Sources of Nutrients in the Nation's Watersheds

By

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Presentation Outline

- Introduction: Objective/Problem
- Description of SPARROW
- Methods
- Results and Conclusions

Objective

To quantify nutrient sources in the nation's watersheds so as to display their relative effects on water quality.

Problem

The effects of nutrient sources on in-stream water quality is a function of **source inputs** and **watershed processes.**

Problem (Cont.)

Source inputs are documented, but watershed processes require a model. There are good arguments for including processes:

- Effects on sources are large
- Effects vary from source to source
- Many management variables affect processes

Desirable properties of the watershed model:

- Comprehensive of nutrient sources
- Nationally consistent
- Based on monitoring data (verified)
- Quantified reliability
- Scale independent

SPARROW

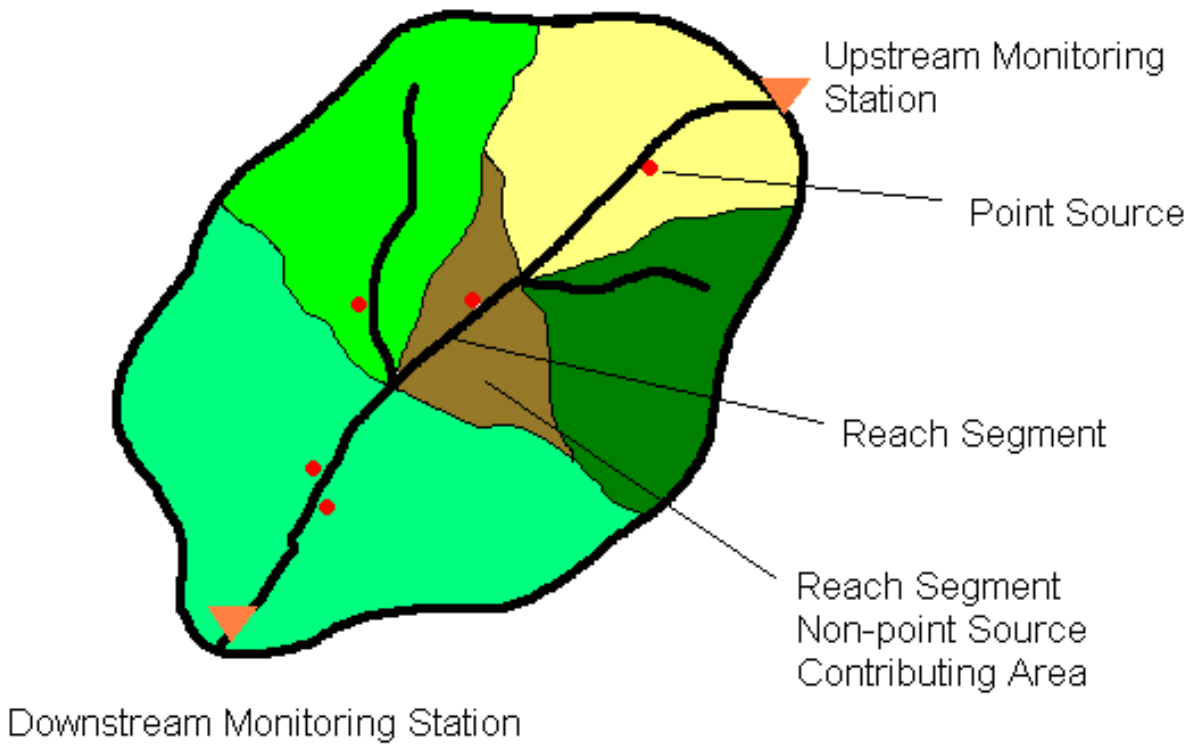
SPAtially Referenced Regressions On Watershed Attributes

A statistical method for regional interpretation of water-quality monitoring data

Overview of SPARROW

- Regression of monitoring data on watershed characteristics
- Model is non-linear description of transport processes
- Separates **land-to-water** processes from **in-stream** processes
- Traces nutrients through stream network

