UNIVERSITY OF WISCONSIN–MADISON • ATMOSPHERIC AND OCEANIC SCIENCES

MAKING WAVES

2015–2016

A Furious Atmosphere: The Fairdale, Illinois, EF4 Tornado

Luke E. Odell, Ph.D. Candidate

The 2015 Fairdale, IL EF4 tornado. The story can be found on page 9. ***(Photos courtesy of Dr. Walker Ashley of NIU).***

CHAIR'S COLUMN

A 30 YEAR PERSPECTIVE
Greg Tripoli

As new chair of the Department, please let me introduce myself. This is my 30th year on the AOS faculty. After being a Research Scientist at Colorado State University and the Geophysical Fluid Dynamics Laboratory for over 14 years, I came to Madison to teach and to continue my cloud/mesoscale modeling research.

At the time, this Department was quite different. First of all, it was the Department of Meteorology. Professor John Young was Department chair, Professor Lyle Horn was my faculty mentor and close friend, Professor Verner Suomi was SSEC director, and Professor Reid Bryson was always available for a spirited water-cooler conversation. Professor Bill Smith headed CIMSS, Professor John Kutzbach was the director of CCR, and Professor Douglas Clark was the official State Climatologist and head of the State Climatology office. Newly hired Professor John Anderson impressed Verner by dramatically changing the way the FAA operated by personally designing, building, and installing the software and computer hardware driving the national Terminal Doppler Weather Radar network.

Professor Roland Stull had just finished his now classic book on Boundary Layer Meteorology Professor David Houghton would hold his outdoor parties once a year at his McFarland home from which he biked to work, Professor Don Johnson led his band of general circulation gurus who talked about the overworld and underworld, Professor Pao Wang was studying the turbulence around raindrops, and Chuck Stearns was building and installing weather stations in Antarctica and Greenland.

In all, the Meteorology Department averaged about 17-18 Meteorology faculty members mentoring about 90–100 graduate students and about 13–15 students in an undergraduate class. At the time, I was a member of ENUWAR (Environmental Consequences of Nuclear War), a WMO group begun by the TAPPS collaboration that studied short term global climate change resulting from nuclear war.

Needless to say, the Department has evolved since then. Today, we are the Department of Atmospheric and Oceanic Sciences, and I am the only remaining active faculty member from that 1987 group. Since then, we have expanded rapidly, adding physical oceanography to our curriculum and moving aggressively into "Earth System Science" with the hire of Frances Bretherton, who was with NCAR at the time. The world was changing, as the Cold War ended, and the ENUWAR group reformed into a more general "climate change" initiative. Professor Clark moved on to Denmark, and the Department gave up the "State Climatologist" faculty position in favor of more emphasis in the Earth Systems Science direction. By late in the 1990s, AOS had expanded into 18 faculty, with programs distributed across Earth Systems Science, and in close collaboration with the Nelson Institute. We had dramatically revised both our Undergraduate and Graduate curriculum to be compatible with the more broad requirements of the "new" National Weather Service, Physical Oceanography program and developing Earth Systems Science career options. After the movie "Twister" was released, our undergraduate class size expanded to about 30 students per class.

But then as we moved into the new millennium, economics, both nationally and at the State level, threw the Department into a period of contraction, where vacant faculty positions were replaced slowly or not at all. Today, we have only 10 full time faculty in AOS, and the University tells us that is the new norm. The undergraduate population is approaching new lows, and the graduate student population reflects the smaller faculty base. We still offer our expanded "Earth Systems Science" curriculum, but with fewer faculty and fewer students, placing some stress on the number and variety of classes that we can offer.

Following Clark's departure, the State Climatology Office (SCO) remained funded but at ever decreasing levels and without a Faculty Director. As of the beginning of this semester, all remaining State support for the SCO ended with the retirement of Lyle Anderson. Fortunately, Emeritus Professor Young (SCO Director) and Ed Hopkins maintain the facility, gratis, until funding to continue this important operation can be restored. We are working hard to find that support from Letters and Sciences, from Extension, or possibly from other sources that we have not yet identified.

Job prospects for Bachelor level graduates of AOS have declined in recent years, as the National Weather Service now make few hires at the Bachelor's level. We are viewing these changes as an opportunity to rethink our Undergraduate program yet again and to move our

See "Chair's Column" continued on p. 13

Dr. David D. Houghton Memorium

Professor Emeritus David D. Houghton passed away on 22 June 2016 in Woodbury, Minnesota. Born on 26 April 1938, in Philadelphia, Pennsylvania, David Houghton was known as a dedicated teacher, research mentor, and outstanding departmental and atmospheric and climate sciences research community citizen for 33 years. At all times best embodied the spirit of the "Wisconsin Idea"—the notion that that education should influence people's lives beyond the boundaries of the classroom. Dr. David Houghton received a B.S. in Meteorology from Pennsylvania State University in 1959 and a Ph.D. in Atmospheric Sciences from the University of Washington in 1963. He was a research scientist at NCAR from 1963 to 1968 before joining the University of Wisconsin–Madison Department of Meteorology faculty in 1968 and was promoted to Full Professor in 1972. David was Department Chair at UW–Madison for two terms: from 1976–79 and from 1991–94. In addition, he held departmental leadership positions as associate chair for both the undergraduate and graduate academic programs of the department. During his tenure at UW–Madison, David was an exemplary departmental citizen and leader, contributing importantly in the foundations of a solid department: teaching, research, and service, until his retirement from the UW–Madison in 2001. He executed and encouraged high ethical standards of conduct in service and leadership at the University.

Dr. David D. Houghton

As professor emeritus, Dr. Houghton remained an active researcher and mentor to graduate students before moving with his wife Barbara to Woodbury, Minnesota, in 2008. In the last decade, David conducted extensive public outreach on a passion of his—educating the broader public on the science and impacts of anthropogenic climate change. His goal was to raise public interest and attention to the issue of climate change including both its reality and complexity.

Dr. Houghton published over 80 refereed journal articles in the areas of climate dynamics, coupled atmosphere-ocean systems, synoptic and mesoscale weather systems, numerical modeling, and education. His research spanned multiple dynamical scales from work on gravity waves, seasonal transitions in large-scale flow, the impact of sea surface temperatures on the monsoonal and mid-latitude circulations. Dr. Houghton had a distinguished teaching record at both the undergraduate and graduate levels serving as the principal advisor for 11 PhD and 30 MS students. He created and taught the first significant numerical weather prediction courses in the department in the 1970's and was a key leader in the instruction of many of the undergraduate and graduate core curricula.

Dr. Houghton provided leadership and distinguished service to the atmospheric sciences community throughout his career. He served on a number of University Corporation for Atmospheric Research, National Science Foundation and NASA advisory committees. He served as Visiting Senior Scientist at the National Meteorological Center (1988), Visiting Consultant at the World Meteorological Organization (1997), and Visiting Professor at Clark Atlanta University (1998). His service for the American Meteorological Society (AMS) included Commissioner for Education and Human Resources (1987–93) and President of the AMS (1995). Dr. Houghton was a fellow of both the AMS and the American Association for the Advancement of Science. Dr. Houghton's deep commitment to education and science, and to the stewardship of institutional processes which advance our sciences' collective goals is evidenced by his being the recipient of two AMS awards the Charles Franklin Brooks Award for enthusiastic and critical support, as both Commissioner and President, for major [AMS] initiatives in education, in environmental applications, and with private industry; and the Charles E. Anderson Award for "for improving educational opportunities for underrepresented groups through efforts as Commissioner and President of the Society and through teaching at Historically Black Colleges and Universities."

