EPA

Office of Research and Development

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM




Science to Support Nutrient-Related Water Quality Goals

Anne W. Rea, Heather Golden, Cheryl Brown, Kate Schofield & Brenda Rashleigh

August 5, 2020

ICOSSE

Background

- Nutrient pollution is a widespread water quality problem with consequences for human and environmental health, environmental condition, and the economy.
- ORD research supports the development of new tools for OW, states, tribes, and local decision-makers to establish and achieve water quality goals.
- Science can inform recommendations to protect different types of waters and different designated uses (e.g., aquatic life, recreation, and drinking water source protection)

ORD's Nutrients and HABs Research

SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM

Assessment and Management of HABs

Science to Support Nutrient-Related Water Quality Goals

Nutrient Reduction Strategies and Assessment

Science to Support Nutrient-Related Water Quality Goals

This research advances the science to inform decisions related to nutrient and co-pollutant water quality goals.

Provides information, methods, or approaches to characterize nutrient-related impacts in watersheds and water bodies, which helps determine protective endpoints for aquatic life.

Assesses the responses of aquatic ecosystems to nutrient pollution.

Links these results in approaches that identify areas that may most effectively respond to restoration and recovery.

EPA
United States
Environmental Protection
Agency

Research for Characterizing Nutrient-Related Impacts Across Multiple Spatial Scales

Office of Research and Development

Research Output 1

Research for Characterizing Nutrient-Related Impacts Across Multiple Spatial Scales

Overview:

- Advances understanding of nutrient related impacts across waterbodies and watersheds
- Will help determine protective endpoints for aquatic life in different waterbody types for a range of endpoints and range of scales
- Products will provide tools that allow partners to more effectively assess nutrient-related impacts

Research Priorities:

Approaches for Understanding Nutrients and Impacts Across Space and Time

Novel Methods to Assess the Status of Nutrient-Sensitive Aquatic Life Endpoints and Nutrient Indicators

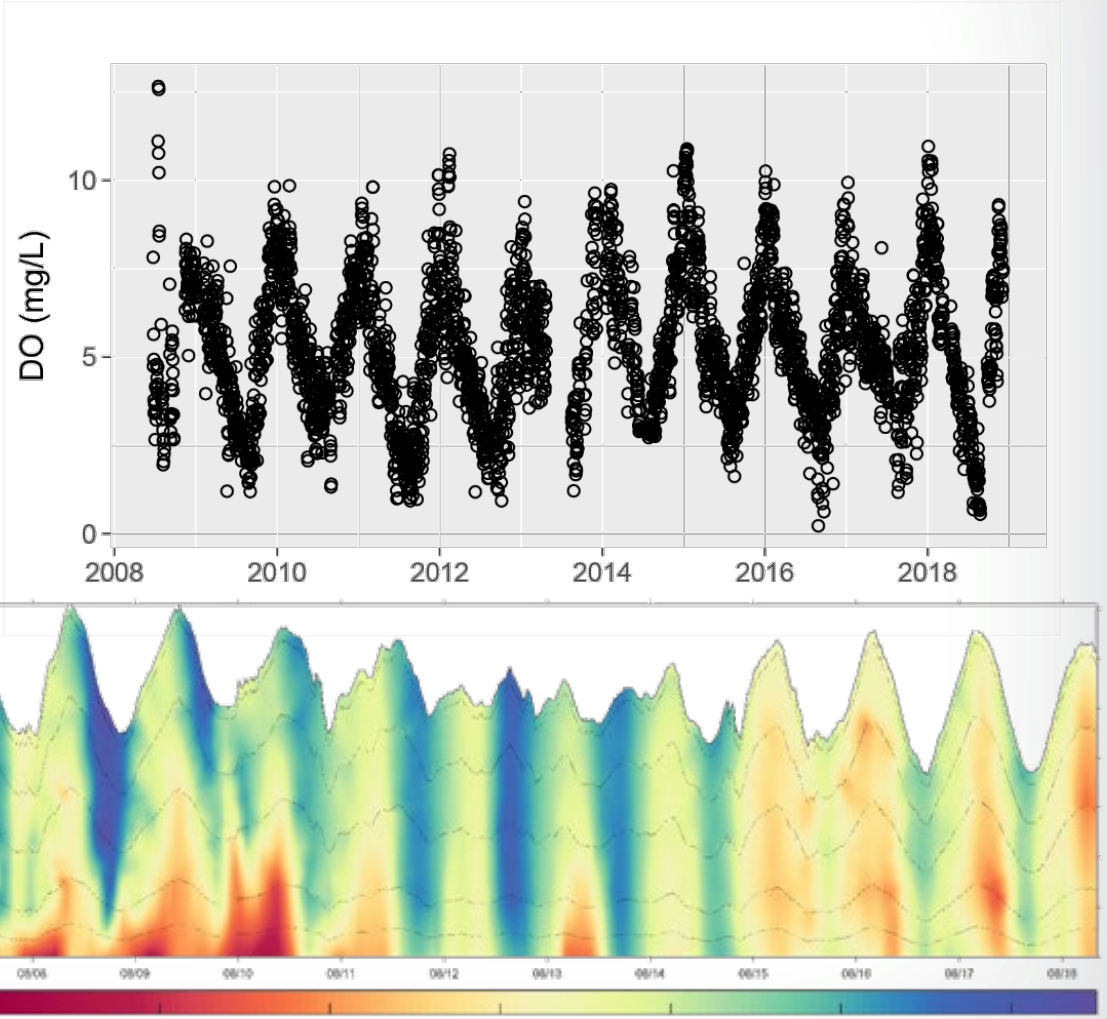
Tools to Support Nutrient Criteria Development and Attainment of Water Quality Goals