Schematic of a Nested Basin



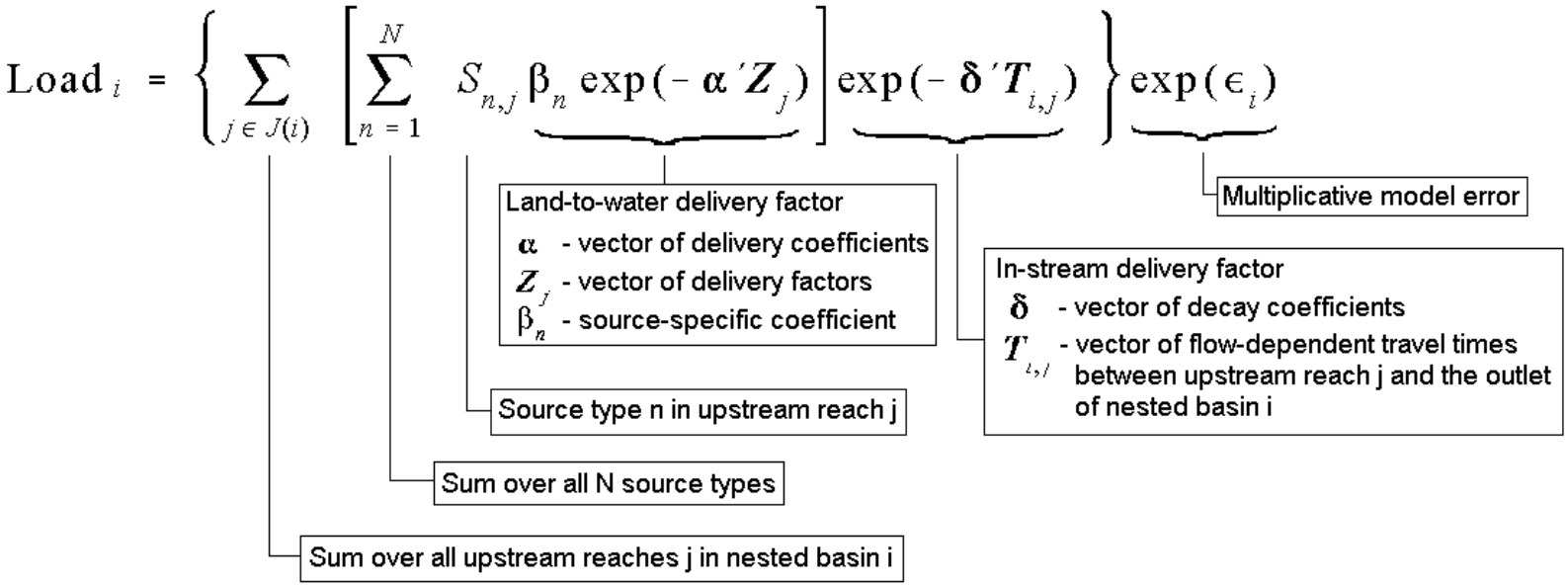
Nutrient Sources

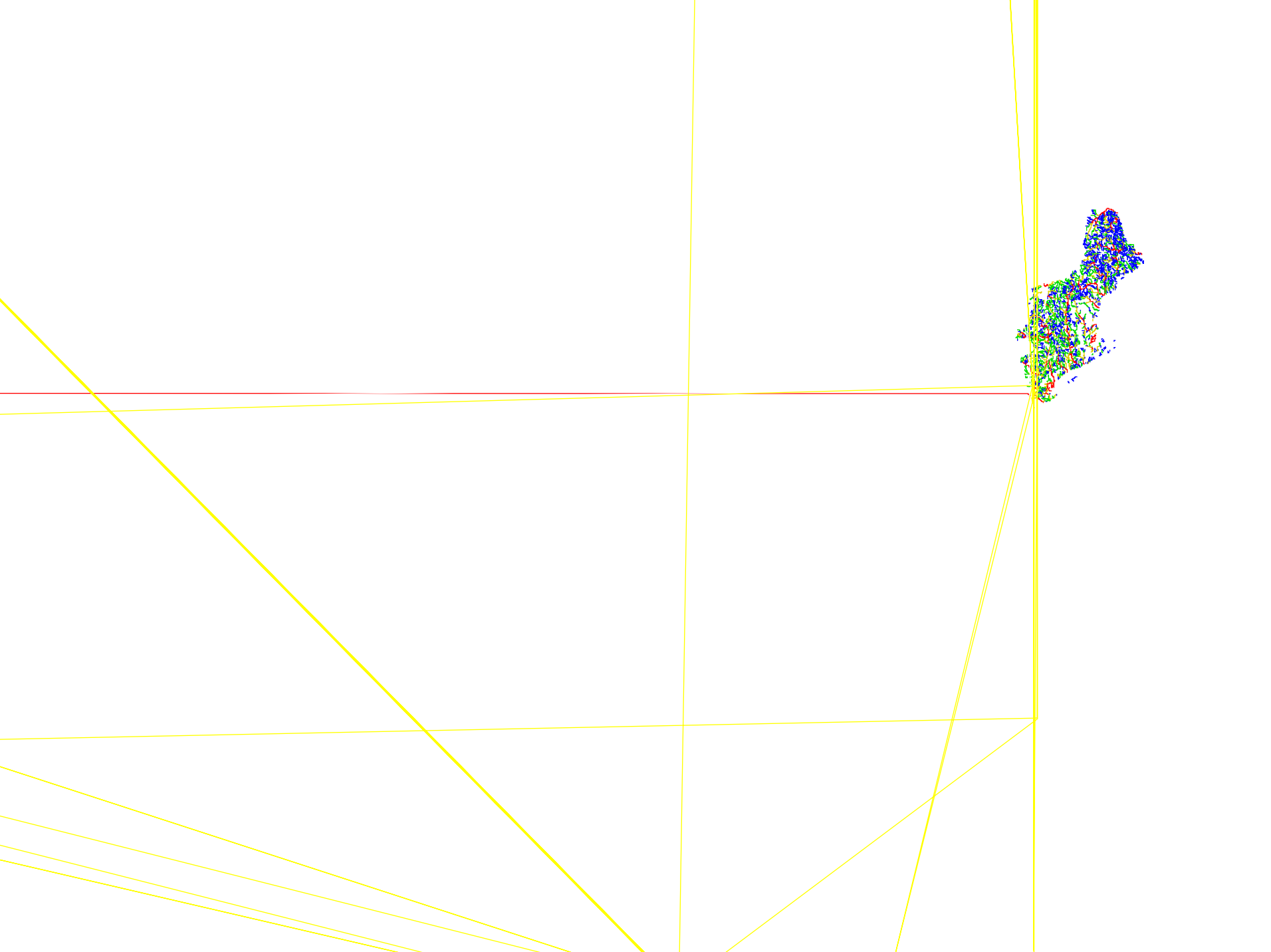
- Point Sources
- Fertilizer
- Animal Agriculture
- Atmospheric Deposition
- Non-agricultural Runoff

