

Department of

# ATMOSPHERIC SCIENCE

V11  
12/15

## AMS Alumni Reception

Please join us for the Atmospheric Science Alumni and Friends Reception at the American Meteorological Society Annual Meeting.

**TUESDAY,  
JAN. 12  
6-8:30 P.M.**

Elmwood Room  
Hilton New Orleans Riverside Hotel  
2 Poydras St., New Orleans, LA 70130

Hope to see you there.



## ASCENT

(Assisting Students, Cultivating Excellence, Nurturing Talent) Fund Supports Student Research in Ireland and Belgium

The ASCENT program was initiated in 2014 to help enrich the graduate experiences of our talented students. One component of ASCENT is an international travel grant allowing students to pursue opportunities for research enrichment activities abroad. Two students received ASCENT travel grants this year: Ph.D. student Christina McCluskey, advised by Professor Sonia Kreidenweis, and Ph.D. student Zitely Tzompa, advised by Assistant Professor Emily Fischer.

Christina traveled to Carna, Ireland, to participate in a research study conducted at Mace Head Atmospheric Research with the BACCHUS (Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding) European collaborative project. Zitely traveled to Liège, Belgium, where she worked with Dr. Emmanuel Mahieu at the University of Liège to examine atmospheric retrievals of ethane.

These unique international research experiences were made possible by your generous donations to ASCENT. Please consider donating again this year as we look to expand this exciting program.



Christina McCluskey



**JEFF COLLETT**  
DEPARTMENT HEAD

## GREETINGS, ALUMNI AND FRIENDS!

2015 was another exciting year here on the hill. This newsletter will give you a taste of some highlights. Included are stories about awards for faculty, students, and staff. You will also find a piece by 2015 Distinguished Alumnus, Jim Fleming. The department continues to recruit top students from across the nation and around the world. This year's entering class, for example, included five of nine students selected nationwide for AMS graduate science fellowships. With your generous support, we successfully launched a new initiative to enrich the graduate experiences of our students: ASCENT (Assisting Students, Cultivating Excellence, and Nurturing Talent). A story on international research experiences supported by ASCENT is at left. Please consider supporting ASCENT again this year (see back page) as we work to expand the program.

I wish you all a happy and prosperous 2016. If you will be at the AMS Meeting in New Orleans, please stop by our reception.

Sincerely,

Jeffrey L. Collett Jr.

## Outstanding Professor of the Year Award Goes to Susan C. van den Heever

Each year, one of the key highlights of the New Student Picnic is, of course, meeting the new students. The department warmly welcomed all 15 of them on Aug. 28 and learned a little more about each of them through introductions by their faculty advisers. It is these same professors who held the key to the other eagerly awaited highlight of the picnic, which was the announcement of the recipient of the Outstanding Professor of the Year Award. Each year, graduate student representatives poll department students on their thoughts regarding their interactions with faculty. After reviewing the results, one faculty member is chosen for the award based on a majority response.

This year, as in last year's case with Professor Eric Maloney, a repeat winner was announced. Associate Professor Susan van den Heever was named Outstanding Professor of the Year.

**THIS WAS SUE'S THIRD TIME TO BE SELECTED FOR THE AWARD - A RECORD.**

Student comments about Sue included, "Professor van den Heever encouraged lively discussions in class, which really helped bring interesting ideas to the classroom and solidified cloud dynamics concepts"; "Sue creates a friendly and enjoyable atmosphere in the class. I looked forward to going to her class"; and "She explains everything so clearly and her class was very organized." With comments like these, Sue was an excellent choice for the award.

More information about Sue can be found at [www.atmos.colostate.edu/faculty/vandenheever.php](http://www.atmos.colostate.edu/faculty/vandenheever.php).



**SUE VAN DEN HEEVER**  
MONFORT PROFESSOR

### 2015 Faculty and Staff CSU Milestones (Years of Service)

<b>5 YEARS</b>	Samantha Mayhew
<b>10 YEARS</b>	Melissa Burt
<b>15 YEARS</b>	Wesley Berg, Christian Kummerow, Stephen Saleeby
<b>20 YEARS</b>	Mostafa Elkady
<b>25 YEARS</b>	David Brunkow, Patrick Kennedy
<b>30 YEARS</b>	Paul DeMott
<b>35 YEARS</b>	Richard Johnson
<b>45 YEARS</b>	Thomas Vonder Haar

## AMS AWARDS TO WAYNE H. SCHUBERT

Professor Emeritus Wayne Schubert was chosen as the recipient of the Jule G. Charney Award for landmark advances in theoretical understanding of convective parameterization, marine stratocumulus, balanced atmospheric flows, and tropical cyclone intensity and structure.

