The OGC/ISO Coverage API Standards

Heavy-Lifting APIs for Massive Multi-Dimensional Data

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ABSTRACT

The concept of coverages, generally grasping multi-dimensional space/time varying phenomena, has received impressive attention among service implementers and operators. The biggest reason for this success is that coverages conveniently model datacubes, specifically in combination with powerful APIs such as the Web Coverage Service (WCS) with its datacube analytics language, Web Coverage Processing Service (WCPS). OGC, ISO, and EU INSPIRE capitalize on coverages, and leading tools implement them. In this tutorial, we first briefly recapitulate the coverage model and simple access with WCS Core, address the status of OAPI-Coverages, and then proceed to datacube analytics with WPCS. Practical demos based on the EarthServer datacube federation serve to illustrate; participants can recap and modify most of the demos. Altogether, this workshop constitutes a unique opportunity for getting up to speed with coverages and datacubes.

CCS CONCEPTS

• Applied Computing • Physical Sciences and engineeering • Earth and atmospheric sciences

KEYWORDS

Coverage, API, standards, OGC, ISO, INSPIRE

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1 Tutorial Description

Spatio-temporal raster data are everywhere - never before it was so easy and comparatively cheap to obtain huge amounts of observed or generated data. Once in the computer these naturally form discretized raster data, also called "gridded data" or "datacubes". Datacubes are an accepted cornerstone for analysis-ready data - homogenization of zillions of scenes into a few space-time cubes with unified spatial and temporal access leads to both simpler and more scalable services.

In standardization, spatio-temporal raster data are modeled through the concept of a *coverage*. Based on work that commenced long before "Big Data" became omnipresent. The OGC/ISO coverage data and service standards offer a modular, widely implemented, and Petabyte-proven baseline, ranging from simple access and encoding in the Web Coverage Service (WCS) Core to high-end analytics through the WCPS datacube analytics language. Recently, activities are under way to add to WCS an OpenAPI based service protocol, OAPI-Coverages, in an open process. A Fall 2019 hackathon in the UK and a 2020 ESIP/OGC sprint in the US served to stress test drafts and expose and discuss in broader expert communities. One ESIP result was that a coverage analytics language like *Web Coverage Processing Service* (WCPS) is desirable. In parallel, is ISO advancing the abstract coverage framework.

Today there is a modular set of specifications in place allowing to derive common as well as specialized coverage structures, and which range from simple access and extraction to analytics, fusion, and visualization. All in all, OGC coverages form a remarkable success story in standardization.

Given this breadth of functionality it is not always straightforward to design and use coverage services. With this tutorial we aim at closing this gap by providing a hands-on introduction, backed by an ample collection of background documents – including articles, slides, and videos – for further study.

Coverages are defined in an interoperable, format-independent, and conformance-testable manner in the OGC *Coverage Implementation Schema* (CIS), which is identical to ISO 19123-2. Such grid coverages can be of any raster type, including SAR and optical satellite imagery, climate variables, DEMs, thematic products, statistical data, etc. CIS-based coverage services are operational on dozens of Petabyte offerings, such as the EU Sentinel archives.

Grid coverages become actionable with high-level, powerful coverage services. The OGC *Web Coverage Service* (WCS) suite starts with simple extraction and reformatting and a URL style for easy client development. Modular extensions add further functionality facets, up to the datacube analytics language, WCPS.

WCPS is the most powerful and, at the same time, simplest way to operate on datacubes: The client sends a query string describing the intended result, and the server evaluates this and returns the result. Moreover, as WCPS is a declarative language, manifold optimizations can automatically be applied by the server to each incoming query, such as parallelization, distributed processing, space / time aware caching, just-in-time compilation, etc. In the EarthServer initiative, datacube providers combine their cube offerings into one common information space with location-transparent WCPS datacube access, processing, and fusion.

We show the expressive power of WCS and WCPS and illustrate optimizations an intelligent server can apply, based on real-life use cases executed in operational federated services which participants can recap and modify.

Ample time will be provided for presentation and discussion of the current status in coverage standardization across OGC, ISO, and European INSPIRE. This will include an inspection of the ISO 19123-1/2/3 adoption path and an update on the forthcoming OGC OAPI-Coverages extension to WCS.

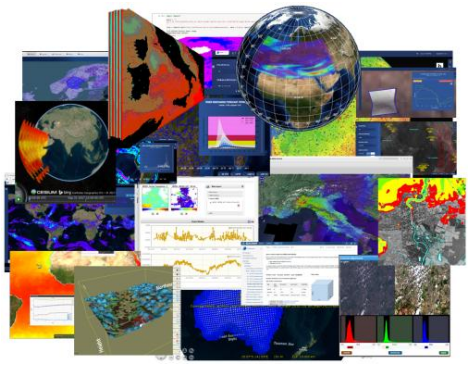

Figure 1: Kaleidoscope of service portals using OGC WCS and WCPS standards as client/server APIs

2 Tutorial Plan

2.1 Session 1 (45 min)

- Introduction:
  - Presentation of instructor
  - elicitation of audience background & interests
- Coverages & Datacubes:
  - Coverages in general
  - Raster data and datacubes in particular
  - Encoding of coverages: from JSON to JPEG
  - Multi-dimensional examples
  - Standardization status in OGC & ISO
- Coverage Processing Part I
  - WCPS overview
  - Hands-on demos
- Discussion

2.2 Session 2 (45 min)

- Web Coverage Services:
  - WCS Core & extensions
  - OAPI-Coverages
  - Hands-on demos
- Coverage Processing Part II:
  - WCPS advanced features
  - Hands-on demos
  - WCPS design rationales
  - Comparison with other approaches
- Wrap-Up & Discussion

3 About the Tutorial Presenter

The presenter is shaping the coverage standards of OGC, ISO, and EU INSPIRE since over 15 years as working group co-chair, project leader, and editor. Further, he has long-standing teaching experience as Professor of Computer Science.

4 Prerequisites

Come with curiosity! Beyond an Internet-connected laptop with a standard Web browser there is no further requirement – all activities will be based on Web APIs and clients running in a browser without any pre-installation.

Background material for the topics covered is available here:

- OGC Coverages group overview wiki: http://myogc.org/go/coveragesDWG
- Public Earth Datacube Sandbox: https://standards.rasdaman.com
- Coverage service tutorials: https://earthserver.xyz/wcs

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