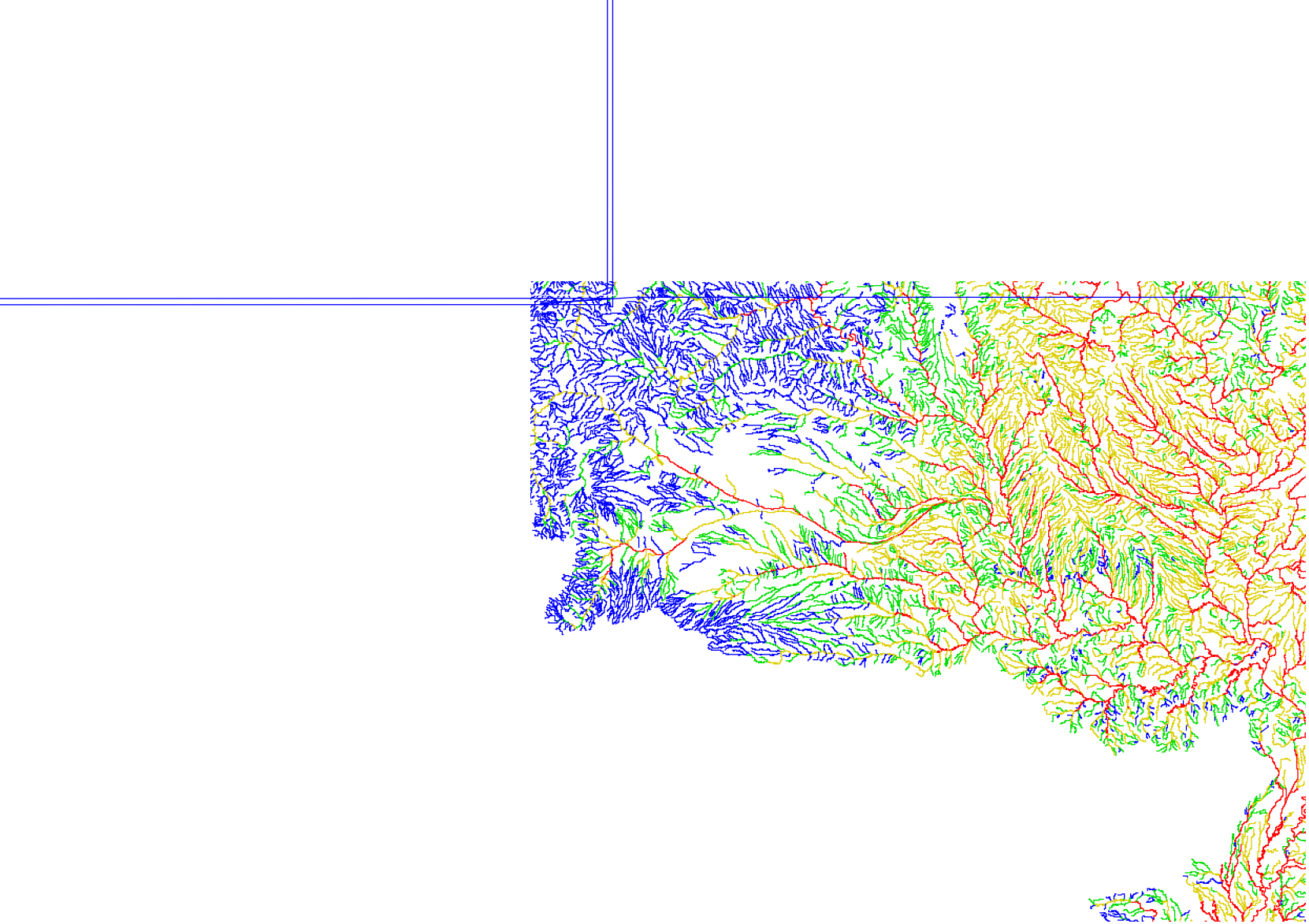
Process Variables

- Land to Water
  - Temperature
  - Soil Permeability
  - Slope
  - Stream Density
- In-Stream Decay
  - Channel Size/Flow
  - Velocity
  - Reservoir Characteristics

