COOPERATIVE INSTITUTE FOR RESEARCH IN ENVIRONMENTAL SCIENCES

CIRES

2015 annual report executive summary

executive summary & research highlights

From the Director

Fiscal Year 2015 was another very strong year for CIRES, marked with a number of outstanding achievements, both in scientific research and in support of the NOAA mission. The commitment and talent of our world-renowned scientists, dedicated administrative staff, outstanding students and all the other members of CIRES have continued to ensure that CIRES' contributions to science, society and the university are something we should all be proud of. With awards of nearly $80M in FY 2015, CIRES funding once again comprised nearly a fifth of the University of Colorado Boulder's research funding. Nearly half (46%, $36.4M) of this amount was from our cooperative agreement with NOAA—our core support base—and we continued to leverage this investment and the support from the university to secure $38M in additional funding from a diverse array of other sources. Among these were NASA, the National Science Foundation, the Department of Defense, and the Department of Energy. With support from these and other sources, CIRES scientists published nearly 700 journal articles across the full spectrum of environmental disciplines in many of the world's most prestigious publications. We have played a critical role in the university's educational mission through our 18 faculty and our 176 undergraduate and graduate students in a wide range of departments across campus.

CIRES' record of outstanding research achievements, funding success, and educational contributions have contributed significantly to the University of Colorado Boulder's stellar ranking as the #2 university in the world for Geosciences (U.S. News & World Report).

Just as we are proud of our achievements in research and education, we are also proud to be valued partners in the execution of NOAA's mission. With 340 scientists and science support personnel located at the David Skaggs Research Center, and dozens more on campus conducting NOAA-related research, we are an integral part of the important work being done at NOAA's Earth System Research Laboratory, Space Weather Prediction Center and the National Centers for Environmental Information. The success of these partnerships is evident in the numerous publications co-authored by CIRES and NOAA personnel and various awards from NOAA and the Department of Commerce recognizing the outstanding achievements realized by NOAA/CIRES teams. Among these were the Silver and Bronze Medals awarded by the Department of Commerce, as well as a NOAA Technology Transfer Award. In addition, a team of more than 60 NOAA and CIRES scientists was honored with the COLABS/

David Oonk/CIRES

Governor's High Impact Award for their work seeking to understand the atmospheric impacts of rapidly expanding oil and gas development.

Looking to the future, CIRES researchers in NOAA's Earth System Research Laboratory are playing a significant role in ESRL's strategic planning, led by ESRL Director Sandy MacDonald and with his invitation. Of about 35 lead participants in that effort, 15 are CIRES scientists who work in the ESRL laboratories, roughly reflecting the makeup of ESRL. On main campus, we are excited to welcome four new CIRES fellows this year with expertise in hydrology, chemistry, geology and oceanography. All are leaders among their peers and will no doubt make significant contributions to CIRES and its mission.

From deep within the Earth to the top of the atmosphere and beyond, CIRES continues to explore and understand the world in which we live, often turning those discoveries into useful and actionable information that ultimately improves our relationship with our environment. We advance science, and we improve lives, and it truly is a privilege to lead such an accomplished and valuable organization doing such important work.

Waleed Abdalati
CIRES Director

Cover photo: Mt. Cook in the Southern Alps, West Coast of New Zealand's South Island Birgit Hassler, CIRES/NOAA

Research colleagues plan the day's radar surveys on Scott Glacier, Cordova, Alaska, March 2013.
Dan McGrath/CIRES

CIRES: Science in Service to Society

CIRES—the Cooperative Institute for Research in Environmental Sciences—is an international leader in research that addresses some of the most 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, and leveraging NOAA investments with partnerships and funding from other institutions around the world. Our researchers use time-honored and cutting-edge approaches to study diverse aspects of Earth system science, with a focus on "use-inspired" research. 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. 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 scientists (often with NOAA and other colleagues):

