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Partnering to Protect Human Health and the Environment

Multiple Scale Nitrogen Loading Risks Across a Large Geographic Region

Year of Water: Thirty Years of Progress Through Partnering

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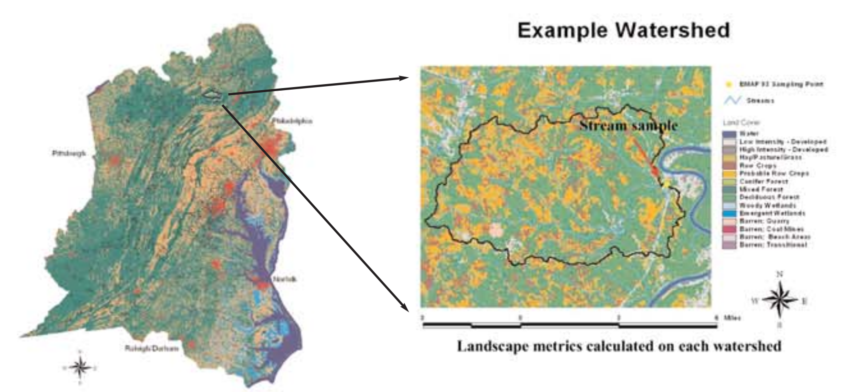
PROBLEM STATEMENT

- Current approaches to list streams and water bodies as impaired under Section 303(d) of the Clean Water Act are highly fragmented and inconsistent. The process which employs establishing Total Maximum Daily Loads (TMDLs) is difficult, labor-intensive, and can be scientifically questionable
- Lack of scientific rigor and objectivity has led to several pending court cases
- Need for comprehensive and objective method to identify streams and other water bodies that have a high potential of exceeding Total Maximum Daily Load (TMDL) thresholds at regional scale
- Method needs to identify likely causes of impairment and how the causes vary in their importance in different biophysical settings. This is important in identifying management options needed to improve conditions

APPROACH

- Develop models that use satellite imagery and other spatial data to predict potential TMDL exceedance
- Conduct analysis and develop the model in the "data rich" Mid-Atlantic Region (477 watersheds)
- Use existing data on nitrogen concentrations in streams from the Environmental Monitoring and Assessment Program (EMAP) and STORET, atmospheric nitrate deposition from the EPA, and spatial data on land cover (National Land Cover Database or NLCD), soils (USDA STATSGO), and topography (Digital Elevation Models) to develop the model
- Use Regression Tree Analysis to establish quantitative relationships between land surface conditions, atmospheric nitrate deposition, and total nitrogen concentrations in streams



Landscape metrics calculated on each watershed

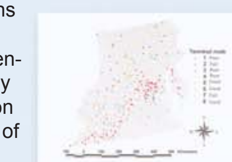
Landscape Metrics Evaluated in the Statistical Analysis

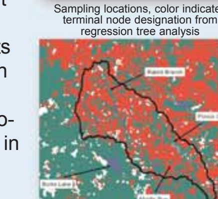
Mean Riparian agriculture
Riparian forest
Forest fragmentation
Road density
Forest land cover
Agricultural land cover
Agricultural land cover on steep slopes
Nitrate deposition
Potential soil loss
Roads near streams
Slope gradient
Slope gradient range
Slope gradient variance
Urban land cover
Wetland land cover
Barren land cover

FINDINGS

- Landscape metrics did a good job of predicting the relative levels of total nitrogen concentrations in streams (60% of variance explained) using regression tree analysis
- There were differences in the importance of landscape conditions in different parts of the Region
  - Streams with the greatest concentration of nitrogen were generally in the northern part of the Region and in areas with high amounts of agricultural lands
  - In northern parts of the Region it took higher amounts of forest to mitigate impacts of high amounts of atmospheric nitrate deposition
  - Forested riparian areas were effective in reducing stream nitrogen concentration but generally in areas with lower atmospheric nitrate deposition


Regression tree analysis results


Sampling locations, color indicates terminal node designation from regression tree analysis


Riparian forest improves water quality in an urban setting

BENEFITS

- Information and the statistical modeling approach provided in this study can be used by environmental managers to evaluate and revise TMDL lists of water bodies relative to nitrogen concentration across the Mid-Atlantic Region and to propose potential ways to reduce risks

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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