the RESEARCHER

IDAHO NSF EPSCoR

June 2024

A stylized scene depicting water, wind turbines, and solar panels in an Idaho landscape.
AI image credit: Lucas Sheneman

A newsletter publication of the Idaho EPSCoR Office

the RESEARCHER

Andy Kliskey
Project Director
akliskey@uidaho.edu | 208-885-6499

Rick Schumaker
Associate Project Director
rschumak@uidaho.edu | 208-885-5742

Sarah Penney-Jackson
Outreach and Communication Coordinator
sarahp@uidaho.edu | 208-885-2345

Tami Noble
Finance Director
tnoble@uidaho.edu | 208-885-5842

Dalynne Veeder
Business Specialist
dveeder@uidaho.edu | 208-885-7102

Follow us on Twitter
@IdahoEPSCoR

Idaho EPSCoR Website
idahoepscor.org

I-CREWS Website
idahocrews.org

Track 1 GEM3 Website
idahogem3.org

Track 1 MILES Website
idahoecosystems.org

LETTER FROM THE DIRECTOR

Waiho i te toipoto, kaua i te toiroa

It is important to keep connected, to maintain relationships and dialog so that we can keep moving forward together.

(NZ Maori whakatauki or proverb)

Andy Kliskey

With Idaho's I-CREWS Track-1 project underway and well through Year 1 there has been a great deal of activity in the start-up phase of the project. We have moved through the strategic planning and evaluation planning phases, and are in the process of gaining a common picture of fundamental aspects of how we approach I-CREWS: from an understanding of what we mean by computational modeling and artificial intelligence (AI), to Tribal data sovereignty, to energy-water (E-W) systems itself, to relationship building with partners and collaborators. These efforts to situate ourselves and the project with a shared awareness are critical to the success of I-CREWS.

We have started to understand what E-W issues and systems look like for partner and community-engagement sites after three lightning talks at the April 2024 I-CREWS annual meeting. Dr. Laura Laumatia provided us with insights on issues and priorities for the Coeur d'Alene Tribe centered upon the tight coupling between lake, salmon reintroduction, historic changes to Coeur d'Alene Lake levels, Tribal sovereignty, prolonged litigation and adjudication of Tribal water, and cultural identity of the Schitsu'umsh people. Please see the article in this issue for further unpacking of Coeur d'Alene Tribe perspectives. Dr. Kendra Kaiser gave a summary of key E-W issues and dynamics in Treasure Valley. This included consideration of urbanized hydrology, irrigation and dam transformations on the landscape, and pumped hydro storage and release systems, such as Cat Creek, providing an example of a physical E-W system. For the Shoshone-Bannock Tribes, Dr. Sammy Matsaw highlighted the criticality of axiology (the things we value), epistemology (the origin

of our knowledge), and ontology (what it means to be who we are) to framing Indigenous research and how we should treat the I-CREWS engagement with Tribal partners. For Shoshone-Bannock Tribes, one notion of E-W is the trade-off or interplay between the Tribe's new strategic energy plan, that encapsulates Tribal energy sovereignty, and water use, demand, and availability across Tribal lands, in particular, Fort Hall Reservation. E-W systems are apparent in the eye of the beholder and I-CREWS has an important responsibility to recognize and interweave these critical perspectives, these different thought-worlds.

The Modeling E-W systems component has provided the project team with a grounding in computational modeling and AI/machine learning techniques with a series of virtual training sessions. The first session in April covered Machine Learning while the second session focused on Computational Modeling and Risk Assessment. These trainings provide foundational concepts and vocabulary for those of us who lack a background or familiarity in these areas. Please see the summary of the first two virtual sessions in this issue.

Also, during the April 2024 I-CREWS annual meeting we were introduced to E-W literacy as one of the tenets of the I-CREWS education and workforce development plan. Our College of Southern Idaho partner, Bill Ebener, led an introduction to how we might create a framework that names and describes energy-water systems as a basis to the core competencies of bringing E-W literacy into communication training. Separately water systems and energy systems are each fundamental to society and bring with them sustainability challenges; we are looking to develop an understanding of how energy and water systems interact. This makes the need for E-W literacy essential.

