

# DOING THE DEW POINT: THE NEXT GENERATION OF GRIDDED HUMIDITY

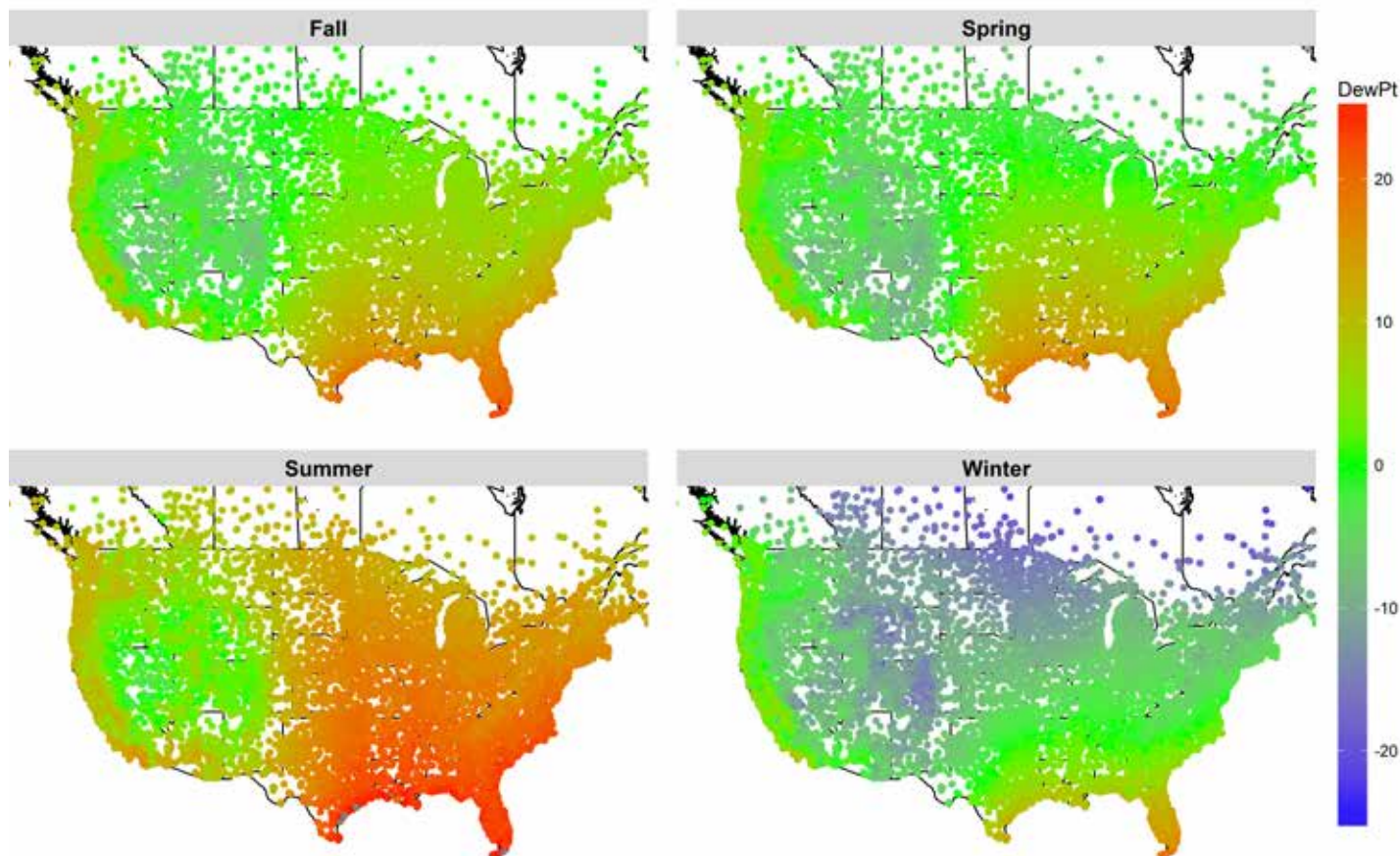


Figure 1. Mean daily dew point across the United States.

by Ruben Behnke in collaboration with Steven Running, University of Montana

The first thing I noticed about moving to western Montana from Wisconsin was that it's dry here. So dry that the phrase, 'It's not the heat; it's the humidity', doesn't apply here. Despite the fact that humidity is often overlooked here with regard to human comfort, it is, however, a vital part of ecological, hydrological, and agricultural research and activities in all climates.

This fact was recognized thirty years ago by **Dr. Steven Running** of the **University of Montana**, who, because he needed humidity data for his work, but did not have any because there were so few observations, had to develop an algorithm to estimate humidity from readily available temperature and precipitation data. In fact, only within the past five years has the number of observed humidity measurements increased to a level on par with that of temperature and precipitation, for which many data sets based directly on observations exist.

