Institute of Water Research
Michigan State University

Annual Technical Report
2019

Products

- Online Drought Forecast Dissemination System
    - Developed a prototype website for sharing drought forecasts through an interactive map (https://iwr.msu.edu/drought/soilmoisture.html).
    - Developed backend Python scripts that take updated forecasts from the Weekly Drought Monitoring and Prediction System (https://drought.geo.msu.edu/research/forecast/drought.php) in a Grid Analysis and Display System (GRaDS) format and converts them to a NetCDF time series rasters that could be displayed in an ArcGIS JavaScript API.
- Master's Thesis: Young, L. (2020). *Perceptions of decision support system success: Lessons from the North Central region*.
- Report of accuracy of the Michigan EnviroImpact Tool (https://www.egr.msu.edu/iwr/reports)

Asher, J.; Thomas, M.; & O'Neil, G. July 2019. Socioeconomic Indicators of Community Vitality: Research and Case Studies of Coastal Communities in Michigan – Final Report.

Wolfson, Lois and Erick Elgin. 2020. PFAS Chemicals: A Concern to Human Health and the Environment, The Michigan Riparian, February, pp: 11-13, 22.

Elgin, Erick and Lois Wolfson. 2020. Tiny Critters Deliver Big Benefits for Lakes. Lakefront Lifestyles Magazine. May/June, Vol. 28 (4): 12-13.

Elgin, Erick, Paige Filice and Lois Wolfson. 2020. Lakes in the Offseason: A look under the ice. Lakefront Lifestyles Magazine, Nov/Dec. Vol. 29 (7): 12-13.

Bohling, Mary, Cincy Hudson, Paige Filice, Jake DeDecker and Lois Wolfson. 2020. MSU Extension Programs Address Aquatic Invasive Species and Microplastics. The Drop, North Central Region Water Network. March 2020.

Information Transfer Program

Offering varied programs in multiple formats and collaborating with partners have been successful approaches for delivering information, engaging stakeholders, and presenting current research at the IWR. Through the development and presentation of conferences, workshops and training programs, IWR programs address a wide range of issues relating to water resources. Many of the programs are collaborations with Extension, Sea Grant, University departments, other agencies and professional organizations. The following programs were offered during the FY2019 grant period, with impacts and outcomes noted.

- In its 29th year, the **Great Lakes conference** attracted 185 registrants, many of whom are returnees. Of those who completed an evaluation, 97% ranked the conference as excellent or very good, 97% learned a lot or some. Many indicated that they would use the information in some capacity in the future. The **Shoreline and Shallows conference** had 152 attendees; 80% ranked conference as excellent or very good; **Water School**, an intensive two-day training for local officials and other decision makers was offered in four different locations in southeastern Michigan. IWR assisted with this Sea Grant program. One planning commissioner indicated that he went back to his planning commission and reopened their master plan to include more green

storm water infrastructure. A city council member attended the workshop; now mayor, she is very receptive to the Watershed's initiatives and has been active educating her council members on storm water.

