Nitrogen – A National to State Perspective

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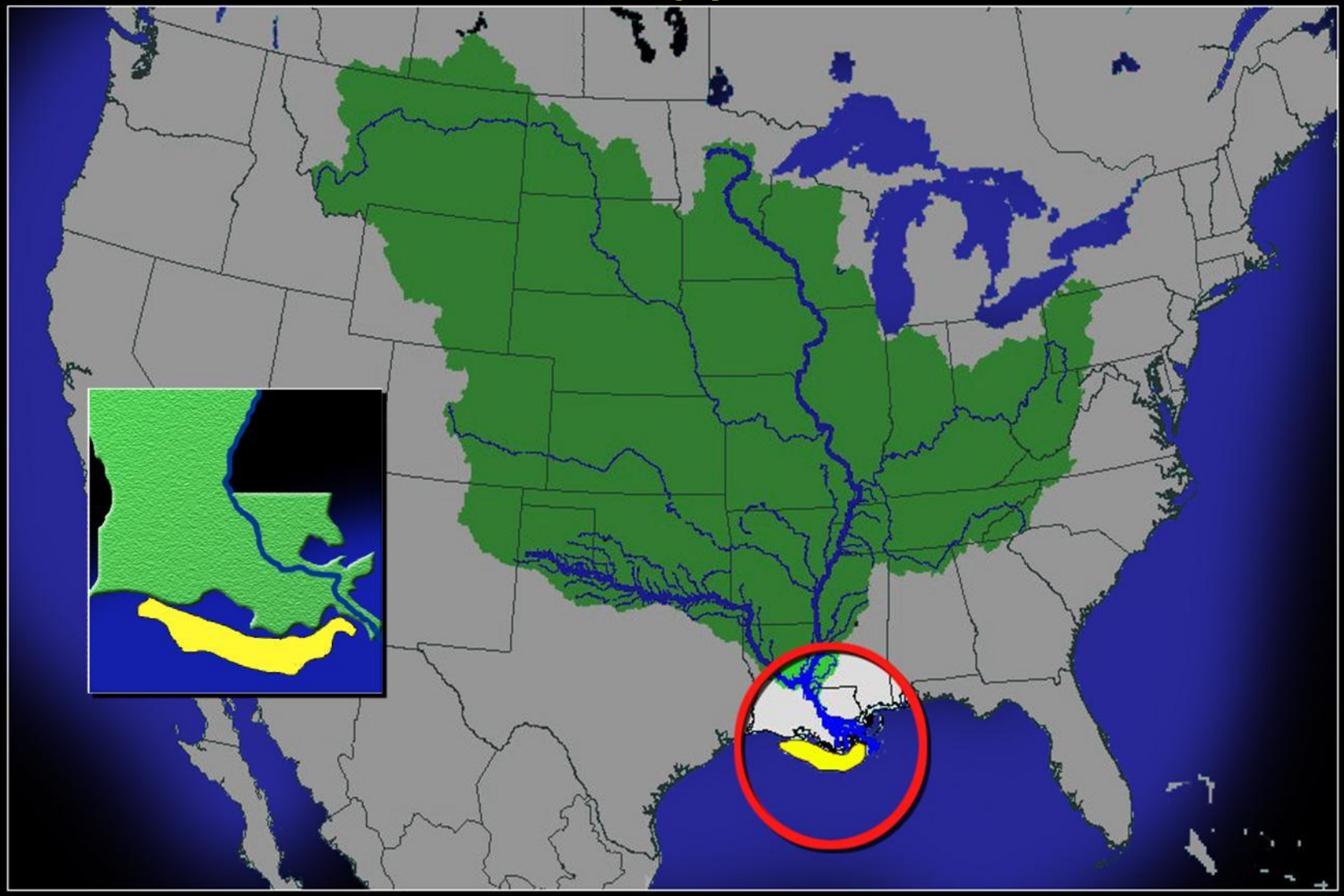
Gulf Hypoxia

