



CIRES
2014
annual
report
executive
summary

CIRES is dedicated to fundamental and interdisciplinary research targeted at all aspects of Earth system science and to communicating these findings to the global scientific community, to decision-makers, and to the public.



COOPERATIVE INSTITUTE FOR RESEARCH IN ENVIRONMENTAL SCIENCES



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An ozonesonde balloon pops.

Photo credit: Patrick Cullis/CIRES

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**Cover photo: Boulder, Colorado, and the Continental Divide from 87,000 feet,
captured by a camera attached to an ozonesonde balloon.**

Photo credit: Patrick Cullis/CIRES

executive summary & research highlights



Fiscal year 2014 was my first year as director, taking over the reins from Dr. William Lewis Jr., who ushered CIRES through a time of critical transition. Thanks to his hard work and that of the outstanding administrative staff at CIRES, I stepped into the position with our new Cooperative Agreement successfully secured, and with the knowledge that CIRES was strong, healthy, and well-positioned for continued success. The key to that success has been, and continues to be, the commitment and talent of everyone at CIRES, from our world-renowned scientists to our efficient and committed administrative staff to our students, who will carry the promise and contributions of CIRES well into the future. We continue to make outstanding contributions to society through our support of NOAA's mission, the execution of our educational mission, and our effective communications. Moreover, we continue to leverage the NOAA investment, roughly doubling it with support from a range of sources, adding greater depth and breadth to our impressive research portfolio. During CU-Boulder's fiscal year (July 2013 to June 2014), CIRES researchers had 224 extramural proposals awarded for more than \$82 million, which is about 20 percent of the university's total.

We look forward to building on the successes of the past and rising to the challenges of the future, to advance science, serve society, and develop the next generation of scientists and environmental leaders.

CIRES is a recognized world leader in many facets of environmental research, and this year has seen some substantial recognition of that leadership. One of our scientists, Dr. Peter Molnar, was awarded the very prestigious Crafoord Prize from the Royal Swedish Academy. Another, Dr. José-Luis Jiménez, was awarded the Ascent Award by the American Geophysical Union, and was recognized this year as the fifth most cited scientist worldwide over the last 10 years, according to Thompson Reuters, in both the geosciences and engineering. Thompson Reuters lists three other CIRES Fellows (Drs. Noah Fierer, Mark Serreze, and Rainer Volkamer) and a former Fellow (Dr. Russ Monson) among the most cited researchers in their fields.

The future continues to look bright at CIRES, as we look to build on our achievements. The University of Colorado has invested substantially in state-of-the-art chemistry facilities in Dr. Jiménez' laboratory, providing capabilities that exist in only a few other places in the world. The movement of the Western Water Assessment (WWA) to the main campus and the appointment of Dr. Lisa Dilling, CIRES Fellow and Environmental Studies Assistant Professor, as director will strengthen the ties of WWA to the university, and continue to build a bridge between CIRES research and the broader community. Finally, we will continue to develop our Energy and

Environment Initiative, working with and complementing the work of the Renewable and Sustainable Energy Institute (RASEI) to apply our capabilities in environmental research to some of society's biggest challenges.

In my inaugural year as CIRES director, the achievements and dedication of our scientists, staff, and students have continually reinforced in my mind what a great institution CIRES is. We look forward to

building on the successes of the past and rising to the challenges of the future, to advance science, serve society, and develop the next generation of scientists and environmental leaders.

A handwritten signature in blue ink, appearing to read 'Waleed Abdalati', written over a white rectangular background.

Dr. Waleed Abdalati

CIRES: Science in Service to Society

CIRES—the Cooperative Institute for Research in Environmental Sciences—is a partnership of NOAA and the University of Colorado Boulder. We are an international leader in research that addresses the pressing challenges facing our planet and people. Many of these challenges are priorities for NOAA: adapting to and mitigating climate change, for example, and conducting research that supports a weather-ready nation. Since its inception more than 45 years ago as NOAA's first cooperative institute, CIRES has been helping NOAA meet these and other strategic goals, by hiring and supporting some of the best and brightest Earth scientists and students.