- IWR staff co-led or played major roles in several offerings. **Introduction to Lakes,** an Extension led program that IWR staff play a major role, offered its online 6 weeks course; 159 students enrolled and 90% completed course. Thirty-seven requested CEUs that we offered from five difference organizations or agencies. One student wrote: "I wanted to thank you for the opportunity to participate in this course. I was able to formulate a plan of action for taking care of our lake. The list of resources is invaluable to me. There is so much info out there and being new to the area and lake living, I was overwhelmed. Still am but I'm not paralyzed."
- IWR staff worked with Extension staff and researchers to assess the recent spread of a class of persistent manmade chemicals known PFASs and held a **PFAS Speed Meeting**: Over 60 people joined the meeting, including a legislative assistant from Senator Gary Peter's office.
- The Institute is a member of several statewide **partnerships** including the Michigan Natural Shoreline Partnership, Michigan Chapter, North American Lake Management Society, and the Michigan Inland Lakes Partnership and helps these organizations in their efforts. The Student Lake Research Grants Program, where Institute staff serve as the lead in soliciting proposals as well as reviewing and offering recommendations to the organizations distributing the funds, awarded grants to two students. In fall, the Institute helped develop and run a Lunch and Learn workshop on harmful algal blooms, which attracted over 100 practitioners and professionals.
- IWR staff gave several **presentations** on emerging issues, all which were by invitation. Over 100 participants attended a legislative meeting held in downtown Lansing on PFAS, including legislators and aides. Another PFAS presentation given at the MSU Alumni Association series, "Coffee with the Profs" had about 75 in attendance but being live-streamed, many others were able to view it. IWR staff were also invited to present at a statewide lakes conference on harmful algal blooms (HABs) as a concurrent session with about 50 in attendance as well as in a webinar which attracted 142 participants across the Great Lakes region.
- IWR teamed up with the Michigan Water Environment Association (MWEA) to offer its **Watershed Online Course.** Those completing all seven modules could obtain Watershed Certification from the MWEA. During this fiscal year, 14 students took 39 classes. A new module directed toward Drain Commissioners was developed by the Michigan Department of Agriculture and Rural Development and a consultant and will be rolled out at the 2020 MACDC conference as part of the Watershed series.
- **University sponsored and related events** that IWR participated in through teaching, demonstration or conversing with participants included:
    - Michigan Science Festival, a statewide event where IWR featured groundwater activities
    - Greening Detroit, a program that brings underserved students to campus to be introduced to natural resources
    - Park Lake Summer Solstice Festival, an outdoor festival where we provided hands-on activities
    - STEM program in Lansing Public Schools, including inner-city schools
    - Autumn Fest, a program directed towards MSU alumni and their families
    - Bill Earl Youth Fishing Program, a hands-on fishing clinic for youth
    - Sustainability at MSU, where we featured water quality in the river that flows through campus
    - Quiet Water Symposium, a natural resources and non-motorized boating event, that attracts 1000s of participants.

The above bulleted programs increased visibility of IWR and MSU. These events are often part of larger programs so the number attending may range from 25 up to more than 1000. Two of these programs, directed toward inner city students included recruiting efforts for students preparing for college in the next few years.

Student Support

- 7 undergraduate students
- 2 graduate students

Notable Achievements and Awards

IWR was able to develop new partnerships through USGS base funding which led to four new grants totally $2,190,000. These grants improved knowledge on water resource management, and provided outreach and training opportunities.

- NRCS Regional Conservation Partnership Program - Maple River Fish Habitat Improvement
- EPA, Great Lake Restoration Initiative - Accelerating Nutrient Management through Farmer-led Outreach and Education
- NRCS – Floating Wetland Research
- Kellogg Company – Maple River Fish Habitat Improvement

Developing And Enhancing Sustainable Water Use Of Natural And Agricultural Systems

Project Type: Annual Base Grant
Project ID: 2019MI136B

Project Impact:

During the project period, IWR enhanced the Great Lakes Watershed Management system, an online decision support platform driven by various groundwater and erosion simulations models, which enabled performance-based implementation of agricultural conservation activities in southeast Michigan. The result of the activity was a reduction of over 1,100 lbs of phosphorus and 4,500 tons of sediment entering Western Lake Erie Basin (WLEB). This effort helped to reduce nutrients driving harmful algal blooms in the WLEB and was seven times more cost effective at reducing phosphorus delivery than traditional conservation programs.

IWR developed low-cost water level sensors being deployed at edge of field research sites and in streams and lakes in Michigan to better understand how watersheds are responding to storm events. These sensors are supporting the state of Michigan's efforts to in southeast Michigan to manage stormwater, reduce E. coli, and improve nearshore health of communities in the Clinton River watershed.