Approaches for Understanding Nutrients and Impacts Across Space and Time

Quantifying dissolved oxygen & ecosystem metabolism in estuaries across space and time using data and models

Develop simple empirical models of relationships between watershed land use and nutrients and co-pollutants

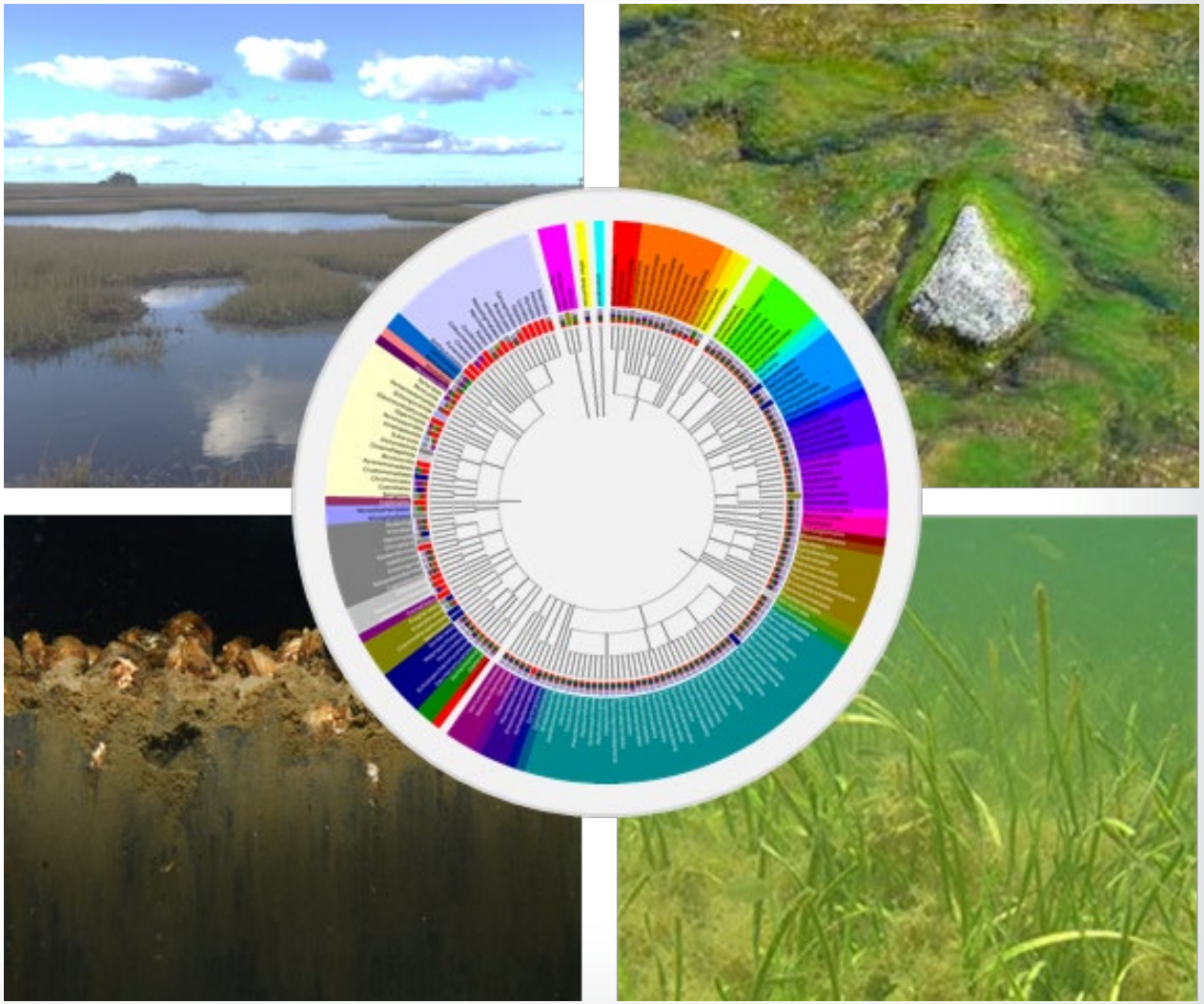
Characterizing nutrient-enhanced acidification and hypoxia (NECAH) in space and time & assessing vulnerability to acidification