THE CHARNEY AWARD IS ONE OF THE HIGHEST AWARDS OF THE AMERICAN METEOROLOGICAL SOCIETY.

Wayne will receive the award at the AMS Annual Meeting in New Orleans in January.

Wayne was also announced as the AMS 2017 Bernhard Haurwitz Memorial Lecturer. Wayne's selection recognizes his "profound insights into the role of cloud processes in the dynamics of large-scale circulations."

Follow Wayne and his research at [www.atmos.colostate.edu/faculty/schubert.php](http://www.atmos.colostate.edu/faculty/schubert.php).

WAYNE SCHUBERT  
PROFESSOR EMERITUS



SONIA KREIDENWEIS  
UNIVERSITY DISTINGUISHED  
PROFESSOR

## Sonia Kreidenweis Named Associate Dean for Research – and Receives AAAR David Sinclair Award

After serving as interim associate dean for research in the College of Engineering since January 2015, University Distinguished Professor Sonia Kreidenweis has been named associate dean for research. Sonia brings a wealth of knowledge to this important position with all of her experience at CSU and her outstanding reputation in research. The appointment is for a five-year term. Sonia will remain active as a Department of Atmospheric Science faculty member during her appointment.

Sonia's outstanding research accomplishments were also recognized by her receipt of the 2015 David Sinclair Award from the American Association for Aerosol Research. Sonia is a past president of AAAR, as well as a Fellow. The award was presented in October at the AAAR annual meeting in Minneapolis.

The David Sinclair Award recognizes sustained excellence in aerosol research and technology by an established scientist still active in his/her career. Sonia is being recognized for her many distinguished achievements in aerosol science, including high-impact contributions concerning aerosol hygroscopicity and cloud condensation nuclei, heterogeneous ice nucleation, aerosol impacts on visibility, and the emission and evolution of smoke from wild and prescribed fires. Congratulations, Sonia, on this outstanding achievement!

More information about Sonia can be found at [www.atmos.colostate.edu/faculty/kreidenweis.php](http://www.atmos.colostate.edu/faculty/kreidenweis.php).

## Susan C. van den Heever Named CSU Monfort Professor

The Department of Atmospheric Science is pleased to announce Associate Professor Susan C. van den Heever as one of the 2015 CSU Monfort Professors. The Monfort Professorship is CSU's premier recognition for mid-career faculty. This prestigious title is given to two faculty members per year by a committee appointed by the provost. Faculty members retain this designation for two years and receive \$75,000 per year to further their teaching and research.

**"DR. VAN DEN HEEVER IS AMONG OUR MOST PRODUCTIVE FACULTY, ALREADY ACHIEVING A RECORD OF OUTSTANDING ACCOMPLISHMENTS IN TEACHING, RESEARCH, AND SERVICE."**

"Dr. van den Heever is among our most productive faculty, already achieving a record of outstanding accomplishments in teaching, research, and service," said David McLean, the dean of the College of Engineering. "Her balanced record of achievement in research, teaching, and service embodies the land-grant mission."

"As one of the nation's top programs in the field of atmospheric science, expectations for CSU atmospheric science department faculty are extremely high; Sue easily bests those standards," said Jeffrey L. Collett Jr., head of the Department of Atmospheric Science. "Sue is an outstanding role model for the many talented young women and men that enter our graduate program. I can think of no one better suited for selection as a Monfort Professor."

*More information about Sue can be found at [www.atmos.colostate.edu/faculty/vandenheever.php](http://www.atmos.colostate.edu/faculty/vandenheever.php).*



**SUE VAN DEN HEEVER**  
MONFORT PROFESSOR

## Christian Kummerow Receives the Abell Outstanding Faculty Research Award

Dean David McLean presented Chris Kummerow with the major College of Engineering Abell Outstanding Faculty Research Award at the All College Meeting on Dec. 2, 2014. The Abell Award is presented each year in recognition of high-quality, nationally acclaimed research productivity with a particular focus on the preceding five years of work. Chris and his research fit this description impeccably. Chris has been extremely busy with his research since coming to the department in June 2000. Since that time, he has worked on multiple missions (TRMM, CloudSat and, most recently, GPM) and has participated in multiple steering committees that include AMSR. Chris plays an active role in planning and defining new space-borne missions geared toward a better understanding of the global water and energy cycle, while also providing exceptional leadership as the director of CIRA.

*More information about Chris can be found at [www.atmos.colostate.edu/faculty/kummerow.php](http://www.atmos.colostate.edu/faculty/kummerow.php).*



**CHRIS KUMMEROW**  
PROFESSOR + CIRA DIRECTOR



In Memory of

## PROFESSOR EMERITUS PETE SINCLAIR

The Department of Atmospheric Science sadly lost Professor Emeritus Peter Sinclair on Jan. 21, 2015, four weeks shy of his 86th birthday. Professor Sinclair joined CSU's Department of Atmospheric Science in 1965 as a turbulence expert with a thesis in dust devils, formally retired in 1993, and remained an active researcher with the department for many years. Professor Sinclair piloted his own aircraft for research in many different field studies during his tenure at CSU. He taught in the areas of meteorology instruments, cloud physics, cumulus convection, and severe weather. He also supervised the construction and operation of the weather radar on the roof of the ATS building during the 1970s to early 1980s. Professor Sinclair left a legacy of personal integrity and a strong work ethic.

More information about Professor Sinclair can be found at [www.atmos.colostate.edu/dept/PeterSinclair.php](http://www.atmos.colostate.edu/dept/PeterSinclair.php).

## Graeme Stephens Elected to National Academy of Engineering

CSU Atmospheric Science University Distinguished Professor Emeritus Graeme Stephens has been elected to the National Academy of Engineering. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to "engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature," and to the "pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

"This is a well-deserved honor for Graeme, and we are enormously pleased to see him recognized among the nation's most accomplished atmospheric scientists," said CSU President Tony Frank. "He has helped significantly advance the atmospheric and climate research for which CSU is known, and he continues to make an important impact on climate science through his ongoing research and leadership of the CloudSat project. This recognition is also a great tribute to the quality of our academic faculty as a whole – illustrating the importance and worldwide impact of the education and research that happens at CSU."

More information about Graeme Stephens and the NASA-funded CloudSat project can be found at <https://science.jpl.nasa.gov/people/Stephens>.



**GRAEME STEPHENS**  
DISTINGUISHED  
PROFESSOR EMERITUS

## WELCOME, NEW STUDENTS

### Graduate Students

NAME	M.S./PH.D	ADVISER	UNIVERSITY
Julie Barnum	M.S.	Steven Rutledge	Missouri State University
Emily Bell	M.S.	Chris O'Dell/Chris Kummerow	Monmouth College
Jared Brewer	Ph.D.	A.R. Ravishankara/Emily Fischer	Stanford University
Samuel Childs	M.S.	Russ Schumacher	Purdue University
Trenton Davis	M.S.	Steven Rutledge	Ohio State University
Kimberly Fewless	Ph.D.	David Thompson	Colorado State University
Sean Freeman	M.S.	Sue van den Heever	Florida State University
Stacey Hitchcock*	Ph.D.	Russ Schumacher	University of Oklahoma
Karly Reimel	M.S.	Steven Rutledge/ Steven Miller	Florida State University
Andrea Jenney	M.S.	David Randall	University of Miami
Nathan Kelly	M.S.	Russ Schumacher	Valparaiso University
Jakob Lindaas	M.S.	Emily Fischer	Harvard University
Louis Rivoire	Ph.D.	Thomas Birner/ John Knaff	Ecole Normale Superieure
Richard Schulte	M.S.	Chris Kummerow	Santa Clara University
Derek Weber	M.S.	Jeff Collett	Loyola Marymount University
Justin Whitaker	M.S.	Eric Maloney	Wofford College

\* Spring 2015 Admission

### Postdoctoral Fellows

Postdoctoral Fellows	Research Adviser	Graduate University
Brittany Bloodhart	Emily Fischer	Penn State University
Bonne Ford Hotmann	Jeff Pierce	Colorado State University
Maria Hakuba	Graeme Stephens	ETH, Zurich, Switzerland
Adele Igel	Sue van den Heever	Colorado State University
John Peters	Russ Schumacher	Colorado State University
Rachel Storer	Graeme Stephens	Colorado State University



*New 2015 CSU Atmospheric Science graduate students L to R back row: Louis Rivoire, Jakob Lindaas, Samuel Childs, Trenton Davis, Richard Schulte, Nathan Kelly; L to R middle row: Derek Weber, Sean Freeman, Justin Whitaker; L to R front row: Julie Barnum, Emily Bell, Andrea Jenney, Karly Reimel; (not pictured: Jared Brewer, Kimberly Fewless, Stacey Hitchcock).*

## Alumni and Herbert Riehl Award Winners

The Herbert Riehl Memorial Award recognizes an outstanding paper based on M.S. research and the Alumni Award recognizes an outstanding paper based on Ph.D. research.



*L to R: Herbert Riehl Jr., Sonia Kreidenweis, Herbert Riehl Award recipient Christina McCluskey, Paul DeMott*



**ADELE IGEL**  
ALUMNI AWARD

# STUDENT AND STAFF NEWS

## College of Engineering 2014 Outstanding Classified Employee Award: Jamie Schmidt

The Outstanding Classified Award is presented each year and is bestowed upon a state classified employee who exemplifies dedication and commitment to the college, the University, fellow department employees, students, and staff.

