PROJECT WiCCED

WATER *in the* CHANGING COASTAL ENVIRONMENT *of* DELAWARE

Contact Information:

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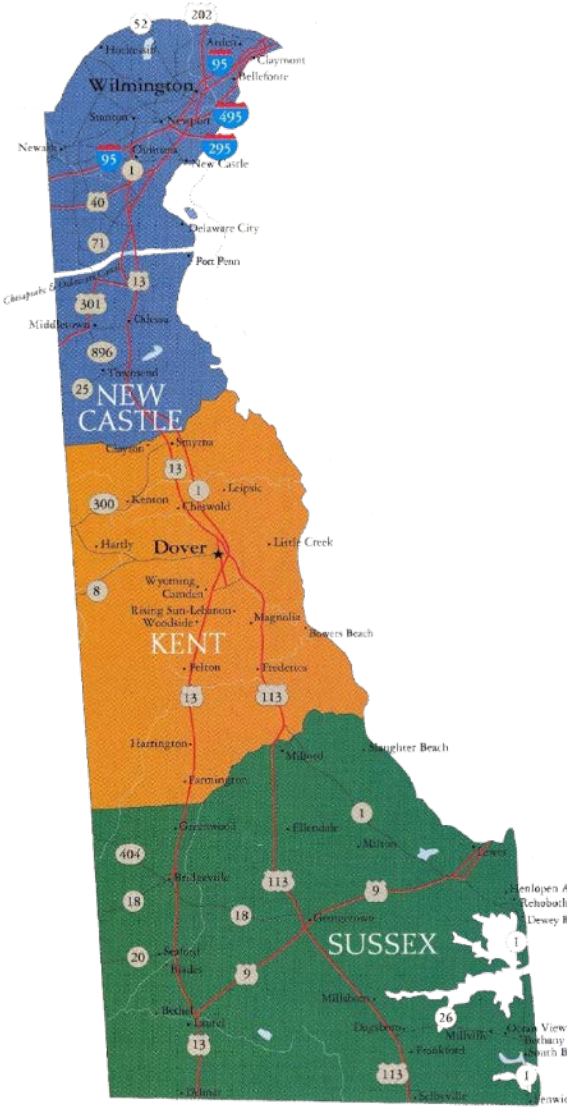
Department of Applied Economics and Statistics, UD

Delaware EPSCoR

- *Strategic intent:* develop a competitive research capability and foster a federal-state partnership that addresses key state priorities.
  - Cooperative agreement between NSF and Delaware
- Fourth consecutive successful project
- This one is focuses on Water in the Changing Coastal Environmental of Delaware (Project WiCCED)
  - $19.2M over 5 years (NSF)
  - $3.8M over years (DE)
  - Started in October 2018



Delaware News Journal: Response to toxic water vastly different in two Sussex communities

THE NEWS JOURNAL

February 19, 2018 - In ar
about pollution of drinking
Delaware and the governr
each case, The Delaware
Assistant Professor Saco
environment
unincorpora

The article
Millsboro,
chicken proces
wastewater on hundreds of acres of

DELAWARE

Alicia Lozano / July 21, 2018

Delaware Officials Warn of Possible Water Contamination

10 PHILADELPHIA

'It's like living in a cesspool,' Sussex County wonders how far dirty water has spread

Maddy Lauria, The News Journal Published 11:18 a.m. ET April 20, 2018 | Updated 12:50 p.m. ET April 26, 2018

As Delaware coastal waters warm, risk of deadly bacteria rises

Maddy Lauria, Delaware News Journal Published 11:05 a.m. ET

2018

State: Sussex residents should still avoid drinking their own water after E.coli found

Meredith Newman, Delaware News Journal Published 12:23 p.m. ET July 23, 2018 | Updated 2:48 p.m. ET July 23, 2018

Warnings lag in Mid-Atlantic as deadly marine bacteria increases threat in summer

Maddy Lauria, Delaware News Journal Published 6:00 a.m. ET Aug. 29, 2018 | Updated 5:38 p.m. ET Sept. 2, 2018

Mountaire Farms' troubles mount as company is hit with lawsuits over water pollution claims

Maddy Lauria, Delaware News Journal Published 3:51 p.m. ET June 28, 2018 | Updated 5:41 p.m. ET June 30, 2018

Sea level rise: Saltwater intrusion laying waste to Delmarva farms

Jeremy Cox, Bay Journal News Service Published 6:18 a.m. ET March 29, 2019 | Updated 11:36 p.m. ET March 29, 2019

What's hidden in this Delaware town's groundwater? Contamination, PFAS and health concerns

Maddy Lauria, Delaware News Journal Published 5:00 a.m. ET Jan. 22, 2020 | Updated 7:22 a.m. ET Jan. 22, 2020

Coastal Water Quality Is a Major Global Challenge

The Coastal Groundwater “Squeeze”

Relevance to Delaware

Delaware is an ideal platform to address critical research questions that will help provide solutions and ensure the state's economic and environmental sustainability.

Delaware's small size and coastal setting make it a microcosm to study pressures on water resources along coastlines worldwide.

Environmental Degradation

Climate Change

The Coastal Zone

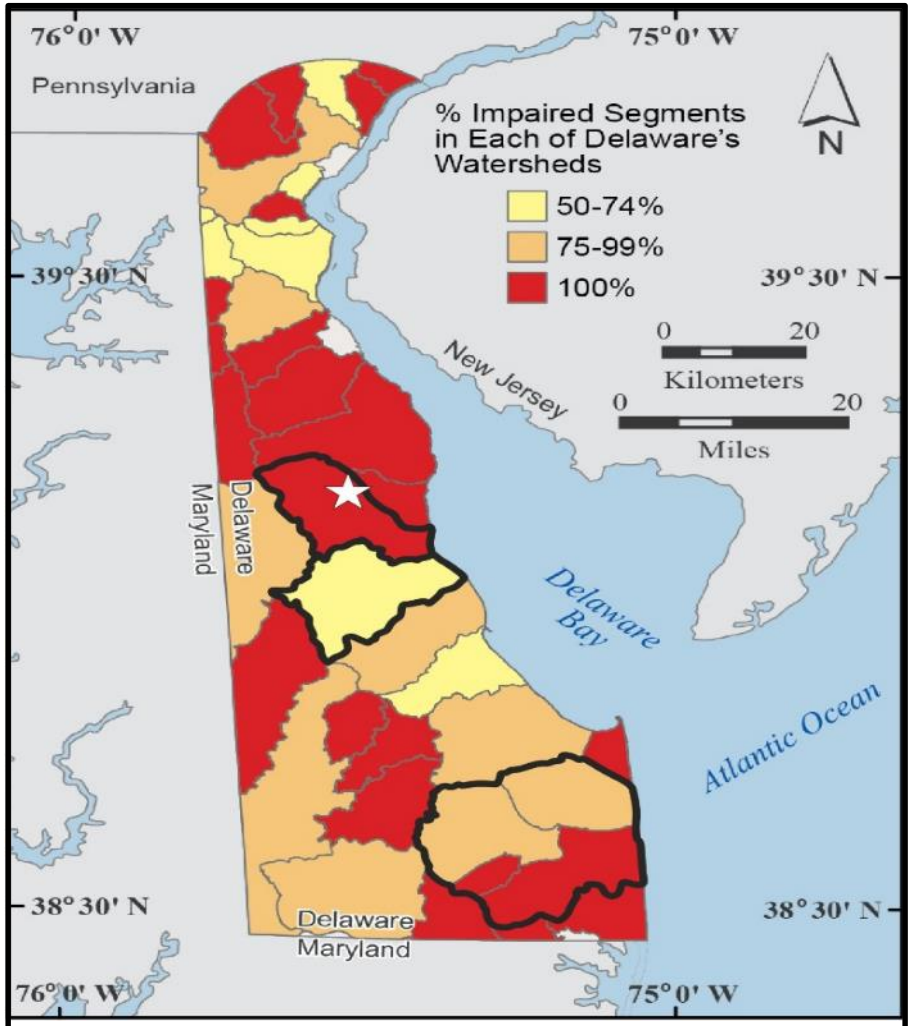
Population Growth

PROJECT WiCCED
WATER *in the* CHANGING COASTAL ENVIRONMENT *of* DELAWARE

Assess threats to the quality of the state's water from

- ***Salinization***
- ***nutrient over-enrichment***

Develop solutions to mitigate the human, agricultural, and natural pressures threatening water quality in Delaware.



Delaware's impaired watersheds. Study watersheds are outlined in black. From north to south: St. Jones River, Murderkill River, and Inland Bays Watersheds. Star indicates Dover.

Partnerships

University of Delaware

Delaware State University

Delaware Technical Community College

Wesley College

Project WiCCED Leadership Team

Kent Messer,
Principal Investigator
/Project Director

Malcolm D'Souza, Co-PI,
Wesley College
Institutional Lead

Venugopal Kalavacharla,
Co-PI, DSU Institutional Lead

Holly Michael, Co-PI
UD, Co-PI Research Lead

Don Sparks, Co-PI
EPSCoR Director

Marth Hofstetter,
DTCC Institutional Lead

Jeanette Miller
EOD Lead

Amy Slocum
EPSCoR Associate Director

Partnerships in Research & Education

Partnerships in Research & Education

- Collaborative research and funding opportunities
- Help with access to partner assets (research sites, research results, etc.)
- Student internships
- Technology development opportunities
- Oversight of the program to ensure that we meeting the project goals and strategic plan.
- And more….!

New Expertise

New UD faculty: Drs. Kelly Davidson and Maik Kecinski (Applied Econ & Statistics), Jing Gao, Pinki Mondal, and Yao Hu (Geography).

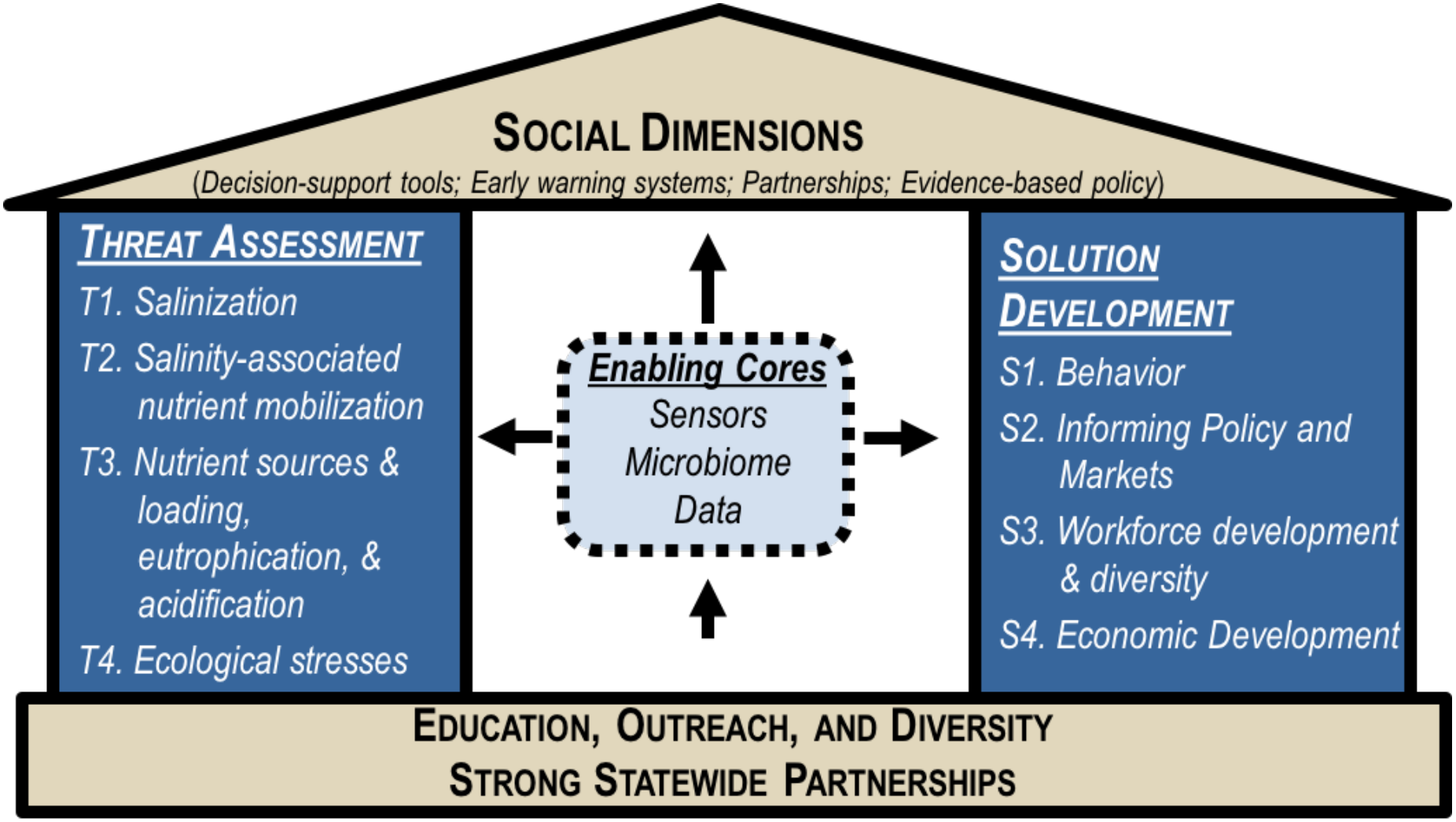
New DSU faculty: Dr. Yanfeng Yue (Chemistry)