Estimated Equation





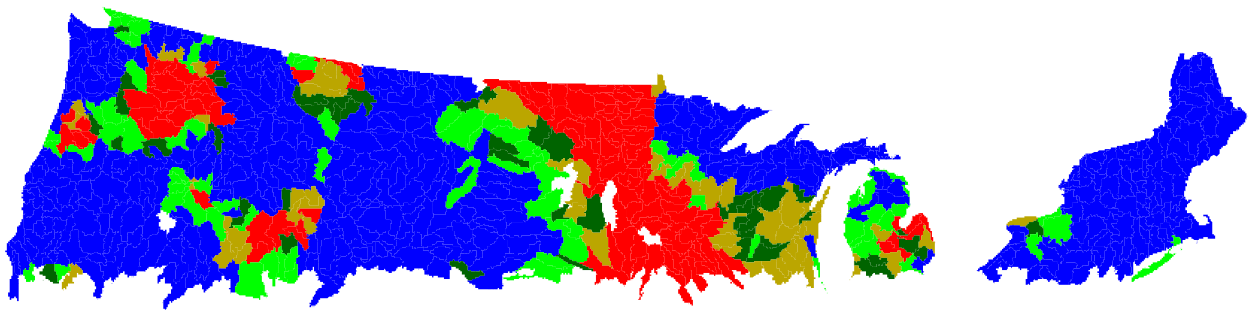


Model Evaluation

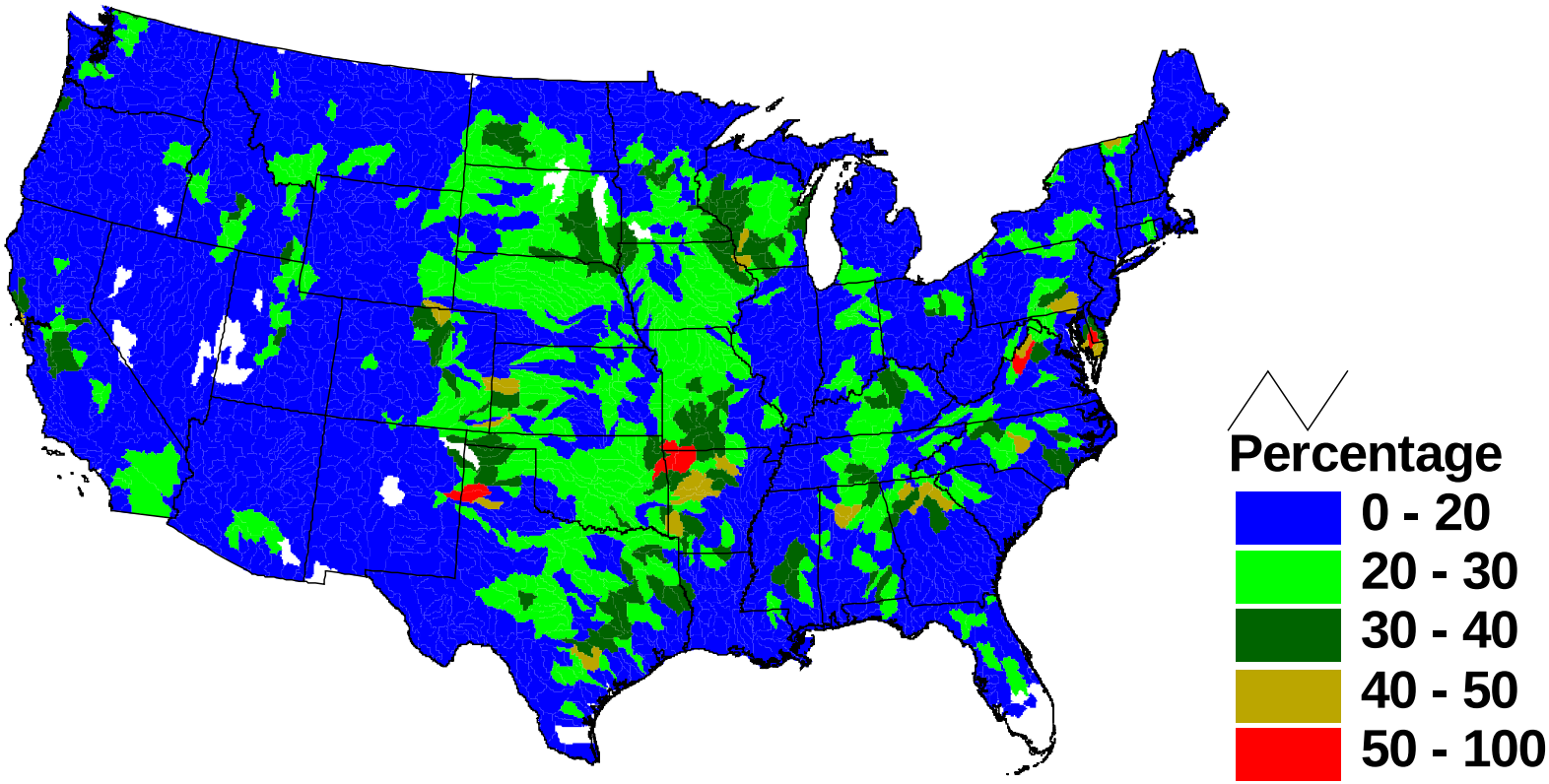
- Conventional statistics (R^2, t statistics)
- Bootstrap estimation of model coefficients and predictions
- Verification of model predictions with independent observations
- Comparison of model coefficients with other published estimates