THE RECIPIENT IS ONE WHO STRIVES FOR EXCELLENCE IN EVERY ASPECT OF HIS OR HER WORK. THERE IS NO BETTER WAY TO DESCRIBE OUR DEPARTMENT AWARD WINNER, JAMIE SCHMIDT.

Jamie is best known for her role as the department graduate coordinator and assistant to the department head, but has many duties beyond this. That being said, one never sees Jamie turn away a student, a faculty member, or a fellow employee who has come to

her for aid. She always finds time to fit everyone into her day. Jamie continues to take classes at CSU to improve herself and continue along her future career path. Her goal is to better herself and everyone else around her and to provide the best support she can. Thank you for all you do, Jamie! Congratulations on this well-deserved award.



**JAMIE SCHMIDT**  
DEPARTMENT GRADUATE  
COORDINATOR

### STUDENT APPOINTMENTS, AWARDS, AND RECOGNITIONS

2015 1st Place AMS Conference on Mesoscale Processes	James Ruppert
2015 2nd Place AMS Conference on Atmospheric Chemistry	Aaron Piña
2015 3rd Place AMS Local Chapter Poster Contest	FORTCAST
2015 AAAR Student Poster Award	Jack Kodros
2015 AMS Best Student Poster	CMMAP Intern Renee Duff
2015 AMS Outstanding Student Presentation	Veljko Petkovic, David Henderson, Leah Grant, Brandon Wolding, Ashley Evanoski-Cole
2015 Best Poster Presentation Prize, 7th International GEOS-Chem Meeting	Zitely Tzompa

## STUDENT FELLOWSHIPS

AMS (American Meteorological Society)	Samuel Childs, Sean Freeman, Jakob Lindaas, Karly Reimel, Richard Schulte
CIRA ATS Fellowship	Karly Reimel
CMMAP Diversity (Center for Multiscale Modeling of Atmospheric Processes)	Dakota Smith
CONACYT (Mexican National Council for Science & Technology)	Zitely Tzompa
2015-2016 CSU International Presidential Fellow	Liji David, Louis Rivoire
CSU Track and Field	Karly Reimel
CSU University Distinguished Professors Scholarship	Leah Grant
Dave Hart Athletic Scholarship	Justin Whitaker
Dietrich Scholarship	Jack Kodros
EPA Star	Ashley Evanoski-Cole
Gates Millenium	Isaac Medina
NREIP (Naval Research Enterprise Internship Program)	Samuel Atwood
NSF (National Science Foundation)	Samuel Childs, Nick Davis, Aryeh Drager, Sean Freeman, Leah Grant, Adele Igel, Peter Marinescu, Eric Nielsen, Elizabeth Thompson
NSF Honorable Mention	Steven Brey, Greg Herman
NSF Postdoctoral	John Peters
PRSE (Programs of Research & Scholarly Excellence)	Louis Rivoire
Shrake Culler	David Duncan
SoGES (Colorado State University Global Sustainability Leadership Fellow)	Ashley Evanoski-Cole, Aaron Piña

## Congratulations, Atmospheric Science Graduates

STUDENT	DEGREE	ADVISER
Brett Basarab	M.S.	Steven Rutledge
Erin Dagg	M.S.	Richard Johnson/ Thomas Birner
Chris Eldred	Ph.D.	Dave Randall
Bonne Ford Hotmann	Ph.D.	Colette Heald
Nick Geyer	M.S.	Scott Denning
Sasha Glanville	M.S.	Thomas Birner
Alex Gonzalez	Ph.D.	Wayne Schubert
Jack Kodros	M.S.	Jeff Pierce
Jianbo Liu	M.S.	Chris Kummerow
Rob Nelson	M.S.	Chris O'Dell
John Peters	Ph.D.	Russ Schumacher
Sarah Ringerud	Ph.D.	Chris Kummerow
James Ruppert	Ph.D.	Richard Johnson
Kim Sakamoto	M.S.	Jeff Pierce
Bradley Wells	M.S.	Jeff Collett
Samantha Wills	M.S.	Dave Thompson

# FIELD STUDIES AND PROJECTS

## PLAINS ELEVATED CONVECTION AT NIGHT (PECAN) FIELD CAMPAIGN

Department of Atmospheric Science Assistant Professor Russ Schumacher and several graduate students took part in the Plains Elevated Convection at Night field campaign from June 1 to July 15, 2015. This project aimed to observe and better understand the thunderstorms that often form over the central U.S. at night. These storms produce much of the rainfall that is critical for agriculture in this region but can also lead to hazardous weather in the way of severe winds, hail, and flash flooding. The project involved scientists, students, and support staff from eight research laboratories and 14 universities including Colorado State University, University of Wyoming, National Oceanic and Atmospheric Administration, National Center for Atmospheric Research, and the Center for Severe Weather Research. A wide array of radars, research aircraft, and atmospheric profiling instruments took on the task of observing convection after dark.

