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Office of Research and Development

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Research Area 2 Overview: Improved Aquatic Resource Mapping

Presented to the Board of Scientific Counselors

October 29, 2020

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Research Area 2:
Improved Aquatic Resource Mapping

OW need:

- Existing geospatial datasets of streams and wetlands are often limited in the degree of accuracy and at the resolution needed to support federal, state, tribal, and local water management decisions, including identifying “waters of the United States” subject to Clean Water Act jurisdiction.

ORD charge:

- To explore methods for improved characterization and mapping of streams and wetlands.
- Engage in interagency workgroup on mapping.

Output 2.1: Improved accuracy and application of geospatially explicit aquatic resource data

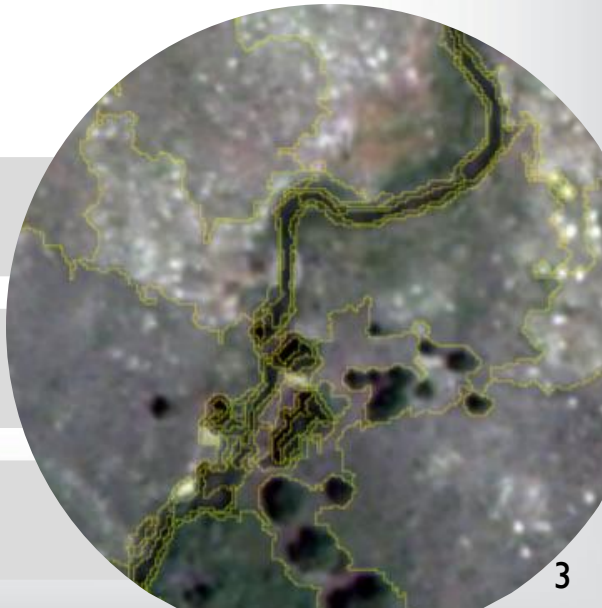
Improved Accuracy and Application of Geospatially Explicit Aquatic Resource Data

- Collaborative effort with federal, state and academic partners
  - ORD-led efforts – OW, USGS, UKentucky, UMaryland, UAlabama, Virginia Tech, TNC
  - Interagency workgroup – USGS, USFWS, USACE
  - Field-based OW efforts
- Three products addressing methodologies, geospatial analyses, and field efforts
- Synthesis of geospatial analyses, methodologies, webinars and workshops.

Product 1 **Review of current mapping approaches and geodatabases**

Product 2 **Geospatial mapping and analysis case-studies**

Product 3 **Field-based tools/indicators to validate maps and estimate error**



Improved Accuracy and Application of Geospatially Explicit Aquatic Resource Data

Product 1 **Review of current mapping approaches and geodatabases**

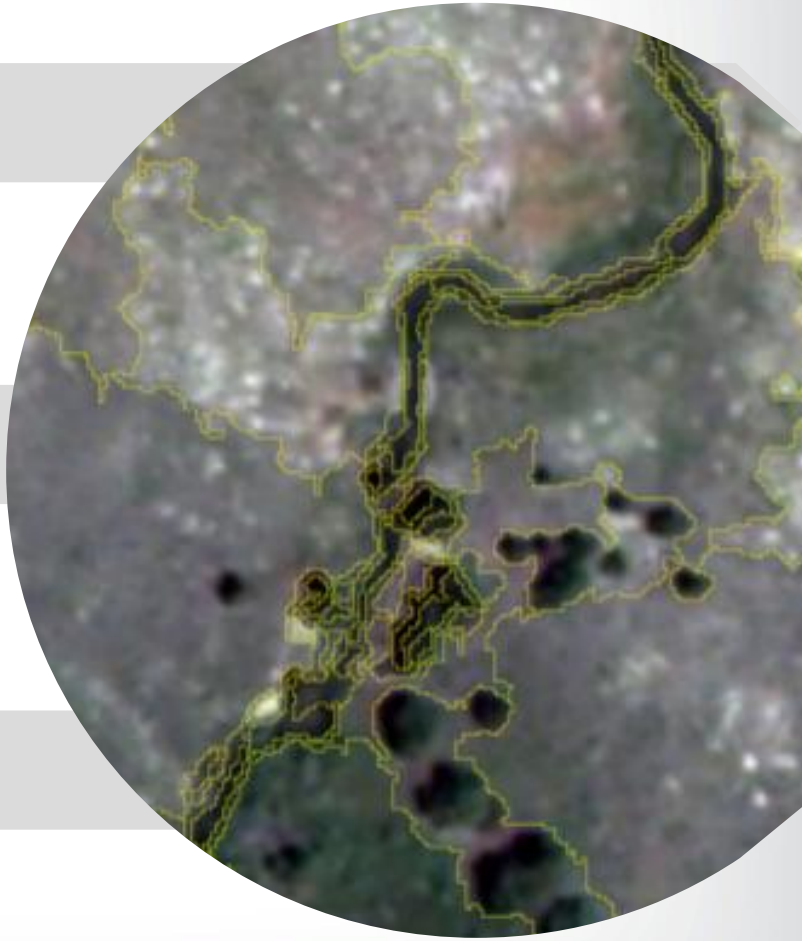
- What is the current state of mapping and what are emerging methods?

