



Funding provided through:
National Science Foundation
EPSCoR RII Track-1 Award
Award # OIA-1355466

ND EPSCoR

Established Program to
Stimulate Competitive Research



INSPIRE-ND

**Innovative and Strategic Program
Initiatives for Research and
Education-North Dakota**

AWARD NUMBER: OIA-1355466
OFFICIAL START DATE: August 1, 2014
EXPIRATION DATE: July 31, 2019

National Science Foundation
Research Infrastructure
Improvement Track-1 Award

From the ND EPSCoR Project Director



July 31, 2017

ND EPSCoR is one of the cornerstones in North Dakota's efforts to build and sustain a transformative, multifaceted, synergistic academic research and education enterprise, anchored by a more diverse skilled workforce to drive our emerging knowledge-driven economy.

As ND EPSCoR begins Year 4 of our 2014-19 INSPIRE-ND cooperative agreement with the Established Program to Stimulate Competitive Research (EPSCoR) section of the National Science Foundation, we want to take this opportunity to highlight what this project means to North Dakota through the eyes of faculty research participants across our 11 participating institutions.

INSPIRE-ND builds on strategic investments made by the National Science Foundation and the state of North Dakota since 1986. In its first three years, ND EPSCoR's INSPIRE-ND project has: 1) developed/expanded two research platforms, 2) increased research infrastructure and 3) integrated research, education and human resources with workforce development initiatives to strengthen North Dakota's overall competitiveness.

Driven by and aligned with North Dakota's science and technology plan and its economic development plan, the two INSPIRE-ND research platforms of regional climate studies and sustainable materials science directly impact North Dakota's strongest industrial sector: agriculture.

Additionally, the research of the Centers for Regional Climate Studies (CRCS) and Sustainable Materials Science (CSMS) has been integrated across North Dakota in the form of: elementary, middle and high school classroom projects for rural and tribal students; support for college students and new faculty; partnerships with industry, agricultural and climate data groups; and, collaborations with academic institutions and federal laboratories.

Enjoy,



Kelly A. Rusch, Ph.D., P.E.

INSPIRE-ND Principal Investigator / ND EPSCoR Project Director

Vice President for Research and Creative Activity, North Dakota State University

kelly.rusch@ndsu.edu

Table of Contents

From the ND EPSCoR Project Director.....	2
Established Program to Stimulate Competitive Research (EPSCoR).....	4
National Science Foundation (NSF) EPSCoR and North Dakota.....	5
NSF EPSCoR Track-1: INSPIRE-ND	
(Innovative and Strategic Program Initiatives for Research and Education-North Dakota)	6
ND EPSCoR Center for Regional Climate Studies	7
Jianglong Zhang (Lead), Associate Professor, Department of Atmospheric Sciences.....	8
Frank Bowman (Co-Lead), Associate Professor and Chair, Department of Chemical Engineering	9
Paul Barnhart, Assistant Professor of Biology, Department of Natural Sciences.....	10
Stacie Blue, Instructor, Environmental Science.....	11
Eric C. Brevik, Professor and Chair, Geology and Soils, Department of Natural Sciences	12
Xuefeng (Michael) Chu, Associate Professor, Civil and Environmental Engineering	13
Andre DeLorme, Professor and Chair, Science Department	14
Lauren Dennhardt, Assistant Professor, Science Department	15
Anne Denton, Associate Professor, Department of Computer Science and Operations Research	16
Carrie Ann Duafala, Land Grant Director / Instructor	17
Erin Gillam, Associate Professor, Biological Sciences	18
Mandy Guinn, Environmental Science Instructor, Environmental Science	19
Kerry Hartman, Chair of Sciences and Academic Dean.....	20
Cindy Juntunen, Chester Fritz Distinguished Professor, Department of Counseling Psychology and Community Services; Dean, College of Education and Human Development	21
Aaron Kennedy, Assistant Professor, Department of Atmospheric Sciences	22
Michael Parker, Instructor, Pre-Engineering	23
David Roberts, Associate Professor, Department of Agribusiness and Applied Economics.....	24
Joshua Steffan, Assistant Professor, Biology and Agriculture.....	25
Xiaodong Zhang, Professor, Department of Earth System Science and Policy	26
Haochi Zheng, Assistant Professor, Department of Earth System Science and Policy	27
ND EPSCoR Center for Sustainable Materials Science (CSMS)	28
Dean Webster (Lead), Professor and Chair, Coatings and Polymeric Materials.....	29
Mukund Sibi (Co-Lead), Distinguished Professor, Chemistry and Biochemistry	30
Mikhail Bobylev, Professor, Organic Chemistry.....	31
Qianli (Rick) Chu, Associate Professor, Chemistry	32
Guodong Du, Associate Professor, Chemistry.....	33
Khawaja Hossain, Professor, Biology	34
Alena Kubátová, Professor and Director of Recruitment, Chemistry.....	35
Mafany Ndiva Mongoh, Agriculture and Science Faculty, Environmental Sciences Program.....	36
Alexander Parent, Assistant Professor, Chemistry.....	37
Mohiuddin Quadir, Assistant Professor, Coatings and Polymeric Materials.....	38
Bakhtiyor Rasulev, Assistant Professor, Coatings and Polymeric Materials.....	39
Jayaraman Sivaguru, James A. Meier Professor, Chemistry and Biochemistry	40
Chad Ulven, Associate Professor, Mechanical Engineering.....	41
Andriy Voronov, Associate Professor, Coatings and Polymeric Materials.....	42
ND EPSCoR Emerging Areas Seed Awards.....	43
Track-1 Programmatic Element: Diversity	45
Nurturing American Tribal Undergraduate Research and Education (NATURE) program	45
EMPOWERED-ND Corps.....	46
Eakalak Khan, Professor, Civil Engineering and Director of the NDSU Environmental and Conservation Science Program.....	47
Robert Pieri, Professor, Mechanical Engineering and NATURE Program University Summer Camp Coordinator.....	48
Track-1 Programmatic Element: Education and Workforce Development	49
K-12 initiative.....	49
Distributed Research Experience for Undergraduates (REU)	50
Leveraging Technology.....	50
James Nyachwaya (Co-Lead), Assistant Professor, Education and Chemistry and Biochemistry and School of Education	51
Aaron Bergstrom, High Performance Computing (HPC) Specialist, Computational Research Center.....	52
Ashley Hutchison, Assistant Professor, Co-Training Director, PhD Program in Counseling Psychology, Department of Counseling Psychology and Community Services, College of Education and Human Development.....	53
Oluwasijibomi (Siji) Saula, High-Performance Computing (HPC) System Administrator, Center for Computationally Assisted Science and Technology (CCAST).....	54
Timothy Young, Professor, Physics and Astrophysics	55
Track-1 Programmatic Element: Partnerships, Collaborations and Communication	56
Partnerships.....	56
Collaborations.....	56
Communication.....	56
Crystal Alberts, Associate Professor, Department of English and Director, UND Writers Conference.....	57
Zoltan Majdik, Associate Professor, Communication	58
Summary	59
Contacts	60

Created by the National Science Foundation in 1979, the Experimental Program to Stimulate Competitive Research was developed in response to congressional concerns about the geographic concentration of federal support for academic research and development. In 2017, the program's title was changed to reflect its longevity to the Established Program to Stimulate Competitive Research (EPSCoR).

Established Program to Stimulate Competitive Research (EPSCoR) ^{1, 2, 3}

Early National Science Foundation EPSCoR success prompted similar programs in other federal agencies and in 1992, the EPSCoR Interagency Coordinating Committee (EICC) was established. While most federal agencies followed with the “EPSCoR” name, the National Institutes of Health chose to call their parallel program the Institutional Development Award (IDeA).

Current EICC member agencies include:

- Department of Energy EPSCoR
- National Aeronautics and Space Administration EPSCoR
- National Science Foundation EPSCoR
- National Institutes of Health IDeA
- United States Department of Agriculture EPSCoR

According to the EPSCoR/IDeA Foundation website, 50 percent of the nation's states (many of which are EPSCoR-eligible states) currently receive approximately 10 percent of the nation's federal research and development funds; making the EPSCoR and IDeA programs especially significant in jurisdictions like North Dakota.

This publication focuses on the current activities of the National Science Foundation EPSCoR's 2014-19 Track-1 cooperative agreement⁴ with North Dakota for Research Infrastructure Improvement: INSPIRE-ND (Innovative and Strategic Program Initiatives for Research and Education-North Dakota). NSF EPSCoR expands and enhances the research capability of scientists in jurisdictions (states and U.S. territories), like North Dakota, that have traditionally lacked the strong university-based research efforts necessary to make them competitive in the federal academic research and development arena.

1 National Science Foundation Established Program to Stimulate Competitive Research (EPSCoR): [nsf.gov/od/oia/programs/epscor](https://www.nsf.gov/od/oia/programs/epscor)

2 National Institute of Health (NIH) Institutional Development Award (IDeA): nigms.nih.gov/Research/CRCB/IDeA/Pages/default.aspx

3 EPSCoR/IDeA Foundation: epscorideafoundation.org/about/overview

4 A cooperative agreement is a “type of assistance award which may be used when the project being supported requires substantial agency involvement during the project performance period.” [nsf.gov/pubs/manuals/gpm05_131/gpm2.jsp](https://www.nsf.gov/pubs/manuals/gpm05_131/gpm2.jsp)

National Science Foundation (NSF) EPSCoR and North Dakota (ND)

North Dakota was awarded its first National Science Foundation EPSCoR competitive Research Infrastructure Improvement Track-1 award in 1985. Since then, ND EPSCoR has enjoyed a nearly continuous record of success, with awards totaling more than \$64 million in federal funding from National Science Foundation EPSCoR since 1986:

AWARD DATES	NSF AWARD #	AWARD AMOUNT
2014-2019	OIA-1355466⁵	\$20 Million
2008-2014	EPS-0814442	\$15 Million + \$1.5 Million with extension
2005-2009	EPS-0447679	\$6 Million + \$450,000 with extension + \$383,333 TC supplement
2002-2005	EPS-0132289	\$6 Million
1999-2002	EPS-9874802	\$3 Million + \$200,000 with extension
1995-1999	OSR-9452892	\$4.5 Million + \$750,000 with extension + \$72,000 SBIR supplement
1992-1995	OSR-9108770	\$3 Million + \$125,000 with extension
1986-1992	RII-8610675	\$3,145,434
		Total = \$64,125,767

⁵ This publication focuses on the activities of the faculty research participants of the OIA-1355466 cooperative agreement between North Dakota and National Science Foundation EPSCoR for INSPIRE-ND (Innovative and Strategic Program Initiatives for Research and Education-North Dakota).



National Science Foundation EPSCoR Track-1: INSPIRE-ND (Innovative and Strategic Program Initiatives for Research and Education-North Dakota)

North Dakota's \$20 million, five-year, INSPIRE-ND cooperative agreement with the National Science Foundation began on August 1, 2014. INSPIRE-ND builds on prior strategic EPSCoR investments made at North Dakota's two research universities (North Dakota State University and the University of North Dakota).

The INSPIRE-ND has five foci:

1. Center for Regional Climate Studies
2. Center for Sustainable Materials Science
3. Diversity
4. Education and Workforce Development
5. Partnerships, Collaborations and Communication

INSPIRE-ND is aligned with the state's science and technology plan and ties directly to agriculture, North Dakota's strongest industrial sector. The first two focus areas represent the research and intellectual merit of the project. The remaining three focus areas represent the broader impact the project has on the state.

Throughout its three-year history, more than 233 participants: students (undergraduate and graduate), post-doctorates, faculty and staff at 11 institutions across North Dakota have reported their effort on this cooperative agreement. Additionally, INSPIRE-ND represents the first time that the five tribal colleges located in North Dakota and the state's four primarily undergraduate institutions have participated in the research component of the award.

