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NATIONAL WATER QUALITY ASSESSMENT PROGRAM (NAWQA)

SPARROW models and Insights into How Wetlands Influence Nutrient Transport to Estuaries in the Southeastern U.S

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Presentation Overview

- Introduction to the <u>SPA</u>tially <u>R</u>eferenced <u>R</u>egression <u>O</u>n <u>W</u>atershed attributes (SPARROW) model
- Updates on current Southeast SPARROW models
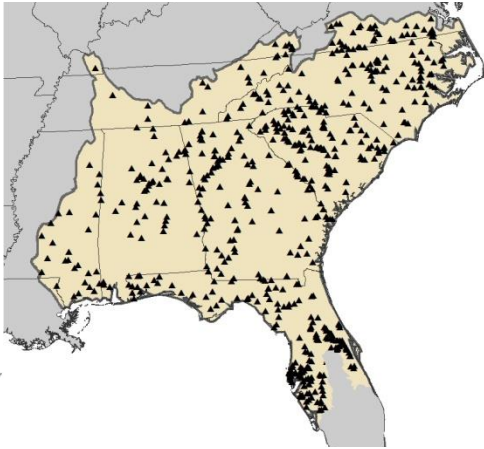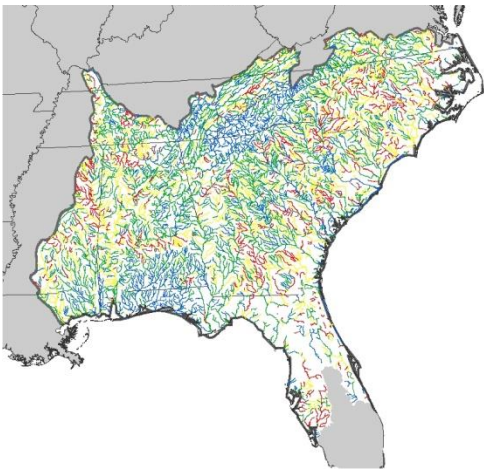- Preliminary results on wetland effects

SPARROW* Model Concept
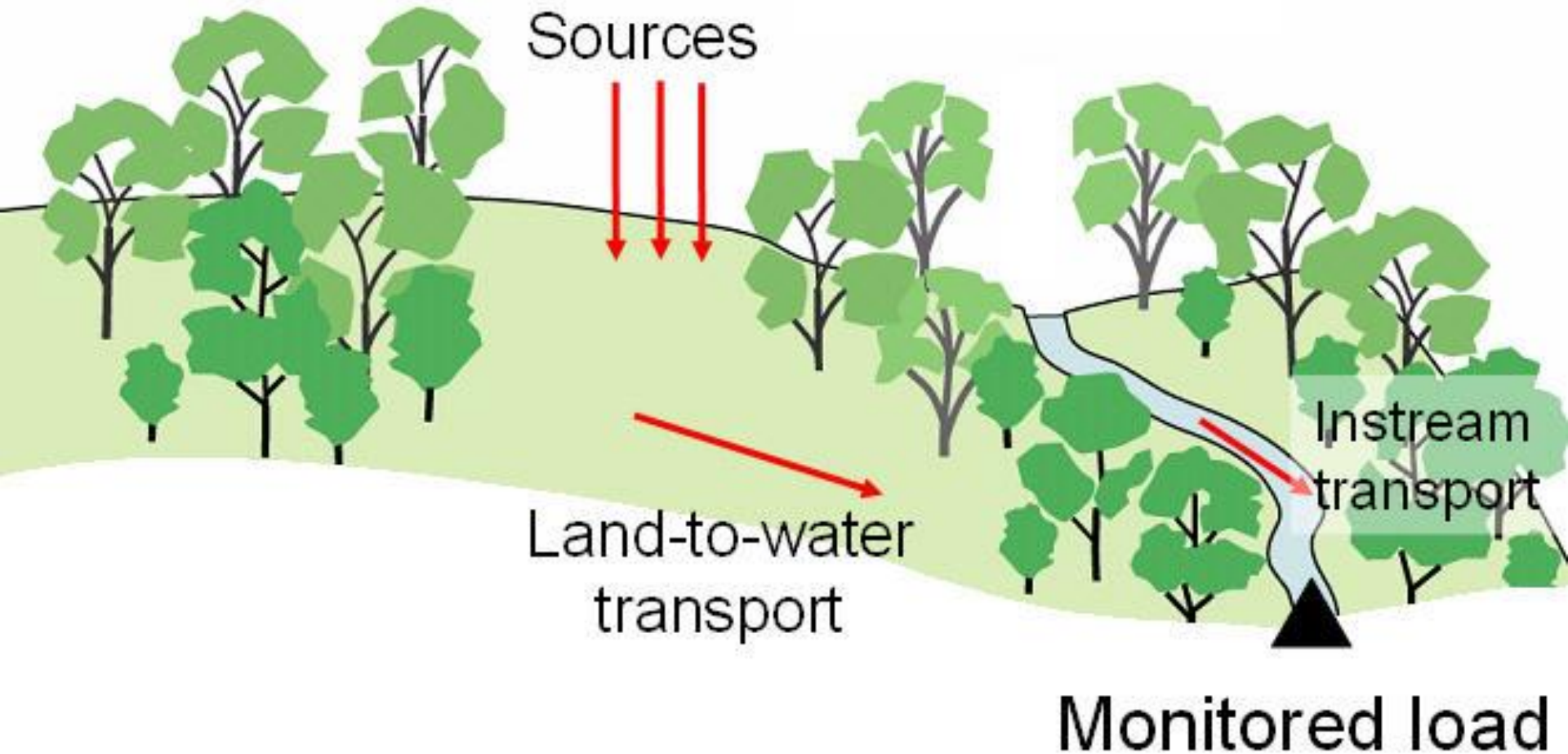
*SPAtially Referenced Regression On Watershed Attributes