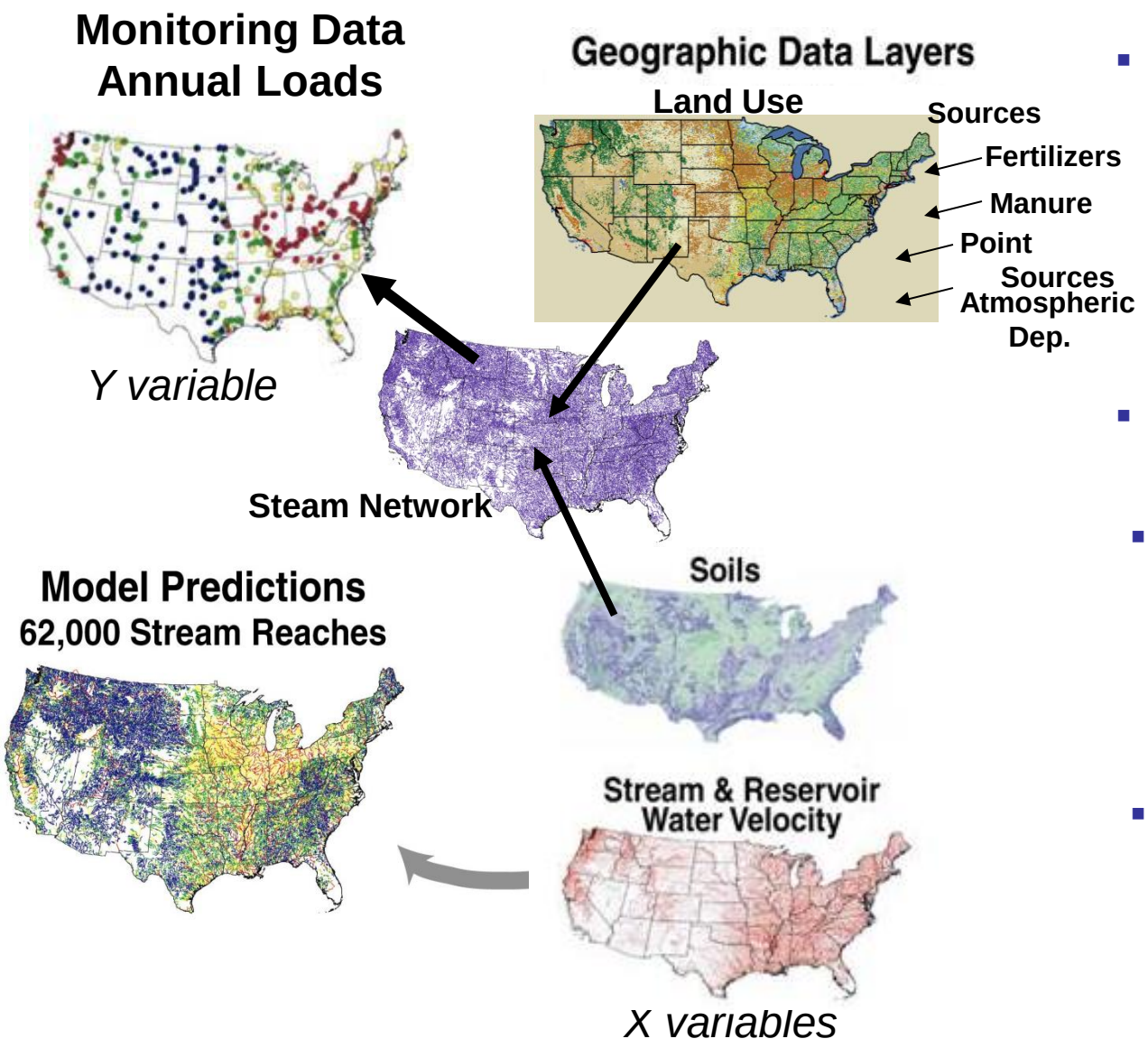


Early results suggested this was driven by Nitrogen (nitrate) Loading from the basin, now both Nitrogen and Phosphorus

Approach - SPARROW Water-Quality Model -

SPAtially Referenced Regression on Watershed Attributes

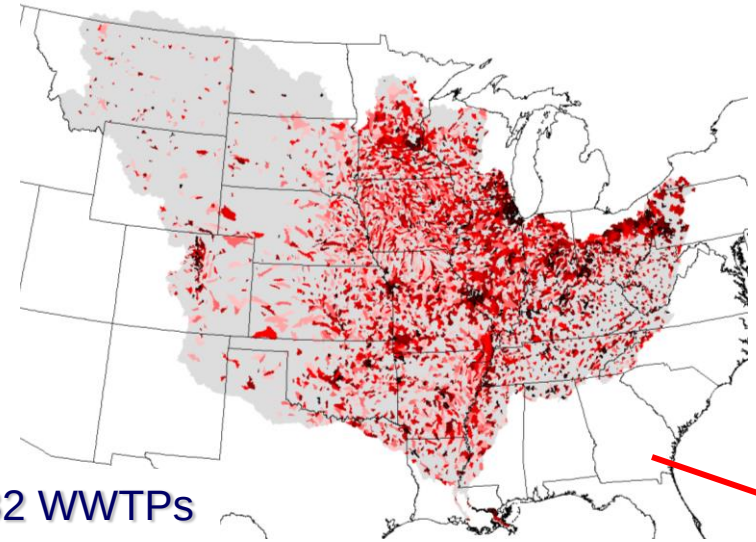
http://water.usgs.gov/nawqa/sparrow



- Mass Balance Model with spatially variable deliveries. Hybrid statistical/ mechanistic process structure. Data-driven, nonlinear estimation of parameters
- Separates land and in-stream processes
- Predictions of mean-annual flux reflect long-term, net effects of nutrient supply and loss processes in watersheds
- Once calibrated, the model has physically interpretable coefficients; model supports hypothesis testing and uncertainty estimation