Novel Methods to Assess the Status of Nutrient-Sensitive Aquatic Life Endpoints and Nutrient Indicators

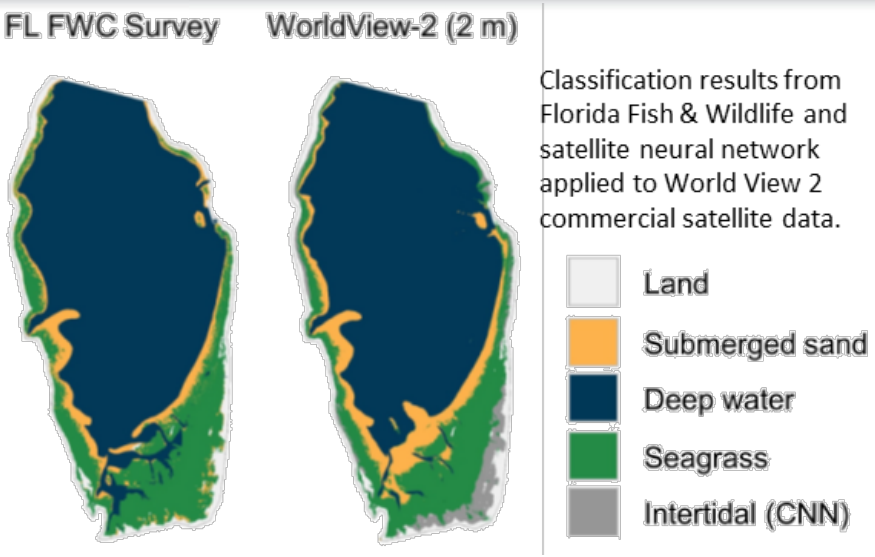
Cost-effective measures to assess environmental responses to nutrient pollution & eutrophication for compliance monitoring & improve nutrient reduction strategies

Develop tools to improve the consistency & speed of identification of nutrient indicators & nutrient-sensitive biota that respond to changing nutrient conditions in watersheds.

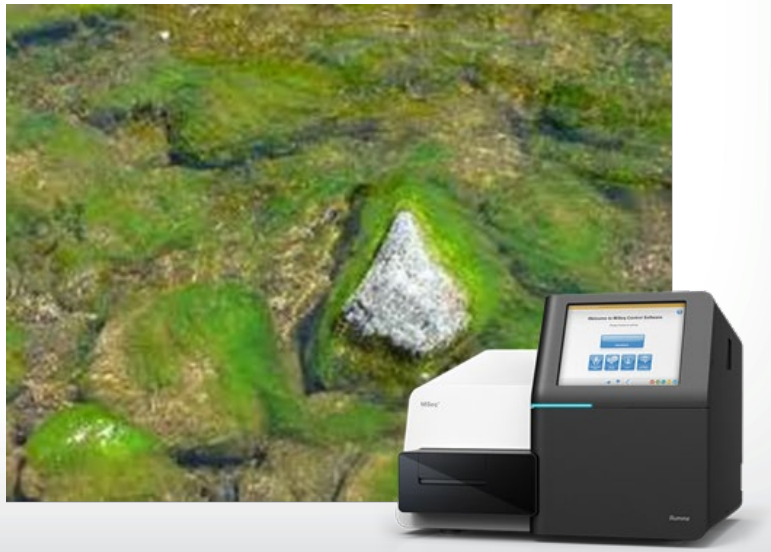


Novel Methods to Assess the Status of Nutrient-Sensitive Aquatic Life Endpoints and Nutrient Indicators

Using remote sensing to map seagrass distribution and response to anthropogenic alterations



Further Development of DNA Metabarcoding of Nutrient-Indicator Biota to Improve Temporal Monitoring for Changing Nutrient Conditions



Tools to Support Nutrient Criteria Development and Attainment of Water Quality Goals

Using weight-of-evidence to combine diverse data to inform nutrient criteria development

Literature review

Nutrients
Ecological responses
Types of relationships

Field datasets

Nutrients
Ecological responses
Types of relationships

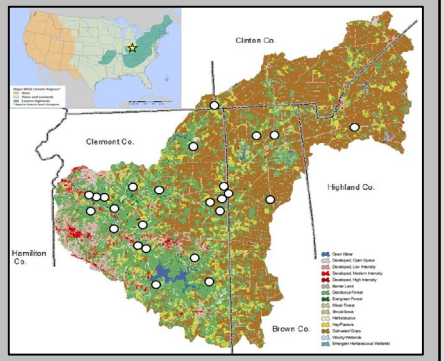
Summarize and synthesize results
Assemble and weight evidence
Weigh the body of evidence/support
Identify support for indicators and nutrient targets

Integrating monitoring, modeling, and experiments to rationalize nutrient reduction goals

Experiments

- Experimental combinations of nitrogen/phosphorus concentrations/ratios
- Suite of ecological responses
- Analysis and synthesis

Watershed case study



- Long-term nutrient monitoring (streams/lake)
- Watershed modeling of nutrient loads and BMPs
- Local BMP partnerships
- Survey using periphyton DNA metabarcoding