David was broadly active and athletic. The breadth and intensity of his play left many an opponent breathless. Many will recall their highly competitive racquetball, handball, tennis and ping-pong games with him. He was an avid bicyclist, often biking daily 13 miles each way to and from work from his semi-rural farmhouse in McFarland. The Houghton's home was the site of many memorable departmental gatherings for incoming graduate students, graduating seniors, and faculty colleagues. All remember the warmth and gracious hospitality of the Houghton's generously sharing their home for these social occasions.

On Saturday, 22 October, a memorial service for family, colleagues, and friends was held at the Houghton's former McFarland home. n

Explaining the 'terrifying' trends of climate change: Q&A with climate scientist Galen McKinley

Jennifer Peek, Nelson Institute for Environmental Studies

The Earth is warming at a pace "unprecedented in 1,000 years," NASA scientists report, threatening to breach the global temperature limits set in the Paris climate treaty that will take effect in November.

"In the last 30 years we've really moved into exceptional territory," Gavin Schmidt, director of NASA's Goddard Institute for Space Studies, told The Guardian in August—a month that tied July for the warmest ever recorded.

With temperatures on the rise and the concentration of carbon dioxide in the atmosphere moving permanently above 400 parts per million, climate change continues to demand national and international attention. In September, President Obama told *The New York Times* that climate change trends are "terrifying," and he recently signed a Presidential Memorandum requiring the federal government to consider climate change impacts a threat to national security. To learn more about why the Earth is warming so fast, what research can be and is being done to adapt to and mitigate climate change, and opportunities for hope, we talked with Galen McKinley, a UW–Madison professor of atmospheric and oceanic sciences and the Bryson Professor in the Nelson Institute Center for Climatic Research.

Why is the Earth warming at an unprecedented rate?

Warming is due to human emissions of greenhouse gases, including carbon dioxide and methane (CO2 and CH4). These emissions are due to human fossil fuel use, cement manufacturing, land clearing and more.

Do you agree with NASA experts that it's "very unlikely" that the planet can stay within a 1.5-degree Celsius temperature increase limit agreed to in the Paris climate accord?

Yes, I agree with this. Plots from the National Oceanic and Atmospheric Administration (NOAA) indicate that it is quite possible that this year will be above 1 degree Celsius in excess of the 20th century mean. The climate system is not yet in equilibrium with the CO2 and CH4 already emitted, so continued warming is inevitable, even if we started making strong emission cuts right now.

President Obama has called climate change trends "terrifying." Can you explain these trends and why they are such cause for alarm?

The trends are "terrifying" because our human society is built on the assumption of a stable climate.

We have built so many cities in the coastal zone, and they are threatened by sea level rise and storm surge. We want to live in the desert Southwest and southern California where water supplies are naturally limited and our man-made supplies are dwindling. And we depend on now-dwindling snow packs and mountain glaciers in many other places for our drinking water. We depend on growing our crops in certain places.

All these systems are threatened by climate change and this is scary because it will disrupt the ways and places humans live. It is also yet another threat to many of the other beings with which we share this planet.

Climate change certainly doesn't mean that all life on the planet will go away, but it will be very inconvenient as it reshapes our coastlines, environments and ecosystems over the coming hundreds to thousands of years.

What kinds of research are you doing that help us understand climate change?

I study the ocean and its ability to absorb carbon from the atmosphere. To date, 40 percent of all human CO2 emissions have been absorbed by the ocean. One might think of the ocean as a sponge that sops up part of our CO2 mess.

In order to better understand how the climate is currently changing and how it can be expected to evolve in coming decades and centuries, we need to better understand how this ocean carbon sink works.

Has your research led to any surprising findings?

Recently we've been studying how much the climate system varies naturally across different components of the system, and across timescales. This variability can make it difficult to identify climate change trends in relatively short climate data records—even for such basic things as temperature and precipitation. In my lab, we are assessing when and where it will be possible to use data that goes back only to the 1980s to directly observe change in the ocean carbon sink.

Do you think there is hope in science and technology, or as these articles and reports tend to frame it, are we doomed?

Clean energy technology and energy efficiency are critical. We need to be able to produce most of our energy without producing CO2, and we should be as efficient as possible when we use energy.

But it is important to understand that even if we got very clean in terms of energy and cut emissions very quickly, we

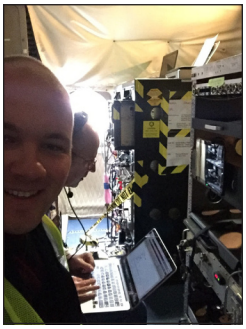
See "McKinley Q&A" continued on p. 13

ORACLES Field Season 2016

Two AOS students journeyed halfway around the world for climate science. Andrew Dzambo and Elin McIlhattan share their experiences from the recent NASA ORACLES field campaign.

Science
Andrew Dzambo

From August 25 through September 8, I had the great fortune to take part in NASA's ObseRvations of Aerosols above CLouds and their intErationS (ORACLES) experiment. This multi-million dollar NASA field campaign, taking place over the SE Atlantic Ocean, included 100+ scientists (on 19 instrument teams) from multiple universities and NASA research centers. The SE Atlantic Ocean during this time of year is, in the words of ORACLES Principle Investigator Jens Redemann, a "natural laboratory" due to the collocation of a semi-permanent stratocumulus cloud deck and biomass burning layer transported from the African continent. I came to Wisconsin specifically to do cloud/aerosol research, but little did I know I'd be collecting the data I will one day use for my dissertation.



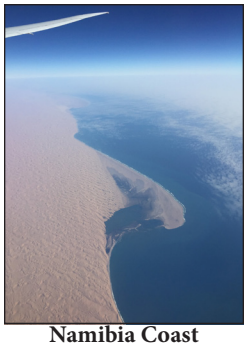
Elin McIlhattan (left) and primary students discussing NASA projects at the Love Pulses conference in Ongwediva, Namibia.

I was a part of the Airborne Precipitation Radar—3rd Generation (APR3) group. This suite of radars, operating at Ku, Ka and W bands aboard the NASA P-3 Orion aircraft, was designed to match the frequencies of the spaceborne Global Precipitation Mission's (GPM) dual-frequency precipitation radar (DPR; Ku/Ka bands) and CloudSat Cloud Profiling Radar (W band) such that aircraft science missions (like ORACLES) can collect data and directly validate the spaceborne measurements. For ORACLES, the end goal of the APR3 team is to quantify changes in cloud morphology and precipitation in the presence of the biomass burning layer. Eventually, we hope this knowledge can be later applied to spaceborne precipitation retrieval algorithms such that retrieved rainfall is robustly characterized and incorporated into climate models to improve predictions of future climate.

In my experience operating the APR3 radar system, the most challenging (or perhaps intimidating) part was recalling my 1990s computer savvy and following operational instructions on the timeless graphical interface software. Getting the radar started and later shut down were the two most important but pedantic tasks while in flight because the startup/shutdown instructions, if not followed correctly, could damage one or more of the APR3's most sensitive parts. Otherwise, operating the radar was as easy as clicking "Start Radar" and "Stop Radar" on a computer screen.

Elin McIlhattan with Rob Wood, NUST, and Gobabeb colleagues, setting up their shared booth at the expo center.