ND EPSCoR Center for Regional Climate Studies

Global climate impacts regional weather, extreme weather events and agricultural productivity. Through computational modeling and simulation, the Center for Regional Climate Studies aims to understand how global climate impacts North Dakota agriculture in the areas of field hydrology, general land use, biomass production (which affects chemical feedstocks) and human behavior. Obtaining insight into these impacts and the long-term effects they have on the agricultural economy of our state is particularly challenging. Successful adaptation is possible only with an inclusionary knowledge-based plan of action. The six objectives of this research are: 1) analyze regional climate variations and data uncertainty, 2) predict hydrological changes for extreme conditions, 3) integrate hydrologic modeling across regional and local scales, 4) assess crop productivity response, 5) predict agricultural autonomous adaptation in response to climate variations and crop productivity and 6) explore feedback of environment and land use changes.



CRCS
Center for Regional
Climate Studies

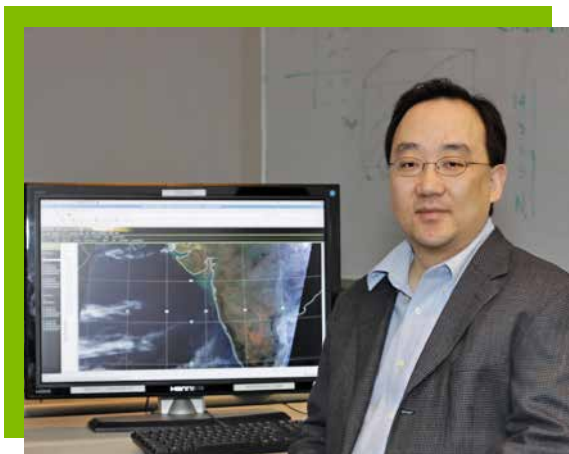
Meet the CRCS current faculty research participants (profiles included in this section):

1. Jianglong Zhang (lead), University of North Dakota, Grand Forks
2. Frank Bowman (co-lead), University of North Dakota
3. Paul Barnhart, Dickinson State University, Dickinson
4. Stacie Blue, Turtle Mountain Community College, Belcourt
5. Eric Brevik, Dickinson State University
6. Xuefeng (Michael) Chu, North Dakota State University, Fargo
7. Andre DeLorme, Valley City State University, Valley City
8. Lauren Dennhardt, Valley City State University
9. Anne Denton, North Dakota State University
10. Carrie Ann Duafala, Cankdeska Cikana Community College, Fort Totten
11. Erin Gillam, North Dakota State University
12. Mandy Guinn, United Tribes Technical College, Bismarck
13. Kerry Hartman, Nueta Hidatsa Sahnish College, New Town
14. Cindy Juntunen, University of North Dakota
15. Aaron Kennedy, University of North Dakota
16. Michael Parker, Cankdeska Cikana Community College
17. David Roberts, North Dakota State University
18. Joshua Steffan, Dickinson State University
19. Xiaodong Zhang, University of North Dakota
20. Haochi Zheng, University of North Dakota

In addition to the 20 faculty research participants currently working within the Center for Regional Climate Studies, the project has been supported by 103 additional participants, the majority of whom are and were undergraduate and graduate students.

Additional information on the center's research (including publications and external funding), research team members, partnerships, outreach, collaborations, events and communication is available on the Center for Regional Climate Studies website: und-crcs.org.





Zhang in a computer lab

**Jianglong Zhang (lead), associate professor,
Department of Atmospheric Sciences
University of North Dakota**

Three nouns that describe me: I am a scientist, father and friend.

Three adjectives that describe my work: Innovative, exciting and challenging

My first memory of wanting to become a STEM scientist: I liked to “invent” my own toys as a kid, which sparked my interest in learning and understanding theories behind phenomena.

ND EPSCoR Role(s):

- Center for Regional Climate Studies lead: I oversee the research progress of the center with an emphasis on facilitating collaborations among different disciplines.
- Center for Regional Climate Studies researcher: My research involves studying long-term variabilities in regional climate-related parameters from remote sensed, ground-based and modeled data.

My ND EPSCoR research focuses on studying regional climate and weather from satellite and ground-based observations, as well as numerical modeled data. My research team also has been involved in evaluating the impact of regional climate on agricultural production in the Upper Great Plains, as well as feedbacks of agricultural-based land use and land change on the regional climate and environment.

For more information about Zhang and his work:

und-crcs.org

jzhang.atmos.und.edu



Bowman inside the UND atmospheric aerosol chamber, which is used to study how particles form and grow in the atmosphere

Frank Bowman (co-lead), associate professor and chair, Department of Chemical Engineering University of North Dakota

Three nouns that describe me: I am a teacher, mentor and father.

Three adjectives that describe my work: Fascinating, fulfilling and fun

My first memory of wanting to become a STEM scientist: I drifted into studying chemical engineering as an undergraduate because I liked the challenge of solving complex problems. After a summer internship at a large chemical processing facility, I realized I didn't want to spend my life working as an engineer in industry. Since I really enjoyed working as a chemistry lab teaching assistant, I thought maybe I could teach as a college professor, so I went off to graduate school where I started to study atmospheric particles and air quality and got excited about doing scientific research.

ND EPSCoR Role(s):

- Center for Regional Climate Studies co-lead: I help coordinate the center's research, collaborations, outreach and reporting.
- Partnerships, Collaborations and Communication team co-lead: I help coordinate collaborations and communications with industry, government and community stakeholders.
- Center for Regional Climate Studies researcher: I conduct laboratory experiments to study the formation and growth of atmospheric particles and use atmospheric computer models to explore the impact of changing land use and climate on air quality.
- EMPOWERED-ND member: I represent Center for Regional Climate Studies and the Partnerships, Collaborations and Communication focus areas of the INSPIRE-ND project.

My ND EPSCoR research focuses on studying regional climate and weather from satellite and ground-based observations, as well as numerical modeled data. My research team also has been involved in evaluating the impact of regional climate on agricultural production in the Upper Great Plains, as well as feedbacks of agricultural-based land use and land change on the regional climate and environment.

For more information about Bowman and his work:
und-crcs.org



Barnhart stands in front of the first hibernacula (cave in which bats hibernate) discovered in North Dakota.

**Paul Barnhart, assistant professor of Biology,
Department of Natural Sciences
Dickinson State University**

Three nouns that describe me: I am a bat ecologist, committed to and passionate about my work.

Three adjectives that describe my work: Novel, fun and muddy

My first memory of wanting to become a STEM scientist: I knew from a young age I wanted to be a scientist. My first memories of it were at about age 10 while watching Jeff Corwin and Steve Irwin. They made nature seem so fun and the passion they had for conservation has lived with me ever since.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I am a Chiropteran (bat) behavioral ecology expert.
- EMPOWERED-ND member: I am the ND EPSCoR principal investigator on my campus.

My ND EPSCoR research centers on the impacts of agricultural land use changes and their influences on bat behaviors. Very little is known about how shifts in change will impact volant, nocturnal species such as bats. In fact, little work has been done on bat habitat use in agriculturally dominated landscapes. Due to potential threats facing bat populations, my work assesses habitat use, current distributions, predatory behaviors and species abundance of bats in these ephemeral agricultural landscapes. The information gathered by my work will lay the foundation for the conservation of bat species as their habitat use changes on agricultural landscapes in the face of climate variations.

For more information about Barnhart and his work:
und-crcs.org



Blue (front) and Scott Hanson, ND EPSCoR Tribal Colleges Liaison Manager, inspect a plum tree.

Stacie Blue, instructor, Environmental Science Turtle Mountain Community College

Three nouns that describe me: I am a mom, educator and collaborator.

Three adjectives that describe my work: Student-led, community-oriented and integrated

My first memory of wanting to become a STEM scientist: I have never seen myself as a scientist, more as someone who loves to learn about the world around her. I enjoy doing small research projects that answer a question and sharing what has been learned. My thoughts and interests have always varied and now I enjoy seeing students doing their research to find answers to their questions.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I am a science faculty member who works with students who want to do research in the areas of environmental science and natural resources.

My ND EPSCoR role is to work with Turtle Mountain Community College students and teach them about research methodology, climate studies and reviewing scientific journal articles. My students will develop a realistic plan, create a project timeline and conduct their research on climate fluctuations, with a focus on the natural resources of the Turtle Mountain area.

For more information about Blue and her work:
und-crcs.org



Brevik explains one of the laboratory methods used in the EPSCoR research being conducted at Dickinson State University.

Eric C. Brevik, professor and chair, Geology and Soils, Department of Natural Sciences Dickinson State University

Three nouns that describe me: I am a hard worker, motivated scientist and enthusiastic student mentor.

Three adjectives that describe my work: Unique, innovative and rewarding

My first memory of wanting to become a STEM scientist: The summer after eighth grade, my earth science teacher took a group of students to the Black Hills on a one-week field trip. I returned from that field trip wanting to be a geologist.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I am a geology and soil expert.
- Emerging Areas Seed co-principal investigator: I'm charged with finding new ways to unite the research efforts of the ND EPSCoR Centers for Regional Climate Studies and Sustainable Materials Science through "Development of A Novel Porous Carbonaceous Material Enhanced for Control of Nitrous Oxide Emissions from Agricultural Soils." For more information, see Emerging Areas Seed Award section.
- ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Billi Jean Petermann. For more information, see the Distributed REU section.

My ND EPSCoR responsibilities include investigating the effects of soil management changes on the agroecosystem and feedbacks related to shifts in climate. Specifically, my role is studying the impact of management changes on soil organic carbon and nitrogen stocks. This in turn is related to potential greenhouse gas emissions related to agricultural management practices.

For more information about Brevik and his work:
und-crcs.org



Chu (far left) works with his students and a USGS researcher to gather hydrologic data at a monitoring site in the Prairie Pothole Region.

**Xuefeng (Michael) Chu, associate professor,
Department of Civil and Environmental Engineering
North Dakota State University**

Three nouns that describe me: I am a hydrologist, water resources engineer and a computer modeler.

Three adjectives that describe my work: Watershed hydrology, hydrologic modeling and contaminant transport modeling

My first memory of wanting to become a STEM scientist: I have always been interested in mathematics and curious about computer programming.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I conduct topographic analysis and hydrologic modeling at both the regional and local scales, as well as hydrologic monitoring and data processing.

My ND EPSCoR group focuses on topographic analysis and hydrologic modeling at both regional and local scales. The ultimate goal of the research is to develop an integrated hydrologic modeling system supported by hydrological and meteorological databases and remote sensing observations across spatial and temporal scales. Specific research topics include land surface delineation and topographic characterization, quantification of depression-dominated overland flow dynamics, hydrologic monitoring and field data collection, watershed hydrologic modeling and model calibration and validation.

For more information about Chu and his work:

und-crcs.org

ndsu.edu/pubweb/~xuchu/research4.htm



DeLorme, in his lab, shows one of the nets used to capture dragonflies.

Andre DeLorme, professor and chair, Science Department Valley City State University

Three nouns that describe me: I am a listener, an introvert and achiever.

Three adjectives that describe my work: Exciting, active and hands-on

My first memory of wanting to become a STEM scientist: Unlike many scientists, I never had a specific “aha!” moment. I’ve just always been curious about nature and the world around me, so it was just a natural progression to becoming a scientist.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I am an aquatic invertebrate expert.
- EMPOWERED-ND member: I am the ND EPSCoR principal investigator on my campus.
- Emerging Areas Seed co-principal investigator: I’m charged with finding new ways to unite the research efforts of the ND EPSCoR Centers for Regional Climate Studies and Sustainable Materials Science through “Fate of Bio-based Materials in Aquatic Environments: Impact on Physical, Chemical, and Biological Characteristics of Receiving Waters.” For more information, see Emerging Areas Seed Award section.
- 2016-17 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Hayden Zander. For more information, see Distributed REU section.
- 2017-18 ND EPSCoR second year Distributed REU assistantship primary adviser to Hayden Zander. For more information, see Distributed REU section.

My research focus with the Center for Regional Climate Studies involves documenting an array of aquatic biota found in North Dakota rivers and streams to establish a solid baseline of data for studies of shifts in climate. To document, understand and possibly mitigate these changes, it is important to determine past and current fauna of North Dakota water bodies and to set up long-term practices for documenting future changes.

For more information about DeLorme and his work:

und-crcs.org

community.vcsu.edu/facultypages/andre.delorme/My_Webpage



Dennhardt out in the field

Lauren Dennhardt, assistant professor, Science Department Valley City State University

Three nouns that describe me: I am interested in prairie ecology, outdoors and plants.

