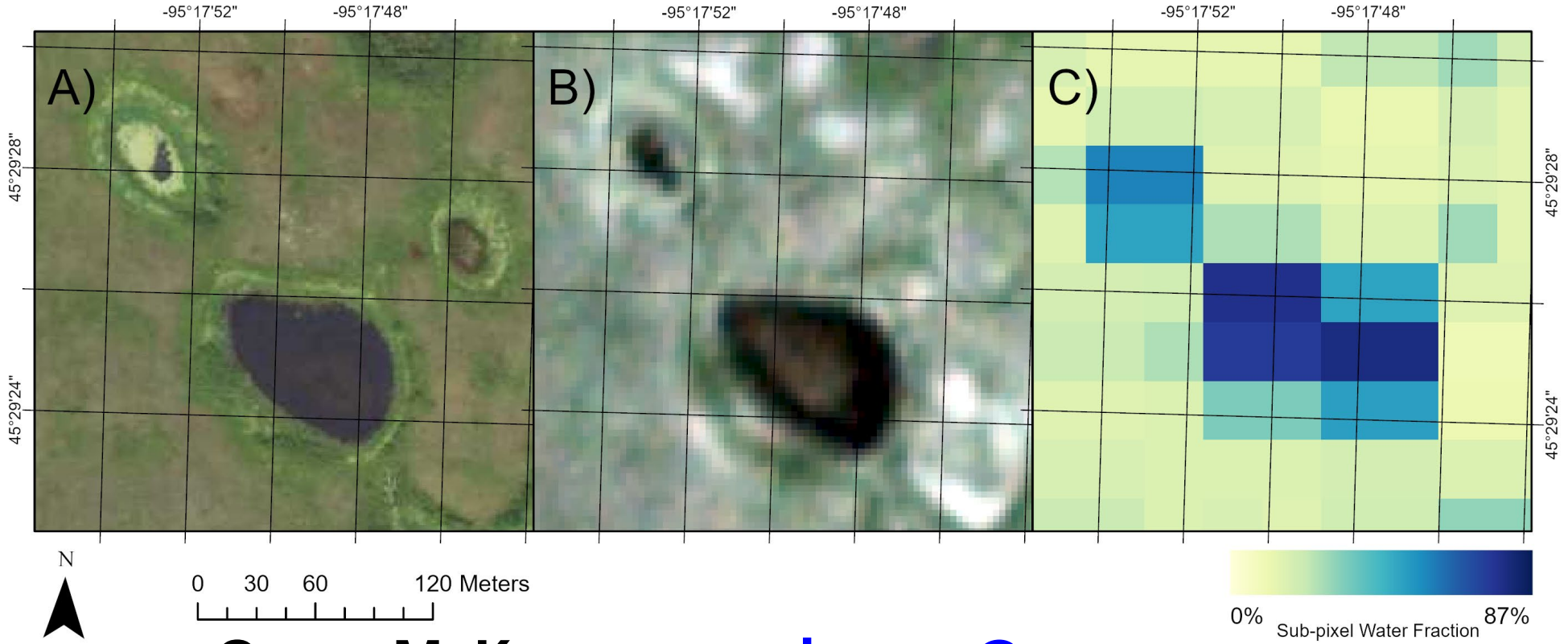
Making Management Relevant Sense of Recent Advances in Remote Sensing



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Visiting Scientist, Midwest Climate Adaptation Science Center, St. Paul, MN

U.S. Department of the Interior
U.S. Geological Survey

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Thank You Collaborators, Partners, Funders

Northern Prairie Wetland Monitoring and Modeling

- **Audrey Lothspeich**
- Dave Mushet
- Caryn Ross
- Elyssa McCulloch-Huseby
- Sadia Sabrina
- Sam Kucia
- Kyle McLean
- Matt Solensky

EMA Climate Research & Development (Land Change Science)

“Vanishing Wetlands”

Used with permission and painted by Cam Forrester for the University of Saskatchewan Global Water Futures

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Wetlands as Nature-Based Solutions to Environmental Crises

"This is the most colossal recovery plan ever attempted,"

Science Times — With the Arts And Entertainment

The New York Times — TUESDAY, FEBRUARY 9, 1988

Urgent Effort to Save Ducks Begins in U.S. and Canada

Millions to be spent to restore ducks' favorite wetlands and grasses.

By PHILIP SHABECOFF

WASHINGTON, Feb. 8 — Alarmed by a steep decline in the number of ducks that migrate across North America, the United States and Canada are embarking on a last-ditch effort to rebuild the flocks of the migratory birds.

The two Governments, working with private conservation and sportsmen's groups, are putting into motion the first steps of a long-range North American Waterfowl Management Plan that is designed to restore ducks to nurseries in the prairie provinces of Canada and to the nation's waterfowl in the lower 48 States.

The waterfowl populations of the 1970's were far below the size of the great flocks that existed in the mid-1950's, when, by conclusion, hunting's heyday. But they say that level is the best they can hope for, given the realities of modern life.

The Delegates say the loss of habitats constitutes the primary reason for the dwindling numbers of ducks. The plan will concentrate on protecting and improving the remaining wetlands and grasslands that ducks, geese and swans need for breeding, feeding and migrating. In some cases, efforts will be made to restore breeding and nesting habitats that have been lost.

Because they are so critical to many stages of the waterfowl's life cycle, the prairie provinces of Canada and the northern United States will receive particular attention.

"For long ago, as nature keeps time, the North American prairies were an earthly paradise for waterfowl. The land was speckled with millions of shallow ponds and lakes ideal for feeding and breeding, and a sea of grass provided nourishment and protection for the birds and their young.

"Today, however, much of the prairie has become a kind of duck's desert. Many of the ponds have been drained by farmers and industry, and most of the grass has been plowed under and the land tilled for crops.

"Without adequate habitat, the numbers of waterfowl, particularly ducks, have diminished. Wildlife managers and conservationists have been experimenting with methods of increasing the flocks by artificial methods of nesting, but the necessary changes in Federal and Canada's Environment Minister, Tom

ENVIRONMENT

As Climate Warms, Algae Blooms In Drinking Water Supplies

September 3, 2018 · 4:29 PM ET

Heard on All Things Considered

DIRK VANDERHART

npr

FROM OPB

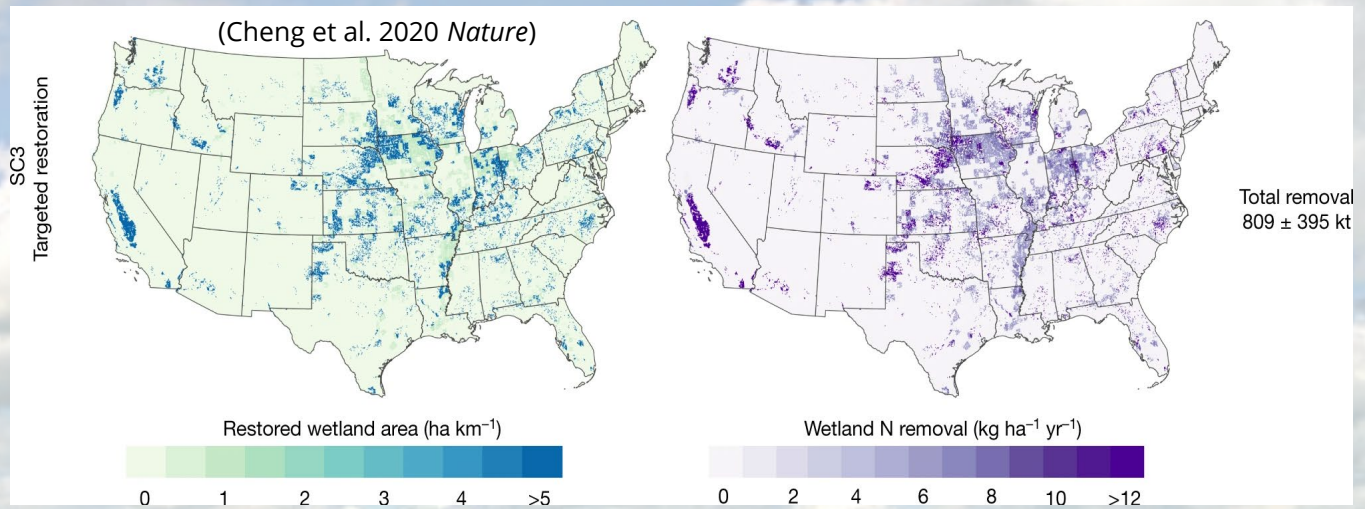
By John Schwartz

The New York Times

June 3, 2020

Gulf of Mexico 'Dead Zone' Will Be Large This Summer, Scientists Predict

The low-oxygen zone can cause harm not just to marine life, but also to those who catch shrimp and fish for their livelihood.



FOX NEWS

GREEN · Published August 13, 2019 11:11am EDT

Beware the toxic algae that can kill your dog

By James Rogers | Fox News

Without wetlands, nitrate loads could be **51%** higher than present (about 1,300 kt N yr^{-1}).

A **22%** increase in wetland area for the Mississippi River Basin could lead to a **54%** decrease in nitrate loading to the Gulf of Mexico.