SPARROW Modeling Process
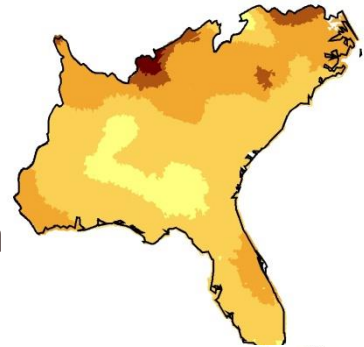

Monitoring Data
370 Sites
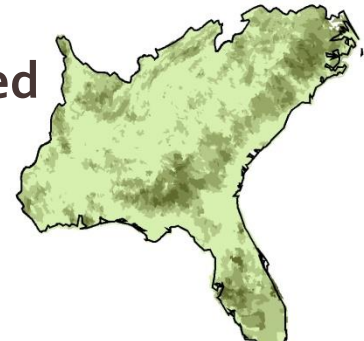
Model Predictions
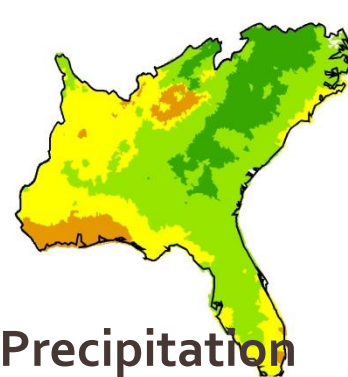**8,092 Stream Reaches**

Spatial Data Layers

Geologic phosphorus contribution

Manure applied to farmland

Precipitation

Water Table Depth
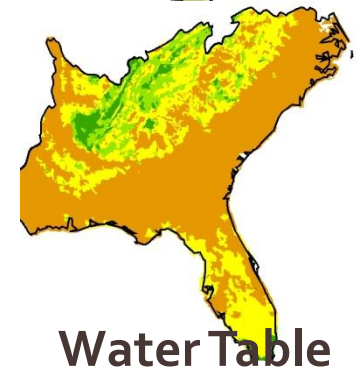
- **NAWQA** provides an understanding of water-quality conditions and how those conditions may vary locally, regionally, and nationally

  - Cycle II NAWQA
    - SPARROW used to assess nutrient condition in 6 regions across the US for the base year 2002 – RF1 and NHD
  - Cycle III NAWQA
    - SPARROW used to assess nutrient condition for 5 regions, base year 2012 – NHD

NAWQA Cycle II study units
1 - New England and Mid-Atlantic
2 - South Atlantic-Gulf and Tennessee
3 - Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy
4 - Missouri
5 - Lower Mississippi, Arkansas-White-Red, and Texas-Gulf
6 - Rio Grande, Colorado, and Great Basin
7 - Pacific Northwest
8 - California

Major River Basins

NAWQA Cycle 3 SPARROW Modeling
What should be the scope of our work?