Our researchers use both time-honored and cutting-edge approaches to study diverse aspects of Earth system science, with a focus on research that NOAA's Research Council terms "use-inspired." That is, CIRES science seeks to improve fundamental understanding of the changing world and to produce applications that are useful and used by decision-makers. A key part of our work is to share our findings with others.

Here, we highlight a few of the past

year's activities and successes as they align with NOAA's priorities: the overarching goals and enterprise objectives outlined in NOAA's Next Generation Strategic Plan.

Climate Adaptation and Mitigation Goal CIRES researchers:

- conducted and published collaborative research showing that every degree Fahrenheit of warming in Salt Lake City could mean a 1.8 to 6.5 percent drop in the annual flow of streams that provide water to the city. This research received a great deal of national media attention.
- worked with NOAA colleagues to continually monitor the concentrations of carbon dioxide and other long-lived greenhouse gases in Earth's atmosphere. In 2013, the combined warming effects of these gases was up by 34 percent above 1990 values. This work earned a team of NOAA and CIRES scientists, led by NOAA's Dr. Pieter Tans, a Governor's Award for High-Impact Research in Colorado.
- published collaborative research quantifying the atmospheric impacts of oil and gas exploration, production, and use in several regions of the United States (in Utah, Colorado, California, and Texas) and across the country as a whole.
- developed several experimental tools to make climate data more accessible, including the Climate Change Web Portal, to help users assess data on climate extremes. Some of this work earned CIRES scientist Cathy Smith a "special award" from the American Meteorological Society.
- studied the movement and transformations of natural and anthropogenic emissions in the U.S. Southeast, to gain insight into air quality, haziness, and climate change as part of a multi-agency focus on the region during the summer of 2013. One CIRES scientist involved in this effort, José-Luis Jiménez, won an American Geophysical Union Ascent award in 2013, and he is one of the world's most highly cited researchers in geosciences and engineering.
- published work showing that surface meltwater draining through cracks in an ice sheet can warm the sheet



Photo credit: Zhibin Yu/CIRES



Photo credit: Chris Gray/CIRES

from the inside, softening the ice and causing it to flow faster.

Weather-Ready Nation Goal

CIRES scientists:

- showed that better observations of wind speed and other meteorological parameters can improve wind forecasts for wind-energy producers.
- worked with colleagues to study and publish work evaluating the roles of weather patterns and climate change and variability on extreme weather events such as surface-wide melting on the Greenland Ice Sheet in 2012.
- investigated and published on the causes for surface water stress in every watershed in the contiguous United States.
- in collaboration with the Federal Aviation Administration, made significant improvements in the analysis of weather forecasts for aviation, including icing and turbulence.
- innovated use of a sophisticated lidar system to characterize the distribution and transport of ozone and greenhouse-gas emissions during air quality- and climate-re-

lated missions in Utah, Nevada, Texas, and Indiana.

Engagement Enterprise

CIRES researchers:

- worked with NOAA and other colleagues on the Science On a Sphere® (SOS) team to achieve the 100th SOS installation, suspending the 6-foot-diameter sphere from the ceiling in NOAA's Silver Spring, Maryland, headquarters. The SOS team also held its first annual teachers workshop, showing how it can be used to support state and national curricula.
- worked with colleagues on Colorado's Water Conservation Board to prepare a report on the current and projected future state of climate change in Colorado, and impacts on water resources.
- made available to the science community and the public new data sets that provide estimates of Arctic sea ice extent and concentration from 1901 to 1956. These were created from a collection of historic, hand-drawn sea ice charts from the Danish Meteorological Institute.
- worked with others on the Meteo-

rological Assimilation Data Ingest System (MADIS) team to add more than 200 new data users and service more than 1 million data requests a day. MADIS—which collects, integrates, quality controls, and distributes weather observations from NOAA and non-NOAA organizations—is already widely available, and is scheduled to go operational at NOAA's National Centers for Environmental Prediction (NCEP) in 2015.