(Cheng et al. 2020 *Nature*)

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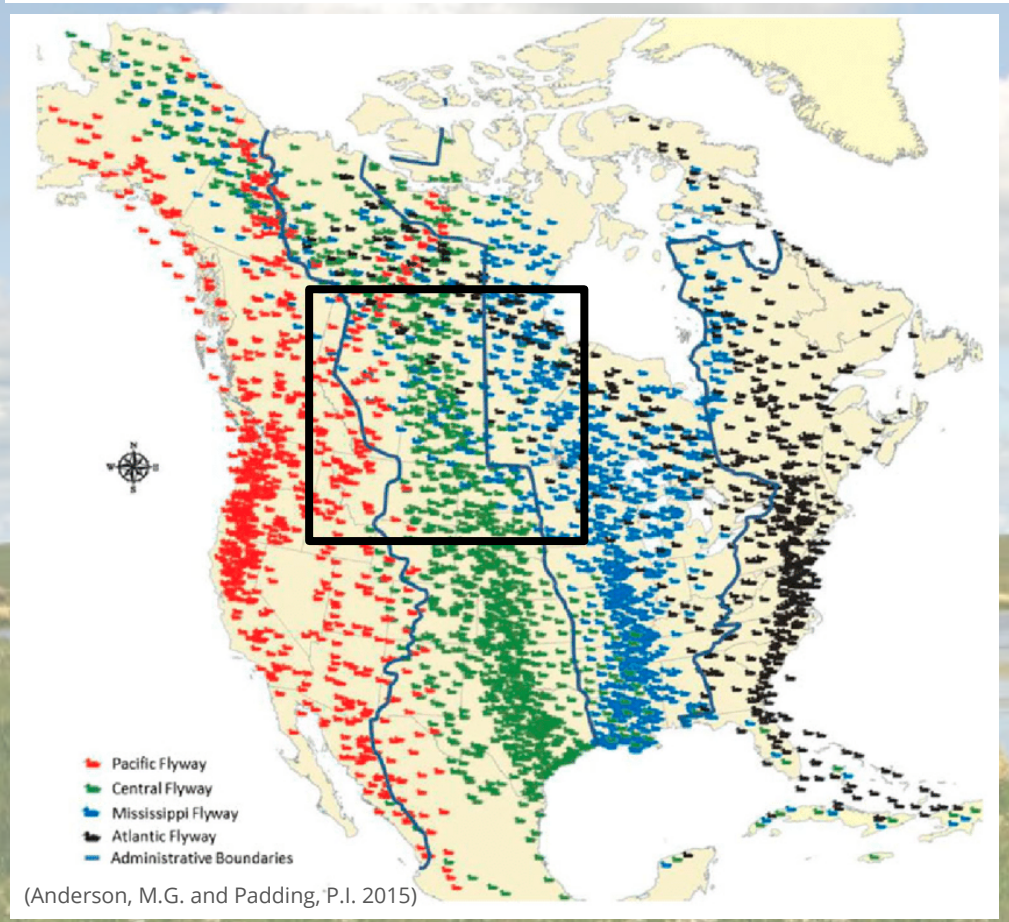
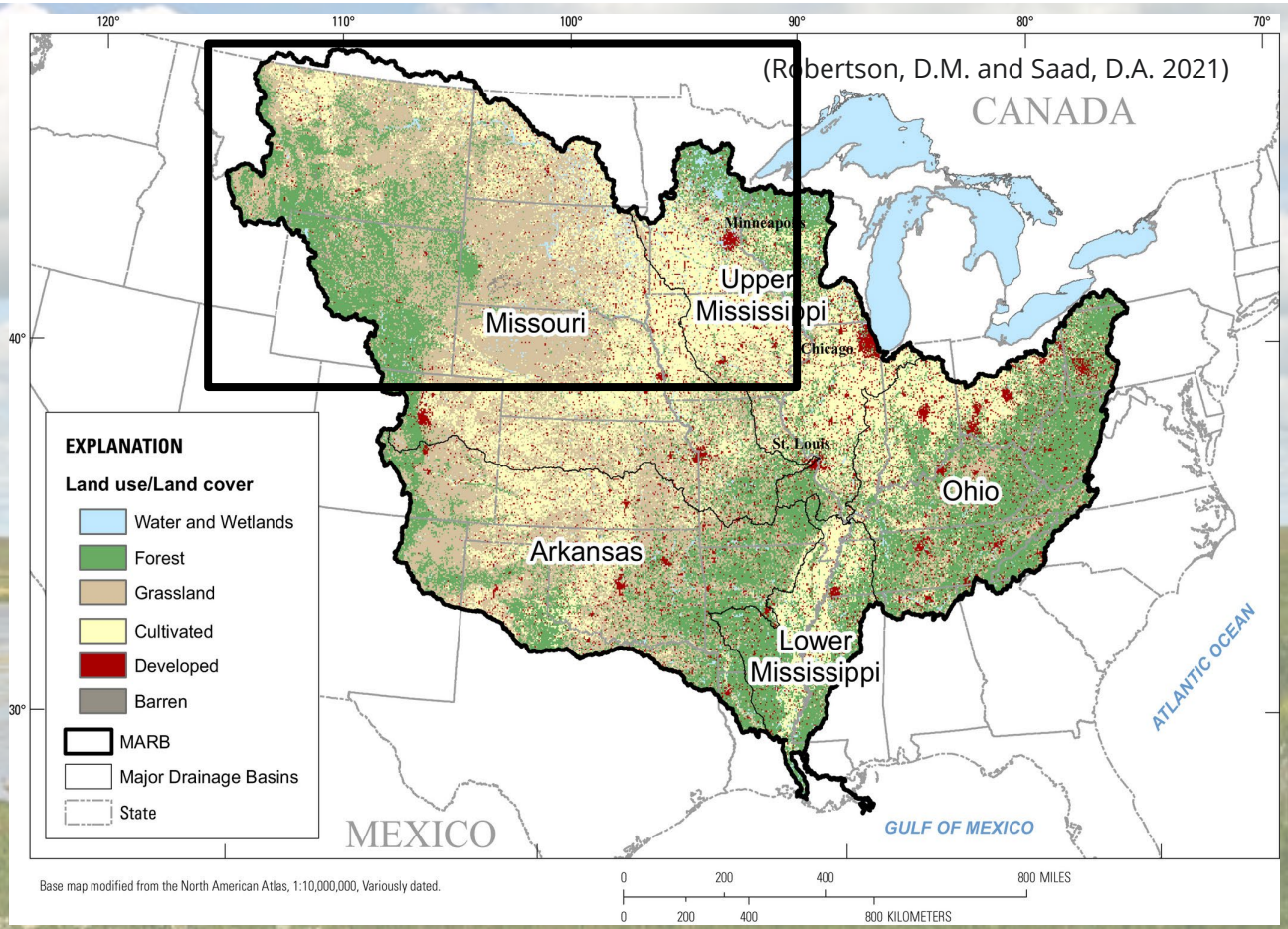
Wetlands Connecting Landscapes: Birds, Water, People

Wetland Ecosystem Services: Wildlife Habitat, Clean Water, Cultural Value…and more



(Anderson, M.G. and Padding, P.I. 2015)



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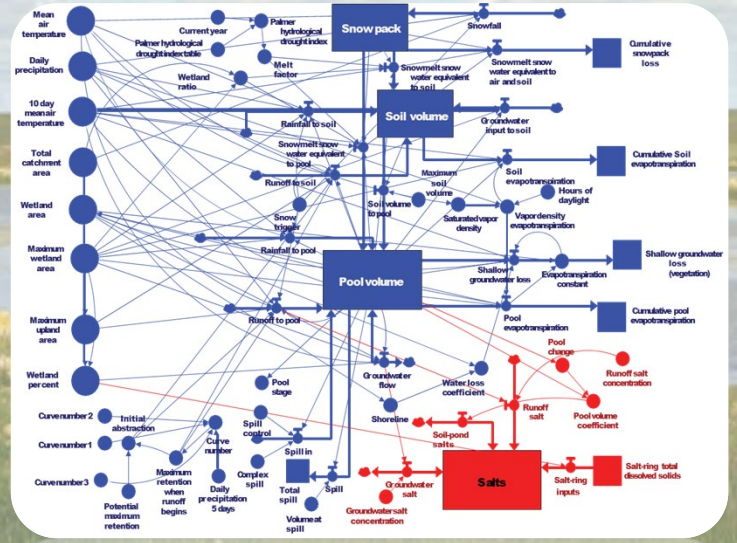
Multi-tool Approach: Spatial and Temporal Scales

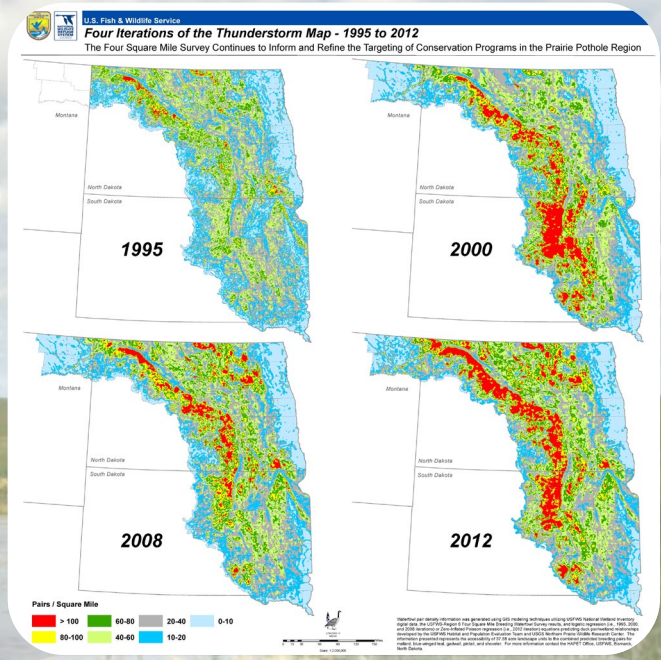
Science-informed Conservation Planning
- Indigenous Tribes
- Federal and State Agencies
- NGOs

Landscape-scale mapping and statistical modeling

Multi-decadal Ecosystem monitoring

Basin/complex-scale process-based modeling





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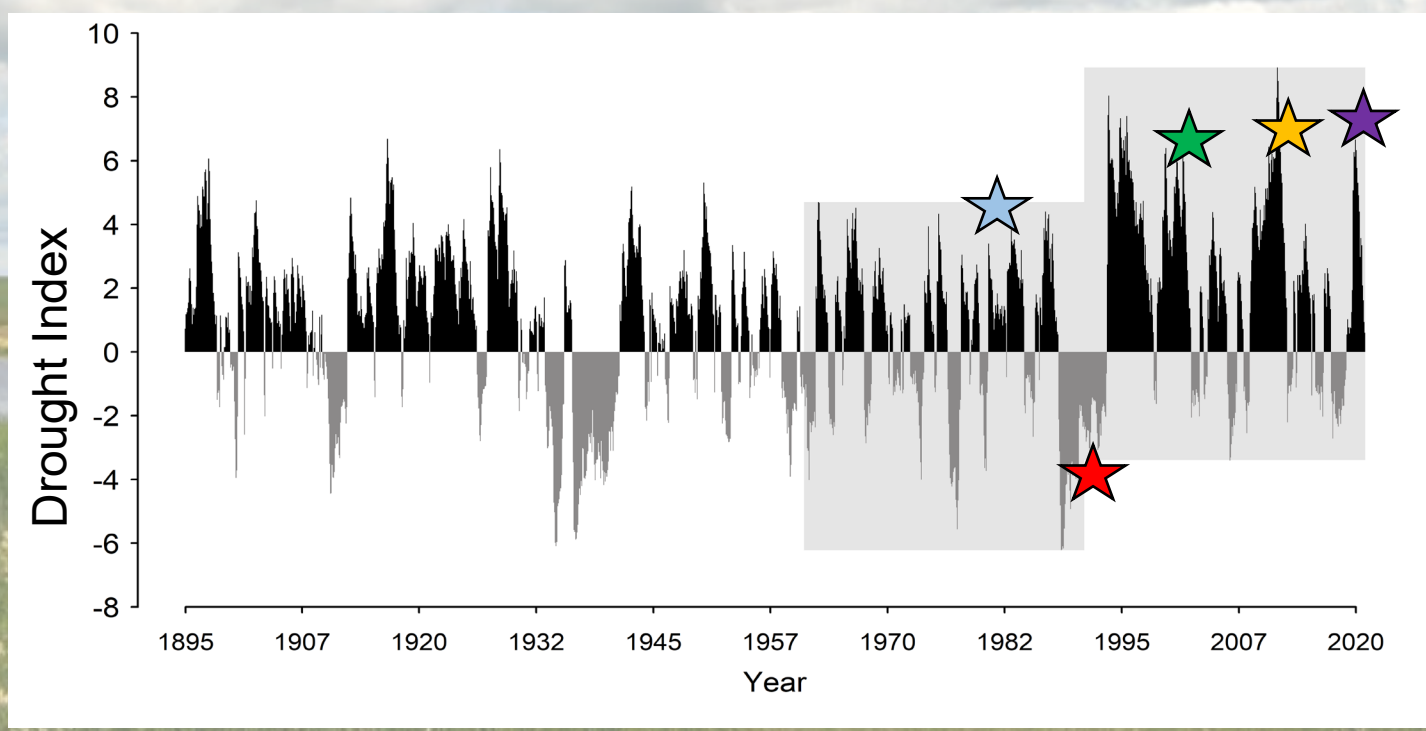
Prairie Pothole Region Climate Shift Dry to Wet



