

SUPPORTING CHESAPEAKE BAY RESTORATION BY MODELING NUTRIENT SOURCES AND TRANSPORT

USGS and EPA

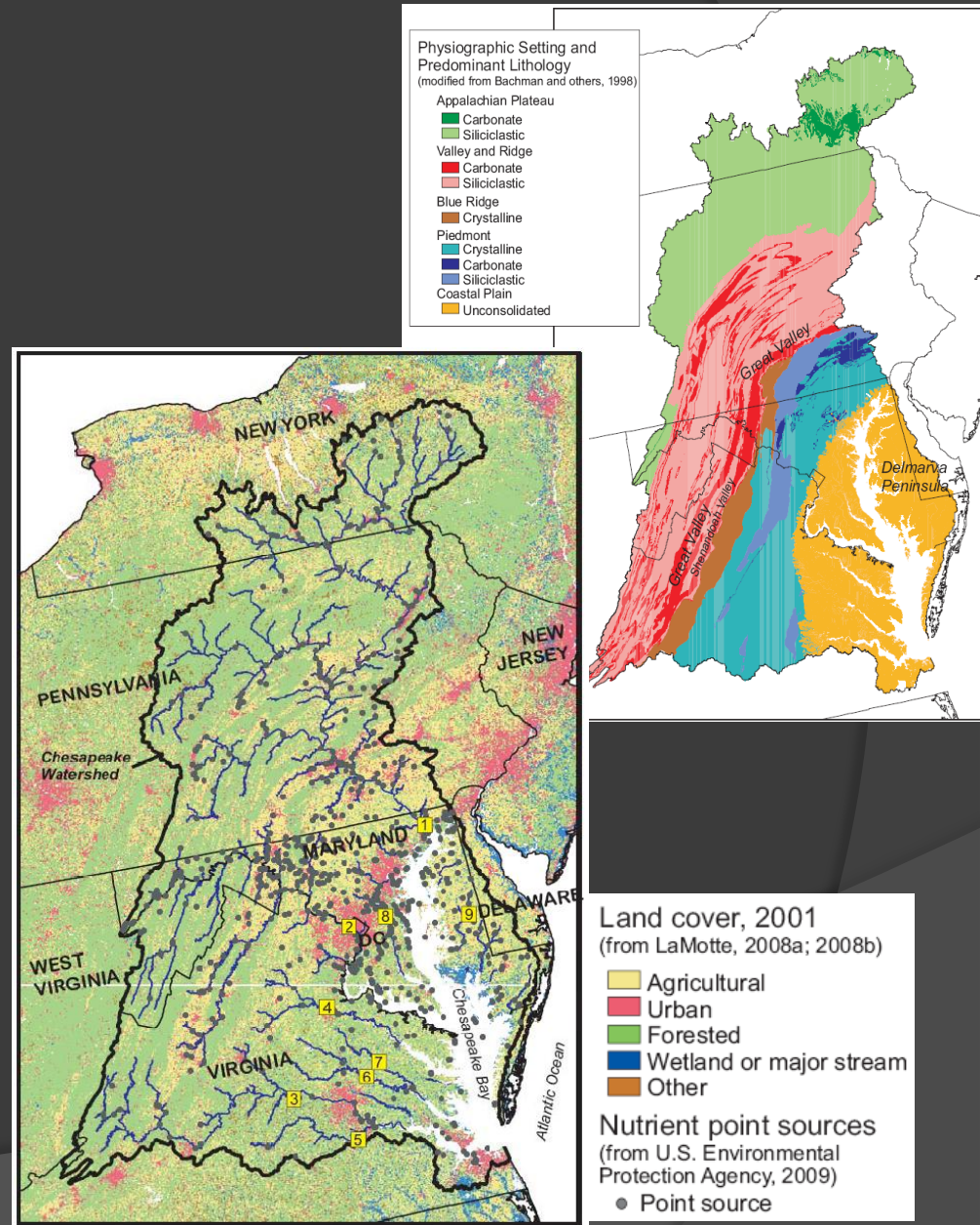
Applications and Results
of SPARROW Models

Goals

- ⦿ Update on recently released SPARROW models of Nitrogen and Phosphorus
 - Background
 - Enhancements
 - Findings
 - Applications
- ⦿ Update on an approach that uses SPARROW predictions and 12 Digit Hydrologic units to help identify areas for water-quality improvement
- ⦿ Next steps

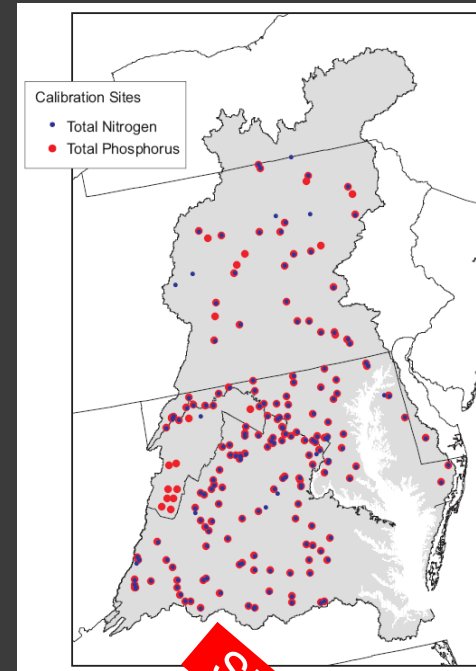
Chesapeake Bay Watershed

- Restoration efforts have been designed and supported using numerical models:
 - Chesapeake Bay Program HSPF watershed model
 - TMDL's implemented and managed
 - USGS SPARROW
 - Help gain a comprehensive understanding of where nutrients and sediment originate
 - How they move throughout the watershed
 - Assist management actions