So, when Dr. Running offered me an opportunity to earn my PhD by creating the first gridded humidity data set for the U.S. based directly on station data, I jumped at the chance. When Dr. Running developed his algorithm in 1987, about

700 stations consistently measured humidity across the United States. Now, there are over 12,000. Current work is showing the detailed spatial, seasonal, and even diurnal (changing throughout the day) patterns of humidity at an observed density no one imagined even just ten years ago. We can look at gradients of dew point with respect to elevation and distance to coast; we can see the effect of the Great Lakes and the local influence of agriculture and irrigation, and we can examine, in detail, the large differences in the diurnal pattern of humidity that occur across the U.S.

As we move forward with our research, we'll be looking at how gridded data sets that estimate or model humidity compare to the observed data. Then, we get to the main objective of our work, which is using the observed data to create our own data set! That is very exciting, and my belief is that we can provide a highly accurate, gridded data set of average daily dew point to all end users who rely on this data.

# PEOPLE AND PARTNERS

## EPSCoR director named top scientist

**Ragan Callaway**, Montana NSF Director and **University of Montana** Regents Professor of Ecology, was named a “highly cited researchers” in the 2015 edition of “The World’s Most Influential Scientific Minds.”

The publication, recently released by Thomas-Reuters, analyzes data to determine which researchers have produced work that is most frequently



**Ray Callaway**

acknowledged by peers. Highly cited papers rank in the top 1 percent by citations for their field and year of publication. “The World’s Most Influential Scientific Minds” lauds Callaway for publishing the greatest number of highly cited papers between 2003 and 2013.

Callaway studies how plants function together in

communities and ecosystems, and his research has taken him around the world. He tracked knapweed back to its native range in Central Europe, researching how the invader interacts with soil microbes and other plants in ways that might naturally keep knapweed in check. Callaway also has sought out low-lying cushion plants on mountaintops from Montana to Alaska, the Andes, Europe, the Caucasus and New Zealand, studying how plants facilitate survival among one another and form communities in some of the harshest environments on Earth.

## IoE Director is visiting scholar in Switzerland

**Cathy Whitlock**, professor of Earth Sciences and director of **Montana State University’s** Institute on Ecosystems hub, is on sabbatical this spring serving as a Visiting Fellow with the **Swiss Federal Research Institute WSL**; and at the **Universität de Bern** as the Bellinzona Visiting

Scientist, Oeschger Centre for Climate Research, and with support from the Hans Sigrist Fellowship. Whitlock’s research areas are Quaternary environmental change and Quaternary paleoecology; vegetation, fire, and climate history of the western U.S. and southern South America; climatic variability through the Cenozoic; and data-model comparison of past climatic change.



**Cathy Whitlock**

## EPSCoR champion Bob Swenson passes away

**Robert “Bob” Swenson**, 81, passed away at home on Dec. 26 in the loving arms of Janet, his wife of 57 years, and his three children, Johanna, Kari and Paul. Swenson was instrumental in starting the Montana NSF EPSCoR program while at **Montana State University**. He was a Fellow of the Ameri-

can Physical Society and the American Association for the Advancement of Science. He received the Governor’s Award for Outstanding Service on the Science and Technology Council, the MSU Alumni Excellence Award in 1986 and 1990, and National Science Foundation’s (NSF) Award for Outstanding Contribution to EPSCoR.

He served on the Board of Directors of the National EPSCoR Coalition, the Montana Biotechnology Center of Excellence, the Association of Retirement Organizations in Higher Education, the Board of Trustees of the EPSCoR Foundation, and the Associated Western Universities.

*We will miss you, Bob! Thanks for everything you did for Montana NSF EPSCoR.*

*~excerpted from the Bozeman Daily Chronicle.  
<http://bit.ly/SwensonObit>*





**Bob Swenson**

## Montana NSF EPSCoR

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Montana EPSCoR’s Track I focus is on understanding the effects of climate change on sustaining healthy ecosystems and economic growth. The Institute on Ecosystems (IoE) is a state-wide Institute based at the flagship research universities through which current Montana EPSCoR activities are implemented.

 @MontanaEPSCoR

 @MontanaEPSCoR and @MtlIoE  
EPSCoR webpage: [mntsepscior.org](http://mntsepscior.org)  
IoE webpage: [montanaioe.org](http://montanaioe.org)

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## IoE, FWP join forces to help Upper Clark Fork River

**Dr. H. Maurice Valett** and **Dr. Marc Peipoch** from the **University of Montana** and the NSF EPSCoR-established Montana Institute on Ecosystems are excited about water quality problems. In a new cooperative agreement with the **Natural Resource Damage Program**, Valett and Peipoch will work closely with representatives of **Montana Fish Wildlife & Parks** to address water quality problems in the Upper Clark Fork River (UCFR), part of the nation’s largest EPA superfund site that is currently experiencing large scale restoration.