Human capacity building through I-CREWS is progressing with three successful hires of early-career faculty already completed – BSU mathematical data scientist Michael Perlmutter, UI energy-water modeler Angel Monsalve Sepulveda, and UI environmental historian Aly Kreikemeier. This places us well ahead of schedule for early-career faculty positions. We have an ISU resilience social scientist search close to being concluded, and a further four faculty positions anticipated for faculty searches in Fall 2024 or Spring 2025. Please see the introductions to Drs. Perlmutter and Kreikemeier in this issue and join me in welcoming all of our new faculty to the I-CREWS project.

I hope you are as excited as I am to be embarking on the process of gaining a common picture of the fundamental aspects of how we approach I-CREWS and better understand the resilience of energy-water systems in Idaho's communities.

This material is based in part upon work supported by: The National Science Foundation under grant numbers OIA-1757324 and OIA-2242769. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Unless otherwise noted in feature byline, articles and features in this publication are written by Sarah Penney-Jackson with editing and content contributions by EPSCoR administrative team.

Energy-Water Resilience through the Coeur d'Alene Tribal Perspective

The Idaho Community-Engaged Resilience for Energy-Water Systems (I-CREWS) project is working to advance a system of innovative solutions and capacity-building to proactively address the impacts of climate, population, and technological change on energy-water (E-W) systems. Through robust Tribal partnerships, the I-CREWS project recognizes the interrelationship of Traditional/Indigenous knowledge with other Local Knowledge, Western scientific research, and capacity development, forming the cornerstone of modern Tribal energy and water sovereignty.

Throughout the project planning process, I-CREWS worked with diverse communities, including Tribal partners, to select locations and co-develop research questions. By incorporating Local Knowledge and expertise, we are positioned to identify values, governance needs and inequity considerations, and scenarios of interest to partners. Knowledge co-production is critical to identifying problems and implementing solutions. Knowledge rightsholders and community leaders help explain what success means to them, while governance structures and industry influencers spur societal change efforts.

Tribal partner representative, Dr. Laura Laumatia, Environmental Programs Manager for the Coeur d'Alene Tribe, recently shared the Tribe's history related to energy-water resilience during the EPSCoR Annual Meeting. The Coeur d'Alene tribe is not new to energy-water systems and have been grappling with changes to energy-water resilience for nearly 200 years.

Since the early 1900s, construction of dams on the Spokane River has altered the living situation for the Coeur d'Alene people, who relied on fish as part of their daily diet. Averaging about a kilo of fish per day (per person), the Coeur d'Alene people had access to cutthroat and bull trout, and Whitefish in the Coeur d'Alene Basin and salmon that swam into Hangman Creek from the Spokane River as well as salmon from the Clearwater River and at Spokane Falls. The Coeur d'Alene people have not had access to most of its fish for 120 years now.

The Coeur d'Alene people also enjoyed an abundance of meadowed lands along the shores of the lake and its tributaries that provided camas root, water potatoes, and other traditional gathering areas. After the construction of the Post Falls dam, however, more than 6K acres of that area was flooded out, and the Tribe has since been trying to mitigate the impacts to their traditional ways of living.

Chatcolet Lake, a subsystem of the Coeur d'Alene Lake, on the Coeur d'Alene Tribe's territory. Photo credit: Laura Laumatia

For over half a century, the Coeur d'Alene Tribe has been involved in litigation related to the Coeur d'Alene lake and basin, primarily due to the impacts of dam construction and the impoundments associated with them, as well as the impacts of legacy mining, nutrient pollution, and impacts of development, resulting in vast cultural losses, fish extraction, shoreline erosion, harmful algae blooms, and other wetland losses.

Currently, the Coeur d'Alene Tribe is working on overall health of its water systems and fisheries restoration. Recently, the Tribe received funding from Bonneville Power Administration that is supporting the Coeur d'Alene and partner Tribes to restore Chinook Salmon to the upper Columbia River system.