McKenna et al. 2017, *Climatic Change*

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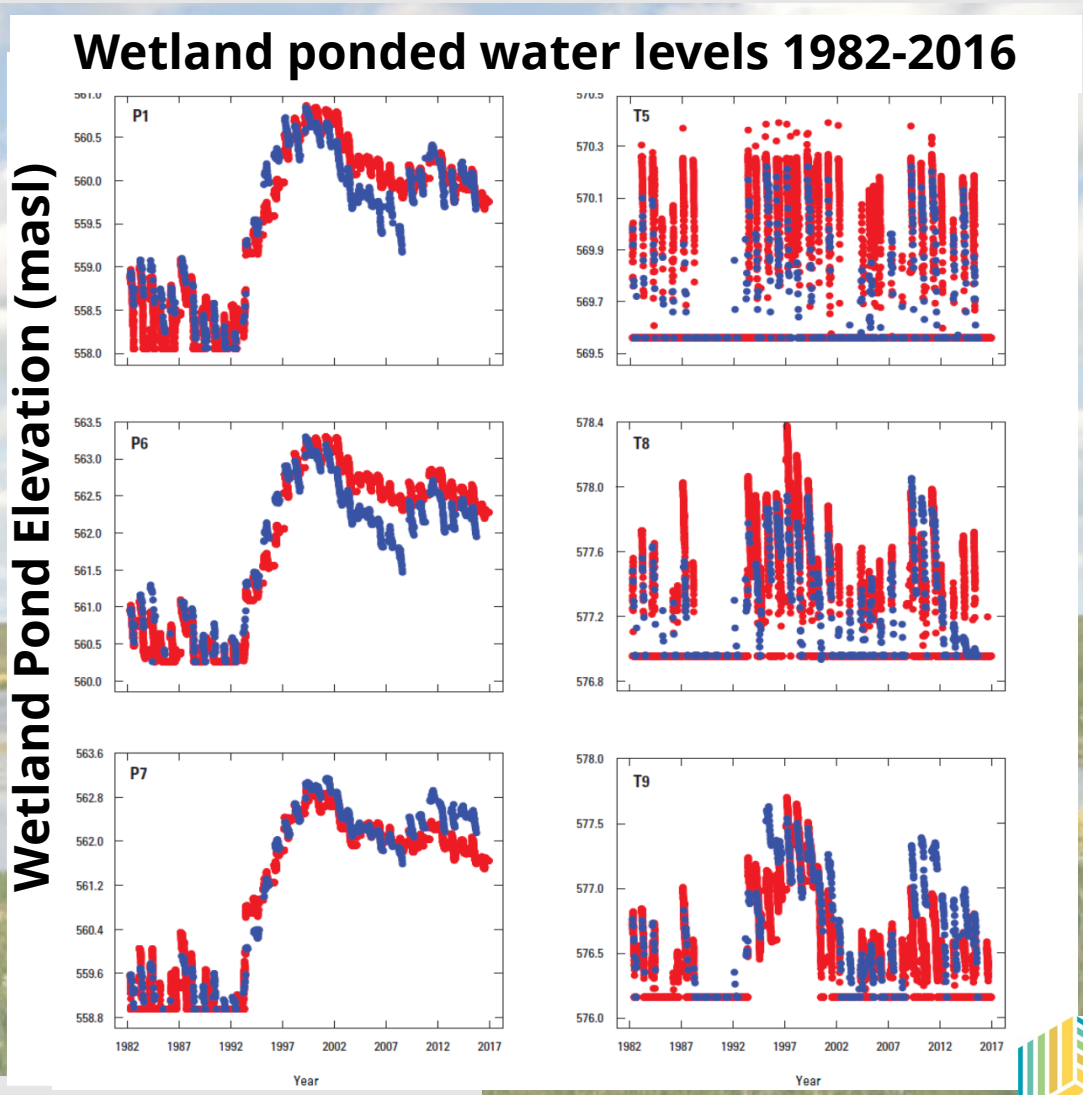
Pothole Hydrology Linked Systems Simulator (PHyLiSS)

Long-term data collection led to mechanistic model development and validation with variety of wetlands

- **Meteorological inputs**
- **Basin morphological inputs**
- **Basin land-cover/soil inputs**



McKenna et al. 2018, *USGS OFR 2018-1165*

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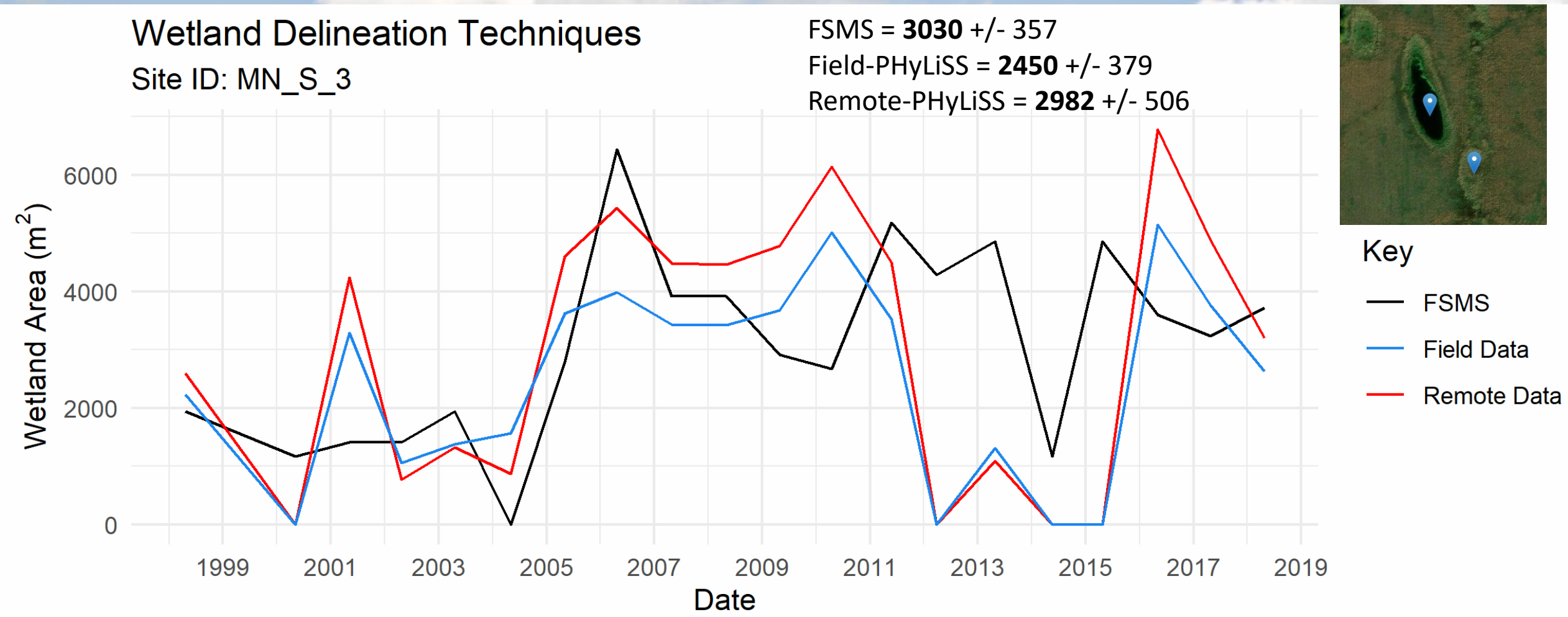
Management-relevant validation and application



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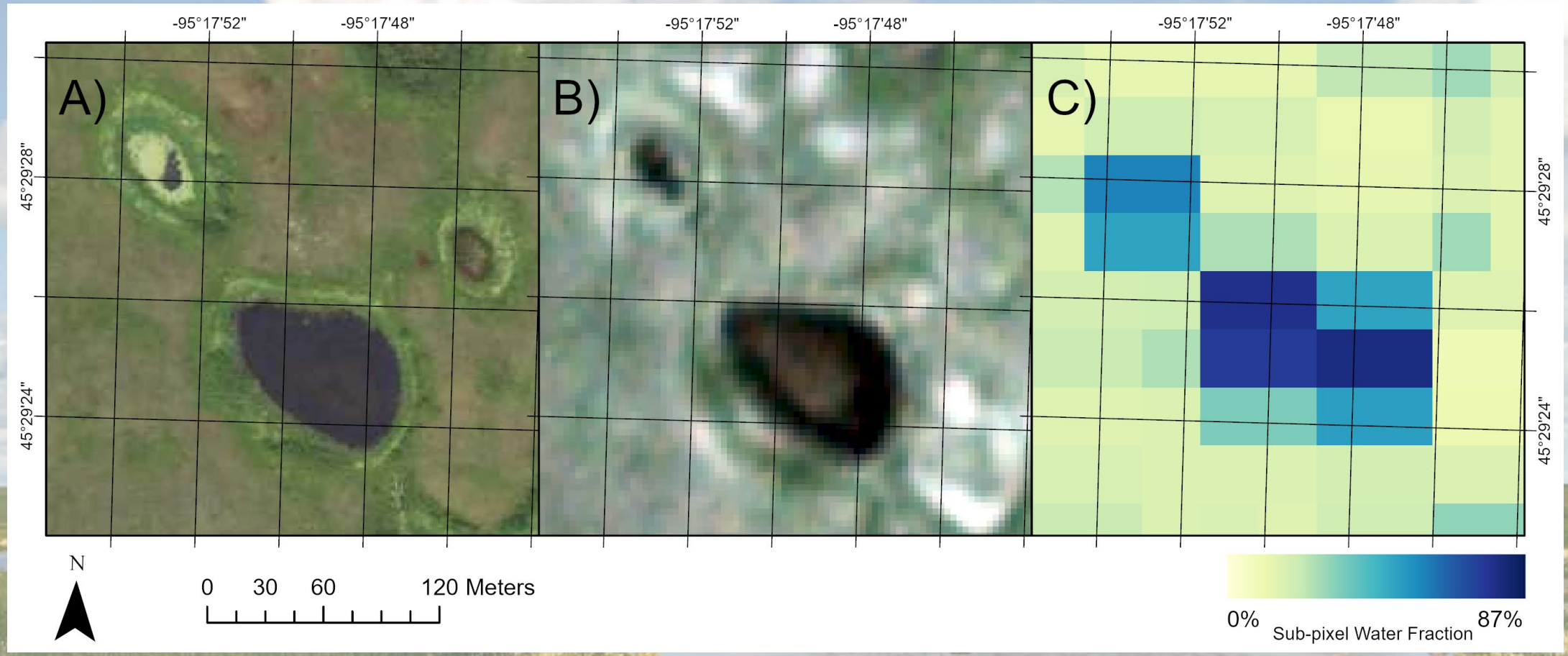
Remote Sensing of Surface Water in Small Wetlands



