest that the post-Ogallala incision of the western High Plains may be more compatible with changes in the hydrology of High Plains river systems than with changes in tectonics. While this incision may have given rise to a modest isostatic response from the lithosphere, there may be no need to invoke independent Late Cenozoic tectonic changes to explain the topography we see today.

*Microbial ecology method development:*
We have spent the past 9 months developing and refining the techniques to be used for the analyses of the microbial communities in the CZO watersheds. Specifically, we have developed a high-throughput sequence-based approach that will allow us to characterize microbial communities in hundreds of water and soil samples simultaneously. This approach will enable us to obtain the first watershed-scale assessment of microbial diversity and structure, an essential step in the process of linking microbial ecology to watershed-scale biogeochemistry. We anticipate that the soil and water samples will be collected from the watersheds this summer and analyzed in the fall. The soil and water samples to be characterized for this component of the project will also be analyzed by other CZO personnel so we can directly link the microbiological measurements with information on sample geochemical and biochemical characteristics.

*Geophysical surveys (summer 2007)*
Green Lake 5 area:

Electric tomography- 5 lines around the rock glacier and wetlands used to identify permafrost in and around the rock glacier.

Seismic refraction- 2 lines were run across the rock glacier.

Ground penetrating radar- 2 lines across the rock glacier show details of the internal structure of the rock glacier.

Niwot Ridge at D 1 station:

Seismic refraction- 6 lines from ridge crest into Green Lake valley give a preliminary estimate of depth to bedrock at the drainage divide.

Geophysical survey data collected in 2006 was integrated with new survey lines from 2007 to characterize periglacially formed parts of the critical zone. Electric tomography, seismic refraction and ground penetrating radar data were combined with soil-geomorphological descriptions from soil pits to establish a preliminary model of the structure, thickness, and distribution of periglacial slope deposits in and adjacent to Green Lakes valley.

**Project Training/development**

Post-doc Miriam Duhnforth is doing our first cosmogenic radionuclide sampling and sample processing, focusing on the deglaciation history of Green Lakes Valley. She is learning about the glacier models developed by RS Anderson and D Ward, and adapting it to the Green Lakes Valley.

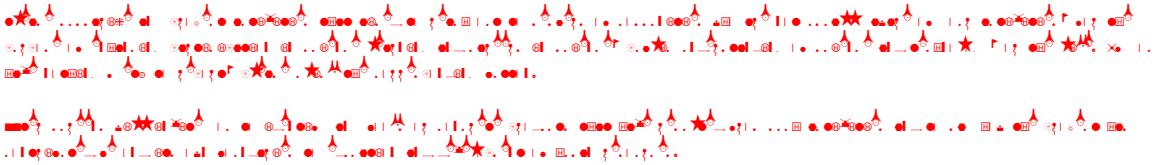
Most graduate students associated with the Boulder CZO are beginning in summer or fall of 2008. Those who are starting in summer (Cary Kandel, Kevin Befus, Rachel Gabor, Kathryn Eilers, Aimee McLaughlin) are immediately becoming immersed in a field project. Cary Kandel and Kevin Befus are taking training in GPS and T-LiDAR with UNAVCO in summer 2008 through contacts of Co-PI Anne Sheehan.

Juliane Huber and Johannes Daferner (TUM) and field assistant Sebastian Doetterl are gaining international experience and collaboration. They have been collecting geophysical field data and doing gemorphological mapping. Juliane Huber will concentrate on interflow in periglacial slope deposits, integrating Boulder Creek data into her PhD thesis. Johannes Daferner will use data he gathers for his Diploma thesis to constrain a three dimensional model of the former North Boulder Creek glacier by developing a new modeling algorithm with roundness factors.

Eirik Buraas (Williams), Evey Gannaway (Sewanee), Ken Nelson (Macalester College) and Miguel Roriguez (Colgate Univ) are the Keck Geology Consortium undergraduate students. They will each learn about the Front Range and the Boulder CZO, conduct field work, and over the course of 2008-09 produce a senior thesis based on their summer field experience.

Three graduate students who have been working on parts of Boulder Creek since before the inception of the CZO have finished their theses. These students (Ken Hill, Ashley Nielson, and Matt Miller) have benefited from having their work contributing to our current understanding of Boulder Creek hydrology, biogeochemistry, and ecology. They will be asked to share their work with us at our first annual meeting.

**Outreach activities**



University of Colorado produced a press release when the CZO funding was announced (see http://www.colorado.edu/news/releases/2007/467.html)

Suzanne Anderson has given presentations about the CZO project to:

- CZEN workshop on cyberinfrastructure (Sept 2007)
- SoilCrit Zone workshop (EU sponsored workshop in Bristol, England) (Oct 2007)
- NSF workshop titled Climate over Landscapes (Oct 2007)
- American Geophysical Union Fall Meeting (Dec 2007)
- Gilbert Club (Dec 2007)
- Western Water (Geog 4501 class at CU) (Jan 2008)
- Water Seminar (Engineering at CU) (Feb 2008)
- University of Colorado Dept. of Geography colloquium (Apr 2008)
- Niwot LTER meeting (May 2008)
- Geochemistry of the Earth's Surface, 8th International Conference, London (Aug 2008)

Robert Anderson will give CZO presentation to:

- NEON meeting (July 2008)

Joerg Voelkel has given a presentation about CZO at the GeoForschungsZentrum Potsdam (GFZ), the German Research Centre for Geosciences

Matthias Leopold has given a presentation about CZO at the German Geographentag

**Products**

Publications


Anderson, S.P., von Blanckenburg, F., and White, A.F. (2007) Physical and chemical controls on the critical zone. *Elements* 3: 315-319.

Anderson, S.P., Blum, A.E., Dethier, D.P., Murphy, S.F., Williams, M.W., McKnight, D., Fierer, N., Tucker, G., Wobus, C., Anderson, R.S., Caine, N., Loague, K., Leopold, M., Voelkel, J., and Sheehan, A. (2007): Developing Methods to Test the Influence of Critical Zone Development on Watershed Hydrology and Biogeochemistry. *Eos Trans. AGU* 88 (52), Fall Meeting Suppl., Abstract H51K-01.

Riggins, SG, Anderson, SP, and Blum, AE (2008): Transformations across the bedrock/saprolite-regolith boundary. Goldschmidt Conference, July 13-18, Vancouver, B.C., *Geochim. Cosmochim. Acta Suppl*.

Anderson, SP, Anderson, RS, and Riggins, SG (2008): Fractures and the weathering front. Goldschmidt Conference, July 13-18, Vancouver, B.C., *Geochim. Cosmochim. Acta Suppl*.

Anderson, S.P., Bales, R.C., and Duffy, C.J. Critical Zone Observatories (2008): Building a network to advance interdisciplinary study of Earth surface processes. *Mineralogical Magazine*.

Ward, D. W., Anderson, R. S., Briner, J. P., and Guido, Z.S., Signatures of glacial erosion and retreat in the Front Range landscape: cosmogenic and numerical modeling constraints (*JGR - Earth Surface* submitted April 2008)

Wobus, C., G. E. Tucker and R. S. Anderson, Cenozoic incision of the North American High Plains: Topographic re-analysis and the possible role of climate change, GSA Annual Meetings abstract 2008

Dethier, David P., and Bove, Dana J., 2007, Slow weathering of granitic rocks and the low-relief landscape of the Boulder Creek catchment, Colorado: Geological Society of America Abstracts with Programs, Vol. 39, No. 6, p. 108.

Leopold, Matthias, Dethier, David, Voelkel, Joerg and Raab, Thomas, 2008, Combining sediment analysis and seismic refraction to describe the structure, thickness and distribution of periglacial slope deposits at Niwot Ridge, Rocky Mountains Front Range, Colorado, USA: *Annals of Geomorphology*, in press

Leopold, Matthias, Dethier, David, Voelkel, Joerg, Raab, Thomas, Corson-Rickert, Tyler and Caine, Nel, 2008, Using geophysical methods to study the shallow subsurface of a sensitive alpine environment, Niwot Ridge, Colorado Front Range, USA: *Arctic, Antarctic and Alpine Research*, in press

R.T. Jones, M.S. Robeson, **N. Fierer**. *In Review*. Moving beyond 'species' richness: phylogenetic comparisons of fungal and bacterial communities in soil. *ISME Journal*.

C.L. Lauber, M.S. Strickland, M.A. Bradford, **N. Fierer**. *In Press*. The influence of soil properties on the structure of bacterial and fungal communities across land-use types. *Soil Biology & Biochemistry*.

Huber, J., Voelkel, J. and Leopold, M. (2008): Periglacial slope deposits and saprolites controlling water discharge – results from a three years measurement on a test site in

the Bavarian Forest, Germany Geophysical Research Abstracts, Vol. 10, EGU2008-A-10561, 2008
Leopold, M., Voelkel, M., Dethier, D. & Raab, T. (2008): Combining geophysical methods and drillings to study the shallow subsurface of a sensitive alpine environment, Niwot Ridge, Colorado Front Range, USA. Geophysical Research Abstracts, Vol. 10, EGU2008-A-10358.
Leopold, M., Dethier, D. & Völkel, J. (2007): Near surface geophysics and sediment analysis to precise the outburst of glacial Lake Devlin, Front Range Colorado, USA, Abstracts at the AGU fall meeting, San Francisco 12/2007. *Eos Trans. AGU* 88 (52), Fall Meeting Suppl., Abstract H51E-0809.
Lutterschmid, E., Placht, S., Huber, J., Roeder, J., Huerkamp, K., Leopold, M., and Voelkel, J. Classification of subsurface sediments to assess the importance of slope deposits and saprolites within the critical zone (Bavarian Forest, Germany). Geophysical Research Abstracts, Vol. 10, EGU2008-A-10846, 2008
Voelkel, J., Raab, T. and Leopold, M. (2008): Stratigraphy, material characteristics and dating of periglacial slope deposits as a crucial element of the critical zone. Geophysical Research Abstracts, Vol. 10, EGU2008-A-10786, 2008
Voelkel, J. Huber, K. Huerkamp and E. Lutterschmid (2008): Regolith and Saprolite as crucial elements within the Critical Zone. Geophysical Research Abstracts, Vol. 10, EGU2008-A-10817, 2008.

