

## WINTER C3WE NEWSLETTER

Wishing everyone a happy 2017 from the Capacity Center for Climate and Weather Extremes (C3WE). Below you'll find the fourth installment of the C3WE newsletter, which provides highlights of some of the work going on within the center, as well as information about what partner organizations are working on. We hope you enjoy these highlights and look forward to hearing from you. Don't hesitate to let us know if you'll be in Boulder – or would like to come to Boulder – for a visit or share details on the work you've been doing via a blog submission (see below for examples from Newcastle University, and the EU Analysis and Experimentation on Ecosystems group). We look forward to seeing many of you at the C3WE meeting in Boulder June 20-21, 2017. Look for additional details on this meeting in the coming months.



### NSF AWARDS 2-YEAR GRANT TO APPLY INDIGENOUS AND WESTERN KNOWLEDGE TO ENVIRONMENTAL PROBLEMS

The National Science Foundation (NSF) has awarded funding to C3WE's Rising Voices and partners to bring together Native American researchers, students, and community members in partnership with Western science organizations. The two-year NSF grant awarded to the University Corporation for Atmospheric Research (UCAR) will develop new partnerships between tribal communities and STEM institutions that promote the participation and inclusion of Native American scientists in the geosciences. Together, the researchers plan to create scientific collaborations that support pathways for Native American students from middle school through to graduate school and beyond. The project will also work on building welcoming workplace climates for indigenous researchers within 'traditional Western' organizations.

Led by Carolyn Brinkworth, UCAR's Chief Diversity, Equity, and Inclusion Officer, project partners include Rising Voices, member tribal colleges and communities with Haskell Indian Nations University, the National Center for Atmospheric Research (NCAR), the University of Arizona's Biosphere 2, and UCAR's Significant Opportunities in Atmospheric Research and Science (SOARS) internship and Global Learning and Observation to Benefit the Environment (GLOBE) citizen science programs. In addition to integrating indigenous and Western knowledge in research collaborations to create more creative, innovative, and culturally relevant science research programs, the project endeavors to provide professional development for NCAR and Biosphere 2 scientists on how to engage appropriately with tribal communities.

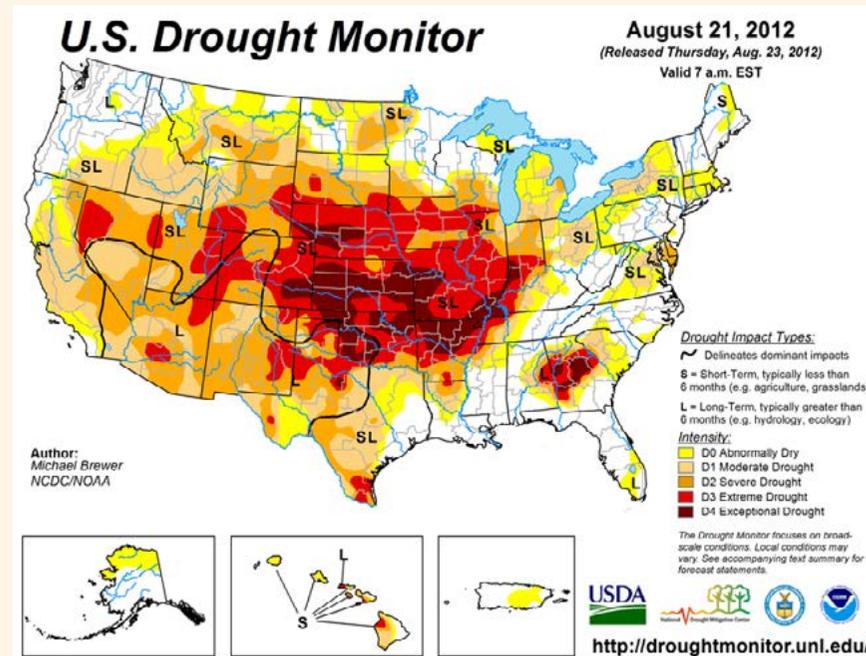
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## REGIONAL MODEL ENSEMBLE AND OBSERVATIONS SUGGEST PREDICTABILITY OF THE 2012 U.S. FLASH DROUGHT

Seasonal drought forecasts issued in May 2012 for the subsequent summer did not foresee a drought forming in the country's midsection. But by the end of August, a drought that had started in the Southern Rockies had spread across the Midwest, parching Oklahoma, Kansas, Nebraska, and Missouri.



The official U.S. Drought Monitor issued on Aug. 21, 2012. The map shows the exceptionally severe drought across the middle of the country. Just three months before, drought forecasts failed to predict that a drought was on the way.

These flash droughts — which form and intensify rapidly — can catch forecasters off guard because they are not preceded by any large-scale climate patterns that could act as a warning signal. The California drought, for example, had a large-scale precursor: a persistent high-pressure system parked off the west coast of Canada that deflected storms away from the state. Because forecasters could identify the high-pressure system, they could also accurately predict fewer storms and a worsening of the drought.