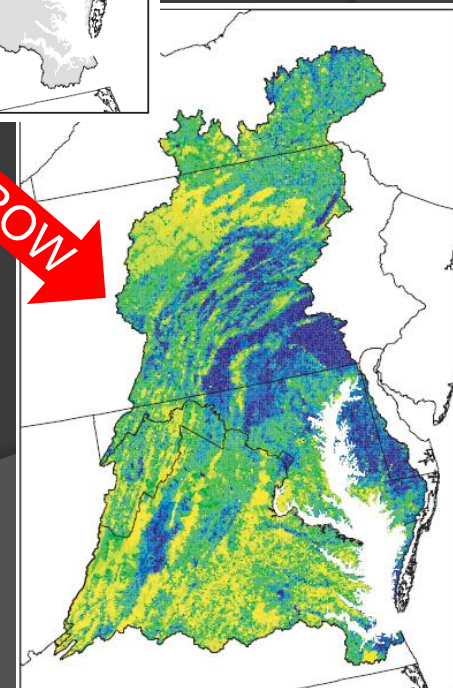


SPatially Referenced Regressions On Watershed Attributes

- Spatial Statistical Approach that Empirically Relates Contaminant Sources and Transport Factors to Measured Stream Flux
 - Identify the spatial variability and magnitude of contaminant supply
 - Quantify the contributions at various locations
- Tool Provides Spatially Detailed Predictions:
 - Map individual contaminant sources in unmonitored locations
 - Statistical importance and quantification of contaminant sources
 - Provides measures of uncertainty
- Spatial Framework
 - Explicit for evaluating geographic distribution of sources that can be used for WIP
 - Potential Geographic Targeting

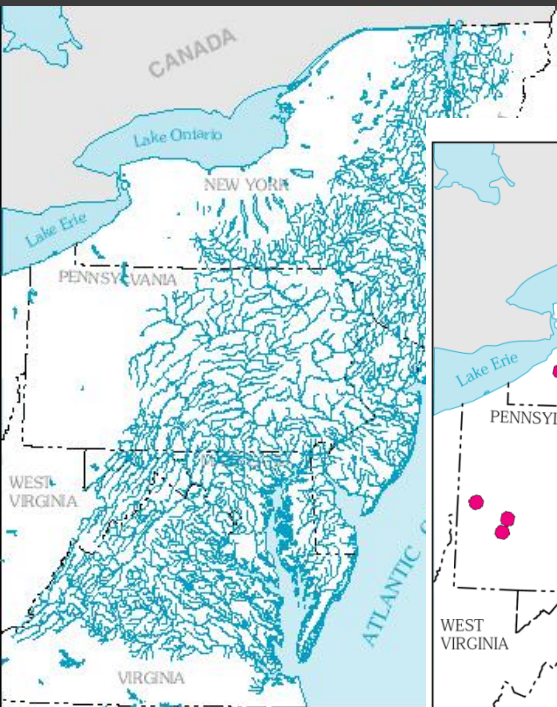


SPARROW

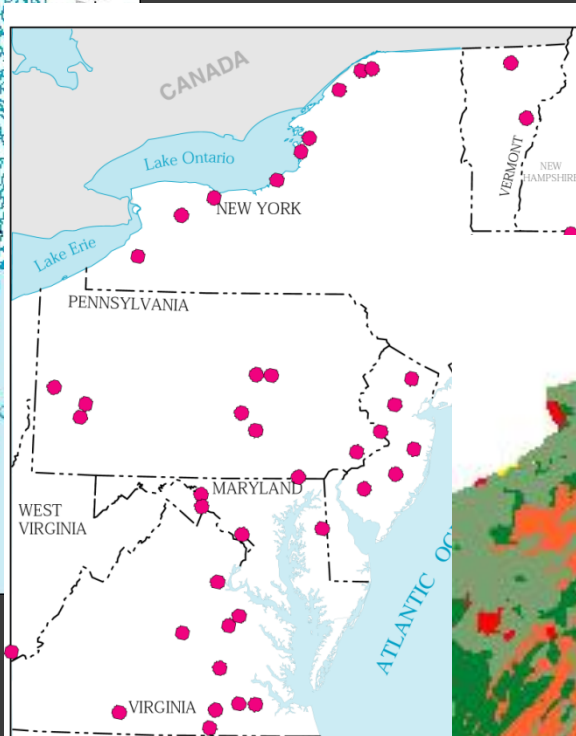


SPARROW Spatially Designed

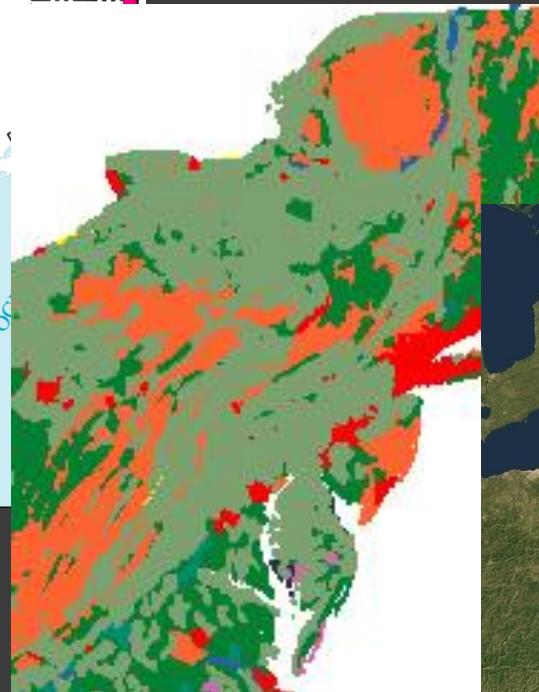
Integrates spatial data over multiple scales to predict origin & fate of contaminants



