Chapter 15
New Model for Geospatial Coverages in JSON:
Coverage Implementation Schema and Its Implementation With JavaScript

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ABSTRACT

Map browsers currently in place present maps and geospatial information using common image formats such as JPEG or PNG, usually created from a service on demand. This is a clear approach for a simple visualization map browser but prevents the browser from modifying the visualization since the content of the image file represents the intensity of colors of each pixel. In a desktop GIS, a coverage dataset is an array of values quantifying a certain property in each pixel of a subdomain of the space. The standard used to describe and distribute coverages is called web coverage service (WCS). Traditionally, encoding of coverages was too complex for map browsers implemented in JavaScript, relegating the WCS to a data download, a process that creates a file that will be later used in a desktop GIS. The combination of a coverage implementation schema in JSON, binary arrays, and HTML5 canvas makes it possible that web map browsers can be directly implemented in JavaScript.

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INTRODUCTION

In geospatial computer science geospatial information is mainly divided into two data models feature data (covering mainly vector data) and coverage data (covering mainly raster data). Feature data in JSON has been covered by the IETF RFC 7946 GeoJSON Format. This Chapter focuses on coverage data. Traditionally, aerial photographs, land cover maps, digital elevation models, etc have been encoded as a sequence of values in binary files, such as GeoTIFF. Geospatial Information Systems (GIS) required a better description for the spatio-temporal domain where these multidimensional arrays were situated (georeferenced) and about the exact meaning and restrictions of its values. The term "coverage" is defined in [ISO19123] as a family of data models based on a "feature that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain" – in practice, spatio-temporal regular and irregular grids, point clouds, and general meshes. In other words, a coverage maps a distribution of space positions and time instants to a set of data values. For example, an UAV photograph can be modeled as a coverage that maps positions on the ground to the colors of the surface of the earth. A climate model maps a multidimensional grid (horizontal space coordinates, elevation, and time) to values of temperature, wind speed, humidity, etc.

Traditionally, encoding of coverages was too complex for web map browsers implemented in JavaScript, relegating the Open Geospatial Consortium (OGC) Web Coverage Service (WCS) standard to a data download; a process that creates a file that will be later used in a desktop GIS. To remedy this, the Chapter on hand presents an implementation that uses a combination of the Coverage Implementation Schema (CIS) in JSON, binary arrays, HTML5 canvas, and JSON styling rules, which makes possible that web map browsers can directly implement support to coverage visualization and analysis using only JavaScript code.

Based on the modern capabilities of the Web standards such as HTML5 and JavaScript, this Chapter describes the CIS standardized by the OGC which comes with a JSON encoding and compares it to a different recent initiative called CoverageJSON. Our modeling of JSON coverages, which is a main topic of this paper, is part of the OGC CIS version 1.1 standard.

BACKGROUND

Coverages represent homogeneous collections of values located in space/time, such as spatio-temporal sensor, image, simulation, and statistics data. Common examples include measures by a static sensor of a variable over time (1-D time series), optical satellite imagery (2-D imagery), series of geometrically corrected satellite images (3-D x/y/t time series), a interpolation representing the temperature distribution of the atmosphere (x/y/z geophysical voxel models), and a simulation representing the evolution of the temperature of the atmosphere over time (4-D x/y/z/t models). Coverages encompass multi-dimensional regular and irregular grids, point clouds, and general meshes. [Baumann et al, 2017]

Often the word "coverage" is used a synonymous of "gridded data", "raster data" or "imagery". Even if the three expressions are examples of coverages, this is not the whole picture. For example, non-gridded data (like a river gauge time series) can also be modeled as a coverage. Generally, the concept of *coverages* encompasses spatio-temporal regular and irregular grids (both discrete and continuous), point clouds, and general meshes.