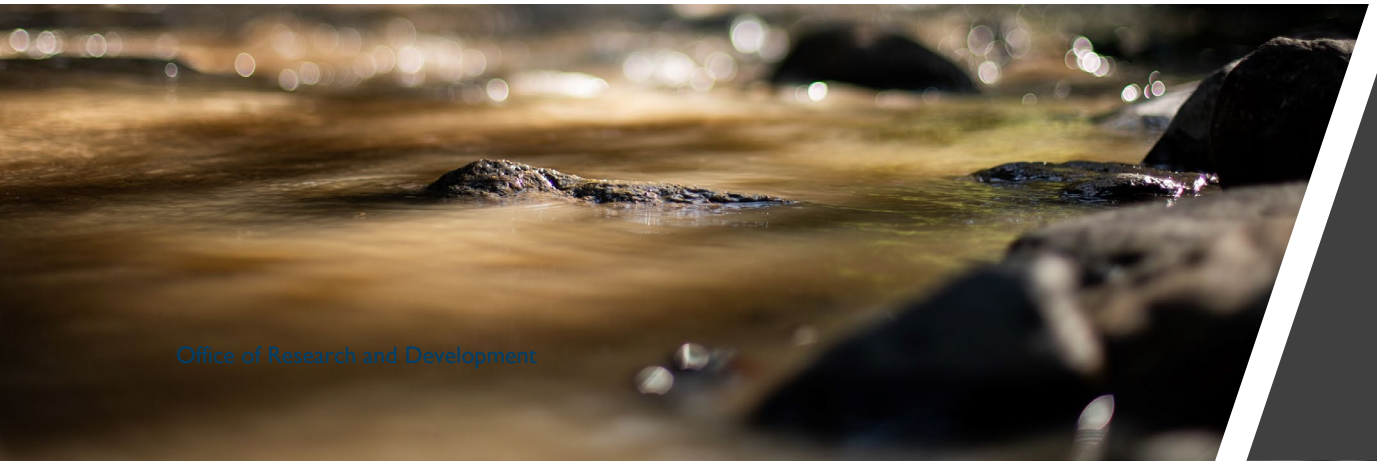
EXPECTED OUTCOMES AND IMPACT:

Support for methods and strategies used to develop criteria
Improve monitoring, modeling, and N&P reduction efforts
Evaluation of the responsiveness of indicators
Advancement of new methods and indicators

Overview of sub-products

EPA
United States
Environmental Protection
Agency

Trajectories of Aquatic Ecosystem Responses to and Recovery from Nutrient Pollution



Office of Research and Development

Research Output 2

Trajectories of Aquatic Ecosystem Responses to and Recovery from Nutrient Pollution

Overview:

- Assesses the responses of freshwater and coastal ecosystems to nutrients and related co-occuring stressors (e.g., nuisance algae, hypoxia, acidification) and the processes and trajectories associated with recovery from those stressors.
- Research focuses on the development, use, and analysis of model results, experiments, existing datasets, and published literature.
- Products will provide science to support CWA decisions related to TMDLs, nutrient reduction projects, and nutrient criteria development.

Research Priorities:

Assessment of nutrient transport to, fate within, and effects on related stressors within freshwater and coastal ecosystems

Assessment of how freshwater and coastal ecosystems respond to nutrient reductions