Network of connected and attributed streams and watersheds

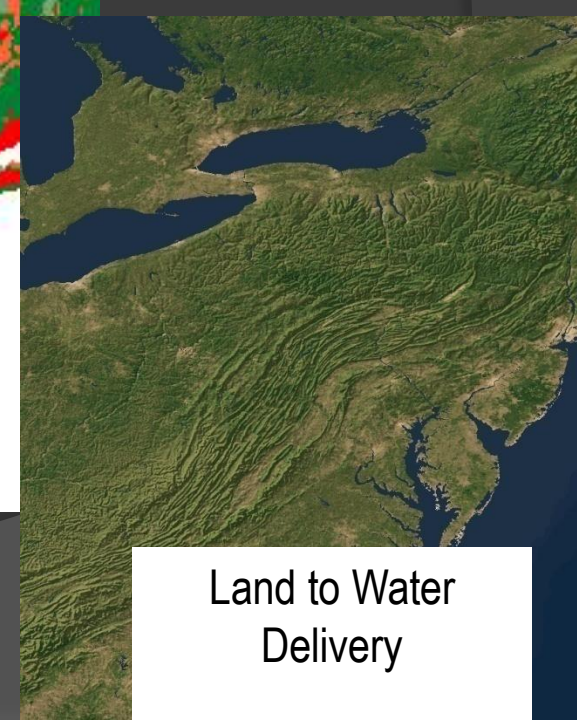


Monitoring Data (Dependent Variable)



Source data

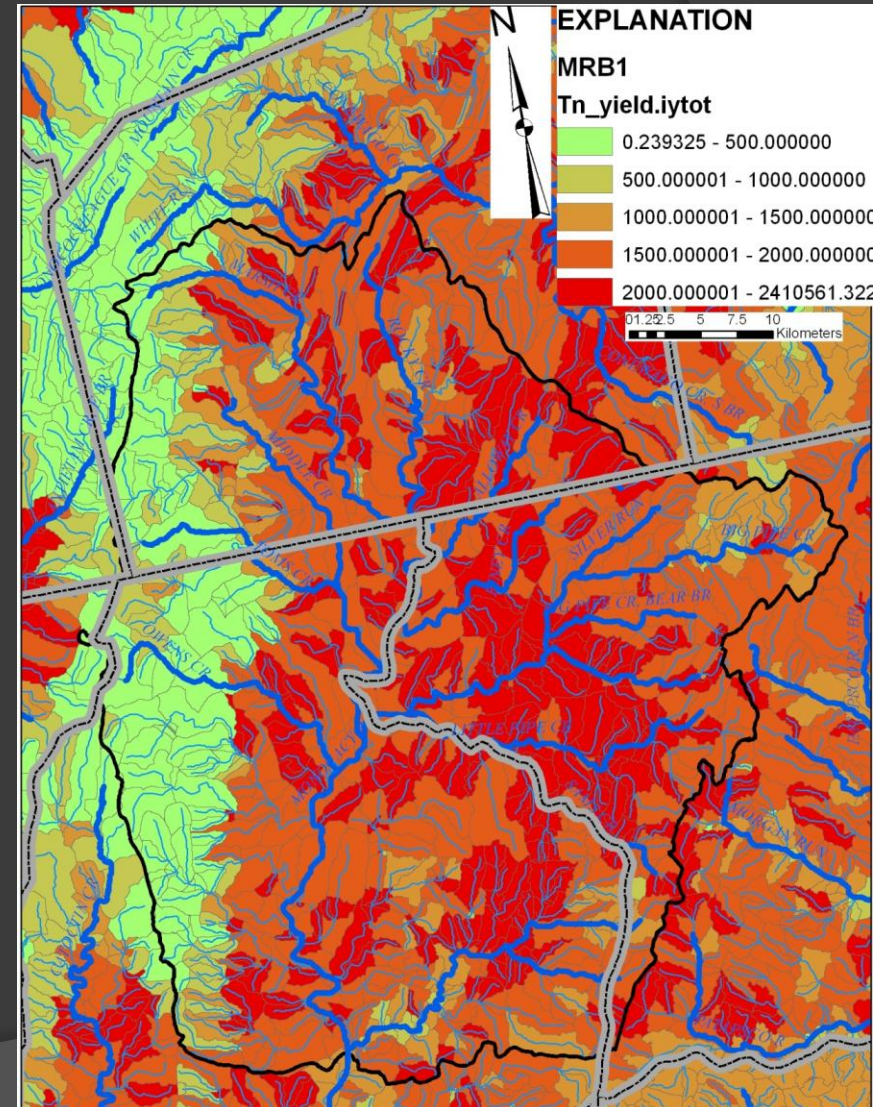
Slope, Physiography,
Soil Characteristics,
Reservoir Systems