The CSU team collected mobile radiosonde observations during the field phase of the project, and sought to better understand the processes that govern the organization, motion, and rainfall production in nocturnal convective systems.

“In the central U.S. in the spring and summer, a large fraction of the rainfall actually occurs overnight. Despite these nighttime storms producing a lot of the agriculturally beneficial rainfall in the Plains, there’s a lot we still don’t know about storms that occur at night,” Schumacher said.

“THERE’S NEVER REALLY BEEN A FIELD PROJECT FOCUSING ON NOCTURNAL STORMS, AND WITH THE WIDE ARRAY OF INSTRUMENTS TAKING PART IN PECAN, WE HAVE A PRIME OPPORTUNITY TO REALLY ADVANCE UNDERSTANDING AND PREDICTION.”

Read more about Russ’s research at [www.atmos.colostate.edu/faculty/schumacher.php](http://www.atmos.colostate.edu/faculty/schumacher.php).



## SEA-POL: Advanced Ship-Based Radar for Open-Ocean Atmospheric Research

Directed by Department of Atmospheric Science Professor Steven Rutledge (principal investigator) and Department of Electrical and Computer Engineering Professor V. "Chandra" Chandrasekar (co-principal investigator), \$1.3 million major research instrumentation award from the National Science Foundation will develop an advanced ship-based radar to study clouds and precipitation over the oceans.

**THIS STATE-OF-THE-ART POLARIMETRIC DOPPLER RADAR IS KNOWN AS SEA-POL, AND EMPLOYS DUAL-POLARIZATION TECHNOLOGY WHERE BOTH HORIZONTALLY AND VERTICALLY POLARIZED RADAR SIGNALS ARE TRANSMITTED AND RECEIVED BY THE RADAR.**

This technology was pioneered at the University's CSU-CHILL National Radar Facility, also directed by Professor Rutledge. The polarization technology improves rainfall estimation and provides information on the distribution of liquid and ice particles in clouds.

This information, which is vital to improving understanding of the global water cycle and air-sea interaction, and validating computer models of global precipitation, is the same technology used on the national radar network to detect severe weather.

SEA-POL will be deployed periodically on U.S.-operated world-class research ships on several monthlong cruises to various areas of the world's oceans. With 75 percent of the world's rainfall occurring over oceans, studying oceanic storms and measuring rainfall they produce with SEA-POL will allow scientists to better understand how tropical clouds and storms contribute to climate change.

When SEA-POL is not deployed at sea, it will operate at Colorado State University for research and education.

## PROGRESS (PROmoting Geoscience Research, Education and Success)

Society needs women in science and technology! As part of an NSF-funded program focused on recruiting and retaining women in the geosciences, Dr. Emily Fischer hosted the first PROGRESS (Promoting Geoscience Research, Education and Success) workshop.

More than 50 students from the University of Colorado, Colorado State University, Colorado College, and the University of Wyoming attended the workshop held in Estes Park on Oct. 10 and 11. Through a range of activities at the workshop, students were introduced to the geoscience fields, they met peers with similar interests across the Front Range, and they learned about their personal strengths. From here, students will take part in an informal mentoring program with scientists across the Front Range.



*You can learn more about the program by visiting the new Web portal, <http://geosciencewomen.org>.*

## Professor James R. Fleming: Distinguished Alumni Award Recipient

On April 17, Professor James R. Fleming was awarded the CSU Department of Atmospheric Science Distinguished Alumni Award by Department Head Jeff Collett. This award is presented to an outstanding alumnus and/or alumna who exemplifies core values revered by the department, including dedication to research, commitment to education, and leadership prowess in the atmospheric sciences. These values, exemplified throughout the course of Jim's distinguished career, are the very reason he was chosen for the award. Since graduating with an M.S. from the department in 1973, Jim earned a Ph.D. in history from Princeton University. Jim is a historian of science and technology and professor of science, technology, and society at Colby College, Maine. His teaching bridges



the sciences and the humanities, and his research interests involve the history of the geophysical sciences, especially meteorology and climate change. In 2003, Jim was elected a Fellow of the American Association for the Advancement of Science "for pioneering studies on the history of meteorology and climate change and for the advancement of historical work within meteorological societies." He held the Charles A. Lindberg Chair in Aerospace History at the National Air and Space Museum, Smithsonian Institution, in 2005-2006

and the AAAS Roger Revelle Fellowship in Global Stewardship at the Woodrow Wilson International Center for Scholars in 2006-07. Jim is the founder and first president of the International Commission on *History of Meteorology*, editor-in-chief of *History of Meteorology*, and series editor for *Palgrave Studies in the History of Science and Technology*. His books include *Fixing the Sky: The Checkered History of Weather and Climate Control* (Columbia University Press, 2010), *The Callendar Effect* (American Meteorological Society, 2007), *Historical Perspectives on Climate Change* (Oxford University Press, 1998), and *Meteorology in America, 1800-1870* (John Hopkins University Press, 1990). He is currently working on a biography of the CO<sub>2</sub> molecule, a book on Harry Wexler and the emergence of atmospheric science, and a project examining "sense of place" in the Belgrade Lakes Region. The department would like to congratulate Jim on his body of work and thank him for proudly representing CSU over the years.

Learn more about Jim at [www.colby.edu/directory/profile/jfleming](http://www.colby.edu/directory/profile/jfleming).

## 2015 ALUMNI UPDATES

Lawrence Cary (Ph.D., '99) was named department chair of atmospheric science at the University of Alabama Huntsville.

Jim Fleming (M.S., '73) is a professor of science, technology, and society at Colby College, Maine. He has been awarded the Eduard Brückner Prize 2015 for outstanding achievement in interdisciplinary climate research. The award, administered by the Helmholtz Zentrum Geesthacht für Material- und Küstenforschung, was presented on Sept. 21 at the German Climate Conference in Hamburg, organized by the Deutsche Meteorologische Gesellschaft, [www.dkt-10.de/](http://www.dkt-10.de/).

Sarah Ringerud (Ph.D., '14) is now at NASA GSFC working as a fellow of the NASA postdoctoral program.

## History Matters

*Professor Jim Fleming, recipient of the CSU Department of Atmospheric Science Distinguished Alumni Award, shares his thoughts and experiences about how history matters in the field of atmospheric science.*

I thank CSU for my grounding in atmospheric science and for appreciating and recognizing my work in the history of science and technology. Here are some excerpts from my new book, *Inventing Atmospheric Science* (MIT Press, 2016).

Atmospheric researchers have long attempted to untie the Gordian knot of meteorology – that intractable and intertwined tangle of observational imprecision, theoretical uncertainties, and nonlinear influences – that, if unraveled, would provide perfect prevision of the weather for 10 days, of seasonal conditions for the next year, and of climatic conditions for a decade, a century, a millennium, or longer. This big-picture history examines the first six decades of the 20th century, from the dawn of applied fluid dynamics to the emergence, by 1960, of the interdisciplinary atmospheric sciences.

In 1904, Vilhelm Bjerknes (1862-1951) initiated a neo-Laplacian program – to measure atmospheric conditions with sufficient accuracy and to calculate the future state of the weather with sufficient precision using the equations of hydrodynamics and thermodynamics. Falling short of analytic solutions to the nonlinear equations of atmospheric motion, he and his students founded the Bergen school of meteorology, where graphical methods prevailed. His protégé, Carl-Gustaf Rossby (1898-1957), established the graduate schools of meteorology at MIT, Chicago, and Stockholm that focused on upper-air dynamics and, after 1947, on global environmental issues. Rossby identified upper-air planetary waves as the keys to long-range forecasting, treating them as idealized cases suitable for computation by digital computers. Rossby's student Harry Wexler (1911-1962) and his colleagues, notably Jule Charney, prepared the foundations for the emergence of the interdisciplinary atmospheric sciences and introduced a number of transformative technologies into meteorology including radar, nuclear tracers, digital computers, sounding rockets, and weather satellites, that helped cut into, if not through, the Gordian knot. They transformed meteorology into a physical science, built new theoretical models, established new institutions, trained new people, and incorporated the most promising new technologies into the atmospheric sciences. Their lives span a full century; their work spans a period of technological flux, from Marconi wireless and the Wright Flier to digital computing and weather satellites and from roentgen and Becquerel rays to outdoor nuclear testing. They aspired to build ever-larger, even global, networks of observation and organization; to attain near-perfect measurement, near-perfect understanding, near-perfect prevision; and to make their science as rational and useful as possible. Their life stories and accomplishments are interwoven into a 60-year big-picture history of atmospheric research, a tapestry formed from the braided threads of technology, science, and social change.

“The goal of meteorology is to portray everything atmospheric, everywhere, always.” This striking proclamation of 1960 by John Bellamy and Harry Wexler captured the excitement of the moment, three months after the successful launch of TIROS 1, the first weather satellite. In a larger historical sense, meteorological researchers everywhere always held this sentiment. In the middle of the 19th century, the electrical telegraph opened up new possibilities for data collection and the distribution of reports and forecasts. In the first decade of the 20th century, researchers pinned their hopes on wireless telegraphy and the dawning of the aerial age. Several decades later, radio, aviation, rockets, digital computing, and Earth-orbiting satellites had opened up entirely new research horizons. Each generation of atmospheric researchers aspired to a more global meteorology, zealously incorporating capabilities provided by new technologies into their science as they worked to link theory with practice. Members of each generation experienced, in their own ways, the heady feeling that they were the direct beneficiaries of new technological breakthroughs and that they stood on the brink of a major revolution in the science and practice of meteorology. Their goal was to produce accurate information about the state of the entire atmosphere, complete mathematical portrayals of its varied and changing states, and useful and timely forecasts of its near- and long-term future.