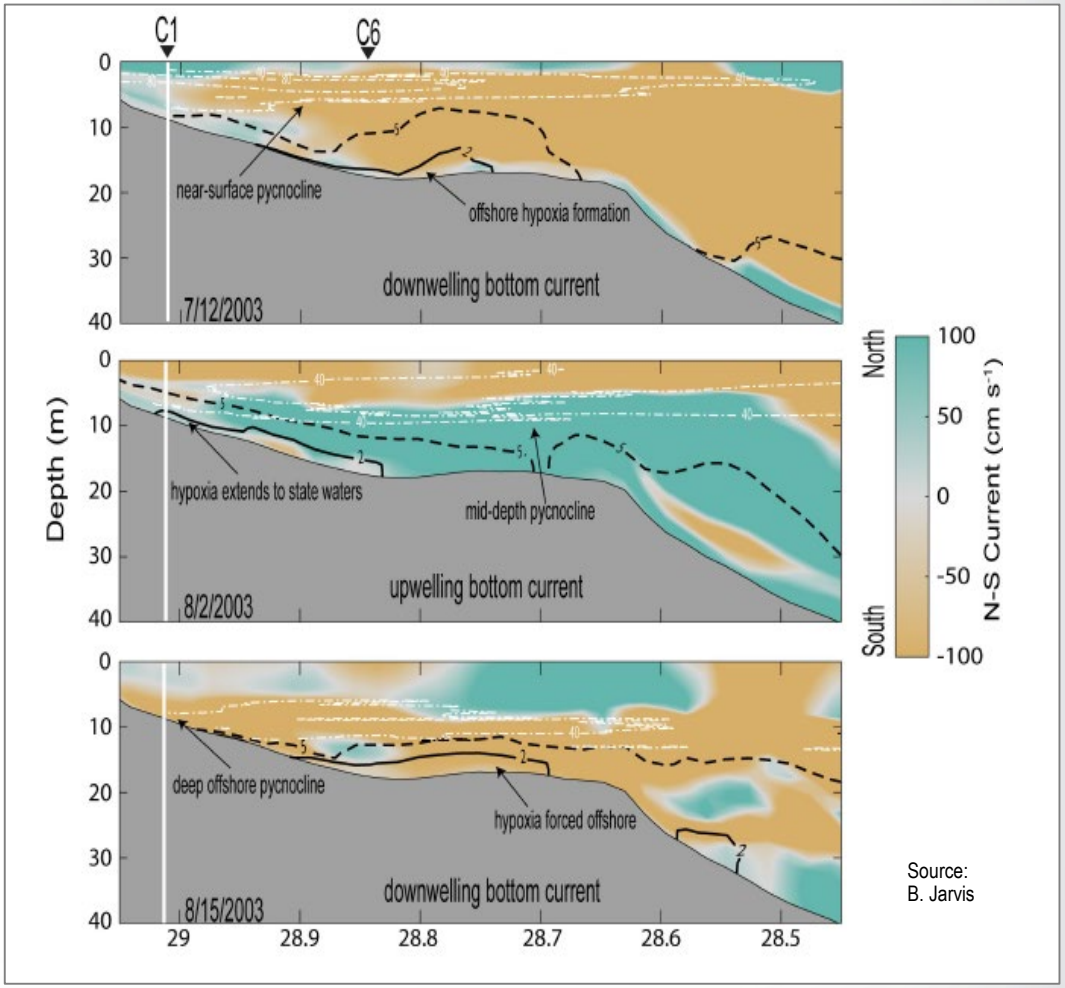
Assessment of Nutrient-Related Stressors and Responses in Freshwater and Coastal Habitats

- Examine how diverse aquatic ecosystems respond to nutrients & related stressors
- 14 projects
- Assess nutrient transport to, fate within, & effects on related stressors in freshwater and coastal ecosystems

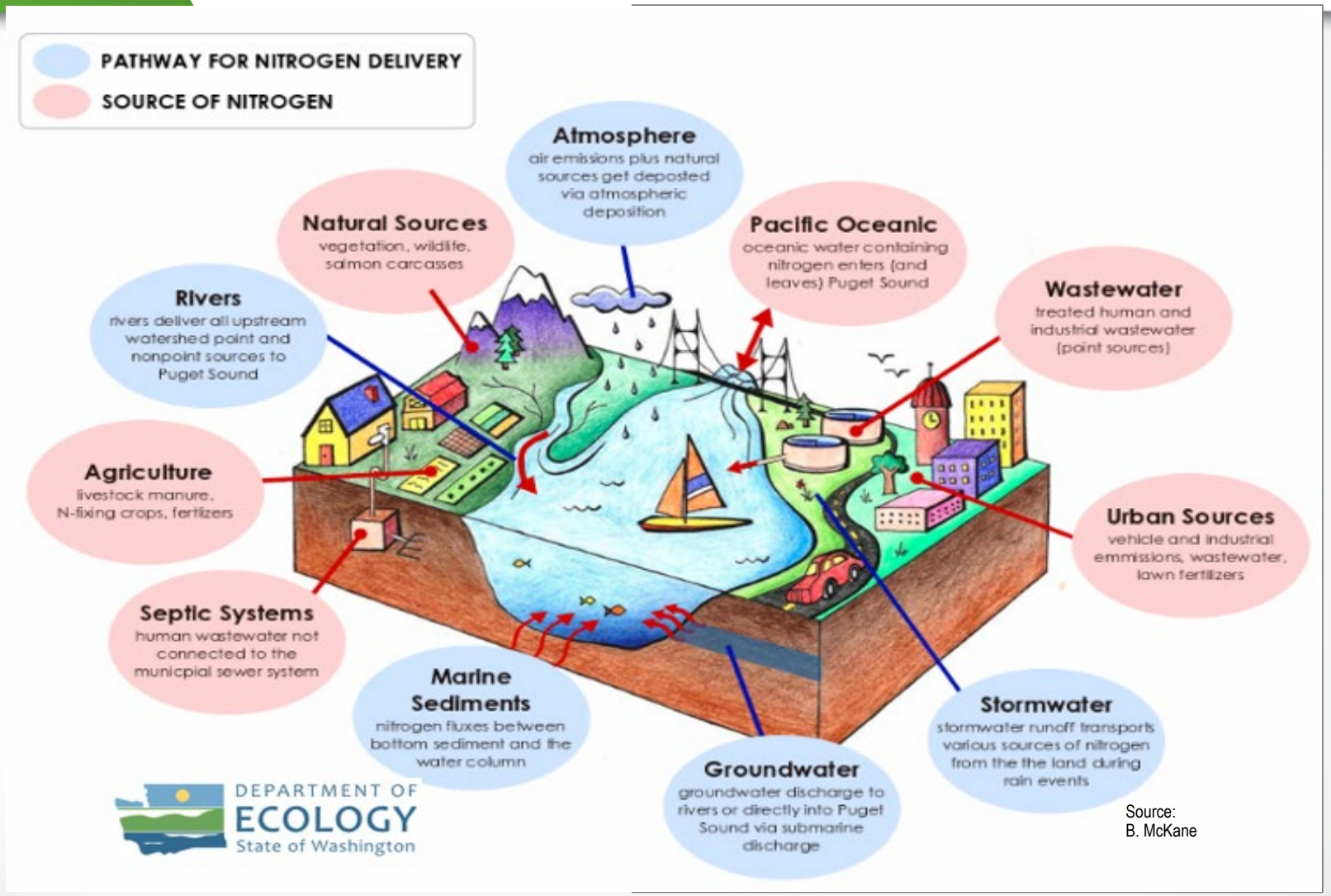
Aquatic Ecosystem Responses to and Recovery from Nutrient Pollution