Perhaps the most fulfilling part of the science experiment, both while in flight and in the main HQ, was interacting with such a large group all dedicated toward accomplishing the same science objectives as me. After a couple days, I nearly forgot about all the 4:45AM wakeup times, the 40 minute one-way drives to/from the airport and 8+ hour-long flights. The energy resonating from person to person was a truly incredible, intangible feeling to describe in words. My perspective of research is forever changed by this field project, and I cannot wait to go back next year!



Namibia Coast

Outreach
Elin McIlhattan

Like Andrew, I was also lucky enough to be part of the APR3 instrument team for the 2016 ORACLES field season. I operated our three frequency radar on 9 out of the 15 P-3 science flights and participated in integration and de-integration of the instrument at the NASA flight facility in Wallops, Virginia, before and after the field campaign.

About a week into my time in Namibia, I was invited to participate in an outreach activity for the project. I went with Rob Wood, deputy PI of the ORACLES campaign, to the "Love Pulses Science: The pulse of innovation" conference in Ongwediva in northern Namibia. We traveled and shared a booth at the Trade Fair Center with host scientists and

See "ORACLES" continued on p. 13

Featured Professor – Pao K.Wang

Greg Tripoli and John Young

Professor Pao K.Wang retired this September after a distinguished career with AOS spanning 36 years. In 1980, Pao was recruited from UCLA and became the Department's chief cloud physicist and air chemistry expert. Pao has been recognized internationally for his extensive work with a broad range of cloud microphysical processes and thunderstorm dynamics. He mentored 9 Ph.D. students and an additional 7 M.S. students, who now have careers in research groups and academia in the U.S. and Taiwan.

Over his productive career at Wisconsin, his research focused on developing mathematical representations of ice hydrometeor geometry that he subsequently used to quantify the nature of turbulent airflow around falling ice and liquid complexes and effects on the efficiency of inter- particle interactions, such as those that lead to the growth of hail and graupel. In the last 2 decades, Pao has been recognized for his study of the dynamics of supercell thunderstorms, associated cirrus clouds, and water vapor transport across the tropopause into the lower stratosphere. Professor Wang regularly taught core classes in undergraduate thermodynamics, graduate level core Thermodynamics, Cloud Physics, and Air Chemistry. Pao also occasionally taught freshman level classes in Weather and Environment.

Throughout his career, Wang has also been active in the cloud physics community in Europe serving on advisory boards, editor roles for several journals and scientific societies and participating in International Workshops. In addition, he also is widely known in the Taiwan meteorological community, where he has recently served as President of the Taiwan (ROC) Meteorological Society.

Pao has written two textbooks distributed in both Asia and the West, including his recent book *Physics and Dynamics of Clouds and Precipitation* (Cambridge University Press, 2013), and previously *Ice Dynamics* (Academic Press, 2002). He published very widely, with six book chapters and 96 journal articles in his main research field as well as historical Chinese climate, fluid dynamics, and mass transfer.

Professor Wang served as Department Chairman of AOS from 1994-1997. He was awarded the S.C. Johnson Distinguished Fellowship (1990) and the Alexander von Humboldt Senior Research Award (Germany, 1993). Wang was named a Fellow of the American Meteorological Society (2004) and a Fellow of the ROC Meteorological Society, Taiwan (2008).

In September 2016, Professor Wang became a member of the Emeritus Faculty of the Department of Atmospheric and Oceanic Sciences of the University of Wisconsin–Madison. We all hope to continue collaborating with Pao in his new roles. n

Len Robock Lecture Series 2015–2016

The Robock lecture series is supported by a generous gift made from the estate of Leonard Robock with the mandate that the Department bring in an expert to give a public lecture on an issue related to the public interest (e.g. climate change, tornadoes, hurricanes, hydrothermal vents, etc.). The lecture is advertised broadly and presented at a level accessible to the public as well as students and educators. It aims at educating attendees on the state of our knowledge on the issue at hand. We were fortunate enough to have two Robock lectures in the 2015–2016 season, both focused on climate change.

Katherine Hayhoe delivered the fall 2015 Robock lecture, co-sponsored by the

Nelson Institute's environmental film festival "Tales from Planet Earth," which had the theme "Belief". Hayhoe is a "climate change evangelist" who you may have seen recently talking climate change with President Obama. She is frequently featured in national media discussing climate science and has made a name for herself reaching out to evangelical Christians, focusing on providing science-based information to religious audiences. She is the author of *A Climate for Change: Global Warming Facts for Faith-Based Decisions*, a book that untangles the complex science of global warming and many of its associated misconceptions. Hayhoes academic credentials include being an atmospheric scientist at Texas Tech University, and founder and CEO of ATMOS Research, which provides information to a broad array of institutional clients on how climate change will affect our lives.

See "Lecture Series" continued on p. 7

John Young Golden Anniversary in AOS

John Young, Emeritus Professor, arrived from MIT as a dynamics modeler in 1966 to start his 42 year teaching career. The department was then 18 years old, and the faculty of seven professors was crammed into part of the 4th ("attic") floor of Science Hall. In about three years, the faculty and student populations doubled in size, the numerical models and weather satellites rapidly matured, and we moved into our AOSS building in 1968.

Young created three graduate dynamics courses and the Midwest Geophysical Fluid Dynamics program. The department joined the research revolutions in dynamical numerical modeling and satellite remote sensing, and the course offerings followed. The department of the early '70s had three primary areas of research strength: synoptics/dynamics, radiation/remote sensing, and climatology. Our expertise allowed many to participate in the Global Atmospheric Research Program ("GARP") of the 1970s, and the graduate course on atmospheric circulation systems was formed in connection with a special program for MS level NWS students. Young extended his tropical-related research into the Asian monsoon ("MONEX": 1978–86) and tropical air-sea coupled systems ("TOGA": 1986–1998). As a result, he created a course in global climate processes and one in atmospheric and oceanic boundary layers.

In 2003, his 6th year as AOS Chair, Young began directing the State Climatology Office due to budget shortfalls. Since then, he and Dr. Edward Hopkins have teamed as half-time volunteers to create the many climate data products on the SCO website. Young has given talks to AOS, UW climate and chaos scientists, and the general public through newspapers and TV. Primary emphases have been to explain both climate change and climate variability, the differences between global and regional trends, and the probabilistic nature of trends in extremes. He continues this role in uncertain times, but especially fondly remembers the students and colleagues of his career with great fondness. n

Social Media Accounts for our Alumni and Friends

AOS departmental Facebook page: facebook.com/uwaos**.** "Like" us to get news, updates, and interesting weather stories from the department.

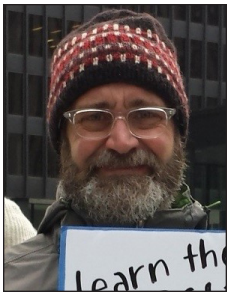
AOS alumni Facebook group: facebook.com/groups/uwaosalumni**.** Join the group to stay in touch with us and with each other! Let us know what you're up to!

AOS network group on LinkedIn: linkedin.com/groups?gid=6563986 Join the group to share professional leads and advice with each other and with our current students.

AOS Twitter account. Follow us at @UW_AOS!

Lecture Series *(continued from page 6)*

David Archer, an expert on the global carbon cycle and its relation to global climate, delivered the spring 2016 Len Robock Lecture. A professor in the Department of Geophysical Sciences at the University of Chicago, Archer is a leading researcher on the balance between carbon dioxide levels in the atmosphere and oceans and the connection to fossil fuel emissions. An elected Fellow of the American Geophysical Union, David Archer is the author of several books on climate change including *Global Warming: Understanding the Forecast*, *The Warming Papers*, *The Global Carbon Cycle*, *The Long Thaw: How Humans are Changing the Next 100,000 Years of Earth's Climate*, and *The Climate Crisis*. He is a regular contributor to RealClimate, a climate science blog written by climate scientists for journalists and the public.



