The Importance of Spatial Support in Environmental Modeling and Decision-Making

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Abstract

In many applications of spatial statistics, the data are measurements recorded at distinct points in space. In other applications, the spatial variable of interest is inherently associated with a unit that has area or volume (e.g. the permeability of a rock, the rainfall in a watershed, the reflectance value of a pixel in satellite images, the cancer mortality rate in a county). The term support has come to mean simply the size or volume associated with each data value, but the complete specification of this term also includes the geometrical size, shape, and spatial orientation of the regions associated with the measurements.

Spatial aggregation or upscaling is sometimes necessary to create or utilize meaningful units for analysis (e.g. exposure units for soil pollution, management units in agriculture), or to make inference about a region of interest (e.g. the average temperature of a lake, the grade of a block of ore). In other applications, the focus is on disaggregation or downscaling, such as the creation of continuous map of population density from census-tract data or the derivation of finer pixel values from sensors with coarse resolution. Last, one might be interested in deriving values for a set of polygons (e.g. census tracts) from another set of overlapping polygons (e.g. ZIP codes), an operation known as side-scaling. The three operations of downscaling, upscaling and side-scaling are part of the general problem of change of support.

This talk will describe how geostatistical interpolation can be used to address the change of support problem, allowing the use of secondary information and incorporating the size and shape of geographical units while fulfilling the mass-preserving or pycnophylactic property of estimation. Besides the change of spatial support, a common issue in spatial interpolation is the combination of data measured over different spatial supports. For example, soil measurements recorded at discrete locations on the ground are often supplemented with choropleth maps (e.g. soil or geological maps) that model the spatial distribution of soil attributes as the juxtaposition of polygons (areas) with constant values. A coherent geostatistical approach to accommodate both areal and point data in the spatial interpolation of continuous attributes will be introduced, with applications to soil science and medical geography.