MRB 7
Pacific Coast
MRB 4
MRB 1
Northeast
West
Midwest
MRB 3
MRB 8
MRB 6
MRB 2
MRB 5
Southeast
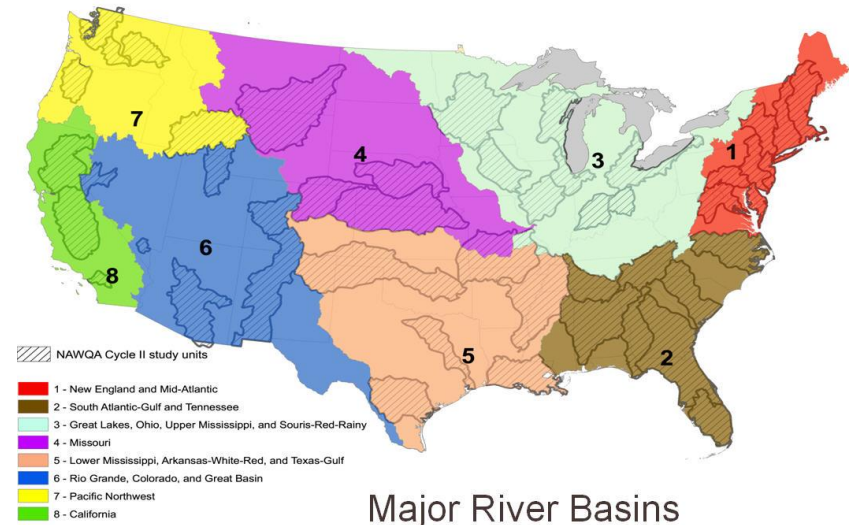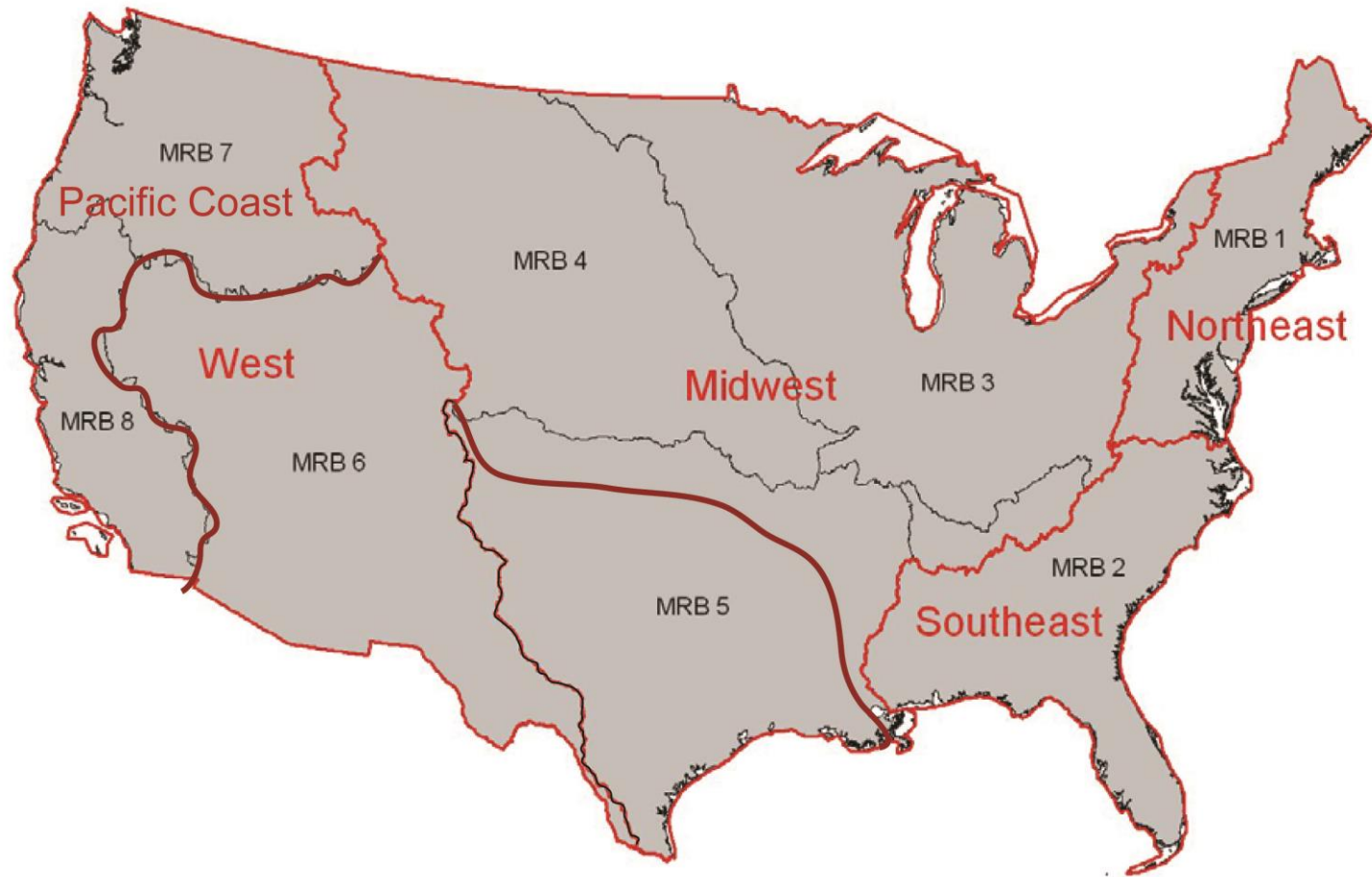
Cycle 3 region boundaries
Major River Basin (MRB) boundaries