IWR continued to strengthen and expand partnerships with MI Sea Grant, USGS, State of Michigan Quality of Life agencies, and other federal and nonprofit organizations such as EPA, NRCS, and the Nature Conservancy. New partnerships were created with Kellogg Company, national NRCS offices, and General Mills resulting in $1.3M in new research grants.

Online Drought Forecast Dissemination System

Project Type: Annual Base Grant
Project ID: 2019MI137B

Project Impact:

This project produced a prototype website (https://iwr.msu.edu/drought/soilmoisture.html) through which users can view forecasts from the Weekly Drought Monitoring and Prediction System (WDMPS) in an interactive map. Previously, the WDMPS produced static map images of the US lower 48 for each forecast. The prototype from this project allows users to zoom in and out of regions, view individual forecast outputs at specific locations, explore different forecast outputs (median and quartile ranges in addition to averages), and navigate and animate a timeline of forecasts. In creating this prototype, the project also yielded a Python-based backend platform that can regularly handle the conversion of new WDMPS forecasts from GRaDS datasets to NetCDF time-series rasters. These rasters can then be shared within an ArcGIS JavaScript environment, upon which the prototype website is built. While the system represents an improvement over the WDMPS' previous dissemination capabilities, it can also serve as an important complement to the US Drought Monitor, arguably the most widely used and referenced resource for drought data in the US. That tool consolidates drought observations into an accessible and interactive website but lacks a similar path for drought forecasts. This project produced a version of a system that could fill that void. The goal now is to seek out funding to move the prototype into production phase, including automating the processing of new WDMPS forecasts so that data is updated in real-time, polishing the front-end, and developing training and outreach materials.

Assessing The Accuracy Of The Michigan EnviroImpact Tool

Project Type: Annual Base Grant
Project ID: 2019MI138B

Project Impact:

During the period of this project, the performance of the runoff risk model, used in the Michigan EnviroImpact tool, was not as anticipated. It was only able to predict runoff events 40% of the time on average and frequently predicted runoff events that did not actually occur, with about 55% of runoff events forecasted turning out to be false positives. Additionally, between the three sites monitored, 62% of the runoff events that did occur were not predicted by the runoff risk model. Looking through the data, some of these runoff events that were not predicted involved snowfall, which perhaps is not considered enough in the model. Additionally, during the period that the cameras were deployed, Michigan did not receive a lot of precipitation, which lowered the number of runoff events as compared to normal and perhaps lead to conditions that weren't part of the underlying data used to develop the runoff risk model. Considering this, it will be useful to see how well the model performs going forward under different seasonal conditions, which might reflect a more normal pattern of precipitation.

Perceptions Of Decision Support System Success: Lessons From The North Central Region

Project Type: Annual Base Grant
Project ID: 2019MI139B

Project Impact:

This study sought to address research gaps associated with the development, implementation and evaluation of decision support systems (DSS) by exploring the extent to which four DSS have been successfully deployed to facilitate decision-making and support agricultural conservation within the North Central Region: Agricultural Conservation Planning Framework, the Daily Erosion Project, the Great Lakes Watershed Management System, and the Runoff Risk Advisory Forecast. Conducting 24 interviews with developers and end-users of these systems, the study examined how outreach, adoption, user satisfaction, maintenance and sustainability contributed to DSS success. A major contribution was documenting the complexity and diversity of roles related to DSS development, deployment and maintenance. Over 12 roles were identified; for example, an “owner” may differ from the DSS “developer”, and other organizations may serve as a “promoter” or “user support”. Furthermore, this study found that for some DSS, there are intermediary users that generate DSS outputs in addition to users that utilize the outputs in their decision-making processes.

While this research supports past findings of mixed DSS adoption, the findings also reinforce the need for standard metrics that assess the nature and extent of adoption; number of users is insufficient in capturing the impact of these systems. DSS sustainability is threatened by lack of consistent funding and the potential to lose key personnel that either possess the technical knowledge or social influence to maintain and promote the system. Despite challenges, the process of developing and deploying DSSs provided value to stakeholders, fostering collaboration among diverse sets of organizations.