A history of mining contamination and present day nutrient loading have stressed ecosystem health, resulting in depauperate fisheries and compromised water quality. Valett and Peipoch’s restoration project will combine biological, chemical, and hydrologic studies of nutrients, algae, and stream bottom invertebrates to address multiple stressors on trout populations. Coordination between IoE and state agencies may lead to synergistic products enabling research and management objectives as riverscape restoration continues.



**Dr. Marc Peipoch**, Division of Biological Sciences, **University of Montana**, is an IoE researcher addressing water quality issues in the Upper Clark Fork River. A new cooperative agreement with the **Montana Natural Resource Damage Program** will focus, in part, on the green algal blooms seen here as one of the stressors that influence resident trout populations.

## EPSCOR-FUNDED STUDENT PUBLISHES ON GLOBAL WARMING IMPACT ON MOSQUITO-FIGHTING INSECTICIDE

A **Montana State University** alumnus who was supported by EPSCoR as a graduate student has published her first journal article — a study on the impact of global warming on a mosquito-fighting insecticide. **Shavonn Whiten**, currently earning a PhD at Virginia Tech, earned her M.S. in entomology from MSU in 2014. While at MSU, she was also supported by the Montana IDeA Networks of Biomedical Research Excellence (**INBRE**). Along with MSU's Dr. **Robert Peterson**, Whiten's work, published in the *Journal of Medical Entomology*, showed that the insecticide permethrin becomes less effective at killing the yellowfever mosquito (*Aedes aegypti*) as temperatures increase. These mosquitoes, which are found in the tropics and the subtropics, can transmit viruses that lead to dengue, chikungunya, yellow fever, and other diseases.



While conducting entomology research at MSU, **Shavonn Whiten (top left)** also taught a summer workshop for kids.

## Poulter named AAAS Climate Fellow

**Ben Poulter**, an associate professor of ecology at **Montana State University** and Fellow of the Institute on Ecosystems, is one of 15 climate change researchers from across the U.S. selected as a 2016-17 Public Engagement Fellow by the American Association for the Advancement of Science (AAAS). His is the first cohort of the Alan I. Leshner Leadership Institute for Public Engagement with Science.



**Ben Poulter**

The group will convene this summer at AAAS headquarters in Washington, DC for a week of intensive public engagement and science communication training, networking, and public engagement plan development. Public Engagement Fellows return to their institutions with resources and connections to develop and implement public engagement activities, opportunities for training other scientists in their communities, and increased capacity for public engagement leadership. AAAS staff provide ongoing support and continuing professional development throughout their fellowship year. Poulter leads the Ecosystem Dynamics Group and studies the role of terrestrial ecosystems in the global carbon cycle. Poulter served as a Contributing Author to Working Groups I and III of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

## WATER CENTER SUPPORTS FACULTY, GRADUATE STUDENT WATER PROJECTS



The Montana Water Center has awarded eight grants to faculty and graduate students from **Montana State University**, **Montana Tech** and the **University of Montana** to research questions about Montana's water, ranging from understanding natural water storage in floodplains to the impacts of glacial processes on nitrogen cycling. Located at MSU, the Montana Water Center is one of 54 federally funded water research institutes in the U.S. The center investigates and resolves water problems by fostering water-resource stewardship and education and training. It also sponsors statewide water-related research. The Water Center is affiliated with the Montana Institute on Ecosystems.

**Lindsey Albertson**, assistant professor, MSU Department of Ecology, received a grant to explore how water temperature and drought influence the ecology of salmon fly populations that play a significant role in the fly-fishing economy of Montana. **Rob Payn**, assistant professor, MSU Department of Land Resources & Environmental Sciences, will study how beaver mimicry restoration influences natural water storage in Missouri River headwater streams. **Alysia D. Cox**, assistant professor, Department of Chemistry & Geochemistry at Montana Tech of the University of Montana, will be characterizing microbial activity related to water quality in the Clark Fork Headwaters.

Supported graduate student work includes the impacts of glacial processes on nitrogen cycling in the Beartooth Mountains (**Jordan Allen**, Earth Sciences, MSU); riparian ecosystem succession following fire disturbance (**Rachel Powers**, Geography, UM); removal of selenium contaminants using microbes (**Neerja Zambare**, Chemical & Biological Engineering, Center for Biofilm Engineering, MSU); microbial contaminants on the Little Bighorn River (**Keenan Brame**, LRES, Center for Biofilm Engineering, MSU), and snowpack controls on nitrogen availability and uptake in Rocky Mountain conifer forest (**Claire Qubain**, Ecology, MSU).

*Ryan Jones—PERU, cont. from back page*

we see a disease that's prevalent in one area or another, we might find a correlation with bacteria that is present in the insect sample from that area. For example, other studies have shown that certain bacteria will limit the ability of mosquitos to spread dengue."