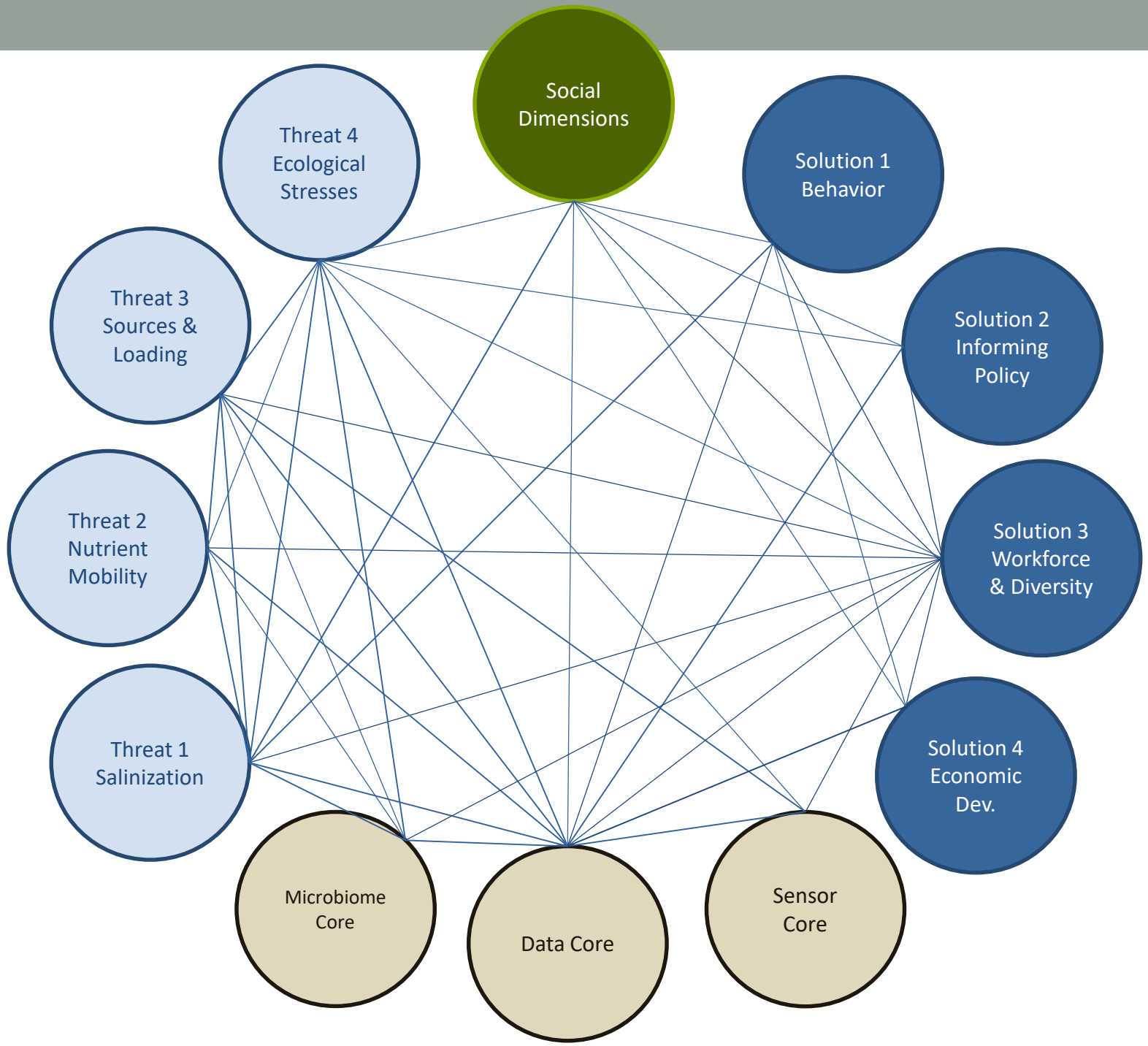
UD funded our proposal for a coastal water security-oriented "cluster hire"

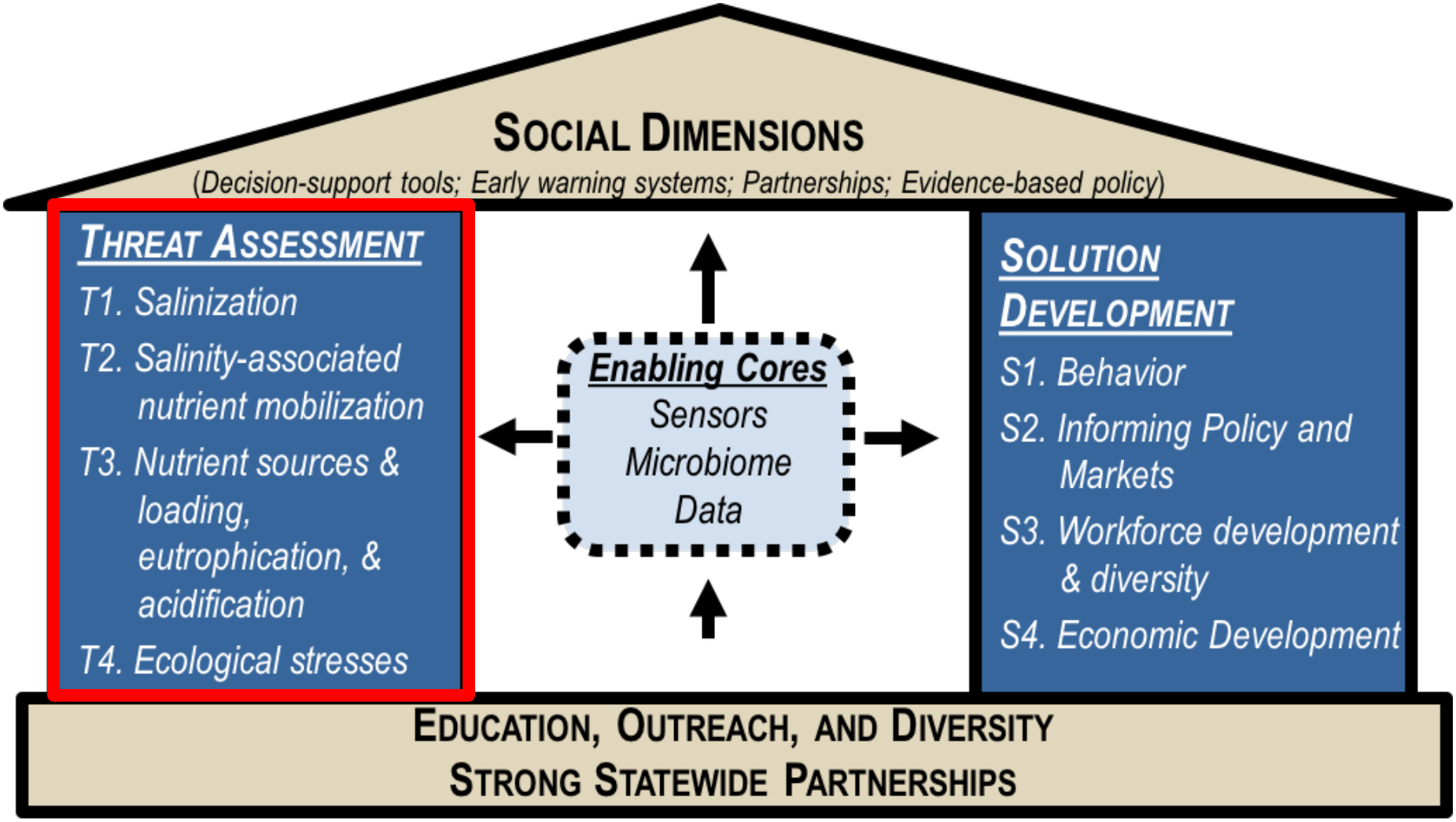
- Search includes hydrological modeler, toxicologists, remediation specialists, and a coupled human and natural systems modeler







SOCIAL DIMENSIONS
(Decision-support tools; Early warning systems; Partnerships; Evidence-based policy)
THREAT ASSESSMENT
T1. Salinization
T2. Salinity-associated nutrient mobilization
T3. Nutrient sources & loading, eutrophication, & acidification
T4. Ecological stresses
Enabling Cores
Sensors
Microbiome
Data
SOLUTION DEVELOPMENT
S1. Behavior
S2. Informing Policy and Markets
S3. Workforce development & diversity
S4. Economic Development
EDUCATION, OUTREACH, AND DIVERSITY
STRONG STATEWIDE PARTNERSHIPS


Social Dimensions
Threat 4 Ecological Stresses
Solution 1 Behavior
Threat 3 Sources & Loading
Solution 2 Informing Policy
Threat 2 Nutrient Mobility
Solution 3 Workforce & Diversity
Threat 1 Salinization
Solution 4 Economic Dev.
Microbiome Core
Data Core
Sensor Core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STRONG STATEWIDE PARTNERSHIPS

T1. Salinization

Transformative Goal: *New understanding of salinization vulnerability and its relationship to water use and system characteristics.*

1. *How do competing demands for water contribute to lateral and vertical groundwater salinization?*
   - *Accounting for relative rates of use and spatial distribution of groundwater pumping*

2. *What aquifer characteristics are critical indicators of vulnerability to salinization?*

3. *How can these impacts be anticipated and mitigated?*

Holly Michael
UD, Lead

Scott Andres
DGS, UD, Co-Lead

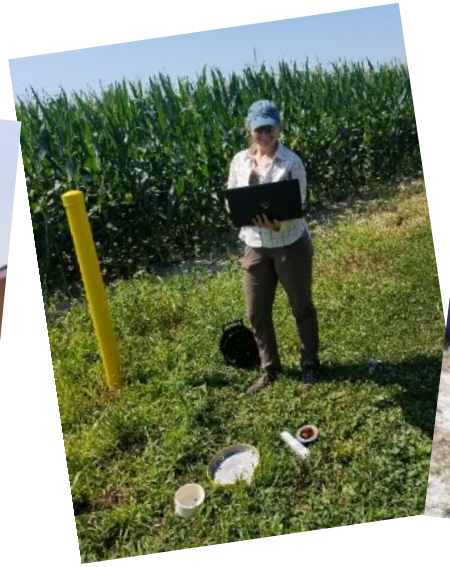
Participants: Brinson (UD), Callahan (UD), Hu (UD), Leathers (UD), Messer (UD), Miller (UD), Mondal (UD), Palm-Forster (UD), Shatley (UD), Slocum (UD), Williams-Bey (UD), new Hydrologic systems modeling faculty

Postdoc: Peters; PhD Student: Hingst; Technician: McQuiggan; Undergraduates: Bieksha and Kimsal

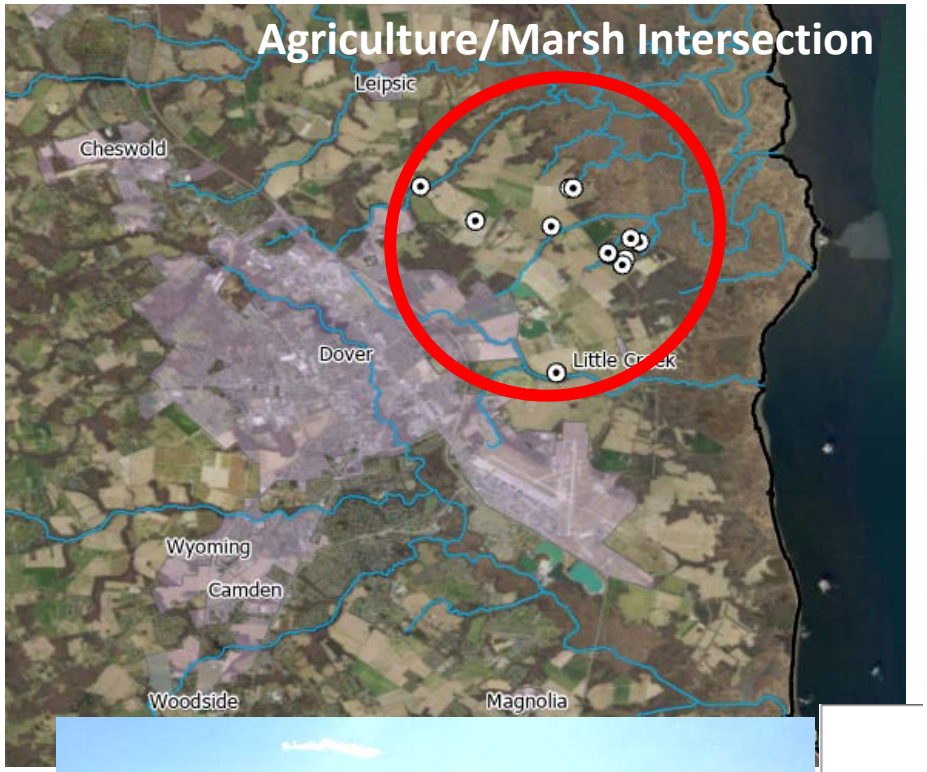
T1.1 Field Program and Salinity Monitoring

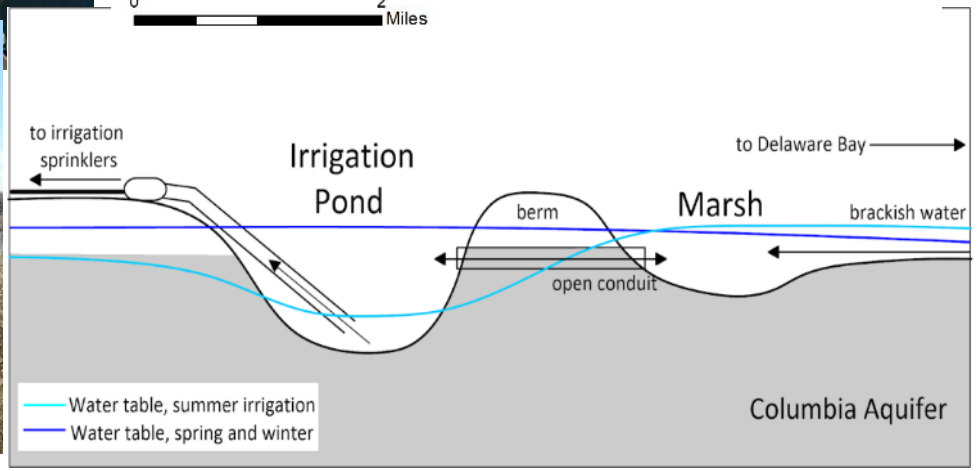
- 36 sites, approx. 641K salinity, 670K water level, 817K temperature observations made since beginning of project.
- Recent additions to monitoring network – 11 deep wells, 6 shallow wells, 8 surface water stations, 1 test boring, 3 geophysical logs.
- Instrumentation of three new farm sites.
- Engagement with DE Environmental Monitoring Coordination Council.