Archer's public lecture explored an alternate reality in which earth's atmosphere had a different concentration of carbon dioxide when humans first started burning fossil fuels. Archer discussed how the timing and intensity of the climate impacts from burning fossil fuels depends on the natural carbon dioxide concentration in the atmosphere at the time fossil fuel energy first becomes widespread. If the natural (pre-industrial) concentration of carbon dioxide had been a factor of two or more lower, the climate impacts of fossil fuel emissions would have occurred about 50 or more years earlier. Given the limits of scientific knowledge a century ago, there would have been significant challenges for society to understand the enormity of the anthropogenic climate change phenomenon in time to prevent it. n

AOSS Rooftop Cameras

Pete Pokrandt, AOS Systems Administrator

Look, up in the sky! It's a bird…it's a plane! It's…what is that, anyway? Let's check the AOSS rooftop cameras and see!

Since 2010, several cameras attached to the wall around the roof of the AOSS building have been continually monitoring the skies for interesting weather and whatever is going on in the skies around Madison. Today, five cameras view the skies to the west, northwest, north, east, and south directions.

We update time lapse movies every few minutes using images 10 seconds apart from before sunrise until after sunset. For each camera, there are loops of the past 15 minutes, the past hour, and 5AM until the current time. A loop of the entire previous day is also available for each camera, updated late in the evening, and these loops are archived.

I am constantly amazed at how you can look out the window at the sky and see just ordinary clouds. But when the clouds are put in to motion through these time lapse videos, you can see the formation, decay, entrainment, virga…the list goes on and on. The clouds really come to life. Almost every day there is something interesting to see.

Over the years, many interesting features have been captured by the AOSS Rooftop cameras. Here are a few that I can think of.

The meteor that fell west of Madison and exploded on the way down on April 14, 2010, produced an epic photo that was featured on several national newspaper front pages and TV news outlets.

We've seen several bores (June 27, 2010, and August 4, 2012, for example), as well as numerous thunderstorms with nice lightning displays and very photogenic gust fronts—July 22, 2013, June 29, 2015, and July 12, 2016, are just a few. There was an epic view of mammatus clouds on Sept. 9, 2014.

Lake effect snow on Lake Mendota? Get real…but yes, the rooftop cameras documented such an event on January 11, 2016.

Several occurrences of steam fog have also been captured, including one strange case on November 2, 2010, of a "fogcane" where a circulation set up over the lake, and the fog appeared to move counter-clockwise around the lake, resembling a small-scale hurricane.

March 10, 2012, was a windy day, and the ice broke up on Lake Mendota. The time lapse shows a giant ice cube breaking loose from the south shore and breaking up over the course of the day.

Trying to explain wind shear to a non-meteorologist can be challenging, but such shear is frequently seen in the rooftop camera videos; March 8, 2011, April 6, 2011, and October 22, 2012, are some great examples.

We're still waiting for the cameras to catch a tornado, but on August 8, 2011, the genesis of a weak tornado was captured over Lake Mendota. This feature passed over the isthmus as a funnel cloud and eventually moved out over Lake Monona as an EF0 tornado, much to the surprise of boaters out for an evening on the lake.

The rooftop camera pictures and videos are all publicly available. The website www.aos.wisc.edu/alumni/webcam.htm

See "Rooftop Cameras" continued on p. 11

A thunderstorm gust front overtakes UW–Madison on August 19, 2016, as seen by the AOSS Rooftop Cameras.

A Furious Atmosphere: The Fairdale, Illinois, EF4 Tornado

Luke E. Odell, Ph.D. Candidate

I first met Clem Schultz as he was pulled, head bleeding, from the remains of his home on April 9, 2015. This was Fairdale, Illinois, or what was left of it. Houses completely leveled, cars tossed like toys, propane tanks and power lines hissing. The strongest tornado of 2015, rated an EF4 on the Enhanced Fujita scale, had just torn a 30-mile stretch across northern Illinois starting near Franklin Grove, finally dissipating just southeast of Rockford. At times it reached up to ¾ of a mile wide.

An approaching nightmare - Clem's view (a video screen-grab) of the tornado from his 2nd floor window looking southwest at about 7:00 pm CDT, less than a minute before it struck his house. Permission to use video provided by Clem Schultz

Clem had been standing on the second story of his Fairdale home filming the tornado roar toward him with a cell phone, in some of the most extraordinary footage ever documented. He thought it was heading to the west of his small town, but the video shows the tornado suddenly bear down on the house with terrifying power. Winds of at least 200 MPH brought his house crashing down in seconds. It was nothing short of a miracle that the 84-year old survived. The tornado left dozens of families without homes but no one lost as much as Clem. His wife, Geraldine Schultz, had been on the first floor as the tornado hit, and was killed.

In four years of storm chasing I have never seen such incredible destruction. The experience was something that cannot be replicated in a classroom and so the opportunity offered to the students of Professor Gregory Tripoli's AOS 453 (Mesoscale Meteorology) class on this day was an extremely rare one.

I have always been fascinated by severe weather, particularly the power of tornadoes. But I'm originally from the United Kingdom, and I had to settle for watching and reading about extreme weather remotely. It wasn't until Professor Tripoli gave me the opportunity to study tornado dynamics as a graduate student here at the University of Wisconsin that I finally saw them in the flesh. Although I wasn't the official teaching assistant of AOS 453 in the spring 2015 semester, Professor Tripoli had asked me to come in on April 9 to help direct a lab on the potential for severe weather in the region that day. Professor Tripoli wanted to draw on my experience as a storm chaser and our collaborative research on how tornadoes form in thunderstorms. I had just arrived back into Madison that morning from chasing storms in Oklahoma with my team, Project Supercell. I knew that favorable severe weather parameters were evolving over parts of Iowa and Illinois.

At about 2PM CDT during the real-time AOS 453 lab, we began to track a line of severe thunderstorms that formed in eastern Iowa and began moving east toward the Mississippi river. A combination of wind shear (large speed and directional changes in wind with height), instability (created by warm moist air trapped below air that rapidly cools with height) and a forcing mechanism

The path of destruction. An aerial shot of Fairdale after the tornado, the original location of Clem's house is circled.

are required to generate storms called supercells that are capable of supporting the most violent tornadoes. This overlap of atmospheric conditions, although rare, occurs most frequently in warm sectors of mid-latitude cyclones during the spring in the central Plains and Midwest of the U.S. As we taught the class that day, we used several data sources to determine that the atmosphere in northern Illinois was developing particularly favorable characteristics for tornadoes into which the line of supercell storms were moving. Seeing an opportunity for the students to experience a tornado in the field, I suggested an impromptu chase. A number of of the undergraduate students volunteered to take part.

The students and I used Doppler radar and communication with remaining students in the classroom to target the strongest storm in the line of supercells. We arrived in eastern Iowa around 5:30PM and saw a weak, short-lived tornado near Clinton, but soon after this storm became heavily precipitation-dominated. When this happens tornadoes do not often form because the excess of cold air generated by precipitation cannot be lifted into the storm from close to the surface. This produces a so-called outflow boundary, which focuses new storm development

See "Fairdale Tornado" continued on p. 10

Fairdale Tornado *(continued from page 9)*

out away from the older storm. With this knowledge, we took off east out ahead of the first storm into northern Illinois. We were in time to watch a rotating cumulonimbus tower explode upwards into the atmosphere just north of Interstate 88 in central northern Illinois. The Fairdale tornado would form from this less than 30 minutes later, shortly after 6:30PM.