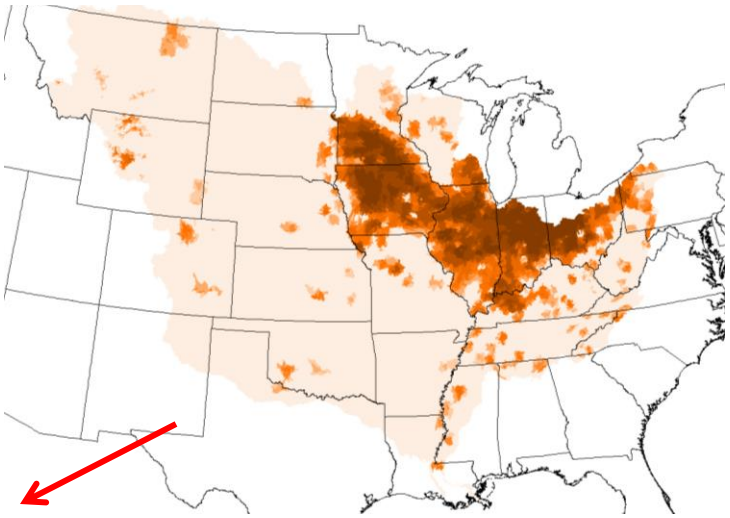
MARB SPARROW Model Calibration

One Source: 2002 Point (WWTP) TN inputs, kg

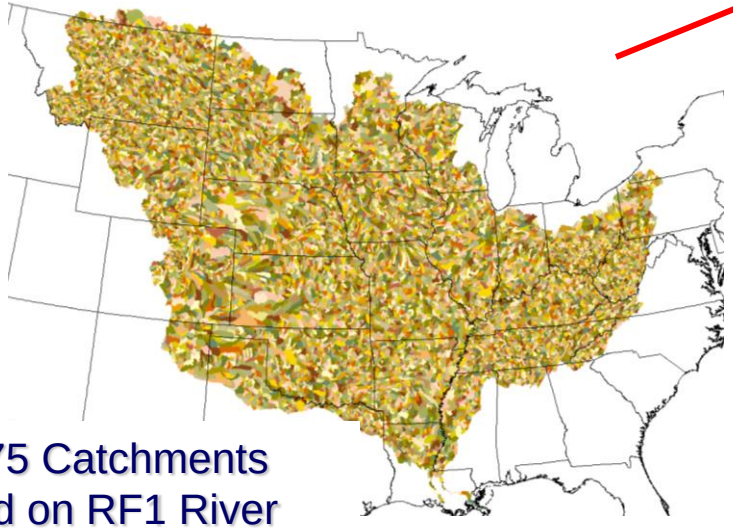


9,182 WWTPs

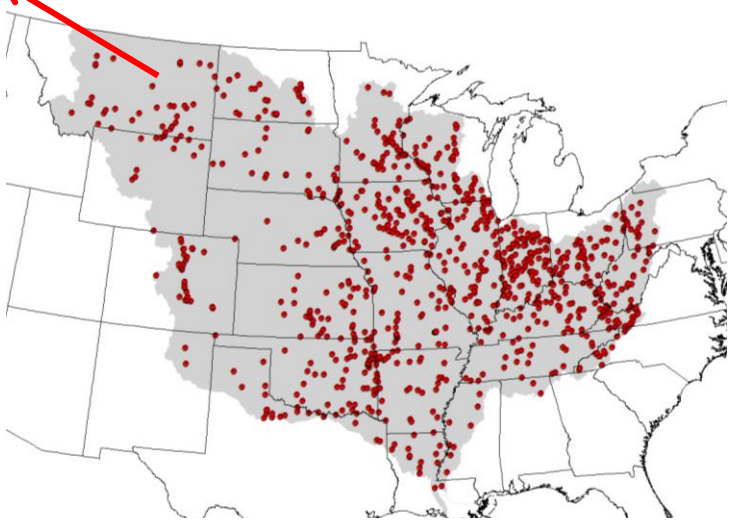
One Land-to-Water Delivery: Tile Drains



Calibration

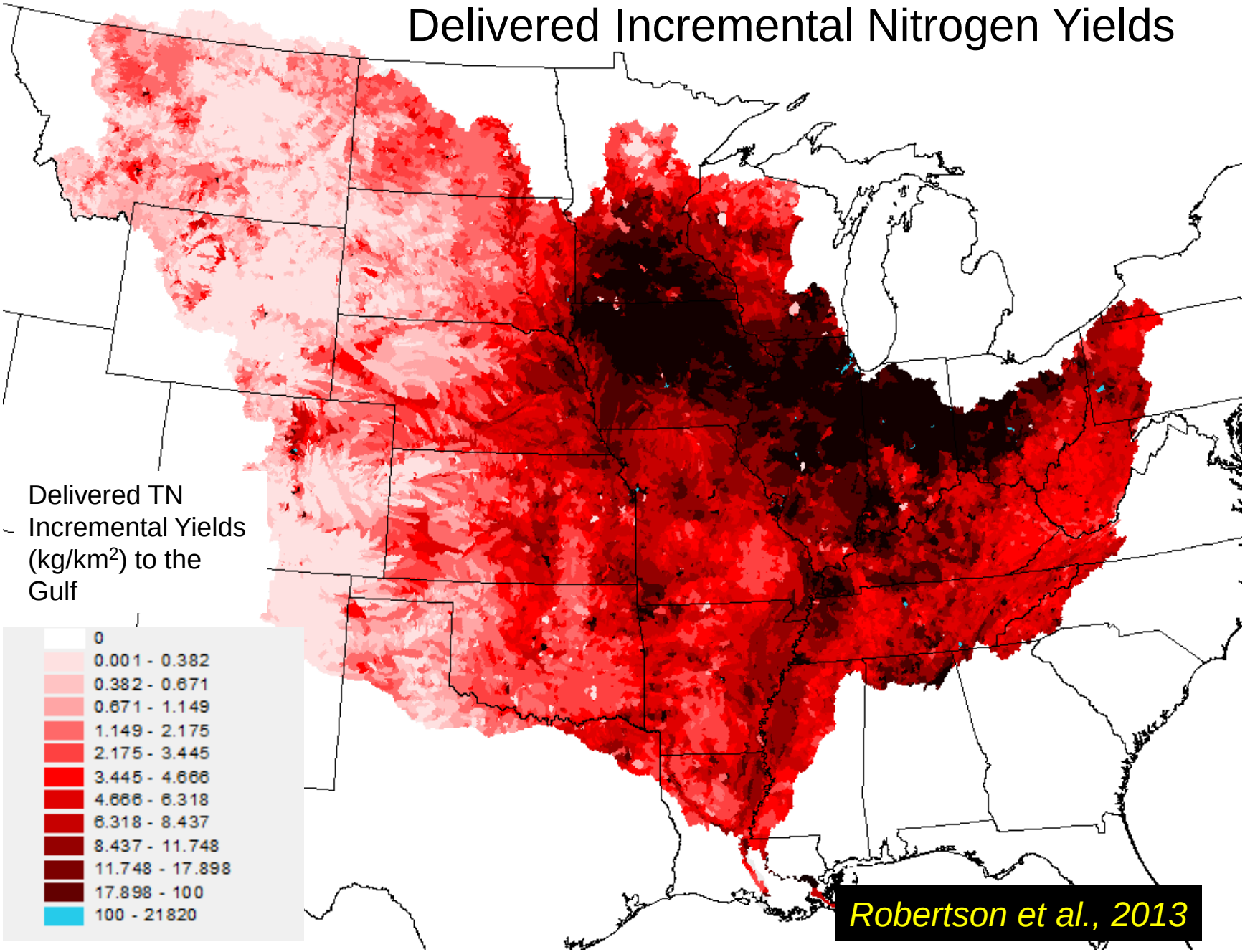


24,475 Catchments based on RF1 River Network

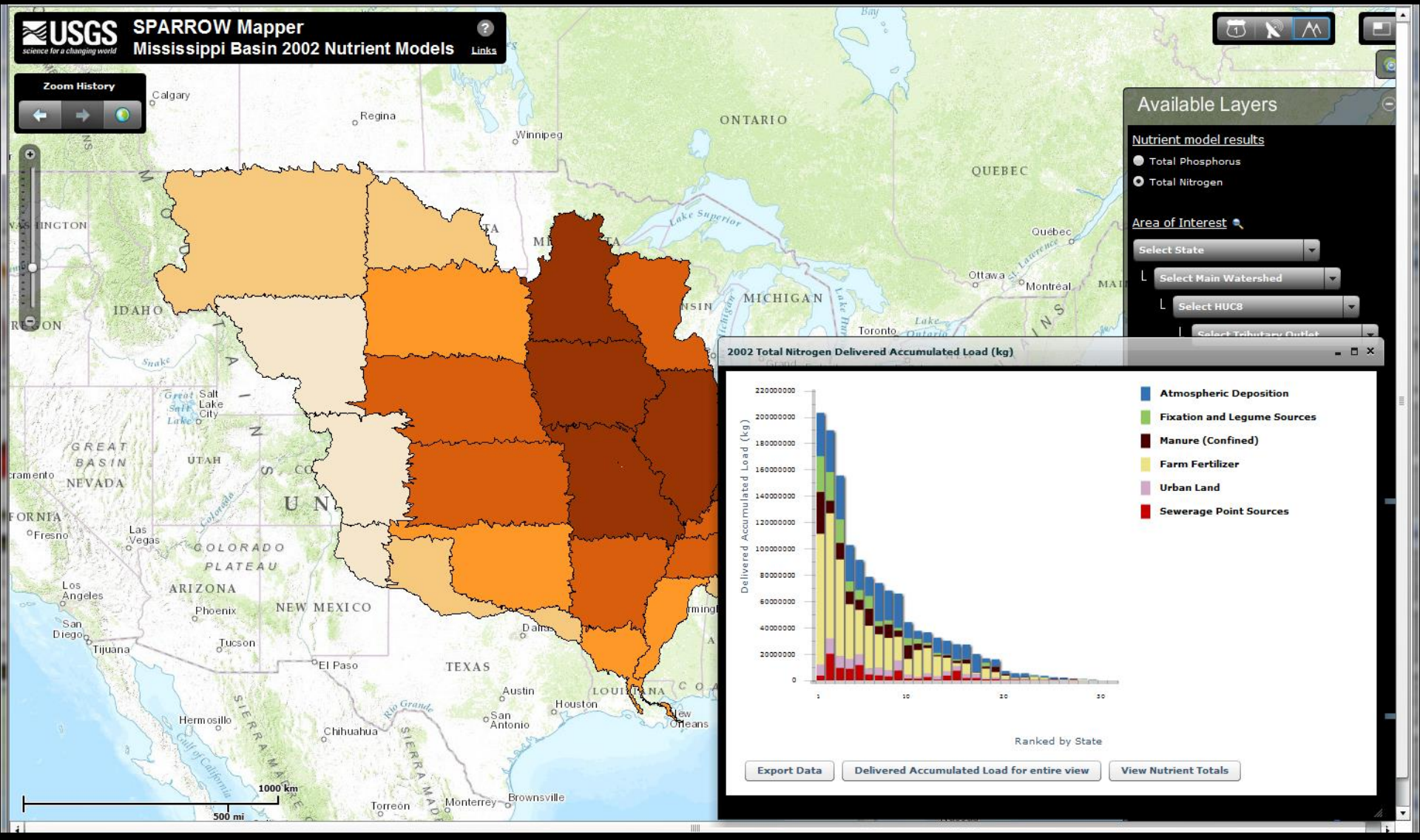


Long-term detrended Loads for 856 sites

Delivered Incremental Nitrogen Yields