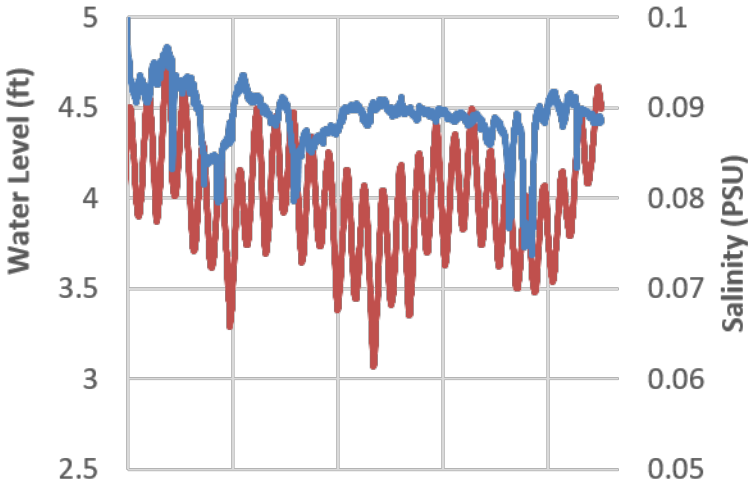

T1.1 Field Program and Salinity Monitoring



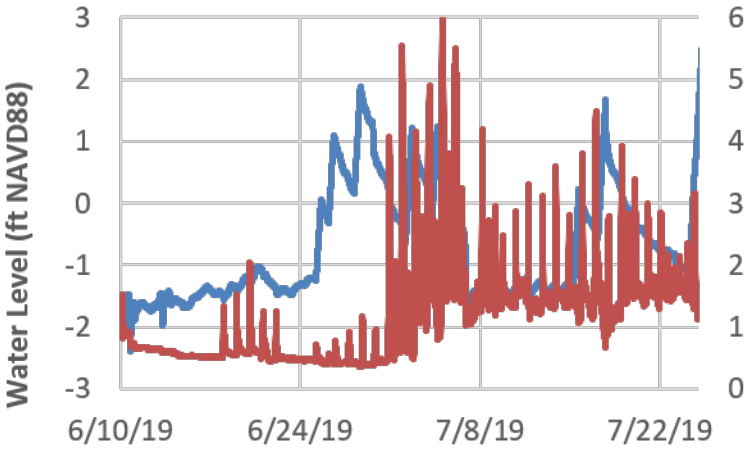


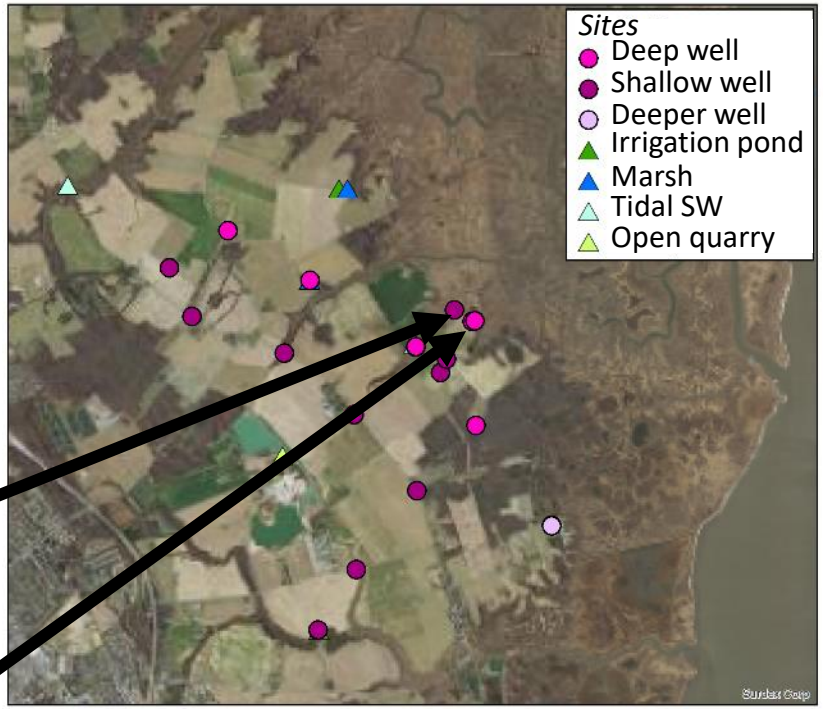
T1.1 Field Program and Salinity Monitoring

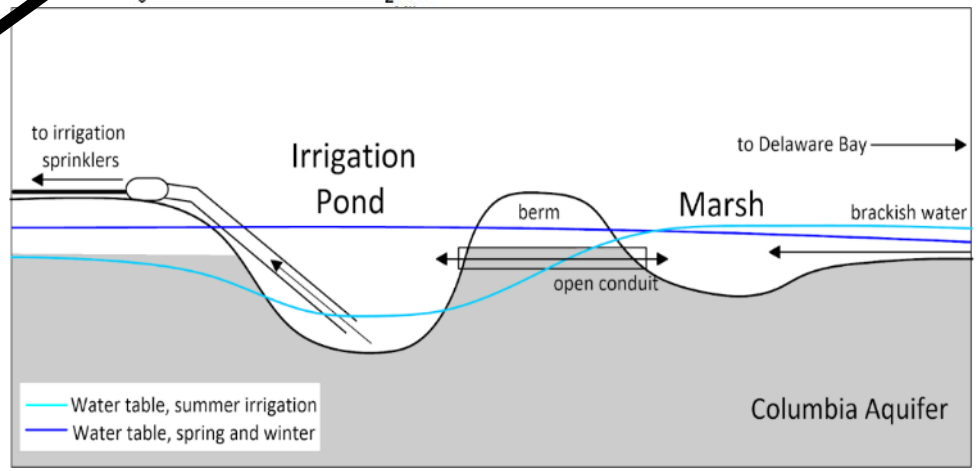
Irrigation Well



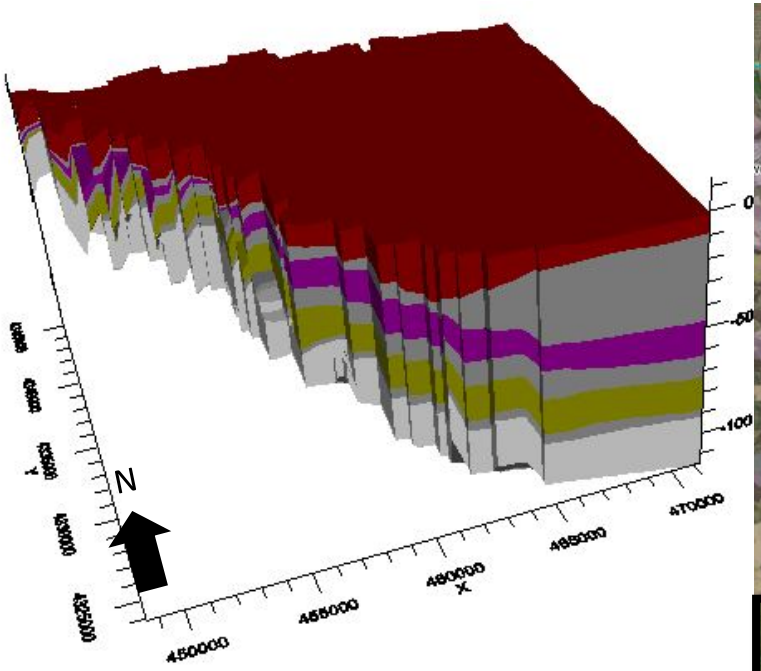
Irrigation Pond







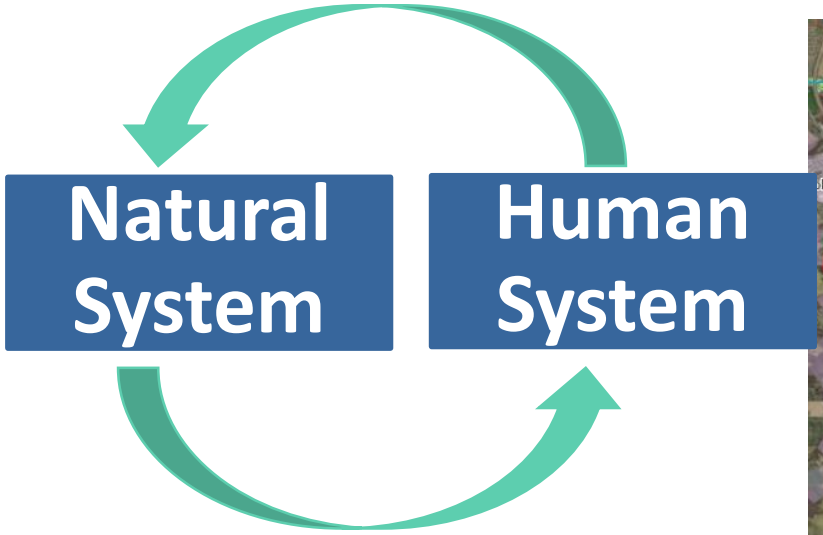
T1.2 Modeling of salinization and competing water use in Dover area



Considering:

- Sea-level rise
- Storm Surge
- Competing water uses, current & future
- Stakeholder input – Water Supply Coordination Council - Kent County Working Group

T1.2 Modeling of salinization and competing water use in Dover area



Pumping Wells
Monitoring Locations
Rivers and Streams
Model Domain
Municipal Areas
Tidal Wetlands

T2. Salinity-associated Nutrient Mobilization and Cycling

Transformative Goal: *Quantitative understanding of changes to phosphorus and nitrogen cycling in freshwater ecosystems undergoing salinization.*

1. *How does the frequency and magnitude of the salinity change force particular pathways of nutrient cycling?*
   - *What are the specific indicators for such pathways?*

2. *Are there specific salinity thresholds that are within the safe and recoverable limits at particular sites?*

3. *Can predictive assessments of the fates of nutrients across scales be developed?*

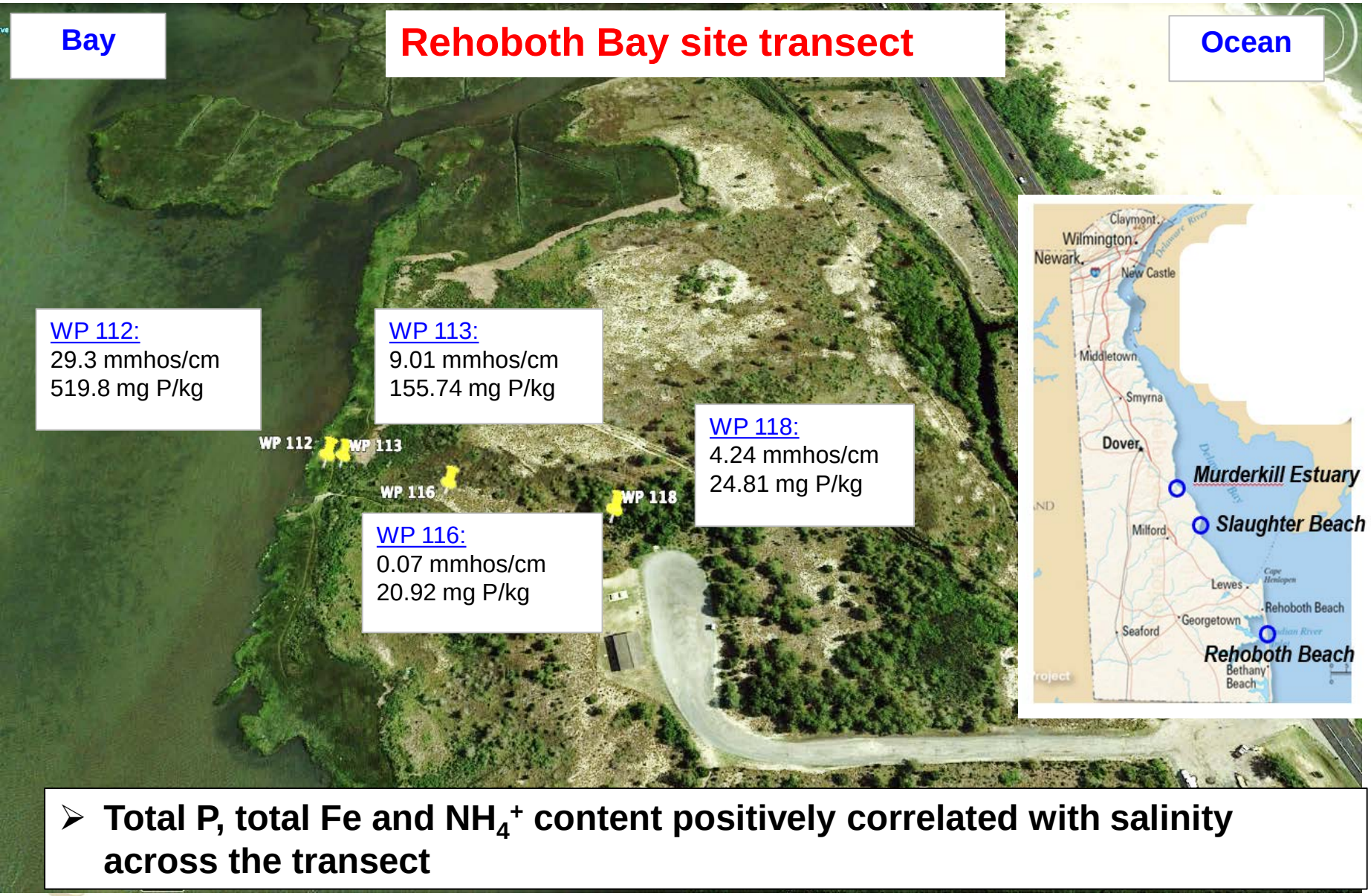
Don Sparks
UD, Lead

Deb Jaisi
UD, Co-Lead

Participants: Brinson (UD), Hanson, (UD), Callahan (UD), Johnson (DSU), Leathers (UD), Miller (UD), Mondal (UD), Palm-Forster (UD), Shatley (UD), Slocum (UD), Williams-Bey (UD)

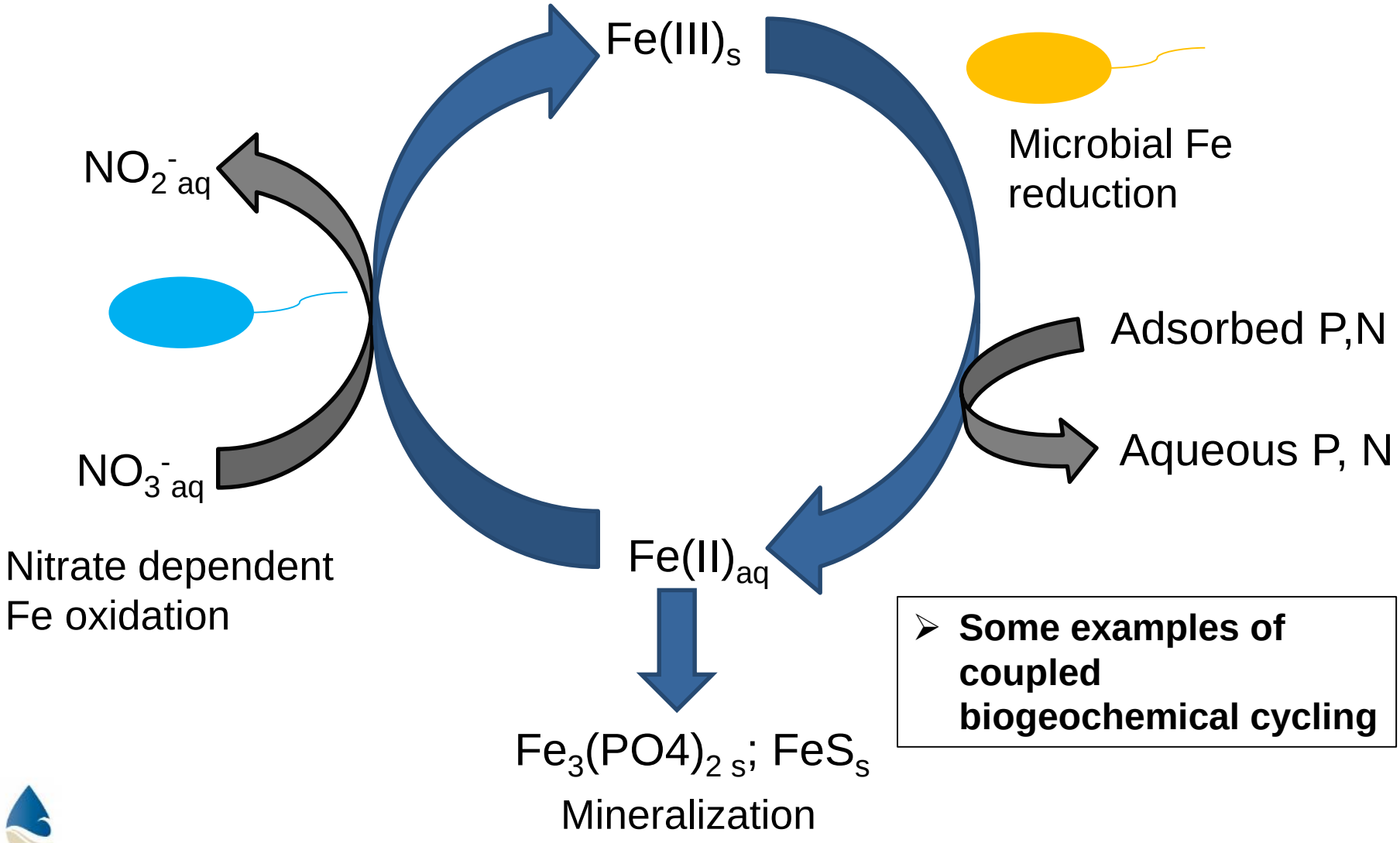
Postdocs: Tomaszewski and Gray; Undergraduate: Messick

T2.1 Soil Sediment Characterization



- **Total P, total Fe and NH_4^+ content positively correlated with salinity across the transect**

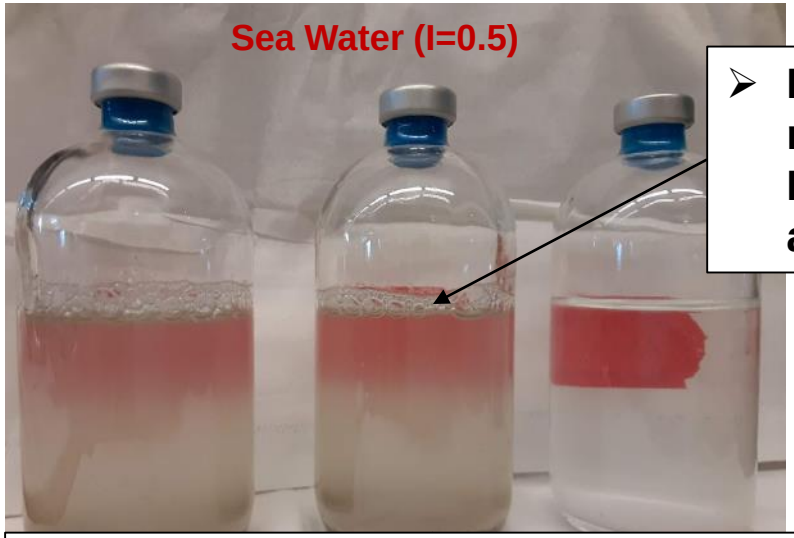
T2.2 Study of the coupling of Fe, P, and N biogeochemical cycles



- **Some examples of coupled biogeochemical cycling**

T2.1 Study of the coupling of Fe, P, and N biogeochemical cycles

Major question: How does Fe biogeochemical cycling affect nutrient mobility *during different magnitudes* of salinization?



- **Evidence of respiration. Fe(II) production also measured**

- **Novel Fe and P solid phase analysis at the National Light Source using a multi spatial scale approach. Goal to co-locate Fe and P phases during salinization.**

- **Early results indicate the bioavailability of carbon and nitrogen cycling are most impacted by salinization**

T3. Estuarine Nutrient Sources and Loading, Eutrophication and Acidification

Transformative Goal: *Identification and quantification of processes controlling nutrient fluxes and response to multi-timescale hydrologic fluctuations.*

1. *What are the primary processes that control loads and attenuation of nutrients in ponds, streams, and marshes across a salinity gradient and on multiple timescales?*

2. *What are the major sources of nitrogen, phosphorus, carbon, and acidity in coastal watersheds?*

3. *How can continuous, automated, and high-frequency environmental sensors and the data they produce best be used to guide management, policy, and remediation?*

Deb Jaisi
UD, Co-lead

Scott Andres
DGS, Co-lead

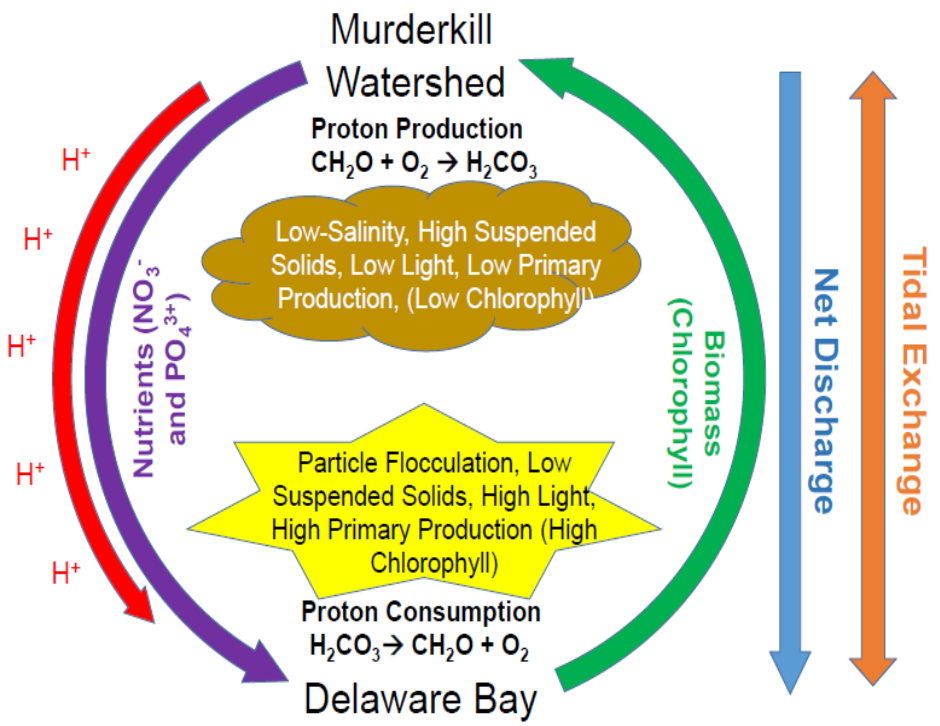
Bill Ullman
UD, Co-lead

Andrew Wozniak
UD, Co-lead

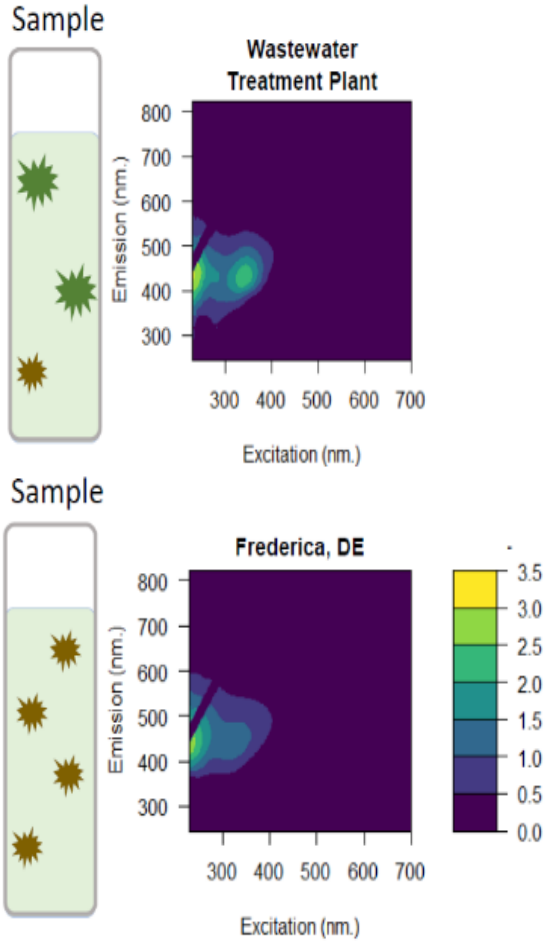
Participants: Brinson (UD), Cai (UD), Callahan (UD), Johnson (DSU), Kalavacharla (DSU), Leathers (UD), Miller (UD), Michael (UD), Mondal (UD), Ozbay (DSU), Palm Forster (UD), Slocum (UD), Volk (UD), Williams-Bey (UD)

T3. Estuarine Nutrient Sources and Loading, Eutrophication and Acidification

Coupled Cycling of Nutrients, Primary Production, and Acidification

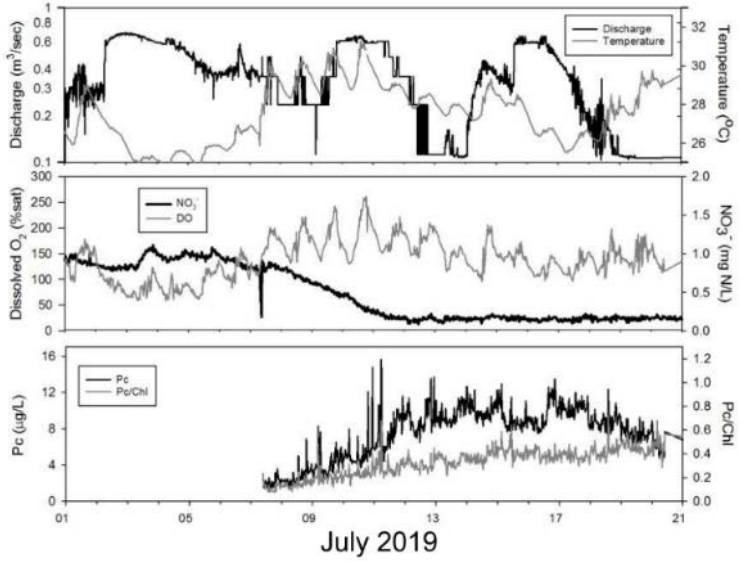


Fingerprinting: Dissolved Organic Matter and P



T3.1 Monitoring

- Automated monitoring instruments (s::can spectrolyser and YSI EXO2) operated at Coursey Pond from Jun-Oct 2019; > 25K successful observations of biogeochemical variables during a harmful algal bloom
- Sensors measure physical (pH, temperature, conductance, dissolved oxygen, turbidity, pond water level), biological (chlorophyll a and phycocyanin) and chemical (nitrate, dissolved and total organic carbon) constituents at 30 minute intervals.
- Grab samples 7 dates, Jun – Oct: dissolved and particulate N, P, and C species.