- Showed that the Larsen C Ice Shelf in Antarctica is thinning from both above and below: Through warmer air temperatures and surface melting, and because of warmer ocean waters or shifting currents.
- Updated NOAA's 2014 Annual Greenhouse Gas Index, which indicates that the warming influence from human-emitted gases continues to increase, up 34 percent since the index year of 1990.
- Led and coordinated the international effort to produce the quadrennial *2014 Ozone Assessment, including the Assessment for Decision Makers*, for the United Nations and World Meteorological Organization.
- Used a 3D printer to efficiently and inexpensively produce components of a particle spectrometer—to measure aerosol size and distribution in the atmosphere. CIRES researchers deployed the Printed Optical Particle Spectrometer on a tall tower, two unmanned aircraft, and a high-altitude balloon.
- Investigated the role of El Niño-Southern Oscillation in extreme precipitation events, finding evidence that strong El Niños increase the frequency of winter-to-early-spring heavy rain events over the upper Missouri River Basin and in parts of Texas (east and northeast).
- Used models and observations to assess the role of climate change in California drought risk. Both show California getting hotter and wetter, a combination that has likely decreased the risk of agricultural drought in the state to date. However, future changes could shift the balance to more drought by the late 21st Century.

Lightning strike over Broomfield, Colorado. Ben Castellani/CIRES

Weather-Ready Nation Goal

CIRES scientists (often with NOAA and other colleagues):

- Completed developing and operationalizing the High-Resolution Rapid Refresh weather model, which improves forecasts of severe weather. Five federal employees in the ESRL Global Systems Division team earned a Department of Commerce Gold Medal for this achievement in 2015, and their nine CIRES colleagues will be recognized with a CIRES Gold in May 2016.
- Evaluated several weather products important to the aviation community, including: Current Icing Potential and Forecast Icing Potential versions 1.1; Icing Product Alaska; and Graphical Turbulence Guidance version 3.
- Conducted the Lidar Uncertainty Measurement Experiment (LUMEX) to compare the observations of newly available wind lidars, with unknown error characteristics. Wind lidars, which can determine the speed and direction of winds in the atmosphere, are critical in atmospheric science and increasingly to industry.
- Were integral to several multi-agency studies designed to help decision makers better understand the origins of air quality challenges in several regions of the country: SONGNEX in the U.S. West; WINTER from the Ohio River Valley east and south to the East and Southeast costs; and DISCOVER-AQ and FRAPPE here in Colorado's Front Range. This work earned a team of 64 NOAA and CIRES scientists a 2014 Governor's Award for High-Impact Research, given by COLABS.
- Improved community access to and use of the Hurricane Weather Research and Forecast model and the Gridpoint Statistical Interpolator, which are important in NOAA operations and in the weather research and development community.
- Diagnosed factors responsible for heavy daily precipitation events observed between 1979 and 2013 in the United States, finding evidence that sea surface temperature patterns linked to internal decadal ocean variability play a more important role than increased external radiative forcing.

Engagement Enterprise

CIRES scientists (often with NOAA and other colleagues):

- Brought MADIS, the Meteorological Assimilation Data Ingest System, into operations at the National Centers for Environmental Prediction. MADIS ingests new weather data into a quality-controlled, organized system, making it accessible for weather forecasting, forecasters and the public.
- Completed a prototype Hazard Services program in the Advanced Weather Interactive Processing System II and began preparing it for operations in 2015. Hazard Services combines and improves on three applications currently used

Sampling for airborne microbes in a Boulder basement.
David Oonk/CIRES

Graduate students set up a seismometer in Greeley, Colorado.
David Oonk/CIRES

to generate various hazardous weather watches, warnings, and advisories.
- Installed the illuminated and illuminating Science on a Sphere® (SOS) at sites in six additional countries, bringing the total countries represented to 22 and total installations to well over 100. CIRES continued to work with SOS users, leading teachers' workshops and unveiling a flatscreen version of SOS for the classroom.