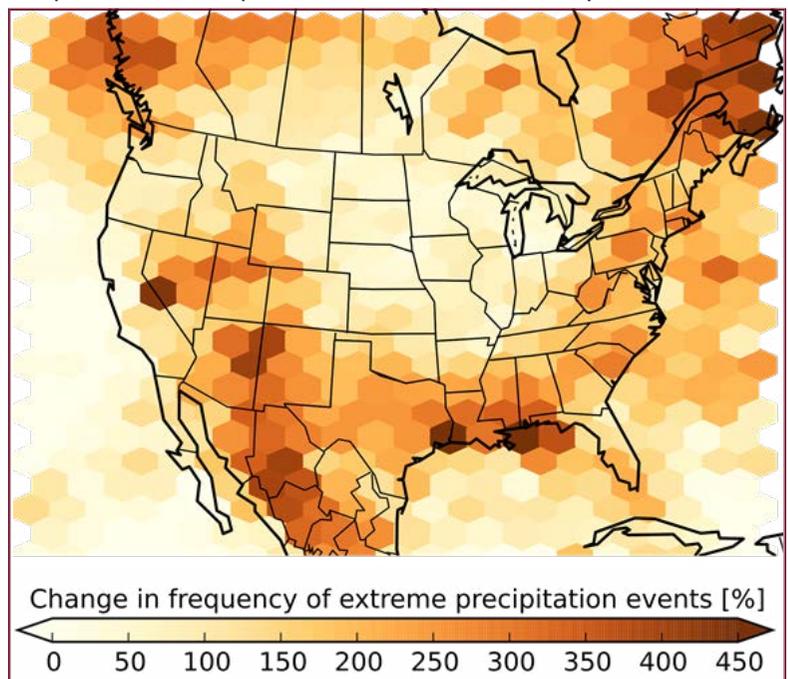
C3WE's Debasish PaiMazumder and James Done analyzed the conditions leading up to the 2012 drought, which ultimately caused \$30 billion in economic losses, looking for warning signs that a drought was on the way. Their [NSF-funded study](#) found that observations of snowmelt and soil moisture could have helped predict the ensuing drought up to four months in advance.

## STUDY SUGGESTS EXTREME U.S. DOWNPOURS LIKELY TO INCREASE BY CENTURY'S END

A [study](#) led by C3WE researcher, Andreas Prein, indicates that the number of summertime storms that produce extreme downpours could increase by more than 400 percent across parts of the United States by the end of the 21st century. Prein and co-authors Roy Rasmussen, Changhai Liu, Kyoko Ikeda, Martyn Clark, and Greg Holland ran the NCAR-based Weather Research and Forecasting (WRF) model at a resolution of 4 kilometers, which allowed simulation of individual storms, indicated that the U.S. Gulf Coast, Atlantic Coast, and the Southwest will be particularly affected. The simulations, which required a year to run, were performed on the Yellowstone system at the NCAR-Wyoming Supercomputing Center.

The study also finds that the intensity of individual extreme rainfall events could increase by as much as 70 percent in some areas, meaning that a storm that produces about 2 inches of rainfall today would be likely to produce nearly 3.5 inches in the future.

"These are huge increases," says Prein. "Imagine the most intense thunderstorm you typically experience in a single season. Our study finds that, in the future, parts of the U.S. could expect to experience five of those storms in a season, each with an intensity as strong or stronger than current storms."



The figure shows the expected increase in the number of summertime storms that produce extreme precipitation at century's end compared to the period 2000 - 2013. (©UCAR. Courtesy Andreas Prein, NCAR.)

## VANDERBILT AT STERLING RANCH

In January, Vanderbilt University students and faculty braved the cold and snowy weather during their annual trek to Colorado as part of the Sterling Ranch and Vanderbilt University research and education center partnership. Sterling Ranch is a 12,000 home, mixed-use, new-build community in south Denver that serves as a unique test bed for smart home and smart community technology integration. Homes will monitor high-resolution water and energy consumption providing a rich data source. During the week, students learned about the community's holistic approach to sustainable development, accounting for community-wide energy and water usage and availability, and municipal financing. Topics included water quality, water and energy monitoring systems, intersections of sustainability and human behavior, envisioning next generation schools, among others.



*Group shot of the Vanderbilt University faculty and student visit to Sterling Ranch, Colorado in January 2017.*

NCAR and Vanderbilt recently signed a memorandum of understanding to work together. Together, VU and NCAR will develop new and innovative ways to use available data and models and corresponding expertise to create tools, information, and communication techniques that decision makers in industry, government, and nongovernmental organizations can utilize when evaluating and implementing policy and operational alternatives.

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Vanderbilt University is renowned for its capabilities and providing student learning in risk assessment, climate resilience, infrastructure adaptation, smart cities, education and community-based decision making. A team of approximately 30 Vanderbilt University students and professors from across civil and environmental engineering, arts and sciences, and education spent three days in the Denver area to understand better how their work will lead to smart, sustainable cities. They were joined external colleagues from their Sterling Ranch project, including home builders, Siemens, Lockheed Martin, and Xcel Energy.