Robertson et al., 2013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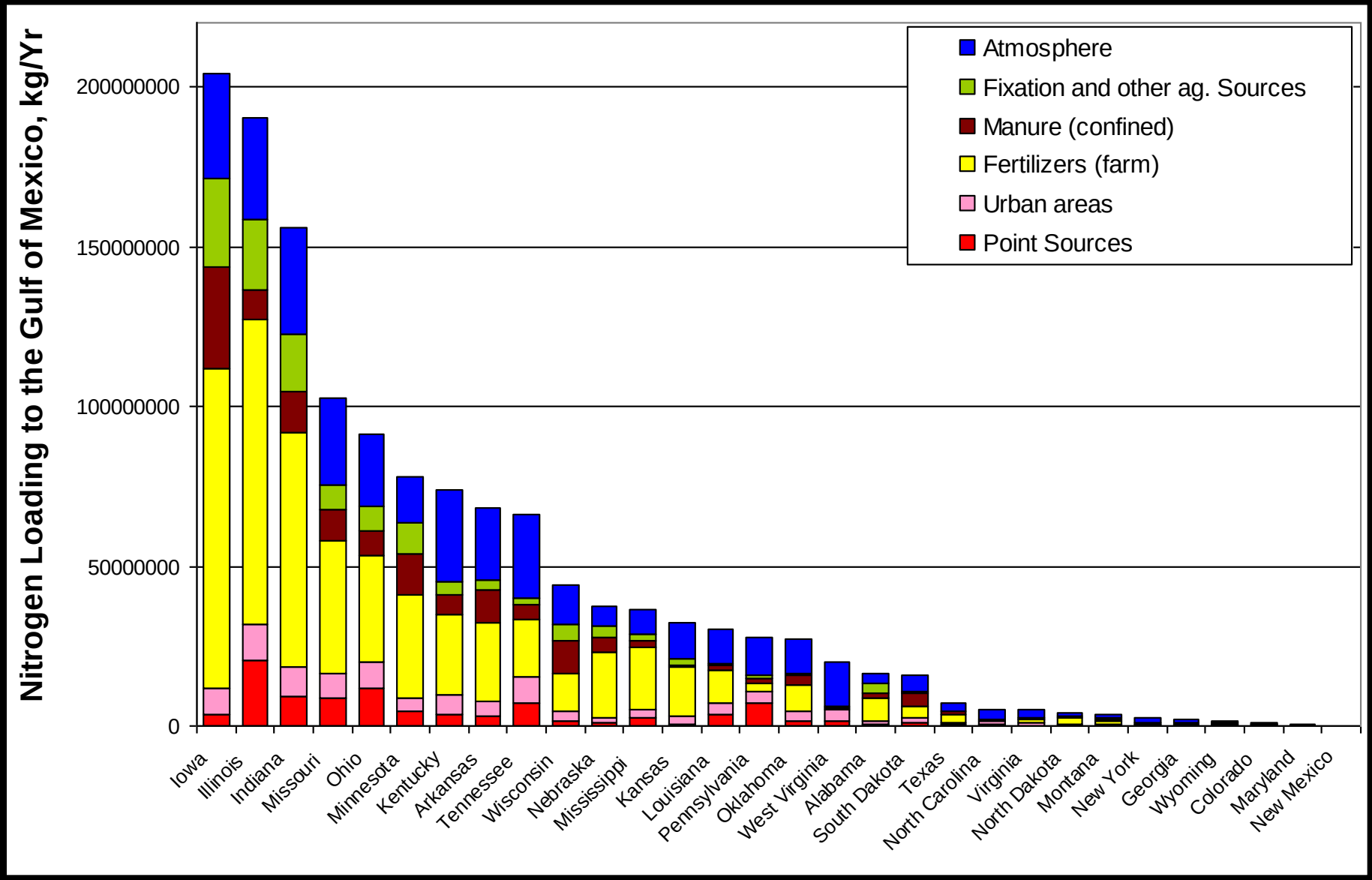
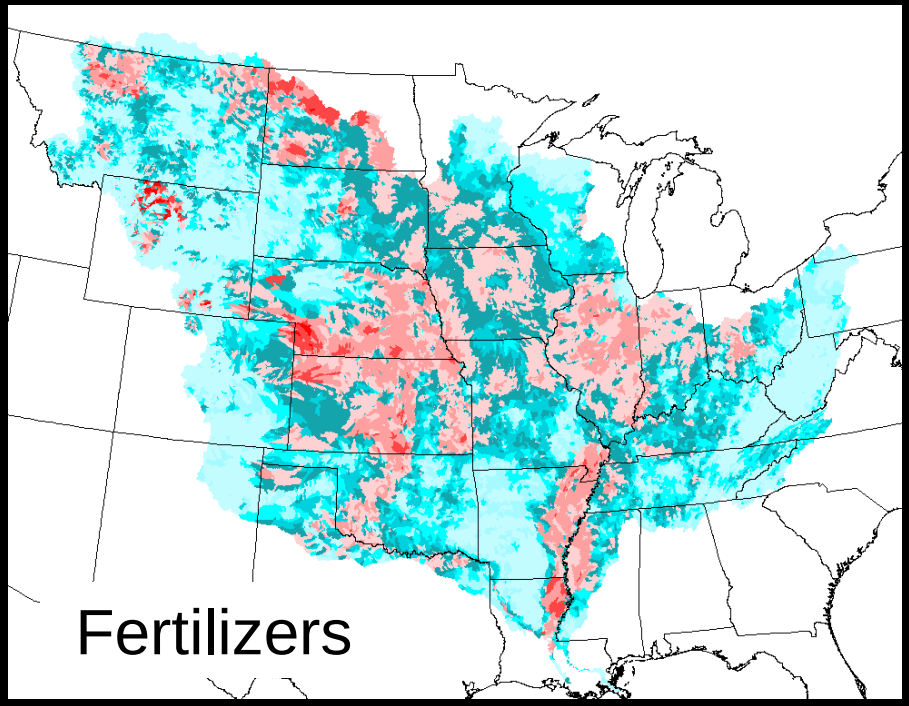
SPARROW Mapper
Mississippi Basin 2002 Nutrient Models
Links
Zoom History
Available Layers
Nutrient model results
Total Phosphorus
Total Nitrogen
Area of Interest
Select State
Select Main Watershed
Select HUC8
Select Tributary Outlet
2002 Total Nitrogen Delivered Accumulated Load (kg)
Delivered Accumulated Load (kg)
220000000
200000000
180000000
160000000
140000000
120000000
100000000
80000000
60000000
40000000
20000000
0
1
10
20
30
Ranked by State
Atmospheric Deposition
Fixation and Legume Sources
Manure (Confined)
Farm Fertilizer
Urban Land
Sewerage Point Sources
Export Data
Delivered Accumulated Load for entire view
View Nutrient Totals
Calgary
Regina
Winnipeg
ONTARIO
QUEBEC
Québec
Ottawa
Montréal
Toronto
MICHIGAN
IDAHO
Salt Lake City
GREAT BASIN
NEVADA
UTAH
COLORADO PLATEAU
ARIZONA
NEW MEXICO
Las Vegas
Fresno
Los Angeles
San Diego
Tijuana
Phoenix
Tucson
El Paso
TEXAS
Austin
San Antonio
Houston
Dallas
Hermosillo
Chihuahua
Torreon
Monterrey
Brownsville
1000 km
500 mi