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Southeast SPARROW Model Online Decision Support System

http://cida.usgs.gov/sparrow/
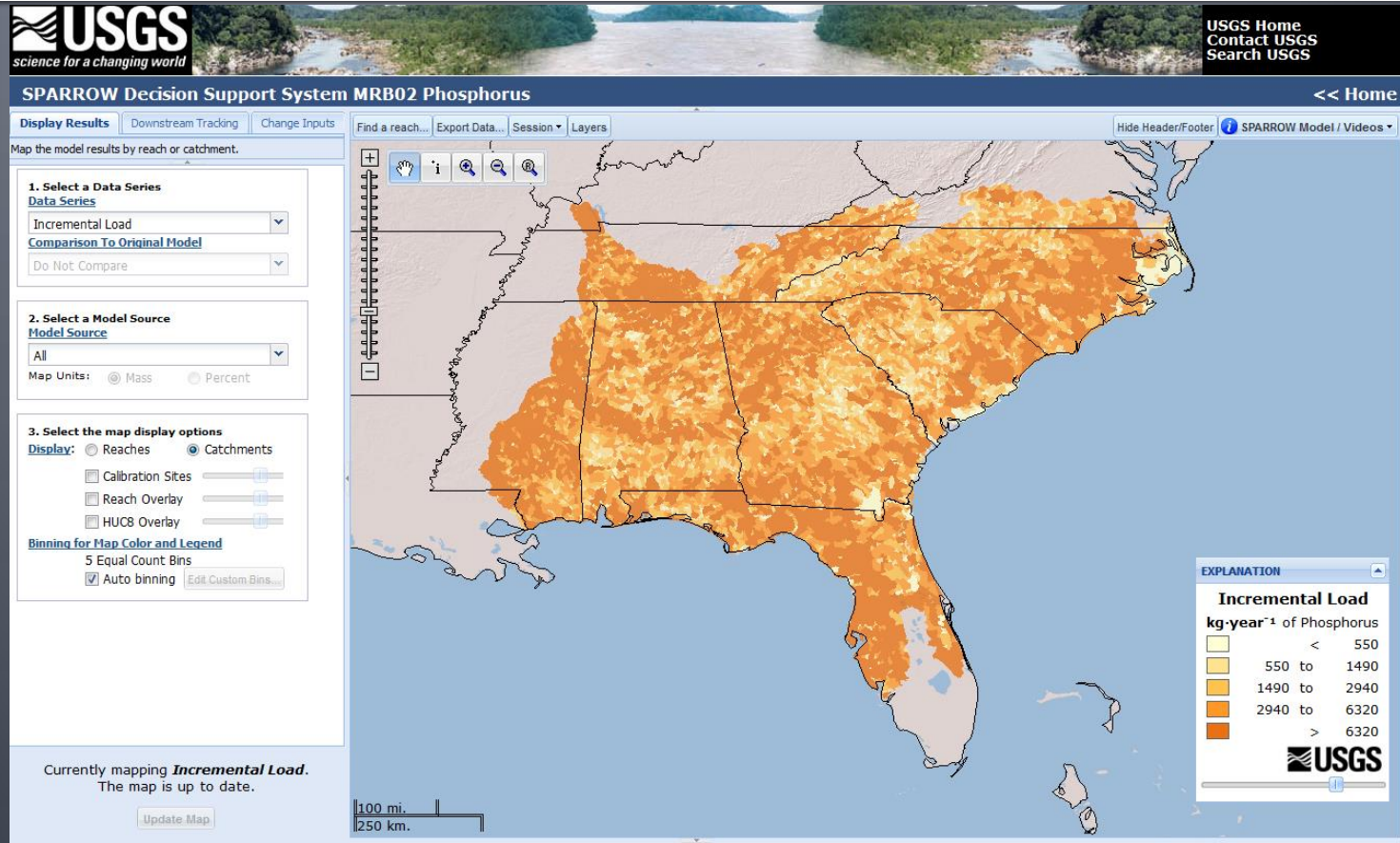
Southeast 2002 SPARROW model