In addition, the Tribe is also working towards energy sovereignty and energy and emissions reductions through numerous efforts that are largely funded by federal initiatives in the Inflation Reduction Act. These include new solar projects that the Tribe is installing on the reservation, completion of an energy plan, and hiring of a Clean Energy Fellow and Tribal Energy Coordinator. The Coeur d'Alene Tribe is also working to reduce energy costs for Tribal members through weatherization, energy efficiency, and renewable energy opportunities.

As the Tribe works to restore what has been lost and protect their natural resources today, partnerships with federal and state entities are also being utilized to help in this process. The partnership with I-CREWS, is one way in which the Tribe's local and Indigenous knowledge can be interwoven with community-engaged research to help determine how communities can adapt to climate, population, and technological change and translate this knowledge to help achieve more resilient communities, landscapes, and waterscapes.

I-CREWS researchers learn to apply machine learning, computational modeling, and dynamic risk assessment to real-world problems

By Elise Overgaard

Artificial intelligence is everywhere these days, and Idaho researchers are harnessing its power. Over the next five years, they'll use powerful computational tools to study energy-water systems as part of the NSF EPSCoR state-wide Idaho Community-Engaged Resilience for Energy-Water Systems, or I-CREWS, project.

In April, the I-CREWS modeling team hosted two virtual workshops to introduce foundational concepts and vocabulary to I-CREWS researchers who lack a background in these areas. The team hopes investigators will come to understand what these computational tools can do for their research and become inspired to collaboratively and creatively incorporate the tools into their energy-water research.

Workshop I: How do we teach a machine?

"As human beings we observe and learn, and then when someone asks us a question we draw from our past experience or memory to answer that question," explained Lan Li (I-CREWS modeling team co-lead, Boise State University). "Machines, or computers, are the same. So how do we teach a machine?"

This was the topic of the first workshop, held on April 12 and attended by 20 participants.

Machine learning is different from traditional programming. In traditional programming, we feed a computer data and tell it what program to run, then the computer spits out an output. In machine learning, we feed the computer data and ask the computer to identify patterns, rules, or relationships within those data, or even to predict new data. So it's really useful in research.

I-CREWS Modeling Team presents during Idaho EPSCoR Annual Meeting in April 2024.

Li reviewed different methods of training machines, introducing the terms: supervised learning, semi-supervised learning, unsupervised learning, and reinforcement learning. After the overview, modeling team members Leslie Kerby (I-CREWS modeling team co-lead, Idaho State University), Michael Perlmutter (Boise State University), and Moji Sadegh (Boise State University) delved deeper into the tools and methods, and walked the group through some real-world applications and studies.

The take-home message of the day was: machine learning will always give you an answer, but that answer depends on the quality and type of data used to train the machine. Data are essential!

Workshop II: Applying the right models to the right questions.

On day two, held on April 19 and attended by 19 participants, researchers tackled computational modeling and risk assessment.

Timothy Link (I-CREWS modeling team co-lead, University of Idaho) kicked off the workshop by covering different types of modeling frameworks. The models we use to simulate systems, he explained, exist on a spectrum from models based on field data - for example, a curve fitted to data on snowmelt over time or other similar field data - to models that take into account the fundamental underlying physics - for example, the mathematical equations that describe and govern the different energy exchanges involved in snow melting.

Link also introduced spatial and temporal representation models and systems models before taking the group through some real-world examples. He emphasized the importance of selecting the right model for the right question and reminded the group that expertise in the physical systems is still important.

"There's still a need to have people that are very aware of the physical systems and the processes we're modeling in order to make sure that what the model produces represents reality," he said.

Bruce Savage (I-CREWS modeling team co-lead, Idaho State University) delved into the specifics of models currently used in hydrology and Brian Johnson (University of Idaho) covered power and energy modeling - all with real-world examples.

The workshop wrapped up with a presentation from R. A. Borrelli (University of Idaho) on dynamic risk assessment.

"Risk assessment involves three essential questions," Borrelli explained. "'What can go wrong?', 'How likely is it to happen?', and 'What are the consequences?'" Borrelli demonstrated ways to calculate, visualize, and analyze risk. As I-CREWS researchers simulate, predict, and design potential futures for Idaho's energy-water systems, they could use dynamic risk assessment tools to inform their work.