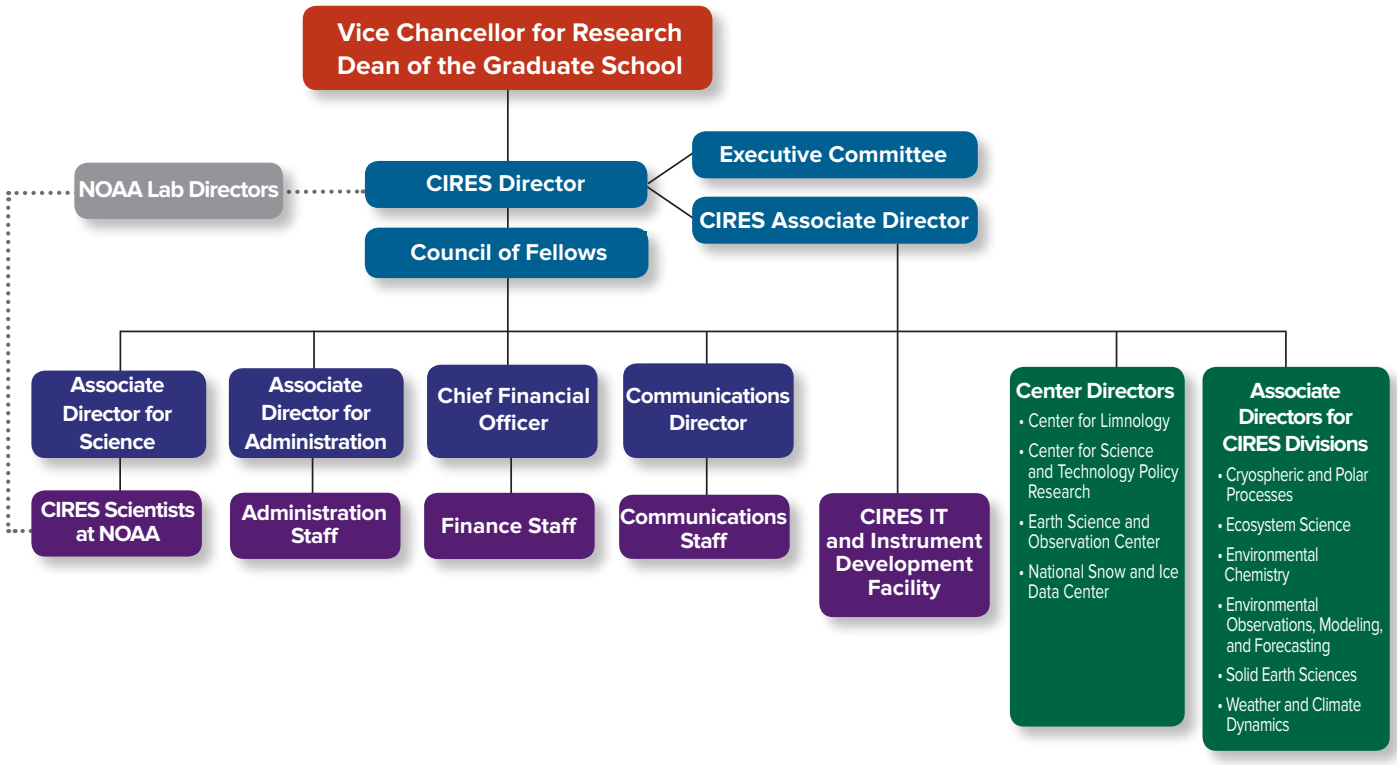
Science and Technology Enterprise

CIRES scientists (often with NOAA and other colleagues):
- Supported NOAA's High Performance Computing team, including acquiring a new system to deal with the intense computational needs of NOAA's Hurricane Forecast Improvement Project.
- Released a new version of the World Magnetic Model (WMM), valid from 2015 to 2019. The WMM is the standard model for navigation, attitude, and heading systems used by several civilian and military organizations, including the U.S. Department of Defense, the U.K. Ministry of Defense, and the North Atlantic Treaty Organization.
- Developed, tested, and maintain software to support the Deep Space Climate Observatory (DSCOVR) satellite, which was launched February 11, 2015, and will deliver key space weather data to the NOAA Space Weather Prediction Center, the nation's official source of watches, alerts and warnings about potentially damaging space weather.
- Helped develop algorithms to turn nighttime lights data from the satellite-based VIIRS instrument (Visible Infrared Imaging Radiometer Suite) into useful information for researchers and regulators. A new boat detection algorithm identifies brightly lit fishing boats; another helps researchers estimate flared gas volumes.
- Developed five new digital elevation models (DEMs) and updated four others in support of NOAA's Tsunami Program and the National Tsunami Hazard Mitigation Program. Updating existing DEMs with recently collected high-resolution lidar-based elevation data improves the accuracy of the models, resulting in better forecasts and warnings for coastal hazards.

Organization

CIRES is governed and managed through its Council of Fellows and Executive Committee, with input from 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 nine university departments. Coordination among all these entities is facilitated through the CIRES administration. During the University of Colorado Boulder's FY15, Waleed Abdalati led CIRES as director.

CIRES Organizational Structure