View of the Fairdale, IL "wedge" tornado from Interstate 39. *(Photo courtesy of Dr. Walker Ashley of NIU)*

Several students and myself witnessed the tornado, more than a half-mile wide, cross Interstate 39 ahead of us. Monitoring Doppler radar and constant communication with students back in the classroom, we used the lessons taught in the lab to stay safely on the southern side of the storm that was moving northeast and away from us. The sight was breathtaking. The students were awe-struck by the physical reality of the science they studied. This turned into horror when we followed the tornadoes path right into the town of Fairdale minutes after the tornado. The whole thing was so surreal that it has been difficult to put into words since. The realization of the danger of severe weather and the public benefit of our research was made starkly apparent.

AOS 453 chase team. *(Photo courtesy of Kirby Wright)*

A year later at the Fairdale memorial event, the governor of Illinois, Bruce Rauner, and Clem's family acknowledged the work that we do and thanked us for studying these violent storms. The Fairdale tornado has gained international media attention. Recently, Craig Oswald (now an AOS graduate student) and I were interviewed by back2back productions for a documentary on tornadoes for a BBC series, *The World's Deadliest Weather,* that will include our story and is scheduled to be aired early next year.

Clem is now doing much better. He now lives in a new farm thanks to help from the community and relief funds. He attends the veteran's hospital in Madison regularly and we always meet and catch up. I am thankful to say he has improved significantly. We have used his astonishing video to compare with our computer simulations of tornadoes here at AOS. SSEC scientist, Leigh Orf, was able to identify similar fine-scale structures in Clem's video that are evident in his modeled storms. Clem hopes that the video will some day help to save someone's life. The AOS 453 students that had the opportunity to take were exposed to the powerful reality of our atmosphere, something few are able to experience in their lifetimes.

See Clem's video of the tornado and other storm chasing videos on Facebook at: facebook.com/projectsupercell

Check out more of Dr. Walker Ashley's coverage of the event on his interactive map page at: https://goo.gl/FhQjUP n

Project Supercell (Luke Odell, left, Anthony Wilcox, right) with Clem Schultz at the Fairdale tornado 1-year memorial in April, 2016.

AOS participates in TCI and SHOUT Field Studies

Gregory J Tripoli

Professor Tripoli and his research group together with scientists from SSEC have been participating in two major field projects focusing on the study of Tropical cyclone outflow and its relationship to intensity. Two field projects were involved, namely the Office of Naval Research project called TCI (Tropical Cyclone Intensity) project and NOAA's Sensing Hazards with Operational Unmanned Technology (SHOUT). Because of its uniqueness the focus will be on the TCI project here.

The TCI project was designed to investigate the utility of a new dropsonde technology, called the High Definition Sounding System (HDSS) which is an automated system deploying the eXpendible Digital Dropsonde (XDD) manufactured by Yankee Environmental Systems. These dropsondes measuring pressure, temperature, humidity and wind are designed for high altitude rapid-fire deployments without a parachute from manned or unmanned aircraft. Their unique capability is that measurements can be taken from several dozen falling sondes simultaneously, allowing aircraft to lay a curtain of sondes across a tropical cyclone with spacing of 1–2 km along the flight trajectory. The aircraft flying missions into tropical cyclones is a WB-57 US Air Force plane, flying up to 64,000 feet above the surface and above the tropical cyclone. These planes fly so high above the surface, that they must be piloted by NASA astronauts.

The initial testing of the HDSS sonde system began during the 2014 TC season, with test missions into Hurricanes Edouard and Gonzalo. After the 2014 shakedown, full missions began in the 2015 hurricane season in the Atlantic and East Pacific. Tripoli participated as a mission scientist out of Wallops Island Flight Facility, and Assistant Researcher Dr. William Lewis participated as a mission scientist and forecaster while graduate student Scott Trevorrow participated as a sonde specialist out of Ellington Air Force Base in Texas where the WB-57 was stationed. Other participants included several AOS graduate students and scientists from SSEC who acted as forecasters, mission scientists and researchers.

This is a rare photo from rear facing camera of the WB 57, during a mission into Erika, where the camera unbelievably caught the sonde in the air, just after it was released and moving away from the plane.

The 2015 hurricane season began slow, but the patience of the TCI team was rewarded with 1 minor and 2 major hurricanes late in the season, beginning with Marty, then Joaquin and finally Patricia which was the most intense tropical cyclone ever recorded in any ocean basin. With the final mission of the season and a "super storm" anticipated by model forecasts, the TCI team put down an unprecedented curtain of sondes across Patricia stretching from the outflow regions across the eye and back into the outflow. The mission plan achieved 1.5 km sonde spacing across the eye, during the period of the Patricia's maximum intensity. This kind of observation set is unprecedented anywhere in the science. Subsequent analysis has revealed explicit measurements of phenomena never measured directly before, such as conduits of moist static energy rising in the eyewall and ejected into the outflow layer, gravity waves, trapped gravity waves, super-critical (turbulence) outflow layers, inertially unstable layers, embedded squall line structures and more. History was made with these unique missions, and AOS was part of it! n

Rooftop Cameras *(continued from page 8)*

has links to the current real-time images and loops, the YouTube "greatest hits" channel, and another interesting perspective where the camera images are overlaid on the corresponding time GOES image over Madison.

If you teach and are looking for some good visuals of atmospheric phenomena, please check the YouTube archive and feel free to share with your class. And please let us know if you do!

To steal a phrase from *Star Gazers*' Jack Horkheimer, "Keep looking up!" n

Students Aim to Help Prevent Frost Damage to Wisconsin Orchards

Grant Petty

Early Sunday morning on May 15, temperatures dropped into the mid-20s over large parts of Wisconsin in an unusually hard late-season frost that affected growers around the state. Wollersheim Vineyards reportedly suffered a 75% loss of their red grapes and more than 25% of their white. Other vineyards and orchards were similarly affected. Overall losses of spring crops in Wisconsin were in the many millions of dollars.

Motivated partly by events like this one, Scott Kee, Vice President of Sacia Orchards in Galesville, Wisconsin, contacted the Atmospheric and Oceanic Sciences department and asked whether we would be interested in putting students on a project to help map the movement of cold air in their apple orchards on frost-prone nights so as help plan future plantings. The suggestion came from Scott's father, Jack Kee, a 1952–53 graduate student under Prof. Vern Suomi.

Senior Cody Beeson and graduate student Brian Zimmerman readily responded to my invitation to participate in this project. Both were enthusiastic about getting out into the field to assist in planning and executing a data collection and analysis effort. Our ability to respond positively to Mr. Kee's request was made possible largely because of weather instrumentation recently acquired through a generous gift to the department.

The project would serve two purposes. First, it would provide Cody and Brian with valuable hands-on experience with "real world" atmospheric measurements that would help prepare them for possible future work in applied meteorology. Second, it would exemplify AOS's commitment to the "Wisconsin Idea," which is the notion that boundaries of the University are the boundaries of the state and that an important part of the University's mission is to provide knowledge and expertise that benefits Wisconsin farmers and other businesses.

On May 21, Brian and Cody drove up to Sacia Orchards and spent two days deploying our five fully equipped logging weather stations at strategic locations across the four Sacia properties, supplemented by 32 nickel-sized temperature loggers called Thermochrons. Radiation shields for the Thermochrons were improvised from a few dollars worth of plastic parts and wire from Home Depot.

