An Improved Understanding of Nitrogen and Phosphorus Delivery: Results from Refined Regional SPARROW Models

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Approach - SPARROW Water-Quality Model - SPAtially Referenced Regression on Watershed Attributes
http://water.usgs.gov/nawqa/sparrow

- 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
Watershed Modeling Continuum
MO/MSSP SPARROW Model Calibration

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

One Land-to-Water Delivery: Tile Drains

9,182 WWTPs

24,475 Catchments based on RF1 River Network

Calibration

Long-term detrended Loads for 856 sites
Delivered Incremental Yields

Nitrogen

Phosphorus

TN Yields (kg/ha) to the Gulf

TP Yields (kg/ha) to the Gulf

Robertson and Saad, 2013
Nitrogen Loading to the Gulf of Mexico, kg/Yr

Atmosphere
Fixation and other ag. Sources
Manure (confined)
Fertilizers (farm)
Urban areas
Point Sources

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

Robertson et al., 2014

ND is 23rd
Ranking of State Contributions to the Gulf of Mexico from the MARB

Robertson et al., 2014
Regional Models part of the NAWQA Program

2002 SPARROW Models

MRB SPARROW
Lead Scientists
Coordinator – Steve Preston
Robertson & Saad, WI

All Published in 2011 in JAWRA
Distribution in Incremental Phosphorus Yields

Robertson and Saad, 2011
Relative Importance of Various Phosphorus Sources – Spatially Explicit

Robertson and Saad, 2011
Binational SPARROW Model for the Upper Midwest

“Mid-Continental” SPARROW Model

G. Benoy (IJC), W. Jenkinson (NRC-Canada), C. Johnston (USGS)
Methods to demonstrate results and help guide decisions > Nutrient Reduction Strategies

1. SPARROW Mapper – Easy and simple way to get SPARROW results, especially by hydrologic and political boundaries.


http://wim.usgs.gov/SparrowGL/SparrowGLMapper.html#

http://wim.usgs.gov/SparrowMARB/SparrowMARBMapper.html#
MRB3 SPARROW Mapper for Delivered P Yields – shown by Major Watershed
Methods to demonstrate results and help guide decisions

2. Decision Support System Scientists/Managers – Capable of using to visualize SPARROW output and run various scenarios.

http://cida.usgs.gov/sparrow/

Booth et al., 2011
Find a Model by Geographical Location:
Select a region or state. When a state is selected, all models containing that state are listed.

Find a Model by Modeled Constituent:
Any

Models matching your criteria (click a model to show details)
- Mississippi/Atchafalaya Basin Total Nitrogen Model - 2002
- Mississippi/Atchafalaya Basin Total Phosphorus Model - 2002
- National Suspended Sediment Model - 1992
- National Total Nitrogen Model - 1992
- National Total Organic Carbon Model
- National Total Phosphorus Model - 1992
- Total Nitrogen Model for the Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy Region - 2002
- Total Nitrogen Model for the Missouri River Basin - 2002
- Total Phosphorus Model for the Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy Region - 2002
- Total Phosphorus Model for the Missouri River Basin - 2002

Selected Model
Mississippi/Atchafalaya Basin Total Phosphorus Model - 2002

- Modeled Constituent: Phosphorus
- Base Year: 2002
- Stream Network: Enhanced River Reach File 2.0
  Geometry and additional reach and network attribute data are available with the stream network data, which is available as a separate download.

Model Updates: View this model's updates

Watershed Based Sessions
To start the DSS with the outlet river reach of a major watershed selected for downstream tracking, select a watershed and click Go.

Scenario Based Sessions
To start the DSS with a predefined scenario, click on the link for one of the scenarios below.
## Current Mapped Value: 7.14 kg·km⁻²·yr⁻¹ of Phosphorus (Incremental Yield)

### Predicted Values (Data Series)

<table>
<thead>
<tr>
<th>Source</th>
<th>Original (Phosphorus kg·year⁻¹)</th>
<th>% of Load (Orig)</th>
<th>Adjusted (Phosphorus kg·year⁻¹)</th>
<th>% of Load (Adj)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater Treatment Plants Total Load</td>
<td>115,077</td>
<td>4.8</td>
<td>115,077</td>
<td>6.2</td>
<td>0</td>
</tr>
<tr>
<td>Manure (total) Total Load</td>
<td>573,253</td>
<td>23.8</td>
<td>286,627</td>
<td>15.3</td>
<td>-50</td>
</tr>
<tr>
<td>Fertilizers (farm) Total Load</td>
<td>506,760</td>
<td>21.0</td>
<td>253,380</td>
<td>13.6</td>
<td>-50</td>
</tr>
<tr>
<td>Forest and Wetland Areas Total Load</td>
<td>235,110</td>
<td>9.8</td>
<td>235,110</td>
<td>12.6</td>
<td>0</td>
</tr>
<tr>
<td>Urban Areas Total Load</td>
<td>290,095</td>
<td>12.0</td>
<td>290,095</td>
<td>15.5</td>
<td>0</td>
</tr>
<tr>
<td>Channel Erosion Total Load</td>
<td>687,324</td>
<td>28.5</td>
<td>687,324</td>
<td>36.8</td>
<td>0</td>
</tr>
<tr>
<td>Loess Soils Total Load</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Load</strong></td>
<td><strong>2,407,620</strong></td>
<td><strong>100.0</strong></td>
<td><strong>1,867,614</strong></td>
<td><strong>100.0</strong></td>
<td><strong>-22</strong></td>
</tr>
</tbody>
</table>

### Incremental Load

<table>
<thead>
<tr>
<th>Source</th>
<th>Incremental Load</th>
<th>% of Load</th>
<th>Adjusted</th>
<th>% of Load</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater Treatment Plants Incremental Load</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Manure (total) Incremental Load</td>
<td>1,056</td>
<td>48.7</td>
<td>528</td>
<td>39.8</td>
<td>-50</td>
</tr>
<tr>
<td>Fertilizers (farm) Incremental Load</td>
<td>629</td>
<td>29.0</td>
<td>314</td>
<td>23.7</td>
<td>-50</td>
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<tr>
<td>Forest and Wetland Areas Incremental Load</td>
<td>50</td>
<td>2.3</td>
<td>50</td>
<td>3.7</td>
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<tr>
<td>Urban Areas Incremental Load</td>
<td>434</td>
<td>20.0</td>
<td>434</td>
<td>32.7</td>
<td>0</td>
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<tr>
<td>Channel Erosion Incremental Load</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Loess Soils Incremental Load</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Incremental Load</strong></td>
<td><strong>2,167</strong></td>
<td><strong>100.0</strong></td>
<td><strong>1,325</strong></td>
<td><strong>100.0</strong></td>
<td><strong>-39</strong></td>
</tr>
</tbody>
</table>
References:


