University of Colorado-Boulder Hosted NC CASC Annual Report for Year 1

August 2019

Submitted by:
Jennifer Balch (University Director), and
Brian R. Johnson (Deputy University Director)
University of Colorado- Boulder

University of Colorado Boulder

CIRES

Award Recipient: Dr. Jennifer Balch
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Attn: Lori LaFon
3100 MARINE ST STE 481 572 UCB
BOULDER CO 80309-0001

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2. PURPOSE AND OBJECTIVES

The overarching objective of CU and its Consortium Partners (CPs) is to accelerate actionable science for key resource management decisions through co-production, data-intensive discovery and open science. Our core activities this Year were to engage CPs in collective agenda-setting for the consortium plans and activities; establish a roadmap for the Climate Science Support Platform; continue ongoing stakeholder engagement established in the previous Phase; launch the Tribal Climate Leaders graduate student program; initiate the training needs assessment; and begin the process of identifying priority resource management needs through discussions with USGS partners and surveys beginning with Tribal resource managers.

We made important progress in meeting our first-year objectives including standing up the NC CASC in its new home at the University of Colorado, Boulder; launching a website on the first day of the official center opening; setting up regular team meetings; and preparing office space, furniture and building and network access to support the work of USGS personnel at the center. We also made significant progress toward establishing the Tribal Climate Leaders Program at CU. The Program will support 5 Native American graduate students to pursue graduate studies at CU-Boulder to become the next generation of climate-smart and data-capable land stewards.

Three additional objectives were added this year, not captured in our original proposal. The first was to work on a change request to the Cooperative Agreement to add directed funding via subawards for CP activities. This was originally part of proposal, but later removed because we could not adequately address questions regarding CP science objectives, activities and timelines during the cooperative agreement finalization. As a consequence, we re-planned how we would support that scope of work within the university. Once underway and with clearer guidance on the NC CASC Strategic Science Agenda and DOI priorities, it was determined that the best way to support the CPs was through funding via subawards. Our progress was slowed somewhat due to the government shutdown. The second addition was responding to a USGS internal directed funding opportunity to establish a new Grasslands Initiative. The proposed Grasslands Project led by CU and its Consortium Partners will synthesize existing information on known stakeholder needs and management issues, as well as the impacts of climate change and variability on grassland ecosystems of the north-central US. Finally, we added a new plan to address a longstanding, identified need for a tool (or tools) to address the challenges of climate data access, integration and usability to better support the National Parks Service Climate Change Response Program, Fish and Wildlife Service, Tribal Resource Managers and other stakeholders in their climate adaptation planning. The additional objectives did require reallocating resources and slowing progress in completing and implementing a communications plan and activities. A draft plan has been completed and some key elements have been initiated.

3. ORGANIZATION AND APPROACH

Person	Role	Responsibility	Level of Effort
Jennifer Balch	University Director	responsible for coordinating all elements of this project, including overseeing the leadership team and consortium partners	***Content Removed from this Version***
Brian Johnson	Deputy University Director	oversee the operations of the CASC. He will manage the climate science support platform team, directly supervising Rangwala, Yocum, & Joseph.	
Lisa Dilling	Co-Production Lead	guide the co-production efforts of the CASC including working with Yocum, the consortium partners, and additional resource managers.	
William Travis	Adaptation Lead	guide the development of adaptation strategies and their implementation through the co-production and consortium process.	
Leah Wasser	Education Lead	oversee the development of training plan and material for climate data	
Imtiaz Rangwala	Climate Science Lead	provide primary climate expertise to the NC CASC-directed projects and will work with boundary organizations to facilitate effective integration of climate research into natural resource management and planning.	
Heather Yocum	Stakeholder & Communication Lead	facilitate research-to- operations processes, convening and structuring stakeholder engagement between scientists and information users, expanding the stakeholder base, and soliciting user feedback to refine information content and delivery platforms. She will also be responsible for developing content for communications strategy	
Max Joseph	Open Science Architect	develop open source, reproducible software, workflows and accompanying trainings to increase access and usability of various data sources.	
Jenny Palomino	Education Trainer	assist with the development of course materials for the Climate Science Workshops.	
To be named	Postdoctoral Researcher	work to synthesize scientific information in partnership with the working groups and through the climate solutions summits	
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Table of funded CU personnel:

Institutions receiving sub-awards: Conservation Science Partners: Co-PI Shelley Crausbay; Great Plains Tribal Water Alliance: Co-PI James Rattling Leaf Sr.; South Dakota State University (SDSU) Extension: Co-PI Laura Edwards; University of Montana: Co-PI Phil Higuera; Wildlife Conservation Society: Co-PI Molly Cross.