The CIRES Team FY2015

Faculty Lines	18
Research Scientists	246
Associate Scientists	272
Visiting Scientists	21
Postdoctoral Researchers	22
Administrative Staff	35
Graduate Students	93
Undergraduate Students	83

Council of Fellows (June 1, 2014, to May 31, 2015)

The Council of Fellows constitutes the "Board of Directors" and chief governing body of CIRES. Fellows are selected because of their outstanding achievements and abilities in diverse areas of environmental sciences. These university faculty, senior research scientists, and government scientists form the core of our institute. Members of the Council of Fellows provide leadership at all levels in environmental science; maintain an active scientific research and education program; support the CIRES infrastructure through indirect cost recovery and in-kind contributions; participate in CIRES management; and contribute interdisciplinary expertise and participate in collaborative work.

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

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

Stan Benjamin Chief of the 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 Associate 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 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

Jennifer Kay Assistant Professor of 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

Stephen Montzka Research Chemist, NOAA ESRL Global Monitoring Division

William Neff CIRES Senior Research Scientist, NOAA ESRL PSD

R. Steven Nerem Professor of Aerospace Engineering

Judith Perlwitz CIRES Senior 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

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

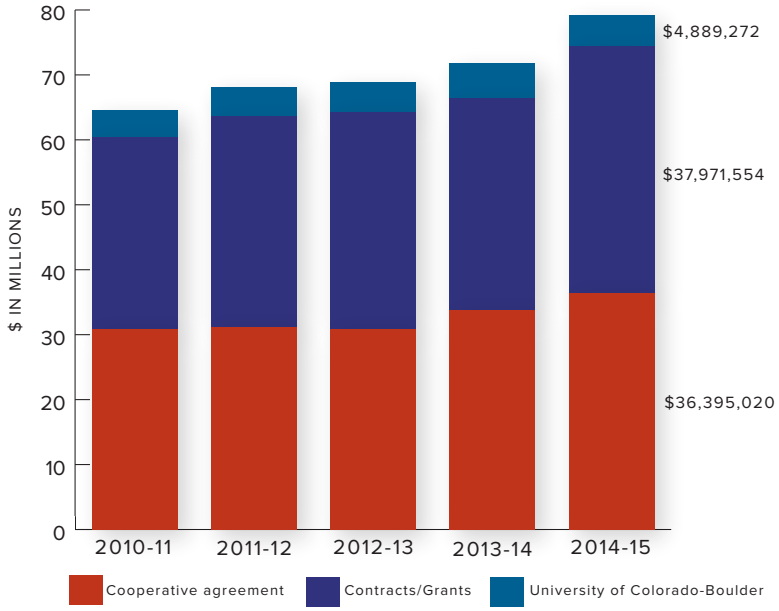
During the university fiscal year, July 1, 2014, to June 30, 2015, CIRES had total expenditures of nearly $80 million (Figure 1).

CIRES researchers enjoy enviable success in obtaining external research awards (48 percent of total expenses). Please see Figure 2 for a breakdown of contracts and grants by funding agency.

