

# Semantic Representation of Topographic Data for Cartographic Presentation and Application

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## Extended Abstract

The U.S. Geological Survey is responsible for topographic mapping of the United States. Historically, this responsibility has been met by the creation and distribution of standard topographic maps as lithographic prints. With the development of digital mapping and operational geographic information system (GIS) capabilities, which began in the 1960s and matured in the 1990s, the USGS has now moved to a completely digital technology to meet this responsibility. Standard 7.5 minute, 1:24,000-scale topographic maps are generated from the digital topographic databases of The National Map and distributed as a layered GeoPDF product, repeating complete coverage of the conterminous 48 states, Hawaii, and the territories, every three years. However, research and development in the broader technological area of geospatial data and information are driving a need for a different representation of geographic phenomena that accounts for the semantics of geospatial information and can be processed and analyzed by machines. For example, representing the source, mouth, left and right banks, tributaries, and other characteristics of a stream and the relationships of that stream to the surrounding landscape are now needed for scientific modeling and management of the stream and its resources and can be used to enhance the cartographic representation of the stream. Similarly, there is a need to access the walls, floor, and mouth of a canyon with any stream or other landscape features associated with the canyon. Representation of these types of geographic feature characteristics enriches data for applications and cartographic product generation. These concepts of geographic phenomena can be represented as semantics, and with the development of the World Wide Web and the associated Semantic Web, each geographic feature can be provided a unique Web address and can be accessed by both humans and machines. The USGS is developing a complete ontology and semantics for all features represented on topographic maps and is making

these available on the Semantic Web. This presentation will provide the basics of knowledge representation of topographic information through semantics and will detail the ontology and semantics that have been developed for USGS topographic data. The representation uses triples of subject, predicate, and object of the Resource Description Framework (RDF) of the Semantic Web. Vector-formatted geographic data in GIS relational databases can be converted directly from the relational tables to RDF, but terrain and other features from raster and continuous three-dimensional data sources, such as images, scanned topographic maps, digital elevation models, and lidar, are problematic to represent in RDF. The capture and representation of these features in semantic formats are detailed as well as application areas for geospatial semantics including cartographic operations such as generalization, data integration, and automated symbolization.