Science and Technology Enterprise

CIRES scientists:

- completed the transition of a weather model, the once-experimental Rapid Refresh (RAP), into operations at NCEP on February 25, 2014. This model accurately simulated the 2012 derecho event that hit the Washington, D.C., area. Now available in weather forecast offices around the country, the model improves forecasts for severe events such as storms, floods, tornadoes, aircraft-relevant turbulence, and more.
- worked collaboratively with colleagues in the NOAA National



Photo credit: David Mencin/CIRES



Photo credit: Allen Pope/CIRES

Geophysical Data Center to improve public and scientific access to large data sets. New software, developed within the Agile framework, improves data extraction and analysis. It has also allowed for better management of undersea data critical to determining new boundaries for the U.S. Extended Continental Shelf.

- developed new ways to calibrate and process magnetic field data from the Defense Meteorological Satellite Program satellites. These data will be used in the planned 2015 release of an updated World Magnetic Model (WMM). That model is critical not only for navigation (WMM is on most mobile phone GPS systems), but it will also help inform research into Earth's core processes.
- continued to work closely with colleagues on tools to improve the reliability, resilience, and usability of NOAA's high-performance computing systems.

Informally, CIRES researchers also support two other NOAA goals: Resilient Coastal Communities and Economies,

and Healthy Oceans. CIRES researchers in NOAA develop and deploy instruments to identify and study phytoplankton blooms in coastal areas. They develop and make accessible detailed digital elevation maps, under the auspices of the NOAA Science and Technology Enterprise. But these detailed maps also help tsunami modelers and emergency planners who want to know likely flooding patterns associated with storm surges. NOAA fisheries managers now use CIRES-developed climate-modeling assessment tools.

In institute news, CIRES maintained a strong financial posture, with expenditures of about \$66 million. The institute's financial health is supported by diverse funding sources beyond NOAA and the University of Colorado Boulder: These include NASA, the National Science Foundation, the Department of Defense, Department of Energy, and more (see Funding breakdown by source, page 8).

During June 2013 to May 2014, CIRES was comprised of 790 people (see table above for breakdown). Our researchers published more than 600 peer-reviewed papers, earned numerous honors and

The CIRES Team FY2014

Faculty Lines	18
Research Scientists	207
Associate Scientists	276
Visiting Scientists	32
Postdoctoral Researchers	37
Administrative Staff	33
Graduate Students	111
Undergraduate Students	76

awards, and were profiled in local, national, and international news outlets. All three measures of success speak to the eminence of CIRES researchers in their fields and are described in greater detail in the full CIRES annual report.

July 1, 2013, following election by the Council of Fellows, Waleed Abdalati became the director of CIRES. Dr. Abdalati is a professor in the CU-Boulder Geography Department, has been a CIRES Fellow since 2008, and served as NASA's chief scientist in 2011 and 2012.



In the CIRES biennial photo contest, researchers share their photos from across the globe. In this executive summary, we show photos from (left to right, starting on page 2): Arrival Heights, Antarctica; NOAA tall tower near Erie, Colorado; a hydrothermal site in Yellowstone National Park, Wyoming; and the Juneau Icefield, Alaska (last two images).

Photo credit: Allen Pope/CIRES

this is CIRES

our mission:

CIRES is dedicated to fundamental and interdisciplinary research targeted at all aspects of Earth system science and to communicating these findings to the global scientific community, to decision-makers, and to the public.

The Cooperative Institute for Research in Environmental Sciences (CIRES) was established in 1967 to facilitate collaboration between the University of Colorado Boulder and the National Oceanic and Atmospheric Administration (NOAA). CIRES' original and continuing purpose is to support NOAA's mission by facilitating research that crosscuts traditional scientific fields. By bringing scientists from CU-Boulder departments (at right) and NOAA groups (at right) together into a network of CIRES divisions, centers, and programs (far right), CIRES researchers can explore all aspects of the Earth system. These partnerships foster innovation, rapid-response capabilities, and an interdisciplinary approach to complex environmental challenges. The work of the CIRES enterprise strengthens the scientific foundation upon which NOAA's environmental intelligence services depend, and allows coordinated studies on a scale that could not be addressed by university research units or NOAA alone.