What is the best method for the job.....It depends

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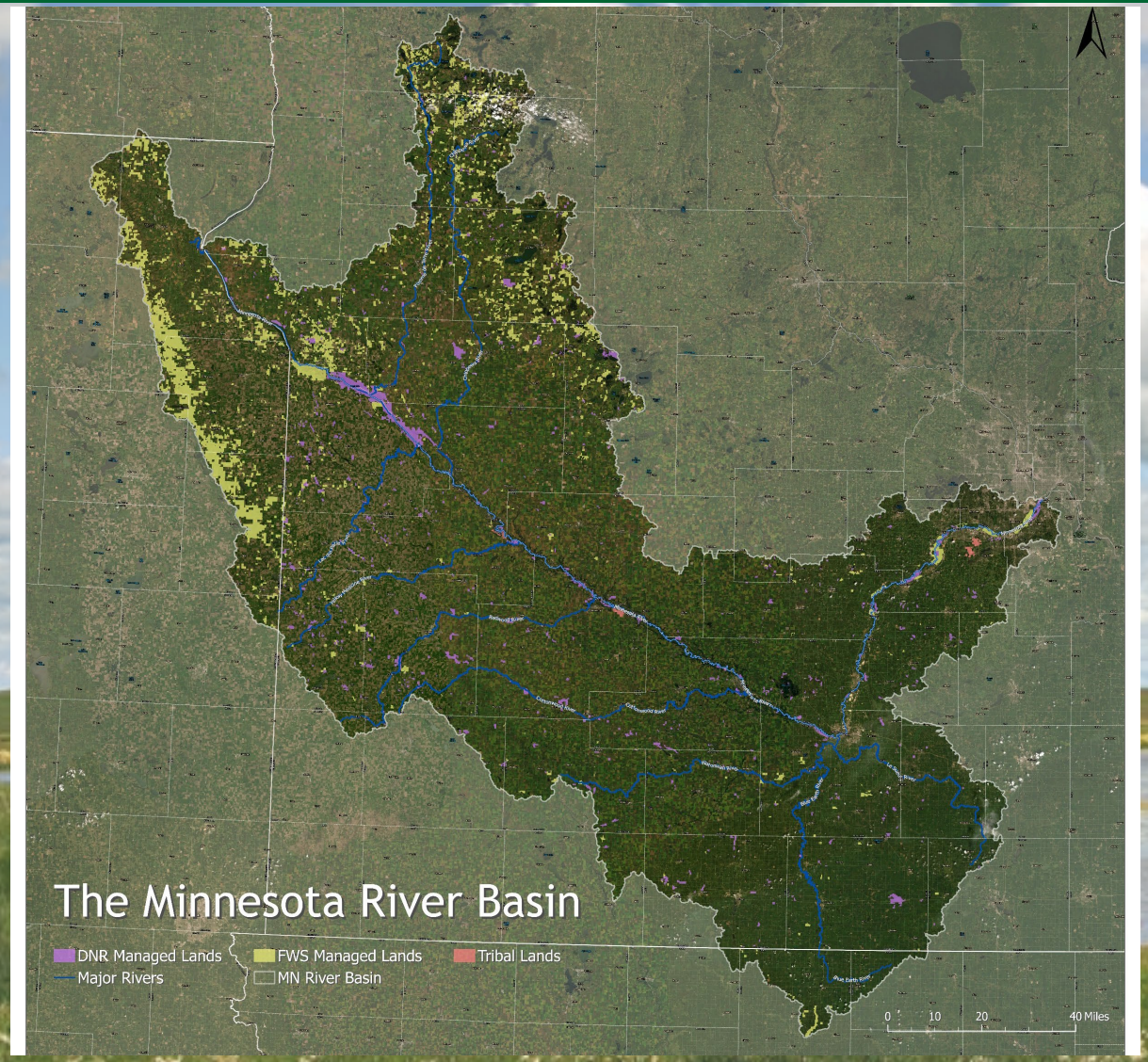
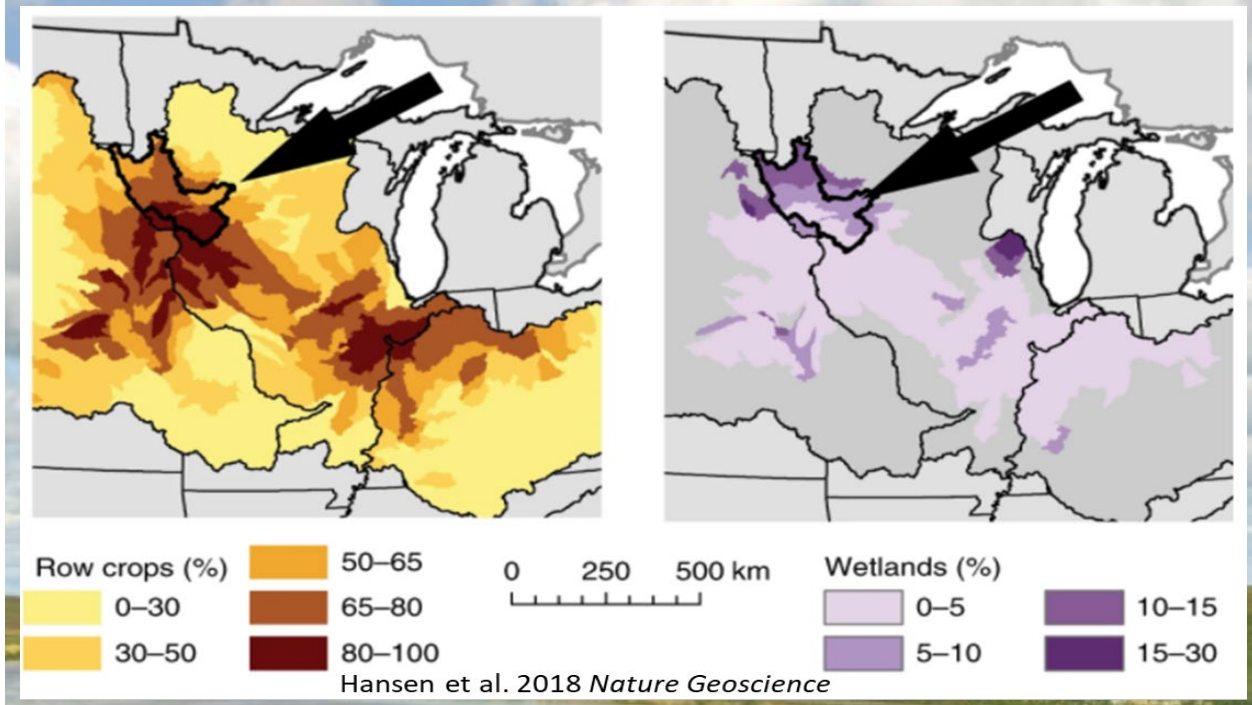
Managing Wetlands in the Minnesota River Basin