From the research, Jones hopes to contribute information to help combat the spread of disease.

"We're seeing diseases where we haven't seen them before," Jones said, pointing to a dengue outbreak last month in Hawaii as one example. "One of the key parameters in epidemiological studies is transmission. If you want to predict how disease will spread, transmission is really important."

Jones' work is also supported by funds from the MSU Office of the Provost, the MSU Office of the Vice President for Research and Economic Development and the Montana EPSCoR program.

# ADVANCING RESEARCH AND EDUCATION IN MONTANA

## UM PROFESSOR AWARDED FULBRIGHT FOR FOREST RESTORATION RESEARCH IN CHILE

**Cara Nelson**, a restoration ecology professor at the **University of Montana**, recently received a Fulbright Scholarship to conduct research on forest restoration in Chile during spring 2016.

Nelson previously was chair of the international Society of Ecological Restoration and the first director of the ecological restoration program in UM's College of Forestry and Conservation. Her research concentrates on increasing knowledge about ecological processes and applying it toward restoration efforts. Nelson currently is involved with the **United Nations Convention on Biological Diversity** and other global efforts to meet the restoration targets set forth by international forums. As part of this work, she recently traveled to Kuwait and partnered with the **Kuwait Institute for Scientific Research** to restore arid land.

While in Chile, Nelson will collaborate with other researchers and focus on two major projects: a holistic assessment of temperate forests needing restoration throughout South America and analysis of the effectiveness of current forest restoration treatments in the region.



**Cara Nelson**

Nelson also will teach a graduate-level restoration ecology course at the **University of Concepcion (UdC)** in Chile this spring. The web-based course will include students from five other South American universities. She plans to contribute to two other undergraduate courses at UdC and work on strengthening relations and developing student exchange programs between UM and other Chilean universities.

"UdC is an ideal place to study forest restoration," Nelson said. "It is one of the leading institutions in South America in the fields of ecology and natural resource management. In addition, my local hosts and collaborators, Cristian Echeverría, Anibal Pauchard and Marcela Bustamante Sánchez, have each made important contributions to the fields of restoration ecology, landscape ecology and invasion biology."

Ecological restoration has become a globalized effort during recent decades. The UN Convention on Biological Diversity set a goal to restore 15 percent of ecosystems by 2020 and the International Union for Conservation of Nature has similarly challenged countries to restore 150 million hectares of forest by the same year.

## NAT GEO FUNDS MSU PROF TO STUDY BACTERIA OF DISEASE-SPREADING INSECTS

By Anne Cantrell, MSU News Service

For years, scientists have known that the Amazon is one of the most diverse places on Earth, but little is known about the bacterial composition of the insects that live there or how those bacteria interact with pathogens that cause disease, according to a **Montana State University** professor who hopes his new research on the insects will help change that.

**Ryan Jones**, an assistant professor in the MSU Department of Microbiology and Immunology and fellow in the Montana Institute on Ecosystems, will travel to the Peruvian Amazon in March to collect thousands of mosquitos, fleas and ticks to bring back to MSU to study. **Nick Pinkham**, an MSU graduate student who works in Jones' lab, will accompany him.

The four-week expedition is being supported by an \$18,000 grant from the **National Geographic Society**.

While in Peru, Jones and Pinkham will travel around the county's Loreto region via boat. Loreto is Peru's largest region that covers almost one-third of the country, and is also one of the most sparsely populated regions. The team will mostly stay in small towns of 200-400 people.

"The majority of the Amazonian portion of Peru is in that area," Jones said. "It's very rural."

Jones and Pinkham plan to collect fleas, ticks and mosquitos from all over the



**MSU Assistant Professor Ryan Jones, left, in Peru in March 2015. Jones and MSU graduate student Nick Pinkham will travel to the Peruvian Amazon in March to collect thousands of mosquitos, fleas and ticks to study. Photo courtesy of Ryan Jones.**

region and then bring those samples back to MSU. Jones estimated that the duo will collect between 5,000 and 10,000 samples during the course of the trip.

Once Jones and Pinkham return to the lab, they'll identify each species and then select a collection to study that represents a large spread over geography and species.

Next, they'll use a technology known as high-throughput DNA sequencing to sequence large amounts of bacterial DNA – Jones estimates that they will obtain 50,000 to 100,000 bacterial sequences per insect. The DNA sequence data will allow the researchers to characterize the bacterial communities living inside the insects.

Finally, the team will analyze the data to determine the relationship between the microbial composition of the insects with disease-causing agents. Essentially, the team hopes to discover how non-pathogenic bacteria living inside the insects impact the insects' ability to spread disease.

"We'll be working to determine the effects of biogeography on microbial community composition, and to assess the relationship between microbial community composition with the presence of specific disease-causing agents," Jones said. "If

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