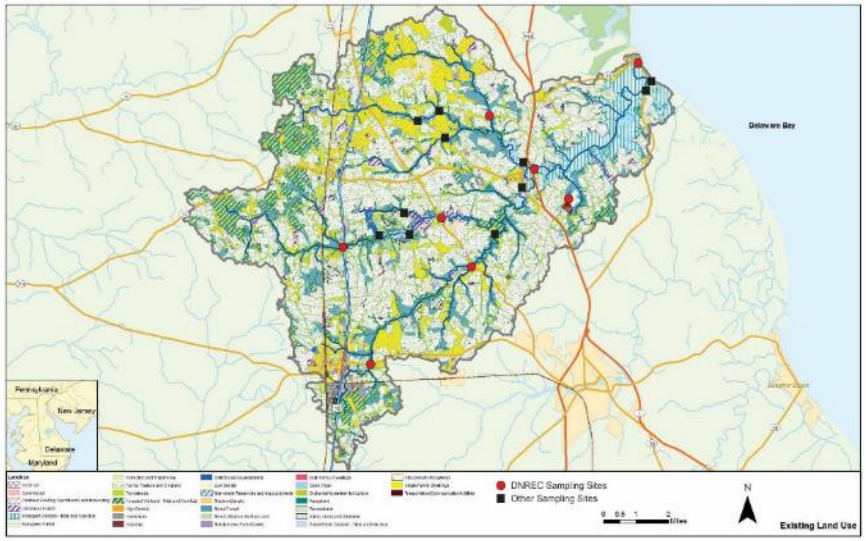
Coursey Pond station and example data

T3.1 Fingerprinting P Sources

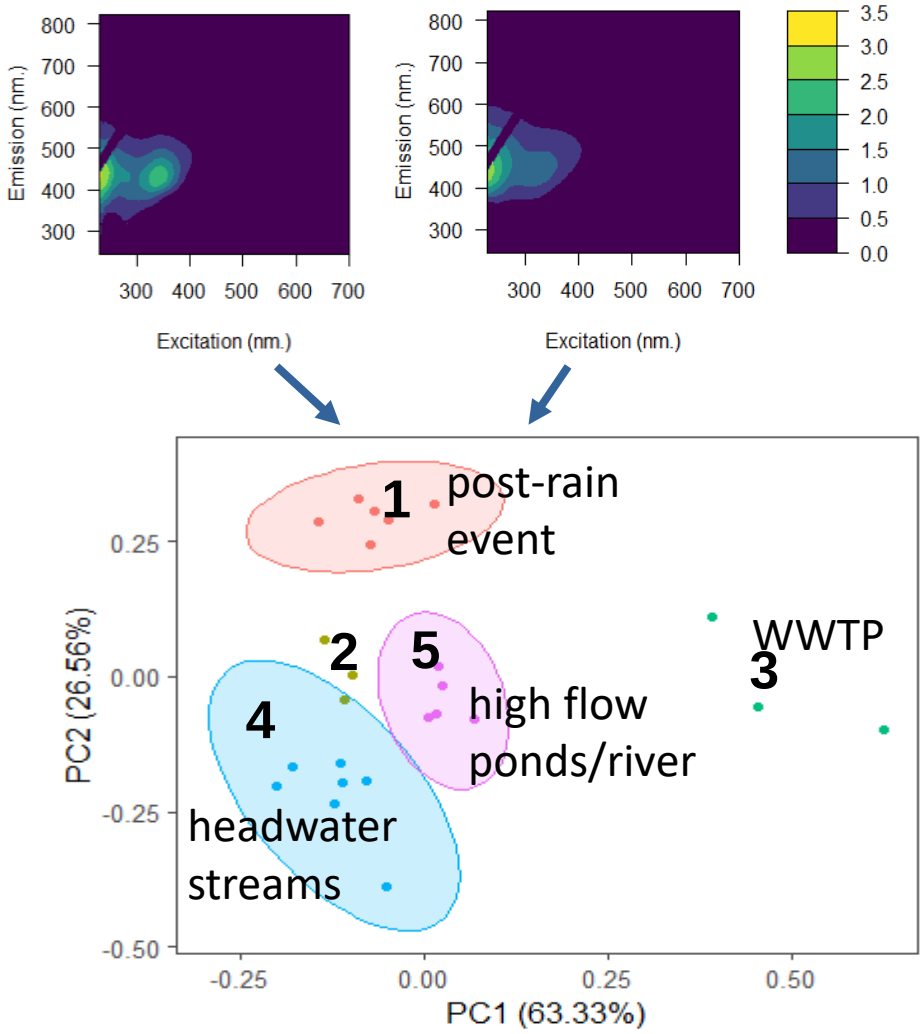
Collected and analyzing P, N and C isotopes of soil and water samples from representative sites in the Murderkill Watershed (sources) and river waters (sinks)

T3.1 Fingerprinting DOM

Murderkill River Estuary Sampling Sites



Excitation-emission matrix spectroscopy



- DOM composition varies by location
- DOM composition varies over time at a given location reflecting shifts in DOM sources.
- Wastewater treatment plant DOM always shows distinct signal.

T4. Ecological Stresses from Nutrients and Salinization

Transformative Goal: *New understanding of nutrient and salinity stress on oysters, forests, and grasses.*

1. *What are the sources of dissolved and particulate carbon, nitrogen, and phosphorus to estuarine waters and oysters?*

2. *Can managed oyster aquaculture play an economically sustainable role in mitigating nutrient pollution in Delaware estuaries?*

3. *How do valuable wetland forests respond to water stress and increased salinity?*

4. *Which genes and epigenetic regulatory mechanisms are active in the salinity-tolerant salt marsh grasses in response to changes in salinity?*

5. *How do symbiotic/beneficial plant-microbe interactions in salt marsh grass and surrounding soil mitigate salinity stress in salt marsh grasses?*

Gulni Ozbay
DSU, Lead

Stephanie Stotts
Wesley, Co-lead

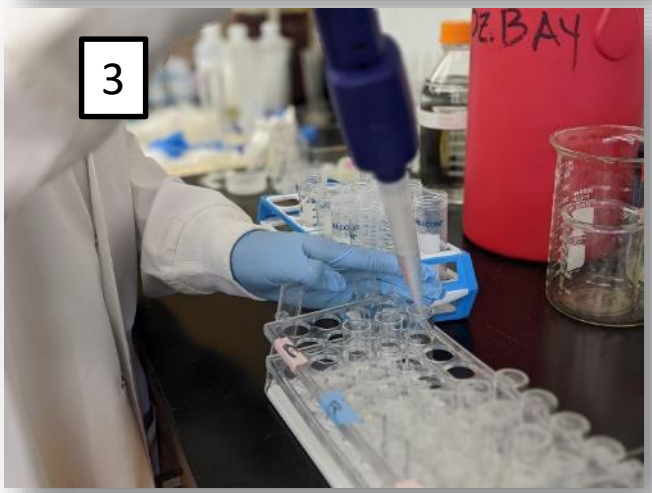
Venugopal Kalavacharla
DSU, Co-lead

Participants: Jaisi (UD), Maramante (DTCC), Messer (UD), Elavarthi (DSU), Smolinski (DSU), Scott (DSU), Michael, (UD), Ullman (UD), Davidson (UD), D'Souza (Wesley), Shuman (Wesley)

T4.1 Impacts of oyster aquaculture on ecosystem health

Oyster: Studying aquaculture and oyster reef-related habitats affected by land uses and relationship to water quality, oyster recruitment and species diversity

- Established oyster reef, partnered with aquaculture stakeholders, collected water quality data.



1. **Site surveying and water sample collection**
2. **Construction of oyster pilot reefs**
3. **Water quality analysis**
4. **Identifying species diversity using nets**

T4.2 Wetland forest salinity stress

Tidal Forests: Studying the drivers of salt stressed tree growth for white and Eastern red cedar along the St. Jones River

Site identification

Sample collection

T4.3 Marsh Grass adaptation to salinity and its ability to act as coastal filters

Marshgrass: Studying the molecular mechanisms (transcriptomic and epigenomic) of marshgrass in high, medium and low salinity stress

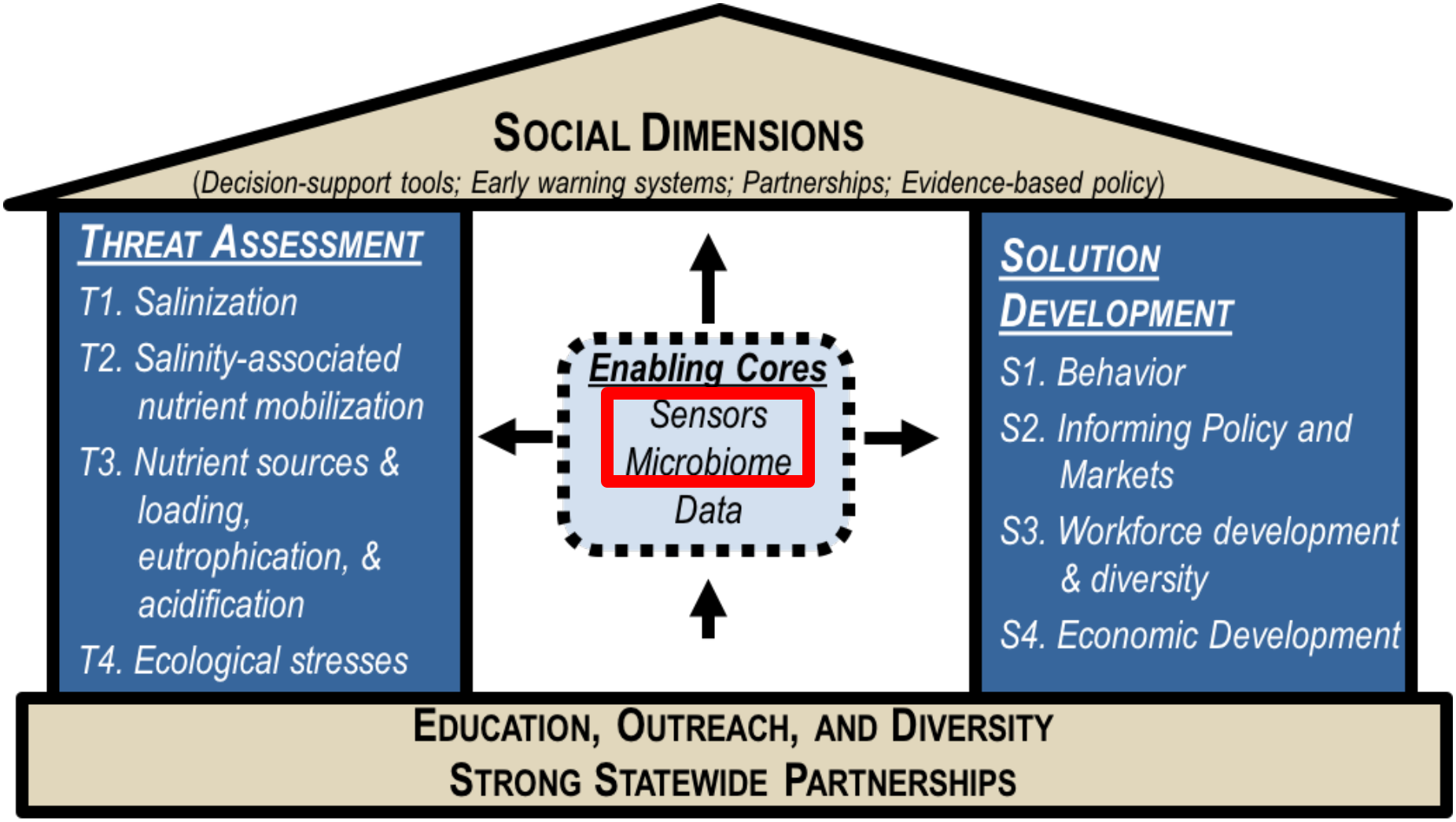
- Identified sites, developed protocols for understanding salinity stress and nutrient uptake, plant microbe interactions.