Modeling to improve prediction of nutrient-related water quality response

- Use multiple EPA ecosystem models to quantify nutrient effects on water quality and aquatic life use in hypoxic coastal systems.
- Compare model performance to reduce uncertainty in water quality simulations and inform nutrient reduction decisions.

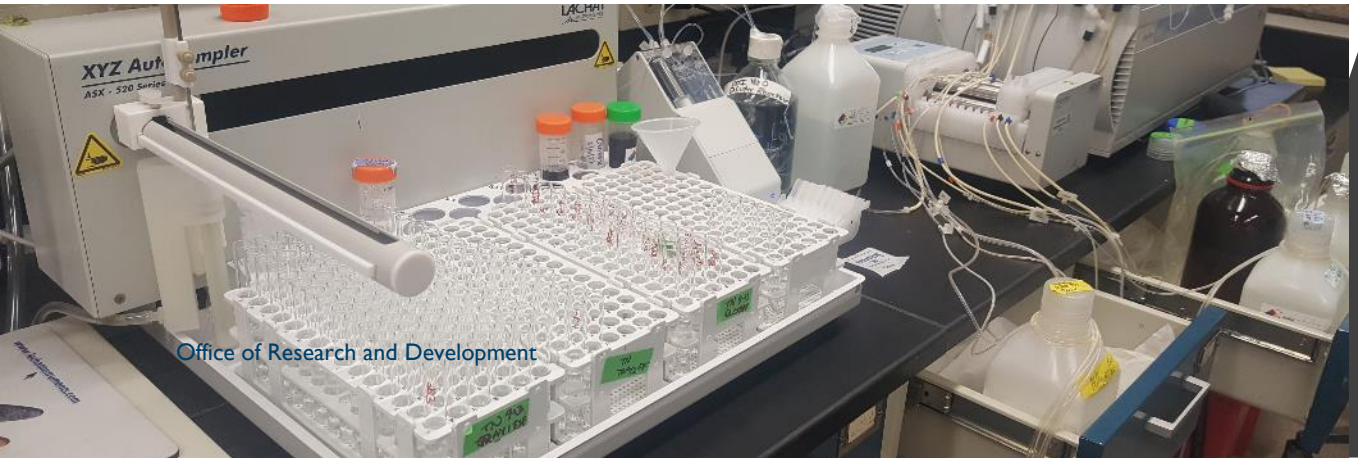


Assessment of Ecosystem Recovery from Nutrient-Related Sources and Stressors in Freshwater and Coastal Habitats



EPA
United States
Environmental Protection
Agency

Scientific Approach for Identifying Which Watersheds and Water Bodies May Most Efficiently Attain Water Quality Goals



Research Output 3

Scientific Approach for Identifying Which Watersheds and Water Bodies May Most Efficiently Attain Water Quality Goals

Overview:

- This research advances the science needed to inform decisions to prioritize watershed nutrient sources for reduction options.
- Data, models, and tools are used to identify watersheds and water bodies that may most effectively respond to restoration and recovery efforts.
- Products will provide science to support CWA decisions related to TMDLs, nutrient criteria development, and recently prioritized market-based programs (e.g., water quality trading).

