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A Different Topology

Moving from Geometry to Geography

Topology is a fundamental and unique thing for GIS. It differentiates earlier GIS from other graphics- and image-based systems for computer aided design and image processing. It is built up with spatial data structure and supports various spatial processes such as query and analysis.

The existing topology is defined at a geometric level in terms of how individual graphic primitives like points, lines and polygons are interconnected with graphic primitives (c.f. Rubio's last year September column). A most striking example of topology is to form different kinds of networks, e.g. street networks and drainage networks. Networks are not an unfamiliar concept to professionals in geoinformatics. Most proprietary GIS have route network functionality for automatic mapping and facility management (AM/FM), an earlier name of GIS. Herewith I will discuss a slightly different topology.

Moving from geometry to geography, this different topology concerns how individual geographic objects (rather than graphic primitives) are interconnected. Graphic primitives are not equivalent to geographic objects in reality. For instance, a street consists of multiple polylines, and multiple lines constitute a polygon. This constitutes a difference for the topology I talk about here. In last year's Oct./Nov. column, I presented how named streets (a type of geographic objects) are interconnected to form a street topology. In fact, the topology can be set up in different ways. Or put differently, the relationship is not just defined by sharing a common thing. For example, a topographic surface can be regarded as a topology of interconnected individual locations, thus forming a kind of large visibility network. A same visibility network or topology could be formed with a built environment as well. Here the individual locations represent small spaces that can be perceived from a single vantage point of view, while the topology represents a large geographic space.

From an analytical perspective, the topology of geographic objects can be used to explore the nature of a geographic system from a system as a whole as well as from the point of view of individual objects. Taking the street topology for example, some fundamental questions linked to it are as follows. Which streets are most accessible? Is a certain set of streets more accessible than others? Which streets are tightly connected? These tightly connected streets are likely to form a kind of "community" or cluster for more efficient communication and interactions. These questions are fundamental to the structure of a street network, and can be answered through some deep topological analysis.

The different topology is closely linked to the existing topologies, in the sense that with appropriate available information and the existing topology, the different topology can be derived. It supports more advanced spatial analysis and modeling. To this point, I shall refer to Waldo Tobler's first law of geography that neatly states, "everything is related to everything else, but near things are more related than distant things". The law appears to suggest an overall structure of any geographic systems, but actual structures may vary from one system to another. This deserves some deep study and analysis. My basic message to deliver with the essay is that the different topology will revive as well!

> *"...everything is related to everything else, but near things are more related than distant things..."*