



Analysis of sources and transport of phosphorus using the SPARROW model

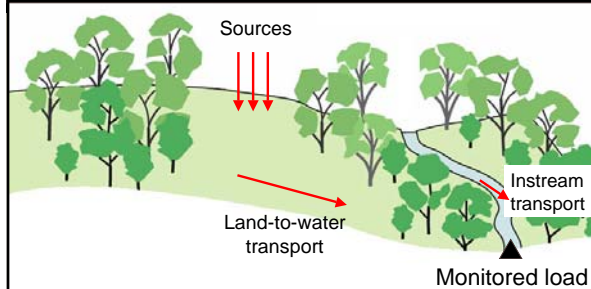
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Presentation Outline

- > SPARROW model concepts
- > Description of the total phosphorus model for the South Atlantic Gulf and Tennessee
- > Preliminary results of phosphorus model for Southeast, with examples of applications for North Carolina

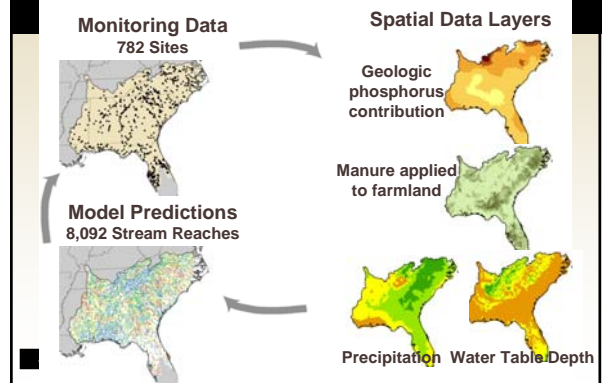


SPARROW* Model Concept



USGS *SPATIALLY REFERENCED REGRESSION ON WATERSHED ATTRIBUTES

SPARROW Model Framework



SPARROW models are in development for Major River Basins



South Atlantic Gulf and Tennessee Total Phosphorus SPARROW Model

- > Seven southeastern states
- > Enhanced River Reach File 2.0
 - 1:500,000 scale
- > Benchmark year 2002
- > Builds upon the completed total nitrogen model



Objectives of Southeast and Tennessee SPARROW Phosphorus Model

- Investigate the up-scaling of field-level phosphorus transport factors
 - P-Index
- Provide estimates of source loadings to nutrient sensitive estuaries
- Incorporate management practices to test their impact at a regional level



Phosphorus Index (P-Index)

- Field evaluation tool that was developed to identify areas that have a high risk of P loss to bodies of surface water.
- Widely used by USDA-NRCS and agencies to develop phosphorus based nutrient plans



Comparing with the P-Index Source Variables

P-Index Source Indicator	SPARROW Source Variable	Significant in SPARROW (p < 0.01)
Soil test P (Soil-P)	Spatial layer of geologic P contribution	✓
	Spatial layer of phosphate mines	✓
Manure application rate	Spatial layer of applied manure	✓
Fertilizer application rate	Spatial layer of applied mineral fertilizer	✓

