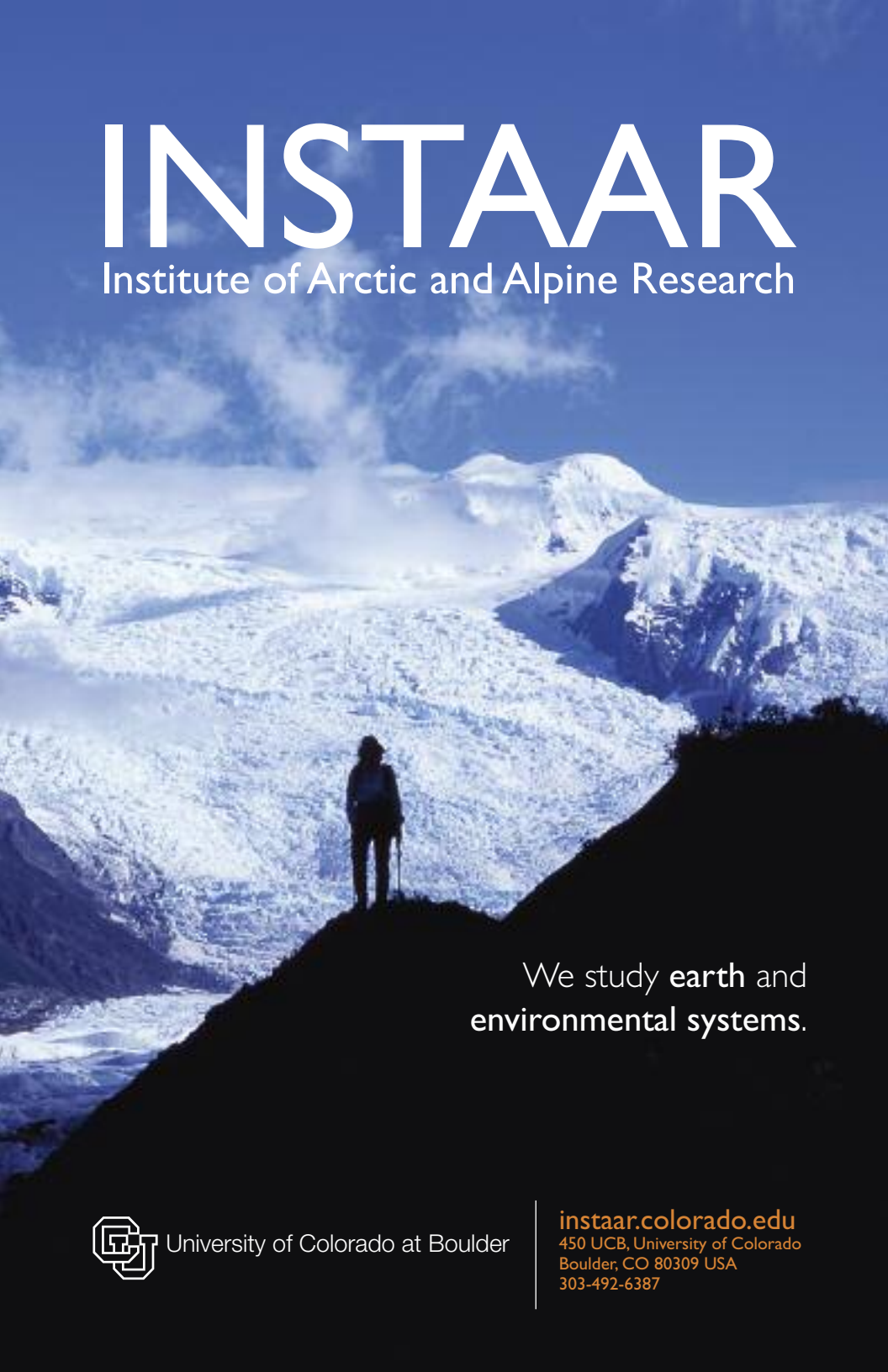


INSTAAR

Institute of Arctic and Alpine Research



We study **earth** and
environmental systems.