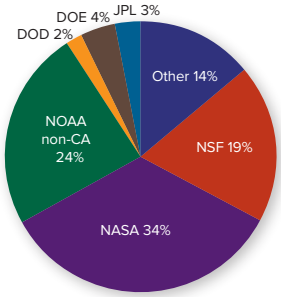
NOAA Cooperative Agreement (NA12OAR4320137) expenditures by task for the reporting period (June 1, 2014 to May 31, 2015) are shown in Figure 3. Task I funding is for CIRES administration and internal scientific programs, such as the Visiting Fellows and Graduate Student Research Award programs; Task II funds CIRES' collaboration with NOAA's Earth System Research Laboratory, the National Geophysical Data Center (now National Centers for Environmental Information), 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.

In graph 4, we provide a breakdown of Task I expenditures from June 1, 2014, to May 31, 2015. The largest share (48 percent) of Task I base funds supports the CIRES administration, primarily salaries and benefits for the administrative staff. Our Visiting Fellows program received 8 percent of Task I base fund support and is subsidized by other institute funding. Task I also provides partial support of CIRES' Education and Outreach program, other research support, and the physical plant facilities.

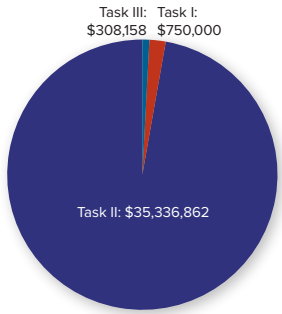
1. CIRES expenditures by funding source
June 2014 to May 2015



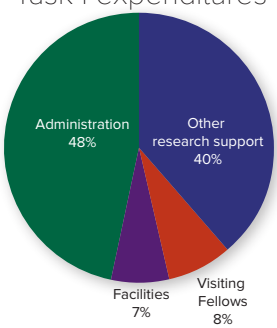
2. Funding breakdown by source



3. Agreement expenditures by Task
June 2014-May 2015



4. Breakdown of Task I expenditures



awards and events

CIRES scientists and staff earn hundreds of awards every year, collectively, from local, regional, national and international scientific organizations. Here, we highlight a few, beginning with our own internal awards program, which recognizes innovative and important science.

CIRES Outstanding Performance Awards

Science and Engineering

Manoj Nair (NGDC/NCEI) for geomagnetic innovations involving tsunami detection, crowd sourcing of Earth's magnetic field, and the World Magnetic Model

Jeff Peischl (CSD) for hisleadership and innovative research measuring and analyzing greenhouse gases

Takanobu Yamaguchi (CSD) for his extraordinary work improving modeling and understanding of aerosol-cloud interactions and climate

Service

Chris Golden (GSD) for innovations instrumental to the success of the Hazard Services application for weather forecasters

Jeff Johnson, Michael Burek, Alysha Reinard, Michele Cash, Tom DeFoor, Richard Grubb, and **Ratina Dodani** (SWPC) for developing, under budget, a robust and fast ground processing system for NOAA's Deep Space Climate Observatory

Ann Weickmann (CSD) for developing innovative software and hardware that enabled great strides in the use of lidar systems for atmospheric science

Waleed Abdalati and Michelle Cash David Oonk/CIRES

CIRES also hosts diverse symposiums, seminars, workshops, and other events throughout the year. This year, two highlights were the 70 Seconds of Science communications challenge, and a particularly successful Distinguished Lecture Serices, which brought four fascinating researchers to campus.

Medals and more

CIRES scientists are often integral to NOAA award-winning science and engineering teams but cannot receive certain federal awards, such as the prestigious Department of Commerce Silver and Bronze Medals. CIRES recognizes their extraordinary achievements with CIRES awards.

Silver

CIRES Silver Medal for scientific/engineering achievement, 2015

Xiao-Wei Quan and **Jon Eischeid**, CIRES scientists in ESRL's Physical Sciences Division, were part of a NOAA team honored with a Department of Commerce Silver Medal for an outstanding scientific assessment of the origins of the 2012 Central Great Plains Drought.