Student Cody Beeson initiates data logging for one of the five weather stations deployed to Sacia Orchards. ***(Photo by Brian Zimmerman)***

The goal is to collect data on spatial differences in nighttime temperatures under clear skies and light winds and to see how these differences relate to larger-scale weather patterns. The data collection will continue through at least winter and spring, 2016–2017, though the full weather stations will have to return in January for use in our spring Field Measurements course.

Two months after the initial deployment, Brian and I returned to Galesville to inspect the weather stations and to verify that data were being correctly recorded. The weather that particular day was not exactly cooperative. For one, it unfolded as the hottest, most humid day of 2016 with a high temperature of 93 and a dewpoint of 78, and working outdoors for hours under the sun was challenging. To top things off, vigorous thunderstorms began popping up in the area and bringing drenching showers, forcing an early departure back home for Madison.

In late November, we returned under much chillier conditions to collect the first data from the fall season, and the analysis will follow shortly. As we gain experience with the micrometeorology of Sacia's orchards, we may plan for an expansion of the variety of observations to be made in future seasons. Resources permitting, this may include the use of a thermal imager and/or inexpensive wireless temperature loggers that can be polled remotely without the need to physically visit each site.

In the end, we are confident that Brian's and Cody's pending analysis of the collected data will provide valuable insights to Sacia Orchards, and we believe that this trial effort will open doors to mutually beneficial collaborations with agricultural interests around Wisconsin. Of particular note is that our ability to engage students with field measurements and data analysis—whether as part of a course or as an independent study project like this one—has been greatly improved as the direct result of recent gifts from our alumni earmarked specifically for this purpose.

See "Frost Damage" continued on p. 13

McKinley Q&A

(continued from page 4)

still have 30-40 years of climate change ahead of us. The things we do today will not have much effect in my lifetime—even if I live to be quite an old lady. Even my children will not see effects until after middle age.

But the effect our mitigation actions today will have on the lives of our grandchildren and further descendants can be expected to be enormous. As hard as it is for us to do politically, we have no choice but to take the very long view with the climate problem. n

Interview reprinted with permission from the Nelson Institute (nelson.wisc.edu).

ORACLES *(continued from page 5)*

graduate students from both the Namibia University of Science and Technology (NUST) and the Gobabeb Research & Training Centre.

Love Pulses was focused on getting young students excited about science and informed about the opportunities that there are in Namibia to get involved. In Ongwediva, I spent most of my time at our booth talking with local primary school children about how special the clouds are that form off Namibia's coast, why NASA is interested in them, and why I love being an Earth scientist. Rob and I also recorded short videos about our careers that were shown in various sessions after we had to return to Swakopmund for more science flights.

Outreach activities like this one are key to the success of the ORACLES mission, because without the support and approval of the Namibian government the project would not be possible. My time in the north was an unexpected and welcome opportunity to see more of the country and help build partnerships with the Namibian scientific and educational communities. n

Frost Damage *(continued from page 12)*

We are working to further expand our capabilities with respect to field measurements. Examples of items on our current "wish list" include the following:

- An Aeromapper Talon fixed-wing unmanned aerial system (UAS) for airborne thermal imaging, $9,600
- Bench equipment for a new instructional instrumentation lab, $8,000
- A simple tethersonde system for boundary layer profiling, $5,000
- Ruggedized laptop computers for use in the field, $3,000 each.
- A 4-Component shortwave/longwave net radiometer, $2,500
- A FLIR Vue Pro R thermal camera, $2,000
- Reserve funds for tools and miscellaneous equipment, $1,000
- Expendable weather balloons, radiosonde units, and helium, $250 per launch.

If you would like to contribute toward the further expansion of AOS's modernized measurement capabilities in support of hands-on instruction and public outreach, please contact the department to earmark a gift specifically-toward that purpose. And thank you for your support! n

Graduate student Brian Zimmerman works in oppressive heat and humidity (heat index 109!) to check the operation of one of 32 Thermochron sensors deployed around the four Sacia properties. *(Photo by Grant Petty)*

Chair's Column

(continued from page 2)

program toward providing what we see as enormous opportunities in the 21st Century economy. The UW is adopting a new "Named Option" program, whereby enhanced curriculum will be designed to accommodate specific designed course plans involving multiple departments and new internship or project requirements designed to confer marketable skills beyond just our AOS students.

Currently, we are actively developing named options in (1) Natural Hazards and (2) Big Data, and we are considering named options for (3) Business, Reinsurance, Markets and Economics of Weather and Climate, (4) Instrument Design, and (5) Air and Water Pollution and Environment. The named options, in addition to requiring outside classes, will entail student projects or internships and possibly a slightly altered path through our core curriculum. Our core AOS curriculum, on the other hand, will not change, but may be reordered a bit and enhanced to accommodate these changes. We will continue to offer what we think is the best AOS curriculum anywhere for

See "Chair's Column" continued on p. 14

Chair's Column *(continued from page 13)*

a student wishing to move on to graduate school or the NWS.

In support of these named options, we are also actively proposing a series of "Freshman Interest Groups" (FIGs) which are supported by a new University initiative to stimulate multidisciplinary interests in the incoming Freshman enabling them to design a path forward in their degree that helps them to reach their educational goals. The idea is to create small groups of 10–20 interested Freshmen who take a series of 3 classes together, one of which is a small class of only the FIG students designed to discuss the issues of the FIG subject, as well as the material they learn in the other 2 classes. As AOS has not made official contact with Freshmen as per University policy in the past, we feel the FIGs will give AOS the opportunity to reach Freshmen early in their college careers, exposing them to the many opportunities in our science. We are currently getting ready to offer a Chemistry FIG with Professor Tracy Holloway in Spring 2017, a Natural Hazards FIG with Tripoli, and a Big Weather FIG with Morgan in Fall 2017.

The FIGs are the first step toward expanding our undergraduate program, and if successful, we expect that it will lead to increased visibility and ultimately the growth of the AOS within the University.

The development of a new paradigm in undergraduate opportunities that we are attempting to create, will require a team consisting of not only Department faculty and staff, but also one coached by our alumni who are out there in the workplace with their finger on the pulse of the discipline. We hope that you, as alumni, will be able to help us with our expanding educational goals. In particular, we will be seeking internship opportunities for our students in concert with each of the named options we are developing, as well as periodic visits from our alumni to talk to each of the FIGs about current and future opportunities in the work place. We also welcome input from you concerning what you may see as named option opportunities that we have missed or opportunities to improve those that we are considering.

Now lets move on to another subject. The Space Sciences and Engineering Center (SSEC) is undergoing perhaps the largest change in its operation since it was formed over 50 years ago. On November 4, it was announced that Dr. Hank Revercomb was stepping down as Director of SSEC and would be replaced by Interim Director Professor Steve Ackerman, who also serves as an Associate Vice Chancellor for Research and Graduate Education. We extend our congratulations to Dr. Revercomb for the excellent work he has done as Director over the past 17 years to bring SSEC to great prominence internationally and financial stability at home. Ackerman is also replaced at CIMSS by Dr. Paul Menzel, who becomes Interim Director of CIMSS.

These changes occur at the same time, when the University Graduate School withdrew its special policy exclusively applied to SSEC, and originally negotiated by Professor Suomi when SSEC was formed, of allowing SSEC to keep all the overhead generated by its research grants. This enabled SSEC to build the remarkably resilient infrastructure with which we are all familiar. The challenge facing SSEC now is to maintain their excellence in the face of this rather dramatic change. SSEC is a close partner to AOS, and their challenge is our challenge as well. Professor Ackerman will work with the University to ease the transition of SSEC to this new funding paradigm and to make sure that SSEC flourishes as it always has.