In 1900, meteorologists focused largely on surface weather conditions; they had a sparse number of stations connected by telegraph lines, no observations over the oceans or unpopulated areas, and few upper-air measurements. Motorized flight was still several years in the future, and although instrumented kites had reached record altitudes, the Eiffel Tower was still considered one of the best upper-air measurement platforms available. Wireless telegraphy was just emerging, rockets were fireworks, Earth had one satellite known as the moon, and computers were people.

By 1960, meteorology had attained significant theoretical and observational capabilities, due in large part to the efforts of Bjerknes, Rossby, and Wexler. A new interdisciplinary field called atmospheric science was emerging. Designed and run by committee, motivated by new opportunities and heightened international tensions, the recipient of massive new federal funding, atmospheric science became an umbrella term for the explosion of research specialties in meteorology and climatology, cloud physics, atmospheric chemistry, and the dynamics of Earth's atmosphere from the surface of the planet to the edge of space and on to the surface of the sun. The atmosphere was getting larger, and atmospheric science along with it.

By the early 1960s, Edward N. Lorenz (1917-2008) was able to demonstrate that the “Gordian knot” analogy was much more subtle than previously thought and that if it even existed, it could never essentially be untied, at least not by mortals. Lorenz introduced the novel understanding that chaos theory applied to meteorology was a new topology, an extreme sensitivity to initial conditions in a dynamical system of deterministic nonperiodic flow. The atmospheric sciences are still coming to terms with this limitation.

# OUTREACH AND CONFERENCES

## First Lady's Kitchen Garden Becomes Part of the Community Collaborative Rain, Hail, and Snow Citizen Science Network

The White House, in collaboration with the National Atmospheric and Oceanographic Administration and the National Park Service, will install a new rain gauge in the First Lady's Kitchen Garden as the White House becomes a new participant in the CoCoRaHS citizen science project. The White House will begin making contributions as an additional data source to the citizen scientist project during Science Fair.

There are millions of citizen scientists in this country willingly contributing valuable time and effort to help advance our collective understanding of the world around us. The CoCoRaHS Network's more than 20,000+ active volunteers serve as the largest source of daily precipitation data in our country, reporting measurement from coastal lowlands to the high peaks of Rocky Mountain National Park. CoCoRaHS data are used by a wide variety of groups, including: NOAA's National Weather Service, private sector and university meteorologists, hydrologists, emergency managers, city utilities (water supply, water conservation, storm water), insurance adjusters, USDA, engineers, mosquito control, ranchers and farmers, outdoor and recreation interests, teachers, and students.

## NOLAN DOESKEN THE WHITE HOUSE



## CMMAP Year 10 and Beyond

The Center for Multiscale Modeling of Atmospheric Processes is a National Science Foundation Science and Technology Center that began in 2006, located in CSU's Department of Atmospheric Science. The funding that CMMAP receives from NSF will conclude as anticipated in June 2016 after a full 10 years of funding. As the center approaches its sunset, we are busy planning which elements of the research, education, diversity, knowledge transfer, and event programming will continue, and which will come to a natural conclusion. In January 2016, we will gather in Boulder, Colo., for our 20th, and final, semiannual CMMAP Team Meeting.

Since its inception, CMMAP has enabled invaluable collaborations and advances in the areas of climate and earth system modeling, undergraduate and graduate student research, and broadening participation from underrepresented minorities in atmospheric and STEM sciences. CMMAP cooperative efforts have fueled innumerable peer-reviewed articles and created the open-access *Journal of Advances in Modeling Earth Systems*, now part of the American Geophysical Union's highly respected family of journals. Additionally, CMMAP facilitated the publication of a hardcover book, *The Development of Atmospheric General Circulation Models*, which covers the history, current efforts, and future outlook of GCMs and their integration into earth system models. In the spirit of continuing the progress that CMMAP made possible in these and other important areas, we have created a new institute called Earth System Modeling and Education Institute.

ESMEI is the institutional legacy of CMMAP, with development currently underway in anticipation of a full transition by July 2016. ESMEI engages in earth system modeling with an atmospheric focus, and welcomes interdisciplinary collaboration to explore novel and existing research problems and to optimize education efforts. ESMEI is also housed at the Department of Atmospheric Science at Colorado State University and receives base funding from the department, the College of Engineering, and CSU's Vice President for Research. I encourage you to visit the ESMEI website to learn more in the coming months as we continue to develop content and make the exciting transition into a new institute: <http://kiwi.atmos.colostate.edu/esmei>.