## VISIT ACCENTUATES VALUE OF BRIDGING SOCIAL & PHYSICAL SCIENCE FOR GOOD DECISION MAKING

Visiting Boulder from June to December 2016, Katharina Schröer had six months immersion with C3WE's cross-disciplinary team. A PhD student at Austria's University of Graz, Schröer works within a cross-disciplinary program focused on understanding climate change uncertainties, thresholds, and coping strategies. Working with a breadth of experts in Graz from the atmospheric sciences, economics, system sciences, philosophers, and social scientists, she looks at the character, causes, and consequences of extreme convective precipitation events in the Austrian Alps.

"During my visit, I worked with Mari Tye and others, connecting effects of damage from extreme events in alpine communities with high-resolution precipitation data," says Schröer. "The goal is to better understand the risk from small-scale, sub-daily rainfall extremes in a warming climate; often, these are not well represented in observational and modeled precipitation datasets."

In addition to learning about the atmospheric processes driving these extremes, the societal risk and vulnerabilities on the ground greatly determine how weather and climate extremes translate into damage. While at NCAR, Schröer wanted to see what she might learn by merging observational meteorological data with local damage data.

The span of C3WE's physical and social science expertise proved invaluable, says Schröer. Her conversations with C3WE researchers put risk and damage from extreme events into greater perspective. Schröer says she also developed a new appreciation for her training, which spans both social and physical sciences. Her ability to understand the issues and perspectives across the spectrum of science will help her facilitate conversations between the two groups to best serve



*In addition to her work at NCAR, Schröer had an opportunity to explore Colorado's Rocky Mountains by bike. The photo above captures her near Salida, CO, where she also eye-witnessed a couple of extreme convective precipitation events, luckily without damage.*

societal needs and consider all aspects of decision making to manage extreme events.

Schröer says she valued working closely with NCAR's many physically based scientist who understand the climate and the meteorological processes of extreme precipitation events, and getting feedback on issues of risk and vulnerability when dealing with climate processes. Also very valuable, she explains, was an opportunity to speak to and get advice

from those just ahead of her in their scientific careers; advice ranged from publishing tips, ideas on which journals to write for, to career advice and professional next steps.

"I didn't recognize this in the moment but, now at home, I realize how important these conversations are – it's helpful interacting with people with more experience and having access to mid-career scientists is not typically available to a PhD student," says Schröer.

Expect to see Schröer return to Boulder sometime in the future, when she hopes to have an opportunity to compare differences and similarities between climate and risk management in U.S. and E.U. alpine environments.

## RECENT BLOG POSTS

**Blog** posts come from partners around the world. Oliver Heidrich, from Newcastle University's Centre for Earth Systems Engineering Research (CESER) writes about the [cost of dikes protecting against sea-level rise in five countries](#). C3WE's Debasish PaiMazumder discusses his [recently published work on the predictability of flash droughts](#). Abad Chabbi and Margaux Dillon from the EU Analysis and Experimentation on Ecosystems group [highlight a need for governments and industry to collaborate more closely to meet society's climate change-related challenges](#). Rob Pressly from Colorado's Resiliency and Recovery Office describes [three new resources recently developed to advance resiliency within the state](#) that may be of relevance to C3WE membership.

## UPCOMING MEETINGS

At the upcoming [American Meteorological Society meeting](#) in Seattle, Washington, you'll find Rachel Hauser who will be meeting partners **January 22-26, 2017**.

Several C3WE researchers and partners – including IAG and Geoscience Australia – will be attending the [Australian Meteorological and Oceanographic Society](#) to be held in Canberra, **February 7-10, 2017**.

**IAG will sponsor the first [ECEP Southern Hemisphere Workshop](#)** to be held in Sydney, Australia on **February 13-14, 2017** focused on "Building Resilience in an Evolving Risk Landscape." The workshop brings together leaders from academia and industry to discuss issues related to risk management and planning for an uncertain future; building community resilience to natural disasters; and the roles of weather, climate, and insurance data in planning decisions for individuals, communities, businesses, and governments.

The [5th annual workshop of Rising Voices: Collaborative Science with Indigenous Knowledge for Climate Solutions](#) will be held at the National Center for Atmospheric Research in Boulder, Colorado from **13-15 April 2017**. The workshop will be convened in partnership with the Cultural Survival and the International Indian Treaty Council. The theme of the 5th Rising Voices workshop is "Pathways from Science to Action."

Several C3WE partners and staff will be attending the [6th International Summit on Hurricanes and Climate Change: From Hazard to Impact](#) in Crete **June 4-9, 2017**. This meeting, which includes Greg Holland on the organizing committee, will focus on how weather and climate extremes impact society.

The next **C3WE/ECEP Workshop** will occur on **June 20-21, 2017**. Keep on eye on the C3WE web site and future newsletters and emails for additional details.

The annual **C3WE tutorial on dynamical and statistical downscaling methods** will be held from **July 10-12, 2017**. Announcements about this workshop will be posted via the C3WE listserv, web site, and newsletters.



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