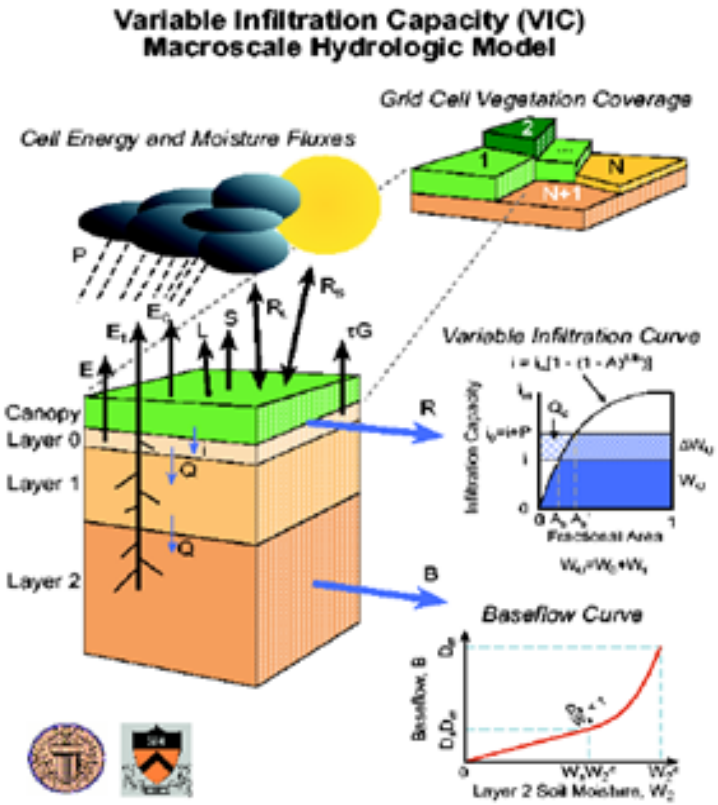
Research Priorities:

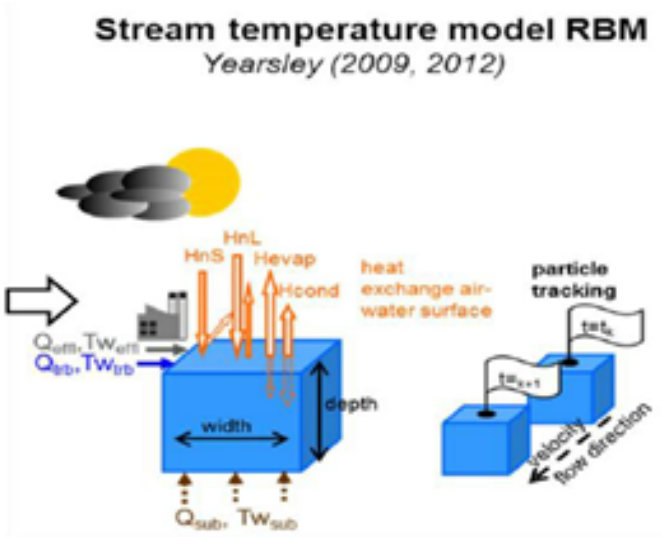
Large-Scale Watershed Assessments to Characterize Potential Gradients of Nutrient Sources and Sinks

Landscape-Scale Tools and Data to Identify Watershed Locations for Targeting Nutrient Reduction, Phase 1

Landscape-Scale Tools and Data to Identify Watershed Locations for Targeting Nutrient Reduction, Phase 2

Large-Scale Watershed Assessments to Characterize Potential Gradients of Nutrient Sources and Sinks