Three adjectives that describe my work: Biodiverse, focused on native plants and attentive to shifting communities

My first memory of wanting to become a STEM scientist: My first memory of wanting to become a STEM scientist was going to Yellowstone with my grandma. It made me want to learn everything about the environment.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I study invasive species in the Northern Great Plains. Specifically, I look at various ecotypes of native grasses and how they compete with cool-season invasive grasses.

My ND EPSCoR research focuses on how prairie plant populations may be changing due to shifting climate. As the number of growing degree days increase in our region, a new climatic niche has formed in our prairies in the early spring and late fall. This niche is typically occupied by invasive grass species with little competition from other species. My lab is testing whether southern ecotypes of native grass species can fill this new niche and compete with invasive grass species. Ultimately, this research may help mitigate biodiversity loss.

For more information about Dennhardt and her work:
und-crcs.org



Denton, in her computer lab, explains her work and that of her students.

Anne Denton, associate professor, Department of Computer Science and Operations Research North Dakota State University

Three nouns that describe me: I am a problem-solver, curious and concerned about the environment.

Three adjectives that describe my work: Strives for logical consistency between domains, crosses disciplines and questions preconceptions

My first memory of wanting to become a STEM scientist: When I was in middle school, my dad got one of the first-generation personal computers. He set it up so I could get into a programming environment, being able to solve difficult problems fascinated me. Although I did not understand how the rest of computers worked, I wrote programs for school science projects, as well as games like Pac-Man.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I use data science for relating climate to agricultural output. After initially focusing on predicting yield, I am now increasingly working on understanding soil health to help preserve the yield of the future. I use data mining techniques for creating additional layers of geospatial data, which increases the accuracy of soil health-related predictions without need for additional sensors on satellites and unmanned air systems.

My ND EPSCoR research group focuses on big data approaches for assessing the impact of climate on agricultural output. Two aspects of this problem are of particular interest 1) quantifying the effect of climate variables on plant growth and 2) establishing the impact of climate on soil health. These relationships are of direct relevance to farmers and they also contribute to quantitative scientific ethics indicators such as footprints. Temporal data mining techniques and generalizations of multivariate correlation analysis are developed for evaluating attribute selection and preprocessing of climate variables as they relate to plant growth. Geospatial approaches, including newly introduced multi-scalar, window-based techniques, enable inferences on soil health from remotely sensed imagery and allow tracking the impact of climate variables over time.

For more information about Denton and her work:
und-crcs.org



Duafala conducts research in the field.

**Carrie Ann Duafala, land grant director and instructor,
Natural Resource Management
Cankdeska Cikana Community College**

Three nouns that describe me: I am a teacher, adventurer and mother.

Three adjectives that describe my work: Exciting, fun and interesting

My first memory of wanting to become a STEM scientist: I have always been interested in animals and the environment. My family fostered these feelings for as long as I can remember, taking me on camping and hiking trips, teaching me how to research things I didn't know and showing me how to sit down and listen to the elements of nature. I have always been interested in dogs, especially the wild varieties, so in college I drifted to wildlife management and canine ecology.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I conduct research on bioremediation of terrestrial crude oil spills by saprophytic fungi.

My North Dakota EPSCoR research team is focused on improving ways to remediate areas after oil spills, through the use of a cost-effective biological method. We are researching the effectiveness of the mushroom mycelium to detoxify the contaminated substrate, and the rate of detoxification. Currently, we are performing all experiments in a laboratory setting, but have plans on expanding to a more natural setting. This method will hopefully provide a cost-effective way to clean up smaller crude oil spills that happen around drilling sites and crude oil pipeline malfunctions.

For more information about Duafala and her work:
und-crcs.org



Gillam, in the classroom, shows an example of the bats she studies.

Erin Gillam, associate professor, Biological Sciences North Dakota State University

Three nouns that describe me: I am a professor, mother and a loud person who loves to laugh.

Three adjectives that describe my work: Adventurous, fun and acoustic

My first memory of wanting to become a STEM scientist: I watched “The Lion King” as a child and after that I wanted to study large African mammals.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I am a Chiropteran (bat) ecologist.

My ND EPSCoR research focuses on understanding how global climate change may impact the ecology of bats in the Northern Great Plains. Specifically, my students and I use field data on the roosting ecology of two species – the little brown bat and the federally threatened northern long-eared bat – to understand roosting habitat preferences and how the availability of such preferred habitats may change under different predictive climate change models. My lab works closely with other center researchers, such as Mandy Guinn and Paul Barnhart, who also ask questions about the biology of bats in the Northern Great Plains.

For more information about Gillam and her work:

und-crcs.org

sites.google.com/site/batsrkul



Guinn takes a Big Brown Bat out of a mist net during a June 2016 trapping session at UTTC.

**Mandy Guinn, environmental science instructor,
Environmental Science
United Tribes Technical College**

Three nouns that describe me: I am an instructor, researcher and committee chair.

Three adjectives that describe my work: Innovative, engaging and timely

My first memory of wanting to become a STEM scientist: As a child, I spent countless hours in drained irrigation ditches near my house searching for crawfish. The fascination of locating, comparing and housing these captured crawfish started a lifelong ecological curiosity.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I focus on the ecology of bats in North Dakota, including the foraging ecology and impact of bats on North Dakota agricultural pests.
- NATURE coordinator for United Tribes Technical College: I coordinate and plan all of the Sunday academy and high school program activities.

My ND EPSCoR research interests are focused on understanding North Dakota bat ecology as it relates to agro-economics and basic biology. Over the past several years, I have worked on projects ranging from understanding bat behavior in communal roosts, determining genetic distinction of species and using genetic analysis to identify bat diet. I also have focused on the economic importance of bats in agricultural systems. With other climate studies team members, I am looking at the ecological services provided by bats and the economic relief they provide in agricultural systems to extrapolate the impact of the disappearance of bats (due to climate shifts, habitat destruction and fungal infections), on the financial model of the North Dakota agricultural industry.

For more information about Guinn and her work:
und-crcs.org



Hartman (far right) and students gather data in the field.

Kerry Hartman, chair of sciences and academic dean Nueta Hidatsa Sahnish College

Three nouns that describe me: I am a faculty member, a father and a researcher.

Three adjectives that describe my work: Exciting, integrated and committed

My first memory of wanting to become a STEM scientist: As a young boy, I liked being outdoors. Eventually I asked myself many things about Mother Nature, including wondering about how different plants talked to one another. I've spent the rest of my life trying to figure that and many other parts of nature out.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I study the environment, with a particular focus on how climate and human use has impacted native fruit species.
- Emerging Areas Seed co-principal investigator: I'm charged with finding new ways to unite the research efforts of the ND EPSCoR Centers for Regional Climate Studies and Sustainable Materials Science through "A Sustainable Approach for Improving Performance Characteristics of Bio-based Poly (lactic acid) Polymer via Incorporating Functionalized Cellulose Nanocrystals." For more information, see Emerging Areas Seed Award section.
- NATURE Coordinator for Nueta Hidatsa Sahnish College: I mentor undergraduate researchers. I also organize and help run our Sunday Academies and Tribal College Summer Science Camp.
- EMPOWERED-ND member: I am the ND EPSCoR principal investigator on my campus.
- 2017-18 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Lee Voigt: For more information, see Distributed REU section.

For more information about Hartman and his work:
und-crcs.org



Juntunen (left) and UND assistant professor Ashley Hutchison present “Helpful Hydrogels: A Useful Tool for Hands-on Learning” at a Science Café held March 2017 during the 48th Annual UND Writers Conference.

**Cindy Juntunen, Chester Fritz Distinguished Professor,
Department of Counseling Psychology and Community Services;
dean, College of Education and Human Development
University of North Dakota**

Three nouns that describe me: I am a scientist, a mom and a farm girl.

Three adjectives that describe my work: Invigorating, creative and fun

My first memory of wanting to become a STEM scientist: I’ve always been a big reader, and, as a result, I became very interested in understanding how people think, but my rural North Dakota high school was too small for a psychology class. However, North Dakota State University offered a correspondence course, which asked me to analyze the art of van Gogh to see if I could determine what work was created when he was in a depressed state, and which was not: the assignment was the most fascinating thing, and it pretty much sealed the deal – I’ve been studying psychology ever since.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I study vocational psychology of rural groups.
- Education and Workforce Development Team co-lead: I am the kindergarten through grade 12 education and workforce development research liaison for the entire Track-1 project.
- K-12 Seed grant PI/awardee: I oversee the implementation of STEM activities in fifth and eighth grade classrooms in rural schools. These STEM activities are developed or adapted based on science emerging from the research clusters, and focus on helping younger students see environmental and related science as more accessible and relevant to their daily lives.
- EMPOWERED-ND member: I represent the education and workforce development focus area of the INSPIRE-ND project.
- 2017-18 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Kayana Trottier: For more information, see Distributed REU section.

My ND EPSCoR assignments are to research the impact of human factors, including the ways in which North Dakota farmers, ranchers and other agricultural producers make decisions about how they use their land. I also work with students in kindergarten through 12th grade in North Dakota’s rural communities to study how exposure to STEM activities during elementary school might influence their relationship with science and their decisions to pursue STEM education in middle school and beyond.

For more information about Juntunen and her work:

und-crcs.org

education.und.edu/counseling-psychology-and-community-services/faculty/juntunen.cfm



Kennedy enjoys a classic North Dakota blizzard.

**Aaron Kennedy, assistant professor,
Department of Atmospheric Sciences
University of North Dakota**

Three nouns that describe me: I am practical, eager and curious.

Three adjectives that describe my work: Innovative, relevant and varied

My first memory of wanting to become a STEM scientist: My dad, a Marine Corps aviator, saw my interest in weather at an early age, took me to visit the station meteorologists where I helped track tropical cyclones.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I perform and evaluate atmospheric models ranging from storm to climate scales; I'm the team's weather and climate expert.

My ND EPSCoR assignments are to explore the fidelity of trends of weather events in the Northern Great Plains region to provide information about future weather conditions in North Dakota to my team members working in watershed and crop modeling.

For more information about Kennedy and his work:

und-crcs.org

faculty.atmos.und.edu/kennedy



Parker describes his research for CRCS.

Michael Parker, instructor, Pre-Engineering Cankdeska Cikana Community College

Three nouns that describe me: I am a farmer, book worm and nature observer.

Three adjectives that describe my work: A learning experience, useful and unique

My first memory of wanting to become a STEM scientist: I followed the space program when I was a kid in the 1960s and watched Neil Armstrong take his “one step for man ...” live on a snowy black and white TV. It got me interested in engineering, which I pursued when I went to college. But, I also grew up on a farm – the same one I live on now – and was always intrigued by watching the crops come up out of the soil and following their life cycle to harvest. I read about Norman Borlaug winning the Nobel Peace Prize in school and realized the importance of research in agriculture. Now, finally, by assisting Carrie Ann Duafala here at Cankdeska Cikana Community College, I have been able to experience grant-funded collegiate research.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I am involved in bioremediation of oil contaminated soils utilizing the higher fungi as a detoxifying agent. I was a commercial mushroom producer so I have extensive experience in clean room culture work and propagating mycelium, which I use in our work.

My North Dakota EPSCoR research team is focused on improving ways to remediate areas after oil spills, through the use of a cost-effective biological method. We are researching the effectiveness of the mushroom mycelium to detoxify the contaminated substrate, and the rate of detoxification. Currently, we are performing all experiments in a laboratory setting, but have plans on expanding to a more natural setting. This method will hopefully provide a cost-effective way to clean up smaller crude oil spills that happen around drilling sites and crude oil pipeline malfunctions.

For more information about Parker and his work:
und-crcs.org



Roberts works on his next crop model.

David Roberts, associate professor, Department of Agribusiness and Applied Economics North Dakota State University

Three nouns that describe me: I am an agricultural economist, statistics fanatic and nature enthusiast.