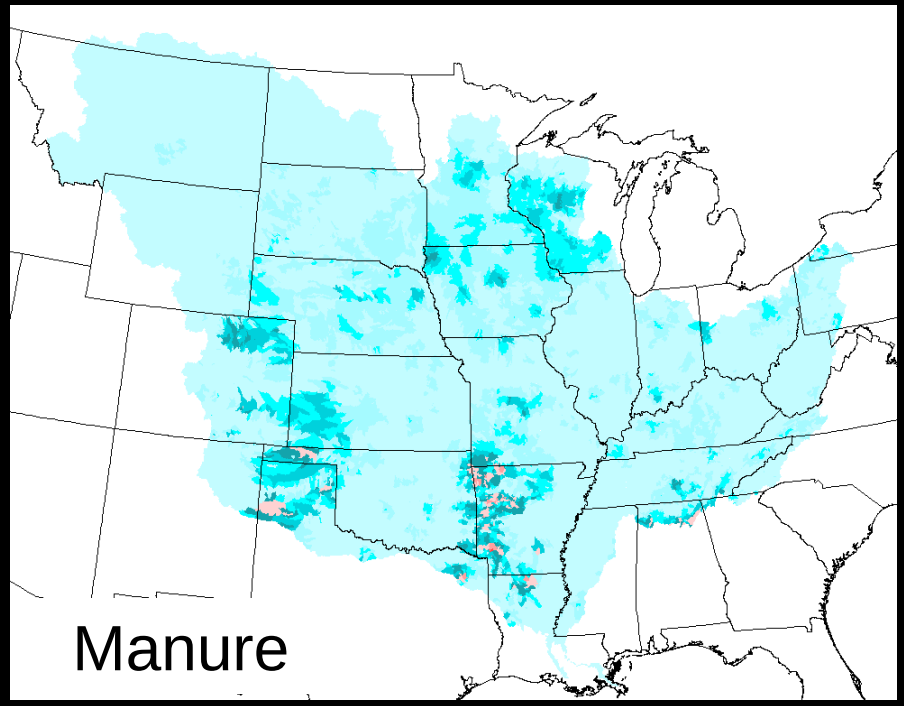
Preliminary Ranking of State Contributions to the Gulf of Mexico from the MARB