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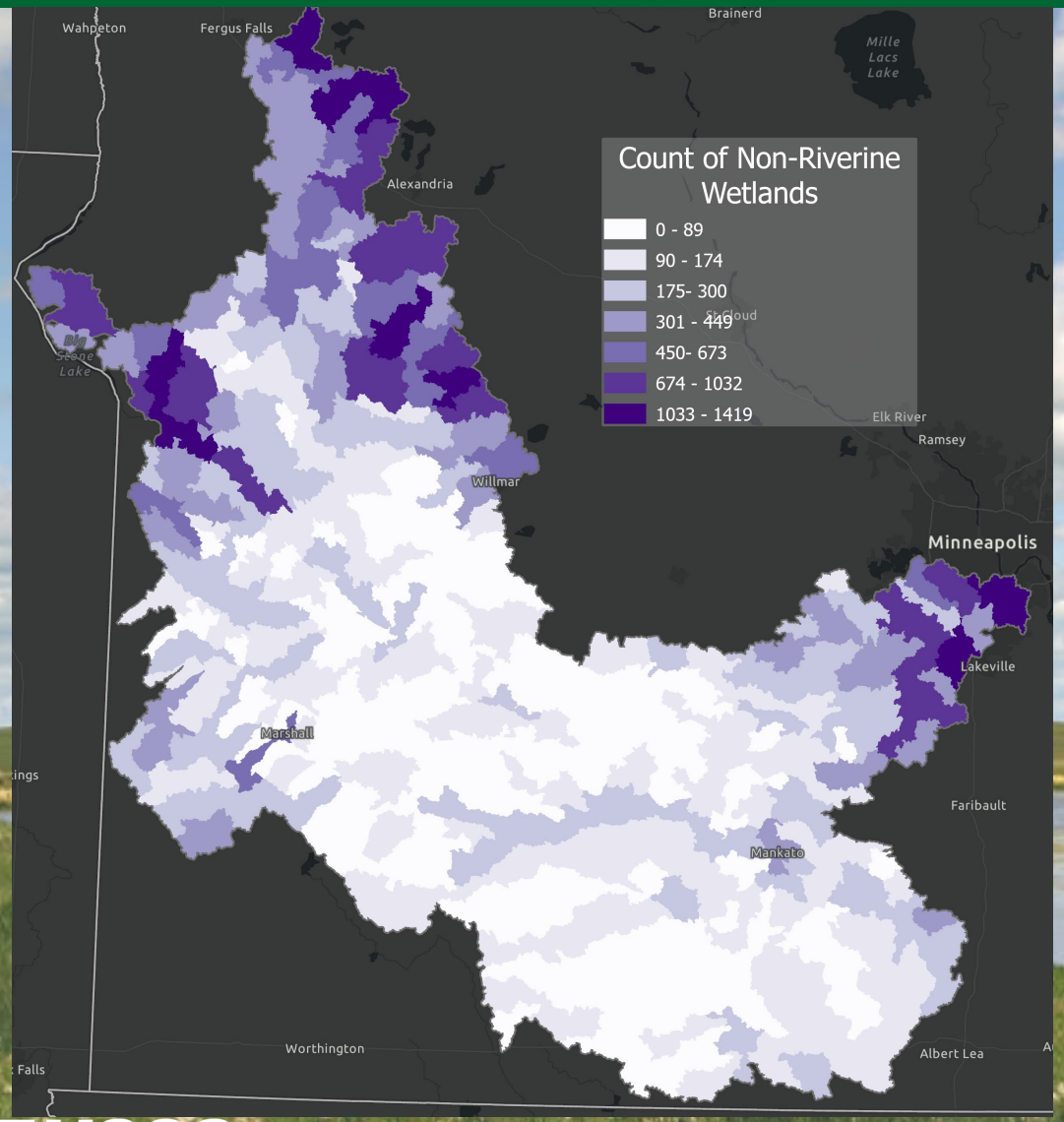
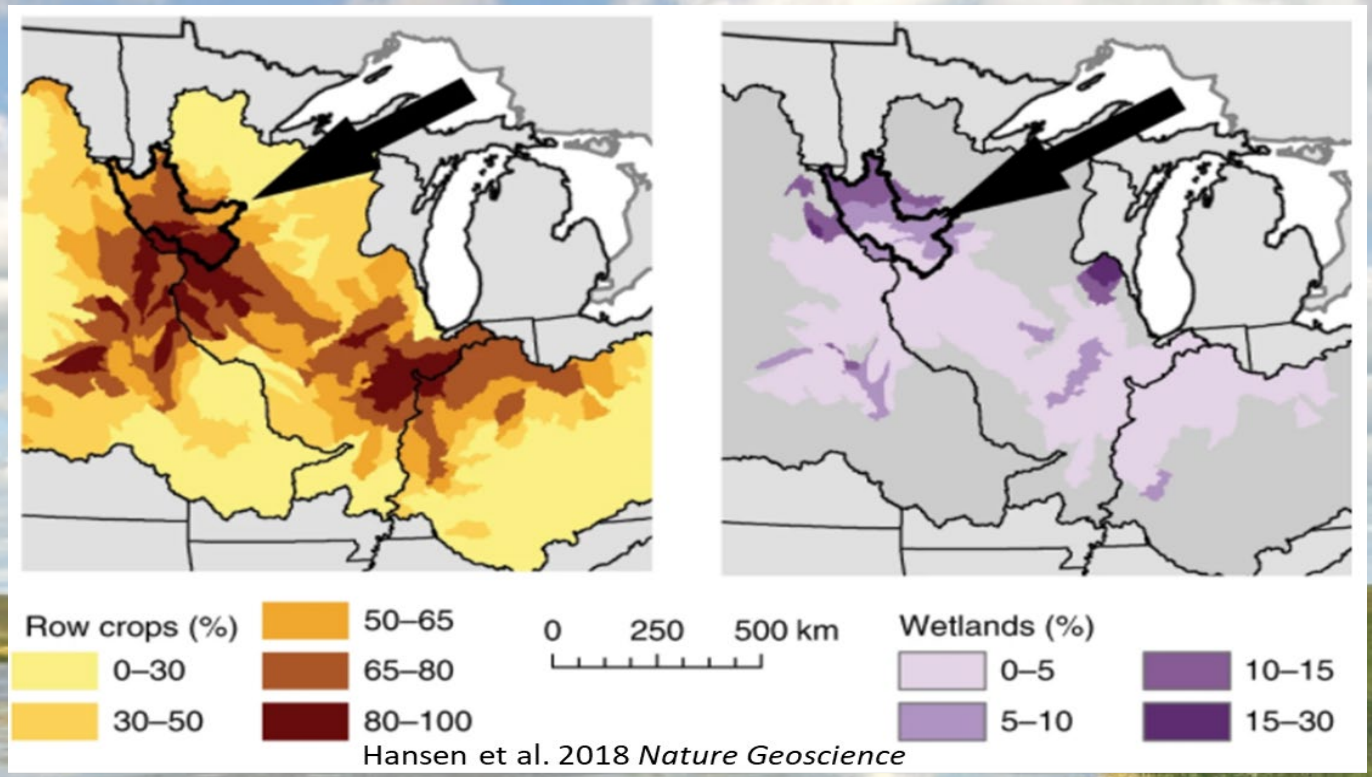
Managing Wetlands in the Minnesota River Basin





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Project Stakeholders and Rightsholders

Tribal Nations

- Upper Sioux
- Lower Sioux
- Shakopee Mdewanketon
- Prairie Island

Federal and State

- US Fish & Wildlife Service
- USDA-NRCS
- MN Dept Nat Res
- MN PCA
- MN BWSR

NGOs

- The Nature Conservancy
- Ducks Unlimited

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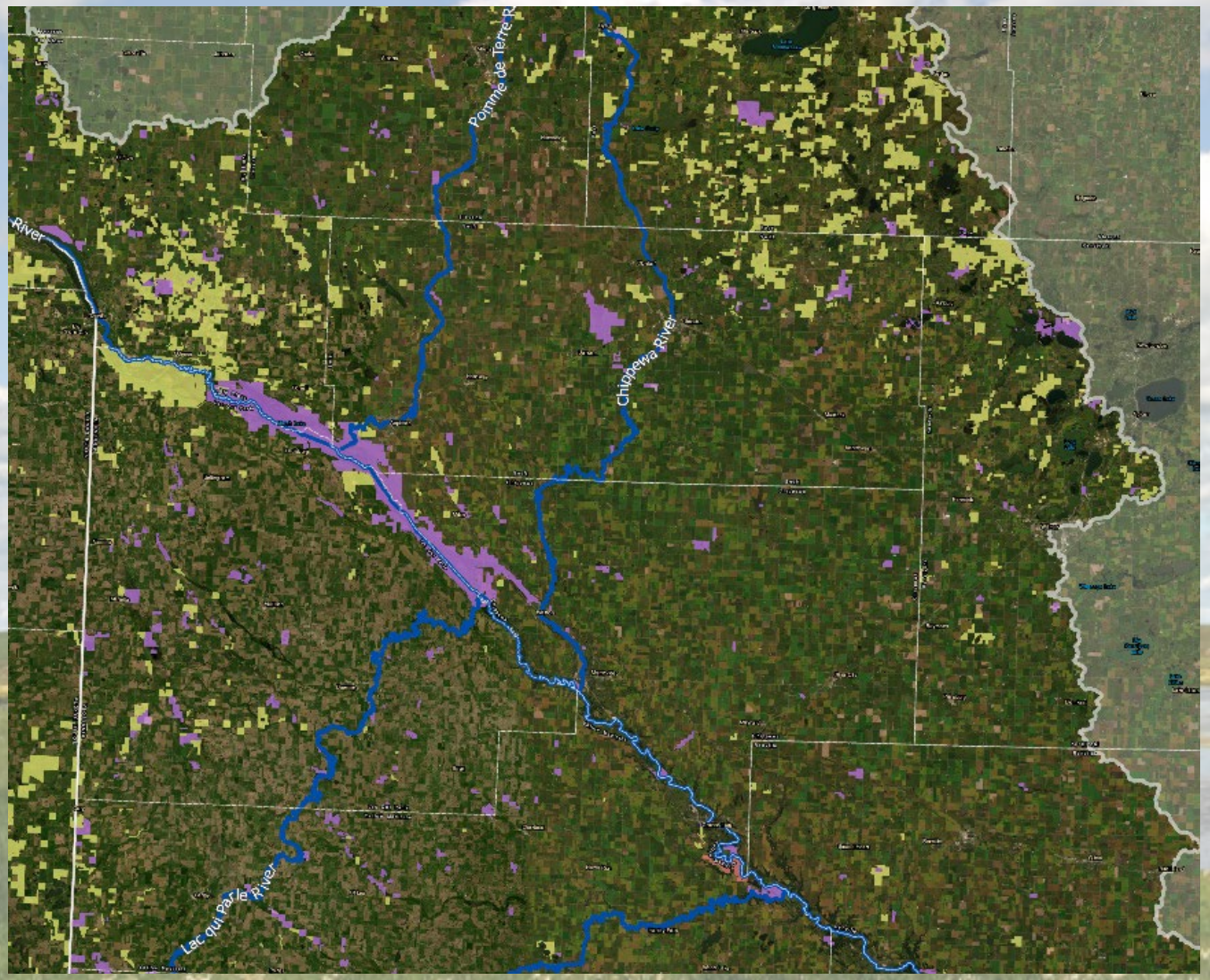
Ecohydrological Modeling & Decision Support Tool Co-Development



How can natural resource management agencies prioritize limited $ towards managing current portfolio and make informed decisions about future acquisitions?

Objectives (What you want)

Decision alternatives (What you can do)

Uncertainties (What you know and don't know)

Models and Analyses

Benefits
Added insight
Better decisions
Clearer communication

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Case Study: Rothi Waterfowl Production Area, Minnesota

- 1200 acres of grassland and wetlands
- Managed by USFWS: Waterfowl habitat is priority
- Water level and vegetation monitoring in 10 wetlands
- Monitoring since 2009

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Remote Sensing of Surface Water in Small Wetlands

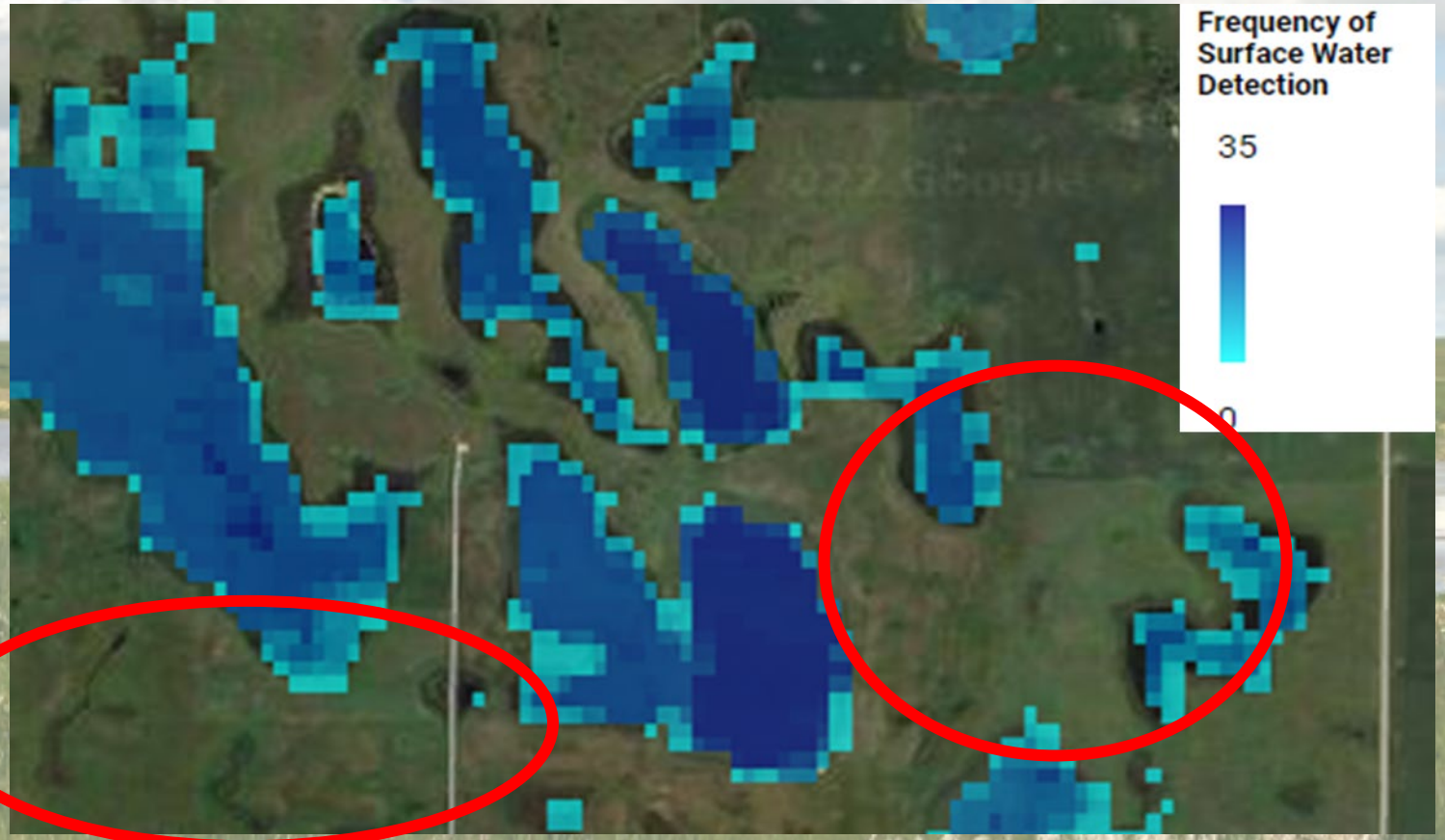
remote sensing

MDPI

Article

The Applicability of LandTrendr to Surface Water Dynamics: A Case Study of Minnesota from 1984 to 2019 Using Google Earth Engine

Audrey C. Lothspeich and Joseph F. Knight *



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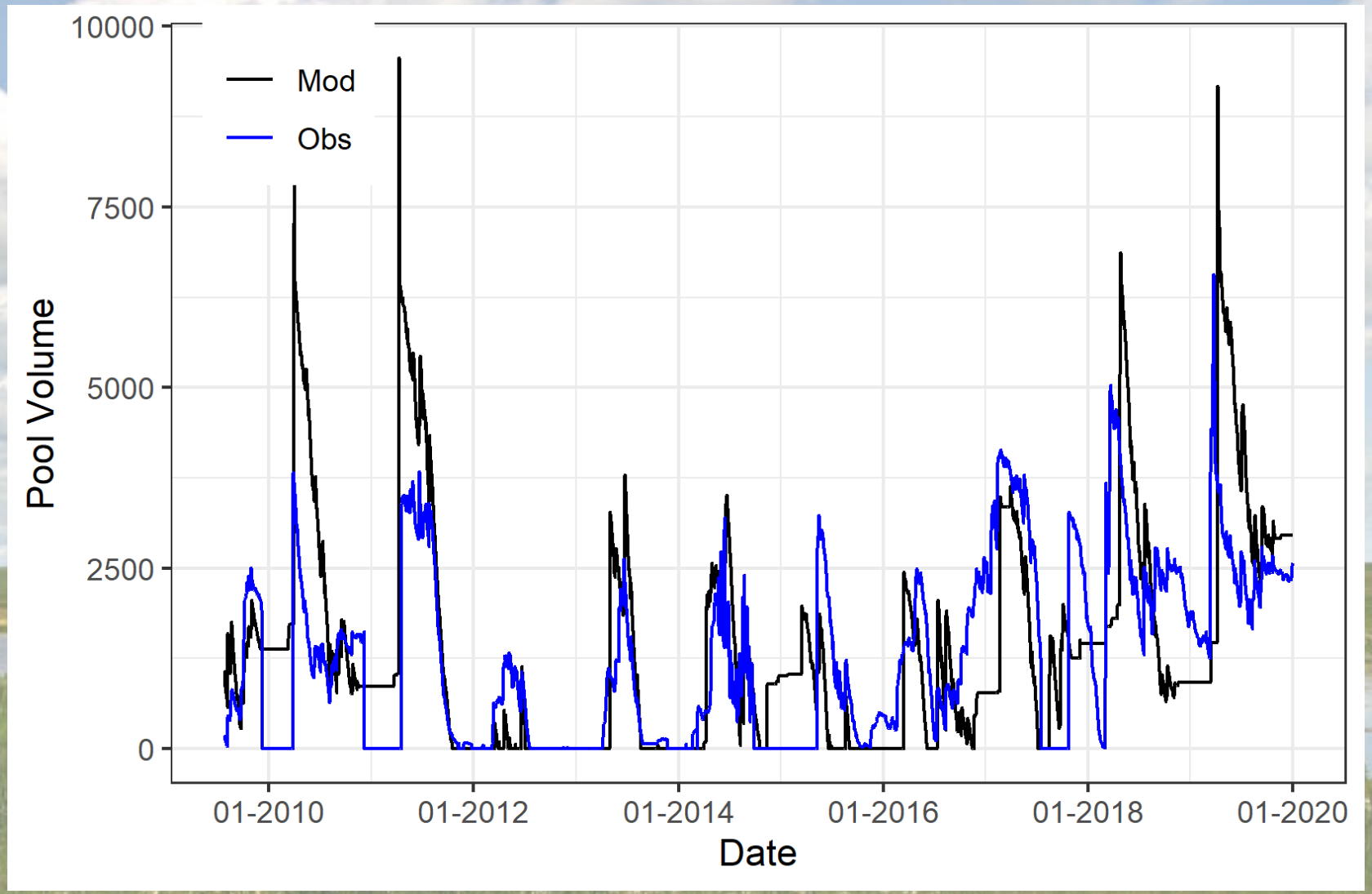
Hydrology Model vs Monitoring 2009-2020



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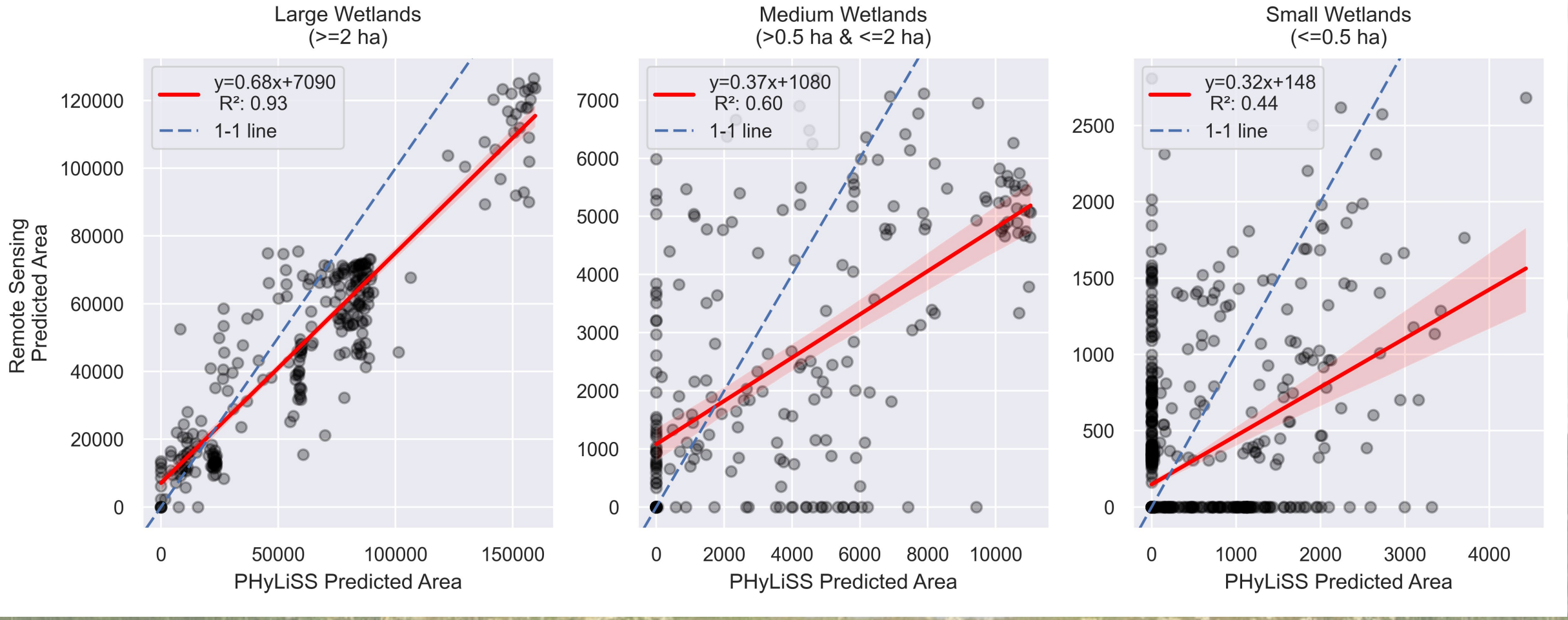
The smaller the wetland, the lower the accuracy