Three adjectives that describe my work: Statistics-based and related to agriculture, as well as climate

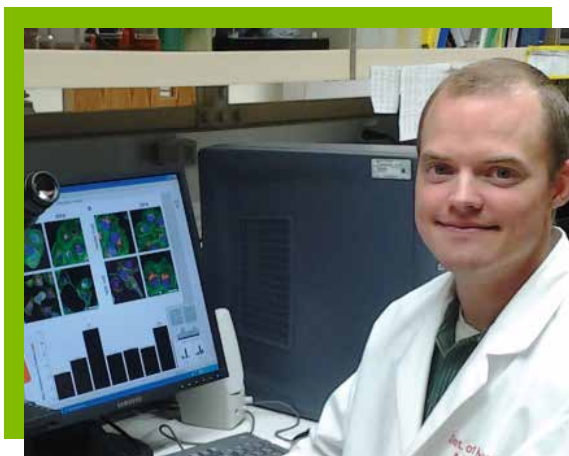
My first memory of wanting to become a STEM scientist: Although my father was a professor of agricultural economics, I didn't realize I wanted to be a STEM scientist until I was in my early 20s. I had a knack for Spanish and other Romance languages, so I majored in Spanish, but I minored in agricultural economics, and I got hooked. Seeing how and why consumer and firm behavior are intertwined with natural resources and environmental quality through intricate, complex feedback loops was eye-opening, so I earned master's and doctoral degrees in agricultural economics. Learning and applying those principles has been exhilarating for me ever since.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I study how crop selection in North Dakota over the past several decades was affected by a changing climate, technological advancement, global market conditions, as well as energy and farm policy. I also study the effects of climate variability and technological change on input use efficiency in agriculture. I teach graduate students how to do the same kinds of research I do.

My ND EPSCoR assignments are to study the economics of agricultural land use change in North Dakota, including the effects of climate and weather on crop selection decisions throughout the state. Rapid conversion from small grains-based agriculture to corn-soy rotations since the mid-1990s, especially in southeastern North Dakota, makes the state an ideal location for investigating how unique climate conditions have interacted with market forces during the intervening years to influence how farmers behave.

For more information about Roberts and his work:
und-crcs.org
ag.ndsu.edu/agecon/people/bios/roberts



Steffan sits at a fluorescent microscope that can be used to visualize soil microorganisms.

Joshua Steffan, assistant professor, Biology and Agriculture Dickinson State University

Three nouns that describe me: I am an optimist, forward-thinking and workaholic.

Three adjectives that describe my work: Interesting, novel and straightforward

My first memory of wanting to become a STEM scientist: From a young age, I was interested in all aspects of science. As a childhood cancer survivor, I was surrounded by physicians, scientists and nurses for many years. That was my introduction to the medical science field. Although particular interests changed in high school and college, all were science related.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I examine how changes in land usage influences the total ecosystem. My particular interest lies in how soil microbial community populations change over time in response to different land uses.
- 2016-17 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Levi Bassett: For more information, see Distributed REU section.
- 2017-18 ND EPSCoR Distributed REU assistantship primary adviser to Brittany Decker: For more information, see Distributed REU section.

My ND EPSCoR research involves documenting the changes that occur to soils under different land-use management. Specifically, I am interested in how the soil microbial communities change as conservation reserve program land is put back into production agriculture. Since soil is the world's foremost source for carbon storage, the carbon content in soil plays a role in climate change. The overall goal of my project is to examine total ecosystem changes, especially with regards to soil carbon and microbes, as they relate to different land uses and how these different land uses impact local and/or regional climate.

For more information about Steffan and his work:
und-crcs.org



Zhang releases a buoy to gather data from Devils Lake.

**Xiaodong Zhang, professor, Department of Earth System Science and Policy
University of North Dakota**

Three nouns that describe me: I am an oceanographer, who also studies lakes, using data collected in, on and above the water.

Three adjectives that describe my work: Exciting, challenging and rewarding

My first memory of wanting to become a STEM scientist: I grew up by the sea, so I always have been passionate about learning more about the oceans.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I focus on how regional climate impacts the hydrological cycle and water quality.
- 2017-18 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Noah Irby: For more information, see Distributed REU section.

My ND EPSCoR research group is focused on monitoring and assessing the water quality of aquatic environments, identifying the drivers of the changes, and developing predictive knowledge of possible future changes. The areas of interest include lakes, wetlands and coasts; the approaches involve field observations, remote sensing and modeling. My personal research focuses on studying the interaction between light and aquatic environments, and then inferring information about dissolved and suspended matter in the water.

For more information about Zhang and his work:

und-crcs.org

und.edu/instruct/zhang



Zheng (far left) and students discuss their research.

Haochi Zheng, assistant professor, Department of Earth System Science and Policy University of North Dakota

Three nouns that describe me: I am an agricultural and environmental economist, and a yogi.

Three adjectives that describe my work: Interdisciplinary, spatially-explicit and policy relevant.

My first memory of wanting to become a STEM scientist: I don't consider myself a STEM scientist. However, I am passionate about the environmental problems that we are encountering as a society and became an environmental economist to study how human decisions, from agricultural land use to what people purchase at the store, impact the world around us.

ND EPSCoR Role(s):

- Center for Regional Climate Studies researcher: I model land use change and evaluate its economic and environmental trade off and I collaborate with team STEM scientists to complement their work by evaluating the economic impacts of it.

My ND EPSCoR assignments are to study the impacts of climate variation on agricultural production, land use and its feedback to ecosystem services, particularly in the Northern Great Plains including the Dakotas and Minnesota. I am interested in questions, such as how market, policy and environmental forces affect crop production and individual landowners' decision-making on land use and management. I also am concerned with what policy instruments can improve both economic efficiency and environmental sustainability by taking into account all private and social costs.

For more information about Zheng and her work:

und-crcs.org

essp.und.edu/people/bios/zheng.aspx

ND EPSCoR Center for Sustainable Materials Science

There is growing worldwide recognition of the need to transition away from fossil-based petrochemicals and their materials to more sustainable platforms. New, sustainable materials can contribute to North Dakota's economy if their sources are low cost and renewable, their lifetimes are long and they are highly durable, and their recyclability is efficient and of high value. The objectives of this research are: synthesis of new monomers and raw materials from crop sources using novel catalysts and green processes; utilization of sustainable methodologies such as green catalysts, high throughput and computational methods; engineering of high-performance polymers and composites from renewable raw materials; design of materials for programmed degradation and assessment of the complete life cycle of these new sustainable materials.



Meet the current faculty researchers:

1. Dean Webster (Lead), North Dakota State University, Fargo
2. Mukund Sibi (Co-Lead), North Dakota State University
3. Mikhail Bobylev, Minot State University, Minot
4. Qianli (Rick) Chu, University of North Dakota, Grand Forks
5. Guodong Du, University of North Dakota
6. Khwaja Hossain, Mayville State University, Mayville
7. Alena Kubátová, University of North Dakota
8. Mafany Ndiva Mongoh, Sitting Bull College, Fort Yates
9. Alexander Parent, North Dakota State University – One of four new hires in this award*
10. Mohiuddin Quadir, North Dakota State University – One of four new hires in this award*
11. Bakhtiyor Rasulev, North Dakota State University – One of four new hires in this award*
12. Jayaraman Sivaguru, North Dakota State University
13. Chad Ulven, North Dakota State University
14. Andriy Voronov, North Dakota State University

* Fourth hire expected in Year 4

In addition to the 14 faculty research participants currently working within the center, the project has been supported by 96 additional participants. Most of those participants are undergraduate and graduate students.

Additional information on the center's research, including publications and external funding, research team members, partnerships, outreach, collaborations, events and communication is available online: csms-ndsu.org





Webster talks about materials characterization methods with students from the Sitting Bull College NATURE science camp.

Dean Webster (lead), professor and chair, Coatings and Polymeric Materials North Dakota State University

Three nouns that describe me: I'm a scientist, educator and leader.

Three adjectives that describe my work: Creative, exciting and intense

My first memory of wanting to become a STEM scientist: As far back as elementary school, I was fascinated by the natural world and what we could learn about it. Growing up in the 1960s, I was excited about the space program and read everything I could about it and even built models of the Saturn V rocket and Lunar Excursion Module. I had several chemistry sets and would use up all the reagents for the experiments. In high school I enjoyed biology, chemistry and physics, but gravitated toward chemistry since AP chemistry and organic chemistry were offered as electives.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science lead: I help coordinate the work of the CSMS team, schedule our monthly meetings and collect information on team progress.
- Center for Sustainable Materials Science researcher

As a member of the ND EPSCoR team, I carry out research in the area of bio-based polymers, using chemicals derived from biomass to synthesize new polymers. We then study the properties of the polymers as a function of composition. The polymers are used as matrix resins for composites where various fillers and fibers are incorporated and the properties studied.

For more information about Webster and his work:
csms-ndsu.org
deancwebster.com



Sibi surveys his lab at NDSU.

**Mukund Sibi (co-lead), Distinguished Professor,
Chemistry and Biochemistry
North Dakota State University**

Three nouns that describe me: I am a leader, educator and scientist.

Three adjectives that describe my work: Inspiring, ground-breaking and creative

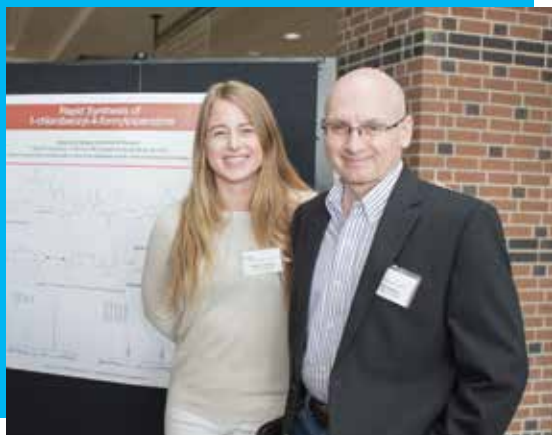
My first memory of wanting to become a STEM scientist: My father worked for a sugar company as a clerk, and we lived close by to the sugar factory. I was fascinated by how the sugar cane juice was converted to a brown syrupy liquid and then to a white crystalline material, the final product for the consumer. This process kindled my interest in wanting to be a chemist.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science co-lead
- Center for Sustainable Materials Science researcher
- Partnerships, Collaborations and Communications Team co-lead
- EMPOWERED-ND member: I represent the center and the partnerships, collaborations and communication focus areas of the INSPIRE-ND project.
- 2017-18 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Anna Renner: For more information, see Distributed REU section.

My scientific contribution in the ND EPSCoR program is on the development of green chemical methods for monomer synthesis from biomass. Our group acts as a lynchpin in the center and has collaborations with a majority of the team members.

For more information about Sibi and his work:
csms-ndsu.org
sibiresearch.com



Bobylev (right) and his CSMS student, Breanne Hatfield, at the April 2017 ND EPSCoR Annual State Conference.

Mikhail Bobylev, professor, Organic Chemistry Minot State University

Three nouns that describe me: I am an educator, a researcher and a chemist.

Three adjectives that describe my work: Innovative, creative and exciting

My first memory of wanting to become a STEM scientist: All members of my immediate and extended families were well-educated people, and they all had many books in their homes. I was reading all the time, both at home and while visiting my relatives. The books were very interesting and covered many different subjects. As a result, I became equally interested in natural sciences, history, politics and languages. However, around the age of 12, I began reading a college-level textbook in organic chemistry, and I suddenly realized that organic chemistry is the ultimate Lego set that allows you to build absolutely everything, from medicines to polymers. Since that moment, I was fully determined to become an organic chemist.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher.
- EMPOWERED-ND member: I am the ND EPSCoR principal investigator on my campus.
- 2016-17 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Breanne Hatfield: For more information, see Distributed REU section.

The topic of my investigation is to develop a novel type of sustainable materials and a novel method for their synthesis.

For more information about Bobylev and his work:
csms-ndsuo.org



Chu checks a bio-based crystalline monomer.

Qianli (Rick) Chu, associate professor, Chemistry University of North Dakota

Three nouns that describe me: I am a researcher, a learner and a thinker.

Three adjectives that describe my work: Creative, simple and useful

My first memory of wanting to become a STEM scientist: I was born as a researcher, who is always interested in how things work and how to make things work.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher.
- 2016-17 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship primary adviser to Quintin Elliott: For more information, see Distributed REU section.