Contributions from unfunded personnel: Dawn Umpleby provided project support in areas of web site development and maintenance, logistics planning for events, reporting and budget planning and tracking including sub-awards to consortium members, and Jenny Briggs assisted NC CASC in collaborative engagement with partners both on and off campus.

Issues hiring or retaining personnel: There has been no issue in retaining personnel. Three months was needed for key personnel to fully transition from their ongoing projects to new NC CASC work.

Summary of consortium governance and operations, and interactions.
The role of each consortium partner is to produce actionable science on a dedicated management theme, serve as a connector between researchers and stakeholders in their region, and help to guide the overall efforts of the NC CASC. Dedicated resources are allocated for the consortium partners to fund these efforts including: travel funds to support co-PI travel to an annual in-person meeting (the first of which was conducted in June 2019); salary support for 1-year of an early career scientist efforts (graduate students, postdocs, or existing staff) and partial support to accommodate co-PI salary time to mentor and advise; funds to support two co-production scientist-stakeholder workshops during the 5-year award; support and consultation on best-available climate science from the CU Climate Science Support Platform; and access to additional training and skills-building opportunities. Monthly conference calls with Consortium Partner Co-PIs and an annual in-person meeting are key touch points for consortium interactions.

4. RESULTS

Key Partnerships

Agency	Project Name & PI	Nature of Engagement
US Fish and Wildlife Service	1. White-tailed Ptarmigan - Species Status Assessment (John Guinotte); 2. Skiff milkvetch - Species Status Assessment (Dara Taylor)	For White-tailed Ptarmigan: Provided expert assessment (also brought in other subject experts on phone calls and emails) to future change in snow, monsoon, and tree line trends in the current range of the species; For Skiff milkvetch: Consulted with the PI on several phone calls and developed a 1-pg climate scenarios table highlighting changes in different climate and hydrology metrics by 2050
NPS Climate Change Response Program (CCRP)	Wind Cave National Park --- Scenario Planning (Gregor Schuurman)	A very direct engagement in the project. Primary role to provide climate expertise regarding use of climate data, data analysis approach, selection of metrics for specific impacts, and selection of future climate scenarios. 10 (1-2 hr) phone calls and visit to the 2day scenario planning workshop in the Park.
Montana Fish, Wildlife and Parks	Mountain Goat SDM (Structured Decision Making) (Justin Gude)	Participating as a team member in the ~ 1-year SDM process toward developing future Mountain Goat management plan for the state. Participated as the sole climate scientist in 3 meetings in person held in Montana. Consulted with the habitat modeling team in the development of the model and use of climate data. Also selected climate scenarios and provided climate and vegetation layers for the habitat model.
Colorado Natural Heritage Program	1. Mancos River Resiliency (Renee Rondeau); 2. Black-footed Prairie Dog Habitat Modeling (Anda Davidson)	Consulting in selection and use of climate data. Designing of model experiments
Mancos Conservation District (incl. Mesa Verde National Park, Ute Mountain Ute tribe, Mountain Studies Institute)	Mancos River Resiliency (Marcie Bidwell)	Providing climate expertise to the project (2 weeks in-kind support). Help with update of climate scenarios information from the NCCASC SW Colorado project. Review and co-authoring the research/communication materials
Science of Nature and People Partnership (SNAPP)/ NCASC USGS	Ecological Drought (Shelley Crausbay)	Providing drought indices data (EDDI, LERI, SPI, FDSI) for pilot-scale analysis in upper Missouri headwaters; (ii) co-author on the paper, provided substantial contribution to the climate science section
Oglala Lakota College	Prof. James Sanovia	Active recruitment for Tribal Climate Leaders Program, and participant in submitted grant proposals to support increased training in climate data skills for undergraduate students.