Collaborative Structure University of Colorado Boulder Departments

- Aerospace Engineering Sciences
- Atmospheric and Oceanic Sciences
- Chemistry and Biochemistry
- Civil, Environmental, and Architectural Engineering
- Ecology and Evolutionary Biology
- Electrical and Computer Engineering
- Geography
- Geological Sciences
- Molecular, Cellular, and Developmental Biology
- Physics
- Environmental Studies Program

NOAA Earth System Research Laboratory (ESRL)

- Chemical Sciences Division
- Global Monitoring Division
- Global Systems Division
- NOAA Environmental Software Infrastructure and Interoperability group
- Physical Sciences Division

NOAA Centers

- National Geophysical Data Center
- Space Weather Prediction Center

CIRES Structure

The CIRES research enterprise is organized into six divisions, four centers, and other programs, all described in more detail in our full annual report.

Divisions

- Cryospheric and Polar Processes
- Ecosystem Science
- Environmental Chemistry
- Environmental Observations, Modeling, and Forecasting
- Solid Earth Sciences
- Weather and Climate Dynamics

Centers & Programs

- Center for Limnology
- Center for Science and Technology Policy Research
- Earth Science and Observation Center
- National Snow and Ice Data Center
- Western Water Assessment
- Education and Outreach

Other Programs

- Visiting Fellows
- Innovative Research Program
- Graduate Student Research Fellowships
- Diversity and Undergraduate programs
- Awards
- Events
- Communications