- Alabama, Florida (partial), Georgia, Mississippi, North Carolina, South Carolina, and Tennessee have major river basins in the study area
- Published in 2009, 2011
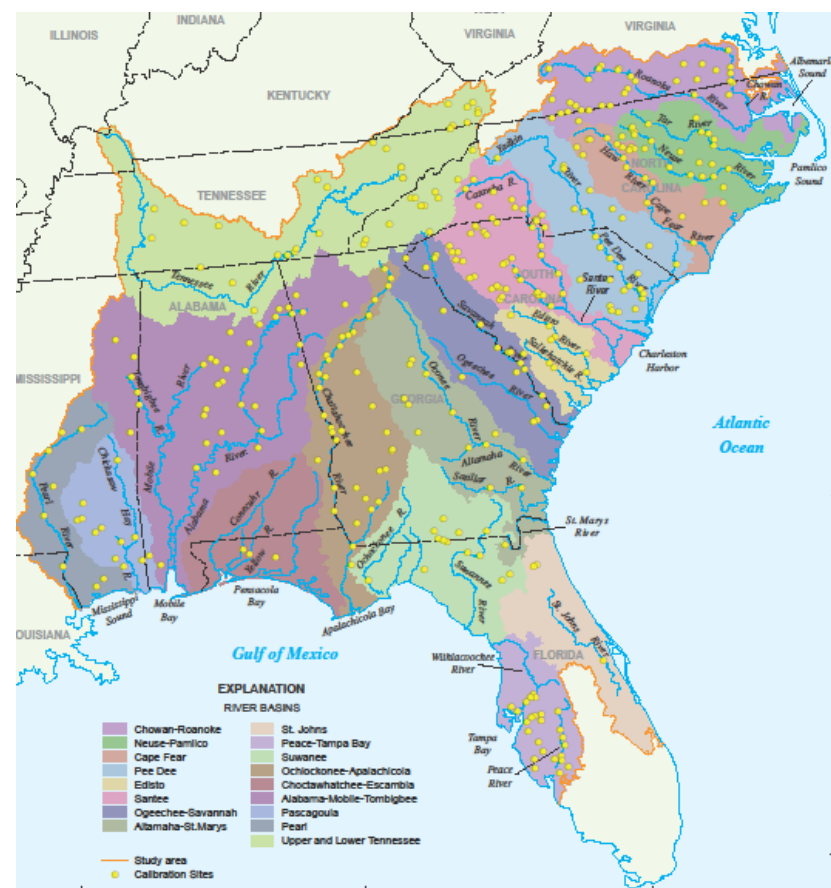
East Coast SPARROW NHD, 2002

- Models for the northeastern and southeastern regions of the United States were recalibrated to achieve a hydrographically consistent model with which to
  - assess nutrient sources and stream transport and
  - investigate the effects of wetlands and
  - investigate the effects atmospheric deposition on nutrient transport.
- Update of SPARROW models to NHD network
- Data series and circular

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National Water-Quality Assessment Program

Simulating Stream Transport of Nutrients in the Eastern United States, 2002, Using a Spatially-Referenced Regression Model and 1:100,000-Scale Hydrography

Scientific Investigations Report 2013–5102

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

East Coast SPARROW NHD, 2002

- Estimates of inputs for manure and fertilizer contribution via atmosphere pathway were included in the model using results of the Community Multi-Scale Air Quality (CMAQ) model (Dennis, 2010).

A. Nitrogen

Basin name	Basin area, based on NHDPlus network (km²)	Nitrogen yield (kg/km²/yr)	Standard error for nitrogen yield (kg/km²/yr)	Nitrogen source shares (percent of total)							
				Point sources	Urban land	Agricultural fertilizer[a]	Manure from livestock[b]	Power plant	Other industry	Vehicle	Back-ground
Summary for northeast region	447,518	791	315	40.9	11.3	24.0/0.7	6.5/2.8	2.4	4.2	5.0	2.1
Basins draining to the St. Lawrence Seaway and the Gulf of Maine[c]	142,512	266	106	19.7	21.5	15.6/1.3	5.2/4.4	3.7	8.9	10.3	9.4
Basins draining to the Middle Atlantic[d] (Waquoit Bay to Maryland Coastal Bays)	134,470	1,389	564	61.0	10.6	13.9/0.5	2.5/1.6	1.5	3.2	3.9	1.2
Basins draining to Chesapeake Bay	170,536	759	304	18.2	9.2	41.0/0.8	12.6/4.0	3.4	4.4	5.1	1.3
Summary for southeast region	761,030	366	145	5.2	18.8	26.0/1.1	19.7/6.4	4.9	8.1	8.2	1.5
Basins draining to the South Atlantic (Albemarle Sound to Indian River)	332,904	260	103	6.9	18.7	29.6/0.9	17.5/7.0	4.3	6.4	7.4	1.2
Basins draining to the eastern Gulf of Mexico (Charlotte Harbor to Lake Borgne)	322,208	435	172	3.9	20.4	22.9/1.3	20.7/6.4	5.1	9.3	8.4	1.6
Tennessee River Basin	105,918	493	196	5.9	14.8	28.3/1.4	20.7/5.5	5.5	7.8	8.7	1.4

Incorporation of wetlands as explanatory variables

- The effects of freshwater wetlands nutrient transport were modeled using spatial data sets of 29 wetland systems classified by plant community types. Each wetland system was further identified as riparian or non-riparian based on the respective presence or absence of hydrologic connectivity between the wetland system and streams or rivers.
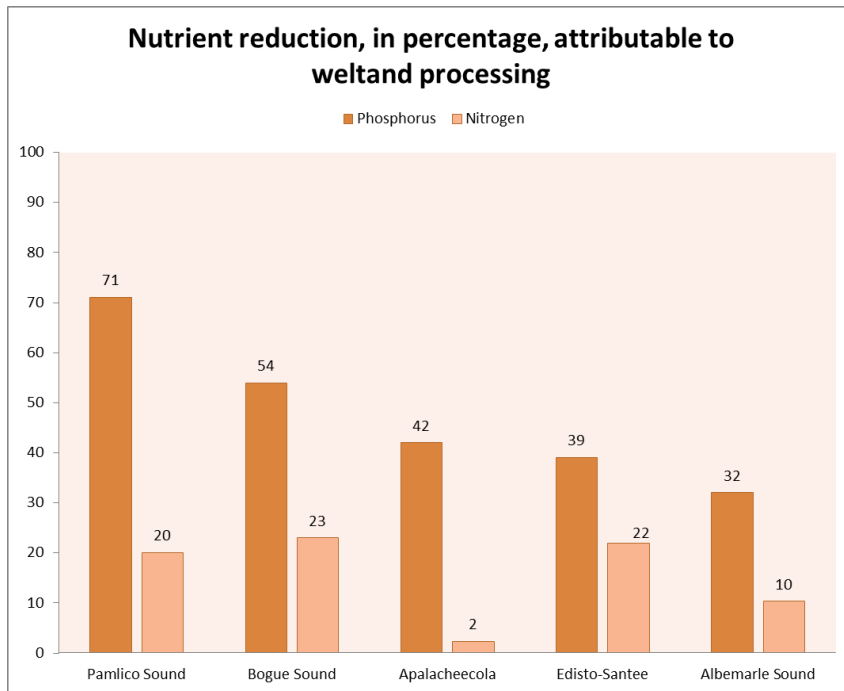

Northeast and Southeast SPARROW model boundary
State boundary
Wetlands
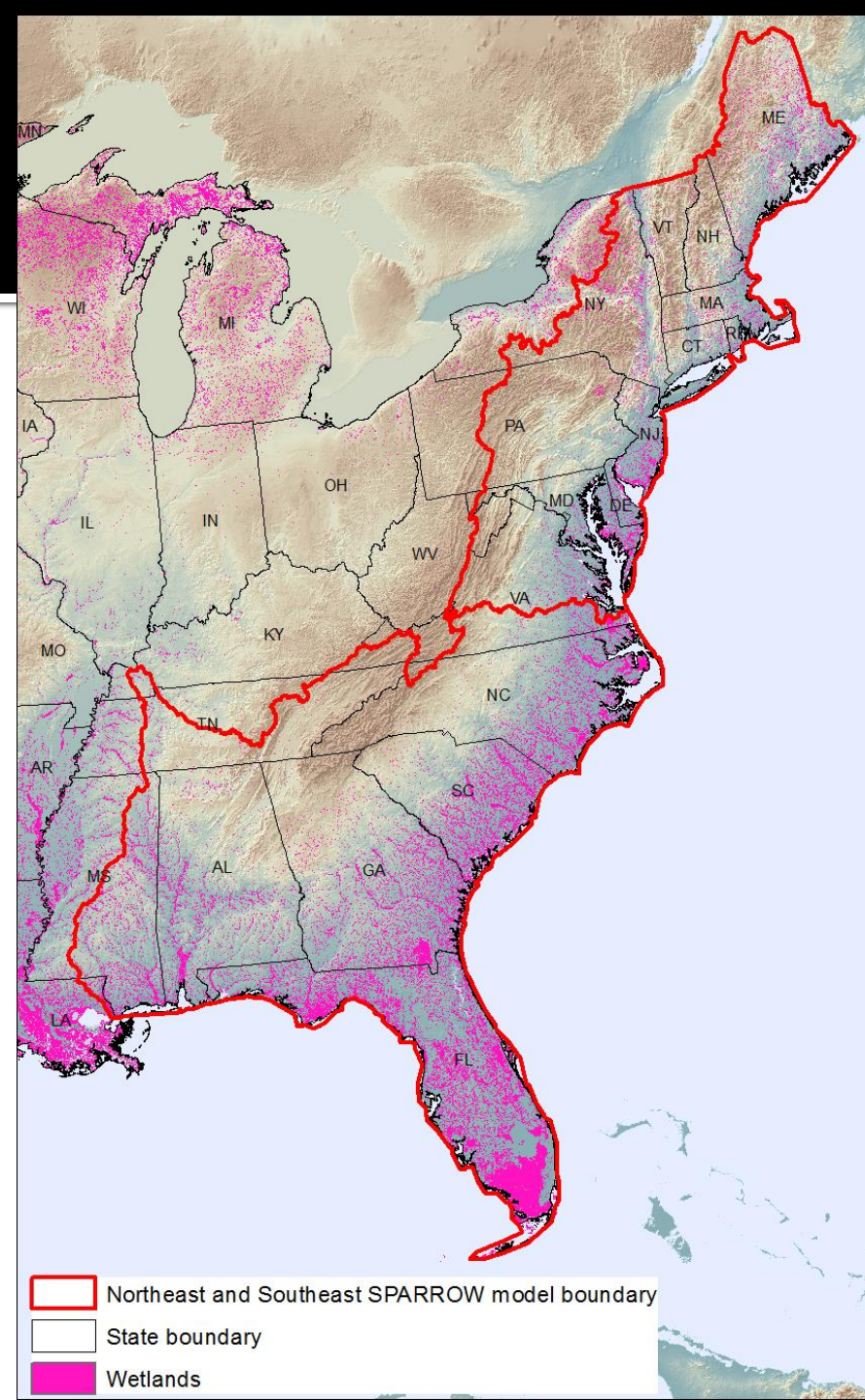
Two riparian wetland systems were associated with an attenuation of aqueous-phase delivery of nitrogen and phosphorus. Both input variables *Atlantic Coastal Plain Blackwater and Stream Floodplain Forest* and *Southern Piedmont Small Floodplain and Riparian Forest* reduced stream nitrogen in the eastern United States and reduced stream phosphorus in the southeast.
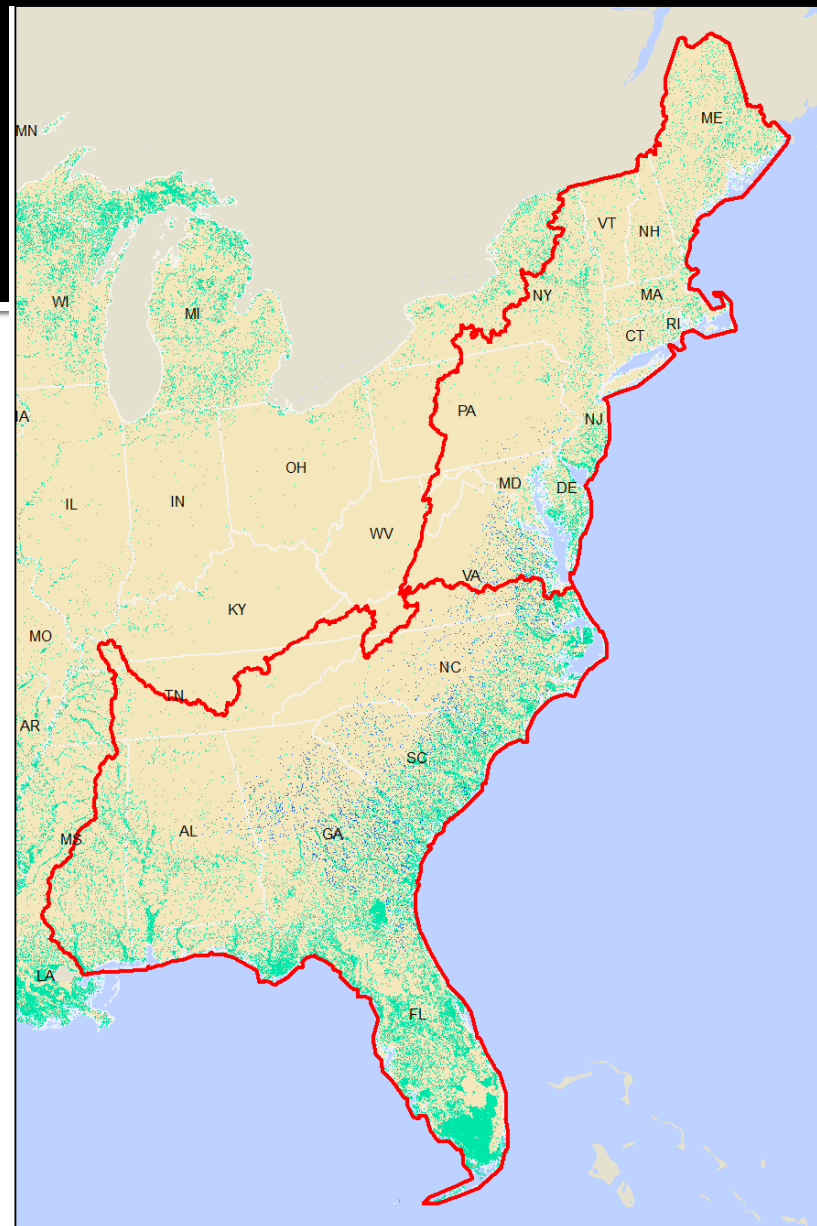
Wetlands associated with instream removal of N