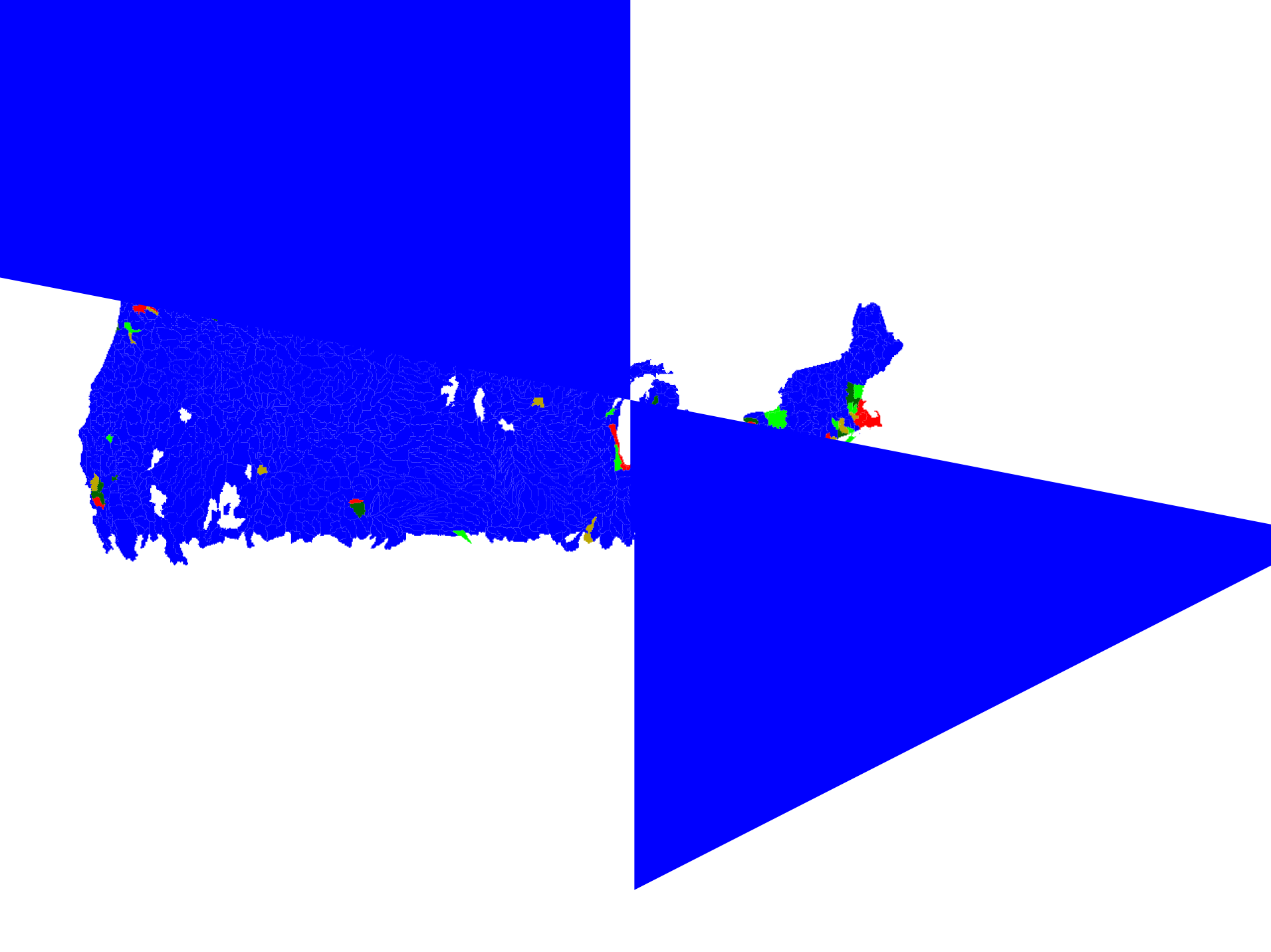
Results displayed for Hydrologic Cataloging Unit watersheds:

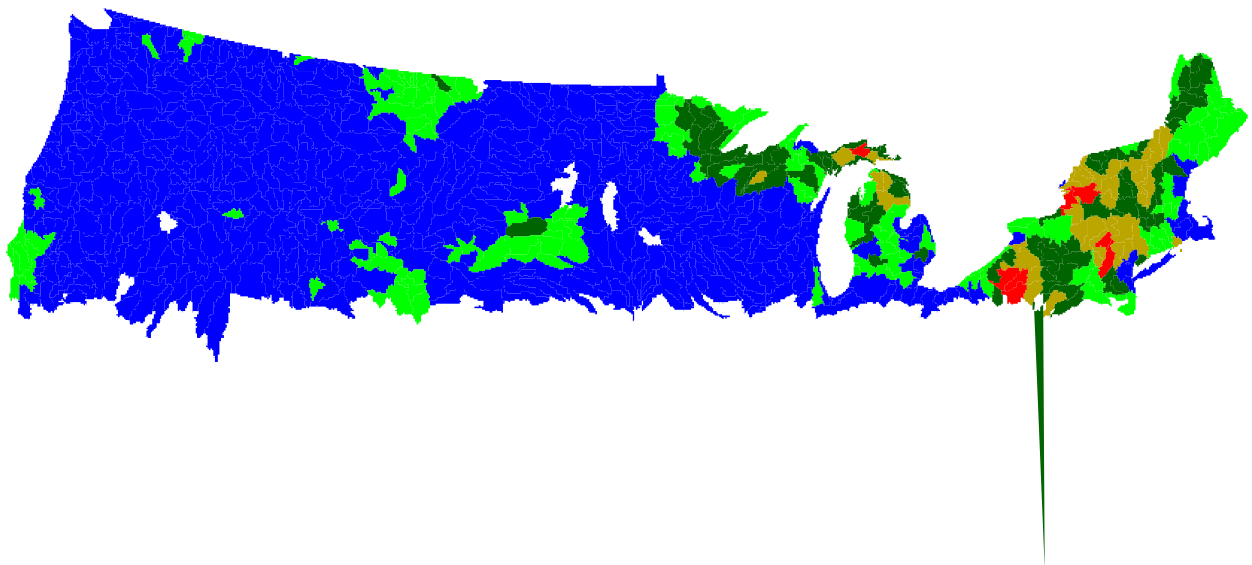
- Total of 2057 watersheds
- Widely recognized
- Systematically developed
- Spatially representative view of water quality conditions