Photo credit: CU-Boulder



Photo credit: Will von Dauster/NOAA



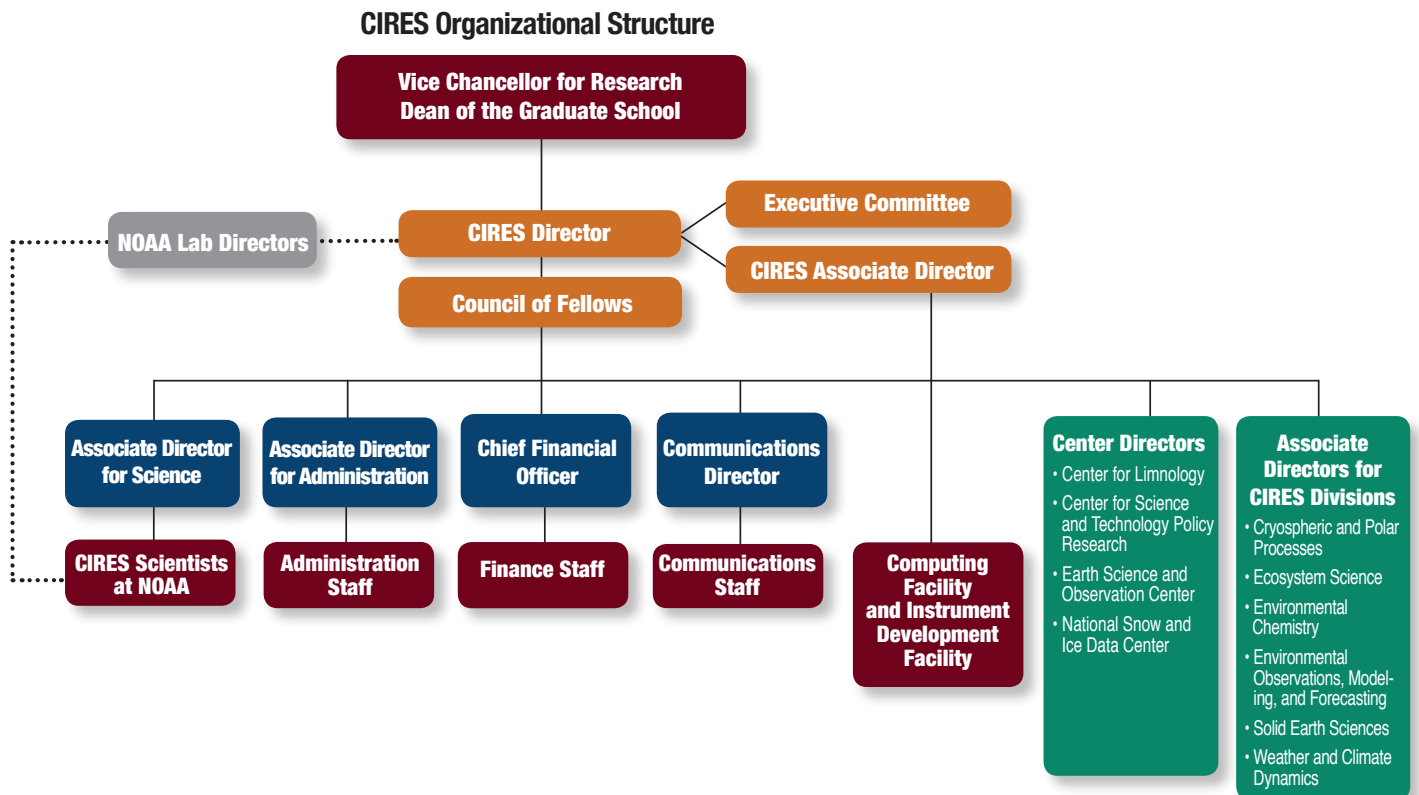
Photo credit: David Oonk/CIRES

governance, management, and organization

CIREs is governed and managed through its Council of Fellows and Executive Committee, with guidance by the CIREs Members' Council. The CIREs Centers—the Center for Limnology, the Center

for Science and Technology Policy Research, the Earth Science and Observation Center, and the National Snow and Ice Data Center—and our other programs link NOAA to 11 university departments. Coordination

among all these entities is facilitated through the CIREs administration. During the University of Colorado Boulder's FY14, Waleed Abdalati led CIREs as director.



Council of Fellows

The Council of Fellows constitutes the “Board of Directors” and chief governing body of CIREs. It is comprised of individuals with an outstanding record of achievement and ability in diverse areas of environmental sciences. They are university faculty, senior research scientists, and government scientists who form the core leadership of the institute.

Diversity Committee

CIREs is committed to enhancing diversity by extending its community and knowledge across the full spectrum of cultures and backgrounds. The Diversity Committee works with CIREs’ Education

and Outreach program, the Communications group, the administration, and scientists and staff to identify programs, mentorships, and other opportunities for CIREs to foster diversity and enrich our professional community.

Members’ Council

The CIREs Members’ Council, created in 1997, serves as an information and policy conduit between institute members and CIREs leadership. At meetings, the Council hears members’ inquiries and concerns, discusses and develops potential solutions to outstanding issues, and works directly with CIREs leadership to implement these solutions. The Members’ Council

performs regular service to the institute by, for example, sponsoring the annual CIREs Rendezvous science symposium, the CIREs Outstanding Performance Awards program, and the CIREs Bike Share program.

Other CIREs Committees

- Distinguished Lecture Committee
- Executive Committee
- Fellows Appointment Committee
- Graduate Student Research Fellowship Committee
- Innovative Research Program Committee
- Visiting Fellows Committee

Council of Fellows (June 1, 2013, to May 31, 2014)

Waleed Abdalati CIRES Director; Professor of Geography; Director of the Earth Science and Observation Center

Richard Armstrong CIRES Senior Research Scientist in the National Snow and Ice Data Center (NSIDC); Associate Director for the Cryospheric and Polar Processes Division

Stan Benjamin Chief of Assimilation and Modeling Branch, NOAA ESRL Global Systems Division

Roger Bilham Professor of Geological Sciences

Maxwell Boykoff Assistant Professor of Environmental Studies

John Cassano Associate Professor of Atmospheric and Oceanic Sciences

Thomas Chase CIRES Senior Research Scientist

Xinzhao Chu Associate Professor of Aerospace Engineering

Shelley Copley Professor of Molecular, Cellular, and Developmental Biology

Joost de Gouw CIRES Senior Research Scientist, NOAA ESRL Chemical Sciences Division (CSD)

Lisa Dilling Assistant Professor of Environmental Studies

Randall Dole Deputy Director for Research, NOAA ESRL Physical Sciences Division (PSD); Associate Director for the Weather and Climate Dynamics Division

David Fahey Research Physicist and Program Lead, Atmospheric Composition and Chemical Processes; Senior Scientist and Acting Director, NOAA ESRL CSD

Christopher Fairall Chief of the Weather and Climate Physics Branch, NOAA ESRL PSD

Lang Farmer Professor and Department Chair of Geological Sciences

Fred Fehsenfeld CIRES Senior Research Scientist, NOAA ESRL CSD; Co-Associate Director for the Environmental Chemistry Division