Thank you for your support of CMMAP over the past 10 years. We look forward to seeing what the future holds for the center's institutional legacy, ESMEI.

Increasing the Diversity of Your Graduate Program:

## TRANSLATING BEST PRACTICES INTO SUCCESS

As the Center for Multiscale Modeling of Atmospheric Processes looks back over its last 10 years, one thing to highlight is the success of its 10-year plan for broadening participation in the CSU Department of Atmospheric Science. As outlined below, a close partnership between CMMAP and the department has transformed the composition of the graduate student body.

In 2014, only 8.5 percent of students nationally enrolled in atmospheric science graduate programs were from traditionally underrepresented groups (i.e., African American, Hispanic, and American Indian students), even though these groups represent almost one-third of the overall U.S. population (Colby and Orton 2015). In 2005, the department had a minority enrollment of 3.5 percent, which was lower than the national enrollment of 6 percent. Now, in 2015, we have nearly quadrupled the number of students from historically underrepresented groups.

Melissa Burt, CMMAP's education and diversity manager, along with co-authors Rebecca Haacker (SOARS), Rebecca Batchelor (SOARS), and Scott Denning (professor, CSU ATS), wrote a manuscript, which has been accepted for publication in the *Bulletin of the American Meteorological Society*, highlighting the best practices used in increasing diversity in the department. In their manuscript, "Increasing the Diversity of Your Graduate Program: Translating Best Practices into Success," they found seven key elements that have contributed to their success:

### 1. Inclusive and supportive Research Experience for Undergraduates program

This intern program introduced diverse undergraduate students to CSU and supported faculty working with them. Studies show undergraduates who participate in research and identify as being part of the scientific community gain confidence in their skills and abilities and are more likely to continue and succeed in the field.

### 2. Partnering with a minority-serving program

CMMAP partnered with the well-established SOARS (Significant Opportunities in Atmospheric Research and Science) program funding proteges' participation in SOARS, participating as mentors, and recruiting students into the ATS graduate program.

### 3. Extensive multidimensional mentoring

Comprehensive, multidimensional mentoring provides the student with a broad sense of support and multiple opportunities to make a meaningful personal connection. To date, almost all of the department's faculty as well as 50 professional research scientists, postdocs, and graduate students have participated as mentors.

### 4. Established relationships of trust with minority -serving institutions

The authors found a key component of increasing diversity is building a relationship of trust with faculty at minority-serving institutions through long-term, regular contact and research collaborations.

### 5. Targeted recruitment

With relationships in place at minority-serving institutions, the faculty are more committed to the program and helped recruit strong applicants, while also providing ongoing support for their students.

### 6. Strengthened faculty commitment to diversity and mentoring

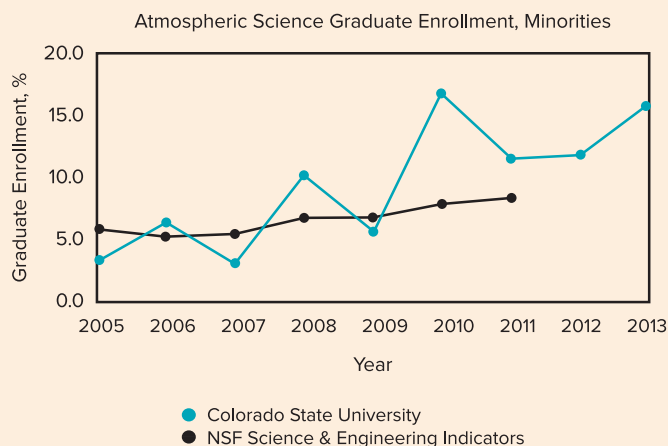
Part of building a supportive and welcoming culture at CSU has been personally engaging faculty and staff with students from a wide range of backgrounds. Mentoring an intern is valued by the department and is recognized in annual faculty evaluations, and has created a supportive community of practice for faculty.

### 7. Hiring a dedicated full-time manager for education and diversity

The CMMAP education and diversity manager created relationships by making regular campus visits, meeting with department faculty and campus leaders, and holding many informal conversations with current and prospective students.

Burt, M.A., R. Haacker, R.L. Batchelor, A.S. Denning, 2015: Increasing the diversity of your graduate program: Translating best practices into success, *Bull. Amer. Soc.* accepted for publication.

Colby, S., Ortman, J.M., 2015: Projections of the Size and Composition of the U.S. Population: 2014 to 2060. U.S. Department of Commerce, 25-1143.





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