Bronze

CIRES Bronze Medal for superior performance by federal employees, 2015

Shilpi Gupta, Hilary Peddicord, and **Beth Russell,** CIRES staff in ESRL's Global Systems Division, were part of a NOAA team honored with a Department of Commerce Bronze Medal for achieving the 100th worldwide installation of Science On a Sphere®.

Technology Transfer

CIRES Technology Transfer Award, 2015

Anna Karion, Tim Newberger, Colm Sweeney, and **Sonja Wolter**, CIRES staff in NOAA's Global Monitoring Division, worked with NOAA's Pieter Tans to develop AirCore, for collecting air from 100,000 ft. to the surface with exceptional data resolution, and which won a NOAA Technology Transfer Award.

Other state, federal and international awards

Thomas Detmer (CU-Boulder)
Recipient of the the George C. and Joan A. Reid Endowed Scholarship Fund, for intellectual contributions to CIRES and leadership within the broader University of Colorado Boulder community

Cecelia DeLuca, Ben Koziol, Robert Oehmke, Ryan O'Kuinghttons, Matt Rothstein, Gerhard Theurich, and **Silverio Vasquez** (ESRL)
Co-winners of the Federal Laboratory Consortium Tech Transfer Award, for NESII's (NOAA Environmental Software Infrastructure and Interoperability) contributions to climate data analysis tools

G Lang Farmer (CU-Boulder)
2014 Fellow of Geological Society of America

Shari Fox Gearheard (NSIDC)
Shared the biennial 2014 William Mills Prize for best non-fiction Arctic or Antarctic book published in the world, for "The Meaning of Ice"

Anne Gold (Education and Outreach)
CU-Boulder Chancellor's Award for Excellence in STEM

Anne Gold, Amanda Morton, Susan Lynds, David Oonk, Lesley Smith, and **Susan Sullivan** (Education and Outreach)
Part of a broad team that won two 2014 Webby Awards for the Teaching Climate section of the Climate.gov website—in the juried Green category, and the People's Choice award

José-Luis Jiménez (CU-Boulder)
Seventh Most Cited Scientist worldwide in the Geosciences, from Thomson Reuters

José-Luis Jiménez (CU-Boulder) and **Richard McLaughlin, Eric Ray,** and **Nicholas Wagner** (CSD)
NASA Group Achievement Award for outstanding accomplishments, Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys (SEAC4RS)

Anna Karion, John Miller, Eric Moglia, Tim Newberger, Colm Sweeney, and **Sonja Wolter** (GMD)
Part of the Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE) team, which won a NASA Group Achievement Award for successfully conducting sustained airborne science campaigns to characterize carbon dioxide and methane fluxes from permafrost in arctic and boreal Alaska

Peter Hale Molnar (CU-Boulder)
The eminent 2014 Crafoord Prize, awarded in geophysics every four years by the Royal Swedish Academy of Sciences, which also gives Nobel Prizes; the City Council of Boulder, Colorado declared that Tuesday, June 3, 2014, was Peter Molnar Day

Gabrielle Pétron (GMD, with NOAA CSD's Jim Roberts and 63 other scientists in GMD, CSD and PSD)
The Colorado Governor's Award for High-Impact Research, given annually by Colorado Leveraging Assets for Better Science (CO-LABS), for research to understand the atmospheric impacts of rapidly expanding oil and gas development across the West

Balaji Rajagopalan (CU-Boulder)
College Research Award, College of Engineering and Applied Sciences, CU-Boulder

Mark Serreze (CU-Boulder)
2014 Fellow of the American Meteorological Society; 2014 Highly Cited Researcher award from Thompson Reuters, ranking among the top 1 percent of researchers in a specific field (climate science)

Anne Sheehan (CU-Boulder)
2014 Fellow of the American Geophysical Union; and 2014 College Scholar Award, CU-Boulder College of Arts and Sciences