Graham Feingold Research Scientist, NOAA ESRL CSD

Noah Fierer Associate Professor of Ecology and Evolutionary Biology

Timothy Fuller-Rowell CIRES Senior Research Scientist, NOAA Space Weather Prediction Center

R. Michael Hardesty Associate Director for the Environmental Observations, Modeling, and Forecasting Division; NOAA ESRL CSD

José-Luis Jiménez Associate Professor of Chemistry and Biochemistry

Craig Jones Associate Professor of Geological Sciences

Jen Kay Assistant Professor, Atmospheric and Ocean Studies

William M. Lewis Jr. Professor of Ecology and Evolutionary Biology; Director of the Center for Limnology; Associate Director of CIRES

Peter Molnar Professor of Geological Sciences

Steve Montzka Research Chemist, NOAA ESRL Global Monitoring Division

William Neff Senior Scientist and Director of NOAA ESRL PSD

Steven Nerem Professor of Aerospace Engineering

David Noone Associate Professor of Atmospheric and Oceanic Sciences

Judith Perlwitz CIRES Research Scientist, NOAA ESRL PSD

Roger Pielke Jr. Professor of Environmental Studies, Director of the Center for Science and Technology Policy Research

Balaji Rajagopalan Professor of Civil, Environmental, and Architectural Engineering

F. Martin Ralph Research Meteorologist and Chief of the Water Cycle Branch, NOAA ESRL PSD

Prashant Sardeshmukh CIRES Senior Research Scientist, NOAA ESRL PSD

Mark Serreze Professor of Geography; Director of the National Snow and Ice Data Center (NSIDC)

Anne Sheehan Professor of Geological Sciences; Associate Director for the Solid Earth Sciences Division

Robert Sievers Professor of Chemistry and Biochemistry; Director of the CU-Boulder Environmental Program

Margaret Tolbert Distinguished Professor of Chemistry and Biochemistry; Co-Associate Director for the Environmental Chemistry Division

Greg Tucker Associate Professor of Geological Sciences

Veronica Vaida Professor of Chemistry and Biochemistry

Rainer Volkamer Assistant Professor of Chemistry and Biochemistry

Carol Wessman Professor of Ecology and Evolutionary Biology; Associate Director for the Ecosystem Science Division

Paul Ziemann Professor of Chemistry and Biochemistry

Finance

CIREs continued to grow during the university fiscal year of July 1, 2013, to June 30, 2014, with total expenditures of more than \$66 million, not including the university portion (chart 1). The university's monetary contribution to CIREs primarily covers faculty salaries, and it fluctuates from year to year due to changes in our rostered university faculty appointments.

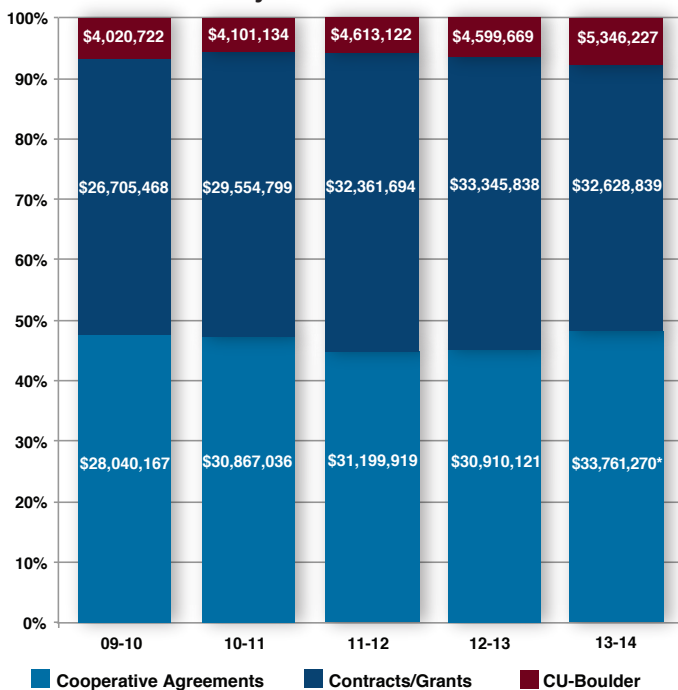
CIREs researchers continue to enjoy success in obtaining external research awards (45 percent of total expenses). To the right of chart 1, we provide a breakdown of contracts and grants by funding agency. Agreement expenditures by task for the