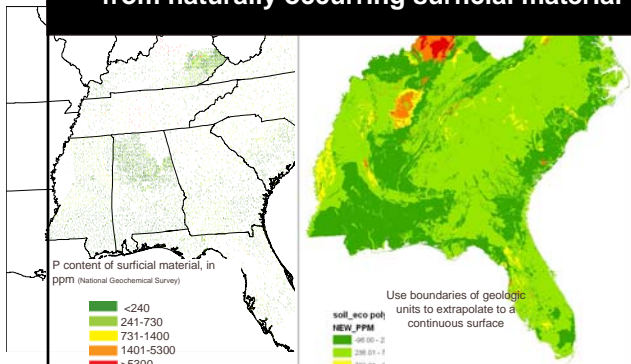


Comparing with the P-Index: Delivery Variables

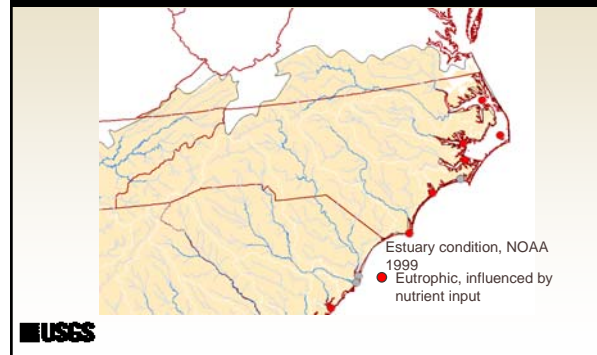
P-Index Transport Factors	SPARROW Delivery Variable	Significant in SPARROW (p < 0.01)
Runoff / Subsurface drainage	Annual precipitation	✓
	Water table depth (STATSGO)	✓
Erosion	Soil clay content	✓
	Soil Erodibility (K-Factor)	✓
Contributing distance	Stream density	✗
Fertilizer/Manure application method	No equivalent yet, limited available data	
Manure source coefficient	No equivalent yet, data available	



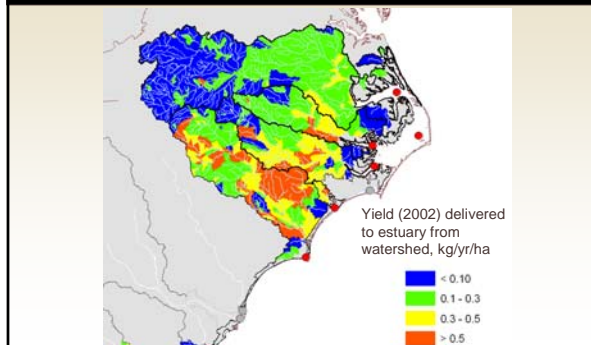
Characterize contribution of P to streams from naturally occurring surficial material



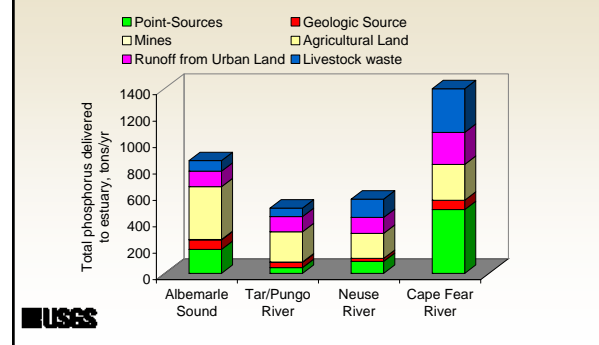
SPARROW Application Coastal Areas Sensitive to Nutrient Input



Coastal Areas Sensitive to Nutrient Input



Model estimated source shares of load delivered to estuary

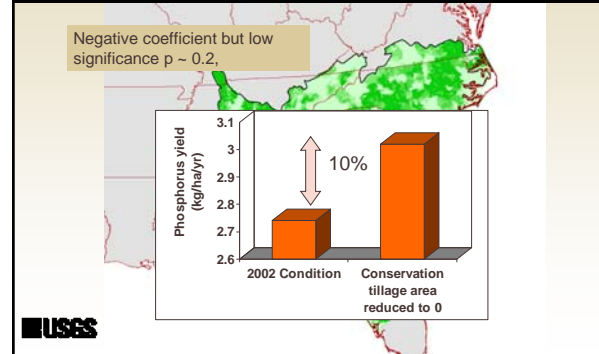


How do we evaluate best management practices at a regional-level?

- Relevant conservation practices
 - Conservation tillage
 - Buffers and riparian areas
 - Large-scale programs such as the Conservation Reserve Program (CRP)
- Data resources for SPARROW modeling are limited

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Distribution of farmland in no-till or conservation till



USGS

Distribution of area in the Conservation Reserve Program (USDA)

- High significance ($p < 0.01$), but positive coefficient
- Proportion of land in CRP contributes to phosphorus transport
- Potential correlation to highly erodable lands



USGS

Summary and Next Steps

- Strengths of the phosphorus model
 - regional scale framework for water quality assessment
 - factors that control total phosphorus transport can be evaluated in a formal statistical sense.
- Future steps include
 - Refinement of spatial data layers that characterize management practices
 - Improve spatial resolution with NHD-Plus network

USGS