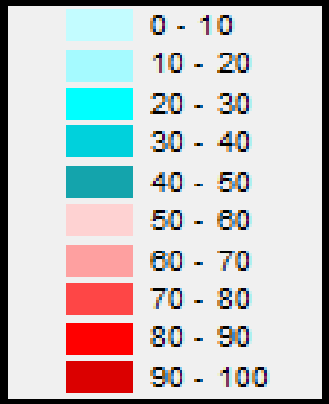
Robertson et al., 2014

Nitrogen Sources

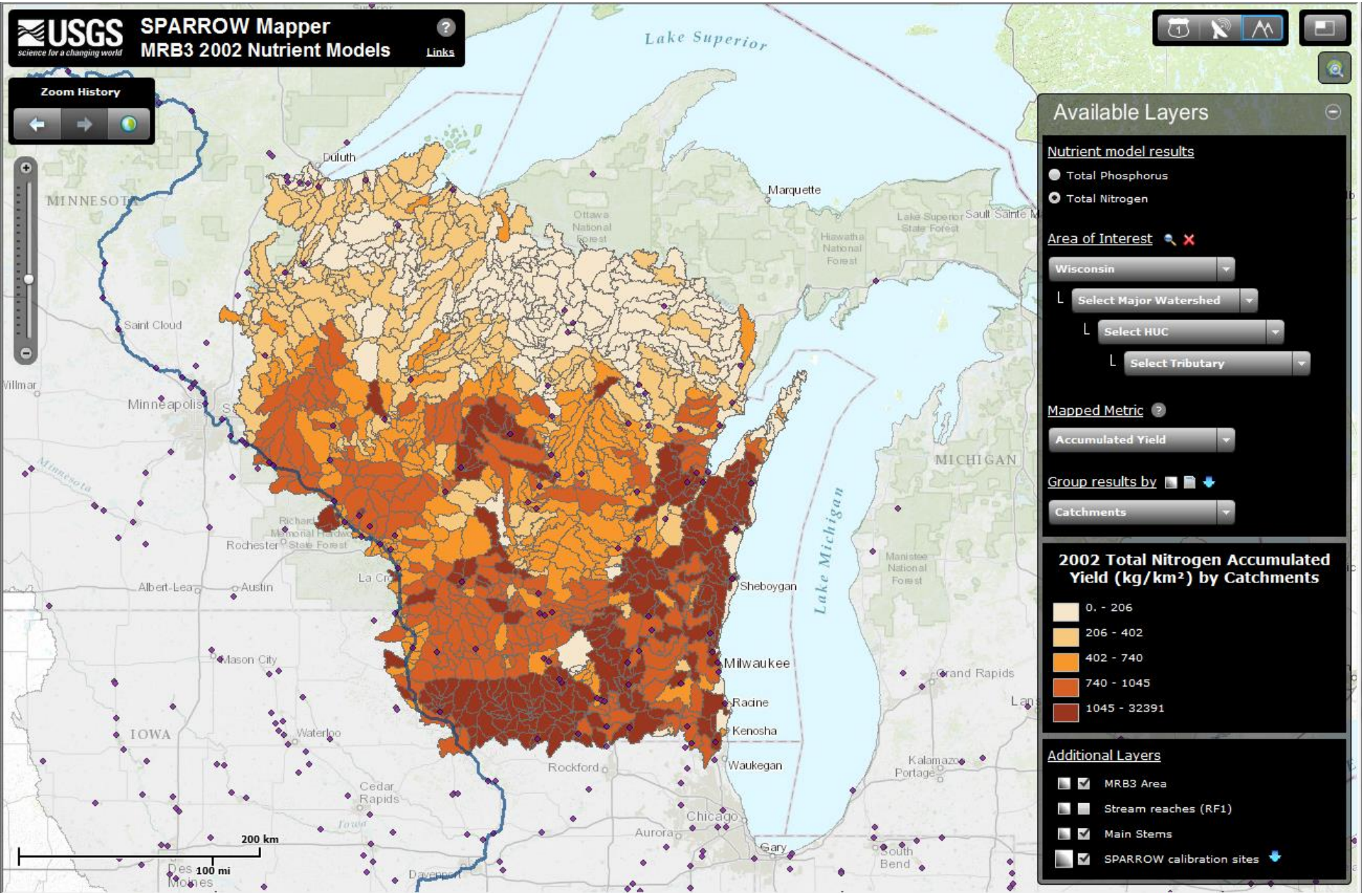




Percent of Source to Total Incremental Load



Robertson and Saad, 2013


USGS
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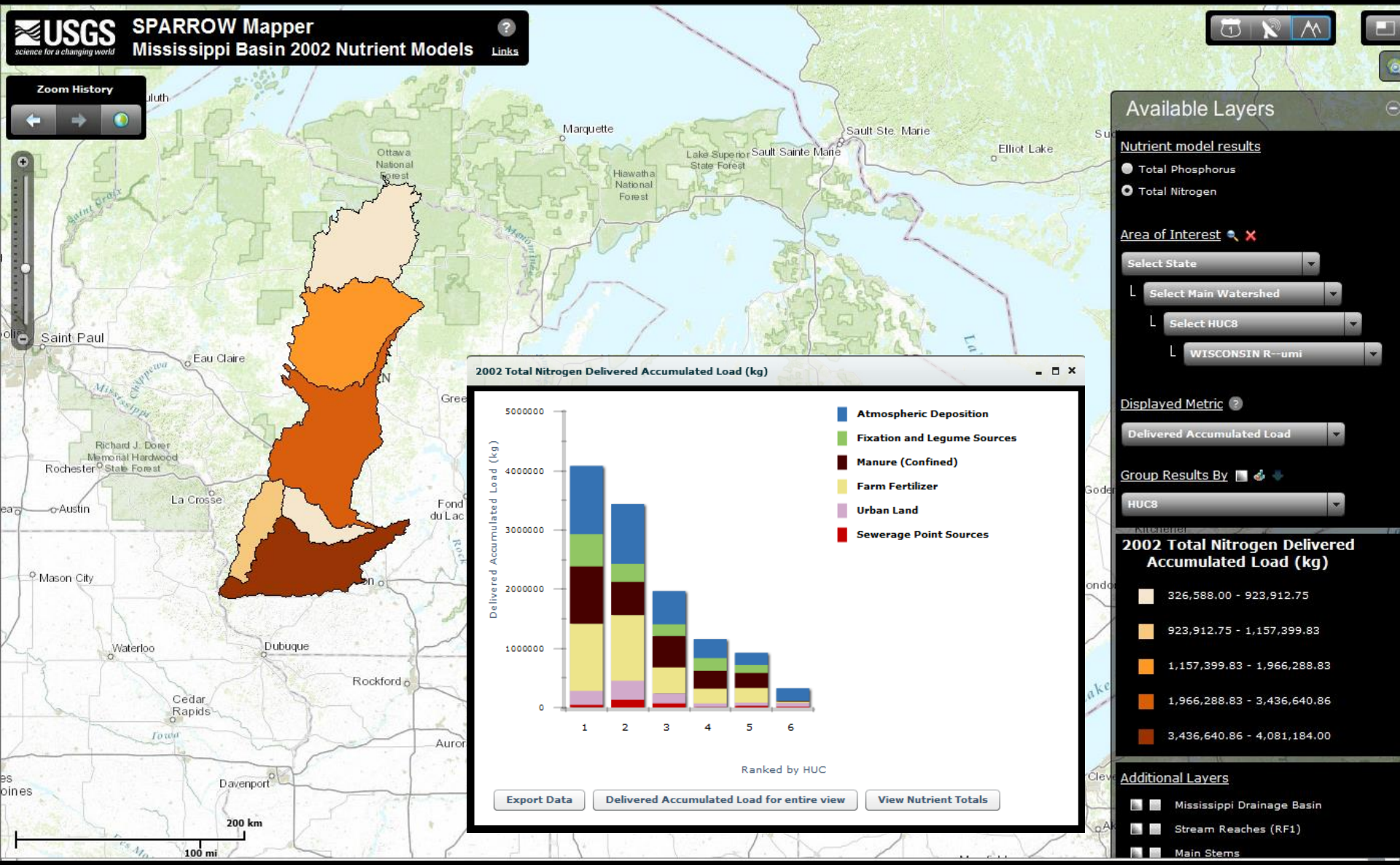
SPARROW Mapper
MRB3 2002 Nutrient Models
Links
Zoom History
Available Layers
Nutrient model results
Total Phosphorus
Total Nitrogen
Area of Interest
Wisconsin
Select Major Watershed
Select HUC
Select Tributary
Mapped Metric
Accumulated Yield
Group results by
Catchments
2002 Total Nitrogen Accumulated Yield (kg/km²) by Catchments
0. - 206
206 - 402
402 - 740
740 - 1045
1045 - 32391
Additional Layers
MRB3 Area
Stream reaches (RF1)
Main Stems
SPARROW calibration sites
Lake Superior
Lake Michigan
MINNESOTA
MICHIGAN
IOWA
Duluth
Marquette
Saint Cloud
Minneapolis
Rochester
Albert Lea
Austin
Mason City
Waterloo
Cedar Rapids
Rockford
Sheboygan
Milwaukee
Racine
Kenosha
Waukegan
Chicago
Aurora
Gary
Grand Rapids
Kalamazoo
South Bend
Des Moines
Davenport
200 km
100 mi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SPARROW Mapper
Mississippi Basin 2002 Nutrient Models