University of Colorado at Boulder

instaar.colorado.edu
450 UCB, University of Colorado
Boulder, CO 80309 USA
303-492-6387

INSTAAR

Institute of Arctic and Alpine Research

Our researchers uncover and communicate processes concerning earth and environmental systems—matters that are becoming ever more urgent as changes in climate and land use are felt worldwide.

As the University of Colorado's oldest institute, INSTAAR has a long history of responding to pressing environmental issues. Our traditional focus has been on polar and alpine regions, where effects of global change are especially pronounced. In recent decades, our research has broadened to include environmental challenges that span local, regional, and global scales. INSTAAR research topics range widely and include Quaternary and modern environments, human and ecosystem ecology, biogeochemistry, landscape evolution, hydrology, oceanography, and climate. Our field sites are located across all seven continents and the world's oceans.

Our expertise across disciplines helps us generate influential science that can inform policy decisions and improve society's awareness and understanding of natural and anthropogenic global change.

“Human beings are not a small part of the environment anymore.”

Humans are a key component, and we see it as necessary to get that message out. We think higher education has a huge responsibility to help guide society toward sustainability, and that is ultimately what INSTAAR is all about. We don't pretend to do it all. We would just like to do our part as well as we can.

James White
INSTAAR Director



More than

200 people

make up our team at
INSTAAR, **25%** of
whom are graduate students.

Introduction

Research
Education
Outreach
Future

We partner with

7 departments & programs
on the CU-Boulder campus:

Anthropology
Atmospheric & Oceanic Sciences
Civil, Environmental & Architectural
Engineering
Environmental Studies
Ecology & Evolutionary Biology
Geography
Geological Sciences

We go beyond arctic and alpine...

Madagascar

Tracking ancient megabeasts. Professor Gifford Miller (INSTAAR & Geological Sciences) and two Malagasy colleagues discover fossil eggshells that will help determine why large animals went extinct in Madagascar less than 2000 years ago. Photo: Steven DeVogel (INSTAAR). May 2007.

performing

research with impact

“ **Our climate is changing...** People have used more fossil fuels since the Kyoto Protocol was signed than in all prior human history. Biodiversity is declining. Population is outpacing food supply. Land degradation and environmental pollution are rampant.

We are the first generation with the tools to analyze these changes and the first with the potential to reverse them.

”

Alan Townsend
INSTAAR Fellow




producing
policy-relevant
science

sharing
results
widely

leading
at
CU-Boulder

INSTAAR is helping discover the mechanisms that drive environmental change, sharing what we find with peers, policy makers, and the public. Our results clearly resonate with the scientific community: citations to our work have grown by more than 20 percent each year for four years running. We also frequently communicate with audiences outside the sciences, from secondary school students, to the media, to U.S. Congressional committees.

The impact of our science is amplified by CU-Boulder's exceptional focus on environmental research. According to the National Science Foundation, CU-Boulder is third in the nation in the amount of environmental research performed. Environmental science is the largest category of federal research and development funding at CU-Boulder, accounting for 37 percent of grant funding. By comparison, the national average is only 5 percent. This emphasis has paid off: INSTAAR and CU-Boulder are leaders in key measures of scientific impact, such as numbers of papers, citations, and research dollars.



Introduction

Research

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INSTAAR raised

17.8 million dollars

in the last two fiscal years to support our research.

We were awarded

138 grants

in that period, with most of our support coming from the National Science Foundation.

More than

3,700 scientific papers

cited INSTAAR research in

2008 alone.