The Atmospheric and Oceanic Sciences address what are perhaps the greatest issues of our time. We, as a Department, together with SSEC and CCR, are moving toward providing the capabilities to observe, understand, and predict the variability of the atmosphere and oceans that society requires. The changes underway in AOS will more effectively empower our students to use the knowledge we gain to fill societal needs while our core program continues to grow the knowledge base and equip new scientists with the tools they need to continue that progress. Reorganization is an opportunity for renewal and improvement. We welcome this opportunity to improve our contributions to the University, Society and the Science. n

2017 Alumni Reception Scheduled

For those planning to attend the upcoming Annual Meeting of the American Meteorological Society in downtown Seattle we are happy to announce that the Robock Alumni Reception is scheduled for

Tuesday, January 24

from 6 to 9PM

in the Grand Ballroom D of the Sheraton Seattle Hotel.

As always, there will be good food and great conversation as we share memories and catch up on the news in each other's lives. We hope to see you there!

AMS 2016 Annual Meeting

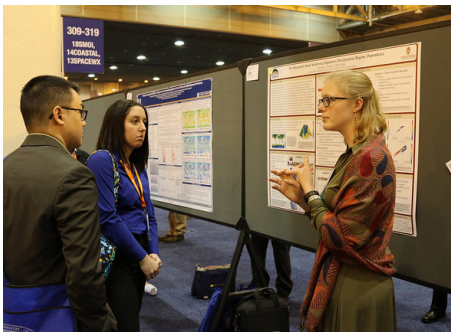
Professor Ankur Desai recieving either his *Clarence Leroy Meisinger Award* or the inaugural *Early Career Achievement Award*.

Professor Jonathan Martin recieving *The Edward N. Lorenz Teaching Excellence Award*.

AOS Alumnus Louis Uccellini (BS '71; MS '72; PhD '77), Dr. Robert Weinbeck, Associate Director, AMS Education Program, Washington, DC and AOS Emeritus and Alumnus Ed Hopkins (PhD '85)

AOS Alumnus Pete Pokrandt (BS '88; MS '92) cruising the posters in Poster Hall

Zak Handlos (PhD '16) perusing the posters



Samantha Tushaus, SSEC Assistant Researcher, talking about her research

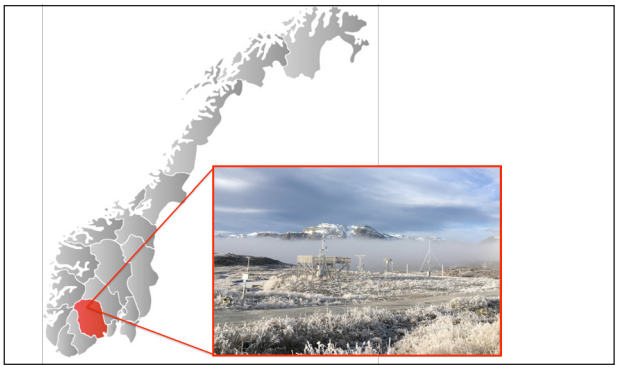
AMS 2016 Annual Meeting *photos courtsey of American Meteorological Society*

Getting Ready to Ship Equipment to Another Country

Claire Pettersen & Norm Woods

This summer, researchers Norm Wood and Claire Pettersen dusted off their engineering and logistics hats to get some instrumentation across the Atlantic Ocean. Wood and Pettersen are part of a National Science Foundation funded project studying how snow formation influences strong high latitude storms to improve wintertime weather forecasts. For the first season of this experiment (Winter 2016–2017), the Principal Investigators, Tristan L'Ecuyer and Steve Cooper (Utah), settled on a site in Haukeliseter, Norway. Nestled in the beautiful and hilly Telemark region of the southern Norway, the Norwegian Meteorological Institute (Met Norway) maintains a suite of instruments recording snowfall accumulation. L'Ecuyer and Cooper proposed augmenting this site with a MicroRain Radar (MRR; small, portable radar), a Particle Imaging Package (PIP; high-speed and resolution videos), and a Multi-Angle Snowflake Camera (MASC; three cameras taking photos of individual snowflakes).

In order to deploy these instruments successfully, Cooper, Wood, and Pettersen spent months working with contacts at Met Norway to design instrument supports, deal with electrical compatibility, and plan how to pack, ship, and get these instruments through customs and into Norway in a timely fashion. With the help of experts on almost every floor of the AOSS building, the team was able to transport the instruments and their accessories to Oslo and then up to the site. Pettersen and Cooper traveled to Norway in October to deploy the instruments. With the help of collaborators at Met Norway, the MRR, PIP, and MASC were installed on the roof of the science facility at Haukeliseter. The instruments will remain at the site until June of 2017, at which point they will be transported to Sweden. n



Location of the Met Norway snowfall measurement site at Haukeliseter, in the region of Telemark, Norway. Inset shows the site shrouded in a low fog.

Met Norway snowfall measurement equipment (left, background) and science container (right, foreground). The MRR, PIP, and MASC are mounted on the top of the container. Not a bad spot to spend a snowy winter.

A Day in Meteorology History

Edward J. Hopkins, PhD
Assistant Wisconsin State Climatologist

8 Nov 1870: The first storm warning was issued by Milwaukee's Professor Increase A. Lapham of the U.S. Signal Service as a cautionary forecast for the Great Lakes. Lapham, who is considered to be Wisconsin's first scientist, believed that warnings of deadly storms on the Great Lakes could be derived from telegraphed weather observations. Through his perseverance, a bill was introduced by his congressman and signed into law the previous February to establish a national telegraphic weather service. One week before Lapham's successful forecast, the Signal Service had begun taking simultaneous observations from 24 stations across the eastern half of the nation and sending these data to Washington, D.C., by its telegraph network.

MILESTONES

Congratulations to Our Graduates

Ph.D. recipients

Spring 2016:

Kyle S. Griffin, *"Investigations of the preferred modes of North Pacific Jet Variability, their Downstream Impacts., and Tropical and Extratripical Precursors." (Martin)*

Zachary J. Handlos, *"Composite and Case Study Analyses of the Large-Scale Environments Associated with West Pacific Polar and SubtropicalVertical Jet Superposition Events". (Martin)*

Mark Smalley, *"Precipitation Aggregation and theLocal Environment." (L'Ecuyer)*

Pei Wang, *"Assimilation of Hyperspectral Infrared Sounder Radiances Under Cloudy Skies in a Regional NWP Model." (Ackerman)*

Summer 2016:

Kuniaki Inoue, *"Gross Moist Stability Assessment: convective Amplificationand Decay in the GMS Plane." (Back)*

Jacola Roman, *"A New Method for Near Real-Time Precipitation Estimates and Realistic Minimum Detection Times Using Remotely Sensed PWV." (Ackerman)*

M.S. recipients

Fall 2015:

Amanda Gumber, *"Investigating 3D Solar Radiative Cloud Effects via MODIS." (Ackerman)*

Spring 2016:

Kyle Hosley, *"The Utility of IDEA-I as a Wldfire Smoke Plume Forecast Tool: A Mid-July 2014 Case Study." (Ackerman)*

Xiaowei Jiang, *"Evaluation of Environmental Moisture from NWP Models with Measurements from Advanced Geostationary Satellite Imager." (Ackerman)*

Feng Zhu, *Non-thesis option.*

Summer 2016:

Yun Hang, *"The Effect of Cloud Type on Earthh's Energy Balance." (L'Ecuyer)*

Marian Mateling, *"Global Snowfall: A combinded reanalysis and spaceborne remote sensing perspective." (L'Ecuyer)*

Elin McIlhattan, *"Powder Days in the Arctic: A proposed physical mechanism behind a known model bias." (L'Ecuyer)*

Keiko Yamamoto, *"Dust Detection Using IR Channels of Himawari-8." (Ackerman)*

B.S. recipients

Fall 2015:

Joshua Weber

Spring 2016:

Lauren Deans

Alex Delvoye

Steven Fons

Alexander Fox

Robert Kelnosky

Kaitlyn Krzyzaniak

Ashtin Massie

Annastasia Sienko

Corinne Trott

Tyler Wright

Summer 2016:

Gabriel Bromley

Scholarships and Awards

Spring 2016 Departmental Awards

Kristen Mayer *received the Horn Award for excellence in overall performance as an undergraduate.*

Michelle Feltz *received the Lettau Award for outstanding master's thesis.*

Ross Dixon *received the Wahl Award for outstanding performance as a Teaching Assistant.*

Connor Dacey *received the Schwerdtfeger Award for excellent performance in the first year of graduate studies.*

Melissa Breeden *received the Colloquium Service Award for creative dedication to the intellectual life of the Department.*

Zoe Brooke-Zibton *received the Sunkel Award for exceptional scholarly potential.*

Shae Hamm *received the Lettau-Wahl Award for excellence in overall performance as undergraduate.*

Cody Beeson *and* **Brian Zimmerman** *received the Ettenheim Award for their participation in the Sacia Orchards field project.*

Alex Matus *received the Reid Bryson Graduate Award from the Center for Climatic*

In Spring 2016, AOS hosted its own formal graduation event. Here, our new B.S. degreee recipients receive applause from families and friends in attendance. Congratulations Class of 2016!

MILESTONES

Research for his poster, "What are the climate impacts of African biomass burning aerosols?" (coauthor Tristan L'Ecyuer).

Yun "April" Hang *received the Reid Bryson Graduate Runner-up Award from the Center for Climatic Research for her poster, "Distinguishing the effects of different cloud types on the atmospheric radiation budget" (coauthor Tristan L'Ecyuer).*

Emily Nettesheim *from the Department of Zoology received the Reid Bryson Undergraduate Award from the Center for Climatic Research for her poster, "Future Prairies Under a Warmer Climate: A Case Study of the Cold Tolerance of Two Prairie Plant Species" (coauthors Laura Ladwig and Ellen Damschen).*

2016 Poster Session Awards

Graduates

April Hang *(winner)*
Kai-Wei Chang *(honorable mention)*
Ethan Nelson *(honorable mention)*

Undergraduates

Henry Nuckles *(winner)*
Gabe Bromley *(honorable mention)*
Matthew Westphall *(honorable mention)*

Outside Awards

Elin McIlhattan *won the prize for Best Student Oral Presentation at the 21st Satellite Meteorology, Oceanography and Climatology Conference for her poster, "Leveraging A-Train Observations to Examine Arctic Cloud Processes in the Community Earth System Model" (coauthor Tristan L'Ecyuer).*

Luke Gloege *won the prize for Outstanding Student Poster Presentation at the Ocean Biogeochemistry, Gordon Research Conference on The Biologically-Driven Ocean Carbon Pumps for his poster, "Parameterizing Carbon Export Below the Euphotic Zone" (coauthor Galen McKinley, Colleen Mouw, Audrey Barnett).*

Navy Ensign Alexander F. Fox of Park Falls, Wisconsin, stands at attention as family members help with a pinning ceremony for graduates of UW–Madison's Army, Navy and Air Force ROTC units during an officer commissioning ceremony at Gordon Dining and Event Center at the University of Wisconsin–Madison on May 14, 2016. The event followed UW–Madison's spring commencement ceremony and formally recognized 34 graduates from UW-Madison as officers in the military. ***(Photo by Jeff Miller/UW–Madison)***

Newly awarded PhD & MS students rejoice during the AOS 2016 graduation ceremony.

ALUMNI NEWS

Correction to the 2015 Newsletter
Bart Adrian (MS '81) is not married to John Knox (PhD '96). John is married to Pam Knox (MS '82). This was a cut and paste error; sorry for the confusion.

Walter F. Dabberdt (MS '66; PhD '69) *has been honored by the Embassy of Finland in Washington D.C. as Knight, First Class, of the Order of the Lion of Finland, which is bestowed annually in recognition of civic and cultural contributions to the nation. Dr. Dabberdt was honored specifically for the know-how and export of Finnish environmental technology.*

Jennifer L. Koch, AICP (BS '08) *has been promoted to Associate within the Rhodeside & Harwell Firm for planning, urban design, and landscape architecture.*

Gijs de Boer (PhD, '09) *has been named a recipient of a Presidential Early Career Awards for Scientists and Engineers, "the highest honor bestowed by the United States Government on science and engineering professionals in the early stages of their independent research careers."*

Louis Uccellini (BS '71; MS '72; PhD '77) *is recipient of The Cleveland Abbe Award for Distinguished Service to Atmospheric Sciences by an Individual for dynamic, forward-looking leadership in a distinguished career dedicated to advancing operational meteorology to make the nation weather-ready*

Jon Davis (BS '85) *has earned the Kenneth C. Spengler Award for his extraordinary vision to advance the role of meteorology in the new energy economy and outstanding leadership of the AMS Energy Committee and its conference*

Kuniaki Inoue (PhD '16) *has won The Max A. Eaton Student Prize for his paper, "Gross Moist Stability Assessment: Convective Amplification and Decay"*

Dmitry Smirnov (MS '09; PhD '11) *was appointed to the National Emergency Management Association's (NEMA) Extreme Weather Adaptation work group for Dewberry.*

Melissa Owens (BS '05) *is the winner of the 2016 Wood Industry 40 Under 40 Award. Winners were selected from a field of more than 135 nominations by a panel at theWoodworking Network, the woodworking industry's leading information source, print and digital publisher.*

James McFadden (PhD '65) *was a finalist for the Samuel J. Heyman Service to America Medals for his nearly 50 years of service to the nation's hurricane hunter program, flying airplanes into hundreds of violent tropical storms to gather information for more accurate weather forecasts.*

SUPPORT ATMOSPHERIC & OCEANIC SCIENCES AT THE UNIVERSITY OF WISCONSIN

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o **AOS Department Fund—Unrestricted General Fund**

Our highest priority for new donations is our flexible Atmospheric and Oceanic Sciences Department Fund. This fund is used for a wide variety of high-priority needs established by the Chair in consultation with the faculty. Examples include

- Support for student travel to conferences and to participate in our Spring Break field observations and measurements course in Colorado.
- Repair and replacement of aging instructional equipment and rooftop weather instruments.
- Outreach and publicity activities, including the departmental newsletter as well as alumni events and special seminars.
- Up to six annual student awards for academic accomplishment or service to the department.

Undergraduate Financial Support

o **Warren E. Sunkel Scholarship in Meteorology Fund**

o **Lyle Horn Scholarship Fund**

o **Professors Heinz Lettau and Eberhard Wahl Scholarship Fund**

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To find out more about the above funds *or* to make your donation online, please visit http://aos.wisc.edu/alumni/giving.htm

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Ice Crystal Forest, Lake Mendota, Madison, Wisconsin. January 2016. Photo by Ilya Razenkov