Product 2 **Geospatial mapping and analysis case-studies**

- Where can we test multiple remote sensing and modeling methods?

Product 3 **Field-based tools/indicators to validate maps and estimate error**

- How can we validate methods and improve field assessments?



Review of Current Mapping Approaches and Geodatabases

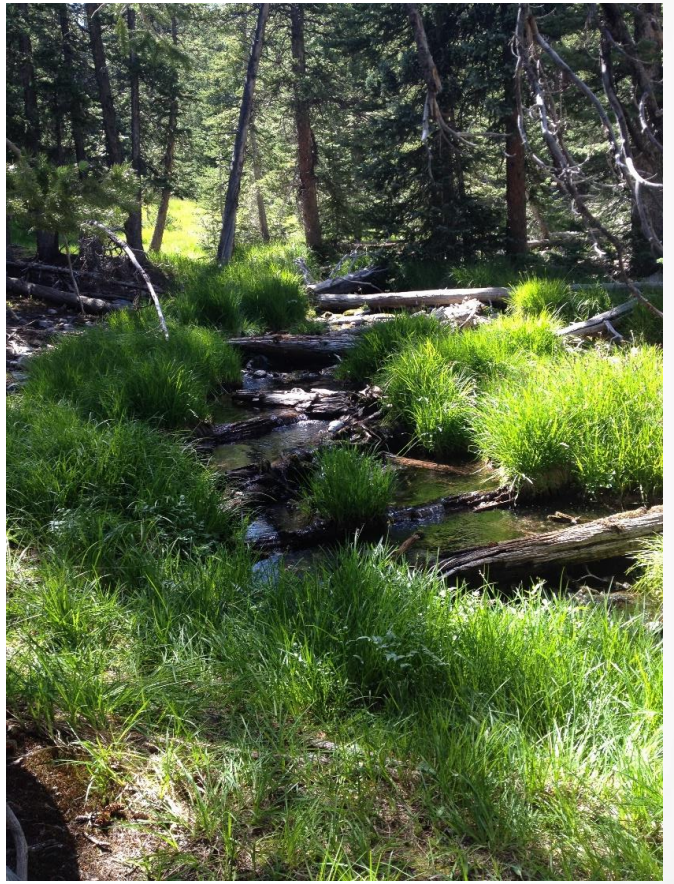
Problem/Issue: Scattered geospatial datasets and numerous methods for mapping streams, streamflow permanence and wetland extent in the literature need to be summarized.

Action: Conduct a technical review of existing and potential approaches for mapping aquatic resources

Product: FY 21 - Report/manuscript describing the results of a thorough review which includes:

- Federal, State, and Tribal geospatial extent and permanence data
- Stream and wetland mapping literature/methods with a deep dive on 260+ publications
- Inform the Interagency Workgroup workplan

External Collaborators: TetraTech, USGS and USFWS



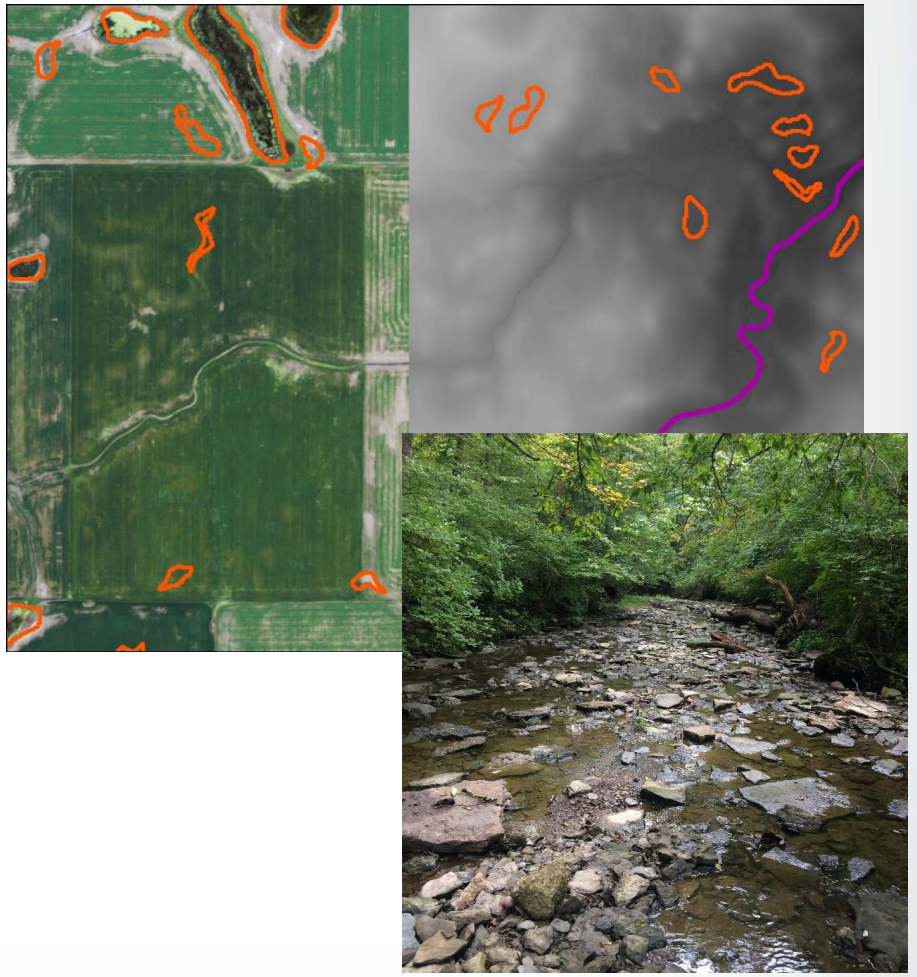
Geospatial Mapping and Analysis Case-Studies

Problem/Issue: The varying geographies, dynamics and types of aquatic resources requires careful consideration of approaches in mapping streams and wetlands

Action: Conduct stream and wetland mapping in chosen case study areas using an ensemble of topographic analyses, multiple models, remote sensing platforms and field-based sensors.

Product: FY22 - Synthesis of lessons learned from one or more case study areas.

External Collaborators: USGS, USFWS, Univ of Kentucky, University of Maryland, University of Alabama, Virginia Tech, TNC