Science
NC CASC continues to advance our understanding of drought processes and climate change related drought risk, including risk of flash droughts in the western mountains and Great Plains. The relevance of extremes in evaporative demand to drought assessment and monitoring in the 21st century is under study leading the analysis in climate change section of the chapter (see Article #5 below), as well as a new framework for understanding socio-environmental extremes (Balch et al. 2019, preprint). Imtiaz Rangwala has also developed approaches to quantify different hydroclimate metrics relevant to ecological impacts for building future climate scenarios - these included identifying and developing data for indices like Forest Drought Stress Index, and use of summer/fall VPD or PET being most salient to wildfire risk in grasslands system. In addition, Balch was a co-author on work to quantify the climate change contribution to California wildfires (Williams et al. 2019), which will serve as a template for possible work in the NC CASC.

Capacity Building
CU has supported existing training efforts throughout the NC CASC, while developing a region-wide training needs assessment that will be administered to stakeholders identified by NC CASC consortium partners by the end of September 2019. In support of existing training efforts, CU designed and administered a data and tools needs assessment survey for the Lower Missouri Tribes Climate Adaptation Planning group, led by Mark Junker of the Sac and Fox Tribe as well as James Rattling Leaf, Sr. and Stefan Tangen from the NC CASC. CU also led a session on the results of the data and tools needs assessment at the first workshop for the Lower Missouri River Tribes Climate Adaptation Planning Group on June 18-19th, 2019 in Reserve, Kansas, which was attended by approximately 30 resource managers from across nine tribes.

Preliminary findings from the needs assessment identified priority for: finding applicable data in a location of interest; integrating data of different types and formats; and combing results from multiple sources. Training needs identified were in areas related to planning/decision support tools, and use of GIS and programming tools.

The CU team has facilitated connections with Tribal colleges, helped in recruiting students for the Tribal Climate Leaders program and provided inputs to the NC CASC Tribal engagement strategy. This work is also contributing to identifying key areas where new or synthesized climate adaptation science can benefit Tribes and be most useful.

Communications
- CU has contributed to resource managers needs through development of usable data products and tools including updates to the LERI webtool and publishing the dataset with Digital Object Identifier.
- Climate Scenarios Toolbox (CST): CU/USGS team has created the software framework, held preliminary NPS and US FWS stakeholder discussion, developed CST and secured USGS Community for Data Integration funding to implement a first version of the Tool.
- Further guidance and development with new data and analytic approaches for increased usability of the Earth Lab/NIDIS Drought Index Comparison Portal for suitability to NC CASC stakeholders.

5. OUTREACH

The NC CASC partnered with CIRES IT to create a website (https://nccasc.colorado.edu/). Viewers can find center news, events, information about center staff, the Joint Stakeholder Committee, consortium partners, and the national network. A page for tribal resources was recently added and pages for funding opportunities and regional conservation resources are planned.

Major Engagements:

- Invited speaker at the Great Plains Tribal Water Alliance meeting & Great Plains Tribal Chairmans' Association (October 2018); Also hosted the GPTWA board visit to CU Boulder in spring 2019
- Represented the CASC network on a university directors' hill visit & met with staffers from Senator Gardner, Rep. DeGette, and Rep. Neguse's offices, March 2019
- Invited panel speaker for CU Boulder campus visit of Representatives Carter, Casten, Castor, Graves, and Neguse at a pre-event associate with the Climate Crisis Field Hearing, July 2019
- Participated in two 3 Centers Retreats (with NOAA and USDA), Dec. 2018 and July 2019
- CU Hosted and participated in USGS Joint Stakeholder Committee meeting in June 2019.
- Attended Community for Data Integration Conference, Boulder, CO June 2019.
- Co-organized Manager's workshop at the MTNCLIM 2018 conference
- Co-organized Scenario Planning panel session at the National Adaptation Forum 2019.
- Review of US Forest Service's technical report on future climate scenarios selection for the 2020 RPA Assessment; NSF-funded AGCI's workshop proposals among other stakeholder-produced literature
- Participated in 2019 Tribal Climate Camp, Flathead Bio Station, MT June 16-21, 2019
- Attended Wind Cave National Park Scenario Planning meeting, July 2019.