Land to Water
Delivery

Chesapeake Bay SPARROW Models

- Previous models:
 - Late 1980s (TN, TP)
 - Early 1990s (TN, TP)
 - Late 1990s (TN, TP)
 - Early 2000s (sediment)
- Updated models:
 - Early 2000s (TN,TP)
 - Finer spatial resolution
 - More calibration stations
 - Updated sources and expanded transport specification



Scale	Water-sheds	Mean Size (km ²)
1:500,000	2,734	75
1:100,000	80,579	2.1

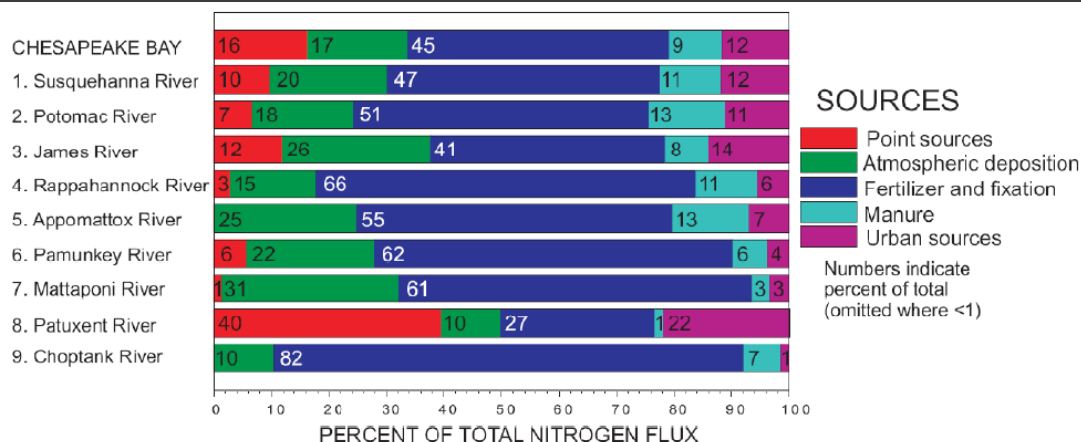
TN

- Sources
 - Point sources
 - Urban areas
 - Fertilizer (and N fixation)
 - Manure
 - Atmospheric N
- Transport
 - EVI (greenness) (negative)
 - AWC (redox) (negative)
 - GW recharge
 - Piedmont Carbonate
- Aquatic Decay
 - Streams
 - Reservoirs

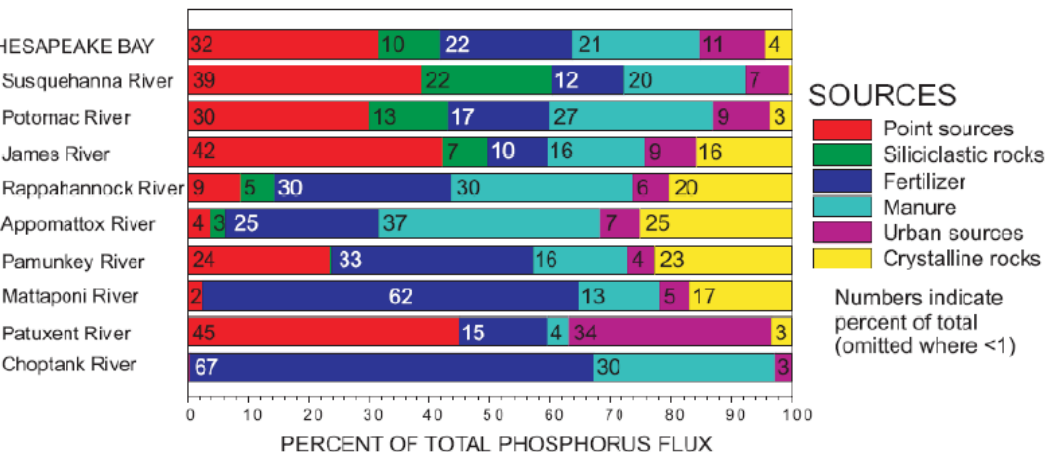
TP

- Sources
 - Point sources
 - Urban areas
 - Fertilizer
 - Manure
 - Mineral P
- Transport
 - Coastal Plain
 - Soil Erodibility
 - Precipitation
 - Well Drained Soils (negative)
- Aquatic Decay
 - Reservoirs