May and June Surface Water 1984-2021

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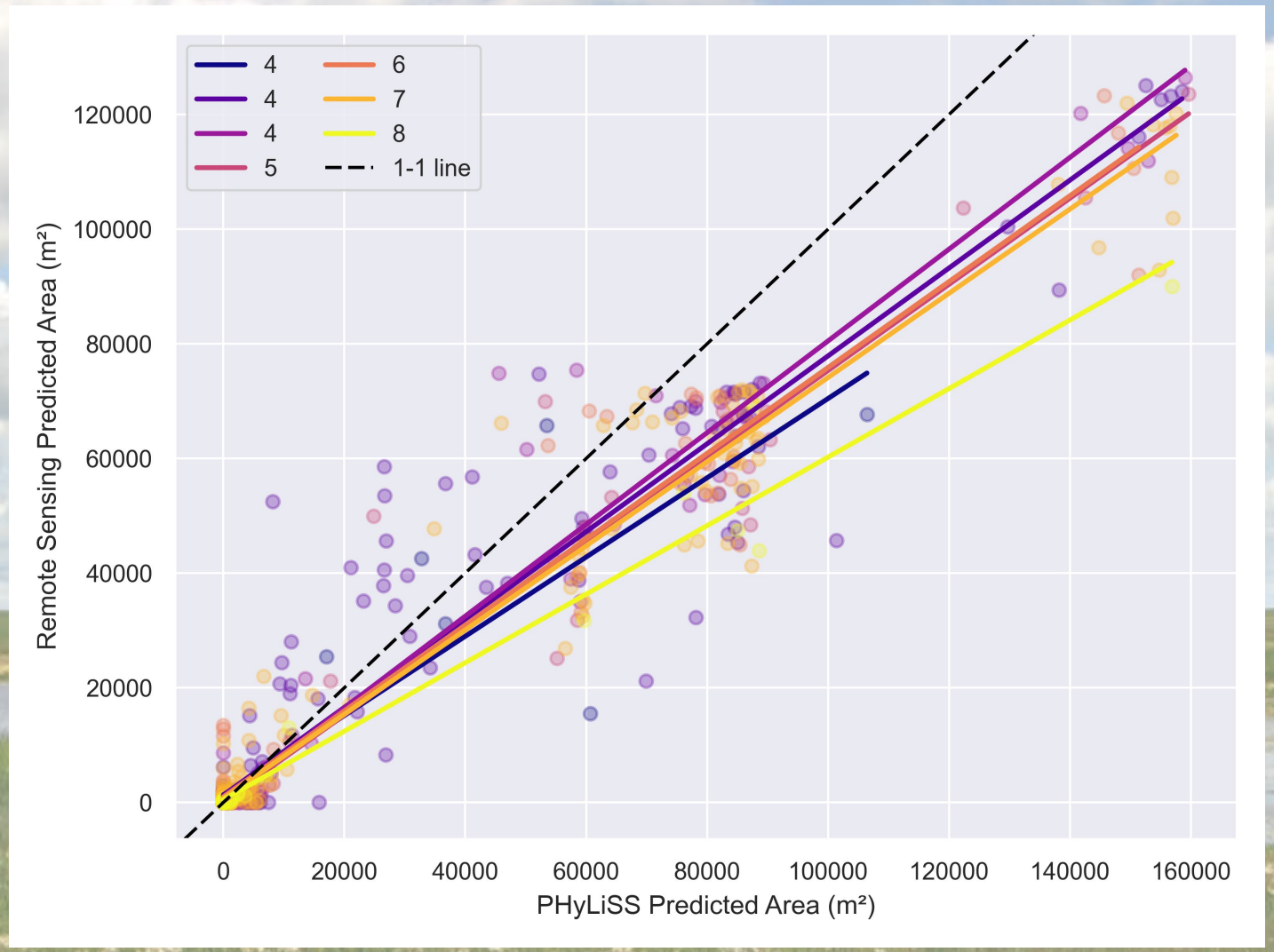
Number of satellite images may impact accuaracy



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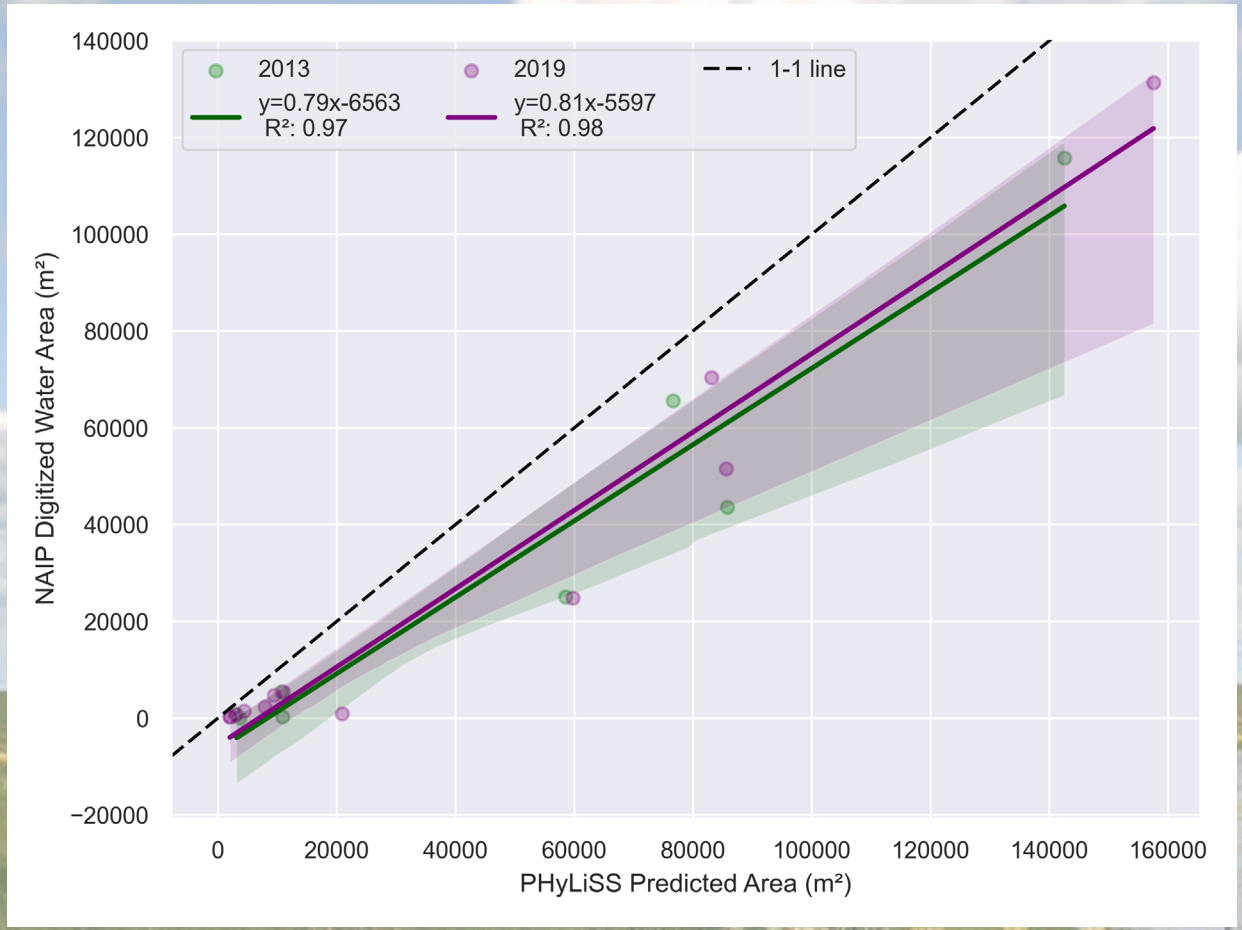
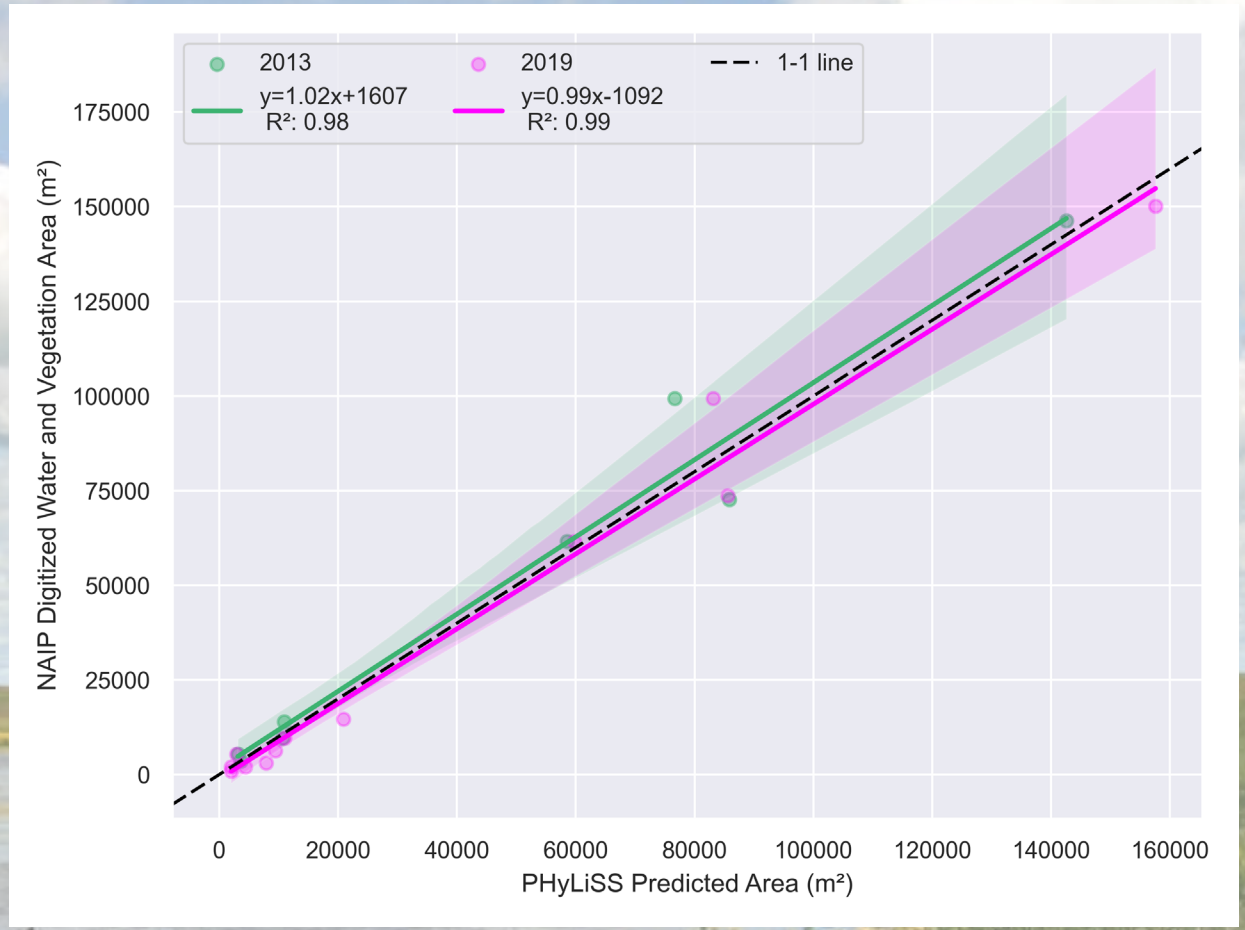
Higher resolution imagery may help in some cases