reporting period (June 1, 2013, to May 31, 2014) are shown in chart 2. As of May 31, 2014, NOAA provided \$40,708,924 for the preceding 12 months of our Cooperative Agreement NA12OAR4320137. Task I funding is for CIREs administration and internal scientific programs, such as the Visiting Fellows and Graduate Student Fellowship programs; Task II funds CIREs' collaboration with NOAA's Earth System Research Laboratory, the National Geophysical Data Center, and the Space Weather Prediction Center, all in Boulder, Colorado. Task III funds support individual university investigators who conduct stand-alone projects, under the umbrella

of our Cooperative Agreement, at NOAA's request.

To the right of chart 2, we provide a breakdown of Task I expenditures from June 1, 2013, to May 31, 2014. The largest share (57 percent) of Task I base funds supports CIREs administration, primarily salaries and benefits for the administrative staff. The Visiting Fellows program received 14 percent of Task I base fund support from June 1, 2013, to May 31, 2014, and is subsidized by other institute funding as well. Task I also provides partial support of CIREs' Education and Outreach program, other research support, and the physical plant facilities.

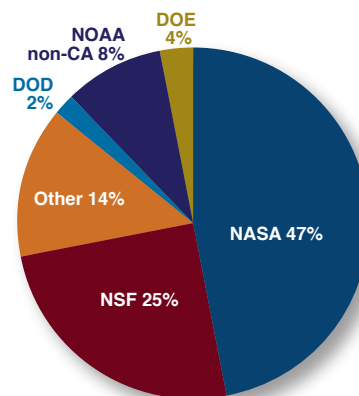
**1. CIREs expenditures by funding source
July 2013 to June 2014**



* Please note that NOAA expenditures this year (the light-blue bar) include funds from both our current and old cooperative agreements, NA12OAR4320137 and NA10OAR4320142.

**Please note that this pie chart depicts funding, not expenditures.

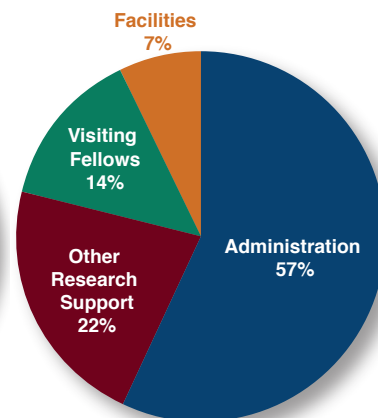
Funding breakdown by source**



**2. Agreement expenditures by Task
June 2013 to May 2014**



Breakdown of Task I expenditures



awards and events

CIREs researchers at NOAA and on the University of Colorado Boulder campus earn so many awards every year, it is challenging to list them all. A few highlights are below, and a more comprehensive list can be found in the full CIREs Annual Report.



Peter Molnar

This year's most notable award was the Crafoord Prize, awarded to CIREs Fellow **Peter Molnar**. The Royal Swedish Academy of Sciences—which also awards Nobel Prizes—confers this geophysics prize only once every four years. In January, Molnar won the Crafoord for his contributions to understanding global plate tectonics, including the deformation of continents and the structure and evolution of

mountain ranges, and his research on the impact of tectonic processes on ocean-atmosphere circulation and climate. Other award highlights include:

- **Ligia Bernardet, Yelena Pichugina, and Carsten Warneke:** CIREs Outstanding Performance Awards in Science and Engineering for outstanding leadership to the Hurricane Task of the Developmental Testbed Center (Bernardet), for groundbreaking research relevant to the wind energy industry (Pichugina), and for coordinating and leading a major field study and work to understand the roles of volatile organic compounds in the atmosphere (Warneke).

- **Patrick Cullis, Jennifer Jencks and Brian Meyer, and Linda Pendergrass:** CIREs Outstanding Performance Awards in Service for stunning training and outreach videos (Cullis), for innovative ideas and outstanding teamwork that resulted in the creation of a Web

interface providing easy access to 30-plus years of foundational marine research data (Jencks and Meyer), and superb work planning, coordinating, and managing the many events hosted by CIREs (Pendergrass).