Costa Rica

Deciphering essential cycles. Graduate student Will Wieder (INSTAAR & Ecology & Evolutionary Biology (EBIO)) and field technician Walkom Cambronero establish plots for a soil nitrogen isotope experiment on the Osa Peninsula, Costa Rica. Their team is working to understand the unusually high biological demand for both nitrogen and phosphorus in this area. Photo: Philip Taylor (INSTAAR & EBIO grad student). June 2009.

advancing

interdisciplinary science

INSTAAR has been an interdisciplinary institute since its inception. This tradition of inclusiveness and collaboration has propelled our scientists to the forefront of fields that require a deep understanding of multiple disciplines, including climate change, ecosystems, earth surface processes, and hydrology. Our culture is built around working actively with collaborators in other disciplines, at INSTAAR, on campus, and worldwide. A few examples include:

Sea ice & society

Arctic sea ice reflects heat and moderates global climate. Astrid Ogilvie is leading an international team integrating data from both physical and social sciences to better understand how sea ice has varied over time, with corresponding changes in ocean circulation and impacts on human systems. The team's fusion of historical accounts, archaeological records, ethnography, and climate data will provide an invaluable perspective on how Arctic and global systems respond to continuing declines in sea ice cover.



Arsenic & groundwater

Natural groundwater arsenic concentrations in Bangladesh are 10 times the World Health Organization's limit. Diana Nemergut and Diane McKnight, with graduate students from four universities, are investigating how natural chemical reactions involving dissolved organic matter and microorganisms affect arsenic concentrations in Bangladeshi aquifers. Their research integrates the fields of geochemistry, molecular biology, and ecology in order to better understand the factors affecting arsenic contamination.

Trace gases & snow

Snowpacks are active photochemical environments that can significantly alter the composition of the air above them. Detlev Helmig is leading an international team of scientists and students measuring ozone fluxes on the Greenland ice sheet. The team has developed an ultra-fast monitor to measure ozone in the snow and its exchanges at the snow surface. Using methods from environmental chemistry, meteorology, climatology, and computer modeling, this research will help improve our understanding of future climate change.





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Boulder Creek Critical Zone Observatory

Earth's surface is not a static boundary between rock and the sky. It is a living, breathing, constantly evolving boundary layer that extends from the tops of trees to the deepest groundwater system, an environment so important that a recent National Research Council report dubbed it the Critical Zone. Water and atmospheric gases move through the porous Critical Zone, and living systems thrive in its surface and subsurface environments, shaped over time by biota, geology, and climate.

Boulder Creek Critical Zone Observatory (CZO), based at INSTAAR, is one of six NSF Critical Zone Observatories designed to bring together scientists across disciplines to study the interactions and feedbacks between the hydrosphere, atmosphere, lithosphere, and biosphere. The Boulder Creek CZO uses the natural laboratory of the Colorado Front Range to explore how glacial erosion, canyon downcutting, and ancient mountain-building events interact with biological and geochemical weathering to produce differing subsurface architectures of the Critical Zone.

Colorado

Going critical. Undergraduate researcher Ken Nelson examines a soil and weathered rock profile developed from Boulder Creek granodiorite. Just a few hundred meters away, Boulder Creek is slicing down into fresh granodiorite. Critical Zone development on the hillslopes between this soil and the bedrock in the creek reflect the current balance between erosion and weathering. Photo: Suzanne Anderson (INSTAAR & Geography). August 2008.

forging

new connections

We live in an interconnected world. To understand it, we need cross-disciplinary science that draws on the work of researchers in many fields. Scientists at INSTAAR have a history of building such coalitions that are at the forefront of research on pressing environmental issues. These national and international collaborations magnify the impact of our efforts and frame our work in a larger context. Recent examples include:

National Ecological Observatory Network (NEON)

NEON will be the first observatory network designed to detect and enable forecasting of ecological change at continental scales over multiple decades.

NEON has partitioned the United States into 20 ecoclimatic domains, each containing a core site that represents wildland conditions within the domain. A committee led by Mark Williams and comprised of NEON staff and INSTAAR, CU-Boulder, and other researchers is advising NEON on the design of the Southern Rockies–Colorado Plateau domain and research sites in the NEON network. NEON plans to locate three research sites in proximity to INSTAAR, with the candidate core site located at Niwot Ridge (image at right). Niwot Ridge is the only candidate site to include subalpine and tundra environments, where researchers generally see earlier and more pronounced effects of climate change.



The data collected at NEON sites will focus on how land use change, climate change, and invasive species affect biodiversity, disease ecology, and ecosystem services. Obtaining integrated data on these relationships over a long-term period is crucial to improving forecast models and resource management for environmental change.