Rainer Volkamer (CU-Boulder)
National Science Foundation Young Investigator (CAREER) award; 2014 Highly Cited Researcher award from Thompson Reuters; 2014 KIT Distinguished International Scientist Award, in recognition of excellence in creative works related to atmospheric chemistry, environmental sustainability and climate

Valery Zavorotny (PSD)
Part of a multi-agency team that won the prestigious 2014 Creativity Prize from the Prince Sultan Bin Abdulaziz International Prize for Water

Peter Hale Molnar, recipient of the 2014 Crafoord Prize, awarded every four years by Royal Swedish Academy of Sciences.
Victoria Henriksson/Royal Swedish Academy of Sciences

A small sample of CIRES seminars and talks

Margaret Tolbert and **Paul Ziemann** A new mechanism for solid formation in the atmosphere: Contact efflorescence; Laboratory studies of the chemistry of secondary organic aerosol formation (9/14)
Shali Mohleji How scientists can engage in the policy process (6/14)
Gesa Luedecke Let's hear from the people: A study on media impact on climate protection and climate adaptation (11/14)
Kritee Kritee Climate smart agriculture in Asia: Measurements, implementation strategy, and challenges (11/14)
Roger Pielke, Jr. Sugar, spice and everything nice: Science and policy of "sex testing" in sport (1/14)
Elizabeth McNie When basic or applied is not enough: Utilizing a typology of research activities and attributes to inform usable science (2/15)
Jordan Kincaid Fracking in Denton, Texas: Who benefits and why was it banned? (4/15)
Alex Crawford A new look at the summer Arctic frontal zone (10/14)
Twila Moon Seasonal ice dynamics on the Greenland Ice Sheet (12/14)
Lewis Brower Sharing indigenous knowledge and concepts of sea ice among indigenous communities, scientists, and beyond (3/15)
National Ocean Sciences Bowl Colorado regional competition (2/15)
Anne Gold and Eric Gordon Free online course: Water in the western U.S. (4/15)
Jerry Meehl IPCC seminar series: Policymakers/Technical summaries (8/14)
Jason Gurdak The out-of-sight global water crisis: A vision toward a sustainable groundwater future (3/15)
Roger Pielke, Jr. The politics of controlling science (4/15)
David Oonk and Anne Gold Tribe's Eye gallery exhibition (4/15)

70 Seconds of Science

CIRES and NOAA communicators led the third annual 70 Seconds of Science communications challenge in April 2014. Two dozen participants gave quick "elevator speeches" about what they do for NOAA or CIRES, and why it's important. Nearly 100 people attended the two-hour event in the David Skaggs Research Center.

David Oonk/CIRES

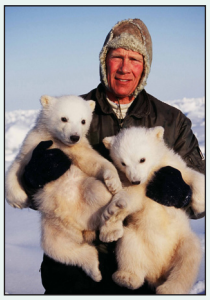
Contest winners Gopakumar Padmanabhan in the Global Systems Division, CIRES Associate Director for Science Kristen Averyt, and Michael Scheuerer in the Physical Sciences Division. David Oonk/CIRES

CIRES DLS distinguished lecture series

CIRES' Distinguished Lecture Series brings in outstanding scientists, historians of science, science policy makers, science journalists, and others, who take imaginative positions on environmental issues and can establish enduring connections after their departure.

Thomas H. Jordan
University of Southern California
The prediction problems of earthquake system science (10/14)

Gavin Schmidt
NASA GISS
Piecing together the climate story (1/15)



Steve Amstrup
Polar Bears Int.
Why should we care about polar bears? (4/15)

Dan Kahan
Yale University
Culture, rationality, and risk perception: The tragedy of the science-communication commons (4/15)

COOPERATIVE INSTITUTE FOR RESEARCH IN ENVIRONMENTAL SCIENCES

NOAA agreement No. NA12OAR4320137

University of Colorado Boulder 216 UCB
Boulder, CO 80309-0216

303-492-1143
info@cires.colorado.edu
http://cires.colorado.edu