My ND EPSCoR research is focused on the construction of innovative organic materials, such as chiral/stereoregular organic materials, and strong and lightweight materials. These materials have a variety of applications in nanoscience and sustainable technology. This research also offers new opportunities for molecular-level structure-property studies. Our group has been synthesizing novel polymers from biomass-derived starting materials, such as furfural and glycerol, using photoreactions.

For more information about Chu and his work:

csms-ndsu.org

csms-ndsu.org/multimedia

und.edu/dept/chu



Du showcases a Parr reactor in his lab.

Guodong Du, associate professor, Chemistry University of North Dakota

Three nouns that describe me: I'm a scientist, reader and dad.

Three adjectives that describe my work: Promising, challenging and green

My first memory of wanting to become a STEM scientist: My first memory was actually of wanting to be a mathematician, because I could count to 200.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher

As part of the ND EPSCoR project, we are interested in making biodegradable or degradable polymers from renewable resources such as carbon dioxide and bio-based building blocks, using synthetic chemistry and catalysis. Our research addresses sustainability from two perspectives: first we use renewable resources as the feedstock instead of petroleum, which is a finite resource. Second, the resulting polymeric materials can degrade into benign materials in the environment after their use, thus alleviating pollution concerns.

For more information about Du and his work:
csms-ndsu.org



Hossain (far right) and his CSMS students, from left to right, Atikur Rahman, Maren Johnson and Cheyenne Durant, at the April 2017 ND EPSCoR Annual State Conference.

Khwaja Hossain, professor, Biology Mayville State University

Three nouns that describe me: I am a researcher, a teacher and a supervisor.

Three adjectives that describe my work: Reinforcing, molding and rate loading

My first memory of wanting to become a STEM scientist: My first memory of wanting to become a STEM scientist was when I was working with a professor. The principal investigator of his project asked me to write three short proposals on what I wanted to research. At the end, they allocated money to one of my proposals.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher
- Emerging Areas Seed co-principal investigator: Charged with finding new ways to unite the research efforts of the ND EPSCoR Centers for Regional Climate Studies and Sustainable Materials Science through:
 - Bio-based dielectric substrate based on sunflower seed shells for radio frequency antenna
 - Collaborative sustainable materials research program in the University of North Dakota
 - Development of a novel porous carbonaceous material enhanced for control of nitrous oxide emissions from agricultural soils

For more information, see Emerging Areas Seed Award section.

- EMPOWERED-ND member: I am the ND EPSCoR principal investigator on my campus.
- 2017-18 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship co-adviser with Mohiuddin Quadir to Hannah Torgerson: For more information, see Distributed REU section.

For more information about Hossain and his work:
csms-ndsu.org



Kubátová (right) and Anastasia Andrianova discuss sample preparation.

**Alena Kubátová, professor and director
of recruitment, Chemistry
University of North Dakota**

Three nouns that describe me: environment, chemistry, outreach

Three adjectives that describe my work: Investigative, challenging and exciting

My first memory of wanting to become a STEM scientist: My first memory of wanting to become a STEM scientist or researcher was during my undergraduate studies when I was involved with investigating toxic pollutants – polychlorinated biphenyl. It still fascinates me that polychlorinated biphenyl actually represents over 209 compounds and thus their identification or quantification is not as straightforward as it may seem.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher
- 2015 adviser to Advanced Undergraduate Research Award recipient Jasmine Kreft.
- Adviser to Doctoral Dissertation Assistantship awardees Jana Rousova (FY16) and Anastasia Andrianova (FY17)
- 2017 adviser to Graduate Student Research Assistantship awardee Brett Nespor.
- Participant in Nurturing American Tribal Undergraduate Research Experience program: Provided a lab tour June 2017 to NATURE camp participants.
- 2017 Women in Science and Engineering (WISE) award

My research for ND EPSCoR involves developing new analytical methods for products from valorization of lignins. We pursue a comprehensive characterization starting with the initial feedstock, serving as a reference point, followed by that of its breakdown products.

For more information about Kubátová and her work:
csms-ndsu.org



Ndiva Mongoh demonstrates the process of scientific thinking in his lab.

Mafany Ndiva Mongoh, agriculture and science faculty, Environmental Sciences Program Sitting Bull College

Three nouns that describe me: I am an inquisitive person, a scientist and a global citizen.

Three adjectives that describe my work: Solutions-driven, rewarding and meaningful

My first memory of wanting to become a STEM scientist: I was exposed to the world of books and discovery at an early age, compared to my peers. We had a huge library at home of books my father had collected from his travels abroad. The almanacs and encyclopedias contained inspirational material which made me dream and become inquisitive about science. My specific interests were drawn to researchers, inventors and scientists who identified societal problems and worked resiliently to find simple sensible solutions to these problems. The first awe-inspiring invention I read about was the automobile windshield wiper. From an early age, I found it easy to understand the logical process by which scientists arrived at solutions.

ND EPSCoR Role(s):

- Center for Sustainable Materials Sciences Track-1 researcher: I study the sustainable biodegradation of novel plant-based polymers using microbial pathways.
- NATURE Coordinator for Sitting Bull College: I mentor undergraduate researchers. I also organize and help run our Sunday Academies and Tribal College Summer Science Camp.
- EMPOWERED-ND member: I am the ND EPSCoR principal investigator on my campus.
- Emerging Areas Seed co-principal investigator: I'm charged with finding new ways to unite the research efforts of the ND EPSCoR Centers for Regional Climate Studies and Sustainable Materials Science through "Novel energy/resource-efficient building material derived from rapidly renewable materials." For more information, see Emerging Areas Seed Award section.

I am interested in finding solutions to the impacts of polymers in the environment, specifically ways to facilitate their breakdown when they get to the waste stream. My team is looking at sustainable plant-based polymer biodegradation using a microbial pathway. We are demonstrating and harnessing the natural potential of microbes to degrade, transform and make biopolymers safe in the waste stream. Several techniques can be used to measure the ability of microbes to accomplish the aforementioned tasks. Measuring the biological oxygen demand of microbes during a biodegradation process offers a unique and interesting approach in investigating the ease with which microbes can break polymers.

I also work with kindergarten through grade 12 students around Standing Rock Sioux Reservation to get them interested in STEM disciplines as viable career options with immense potential. The activities I do as outreach have impacts on their decisions to pursue STEM education in middle school, high school, college and beyond.

For more information about Ndiva Mongoh and his work:
csms-ndsu.org



Parent, right, demonstrates use of an electrochemical cell to a student.

Alexander Parent, assistant professor, Chemistry North Dakota State University

Three nouns that describe me: I am a chemist, an investigator and a researcher.

Three adjectives that describe my work: Green, sustainable and chemical

My first memory of wanting to become a STEM scientist: My first memory of wanting to become a STEM scientist was sometime between third and fourth grade. I wanted to explore natural phenomena.

ND EPSCoR Role(s):

- ND EPSCoR New Hire and Center for Sustainable Materials
Science researcher

My research in ND EPSCoR involves developing sustainable methods for producing polymer precursors. We are particularly focused on developing catalyst systems using earth abundant metals and chemical processes using benign solvents and reagents, such as water and air. By improving the methods used for generating polymer building blocks the polymers themselves can be made more cheaply and sustainably.

For more information about Parent and his work:
csms-ndsuo.org



Quadir in his lab

**Mohiuddin Quadir, assistant professor,
Coatings and Polymeric Materials
North Dakota State University**

Three nouns that describe me: I am a scientist, mentor and an innovator.

Three adjectives that describe my work: Formative, innovative and curative

My first memory of wanting to become a STEM scientist: My first memory of wanting to become a STEM scientist was when I did my first science experiment as a child: extinguishing the flame on a candle by placing it inside an inverted glass jar.

ND EPSCoR Role(s):

- ND EPSCoR New Hire and Center for Sustainable Materials Science researcher
- 2017-18 ND EPSCoR Distributed Research Experience for Undergraduates (REU) assistantship co-adviser with Khwaja Hossain to Hannah Torgerson: For more information, see Distributed REU section.

My research involves designing value-added biomedical polymers and materials from renewable sources. The cohort of macromolecules and assemblies synthesized from our laboratory includes nanotechnology-powered delivery platforms, bioactive hydrogels and synthetic implants. In parallel to the objectives of the Center for Sustainable Materials Science, we will use building blocks derived from biomass to generate sustainable analogues comparable in efficacy to current state-of-the-art pharmaceutical polymers and devices.

For more information about Quadir and his work:
csms-ndsu.org



Rasulev works with molecular modeling software.

Bakhtiyor Rasulev, assistant professor, Coatings and Polymeric Materials North Dakota State University

Three nouns that describe me: I am a scientist, a computational chemist and a photographer.

Three adjectives that describe my work: Interdisciplinary, innovative and exciting

My first memory of wanting to become a STEM scientist: I've always been interested in technology and how things work, beginning from my childhood. When I was a high school student, I got a gift from my dad on my birthday – a chemistry kit. Using it made me feel like I was discovering a new world by myself. My interest in chemistry started to grow exponentially. Since my school had a very strong program in chemistry, I started to learn a lot from my chemistry teacher. Later, I started to participate in various chemistry competitions and several times won top student prizes in regional chemistry Olympiads. These achievements have added to my confidence with, and commitment to, chemistry.

ND EPSCoR Role(s):

- ND EPSCoR New Hire and Center for Sustainable Materials Science researcher: My role in ND EPSCoR is to provide computational properties assessment of bio-based polymers synthesized in the center under the EPSCoR program. Also, my group is working on developing computational structure-activity relationship models, to help with design of new improved bio-based polymers and to suggest better synthetic pathways.

My research is quite unique, since this is the first computational chemistry and cheminformatics lab in the state that focuses mainly on polymeric materials and computational design of them. The lab applies a unique combination of computational chemistry and cheminformatics approaches that are able to assess various properties of different materials virtually, without synthesizing them. Access to supercomputers allows group members to conduct computer simulations of large polymeric materials much faster, make a virtual screening of millions of hypothetical structures and select the best ones. This way, the computational lab helps synthetic chemists save time by investigating many properties of polymeric materials before synthesis.

The group is involved in STEM education, by training undergraduate and graduate students in computational chemistry and cheminformatics. In addition, our plans are to involve students from North Dakota's rural communities and from Tribal Colleges in North Dakota in our computational chemistry research.

For more information about Rasulev and his work:
csms-ndsu.org



Sivaguru works on analytical methods to evaluate programmed photodegradation of biomass derived polymers.

**Jayaraman Sivaguru, James A. Meier Professor,
Chemistry and Biochemistry
North Dakota State University**

Three nouns that describe me: I am a teacher, researcher and student.

Three adjectives that describe my work: Thoughtful, passionate and energetic

My first memory of wanting to become a STEM scientist: My first memory of wanting to become a STEM scientist was when I was in school. Math and science interested me.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher

My research focuses on designing biomass with built-in phototriggers; building biobased photodegradable polymers that can lead to high-performance materials, addressing the issue of sustainability, recyclability and renewability; and developing new photoinitiators from bio-resources.

For more information about Sivaguru and his work:
csms-ndsu.org



Ulven talks about searching for a better future through sustainable materials at TedxFargo, August, 2016.

Chad Ulven, associate professor, Mechanical Engineering North Dakota State University

Three nouns that describe me: I am creative, open-minded and a team player.

Three adjectives that describe my work: actful, practical and synergistic

My first memory of wanting to become a STEM scientist: I was hired as an undergraduate research assistant to fabricate composite materials and shoot them with a gas gun to evaluate how ballistic resistant they were.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher
- Diversity Team co-lead
- EMPOWERED-ND member: I represent the diversity focus area of the INSPIRE-ND project.
- Sunday Academy: I coordinated this NATURE program through 2017.

My research mainly involves the development of novel bio-based composites using flax fiber and bio-based thermoset resins such as epoxidized sucrose soyate or methoxylated sucrose soyate polyols. Investigating time-dependent properties of newly developed composites is another important aspect of the research projects being conducted by the biocomposite group. Fatigue and creep testing along with the development of fatigue damage and creep models applicable to these bio-based composites help us gain a thorough understanding of their potential expansion into more engineering and structural applications.

For more information about Ulven and his work:
csms-ndsu.org



Voronov (left) discusses work with graduate students Kyle Kingsley and Zoriana Demchuk.