The ultimate goal is to help ensure Idaho's energy-water systems are resilient over time as they face challenges like population growth and climate change.

Perspectives on E-W Systems Literacy

Literacy, at its most basic, is essential understandings and an ability to use those understandings. As part of the new state-wide Idaho Community-Engaged Resilience for Energy-Water Systems (I-CREWS) project, Idaho educators are working to create a framework that names and describes Energy-Water (E-W) systems literacy and related competencies. The overall goal of the I-CREWS Education (ED) and Workforce Development (WFD) plan is to develop individual, community, and institutional capacity for more resilient and equitable futures with respect to education and E-W systems.

I-CREWS will implement programs at levels spanning K-12, through graduate education, to faculty. The research and education ecosystem of I-CREWS currently includes three research universities, two Tribal nations, three Primarily Undergraduate Institutions (PUIs), and more than a dozen public, private, and nonprofit collaborators and stakeholders. PUIs include Lewis-Clark State College (LCSC), College of Western Idaho (CWI), and College of Southern Idaho (CSI). Tribal nations include the Coeur d'Alene Tribe and Shoshone-Bannock Tribes.

How do we get there?

Activities include infusing E-W literacy into communication training, one of the core competencies identified as critical for effective E-W systems leadership. Communities of Practice (CoPs) will also be developed, particularly within PUIs, to engage students by integrating E-W systems literacy into existing General Education courses required for all students in the state of Idaho, regardless of degree program.

The I-CREWS ED/WFD component team has been meeting to begin the structure of the Framework and has reviewed several literacy frameworks developed for energy and climate. The question becomes how do we deliver something that is consequential for both research and practice? Toward this end we propose to engage with multiple types of knowledge holders to co-produce a series of guiding questions that will allow research consumers to query E-W systems, translating science for society. In addition, a second series of guiding questions will be developed to guide researchers (formal and informal learners) as they consider their own course of exploration and discovery, probing the unknown, creating, and extending knowledge. The team is in the process of creating a survey and interview process for community members and project participants to help better define energy-water systems and to gain a greater understanding of the efforts needed to promote effective decision-making within energy-water systems. Having a diverse approach is integral to/for resilience and sustainability.

This E-W Literacy Framework will help in engaging diverse community members, rightsholders, and other knowledge holders by establishing consistent and inclusive dialog frames that support the necessary cultural competency for relationship building, trust, and equitable partnering and co-production of energy-water systems knowledge.

I-CREWS teams chart five-year plan at annual meeting

By Elise Overgaard

Researchers from across the state gathered at The Grove Hotel in Boise on Tuesday, April 23 to discuss Idaho's new state-wide research and capacity-building project, Idaho Community-engaged Resilience for Energy-Water Systems, or I-CREWS. The project is funded by a $20 million federal NSF EPSCoR award plus a $4 million state-match. But it's no ordinary research project.

Over the next five years, researchers will study energy and water systems used by communities in three geographical regions: The Coeur d'Alene Tribe (Schitsu'umsh) in the north, the The Shoshone-Bannock Tribes of Fort Hall in the southeast, and communities of the Treasure Valley in the southwest. And community input is a crucial component of this project.

Instead of posing research questions, getting a grant, then rushing into communities to collect data, the team has baked community input into the fabric of the project. Scientists will work with local communities to define the energy-water issues that matter most to them, then build research questions and scientific research plans collaboratively. Building trust and long-term relationships takes time, but it's key to the project's success.

Interweaving collaborators, communities and ways of knowing

The project - led by researchers from University of Idaho, Boise State University, Idaho State University, the Coeur d'Alene Tribe and the Shoshone Bannock Tribes - will also involve dozens of collaborators from the College of Southern Idaho, Lewis-Clark State College and College of Western Idaho as well as community partners like Idaho Power, Idaho National Laboratory, Center for Advanced Energy Studies, Idaho STEM Action Center, Idaho Consumer Owned Utilities Association, and the Idaho Department of Water Resources. As this was the first in-person all-hands meeting for the year, meeting attendees had a lot to discuss.