Open water only



Open water + emergent vegetation

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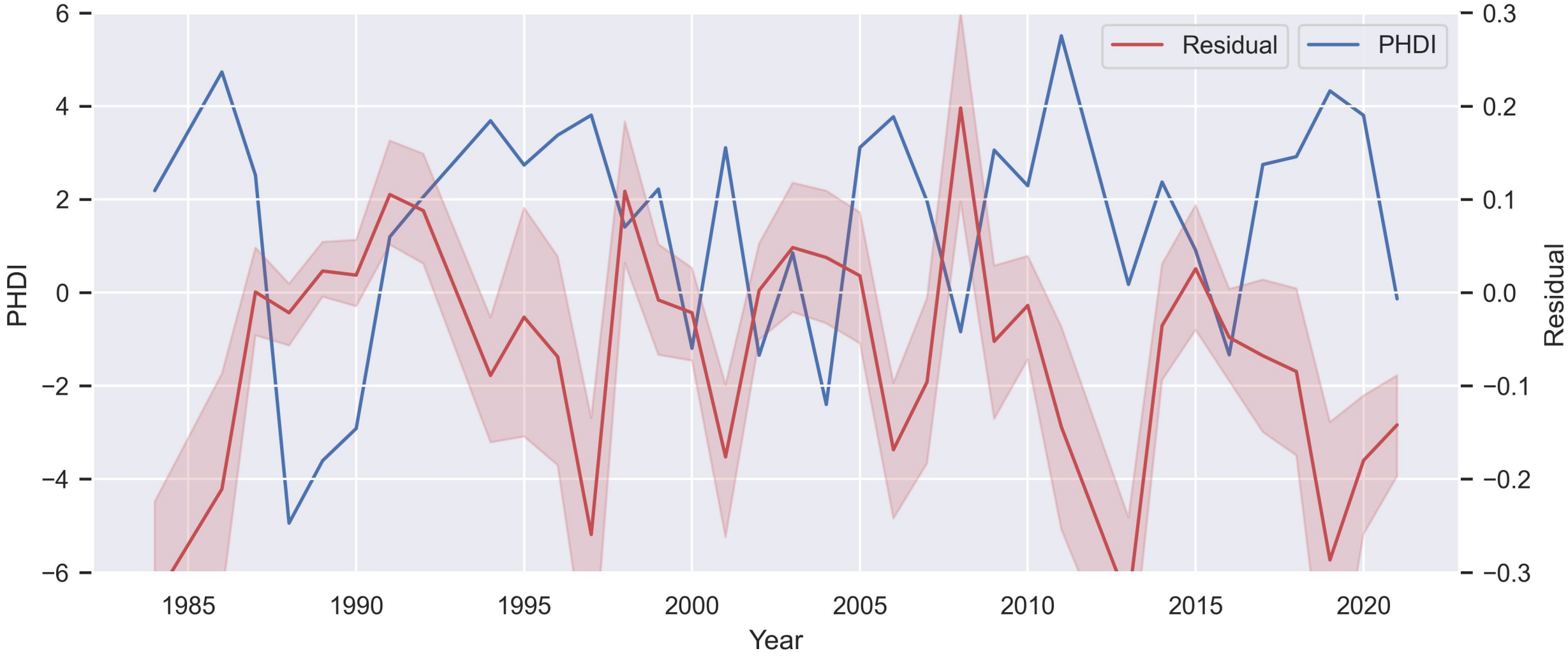
Accuracy is dependent on climate



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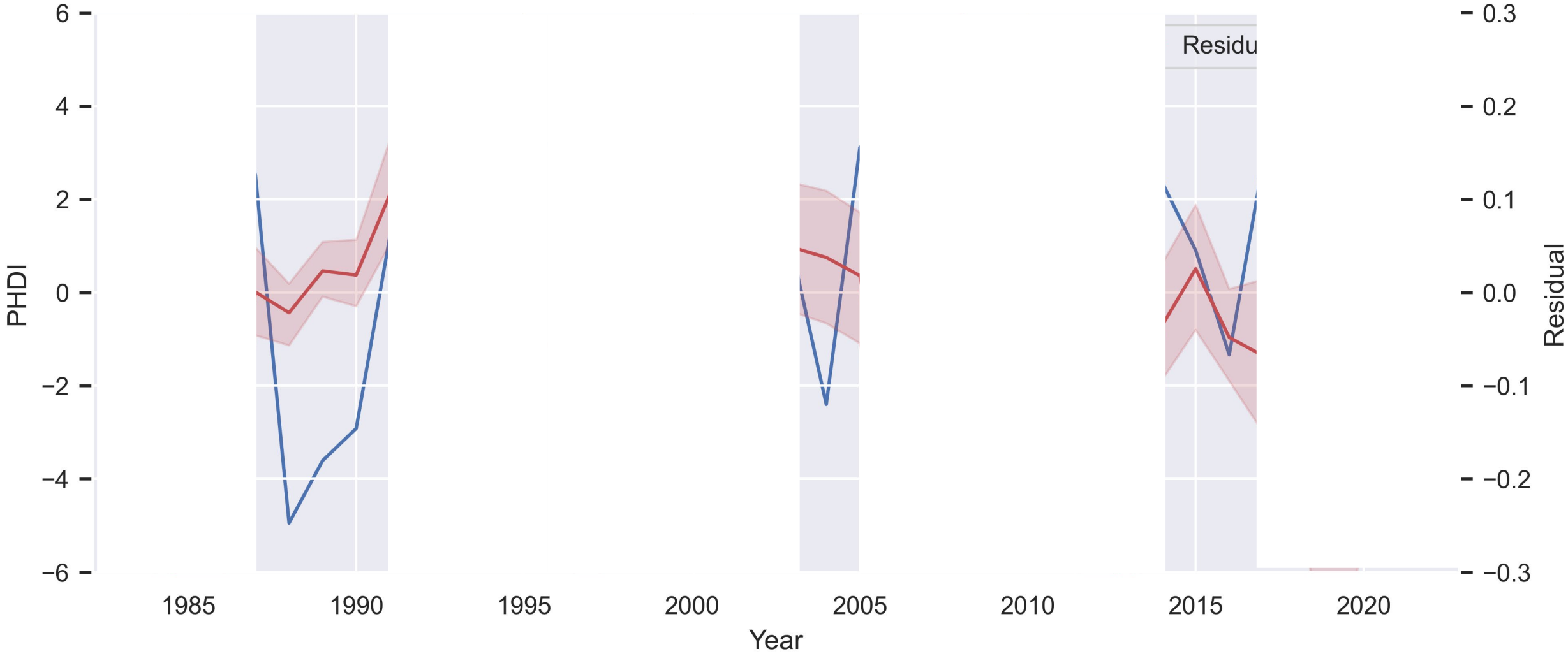
Drier times make for better fits



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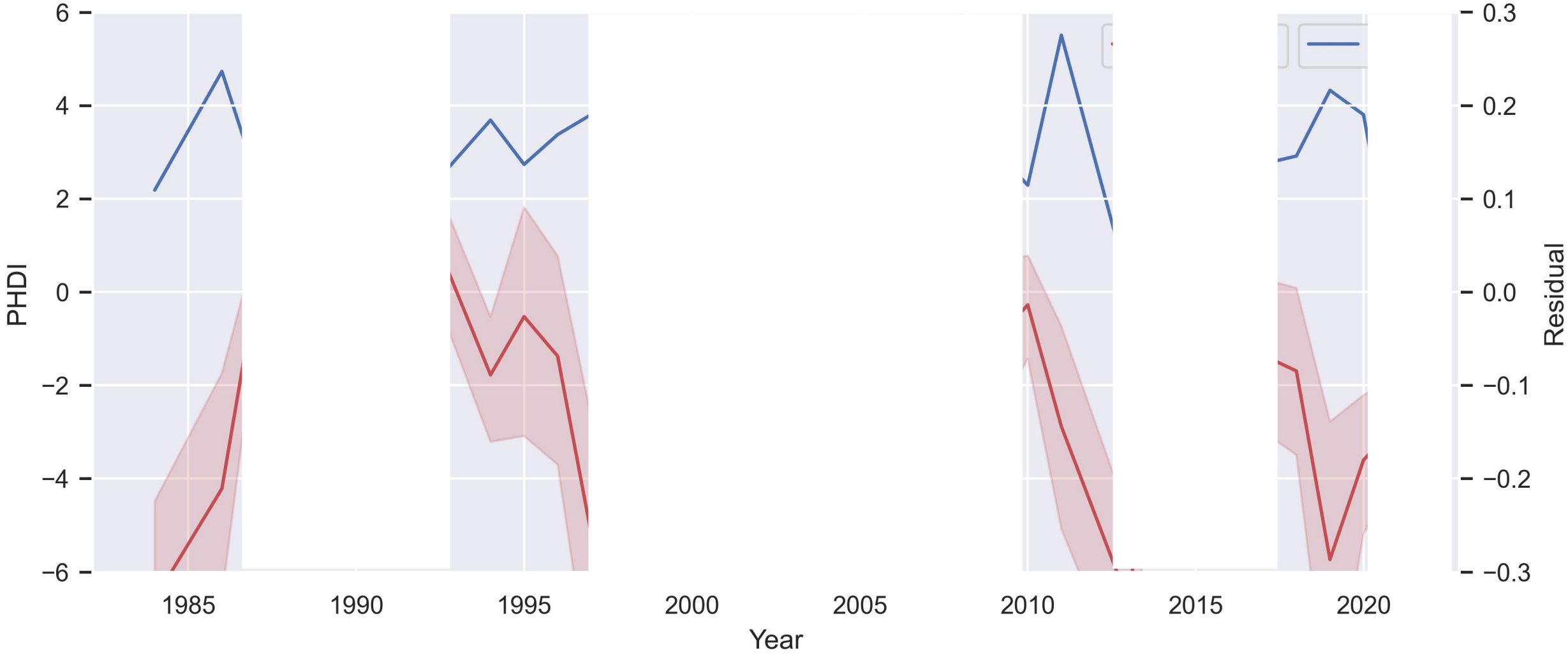
Wetter times make for worse fits (underprediction)



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Questions?

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