Understanding dynamic landscapes. This background image from CSDMS (see story top right) shows the Algodones Dune Field at the junction of California, Arizona, and Mexico. The All-American Canal, the largest irrigation canal in the world, is visible at the bottom of the image. CSDMS models complex landscapes like this one, in which water supply, agriculture, and political borders intersect with natural systems. Photo: James Syvitski (INSTAAR/CSDMS). 2007.

Community Surface Dynamics Modeling System (CSDMS)

Using its new supercomputer cluster, the largest computing facility on the CU-Boulder campus (opening ceremony at right, February 2009), CSDMS members study the dynamic interactions of lithosphere, hydrosphere, cryosphere, and atmosphere at Earth's surface. CSDMS is a virtual home for a vibrant and growing community of international modeling experts. Participating in cross-disciplinary groups, members develop integrated software modules that predict the movement of fluids, sediment, and solutes across landscapes. They share an open library of vetted models, software, and access to high-performance computing. Together, they support the discovery, use, and conservation of natural resources; mitigation of natural hazards; geotechnical support of commercial and infrastructure development; environmental stewardship; and terrestrial surveillance for global security. CSDMS is about glaciers, floods, deltas, coastal erosion, climate impacts, underwater avalanches, tropical reefs, ocean storms, and much more.



Consortium for Capacity Building (CCB)



The Consortium for Capacity Building (CCB) is an educational, outreach, and networking unit focused on enhancing the value and use of climate information for the betterment of humankind. CCB works in both developed and developing countries to help the most vulnerable populations mitigate and adapt to the impacts of a changing climate. CCB is supported by the Rockefeller Foundation and is a Clinton Global Initiative.

Recent CCB activities include convening the First International Undergraduate Conference on Climate, Water, Weather, and Society in Shanghai, China, July 2009 (image at left). The conference is a model for follow-up activities in other countries.

forwarding

graduate education

Students are an integral part of INSTAAR. In both the field and lab, graduate students are at the forefront of research projects, with undergraduates assisting those projects. Although students perform their research at INSTAAR, they enroll in one of our seven partnering departments for their degree program. INSTAAR students and faculty are also involved in interdepartmental graduate programs like Hydrologic Sciences and the Oceanography Certificate.

interdisciplinary
culture

friendly,
supportive
community

INSTAAR is a supportive community for students moving into scientific careers. A mentorship program makes the transition into graduate school easier for new enrollees. Graduate students organize a weekly series of talks to share their research and prepare for conference presentations. They conduct research and outreach projects at many locations around the world, including INSTAAR's Mountain Research Station, located 20 miles west of Boulder.

But students at INSTAAR are just as likely to meet at a weekly tea or rock climbing session as in a laboratory. The friendly community that students form is part of the unique, interdisciplinary culture of INSTAAR.

In the lab.

Graduate student Caroline Alden (INSTAAR & Geological Sciences) prepares a mass spectrometer to measure isotopes of carbon and oxygen from air samples collected worldwide. Alden is combining such isotopic data with information from computer models to help determine causes of year-to-year variability in the global carbon cycle. Photo: Bridget Carey (INSTAAR). October 2009.



Colorado

Our students
performed research on

6 continents
in 2007 and 2008.

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Our students
co-authored more than

60 papers
in scientific journals
during the last two years.

Alaska

In the field. Graduate student Dylan Ward (INSTAAR & Geological Sciences) samples granite in the Kichatna Mountains of Alaska to understand the role of rock type in the development of glacial landscapes. Photo: Peter Haeussler (USGS, Anchorage). September 2008.

connecting

science and society

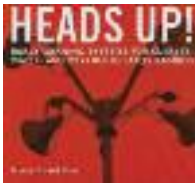
Sharing science can make a difference in the wider world. INSTAAR connects students, policy makers, professionals, and the public to discoveries and ongoing research.



MEDIA

Dialogues with the media help broadcast our research results to wide audiences.