"There's still a lot to figure out," said Andy Kliskey, the I-CREWS project director, in his opening remarks, noting that the annual meeting represented, "an important opportunity to share our current thinking and progress on each aspect of the project and also to talk about how we interweave across those. And really the interweaving - making those cross connections - is absolutely integral to this project."

Interweaving is also critical to the project's mission of incorporating alternative ways of knowing about

Andy Kliskey, EPSCoR Project Director, provides an overview of the I-CREWS project during the Idaho NSF EPSCoR Annual Meeting in Boise, ID.

energy-water systems. With input from a new Tribal Nations Research Network, the team aims to recenter knowledge exchange between tribes and Idaho universities. The project will emphasize the development of tribally-originated research by incorporating methodologies and research frameworks that originate from Tribes.

With all this interweaving to do, the annual meeting presented an excellent opportunity for team members to meet face-to-face, listen and learn, and hash out some logistics.

Meet the teams: Characterize, Modeling and Alternative Futures

After Sammy Matsaw, a representative of the Shoshone Bannock Tribe's leadership team, opened the meeting with a prayer, each team had time to present about their team's role, progress and plans. They also got some precious face time during breakout sessions.

Presentations started with the Characterize team, which will collect and consolidate both historical and current data of all kinds - spatial, temporal, qualitative, quantitative, etc. - from the areas and systems being studied.

"Characterization is not just about the way water is flowing, electricity is flowing - it's about the way people are affected by it as well," said Ben Crosby, a professor at Idaho State University and co-lead of the Characterize team. "It's about the communities, about the economics, about the politics that are going on that dictate where and when these resources are being produced, how they're being distributed, and being consumed."

The Characterize team will consolidate and organize that information into a central data hub. That data hub is a deliverable of its own and will continue even after the project ends. The team envisions it as an open-source tool to disseminate the outcomes of the project through interactive, useful forms like data dashboards, visualizations, and data access mechanisms. And, as the project gets going and researchers start to accumulate data, they'll have a centralized place to organize it. The Modeling team can then access the data and use powerful computational tools to analyze it.

The Modeling team consists of three components: machine learning, computational modeling, and risk assessment using numerical models and/or machine learning models. The team had already hosted two workshops they held in April covering what these tools are and demonstrating how they've been used to study energy and water systems in the past.

Once more detailed research questions are developed, the Modeling team will work with researchers to decide what kind of data to collect and how to analyze them with these tools. The team will look for patterns in the data and work alongside the Alternative Futures team to develop alternative futures scenarios of energy-water systems and evaluate their resilience to change and the community's changing needs. Risk assessment tools will be incorporated, for example, to compare models of future outcomes against themselves or try to determine if and how those outcomes might be more or less resilient to things like population and climate change.

The Alternative Futures team will co-develop and communicate about these scenarios with the communities they'll impact. And the team hopes those future conversations will be bolstered by the foundational relationships they are building with communities now, at the beginning of the project.

The project also boasts a large number of educators and staff who will tackle workforce development, education, communication, and energy-water system literacy efforts. The project will support 8 new early-career faculty, 10 post-doctoral fellows and 20 graduate students in addition to creating research and educational opportunities for undergraduates and learners from communities and Tribes across the state.

More information about the project is available at idahocrews.org

I-CREWS New Hire

Meet I-CREWS new hire

Michael Perlmutter

By Elise Overgaard

Michael Perlmutter joined Boise State University and the I-CREWS team in August 2023 as an Assistant Professor in the Department of Mathematics. He is also affiliated with Boise State's Computing Ph.D. program and will serve as a data science consultant on the I-CREWS modeling team.

Michael earned a B.S. in Mathematics from Tufts University, an M.S. in Mathematics with a concentration in Computational Science and Engineering from Purdue University, and a Ph.D. in Mathematics from Purdue University. Prior to joining Boise State, he held postdoctoral positions at the University of North Carolina at Chapel Hill in the Department of Statistics and Operations Research, at Michigan State University in the Department of Computational Mathematics, Science and Engineering, and at the University of California, Los Angeles in the Department of Mathematics.

