

# **OPEN GEOSPATIAL CONSORTIUM (OGC) STANDARDS FOR THE GEOSCIENCES**

*George Percivall*

The Open Geospatial Consortium, Inc. (OGC)

## **1. INTRODUCTION**

We can adequately study broad global issues and policies only by taking geosciences into account. Our research and decision-making must share and make effective use of interdisciplinary data sources, models, and processes. Non-interoperability impedes sharing of data and computing resources. Standards from the Open Geospatial Consortium (OGC) and other organizations are the basis for successfully deploying a seamless, distributed information infrastructure for the geosciences. Several specifications now adopted by the OGC consensus process are the result of OGC interoperability initiatives. The OGC standards, deployment architectures and interoperability initiatives are described showing how the OGC standards baseline has been developed and applies to the geosciences.

## **2. INTEROPERABILITY IS ESSENTIAL FOR GEOSCIENCES**

We can adequately study broad global issues and policies only by utilizing interoperability in the geosciences. Seamless discovery and access of relevant information from data providers around the world is achieved through standards-based protocols and metadata. Too much of researchers' time has traditionally been spent on locating data and many times there are datasets that satisfactorily fit the need that go undiscovered. Access to geoscience data in a fashion similar to the World Wide Web dramatically reduces the time spent finding and evaluating data. Accuracy and precision of scientific data and information are achieved only through agreements about the data itself and how it is stored. The International Council for Science has stated the challenge this way:

“The assumption that future scientists will be able to use data collected over long time periods and to integrate data from disparate sources to create new datasets is dependent upon interoperability of the data, software (including both data base and analytic software), and hardware. Coordination in standards development and the use of commonly accepted standards are needed to promote data interoperability, so that data collected in different countries, in different time periods, using different software and hardware configurations, and across different disciplines can be integrated.” [1]

### **3. OPEN STANDARDS ARE NECESSARY FOR INTEROPERABILITY**

Standards are the basis for the success of the Internet (or Net) and the World Wide Web. A standard describes a set of rules that have been agreed to in some industry consensus forum, such as the Internet Engineering Task Force (IETF), the International Organization for Standardization (ISO), or the Open Geospatial Consortium (OGC). As described in “The Importance of Going Open,” [2] non-interoperability causes organizations to spend much more than necessary on geospatial information technology development. Organizations like the OGC, the World Wide Web Consortium (W3C), the IETF, and others are open organizations as any individual or organization can participate, the topics of debate are largely public, decisions are democratic (usually by consensus), and specifications are free and readily available. An “open” process is necessary to arrive at an “open” standard. The openness that OGC promotes is part of this general progress.

### **4. THE OPEN GEOSPATIAL CONSORTIUM**

The OGC is an international not-for-profit voluntary industry consensus standards organization that provides a forum and proven processes for the collaborative development of free and publicly available interface specifications (open standards) [3]. OGC open standards have been implemented broadly in the marketplace and are helping to foster distributed and component technology solutions that geo-enable web, wireless, and location based services as well as broader government and business IT enterprises worldwide. OGC works closely with standards organizations and consortia in the technology community. For example, OGC maintains alliances for coordination with IEEE, IETF, W3C, ISO and other organizations:

### **5. OGC STANDARDS FOR GEOSCIENCES**

OGC standards were developed with requirements from the geosciences. Those OGC standards are now widely implemented providing interoperability for the geosciences. The standards are described in the following categories [4]: OGC Web Services (OWS), Sensor Web Enablement (SWE), and Geo-Processing Workflow (GPW). All OGC standards are available on the Web for no charge [5]. Several OGC standards are also co-published as ISO standards by ISO TC 211.

#### **5.1 OGC Web Service (OWS) Standards**

OWS standards provide access, discovery and encoding of geoscience information. The OWS standards are defined using open Internet standards; in particular HTTP, URL, MIME and XML.