Andriy Voronov, associate professor, Coatings and Polymeric Materials North Dakota State University

Three nouns that describe me: I am a researcher, an experimentalist and ... a huge soccer fan.

Three adjectives that describe my work: Dynamic, inspiring and hard

My first memory of wanting to become a STEM scientist: I grew up in an organic chemistry professor's family. I remember overhearing my dad discuss his work with group members, sometimes at home, sometimes over the phone. And while I did not understand most of the words (though I liked the word "aura"), at some point, I believe this scientific environment at home inspired me. When I enrolled to study chemistry at Lviv Polytechnic National University, I already knew that my intention would be to pursue an academic career. My interest in polymer chemistry came to me naturally; it was a modern and fast developing field, with many useful potential applications and very exciting fundamentals.

ND EPSCoR Role(s):

- Center for Sustainable Materials Science researcher: I work on synthesizing new sustainable monomers and polymers and their application for making bio-based polymeric materials.

My ND EPSCoR goal is to study the perspective of plant oils application as starting materials in making paints, coatings, adhesives and other polymeric materials. Replacing the petroleum-based content in those materials by keeping high-performance and properties is the main challenge. My other ND EPSCoR assignments are to help graduate and undergraduate students become professional scientists, to help them learn skills and activities that further their professional development in science, and to help them pursue long and successful careers, either in academia or in industry.

For more information about Voronov and his work:

csms-ndsu.org

cpmvoronov.wordpress.com

ND EPSCoR Emerging Areas Seed Awards

Eight new Track-1 participants were added to the project during Year 3 as recipients of ND EPSCoR Emerging Areas Seed awards. Designed to further the combined work of the two ND EPSCoR research centers [regional climate studies (CRCS) and sustainable materials science (CSMS)], the NDSU and UND awardees of these six projects were required to partner with an existing Track-1 research participant from one of the five tribal colleges or four primarily undergraduate institutions located in North Dakota in a project that combined or furthered the research efforts of both CRCS and CSMS. The objectives and anticipated outcomes of these awards are outlined on subsequent pages. During Year 4, the CRCS and CSMS leads and co-leads will assess award outcomes and future potential.

Awardees include:

1. “Bio-Based Dielectric Substrate Based On Sunflower Seed Shells For Radio Frequency Antenna” (\$40,000)
 - Principal Investigator (PI): Ali Alshami, Assistant Professor, Chemical Engineering, University of North Dakota
 - Co-PI: Khwaja Hossain (Center for Sustainable Materials Science Researcher), Professor, Biology, Mayville State University
 - Co-PI: Sima Noghanian, Professor, Electrical Engineering, University of North Dakota
 - CRCS/CSMS Anticipated Output: The project output will be a functional sensor and external publication.
2. “A Sustainable Approach for Improving Performance Characteristics of Bio-based Poly (lactic acid) Polymer via Incorporating Functionalized Cellulose Nanocrystals” (\$25,000)
 - Principal Investigator (PI): Dilpreet Bajwa, Associate Professor, Mechanical Engineering, North Dakota State University
 - Co-PI: Kerry Hartman (Center for Regional Climate Studies Researcher), Chair and Academic Dean, Sciences, Nueta Hidatsa Sahnish College
 - CRCS/CSMS Anticipated Output: The project output will be a conference presentation, peer-reviewed publication or an external grant proposal.

3. “Collaborative Sustainable Materials Research Program in the University of North Dakota” (\$40,190)
 - Principal Investigator (PI): Surojit Gupta, Assistant Professor, Mechanical Engineering, University of North Dakota
 - Co-PI: Khwaja Hossain (Center for Sustainable Materials Science Researcher), Professor, Biology, Mayville State University
 - Co-PI: Yun Ji, Assistant Professor, Chemical Engineering, University of North Dakota
 - CRCS/CSMS Anticipated Output: The project output will be fabrication and design of fibers and composites; peer-review papers, presentations and other derivatives; and proposals.
4. “Fate of Bio-based Materials in Aquatic Environments: Impact on Physical, Chemical, and Biological Characteristics of Receiving Waters” (\$25,000)
 - Principal Investigator (PI): Eakalak Khan, Professor, Civil Engineering and Director of the NDSU Environmental and Conservation Science Program, North Dakota State University
 - Co-PI: Andre DeLorme (Center for Regional Climate Studies Researcher), Professor and Chair, Science Department, Valley City State University
 - CRCS/CSMS Anticipated Output: The project output will be a peer reviewed publication or an external grant proposal.
5. “Novel Energy/Resource-Efficient Building Material Derived from Rapidly Renewable Materials” (\$25,000)
 - Principal Investigator (PI): Long Jiang, Associate Professor, Mechanical Engineering, North Dakota State University
 - Co-PI: Mafany Ndiva Mongoh (Center for Sustainable Materials Science Researcher), Instructor, Agriculture/Science, Sitting Bull College
 - CRCS/CSMS Anticipated Output: The project output will be peer-reviewed publications, an intellectual property and external grant proposals.
6. “Development of A Novel Porous Carbonaceous Material Enhanced for Control of Nitrous Oxide Emissions from Agricultural Soils” (\$39,988)
 - Principal Investigator (PI): Feng Xiao, Assistant Professor, Civil Engineering, University of North Dakota
 - Co-PI: Eric Brevik (Center for Regional Climate Studies Researcher), Professor of Geology and Soils and Chair, Department of Natural Sciences, Dickinson State University
 - Co-PI: Khwaja Hossain (Center for Regional Climate Studies Researcher), Professor, Biology, Mayville State University
 - CRCS/CSMS Anticipated Output: The project output will be a new material, peer-reviewed publications and external grant proposals.

For more information, visit:
ndepscor.ndus.edu/funding/awardees/emerging-areas-seed-awardees

Track-1 Programmatic Element: Diversity

ND EPSCoR Role(s):

- Eakalak Khan (Lead), North Dakota State University – profile in this section
- Chad Ulven (Co-Lead), North Dakota State University – profile in Center for Sustainable Materials Science section
- Scott Hanson, Tribal Colleges Liaison Manager, ND EPSCoR – contact information on the back cover
- Mark Hoffmann, Associate Project Director, ND EPSCoR – contact information on the back cover
- Tyson Jeannotte, EPSCoR NASSE Mentor, University of North Dakota – profile below
- Jean Ostrom-Blonigen, Project Administrator, ND EPSCoR – contact information on the back cover
- Robert Pieri, Professor, Mechanical Engineering, North Dakota State University – profile in this section

North Dakota is a 357-mile by 211-mile rectangle. The state's largest diverse population is the American Indian (5.5 percent). According to the North Dakota Indian Affairs Commission, the state contains five federally recognized Tribes and one Indian community: the Mandan, Hidatsa and Arikara Nation, the Spirit Lake Nation, the Standing Rock Sioux Tribe (also in South Dakota), the Turtle Mountain Band of Chippewa Indians, the Sisseton-Wahpeton Oyate Nation (also in South Dakota) and the Trenton Indian Services Area.

Track-1 Programmatic Element: Diversity

This ND EPSCoR sponsored education outreach project aims to improve science, technology, engineering and mathematics (STEM) education among tribal college and high school students in North Dakota and to build a pathway for the pursuit of careers in STEM disciplines. Nurturing American Tribal Undergraduate Research Experience (NATURE) builds on activities of a long-term collaboration between tribal colleges in North Dakota, NDSU and UND.

ND EPSCoR NATURE Programming includes:

- University Summer Camp: This two-week camp held at both UND and NDSU hosts tribal college and high school students in North Dakota who are over 18 years old. This camp is funded with leveraged state dollars.
- Tribal College Summer Camp: These two-week camps are held at each of the five tribal colleges in North Dakota. Camp participants are local middle and high school students. These camps are funded with National Science Foundation dollars.
- Sunday Academy: these lessons are held one Sunday a month at each of the five tribal colleges in North Dakota from September through March. NDSU and UND faculty travel to the tribal colleges to work with local middle and high school students on STEM projects. This program is funded with leveraged state dollars.

Instrumental to the success of these ND EPSCoR NATURE programs are the 268 American Indians (repetitive three-year total) who work with the ND EPSCoR NATURE coordinators, listed below, on the five tribal colleges to deliver this programming:

- Chris Dahlen, Cankdeska Cikana Community College
- Mandy Guinn, United Tribes Technical College – also a ND EPSCoR Track-1 CRCS researcher
- Kerry Hartman, Nueta Hidatsa Sahnish College – also a ND EPSCoR Track-1 CRCS researcher
- Mafany Ndiva Mongoh, Sitting Bull College – also a ND EPSCoR Track-1 CSMS researcher
- Miles Pfahl, Turtle Mountain Community College

ND EPSCoR American Indian Success in Science and Engineering

Tyson Jeannotte provides drop-in academic tutoring for native STEM students at the University of North Dakota American Indian Student Services center. The priority for his position is tutoring upper-division physical science and engineering students, but, as time allows, he also provides tutoring for native lower-division students. He also connects UND American Indian students with STEM activities at the Tribal Colleges to encourage younger students to pursue STEM college degrees. Additionally, Jeannotte serves as the UND campus coordinator for the NATURE University Summer Camp.

Visit the ND EPSCoR NATURE website for lesson plans and more information on the programs:
ndepscor.ndus.edu/ndep/nature

EMPOWERED-ND Corps

Formed as part of the INSPIRE-ND project, EMPOWERED-ND Corps is comprised of the Track-1 Leads and Co-Leads, the PIs from all 11 campuses and the ND EPSCoR Leadership. Chaired by Scott Hanson, ND EPSCoR Tribal Colleges Liaison Manager, during Year 3, the group developed a broader impacts white paper in an effort to produce a document that would result in significant and individualized broader impacts for each of the five tribal colleges and four primarily undergraduate institutions located in North Dakota. The results were a compiled list of STEM needs on each of those campuses that were then prioritized by the faculty and administrators on those campuses:

STEM NEEDS AT THE TRIBAL COLLEGES AND THEIR PRIORITY RANKINGS.					
STEM NEEDS	CCCC	NHSC	SBC	TMCC	UTTC
Scholarships for junior and senior STEM undergrads	7	1	4	5	6
Tutoring	3	6	5	3	5
TC STEM students doing K12 outreach activities	4	2	2	4	3
More research opportunities for TC STEM faculty	6	3	3	1	7
Summer bridge camp for graduating high school seniors	2	5		2	4
Transfer specialist at each TC	1	7	6	7	2
K12 STEM outreach coordinator at each TC	5	4	1	6	1

STEM NEEDS AT THE PUIS AND THEIR PRIORITY RANKINGS.				
STEM NEEDS	DSU	MaSU	MiSU	VCSU
K12 outreach activities	4	3	4	2
Renovating labs	2	2	2	4
Graduate student teaching interns	1	1	3	3
A sponsored programs office	3	4	1	1

The full report is available on the ND EPSCoR website:

ndepscor.ndus.edu/fileadmin/ndus/ndepscor/R11_Tk1_2019-24/BroaderImpactsWhitePaper_2017-04-20.pdf



Khan (left) observes while his doctoral student, Tauqeer Abbas (right), shares information about groundwater contamination in rural areas and treatment alternatives with student visitors from the June 2017 Sitting Bull College NATURE science camp.

Eakalak Khan, professor, Civil Engineering, and director, NDSU Environmental and Conservation Science Program North Dakota State University

Three nouns that describe me: I am an educator, a researcher and a low-key person.

Three adjectives that describe my work: Interesting, exciting and challenging

My first memory of wanting to become a STEM scientist: I grew up not wanting to be anything else but an engineer. My grandfather and father were engineers. I looked up to them. As a child, I liked to build things, take things apart, loved to solve math and science problems, asked lots and lots of questions. When I attended college, I chose to study environmental engineering because of my love for nature, especially water. I want to keep natural waters clean for future generations. That is why my work in the past 27 years has been dedicated to the treatment of contaminated water.

ND EPSCoR Role(s):

- Diversity Team lead: I lead for the entire Diversity component of the Track-1 project. NATURE is one of the programs/activities in the Diversity Component.
- Emerging Areas Seed grant PI: “Fate of Bio-based Materials in Aquatic Environments: Impact on Physical, Chemical, and Biological Characteristics of Receiving Waters”– for more information see Emerging Areas Seed Award section.
- Nurturing American Tribal Undergraduate Research and Education (NATURE) Program: I coordinated the entire NATURE program through July 31, 2017.
- EMPOWERED-ND member: I represent the Diversity focus area of the INSPIRE-ND project.