Michael's work is focused on the mathematics of data science and applied harmonic analysis. Recently, his primary area of research has been geometric deep learning, where he works on developing, analyzing, and applying deep-learning methods to data with irregular geometric structures - like curved surfaces or network data - as opposed to grid-like structures - like a photo with structured pixels.

For the I-CREWS project, Michael hopes to apply data science methods to support his colleagues in studying energy-water systems.

Michael Perlmutter, Assistant Professor in the Department of Mathematics at Boise State

"This is really an exciting opportunity to branch out into a new area and to work with people from a wide variety of backgrounds. Hydrology is new to me, but my math background is largely complementary to the team's existing skill sets. Traditionally scientists have used mathematical models based on physical understanding - such as 'force equals mass times acceleration' - and there is little need for data science when the governing physics are well-understood and may be cleanly applied. The problem is that real world problems are often messy. What data science can do is, rather than trying to start from a top-down physical model of how it all works, we take our observations and try to detect patterns. So it can be complementary to the more traditional physics-based models."

Meet I-CREWS new hire

Alyssa Kreikemeier

Alyssa Kreikemeier is an environmental historian trained in interdisciplinary and socially engaged methods. Alyssa's research focuses on the peoples and places of the American West and conflicts over natural resources and their management. She holds a Ph.D. in American Studies with areas of specialty in environmental history, Native American and Indigenous Studies, public history, and modern U.S. history. Alyssa has been a Humanities Without Walls fellow and a Kluge scholar in residence at the Library of Congress.

Alyssa grew up on a farm in southwestern Montana and completed her undergraduate studies at Montana State University before relocating to teach in Santa Fe, NM. She then completed an Ed.M. at Harvard University focused on cross-cultural exchange and socially engaged research. Her thesis examined race and representation in the media via a participatory and arts-based exhibit designed with Boston youth. Alyssa published a methods paper from that project in Teachers College Record titled, "Youth Research in Community Settings: Inspiring Social Engagement through Critical Pedagogy, Collaboration, and Arts-Based Research." While at Harvard, she also designed and taught place-based educational programs with young adults in Cambridge, MA and around the globe.

Longing for vast skies led Alyssa to write a dissertation on air in the Mountain West — a significant gap in a field founded on studies of the region's land and water. Just before the COVID-19 pandemic, Alyssa moved back to Santa Fe, NM to finish her dissertation research closer to the communities and places she studied.

After completing her PhD, Alyssa took a postdoctoral fellowship at the University of New Mexico funded by the National Park Services (NPS) to write a management history of Bandelier National Monument, which involved collecting oral histories and working with a Tribal advisory committee. Her postdoctoral research identified how shifts in federal-Indian policy — such as the 1990 Native American Graves Protection and Repatriation Act — influenced the management of NPS sites. This research charted efforts and roadblocks to co-managing public lands with Tribal governments. It also examined wildfire and the challenges of interagency cooperation in federal fire management.

Alyssa is excited to continue collaborating with Tribal Nations and scholars across disciplines on environmental research through the I-CREWS project as an Assistant Professor of History at the University of Idaho. She brings expertise in the history of modern environmental management between Tribal, state, and federal governments and looks forward to contextualizing the history of Energy-Water systems in service of the project's goal to develop more resilient energy-water systems moving forward. Alyssa is relocating from Santa Fe, NM to Moscow this summer, and is excited to join the community and this important project.

Alyssa Kreikemeier, Assistant Professor of History at the University of Idaho

Idaho EPSCoR
University of Idaho
875 Perimeter Drive MS 3029
Moscow, ID 83844-3029

208-885-7102
idahoepscor.org

* 8 7 3 8 7 7 *

The NSF EPSCoR Research Infrastructure Improvement Track-1 project to study Idaho's energy-water systems requires dozens of collaborators to coordinate with the communities directly impacted by those systems. Photo credit: Elise Overgaard (BSU)