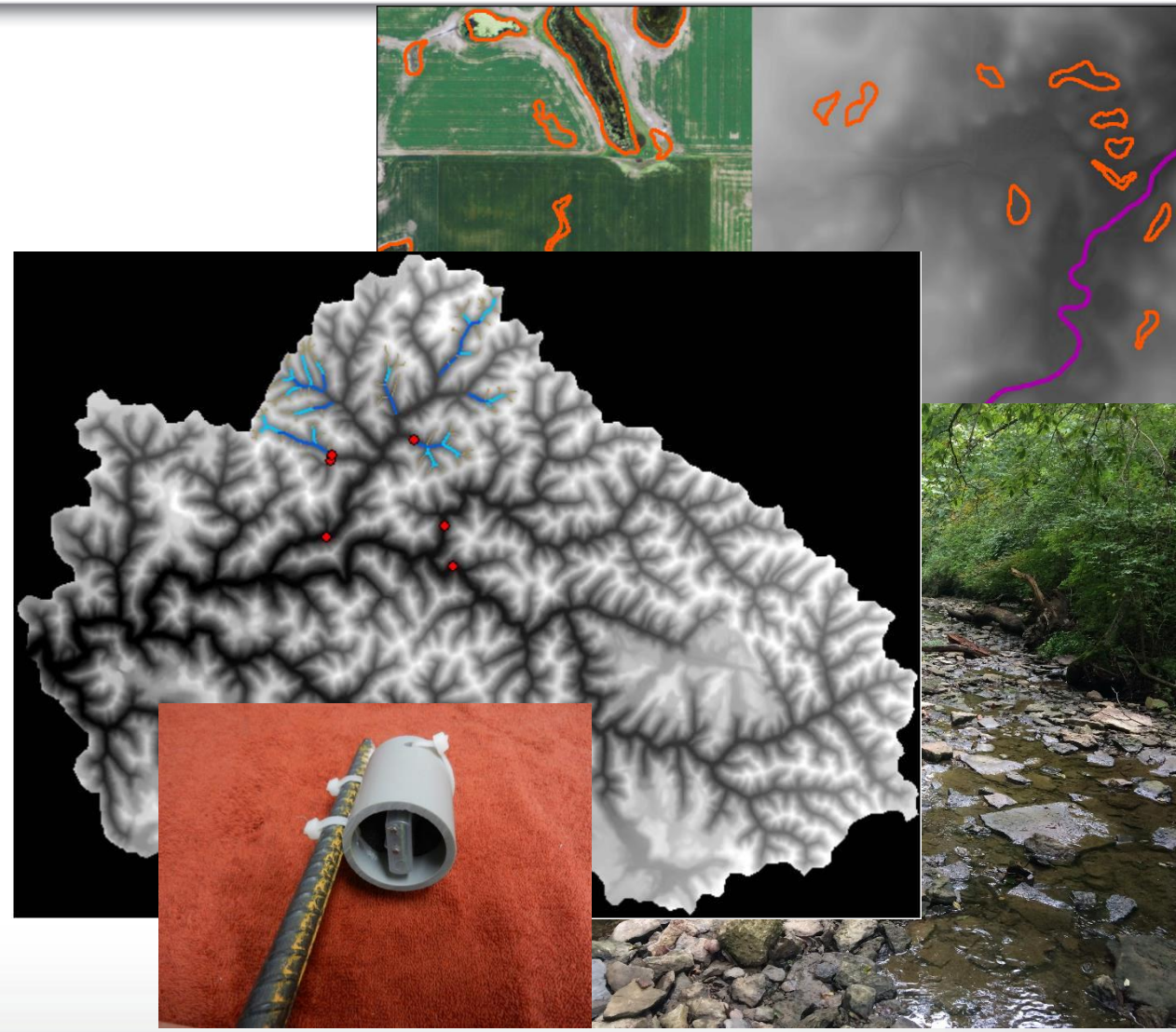


Geospatial Mapping and Analysis Case-Studies

Case study research includes:

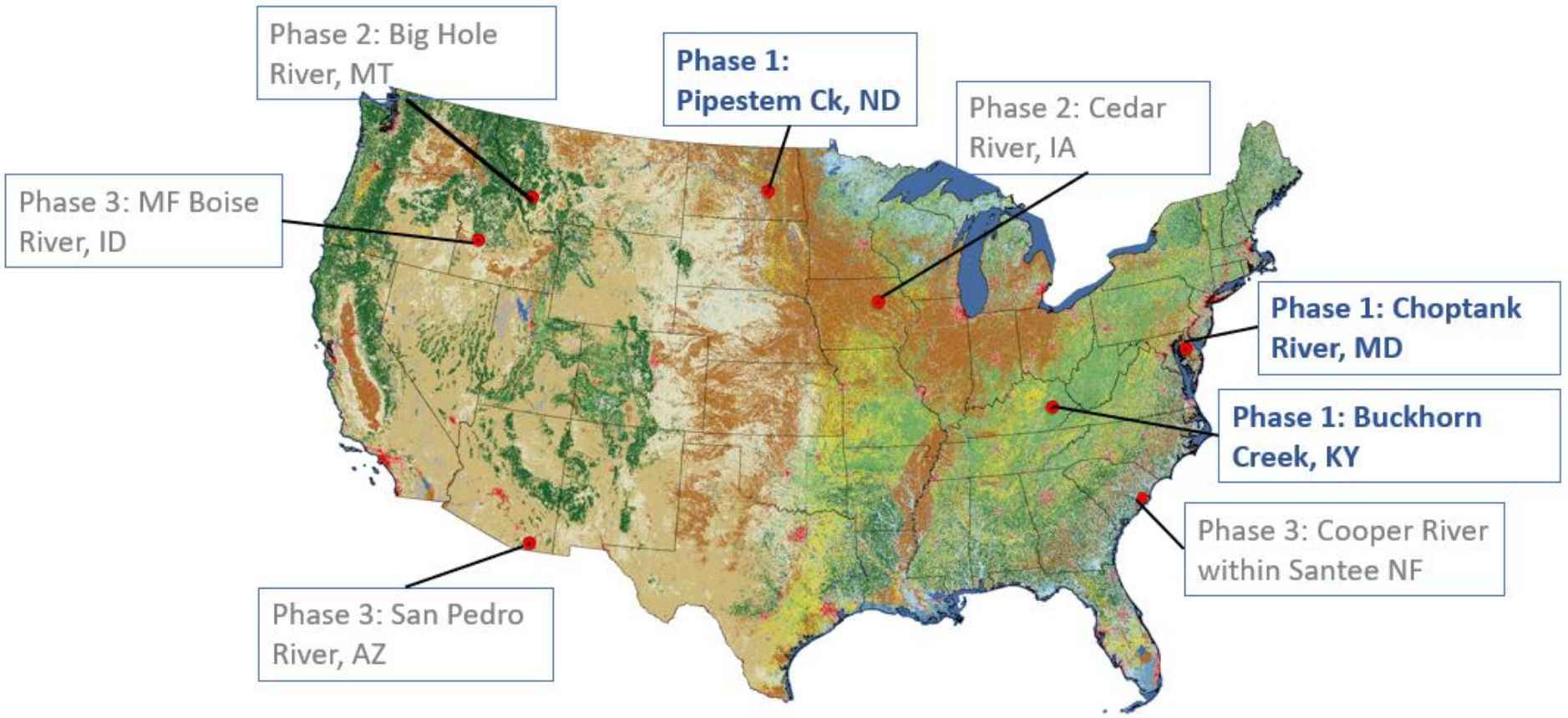
- Stream/wetland characterization via LiDAR methods
- Fine and moderate resolution remote sensing
- Ensemble of multiple hydrologic models
- Use of past field data and new field data via loggers and visits (Product 3)