For example, Jim White presents climate research to meteorologists working for television networks, including the Weather Channel, at yearly meetings. Likewise, Giff Miller's work on extinctions was featured in the National Geographic Channel show *Death of the Megabeasts* (at left).



POLICY

Environmental change carries with it policy ramifications. INSTAAR scientists often

engage with and advise legislators, business leaders, and community members on such issues. For instance, Alan Townsend has advised the U.S. House of Representatives Energy and Environment Committee on climate legislation. The Center for Capacity Building has authored three books (one at left) that various United Nations agencies distributed at the 2009 U.N. Climate Change Conference (COP15) in Copenhagen.



EDUCATION

Many INSTAAR projects involve K–12 students.

Recently, Tim Seastedt coordinated hands-on projects for Boulder County middle- and high-school students using insects to manage invasive plants. With three Boulder High seniors (one at left), Sarah Spaulding studied an invasive diatom species (“rock snot”). The students were invited to the prestigious Intel International Science Fair and have a paper in press.

INSTAAR hosted
more than

350 middle-school students

at our annual Open House in 2008 and 2009.

Their excursion included hands-on activities along Boulder Creek, lab tours, talks, and science games. Each year, a team led by William Manley organizes the Open House.

Colorado

Performing creekside science. Middle-school students check out insects collected from Boulder Creek by graduate student Rachel McLoughlin (INSTAAR & Environmental Studies, in white coat). The students were studying aquatic ecosystems during INSTAAR's annual Open House. Photo: Casey Cass (CU-Boulder). April 2008.

you can

make a difference

Support research that can change the way we see and care for the world. Your gift to INSTAAR makes it possible to build our research program, teach students to become tomorrow's scientists, and create new facilities that carry forward critical climate, earth, and environmental research. Large or small, your donation invests in a future that is resilient and sustainable.

Geosciences Building Fund

INSTAAR is leading an effort to build a new laboratory facility that will house university units and federal labs in a collaborative, state-of-the-art setting. Your support will fund a home for INSTAAR with other groups such as the Environmental Studies Program, Department of Atmospheric and Oceanic Sciences, NOAA Paleoclimatology Program, and National Renewable Energy Laboratory. Researchers and students will benefit from the new research directions afforded by working together.

Graduate Student Support Fund

By funding research and travel to field sites and conferences, your gift helps INSTAAR students become well-rounded scientists with significant field, lab, and outreach experience.

INSTAAR Research Fund

Your support is invaluable to funding essential parts of the research process that are difficult to cover using grant funds, such as purchasing key equipment and seeding promising avenues of study.

Director's Discretionary Fund

This fund is for support in the broadest sense, allowing us to meet our most pressing needs as they evolve.

To contribute, visit our web site at <http://instaar.colorado.edu/donate> or contact Robyn Fugett at the CU Foundation, 303-541-1445, robyn.fugett@cufund.org.

Antarctica

Studying extreme environments. Recently graduated Corey Wilson (BA Environmental Studies) measures austral summer discharge of Canada Stream, Antarctica, while working with the McMurdo Dry Valleys Long-Term Ecological Research (MCM LTER) program. As a member of the LTER's "Stream Team," Wilson helped with interdisciplinary studies of hydrology, water quality, biogeochemistry, and aquatic ecology. Photo: Seth Davidson (USGS). December 2008.

performing

research with impact

advancing

interdisciplinary science

forging

new connections

forwarding

graduate education

connecting

science and society

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Institute of Arctic and Alpine Research

Front Cover. **Associate Professor Suzanne Anderson (INSTAAR & Geography) looking at the ice falls of the Root Glacier, Wrangell Mountains, Alaska.** Anderson has studied glacier floods, ice dynamics, and water chemistry of the Kennicott Glacier system, to which the Root Glacier is tributary. Photo: Robert Anderson (INSTAAR & Geological Sciences). July 2006.

The paper stock used for this brochure (Neeah – Environment) has earned certification by the Forest Stewardship Council and is Green Seal Certified, 100 percent post-consumer waste, and made with 100 percent Green-e certified renewable energy.

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450 UCB, University of Colorado
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