Links
Zoom History
Available Layers
Nutrient model results
Total Phosphorus
Total Nitrogen
Area of Interest
Select State
Select Main Watershed
Select HUC8
WISCONSIN R--umi
Displayed Metric
Delivered Accumulated Load
Group Results By
HUC8
2002 Total Nitrogen Delivered Accumulated Load (kg)
326,588.00 - 923,912.75
923,912.75 - 1,157,399.83
1,157,399.83 - 1,966,288.83
1,966,288.83 - 3,436,640.86
3,436,640.86 - 4,081,184.00
Additional Layers
Mississippi Drainage Basin
Stream Reaches (RF1)
Main Stems
2002 Total Nitrogen Delivered Accumulated Load (kg)
Delivered Accumulated Load (kg)
5000000
4000000
3000000
2000000
1000000
0
1
2
3
4
5
6
Ranked by HUC
Atmospheric Deposition
Fixation and Legume Sources
Manure (Confined)
Farm Fertilizer
Urban Land
Sewerage Point Sources
Export Data
Delivered Accumulated Load for entire view
View Nutrient Totals
Marquette
Sault Ste. Marie
Sault Sainte Marie
Elliot Lake
Lake Superior State Forest
Hiawatha National Forest
Ottawa National Forest
Saint Paul
Eau Claire
Rochester
Richard J. Dorer Memorial Hardwood State Forest
La Crosse
Austin
Mason City
Waterloo
Dubuque
Rockford
Cedar Rapids
Davenport
Fond du Lac
200 km
100 mi