Multiple approaches converge on evidence to map the dynamics of stream and wetland systems



Geospatial Mapping and Analysis Case-Studies

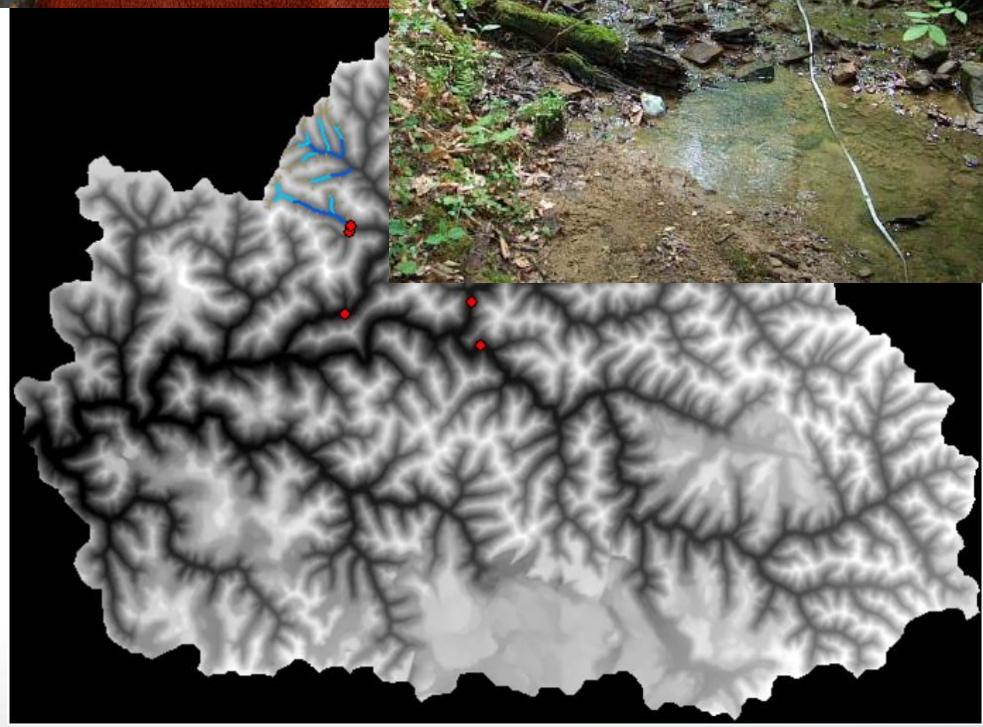
Diverse representation via a phased approach



Geospatial Mapping and Analysis Case-Studies

Buckhorn Creek, KY

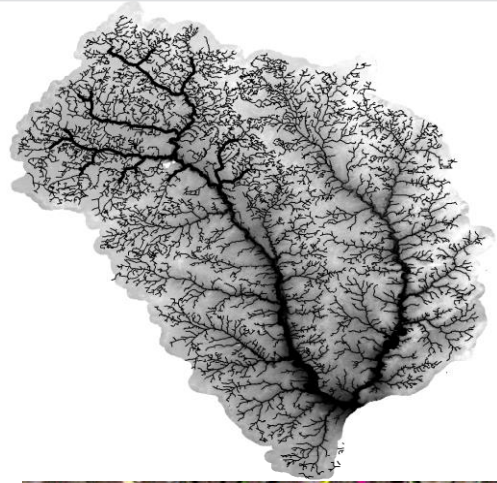
- Steep hillslopes with well-drained soils overtop shale/sandstone/coal with rapid streamflow response to rainfall
- Plentiful existing data
- Ongoing work
  - Lidar research - methods comparisons
  - Developing Dynamic TOPMODEL
- Future work
  - Deploying loggers to support validation of models and RS
  - Remote sensing – Sentinel 1&2
  - Additional surface model