Articles:

1. Crausbay S., I. Rangwala, and others (2019). Unfamiliar territory: emerging themes for ecological drought research and management. *One Earth* (submitted).
2. Adhikari A., A. J. Hansen and I. Rangwala (2019). Ecological water stress under projected climate change across hydroclimate gradients in the north central United States. *Journal of Applied Meteorology and Climatology* (in press).
3. Hanberry, B., M. C. Reeves, A. Brischke, M. Hannemann, T. Hudson, R. Mayberry, D. Ojima, H. R. Prendeville, and I. Rangwala. (2019). Management effects of drought in the Great Plains. Chapter in *Effects of Drought on Forests and Rangelands in the US: Translating Science into Management Responses*. Edited by J. M. Vose, D. L. Peterson, C. H. Luce. T. Patel-Weynand (in press).
4. Rangwala I. and M. Hobbins (2019). Flash Droughts in the Mountain West: Emerging Risks under a Warmer Climate. *Mountain Views*, Vol. 13(1), May 2019, pg 34-37.
5. Hobbins M.T., I. Rangwala, J. J. Barsugli, and C. Dewes (2019), Extremes in evaporative demand and their implications for drought and drought monitoring in the 21st Century. Chapter 25 in *Extreme Hydrology and Climate Variability: Monitoring, Modeling, Adaptation and Mitigation*, edited by A. M. Melesse, W. Abtew, and G. B. Senay; Elsevier, New York, ISBN-9780128159989.
6. Rangwala, I., Smith, L.L., Senay, G., Barsugli, J., Kagone, S., and Hobbins, M. (2019). Landscape Evaporative Response Index (LERI): A high resolution monitoring and assessment of evapotranspiration across the Contiguous United States. *ScienceBase,* doi.org/10.21429/43r4-3q68.
7. Lyon N. J., D. M. Debinski and I. Rangwala. (2019). Evaluating the Utility of Species Distribution Models in Informing Climate Change-Resilient Grassland Restoration Strategy. *Frontiers in Ecology and Evolution*. doi: 10.3389/fevo.2019.00033.
8. Williams, A. P., Abatzoglou, J. T., Gershunov, A., Guzman-Morales, J., Bishop, D. A., Balch, J. K., & Lettenmaier, D. P. (2019). Observed impacts of anthropogenic climate change on wildfire in California. *Earth's Future*, 7. https://doi.org/10.1029/2019EF001210
9. Balch, Jennifer, Virginia Iglesias, Anna Braswell, Matthew Rossi, Maxwell B. Joseph, Adam L. Mahood, William Travis et al. "Socio-environmental extremes: rethinking extraordinary events as outcomes of interacting biophysical and social systems." *PeerJ Preprints* 7 (2019): e27877v1.

6. NEXT STEPS

- Next steps in Grasslands project are to convene an Advisory Working Group of Boundary organizations, and Climate, and Ecology Synthesis Working Groups, and hire a postdoctoral researcher to work across these groups to synthesize and disseminate findings and results in year 1 of the activity.
- Next steps for the Tribal Climate Leaders Program will be to work with CU colleges and departments to identify academic advisors and social support for Native American students and assist them with the application process. The first Tribal Climate Leader, Shelby Ross begins her graduate work in Fall 2019, and the NC CASC is currently recruiting students for Fall 2020, including helping them identify advisors and supporting on-campus visits.
- Finalize communication strategy and plan, publish first monthly newsletter at the end of September, bring in external person to evaluate our website user interface and experience, and hire an undergraduate student to support content collection and publication.
- To develop a plan for education and training, CU will administer a region-wide training needs assessment to stakeholders identified by NC CASC consortium partners by the end of September 2019. The assessment results will be summarized and used to develop the first training workshops for consortium partner-affiliated resource managers, faculty and students to begin in year 2.
- First versions of the Climate Scenarios Toolbox R packages released openly in a GitHub repository with guidelines for using the packages, and initial development of a community of practice using and extending the Toolbox.
- Initiate CP activities, with contract modification in place, & begin fire synthesis working group efforts in Year 2.

7. BUDGET

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