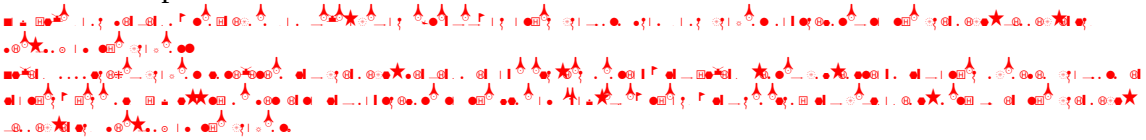
Hill, Ken (2008): Hydrologic and hydrochemical response to 25 years of climate change, Green Lakes Valley, Colorado, M.A. Thesis, University of Colorado at Boulder.
Nielson, Ashley (2008): The hydrology and hydrochemistry of an alpine wetland, Green Lakes Valley, Colorado, M.A. Thesis, University of Colorado at Boulder.
Miller, Matthew (2008): Interactions between hydrology, dissolved organic matter, and algal populations in the headwaters of Boulder Creek, Ph.D. dissertation, University of Colorado at Boulder.

Internet site
http://czo.colorado.edu/

Other (databases, physical collections, educational aids, software, instruments, etc)
None

**Contributions**

Within discipline



The Boulder Creek Critical Zone Observatory takes an interdisciplinary approach to understanding the structure and function of the region at the Earth's surface (known as the critical zone) where air, water, rock, and life interact. Our observatory spans three distinctive erosion regimes in which the rate and history of removal of material from the so-called "reactor" of the critical zone varies. We posit that these differences in erosion will be manifested in differences in the depth and development of the weathered rock

profile. Simply posing the conceptual model of weathered profile development in terms of interplay between erosion and weathering front advance constitutes an advance of the science.
The project has brought together team scientists from geomorphology, geophysics, biology, geography, and engineering to think in a unified way about the critical zone.

Other disciplines

The Boulder Creek CZO has provided support to others working on instrument development (COSMOS soil moisture) and cyberinfrastructure (Purdue DataNet). To date, our support has not come to fruition.

Human resources development

We are providing the research context for a group of undergraduate students for the Keck Geology Consortium in summer 2008. A group of 4 undergraduates from across the country will learn about the critical zone and will undertake senior research projects rooted in the Boulder Creek CZO.
PI Suzanne Anderson teaches about the critical zone in her large, freshman level physical geography class titled Landscapes and Water. The majority of these students are non-science majors for whom this course may be their sole training in college level science.

Research and Education

We are augmenting the meteorological instrumentation of the Niwot LTER Green Lakes Valley site, and adding soil instrumentation (moisture, temperature, hydraulic head, and soil water samplers) to this heavily studied valley.
We are developing two entirely new watershed field sites in Gordon Gulch and Betasso. This entails first developing an understanding with the landowners (USFS, County and City of Boulder). Each watershed will be instrumented with stream gauges, soil instrumentation, and meteorological instrumentation.
PI Anderson is expanding her water analysis lab to handle the regular field sampling and parts of the analyses for CZO samples. The lab now occupies more space at INSTAAR, and is being reorganized to act as a hub of field activity for the project. The lab is run by the CZO field and lab technician, Zan Frederick.
We are supporting and sustaining a community website (BASIN) that provides information and education about a variety of environmental issues within the Boulder watershed.
We are in the process of establishing a data management system for the research community.

Beyond Science/Engineeering

Nothing to report

Data Access and Standardization:

We are in the process of searching for a data manager for the Boulder Creek CZO. Our data collection systems are just becoming established in summer of 2008. For the present, our data is stored and available through the Niwot Ridge LTER. Discussions have been ongoing with the Sierran CZO and the Susquehanna CZO about how they will establish their data management systems. Significant progress will come when we all have data managers on-board.

Annual Meetings:

The first annual CZO science meeting will be held in September 2008 at the Sierran CZO. We have requested supplemental funding that includes support for non-hosting CZO members to attend this meeting.

Steering Committee (SC):

A national Steering Committee has been established. Five distinguished scientists have accepted membership on the committee, and the first meeting of the group will take place at the first annual CZO science meeting in September 2008.