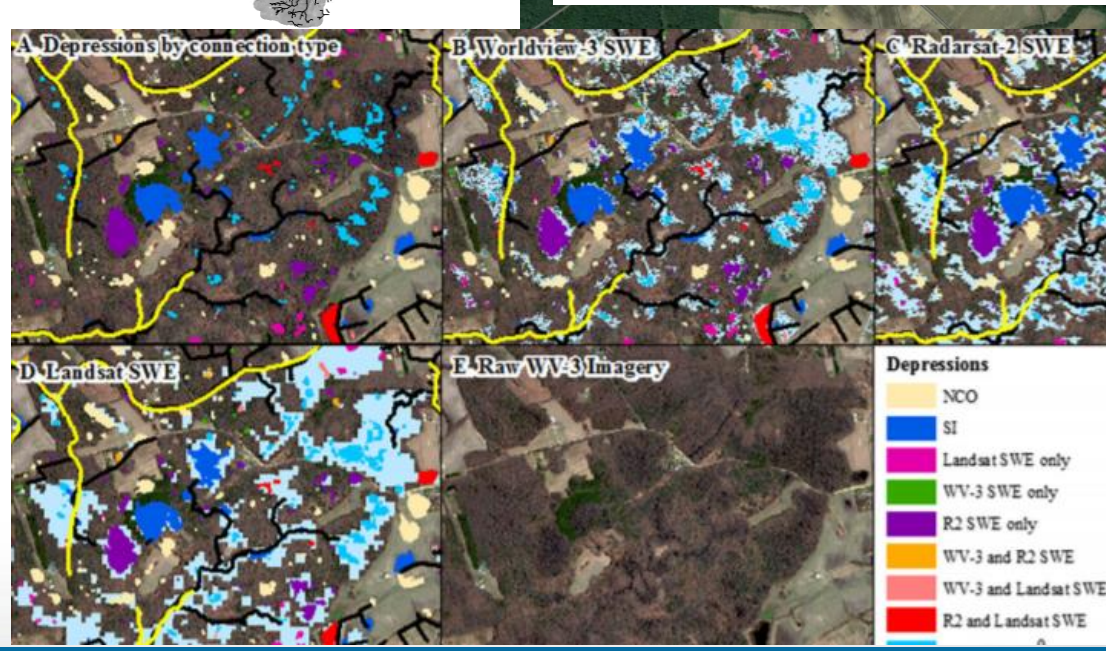
Geospatial Mapping and Analysis Case-Studies

Choptank River, MD

- Flat forested wetlands in ditched ag lands with sandy soils and shallow subsurface flows
- Spring wetting up of wetlands and streams & summer drying and irrigation
- Existing lidar, models and imagery
- **Included as an Interagency case study**
- Ongoing work
  - Logger deployment into temporary streams
  - Acquisition of Sentinel and fine-scale imagery
- Future work
  - Saturation-excess hydrology model
  - Loggers to support the validation of models and RS



