Interpolating Missouri Population Pressure on Urbanizing Natural Areas

Problem

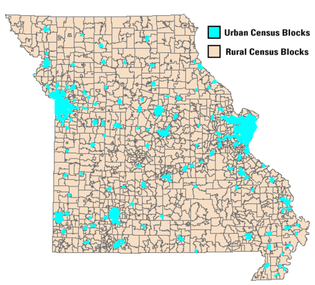
Cities demand resources from a broad region of variable extent. As a factor of environmental change, however, urbanization commonly is generalized and represented in geographical information systems (GIS) as only two factors: census enumeration or impervious surface area. This approach fails to account for the use of environmental resources on the periphery of urbanized places. These natural areas experience stress from the existing population through the maintenance of recreational lands and the increasing demand on natural resources, such as ground-water supply.

Objective

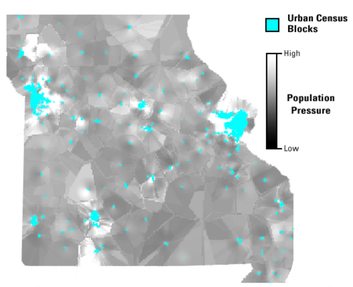
The purpose of this research is to broaden the geographical representation of Missouri's urbanized area data to encompass the environmental resources that sustain our cities. This extended regional scale of urbanization estimates population pressure, interpolated by kriging a variable combining population and wealth from U.S. Census Bureau data. The extension of urbanization to the regional scale may form the basis for integrating generalized geospatial data of urbanized areas with other natural resource models and data in the future.

Definitions

- "City" is a relatively densely inhabited settlement operating at higher order economies and systems of administration.
- "Urban" refers to the characteristics of a city.
- "Urbanism" is the characteristic *way of life* in a city.
- "Urbanization" is the process of becoming urban or urbanized.

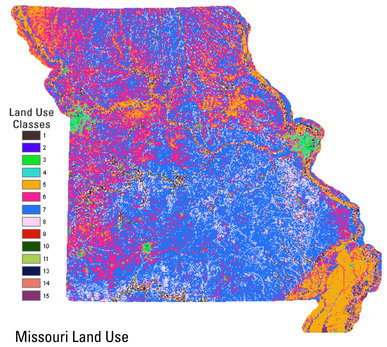


Missouri Urban/Rural Block Groups

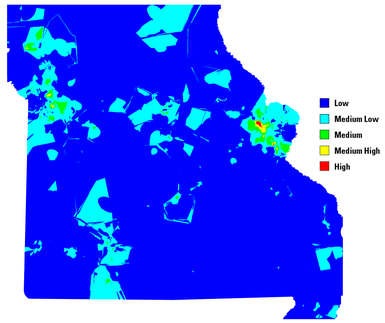


Kriging Surface Interpolated From Urban Census Block Groups

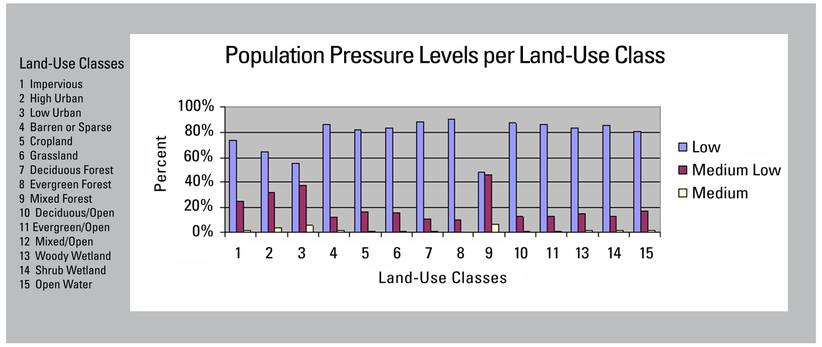
Images do not represent areas to scale



Missouri Land Use



Population Pressure Trend Surface Grouped Low-High



Approach

Urban patterns and scale are ordered by population and demographic transitions and production/consumption patterns. The approach aims to capture the "operational scale" of urbanism by representing the physical material flow and transportation. The basic assumptions are that people use natural resources as they move and act across the landscape, and consumption of resources will be greater closer to places of residence than farther away.

The method is to apply kriging to interpolate population pressure values for land cover areas partitioning the State of Missouri. Kriging is an appropriate interpolation method because population pressure is a continuous variable. The output values of the kriging surface were classified into five levels of pressure from low to high for comparison with categorical land-use data. The cross-tabulation matrix used to compare population pressure and land-use classes was represented as a graph.

Data

The analysis requires bridging urban and environmental data in GIS. Local vector data involves discrete variables within political or watershed boundaries for administrative use. Regional data of environmental (continuous) variables usually are raster for physical science use. A unit of analysis and geographical extent of variables that would allow comparison between the two datasets needs to be set. Centroids are assigned to enumeration units for interpolation.

A consumption variable was derived by combing population, wealth, and area. Technological development is assumed to be a constant. The impact of trade as population pressure is represented by local labor, even if the actual consumption is outside the state. The environmental burdens of imported resources consumed in Missouri are not considered.

Kriging produces raster output that can be overlaid with land-use data. Census urban block group data and Landsat 7, 30 meter classified land use data span 2000-2004.

Results

Initial results suggest that interpolated population pressure may be greatest on mixed-forest land-use areas. These forest areas are classified as "mixed" because of the presence of cedars. Cedars grow in cleared areas on the periphery of development. Some possible reasons for this pattern are land where cedars have invaded low-density suburbanization; land that has been vacated after land speculation; or farms where agricultural practices have been abandoned. The mixed-forest land-use class has the smallest proportion of land cover in Missouri, so the high level of population pressure is inversely proportional to geographical area.

Conclusions

This method has or may have potential as an indicator of population pressure; further research is needed to refine the methodology and validate findings. Future research may adjust the results by measuring the interaction of urbanized activity between specific urban sites along road networks connecting places of increased non-residential population density including recreation areas, large employers, airports, and other nodes of excessive traffic. The population pressure surface also will be tested by integrating with other environmental systems models and data.

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