

Cloud-Based Multiresolution Geodata Cube for Efficient Raster Data Visualization and Analysis

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Abstract : The use of raster-formatted data sets in geospatial analysis is increasing rapidly. At the same time, geographic data are being introduced into disciplines outside the traditional domain of geoinformatics, like climate change, intelligent transport, and immigration studies. These developments call for better methods to deliver raster geodata in an efficient and easy-to-use manner. Data cube technologies have traditionally been used in the geospatial domain for managing Earth Observation data sets that have strict requirements for effective handling of time series. The same approach and methodologies can also be applied in managing other types of geospatial data sets. A cloud service-based geodata cube, called GeoCubes Finland, has been developed to support online delivery and analysis of most important geospatial data sets with national coverage. The main target group of the service is the academic research institutes in the country. The most significant aspects of the GeoCubes data repository include the use of multiple resolution levels, cloud-optimized file structure, and a customized, flexible content access API. Input data sets are pre-processed while being ingested into the repository to bring them into a harmonized form in aspects like georeferencing, sampling resolutions, spatial subdivision, and value encoding. All the resolution levels are created using an appropriate generalization method, selected depending on the nature of the source data set. Multiple pre-processed resolutions enable new kinds of online analysis approaches to be introduced. Analysis processes based on interactive visual exploration can be effectively carried out, as the level of resolution most close to the visual scale can always be used. In the same way, statistical analysis can be carried out on resolution levels that best reflect the scale of the phenomenon being studied. Access times remain close to constant, independent of the scale applied in the application. The cloud service-based approach, applied in the GeoCubes Finland repository, enables analysis operations to be performed on the server platform, thus making high-performance computing facilities easily accessible. The developed GeoCubes API supports this kind of approach for online analysis. The use of cloud-optimized file structures in data storage enables the fast extraction of subareas. The access API allows for the use of vector-formatted administrative areas and user-defined polygons as definitions of subareas for data retrieval. Administrative areas of the country in four levels are available readily from the GeoCubes platform. In addition to direct delivery of raster data, the service also supports the so-called virtual file format, in which only a small text file is first downloaded. The text file contains links to the raster content on the service platform. The actual raster data is downloaded on demand, from the spatial area and resolution level required in each stage of the application. By the geodata cube approach, pre-harmonized geospatial data sets are made accessible to new categories of inexperienced users in an easy-to-use manner. At the same time, the multiresolution nature of the GeoCubes repository facilitates expert users to introduce new kinds of interactive online analysis operations.

Keywords : cloud service, geodata cube, multiresolution, raster geodata

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