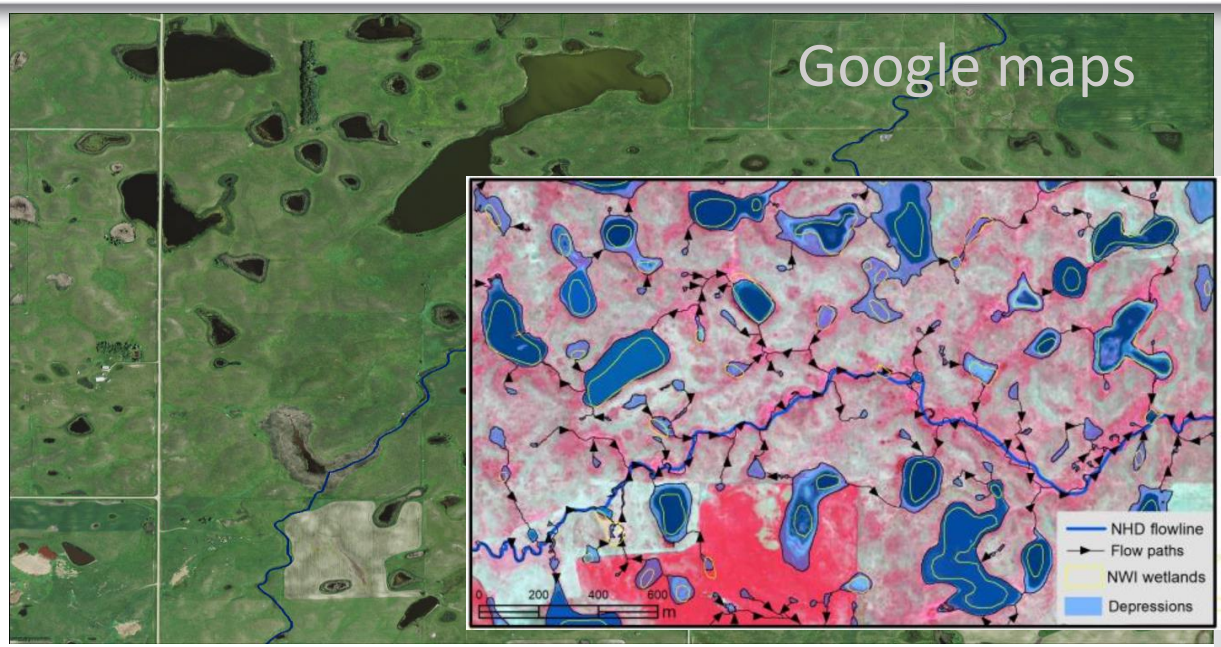
Vanderhoof et al 2017



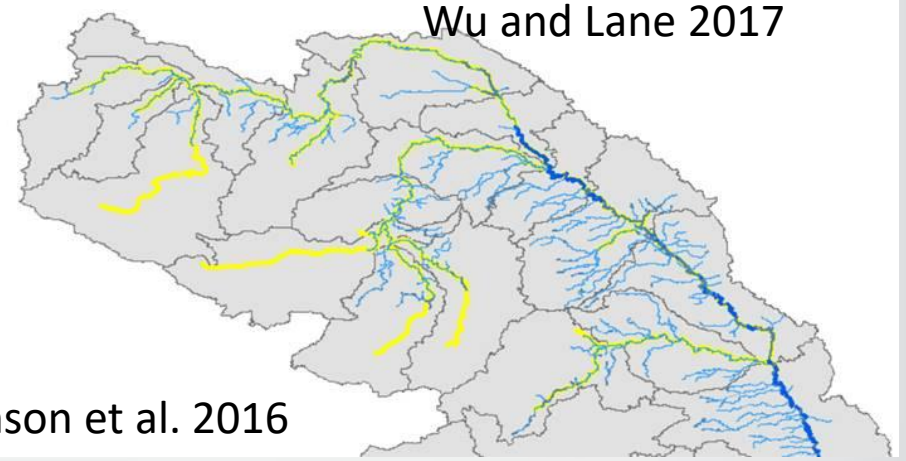
Geospatial Mapping and Analysis Case-Studies

Pipestem Creek, ND

- At the edge of Missouri Coteau, it has many dynamic wetlands that interact with the creek
- Dominated by snowmelt and spring rains via surface flows with high evapotranspiration in the summer and fall
- Existing lidar, models and imagery of wetlands
- Ongoing work
  - Planned use of Sentinel 1&2 to look at seasonal wetting of streams
  - Logger deployment with sites visited in July and October
- Future work
  - Modify existing SWAT model
  - Apply Dynamic TOPMODEL



Wu and Lane 2017



Evenson et al. 2016

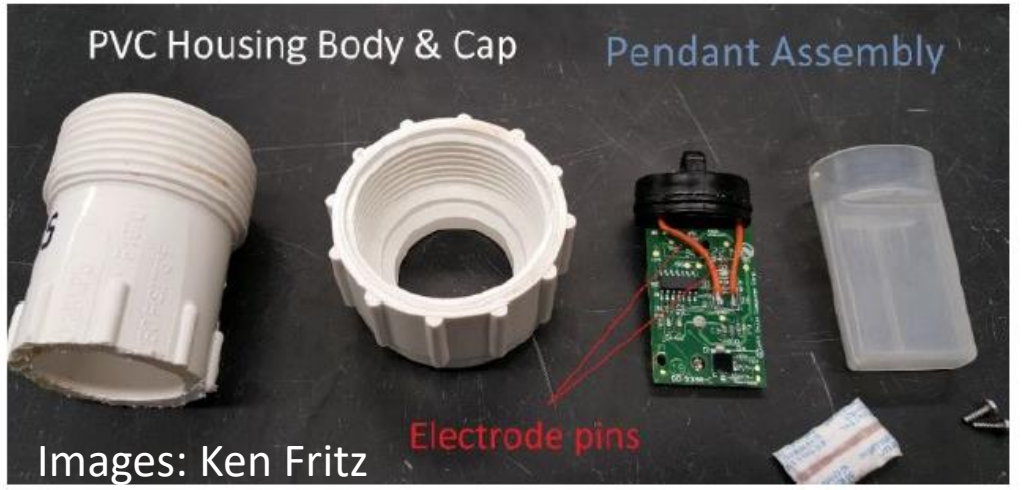
Field-Based Tools/Indicators to Validate Maps and Estimate Error

Problem/Issue: Field data is needed to validate models and additional rapid assessment methodologies are needed to determine stream flow permanence.