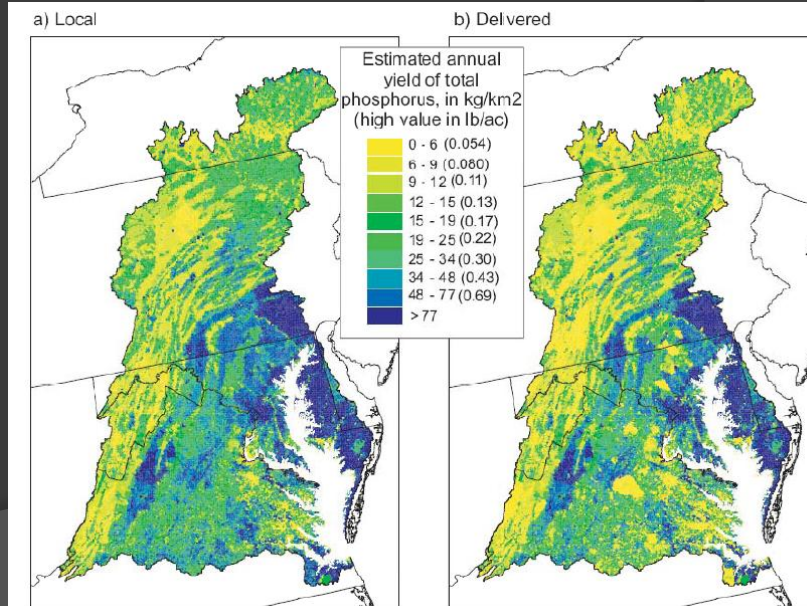
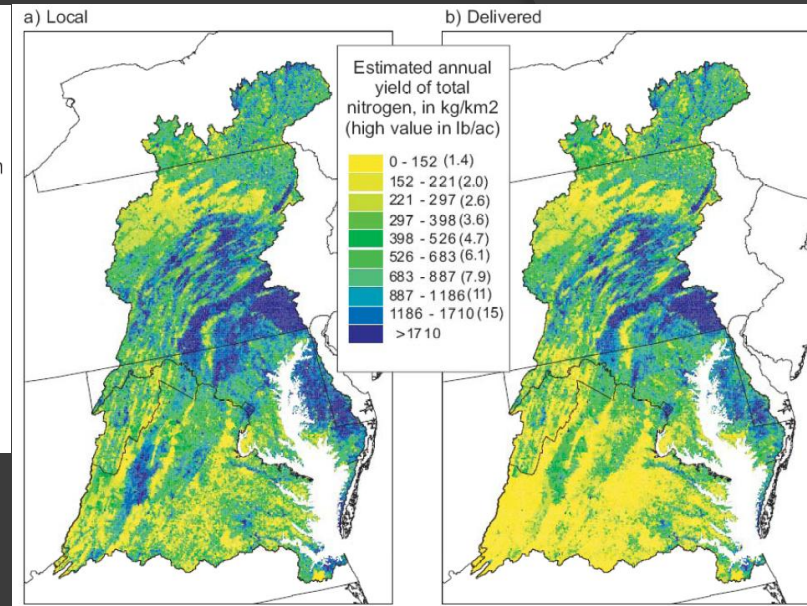
Key Findings



- Agriculture (Fertilizer and manure) is widespread, and a dominant sources of N to the Bay and most tributaries



- Natural mineral sources represent about 14 percent of TP sources



- 2002 Chesapeake Bay Nitrogen and Phosphorus SPARROW models
 - USGS SIR Report (including predictions)
 - <http://pubs.usgs.gov/sir/2011/5167/>
 - Also available in Decision Support System (DSS) for customized mapping and reporting of SPARROW results
 - Total Nitrogen:
<http://cida.usgs.gov/sparrow/map.jsp?model=54>
 - Total Phosphorus:
<http://cida.usgs.gov/sparrow/map.jsp?model=55>
 - Web demonstrations of SPARROW DSS – TBD
 - Web Summaries – Late winter, 2012

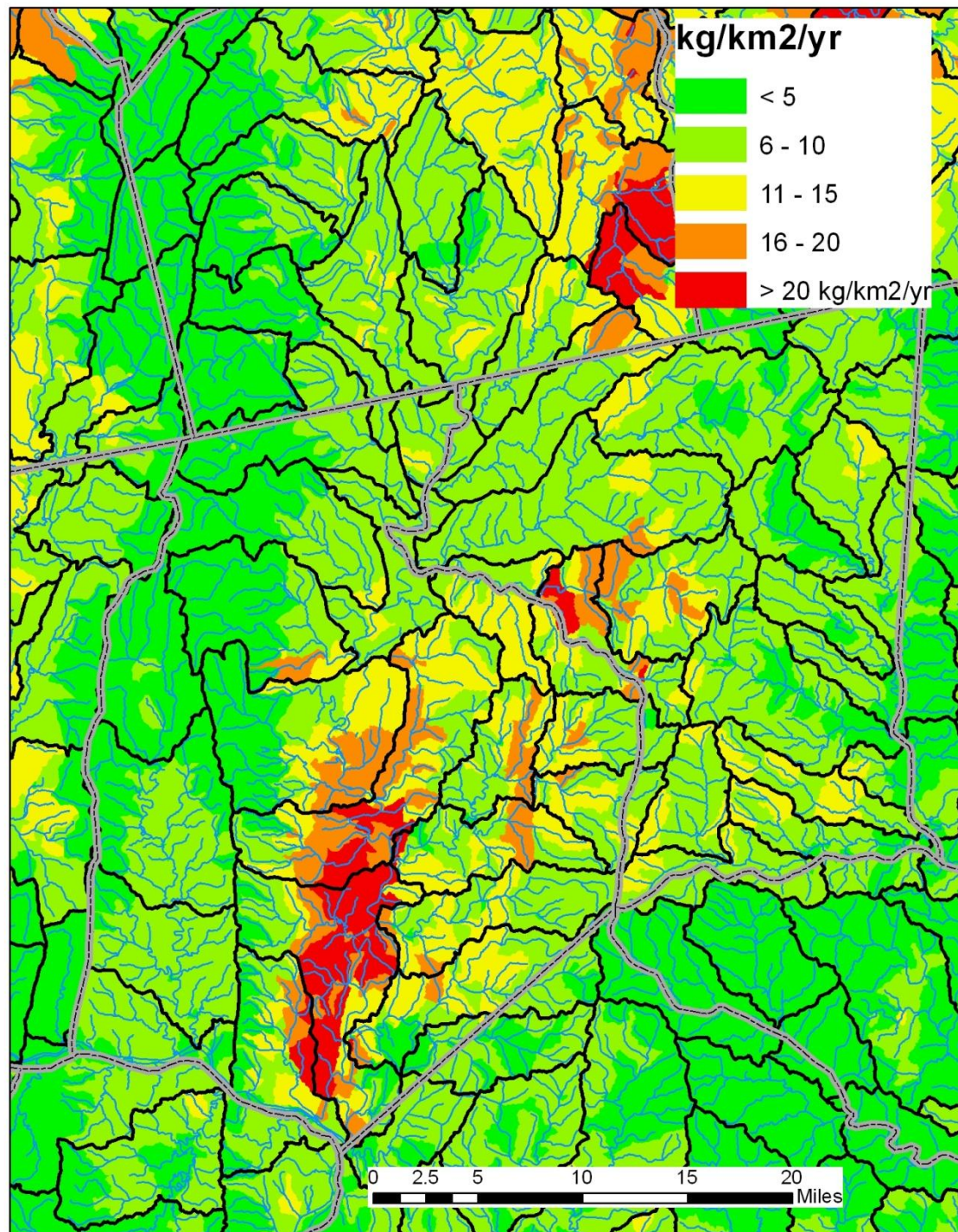
Applications at multiple scales.