Marshgrass sample collection

Marshgrass processing

Isolation of microbes for Plant-microbe interactions

Preparation of marshgrass leaf tissue for molecular analysis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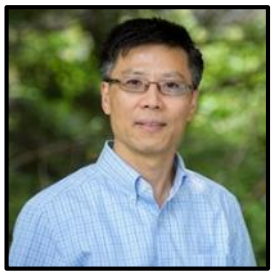
Sensor Core: Next-Generation Strategies for Detecting Water Quality

Transformative Goal: *A colorimetric sensing platform with amplified output for nanomolar concentrations of analytes, including nutrient pollution (N and P).*

- *Demonstrate feasibility of proposed nanosensor architectures*
- *Deploy sensors for detecting key chemicals and biologics. Provide monitoring data for other research teams*
- *Demonstrate prototype N sensor with nanomolar sensitivity*
- *Develop processing protocols for scale-up of nanosensors*

John Rabolt
UD, Co-Lead



Wei Jun Cai
UD, Co-Lead

Participants: Kloxin (UD), Martin (UD), Yue (DSU)

Postdoc: Street; Graduate Student: Norris; Undergraduate: Wentzien

Microbiome Core: Enhanced Access, Capability, and Engagement

Transformative Goal: *Provide rapid, low-cost access to microbiome data for this proposal and beyond.*

- *Implement community profiling and genome sequencing computation pipelines*
- *Launch, manage Delaware Microbiome Project and Delaware Community Sequencing Program*
- *Meta-analysis of microbiome samples with paired environmental data*

Tom Hanson
UD, Co-Lead

John McDowell
DTCC, Co-Lead

Participants: Brinson (UD), Callahan (UD), Kalavacharla (DSU), Leathers (UD), Mondal (UD), Polson (UD), Shatley (UD), Shuman (Wesley)

Graduate Student: Bennett

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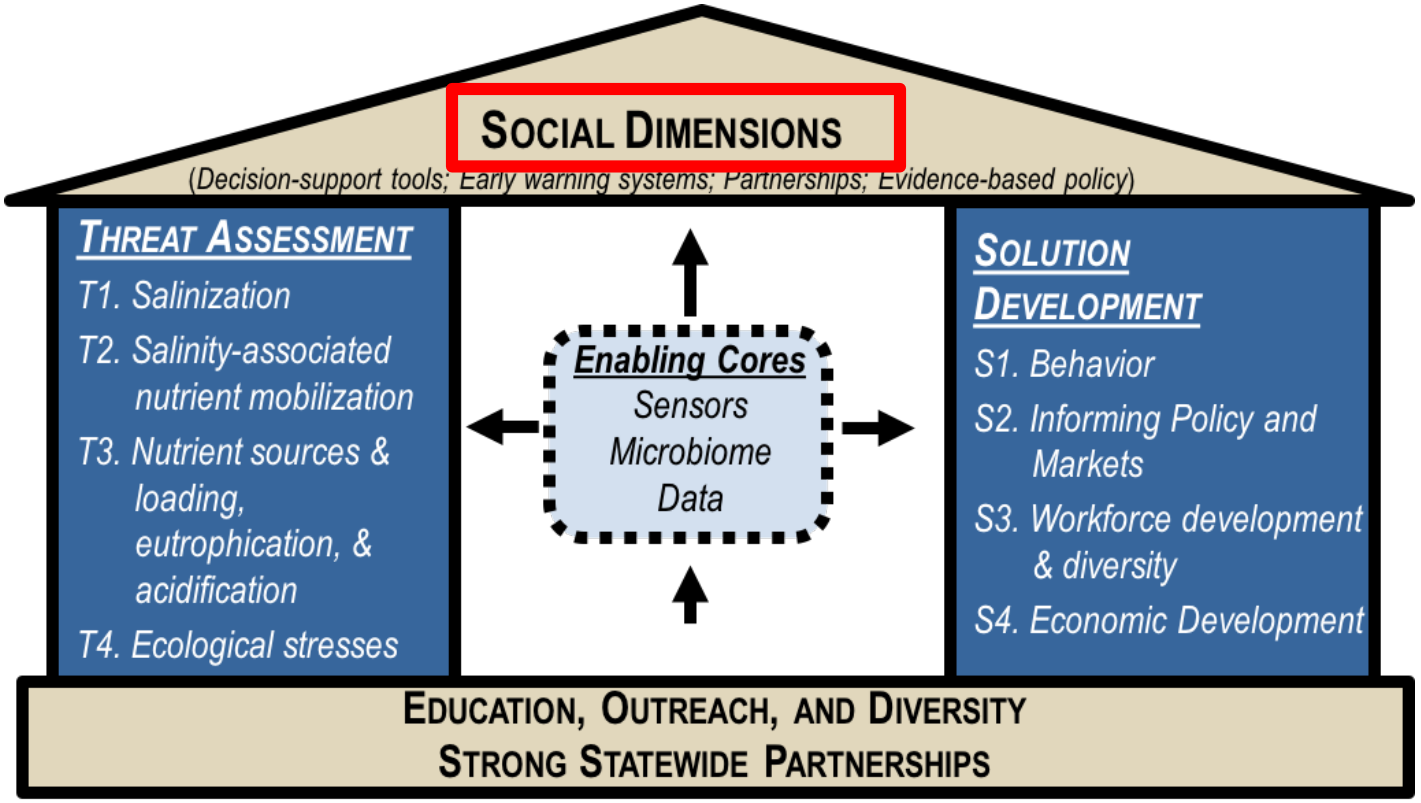
Delaware EPSCoR



Social Dimensions – Goals & Objectives

Transformative Goal: *Evidence from interdisciplinary research will inform cost-effective policies, programs, and stakeholder engagement to improve water security.*

- *Conduct behavioral research to inform policy and programs*
- *Develop decision-support tools*
- *Develop early warning system related to key water quality threats*
- *Develop partnerships with key governmental agencies, industry, and nongovernmental organizations*
- *Developing evidence-based "blue prints" on how programs can be designed*

Leah Palm-Forster
UD, Lead

Dan Leathers
UD, Lead

Kent Messer
UD, Co-Lead

George Parsons
UD Co-Lead

Participants: Ahsanuzzaman (UD), Brinson (UD), Callahan (UD), Cortes (UD), Davidson (UD), Ding (UD), Gao (UD), Hu (UD), Hughes (UD), Kelley (UD), Langer (UD), Michael (UD), Mondal (UD), Paul (UD), Shatley (UD), Shober (UD-Extension), Volk (UD-Extension), Yan (UD)

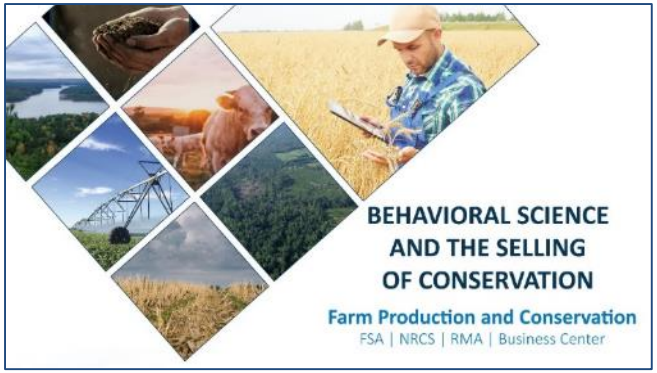
Social Dimensions – Key activities

- Engage with research projects studying social dimensions of water security
- Optimization of Decision Support Systems (DSS) and Warning Systems
- Interactions with Education, Outreach, and Diversity

Research and Outreach Outcomes

- Training developed for USDA FPAC nationwide
  - Materials used in 2019 rollout of Farm Bill's conservation programs.

- New Grant:
  - Center for Behavioral and Experimental Agri-environmental Research
  - co-headquartered at UD



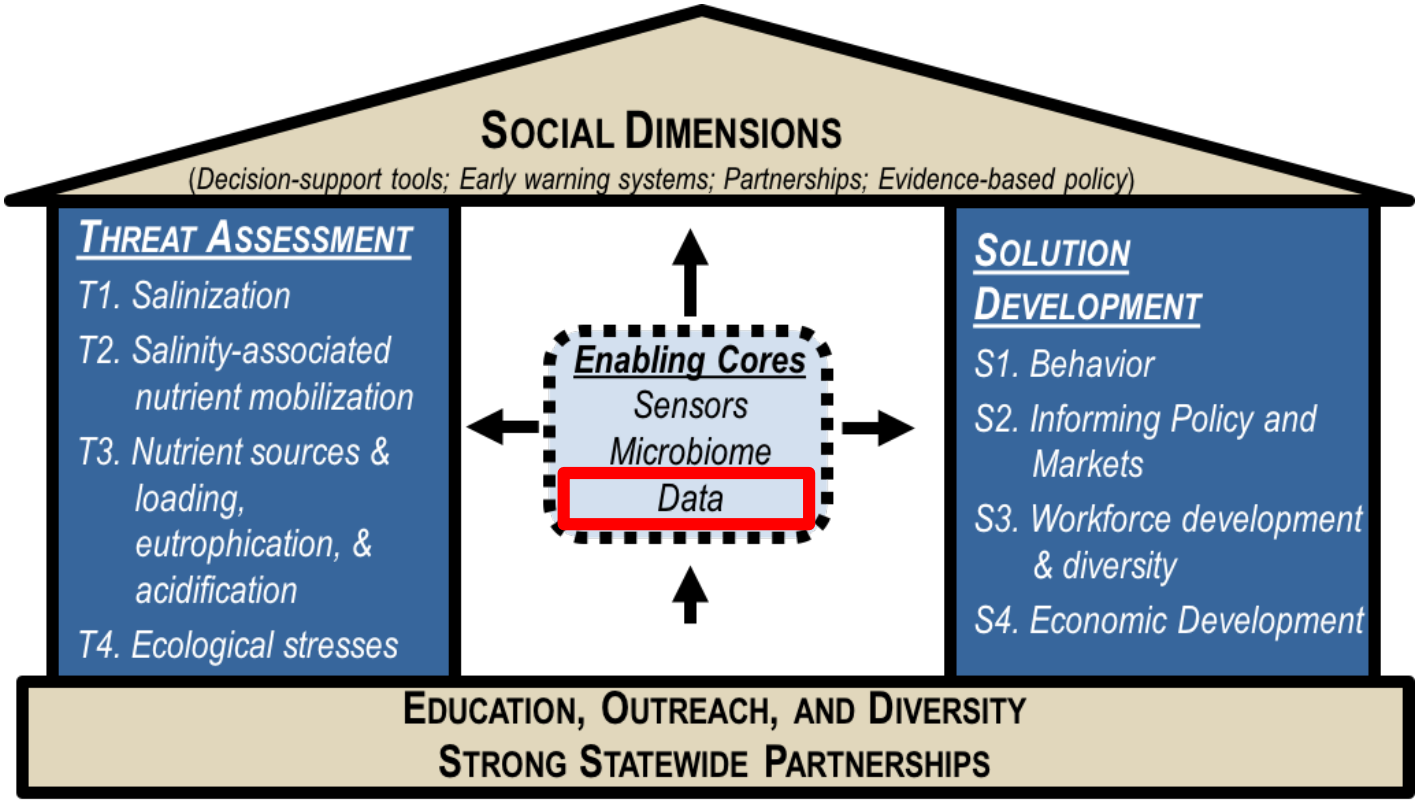
- New papers to guide behavioral research

Palm-Forster, L.H., P.J. Ferraro, N. Janusch, C.A. Vossler, and K.D. Messer. 2019. Behavioral and experimental agri-environmental research: methodological challenges, literature gaps, and recommendations. *Environmental & Resource Economics* 73(3): 719-742. https://doi.org/10.1007/s10640-019-00342-x

Streletskaya, N.A., S.D. Bell, M. Kecinski, T. Li, S. Banerjee, L.H. Palm-Forster, and D. Pannell. 2020. "Agricultural Adoption and Behavioral Economics: Bridging the Gap." *Applied Economic Perspectives and Policy* 42(1):54–66.https://onlinelibrary.wiley.com/doi/abs/10.1002/aepp.13006

PROJECT WiCCED
WATER *in the* CHANGING COASTAL ENVIRONMENT *of* DELAWARE

Delaware EPSCoR



Data Core and Analysis – Goals & Objectives

Transformative Goal: *Data science generating justifiable predictions for stakeholders.*

- *Map and integrate stakeholder decisions to big data analytical capabilities*
- *Deploy early warning decision-support systems*
- *Commercialize and package new capabilities*
- *Build and foster pipeline of talent and data science capabilities*

Dan Leathers
UD, Co-Lead

Andy Novocin
UD, Co-Lead

Tina Callahan
UD, Co-Lead

Participants: Brinson (UD), Callahan (UD), Czajkowski (APG), Ding (UD), Gao (UD), Hansen (APG), Hughes (UD), Mondal (UD), Patel (APG), Shatley (UD)

Data Core – Key Activities

- Data ingestion, access, and visualization testing (end-to-end solutions development and documentation)

- Strong interaction and knowledge transfer U.S. Army's Combat Capabilities Development Command (CCDC) C5ISR Center and the Intelligence and Information Warfare Directorate (I2WD) – referred to internally as APG

- Water Quantity in Delaware Study:
  - Stakeholders and data are identified.
  - Data acquired and ingested.
  - Water balance model developed and implemented

- Decision support tools
  - Evolving Land Cover Use Patterns in Delaware
  - Delaware Irrigation Management System

Data Core – Unique Outcomes

Unique, hands-on educational opportunities for students

APG interactions

- pipeline of talent
- mentoring
- knowledge transfer improving data science capabilities
- Acquisition of data pod

Coastal Observer App

- Citizen Science
- Supplement data gaps
- Regional & Federal Collaborations
- Integrate with stakeholder engagement opportunities

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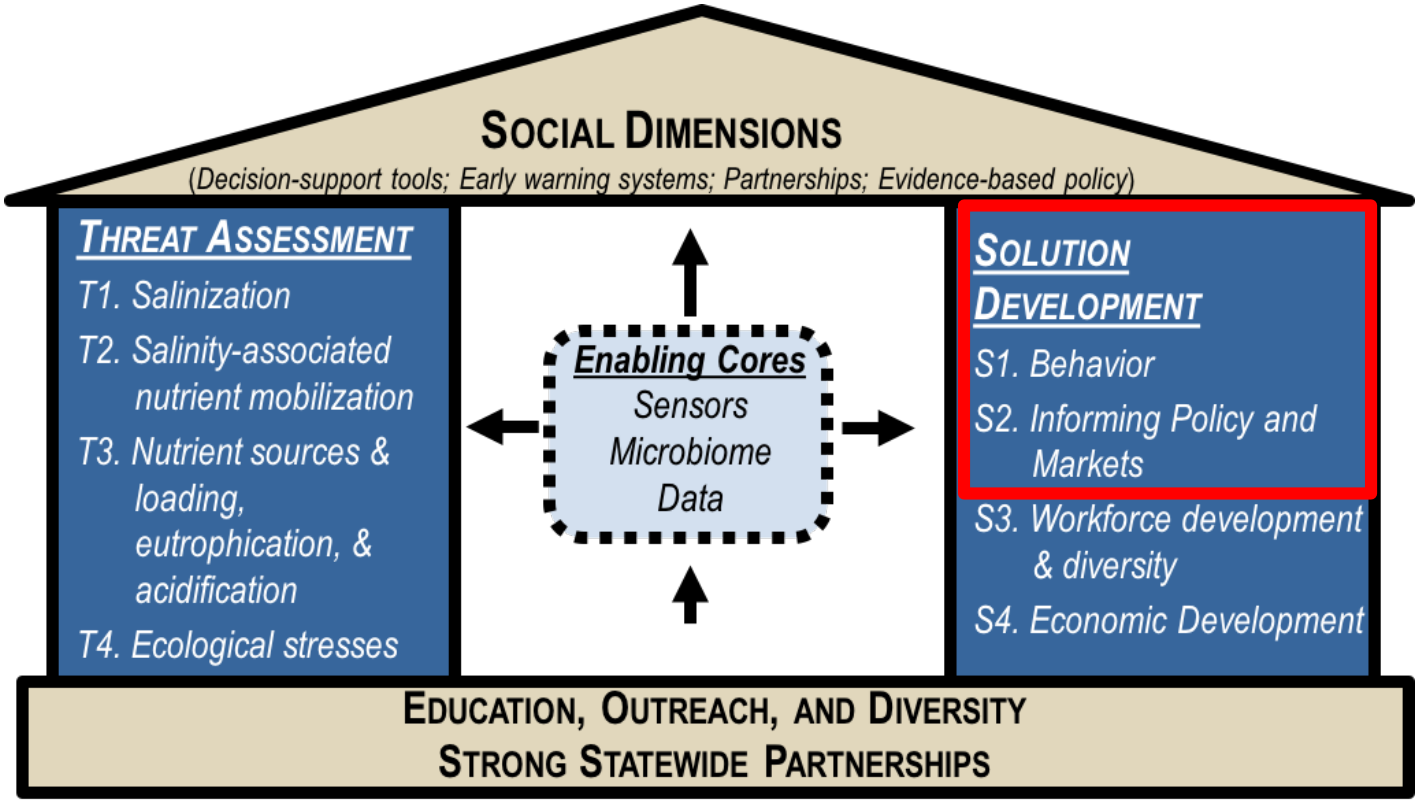