- Northeast and Southeast SPARROW model boundary
- Wetlands associated with instream attenuation
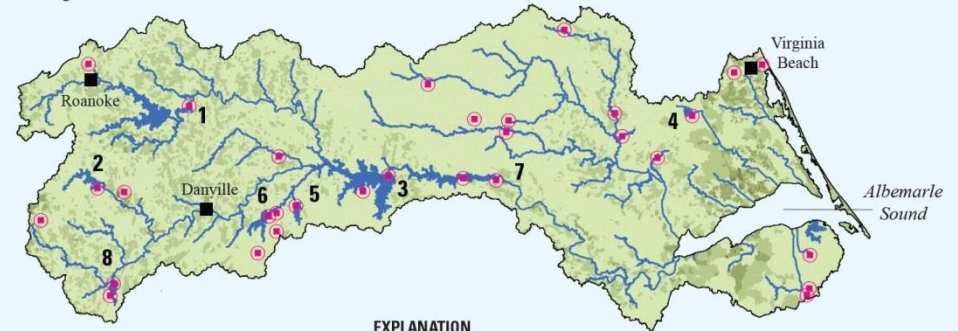- All wetlands
- State boundary

Next steps

Nutrient reduction, in percentage, attributable to weltand processing

Next steps

- Dissemination of new predictions of nutrient yield and delivery

44. Contributing watersheds and nutrient yield for Albemarle Sound
(Chowan and Roanoke River Basins)

NAWQA Cycle 3 SPARROW Modeling
What are our goals / objectives?

Cycle 3 Issues of Concern (from Advisory Committee and NRC):

1. Contaminants – we contribute minimally

2. Excess nutrients – major contribution

3. Sediment – potentially major contribution

4. Streamflow alteration – potential contribution

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NAWQA Cycle 3 SPARROW Modeling
What should be the scope of our work?

Time Frame (Cycle 3 – 2013 to 2022):

    1. Regional modeling – 2013 through 2017

    2. National modeling – 2018 through 2020

    3. Publication and Communication – 2018 through 2022

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