Monocacy Basin example,
Total Nitrogen

Local yield
Delivered yield

All sources
or each source
individually

12 Digit HUC



Applications

- ◉ USDA Farm Bill allocations
- ◉ Developing EPA water-quality grant guidance
- ◉ Local Pilot
 - Carroll County Bureau of Resource Management
 - Target actions to maximize investment return and meet local TMDLs
 - Based on EPA WSM, State of MD has provided:
 - ◉ Specific required N and P load reductions
 - ◉ Sector specific: POINT, URBAN, AG
 - ◉ List of BMPs and “credits” for each
 - ◉ No guidance on what to do or where to do it

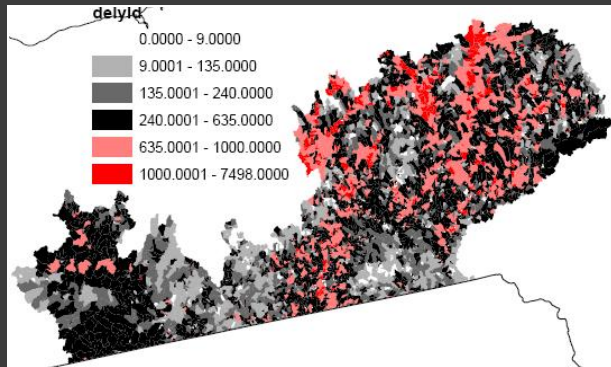
Sparrow Application

Updating Agricultural Priority Watershed Maps

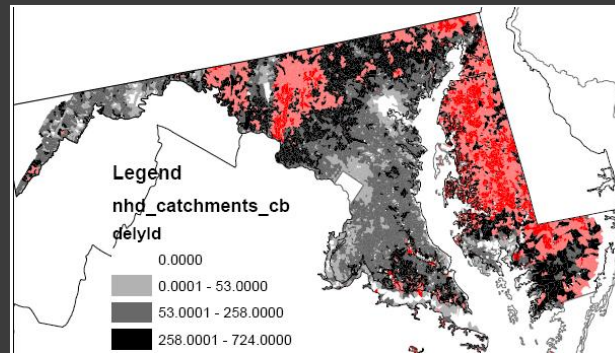
- ⦿ Current Ag Priority Watershed Maps used to focus implementation for greatest water quality benefit:
 - EPA implementation grants to Bay states.
 - EPA CBRAP grants.
 - NFWF Chesapeake Stewardship Fund
 - USDA CBWI Farm Bill Program
 - MD Bay Trust Fund
- ⦿ EPA Grant Guidance Affords Flexibility: States have option to propose other priority watersheds based on additional information.
- ⦿ Collaboration between EPA, USGS, USDA, States, other partners to update Ag Priority Watershed Maps with latest Sparrow analysis.

Delivered TN Yield from Agriculture – By State

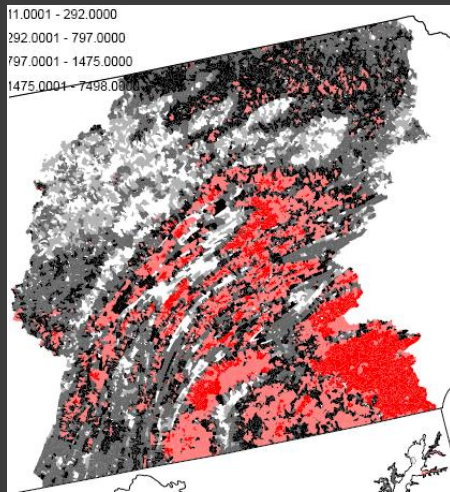
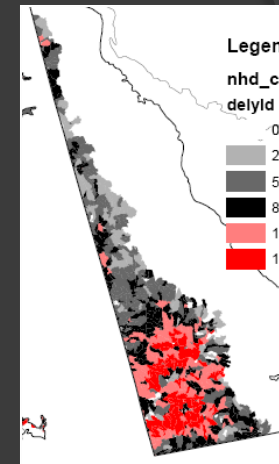
New York



