Chapter 2
Geographic Space Ontology, Locus–Object, and Spatial Data Representation Semantic Theory

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ABSTRACT

Within the general framework of the analysis of the geographic space and its ontological components by remote sensing, the author explores the ability of the morphogenetic modeling in the recognition of one major ontological and semantic concept of geography: the “locus-object.” The “locus-object” couple concept results from the interrelation formalization between the geographic locus, the geographic object, and the geo-localization notions. Geographic loci and objects are linked and both geo-localized. The links and relations between locus and object are mathematically formalized by geospatiology, the study of the logical role of space in the study of entities on the surface of the Earth. Morphogenetic modeling recognizes the loci of the geographic space by spatial discontinuities detection. The spatial discontinuities allow the identification of the types of spatial differentiations (boundaries, limits) between two geographic entities. The concept of “locus-object” is one of the key conceptual ontological elements of the geographic space.

CARTOGRAPHY AND GEOGRAPHY OF THE GEOGRAPHIC SPACE

In ancient Greek thought, the reflection on the nature and origin of the cosmos included an investigation into the shape of the Earth as a whole and on the design of the inhabited world (Ecumene) to determine the status of its parts against each other. Eratosthenes (275–193 B.C.), creator of the word “geographiká" (from “ge” Earth and “gráphein” incision to write or draw), supports this line of thought. His Geography included two books. The first was a discussion of the value of geographical description in the poetic world of
Homer and the announcement of a project that would replace it with a scientific approach. The second contained an assessment of the size of the Earth (regarded as a sphere), based on astronomical angular measurements and assessments of terrestrial distances. Eratosthenes proposed the first frame of the geometrical and rational world, which was then called “map” from the sixteenth century in the West, but whose use does finally prevail until the late nineteenth century (in French, the term cartographer appears in 1877). From the mid-twentieth century, we have in geography a reciprocal assimilation of geographic space and map.

The history of geography is inseparable from the cartography. Geography, description of the Earth, is based on the discovery and increasingly accurate representation of the Earth’s surface using maps. In this conception, the Geography begins with the development of a tracking system using coordinates referred to as axes drawn on a map. This technique has the advantage of allowing the use of the Euclidean definition of mathematical distance (reciprocal and linear); and to introduce directly the use of geometry to represent the Earth’s surface in two or three dimensions. However, if the classical geographers from the late nineteenth and early twentieth century believed that geography should be based on a preliminary study of cartographic representations and their systematic use, many were against the project to reduce the properties of geographic space to those of space or geometric mapping. They used the relation between the whole and the parts in an attempt to escape this reduction (Marcus & Nicolas, 1999).

The reflection on the whole and the parts on the surface of the Earth, with or without the help of mapping, is a continuation of the history of Western geography (Nicolas, 2001). The use or the non-use of maps in the history of geography is not linear. Narratives, writings, graphic, schemas, maps, images, and databases, can formalize geography.

Geography with or without mapping has some constants: the research of description and representation of the geographic space based on its semantic components: the geographic objects. These description and modes of formalization, maps, images, writings, etc., are based on the differentiation process of the geographic components, physicals and humans, structuring the geographic space: limits for differentiating physical objects as mountains, lands, borders separating countries, etc. These geographic objects, designed and constructed, are the intrinsic elements of the Earth surface and the geographic space: the parts (geographic objects) of a whole (the Earth).

Whole and parts constitute one of the epistemological foundations of geography, cartography, and geomatics (diminutive of informatics geography). They give one of the formal semantic representations of the geographic space; and they should be measured, recognized, identified, named, modeled, and characterized in geomatics (Gadal & Nicolas, 2000). Observations (humans, satellite images), modeling (spatial modeling, geo-mathematics), recognize, characterize, and design the geographic objects by the identification of their limits, borders (Gadal, 1998), loci, forms, and localizations. Locus, object, and localization are the ontological fundamental base elements of the geographic space concept and the base construction of the geographic knowledge. They are also the semantic base components of the geographic representations in cartography, remote sensing, and Geographic Information System (GIS). Each geographic object represented in cartography or GIS has localization, a locus, or it is one of the constituents of locus. Their relations can be formalized by geospatialogy, mathematical formalization, developed conjointly by Nicolas and Marcus (2003).