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Using land-cover data to understand effects of agricultural and urban development on regional water quality

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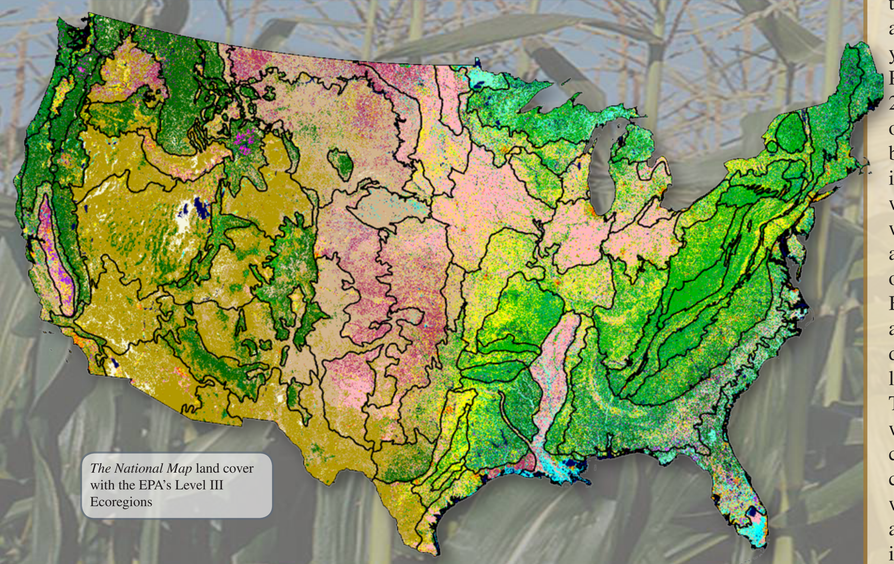
Introduction

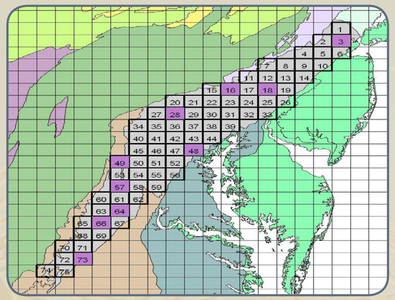
The Land-Cover Trends project is a collaborative effort between the Geographic Analysis and Monitoring Program of the U.S. Geological Survey (USGS), the U.S. Environmental Protection Agency (EPA) and the National Aeronautics and Space Administration (NASA) to understand the rates, trends, causes, and consequences of contemporary land-use and land-cover change in the United States. The data produced from this research can lead to an enriched understanding of the drivers of future land-use change, effects on environmental systems, and any associated feedbacks.

USGS scientists are using the EPA Level III ecoregions as the geographic framework to process geospatial data collected between 1973 and 2000 to characterize ecosystem responses to land-use changes. General land-cover classes for these periods were interpreted from Landsat Multispectral Scanner, Thematic Mapper, and Enhanced Thematic Mapper Plus imagery to categorize and evaluate land-cover change using a modified Anderson Land-Use/Land-Cover Classification System for image interpretation.



The National Map land cover with the EPA's Level III Ecoregions

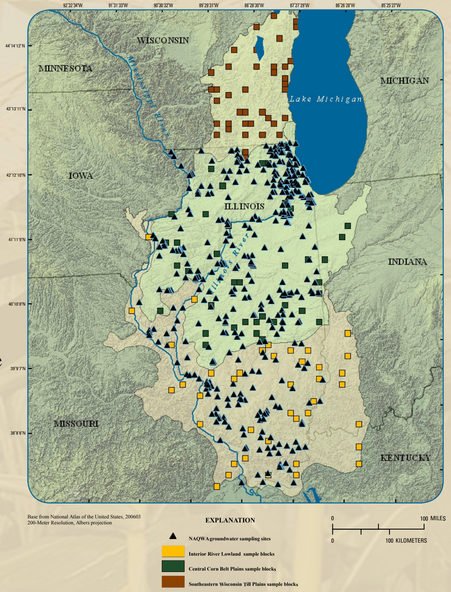
Methods



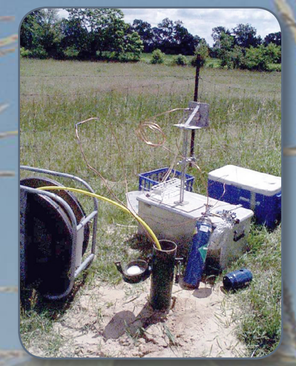
Probability-based sampling strategy used to provide efficient and reliable estimates of land-use/land-cover change over large areas.

The rates of land-cover change are estimated using a stratified, random sampling of 10-kilometer (km) by 10-km blocks within each ecoregion. The sample block data are then incorporated into statistical analyses to generate an overall land-cover change matrix for the ecoregion. Although the current 2010 method utilizes land-cover change from a single ecoregion, it can be extended to give a detailed statistical assessment that incorporates sample blocks from multiple ecoregions.

For example, the Illinois River flows across the Central Corn Belt Plains and Interior River Lowlands ecoregions before its confluence with the Mississippi River. Though the Interior River Lowlands has a lower average annual nitrogen yield than the Central Corn Belt Plains (Goolsby and others, 2001), monitoring the impact of land-cover change on yield between these two ecoregions is essential. The sample blocks within these two ecoregions will be sub-sampled to create a new region covering the area of interest in the Illinois River Basin. Land-cover change analysis within this newly defined region will create a more localized land-cover assessment. This new statistical assessment will be used to examine land-cover change compared to changes in water quality in areas where baseline water quality and trends have been assessed in recently recharged water and surface water.



NAWQA groundwater sampling sites, associated ecoregions, and areas with detailed land-use classification



Urban and agricultural water quality sampling done as a part of the Upper Illinois National Water-Quality Assessment (NAWQA). (Illinois Water Science Center NAWQA, 2000, 1999, 2001)

Next Steps

The outcome of coupling USGS water-quality data with land-cover trends data will enhance the way scientists and policy makers plan future development. It also may suggest ways to modify agricultural sustainability operations and best management practices.

References

Goolsby, D.A., Battaglin, W.A., Aulenbach, B.T., and Hooper, R.P., 2001, Nitrogen input to the Gulf of Mexico: Journal of Environmental Quality, v. 30, p. 329-336.

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