S1. Behavior – Goals & Objectives

Transformative Goal: *Quantify how behavioral and policy interventions can influence adoption of land management practices that improve water quality.*

1. *How can behavioral "nudges" be used cost-effectively to increase adoption of these practices at a landscape scale?*

2. *Which land management practices that reduce nonpoint source pollution are most likely to be adopted and maintained by landowners and homeowners?*

Kent Messer
UD, Lead

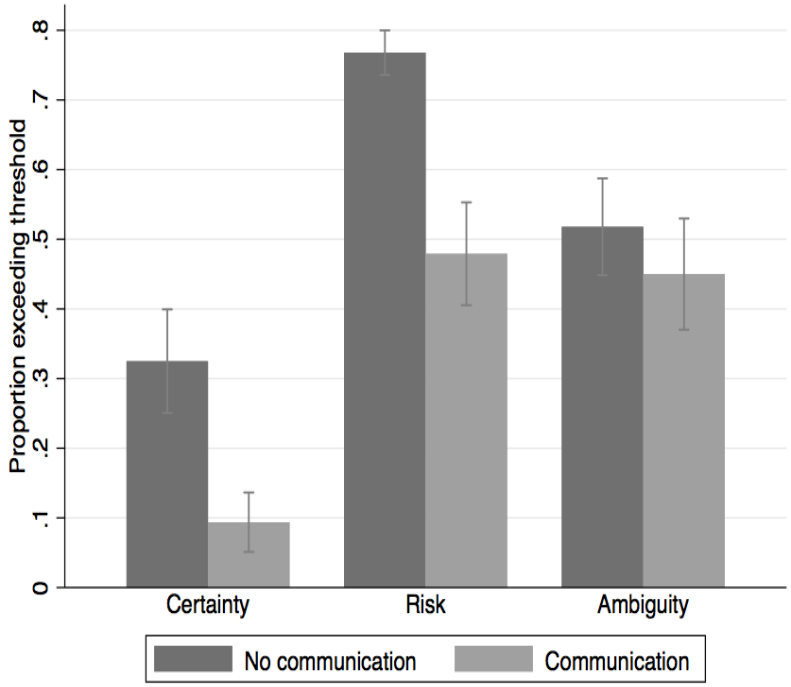
Leah Palm-Forster
UD, Co-Lead

Participants: Ding (UD); Davidson (UD), Hu (UD), Michael (UD), Shober (UD-Extension), Volk (UD-Extension)

Graduate Student: Kelley
Postdocs: Ahsanuzzaman, Paul

Example project: Experimental economics study of groundwater management

Research question: How does risk and ambiguity about the collapse of a common pool resource affect resource extraction behavior with and without communication?



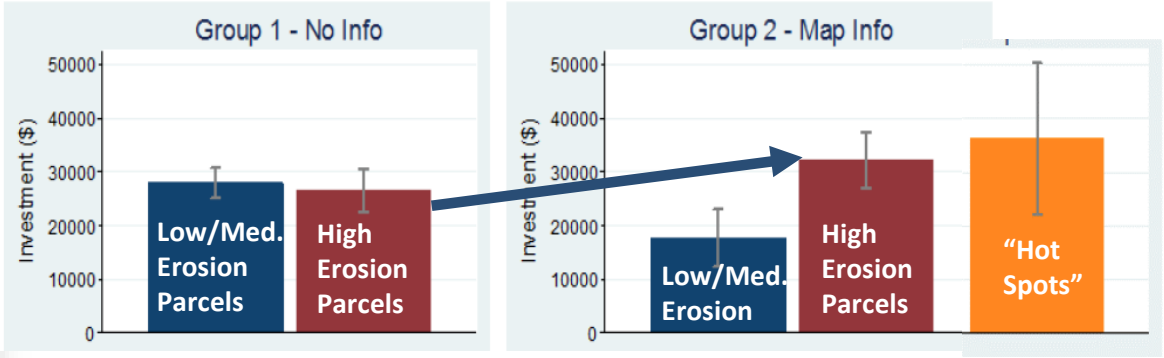
Key results

- Participants conserve the resource more when the critical extraction threshold is ambiguous.
- Communication improves coordination in all cases.
- What happens when spatial heterogeneity exists across the landscape?

Ahsanuzzaman, L.H. Palm-Forster, and J.F. Suter. 2019. Threshold uncertainty and coordination in common pool resource use. BEEMA V Conference, Villanova University, October 3-4.

Example project: Land owner willingness to invest in stream restoration

Research question: How is landowner willingness to invest in stream restoration affected by information about the magnitude and causes of erosion problems?



Landowners invested more if they were given information about erosion rates <u>AND</u> they controlled a high-erosion parcel.

Goodkin, J.M., L.E. Kelley, P.M. Fleming, and L.H. Palm-Forster. 2019. "Willingness to Invest in Legacy Sediment Mitigation: Results from a Field Experiment with Rural Landowners." Water Science Institute.

Example project: Innovative Manure Management Strategies to Promote Phosphorus Balance, Improve Water Quality, and Sustain Agriculture on the Delmarva Peninsula

- Manure broker interviews completed (Fall 2019)
- Crop producer survey designed, pretested, and approved by NASS (launching April 2020)
- Poultry grower survey designed and pretested (launching April, 2020)
- Administering crop producer survey and poultry grower survey
- Working with Spin In® team and industry partners to develop a manure clearinghouse app for the Delmarva region.

USDA NRCS Conservation Innovation Grant. "A solutions-based evaluation of barriers to farmer adoption of in-season nitrogen decision support tools." $1,606,099. N. Fiorellino (PI), A. Shober, L. Palm-Forster, C. White, K. Davidson, J. Miller (Co-PIs). 2020-2025.

S2. Informing policy and markets

Transformative Goal: *Fully integrated model valuing water quality improvement for human use and nonuse with application for decision making.*

1. *What is the public's willingness to pay for water quality improvements in Delaware?*
   - *Timing designed to help inform Delaware's proposed $50 million annual fund (HB200)*
2. *What is the recreation demand for Delaware's waterways and how is it affected by water quality?*
3. *How large is the implied federal subsidy for flood insurance?*
4. *How can answers to 1-3 be used to formulate better policy?*

George Parsons
UD, Lead

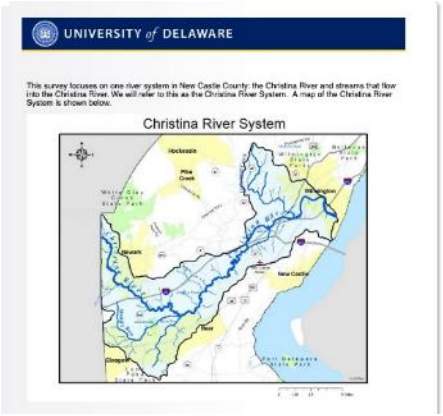
Leah Palm-Forster
UD, Co-Lead

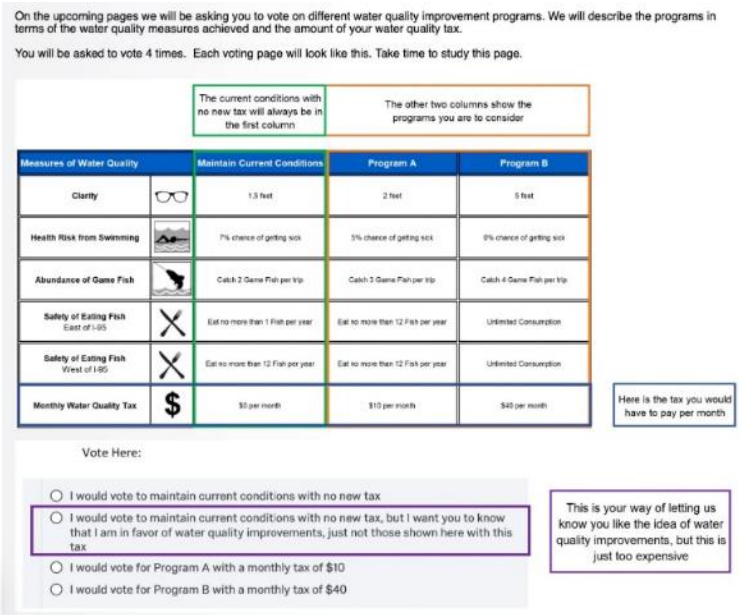
Participants: Messer (UD), Michael (UD), Ding (UD), Shober (UD-Extension), Volk (UD-Extension), Hu (UD)

Graduate students: Cortes, Langer
Postdocs: Paul

Example project: Willingness to pay for water quality improvements on Delaware's waterways

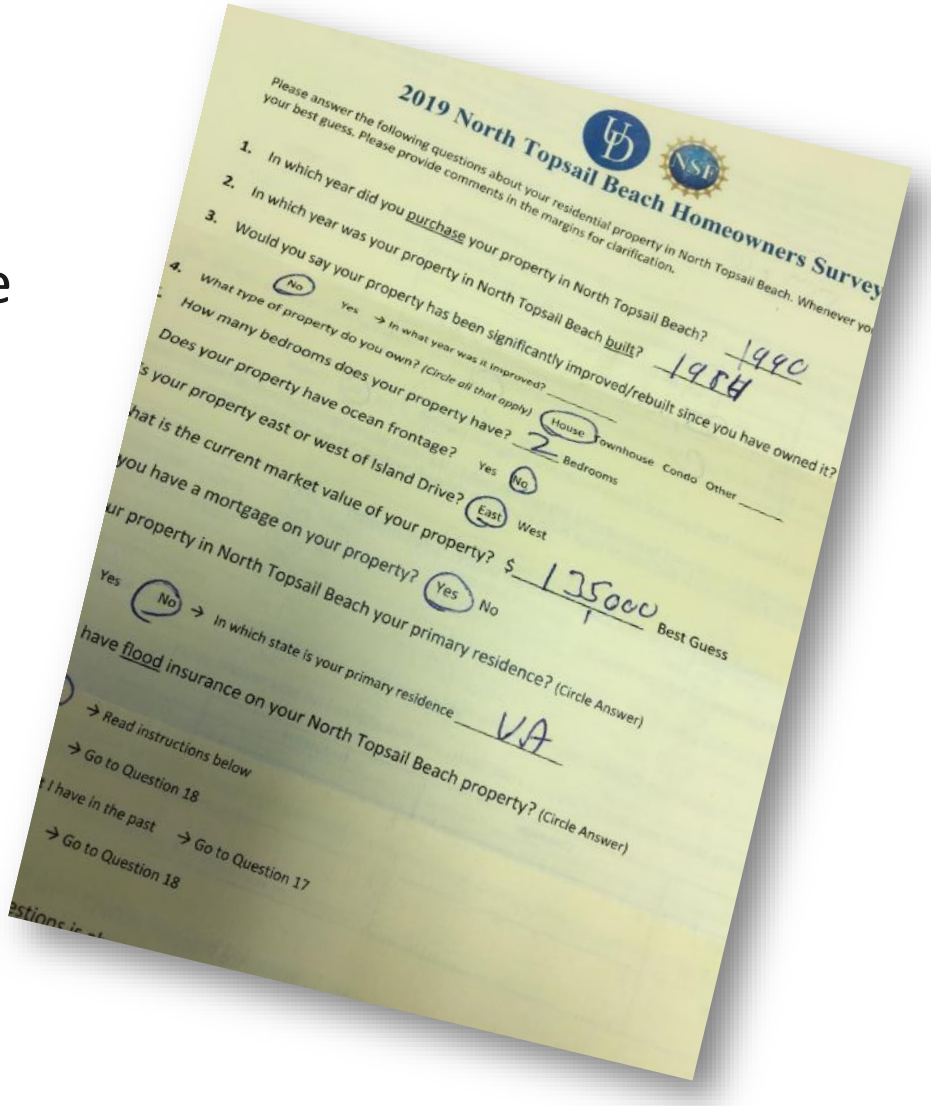
- Email-based survey methodology test completed
- Area for first application chosen
- Study design complete
- Maps and baseline water quality data complete
- Draft survey complete





Example project: Hazards, Risks and Insurance in Coastal Housing Markets

- Study design complete
- Delaware Survey complete
- Analysis underway
- North Carolina Survey launched