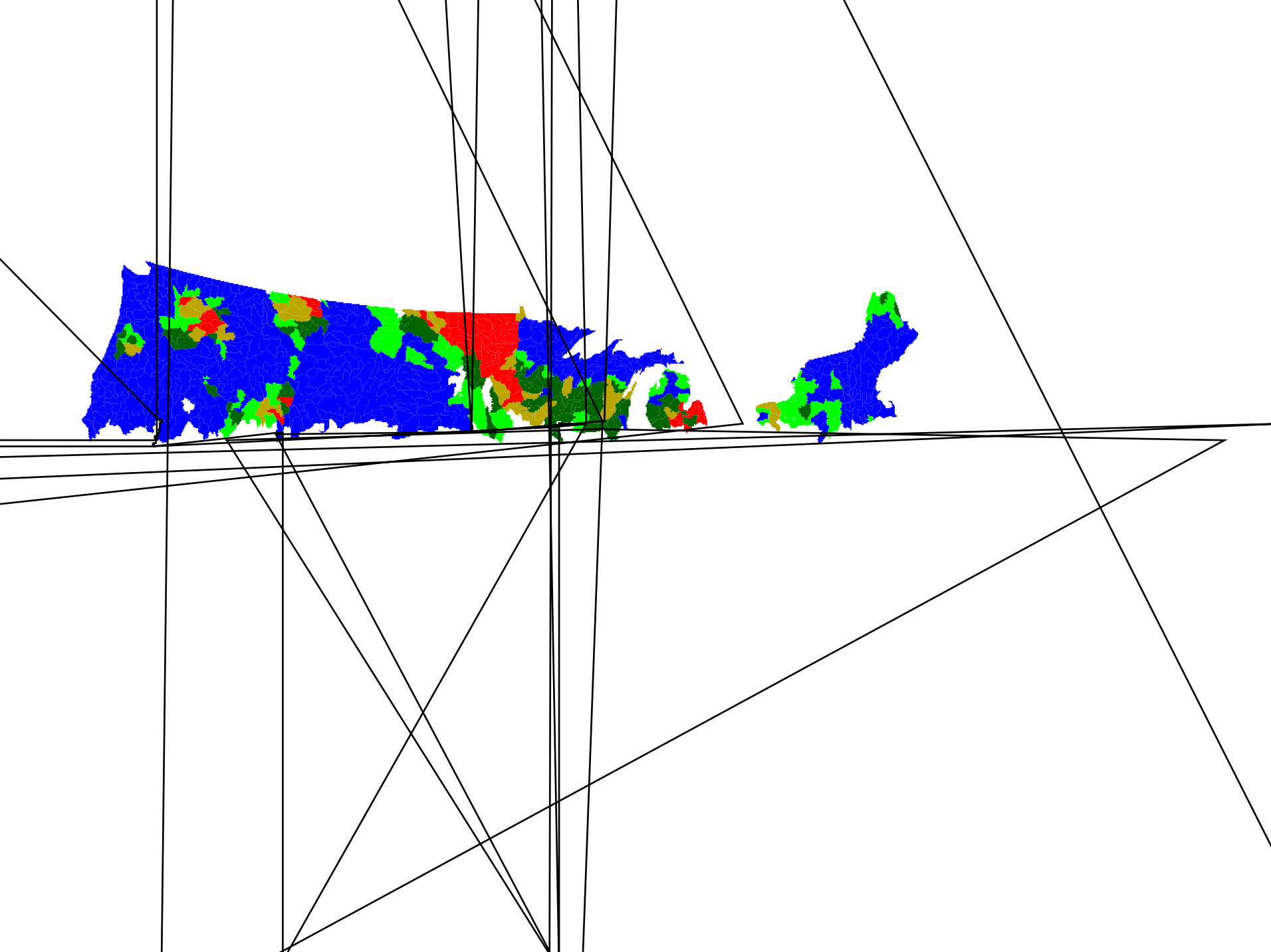


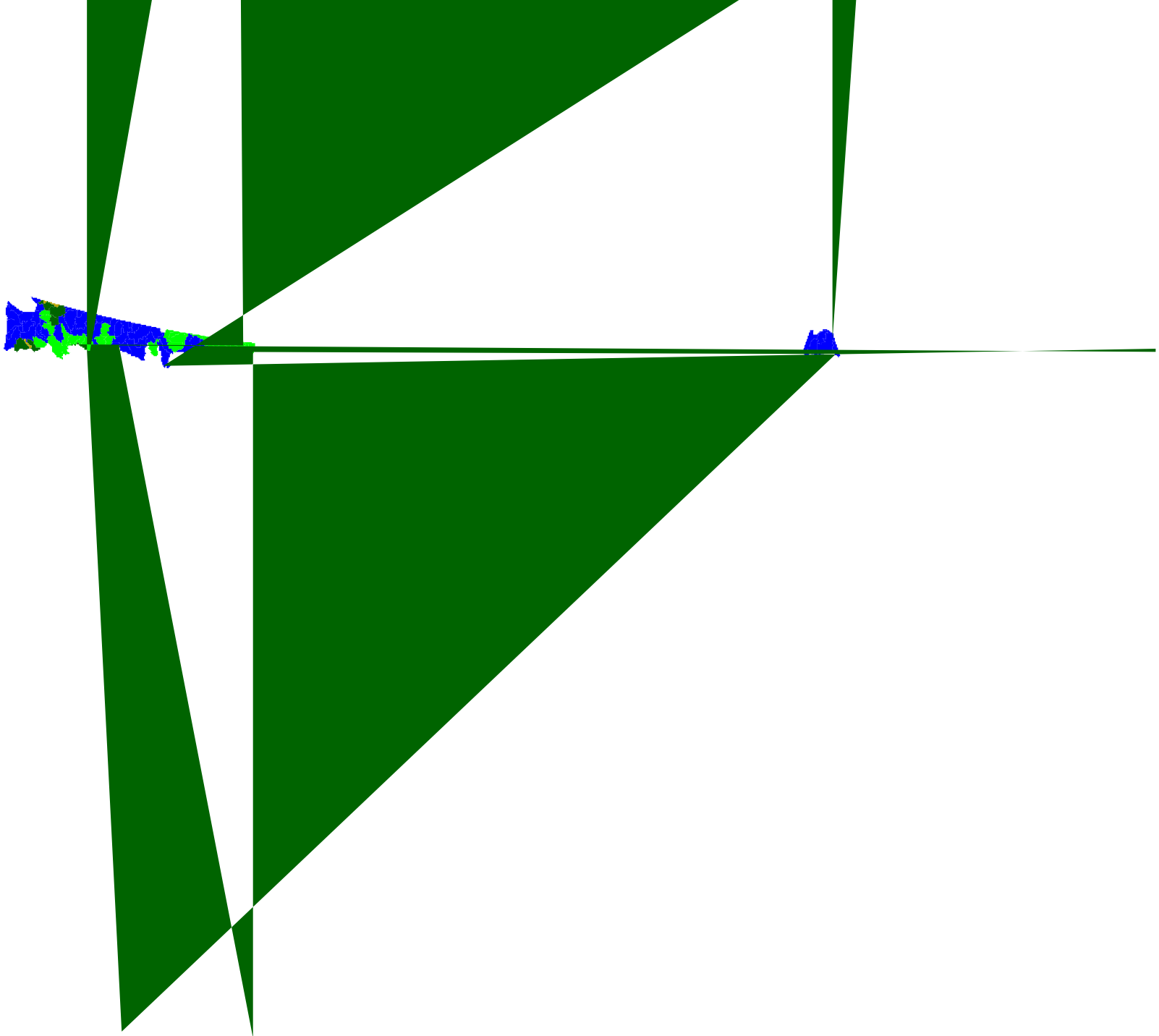
Animal Agriculture Contributions to Total Nitrogen Export











Conclusions

- The relative importance of nutrient sources is best expressed in **in-stream** terms rather than “raw” **inputs.**
- SPARROW models provide reliable, scale-independent estimates of the total N and total P contributions to watershed export from five categories of nutrient sources.

Conclusions (continued)

- The relative importance of different source categories varies greatly from one region to another.
- Point sources contribute little to nutrient export in most watersheds, but are the major source of total P in some densely-populated basins.

Conclusions (continued)

- Atmospheric deposition is the largest contributor to total N export in the northeastern U.S.

- Agricultural fertilizer is the largest contributor in most watersheds in the Ohio Valley and Midwestern U.S.

Conclusions (continued)

- **Animal agriculture** is also an important contributor of both TN and TP in many agricultural areas, but is generally a much larger contributor of **total P** than of total N.

SPARROW Web Page

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