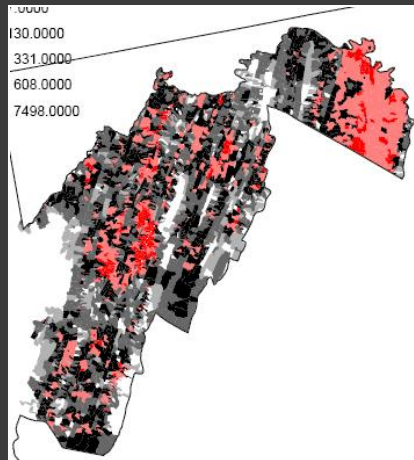
Maryland



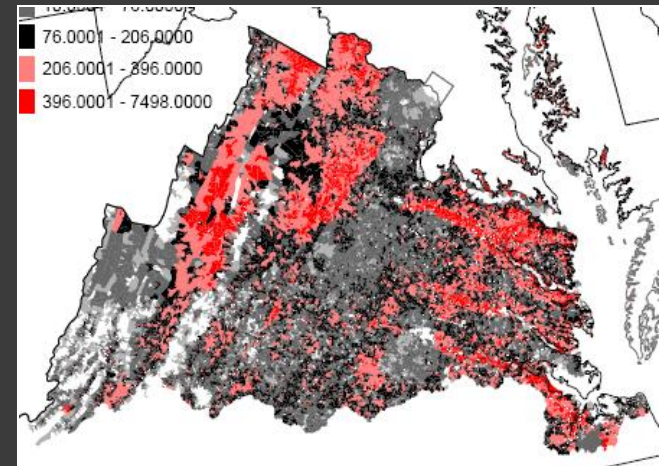
Delaware



Pennsylvania



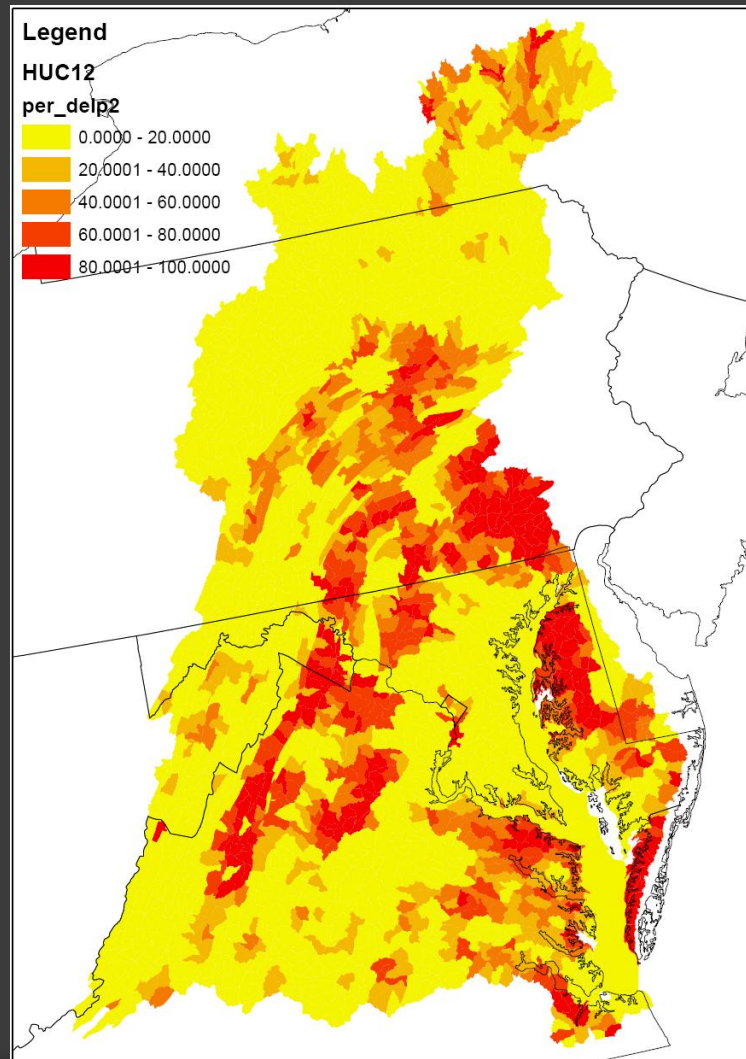
West Virginia



Virginia

DRAFT: Displaying Sparrow Analysis at the HUC-12 Scale

Percent of HUC12s in top 25% of TN Delivered Yield from Agriculture By State



DRAFT Example
for N

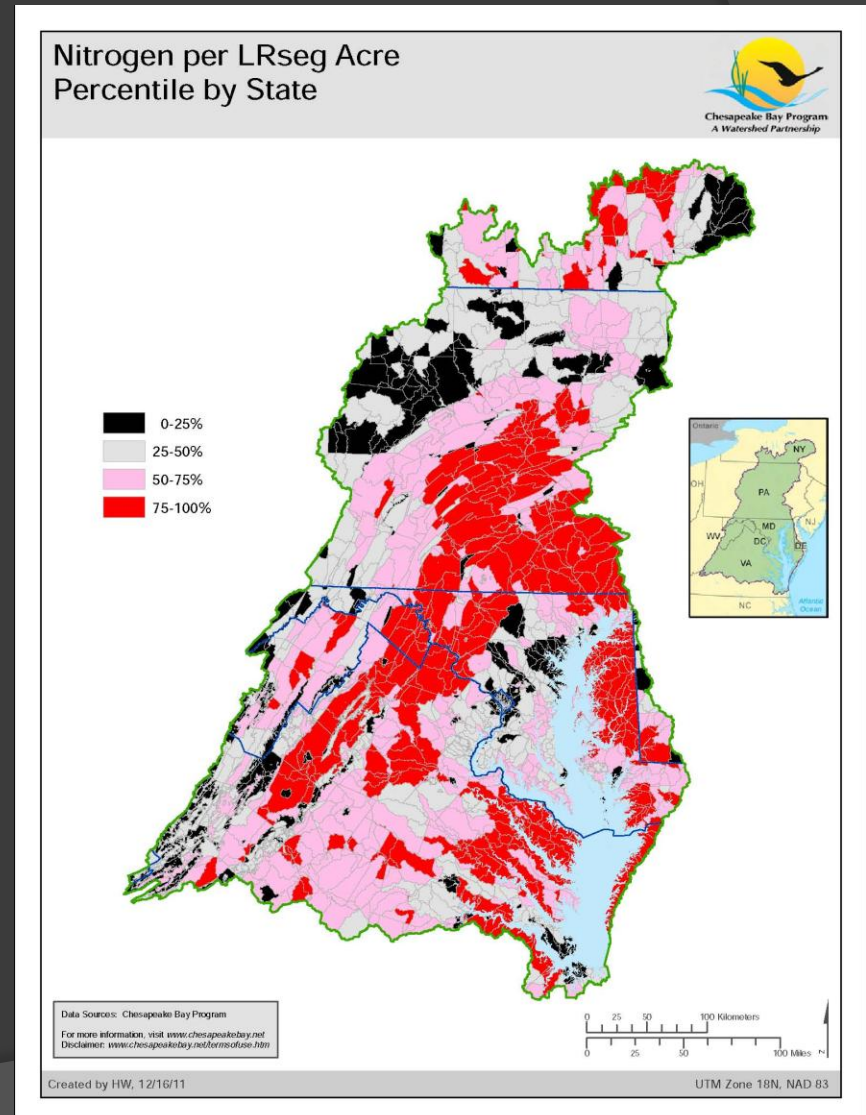
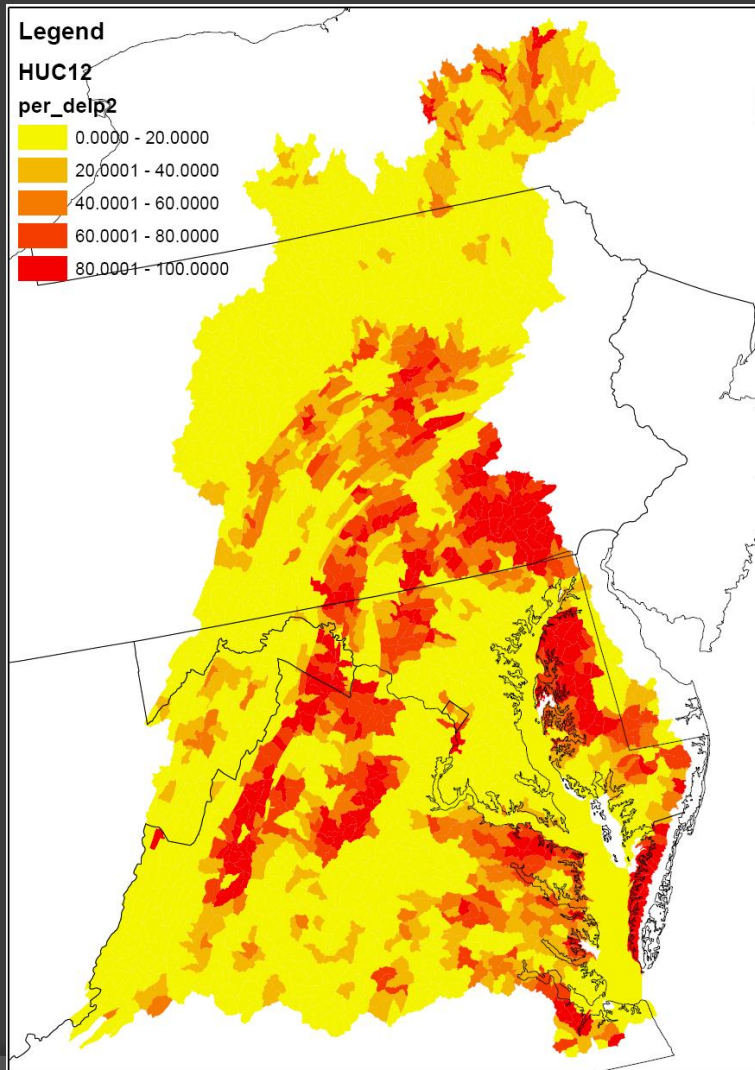
Purpose: Aggregate the Sparrow data to a scale that is meaningful to the states (HUC-12).

Which HUC-12 watersheds have the highest N yields to the tidal Chesapeake Bay? [Top 25%]

Red areas show HUC-12's with the majority of watershed area being in the top 25% yielding category.

Using Multiple Models and Analyses

Good Agreement between CBP Watershed Model and USGS Sparrow Analysis By State



Feedback Requested on Next Steps

- Need for more detailed SPARROW briefing and discussion on utility for targeting funding and implementation actions?
- Process for reviewing and providing input to draft agricultural priority watershed maps?
- Feedback on how SPARROW could be used for other targeting efforts beyond agriculture.

Thank You

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