My first ND EPSCoR assignment is to coordinate the NATURE Program including facilitation of all NATURE-related activities, personnel and budget administration, long-term program success evaluation, publicizing the program, and short- and long-term program improvements. As the lead of the diversity component, I coordinate programs/activities in the Track-1 project that create broader impacts particularly those for underrepresented groups with a focus on American Indians. Examples of these programs/activities are recruitment of American Indians for Graduate Studies in STEM and integration of research cluster themes in NATURE programs.

For more information about Khan and his work:
ndsu.edu/ce/faculty/Eakalak_Khan/index.html
ndepscor.ndsu.edu/ndep/nature



Pieri (left front) with the 2017 University Summer Camp participants and mentors

Robert Pieri, professor, Mechanical Engineering North Dakota State University

Three nouns that describe me: I am a teacher, observer and engineer working to make a difference for individuals and society.

Three adjectives that describe my work: Creative, collaborative and innovative to improve the current conditions for people

My first memory of wanting to become a STEM scientist: My first memory of wanting to become a STEM scientist was trying to understand how things worked while in elementary school. Going from mechanical gears and linkages to electrical power to internal combustion engines, systems that were able to help get stuff done that needed to be done. In high school and undergraduate studies, I learned about the theory that was the foundation to these systems and eventually about the connectivity between phenomena. Eventually I understood that my greatest impact would be to help others to understand those same connectivities.

ND EPSCoR Role(s):

- Diversity Team member.
- University Summer Camp: I coordinate this NATURE program.

Track-1 Programmatic Element: Education and Workforce Development

Meet the Education and Workforce Development Team:

- Cindy Juntunen (Co-Lead), University of North Dakota, Grand Forks – profile in Center for Regional Climate Studies (CRCS) section
- James Nyachwaya (Co-Lead), North Dakota State University, Fargo – profile in this section
- Aaron Bergstrom, North Dakota University System, Grand Forks – profile in this section
- Frank Bowman, University of North Dakota – profile in CRCS section
- Scott Hanson, ND EPSCoR – contact information on back cover
- Mark Hoffmann, ND EPSCoR – contact information on back cover
- Ashley Hutchison, University of North Dakota – profile in this section
- Jean Ostrom-Blonigen, ND EPSCoR – contact information on back cover
- Oluwasijibomi (Siji) Saula, North Dakota State University – profile in this section
- Mukund Sibi, North Dakota State University – profile under Center for Sustainable Materials Science section
- Timothy Young, University of North Dakota – profile in this section

K-12 initiative

In an Education and Workforce Development initiative, ND EPSCoR participants are working to increase STEM capacity by inspiring North Dakota students early in their careers; a major accomplishment of rural K-12 outreach (RK120) is establishing collaborative relationships with teachers of grades 5 and 8 in 10 rural schools. Class sizes range from 1 to 28 students, with some schools classified as “frontier” and one school serving American Indian students exclusively. In the first year of data collection (2016-17), 268 students have participated. Based on innovative science emerging in both CRCS and CSMS, ND EPSCoR’s K-12 team developed weather and sustainability interventions for both 5th and 8th grade. In the 5th grade curriculum, there are three CSMS interventions and four CRCS interventions; in the 8th grade curriculum, there are three CSMS interventions (one of which has multiple components) and four CRCS interventions. These interventions support educational standards across multiple areas and have been vetted by certified teachers. The RK120 teacher partners are located in the following North Dakota school districts: Bowman, Circle of Nations, Gackle, Montpelier, Napoleon, Steele-Kidder County, Sterling, Wilton, and Wing. All teacher partners have completed training with Juntunen’s group (UND) in the interventions and are delivering them in classrooms this year.

To assess the impact of these educational interventions, instruments were developed to measure student interests, self-efficacy and intentions. The instruments developed use Social Cognitive Career Theory and the Theory of Planned Behavior. One initial finding, that interests may precede self-efficacy, is already adding new knowledge to the theory base in vocational psychology and achievement in STEM. Data will be collected longitudinally, adding significantly to our existing understanding of STEM interest and engagement in children between grades 5 and 11. The findings will contribute to changes in the STEM interventions implemented in North Dakota’s rural classrooms to maximize impact. Importantly, although this is part of Education and Workforce Development (EWD), our implementation process will result in original translational research products, again by Juntunen’s group.

Distributed Research Experience for Undergraduates (REU)

During Year 3, as outlined at our March 2016 National Science Foundation Reverse Site Visit (RSV), ND EPSCoR piloted a Distributed REU model, in which students work with researchers at either their home or a remote institution. The first distributed REU, which ran through May 31, 2017, had five students from four institutions. Four of the five students completed their work during the summer of 2016, and the fifth student completed her distributed REU experience at the end of the 2017 spring semester. Four of the five students were from Primarily Undergraduate Institutions (PUIs): two students were from Dickinson State University (DSU), one from Minot State University (MiSU) and one from Valley City State University (VCSU). The fifth student, from the University of North Dakota (UND), is American Indian. Three of the students aligned with CRCS and two of the students aligned with CSMS. The 2018 cohort will have seven students: three of them are from PUIs [one from DSU, one from Mayville State University (MaSU) and one from VCSU]; one is from the tribal college Nueta Hidatsa Sahnish College (NHSC); one is from UND; and, one is from North Dakota State University (NDSU). Four of the students are aligned with CRCS, two of the students are aligned with CSMS, and one student is aligned through a CRCS/CSMS Emerging Areas Seed award.

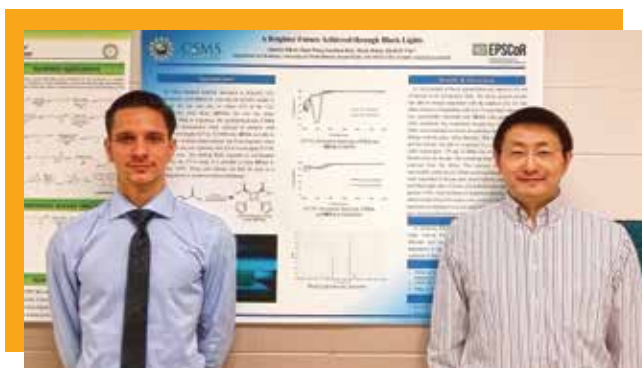
Leveraging Technology

ND EPSCoR's collaborative Track-1 environment is leveraged through collaborative infrastructure in both the state's Interactive Video Network (IVN) and in high-performance computing (HPC) centers located on the NDSU and UND campuses. Cyberinfrastructure (CI) is embedded throughout each of the five strategic foci and is an enabling technology for the project. In the Center for Regional Climate Studies (CRCS), CI helps team members, located across the state, in growing, curating, processing and sharing large climate, agriculture, and other datasets and provides a data transfer tool (the Globus Online GridFTP). The Center for Sustainable Materials Science (CSMS) will soon begin working on their CI applications following the recent hire of their computational scientist.



2016-17 REU students and their advisers with Denise Barnes, NSF EPSCoR section head at April 2017 ND EPSCoR Annual State Conference

(From left: VCSU student, Hayden Zander, with adviser, Andre DeLorme; DSU student, Billi Jean Petermann, with her adviser, Eric Brevik; DSU student, Levi Binstock, with his adviser, Josh Steffan; Denise Barnes; MiSU adviser, Mikhail Bobylev, with his student, Breanne Hatfield; and UND adviser, Qianli (Rick) Chu.



UND student Quintin Elliott (left) with his adviser, Qianli (Rick) Chu and their poster from the April 2017 ND EPSCoR Annual State Conference



Nyachwaya

**James Nyachwaya (co-lead), assistant professor, Education and Chemistry/Biochemistry and School of Education
North Dakota State University**

Three nouns that describe me: I am a researcher, a teacher and a father.

Three adjectives that describe my work: Fun, challenging and important.

My first memory of wanting to become a STEM scientist: My interest in Discipline Based Education Research (DBER) dates back to my days as a high school chemistry and mathematics teacher. As a new teacher, I realized that concepts I expected students to understand easily, were otherwise difficult for them, but I could not figure out why. During my graduate studies, as a teaching assistant in chemistry, I encountered students who lacked understanding of very fundamental science concepts. A desire to probe students' understanding led me into chemistry education research for my graduate studies, and now my career.

ND EPSCoR Role(s):

- Education and Workforce Development Team co-lead: I am responsible for Track-1 educational and workforce development bridging programs.
- Distributed REU coordinator: I am the REU coordinator for the entire Track-1 project.
- EMPOWERED-ND member: I represent the Education and Workforce Development focus area of the INSPIRE-ND project.

My ND EPSCoR assignments are to coordinate the Distributed REU. I review applications and recommend students for funding. I organize and facilitate professional development for the REU students. I also travel to the various institutions while students are conducting research to meet the students and researchers and get a sense of how the students are doing in their research.

For more information about Nyachwaya and his work:
ndepscor.ndus.edu/funding/awardees/reu-awardees



Bergstrom meets with computer science colleagues in the North Dakota University System Data Center to discuss the university's high-performance computing system.

Aaron Bergstrom, high-performance computing (HPC) specialist, Computational Research Center North Dakota University System

Three nouns that describe me: I am a technologist, facilitator and academic.

Three adjectives that describe my work: Complex, interesting and assistive

My first memory of wanting to become a STEM scientist: At the end of my sophomore year of college, I saw a television documentary on ancient civilizations, and I thought – “I want to be an archaeologist!” Unlike Europe, where archaeology falls within the humanities, archaeology in the U.S. is considered to be a science. My specialization became computer applications in archaeology, which eventually led me to use supercomputing resources to develop 3D archaeological reconstructions. Through this path, I eventually found my way to a career in high-performance computing (HPC).

ND EPSCoR Role(s):

- Education and Workforce Development Team member: I am a cyberinfrastructure specialist.

My ND EPSCoR responsibilities include consulting with faculty and students on the use of local and national HPC (aka supercomputing) and visualization resources, particularly related to the Center for Regional Climate Studies (CRCS). I also serve as the UND Campus Champion and the Deputy Region 3 Campus Champion (ND, SD, MN, IA, WI, IL) for national HPC resources available through XSEDE.

For more information about Bergstrom and his work:
und.edu/research/computational-research-center



Hutchison (left) with graduate student, Meara Thombre (right), presenting at a "Science Café" in March 2017.

**Ashley Hutchison, assistant professor, co-training director, PhD Program in Counseling Psychology, Department of Counseling Psychology and Community Services, College of Education and Human Development
University of North Dakota**

Three nouns that describe me: I am a researcher, animal lover and gardening enthusiast.

Three adjectives that describe my work: Innovative, meaningful and ever-changing

My first memory of wanting to become a STEM scientist: My first memory of being interested in science is after seeing the movie "Apollo 13" when I was 10 years old. I became obsessed with space and the specific Apollo 13 mission, in particular how they used creativity and problem-solving to survive the mission. I remember picking up James Lovell's (one of the astronauts on the mission) book and reading it over and over again. Although I did not become an astronaut like my ten-year-old self thought I would, that interest in using science to solve both immediate and long-term problems became ingrained in my worldview and future educational goals, which continues today.

ND EPSCoR Role(s):

- Education and Workforce Development Team member: I study what predicts adolescents' interests and engagement in STEM education and future career goals and decisions.

My ND EPSCoR responsibilities include working with other researchers to find out what predicts young North Dakotans' interest in STEM and eventual entry into STEM fields. More specifically, I research the impact of STEM curriculum delivered in fifth and eighth grades in rural schools and at tribal colleges. Through this work, I am hoping to learn more about what helps get rural and American Indian middle and high school students interested in STEM and into STEM careers.

For more information about Hutchison and her work:

und-crcs.org

education.und.edu/counseling-psychology-and-community-services/faculty/hutchison.cfm



Saula accesses a racked storage enclosure and its hard drives at one of the CCAST datacenters located within the NDSU Research Park Research 1 building.