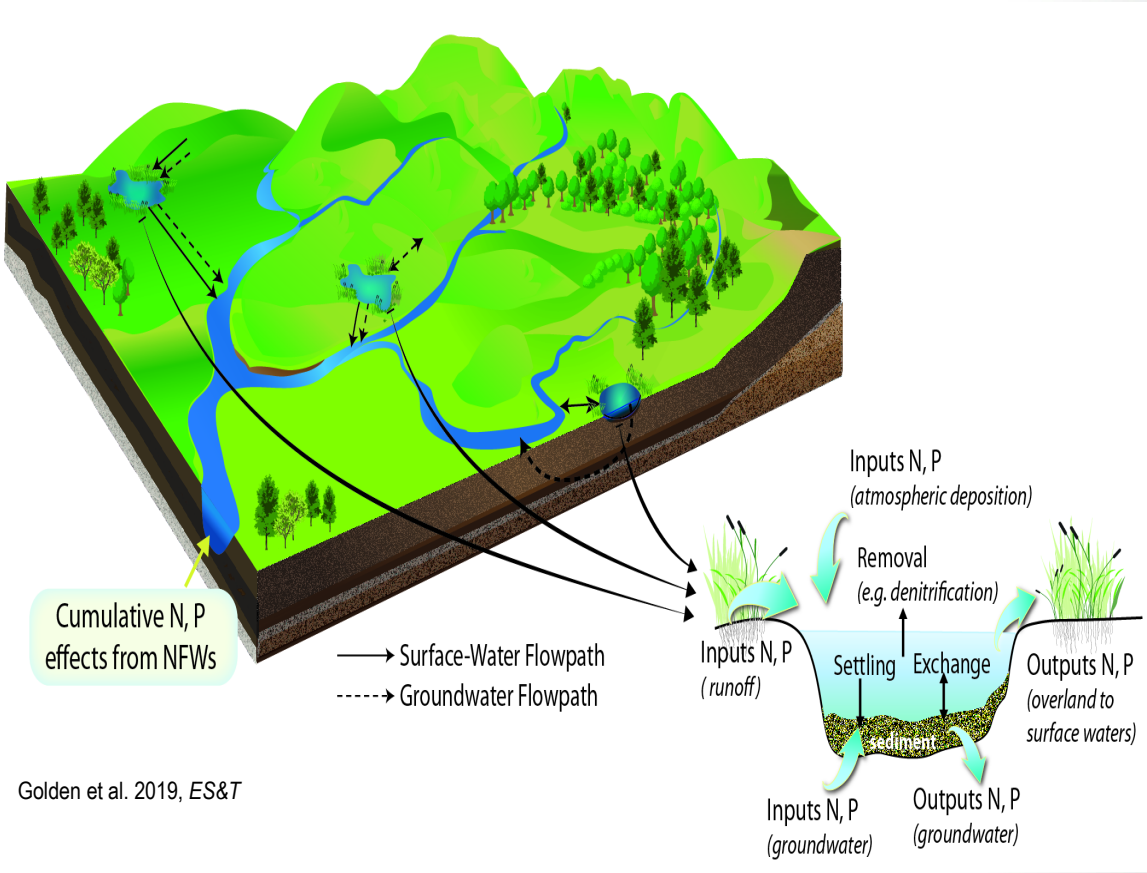


Source: C. Tang

Landscape-Scale Tools and Data to Identify Watershed Locations for Targeting Nutrient Reduction, Phase I

Phase 1:
Identify locations within watersheds for nutrient reduction by expanding an existing decision support system

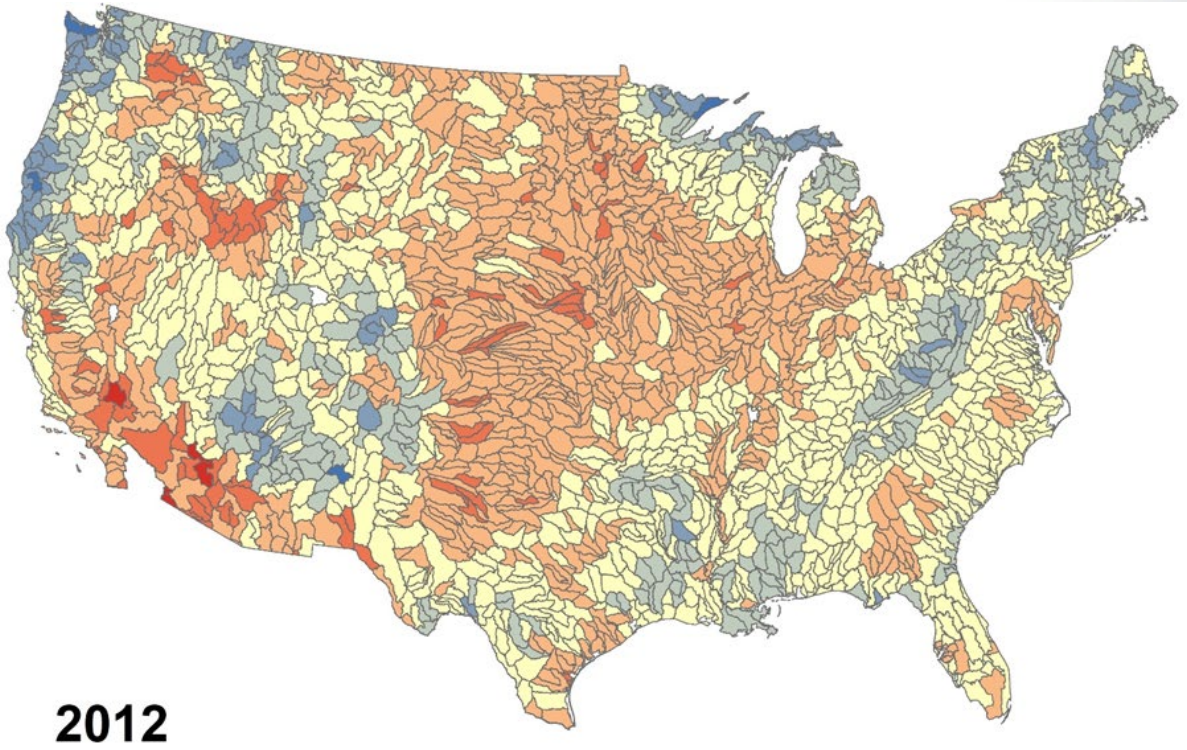
Quantify the spatial and temporal effects of wetlands on large river basin nutrient delivery



Golden et al. 2019, *ES&T*

Landscape-Scale Tools and Data to Identify Watershed Locations for Targeting Nutrient Reduction, Phase 2

Phase 2 Identify areas across the country where nutrient reduction strategies may be most efficient and how temporal variability of precipitation and other factors affect these sites' potential for nutrient processing



2012

Warmer temperatures and increased fertilizer drove regional increases in summer TP concentrations in 2012

Source: R. Sabo

United States Environmental Protection Agency

Contact:
Anne Rea (Rea.Anne@epa.gov)

Links:
EPA Water Research:
https://www.epa.gov/water-research

SSWR Strategic Research Action Plan:
https://www.epa.gov/research/strategic-research-action-plans-2019-2022

Office of Research and Development