- **Betsy Andrews, Derek Hageman, and Anne Jefferson:** CIREs Silver Medal. In collaboration with NOAA GMD colleagues, these CIREs scientists were part of a NOAA Silver Medal team lauded “for establishing an international, cooperative network to make coordinated, long-term measurements of aerosol climate-forcing properties.”

- **Jennifer Jencks:** CIREs Bronze Medal. In collaboration with NOAA NGDC colleagues, Jencks was part of a NOAA Bronze Medal team lauded “for superior leadership and interagency collaboration in creating the comprehensive digital information publication “Gulf of Mexico Data Atlas.”

CIREs hosts diverse symposiums, seminars, workshops, and other events throughout the year. This year, one highlight was a Distinguished Lecture by **Pamela Matson** from Stanford University, who spoke about “A new form of global change science: Science for a sustainability transition,” in April 2014. And during our annual Rendezvous science symposium, more than 100 scientists presented research posters. The following are just a few more of the dozens of seminars, research presentations, workshops, panels, and conferences CIREs hosted or sponsored:

- **Margaret Tolbert** Deliquescence of calcium perchlorate: A route to liquid water on Mars and other possibly habitable planets

- **Amy Quandt, Arielle Tozier de la Poterie, and Kanmani Venkateswaran** Climate change communication and adaptation decision-making in the humanitarian sector in East Africa—three cases

- **Kristopher Karnauskas** An undercurrent of change in the Pacific: Climate dynamics with ecosystem impacts

- **Andrew Revkin** An evening of conver-

sation and music with ‘climate communicator’ Andrew Revkin

- **Robert Sievers Group** studies of needle-free delivery of dry powder aerosol vaccines and pharmaceuticals

- **José-Luis Jiménez** Instrument and technique development, field studies, and computer modeling to elucidate organic aerosol sources, properties, processes, and fate

- **A.L. Ramanathan** Jawaharal Nehru University research activities and results from studies on Himalayan glaciers of India over the past decade

- **Bjorn-Ola Linner** International negotiations survey: Exploring possible avenues for climate diplomacy

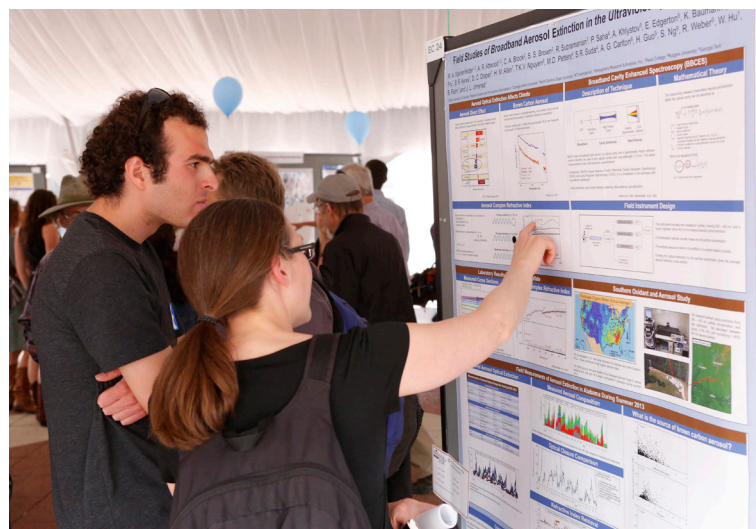
- **Saffron O’Neill** Place attachment, performance and climate change adaptation

- **Joost de Gouw** Organic carbon in a changing atmosphere: How our energy choices affect air quality

and climate change

- **Kristy Tiampo** Advanced DInSAR analysis of natural and anthropogenic hazards

- **Nolan Doesken, Kelly Mahoney, Klaus Wolter, Martin Hoerling, and Jeff Lukas** Western Water Assessment Front Range Flood Panel



2014 Rendezvous science symposium poster session.

Photo credit: David Oonk/CIREs



COOPERATIVE INSTITUTE FOR RESEARCH IN ENVIRONMENTAL SCIENCES