**Oluwasijibomi (Siji) Saula, high-performance computing (HPC) system administrator, Center for Computationally Assisted Science and Technology (CCAST)
North Dakota State University**

Three nouns that describe me: I am a problem-solver, a leader and a pianist.

Three adjectives that describe my work: Immersive, rewarding and impactful

My first memory of wanting to become a STEM scientist: Tinkering with electrical sockets, power line switches and VHS players were my first steps into science and engineering. I soon became engrossed in electrical and magnetic fields and was curious to know more. I enrolled at North Dakota State University for an electrical engineering degree and was blown away at the practicality of the field. Needless to say, I still tinker with scientific and mathematical theories and applications today.

ND EPSCoR Role(s):

- Education and Workforce Development Team member: I am NDSU's HPC Systems administrator. My tasks include architecting, designing, configuring, provisioning and maintaining various hardware and software systems in the CCAST datacenter necessary for the processing of computational research jobs. I am also an HPC outreach coordinator. My tasks in this role include composition and collation of content required for education of budding and advanced computational research scientists, faculty, staff, and students across the ND EPSCoR project.

At CCAST we are positioned as enablers of high-performance computing, sourcing and implementing computer hardware and software, high-speed networking and data storage facilities necessary for computational research work from various STEM fields. We oversee and maintain the computing environment for millions of compute hours every year and collaborate with researchers from diverse fields, facilitating their scientific work where possible.

For more information about Saula and CCAST:
ccast.ndsu.edu
ccast.ndsu.edu/welcome/our_staff



Young presents western science material inside the GeoDome with Earth projected on the theater's screen.

Timothy Young, professor, Physics and Astrophysics University of North Dakota

Three nouns that describe me: I am a scientist, father and educator.

Three adjectives that describe my work: Novel, cutting-edge and cross-cutting.

My first memory of wanting to become a STEM scientist: When I started building models of nature, chemical bonds, rockets, ships and planes in third and fourth grade, I knew I wanted to be a scientist.

ND EPSCoR Role(s):

- Education and Workforce Development Team member: I serve as the director of productions, science content and planetarium shows designer. I collaborate with American Indian Storytellers around the state to speak in the GeoDome.

My ND EPSCoR roles include collaborating and coordinating with David DeMuth, co-director of production, design and technical aspects of GeoDome shows, as well as Luke Black Elk, director of American Indian storytelling in the GeoDome.

For more information about Young's (and DeMuth's) work:

und-crcs.org
und.edu/geodome

Track-1 Programmatic Element: Partnerships, Collaborations and Communication

Meet the Partnerships, Collaborations and Communication Team:

- Frank Bowman (Co-Lead), University of North Dakota, Grand Forks – profile in Center for Regional Climate Studies section
- Mukund Sibi, (Co-Lead), North Dakota State University, Fargo – profile in Center for Sustainable Materials Science section
- Crystal Alberts, University of North Dakota – profile in this section
- Anne Denton, North Dakota State University – profile in Center for Regional Climate Studies section
- Erin Gillam, North Dakota State University – profile in Center for Regional Climate Studies section
- Scott Hanson, ND EPSCoR – contact information on back cover
- Mark Hoffmann, ND EPSCoR – contact information on back cover
- Alena Kubátová, University of North Dakota – profile in Center for Sustainable Materials Science section
- Zoltan Majdik, North Dakota State University – profile in this section
- Jean Ostrom-Blonigen, ND EPSCoR – contact information on back cover
- Kelly Rusch, ND EPSCoR – contact information on inside front cover
- Chad Ulven, North Dakota State University – profile in Center for Sustainable Materials Science section
- Dean Webster, North Dakota State University – profile in Center for Sustainable Materials Science section
- Jianglong Zhang, University of North Dakota – profile in Center for Regional Climate Studies section

Partnerships

Industry partnerships were identified (recommendation #2) by the NSF RSV panel in March 2016 as an area for additional emphasis. Progress has occurred during Year 3. A major achievement is a funded project between CSMS researchers (Sibi and Webster – both NDSU) with AkzoNobel (the second largest polymer coatings company in the world). This CSMS industry partnership (NDSU award #FAR0023897, Sept. 1, 2016-Aug. 31, 2017) brings \$150,000 to CSMS for developing novel epoxies to replace bisphenol A-based coatings. AkzoNobel's funds were matched by the NDSU Center for Bio-based Materials Science and Technology (BiMAT) with an additional \$150,000 allocation to Sibi and Webster from that preexisting award, which is in place to enhance the scope of research projects in these arenas at NDSU. The new AkzoNobel CSMS industry partnership joins two CRCS and three CSMS industry partnerships established in prior years.

CRCS continued to make progress during Year 3 with its agricultural group partners (#1-6) and climate data partnerships (#7-9), established in prior years:

- | | |
|-------------------------------------|------------------------------------|
| 1. Holland Scientific | 7. United States Geological Survey |
| 2. Satshot (aka Agri ImaGIS) | Northern Prairie Wildlife |
| 3. NASA Goddard Space Flight Center | Research Center |
| 4. NASA Langley Research Center | 8. Laboratoire d'Océanographie |
| 5. John Deere | de Villefranche-sur-Mer |
| 6. American Crystal Sugar | 9. United States Naval |
| | Research Laboratory |

Collaborations

In an April 2017 poll taken by ND EPSCoR's External Evaluator, CSMS team members had 44 active collaborations with researchers in regional, national and international institutions. Similarly, CRCS team members had 36 active collaborations. These collaborations are outside of the ND EPSCoR Track-1 participants. Inside of North Dakota, the new Emerging Areas Seed Awards (see that section) continue to expand research links between the research universities (NDSU and UND) and the tribal colleges and primarily undergraduate institutions located in North Dakota.

Communication

At the Year 3 reporting period, the INSPIRE-ND project had 196 cumulative publications; 98 of which were submitted or accepted during Year 3. Nine other products were also recorded: seven thesis or dissertation videos, one software and one dataset/database.

External communication efforts (RSV recommendation #1) also were identified by the March 2016 NSF RSV panel as an area for additional emphasis, and significant progress has occurred during Year 3. The INSPIRE-ND leadership recruited two specialists to assist the CRCS and CSMS groups in enhancing their communication activities. Zoltan Majdik, associate professor, Department of Communication, NDSU, began his work with CSMS in November 2016 and Crystal Alberts, associate professor, Department of English, UND, started working on CRCS communication efforts in November 2016. These two senior personnel have provided expertise to assist researchers in communicating their science to a variety of stakeholders and are making an impact on the presentation of content on the CRCS (und-crcs.org) and CSMS (csms-ndsu.org) websites.



Alberts at the 48th Annual UND Writers Conference, "Citizen," March 2017

Crystal Alberts, associate professor, Department of English and Director, UND Writers Conference University of North Dakota

Three nouns that describe me: I am a literary scholar, first-generation college student and chameleon.

Three adjectives that describe my work: Transdisciplinary, archive-based and against the grain

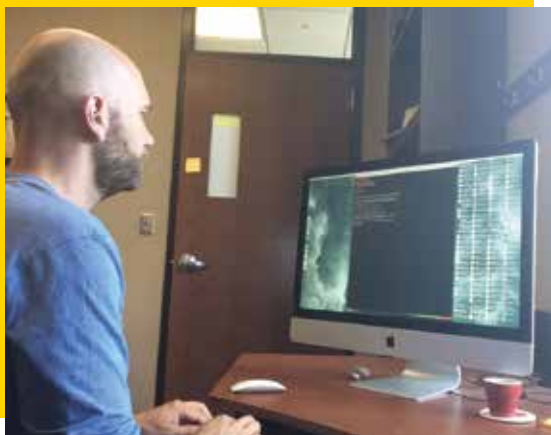
My first memory of wanting to become a STEM scientist: I am a humanist. However, I learned to program in BASIC in my rural northern Minnesota high school and continued my interest in computer science from that point forward. It is part of my work as a digital humanist. My current literary research, in print, involves the history of mathematics, the basics of quantum theory, as well as the physics and philosophies of time.

ND EPSCoR Role(s):

- Partnerships, Collaborations and Communication Team member: I am senior personnel in charge of helping to communicate science to a broader audience, particularly in relation to the Center for Regional Climate Studies.
- I am in charge of web content and updates for the Center for Regional Climate Studies.

My responsibilities include working with ND EPSCoR researchers, graduate students and undergraduate students to assist them with bringing their science out of the lab, field and classroom, so that it can be shared with non-scientists (or non-specialists) across campuses, the state of North Dakota and beyond. This includes one-on-one writing instruction, as well as group presentations on communicating science, such as my co-presentation with Zoltan Majdik at the April 2017 ND EPSCoR Annual State Conference or my session at the 2017 NATURE University Summer Camp. I also assist with public relations, including contacting the local press and creating multimedia content for the CRCS website.

For more information about Alberts and her work:
und-crcs.org/multimedia
arts-sciences.und.edu/english/faculty/alberts.cfm
und.edu/orgs/writers-conference



Majdik works in his office.

Zoltan Majdik, associate professor, Communication North Dakota State University

Three nouns that describe me: I am a communication scholar, espresso drinker and Swiss expat.

Three adjectives that describe my work: Humanistic, computational and driven by curiosity

My first memory of wanting to become a STEM scientist: As a communication scholar, my work is influenced more by humanistic, social scientific and computational approaches to language-use than by STEM. I came to be interested in my field of study through an early interest in language and literature, which turned into a more specific interest in how people use language to accomplish specific goals, and what motivates people's use of certain language patterns over others.

ND EPSCoR Role(s):

- Partnerships, Collaborations and Communication Team member: I am senior personnel in charge of helping to communicate science to a broader audience, particularly in relation to the Center for Sustainable Materials Science.

My ND EPSCoR responsibility is to help researchers and students translate their findings and insights, and the importance of their work, to a diverse range of audiences across the state and its educational institutions.

For more information about Majdik and his work:
www.ndsu.edu/communication/faculty/zoltan_p_majdik

Summary

As evidenced in ND EPSCoR's Year 3 Annual Report to the National Science Foundation and recommendations of our evaluating bodies [the NSF RSV panel (March 2016), our external evaluator, and our external advisory board], INSPIRE-ND, is making good progress in each of its five focus areas.

The research being conducted by the Centers for Regional Climate Studies and Sustainable Materials Science is becoming increasingly cohesive across the varied institutions and disciplines and continues to show high levels of productivity (intellectual merit). Efforts during Year 3 (Emerging Areas Seed Awards) are expected to pay dividends in Year 4 in the form of increased cohesiveness between the two centers. The research participants of both centers are to be commended for their efforts to date as they turn their attention in Year 4 to making these centers self-sustainable.

The programmatic element foci (broader impacts) being performed by the greater INSPIRE-ND team are sound, and significant progress was made during Year 3 across all focus areas (diversity, education and workforce development, and partnerships, collaborations and communication). The participants in these areas should also be commended for their efforts to date as they too begin the work of ensuring that their best efforts are sustainable following this cooperative agreement.



Mark R. Hoffmann, Ph.D.

INSPIRE-ND Co-Principal Investigator / ND EPSCoR Associate Project Director (through 6/30/17)
Associate Vice President for Research and Capacity Building
University of North Dakota
mark.hoffmann@und.edu



Jean Ostrom-Blonigen, Ph.D., CPA

INSPIRE-ND Co-Principal Investigator / ND EPSCoR Project Administrator
jean.ostromblonigen@ndus.edu



Scott Hanson, Ph.D.

ND EPSCoR Tribal Colleges Liaison Manager
scott.martin.hanson@ndus.edu

ND EPSCoR Campus Principal Investigators:

1. Cankdeska Cikana Community College: Teresa Harding
2. Dickinson State University: Eric Brevik
3. Mayville State University: Khwaja Hossain
4. Minot State University: Mikhail Bobylev
5. North Dakota State University: Kelly A. Rusch
6. Nueta Hidatsa Sahnish College: Kerry Hartman
7. Sitting Bull College: Mafany Ndiva Mongoh
8. Turtle Mountain Community College: Miles Pfahl
9. University of North Dakota: Mark Hoffmann
10. United Tribes Technical College: Jeremy Guinn
11. Valley City State University: Andre DeLorme

Website: ndepscor.ndus.edu

Email: ndepscor@ndus.edu