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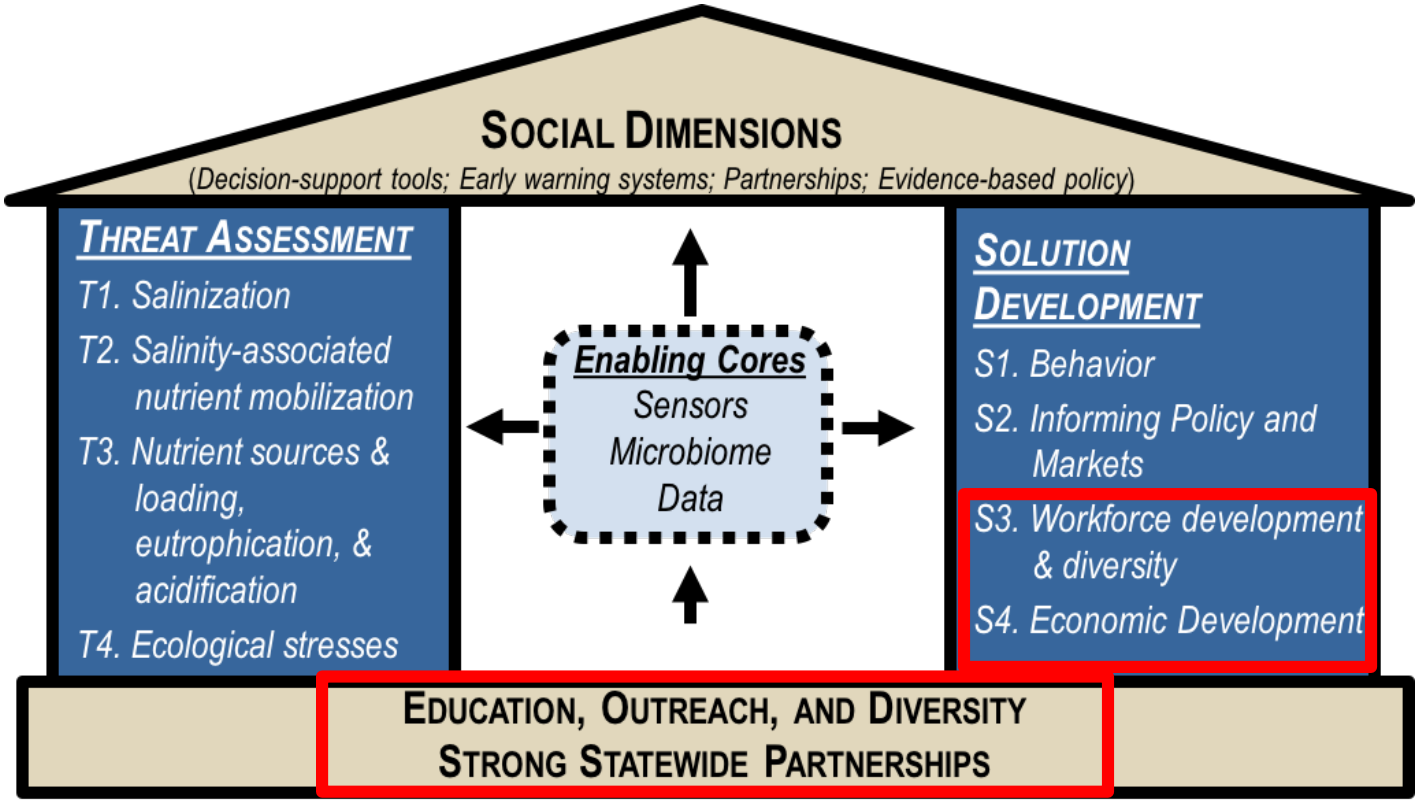
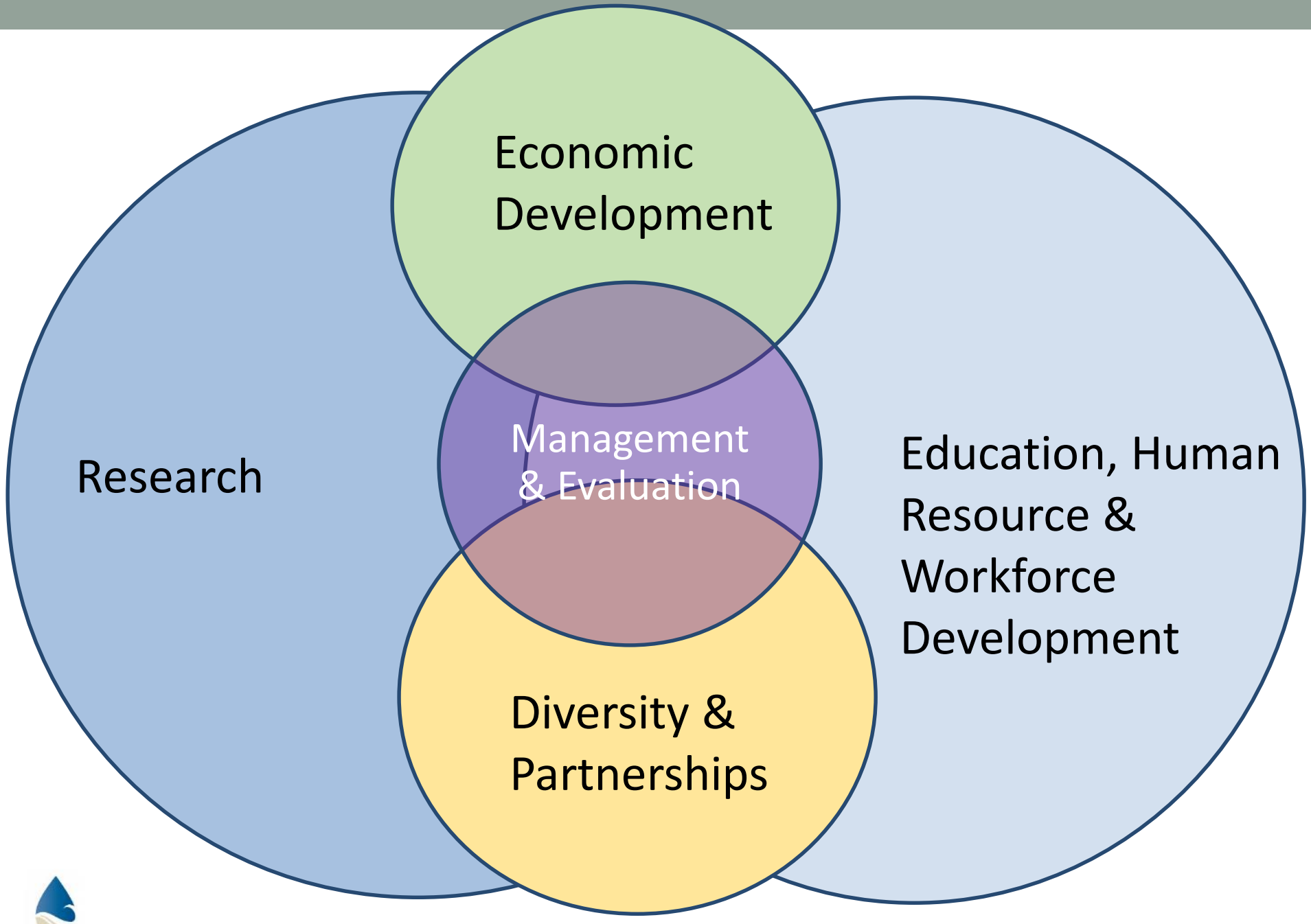



Economic Development
Research
Management & Evaluation
Education, Human Resource & Workforce Development
Diversity & Partnerships

Education, Outreach, Diversity, and Economic Development

Pathway to STEM
Bethany Beach, Delaware

- High Impact Educational Practices
- Mentoring and Team Science
- Diversity
- Workforce Development
- Communication
- Economic Development
- Evaluation
- Program Management
- Sustainability
- Partnerships
- Jurisdictional Impacts

S3. Workforce Development (Education, Outreach and Diversity)

Transformative Goal: *Provide meaningful professional development activities across the STEM career development continuum to build skills and foster collaboration.*

- *High impact educational practices*
- *Team science training and resources*
- *Bridging to K-12*
- *New courses and certificate programs*
- *Student persistence/graduation*
- *Partnerships & outreach to build diversity*

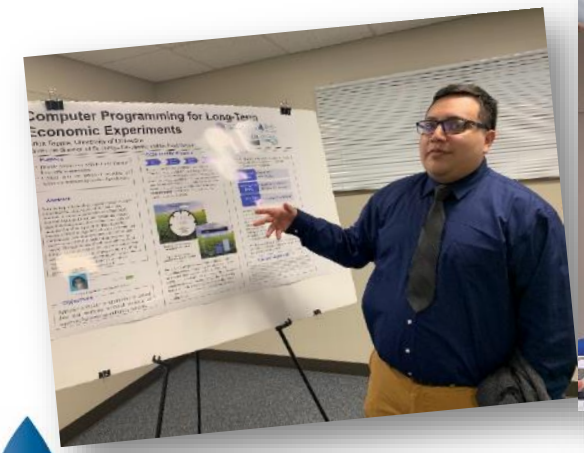
Jeanette Miller
UD, Lead

Malcolm D'Souza
Wesley, Co-Lead

Participants: : Bennett (UD), Booksh (UD), Cai (UD), Callahan (UD), Hofstetter (DTCC) Johnson (DSU), Kalavacharla (DSU), Liu (DTCC), Martin (UD), McDowell (DTCC), Messer (UD), Novocin (UD), Powers (UD), Rassias (UD), Rabolt (UD), Sapna (DTCC), Slocum (UD), Shuman (Wesley), Weir (UD), Williams-Bey (UD)

Education - Major Outcomes

- Delaware Environmental Institute Graduate Fellows – 4
- Spin In results – 35 students engaged, 1 business established
- K-12 students in Stem Expos – 141
- Students in bridge program – 28 students with 100% persistence
- New courses on research/environmental ethics – 1 degree, 4 courses, and 1 certificate program
- Sponsored conferences/workshops/stakeholder engagement activities in Delaware – 15

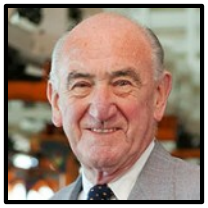


S4. Economic Development

Transformative Goal: *To ensure that the products of basic research and infrastructure development, funded by the EPSCoR Cooperative Agreement, translate from the lab to the marketplace.*

- *Develop culture for Economic Development and supporting processes*
- *Engage in workforce development – education and training*
- *Provide IP support, management and training to ensure discovery is protected in translation from lab to the customer.*
- *Establish partnerships and collaborations to accelerate research and education into the marketplace.*

Amalea Rassias
UD, Lead



David Weir
UD, Lead

Martha Hofstetter
DTCC, Co-Lead

Amy Slocum
UD, Co-Lead

Don Sparks
UD, Co-Lead

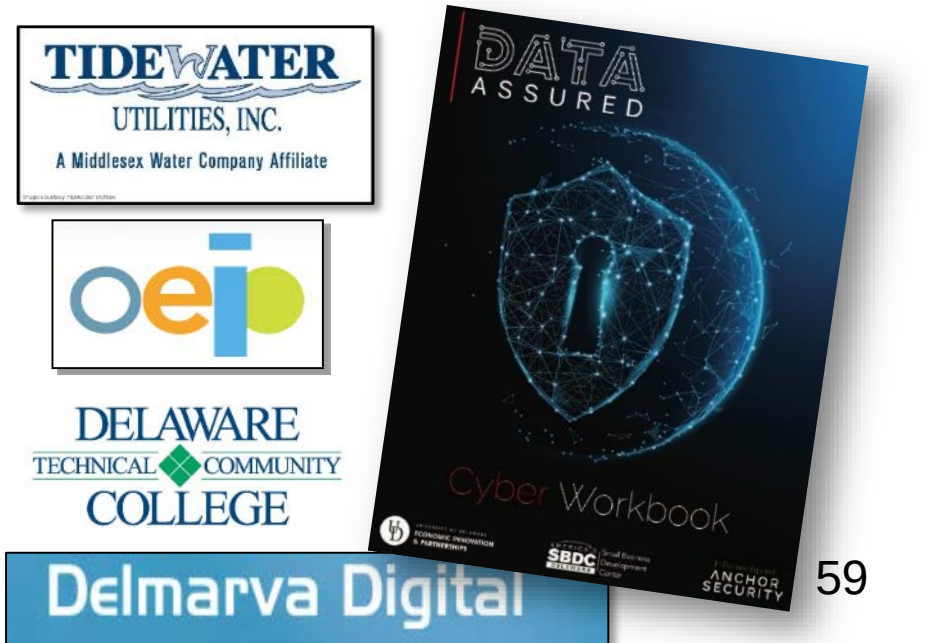
Participants: Casson (DSU POC), DiNetta (UD POC), D'Souza (Wesley POC), Hofstetter (DTCC POC), Morris (DTCC), Yops (UD)

Establish partnerships and collaborations to accelerate research and education into the marketplace

- Established partnership with Tidewater Utilities, Inc. to support cybersecurity and water quality (technical) needs.

- Worked with Delmarva Digital and Delaware Tech to determine workforce needs of water utilities/waste water treatment employers in Delaware

- OEIP, through the Delaware Small Business Development Center's (DSBDC) Data Assured™ Program, provides cybersecurity information, counseling, training, industry-specific training, etc. to Delaware small businesses



Disseminate results via publications and presentations, seminars and events

- 43 presentations and 109 posters
- 9 pubs, 4 theses
- Hosted 3-5 events, brown bag seminar series
- This Coming Week in the Environment for research seminars
- Project WiCCED infographic and newsletters
- Social media

@ProjectWiCCED

Project WiCCED Channel

Want to learn more?

Check out our website: https://projectwicced.org/