Action: Deploy conductivity loggers in case study areas and support ongoing OW-led efforts on stream assessments

Product: FY22 - Synthesis of geospatial methodologies & maps with metadata relating to validation efforts and OW stream assessments

External Collaborators: EPA-OW,USGS, VA DNR, Univ of Kentucky, University of Maryland, University of Alabama, Virginia Tech, TNC



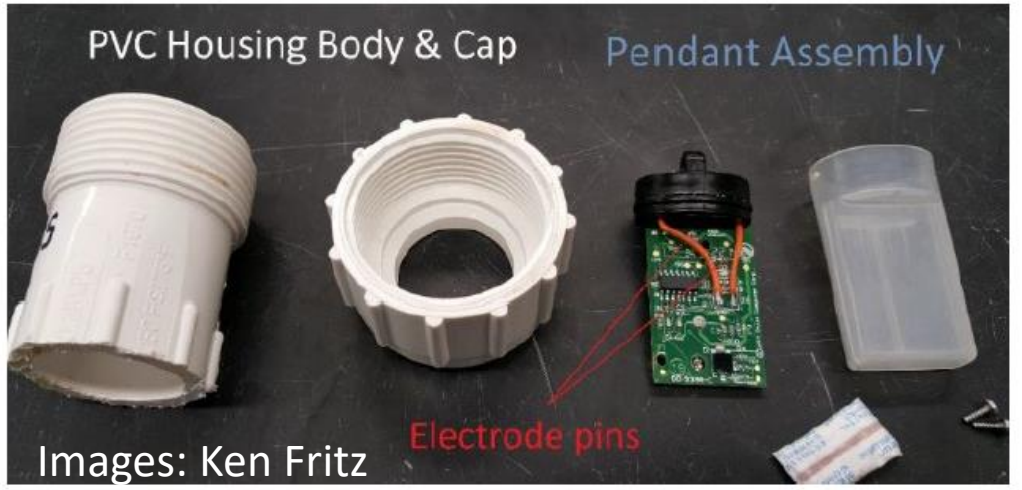
Field-Based Tools/Indicators to Validate Maps and Estimate Error

Field validation efforts to support remote sensing and modeling work

- Ongoing – deployment of loggers at the case study locations
- Planned development of logger datasets to support Product 2
- Supports interagency case study in MD

ORD efforts to support the development of regional Streamflow Duration Assessment Methods (SDAMs)

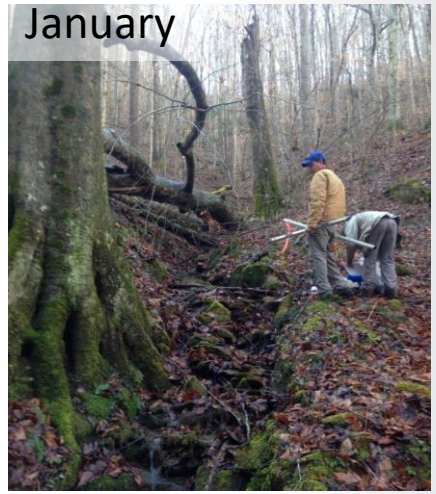
- Rapid field-based assessment tool.
- Use machine learning approaches to identify best sets of reach-scale physical and biological indicators that most accurately predicts flow duration class for stream reaches

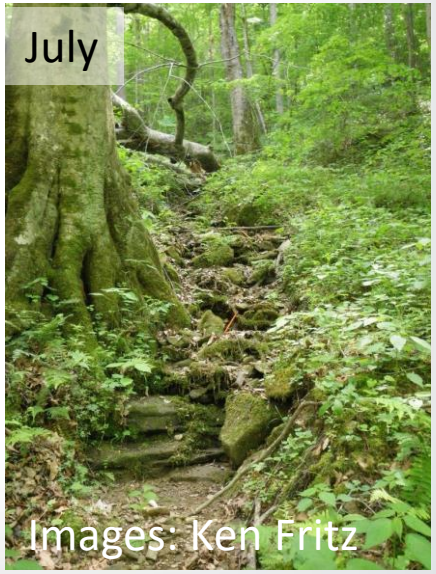


Field-Based Tools/Indicators to Validate Maps and Estimate Error

ORD support of SDAMs

- All sites included as intensive sites in SDAM effort
  - ND loggers – Summer/Fall 2020
  - MD loggers – Fall 2020
  - KY loggers – Fall 2020 or Spring 2021
- Fritz et al. *Classifying Streamflow Duration: The Scientific Basis and an Operational Framework for Method Development*. Water. 2020 https://doi.org/10.3390/w12092545
- ORD effort to improve methodologies for SDAMs using existing ORD data
  - Compiled biological and physical dataset to inform SDAMs with a focus in the Northeast, Southeast and Northern Great Plains regions





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Questions?