- OGC Web Map Service (WMS) Standard
- OGC Web Feature Service (WFS) Standard
- OGC Web Coverage Service (WCS) Standard
- OGC Catalogue Service for the Web (CSW) Standard

#### **5.2 Sensor Web Enablement (SWE) Standards**

The SWE initiative is focused on developing standards for discovery, exchange, and processing of sensors and corresponding observations, as well as the tasking of sensors and sensor systems [6]. SWE specifications include:

- OGC Sensor Model Language (SensorML) Standard
- OGC Observations & Measurements (O&M) Standard
- OGC Sensor Observation Service (SOS) Standard
- OGC Sensor Planning Service (SPS) Standard
- OGC Sensor Alert Service (SAS) Best Practice
- OGC Web Notification Service (WNS) Best Practice

### **5.3 Geoprocessing Workflow (GPW) Standards**

GPW is the automation of spatial process/models, in whole or part, during which information is passed from one distributed Geoprocessing Service to another according to a set of procedural rules using standardized interfaces.

The most robust approach OGC has implemented for GPW utilizes [7]:

- OGC Web Processing Service (WPS) Standard.
- OASIS Business Process Execution Language for Web Services (BPEL)

### **5.3 Encoding Standards**

OGC has issued several specifications for encoding of geospatial information.

- Geography Markup Language (GML) and multiple profiles
- CityGML Standard
- GML in JPEG 2000 Standard
- GeoPDF Best Practice
- KML Standard

## **6. GEOSCIENCE APPLICATIONS OF OGC STANDARDS**

OGC standards are developed mainly in the OGC Interoperability Program [8]. Multiple OGC Interoperability Program initiatives (Testbeds, Experiments, Pilots) have implemented geoscience requirements.

### **6.1 OGC Web Services (OWS) Testbeds**

OGC Testbeds are fast-paced, multi-participant collaborative efforts to define, design, develop, and test candidate interface and encoding specifications to meet the requirements of sponsors. Geoscience requirements have been in each testbed OWS testbeds beginning with the Web Mapping Testbed in 1999. Since 2001, the OGC has conducted a series of OGC Web Services (OWS) testbeds, which have developed hundreds of engineering reports, component implementations and demonstrations relevant to the geosciences. The seventh testbed in the series (OWS-7) began in 2009.

### **6.2 OGC Interoperability Experiments**

OGC IEs are brief, low-overhead, formally structured and approved initiatives led and executed by OGC members to achieve specific technical objectives that further the OGC Technical Baseline. The following IEs have addressed geoscience requirements

- GALEON (Geo-interface for Air, Land, Earth, Ocean NetCDF) IE using WCS for “fluid Earth systems”
- Ocean Science IE advancing interoperability of ocean-observing systems by using OGC Standards.
- Hydrology IE is advancing WaterML 2.0 and its use with various OWS standards
- Meteorology/Oceans Domain Working Group is planning an Interoperability Experiment

### 6.3 OGC Pilots and GEOSS

Pilot initiatives apply and test OpenGIS specifications in real world applications using products that implement OGC Standards. OGC uses the Pilot procedures to lead the Architecture Implementation Pilot that is contributing to the development of the Global Earth Observing System of Systems (GEOSS).

## 7. SUMMARY

Interoperability is vital to progress and application of the geosciences. Open standards are essential to achieving interoperability in science information systems. The OGC, as a leader in the development of open standards for geospatial interoperability, has developed and approved a set of standards that meet this need. Working with other standards developing organizations, the OGC has developed and deployed standards considering the needs of geoscience knowledge. Standards-based information infrastructures are necessary to enable the highest order of geoscience development and to support humanity's critical decisions. The following papers provide much more detail on how this standards-based infrastructure exists and is growing to meet the needs of the many domains of the geosciences.

## 8. REFERENCES

- [1] "Scientific Data and Information," Report of the CSPR Assessment Panel, ICSU Priority Area Assessment on Scientific Data and Information, The International Council for Science (ICSU), December 2004, [http://www.icsu.org/Gestion/img/ICSU\\_DOC\\_DOWNLOAD/551\\_DD\\_FILE\\_PAA\\_Data\\_and\\_Information.pdf](http://www.icsu.org/Gestion/img/ICSU_DOC_DOWNLOAD/551_DD_FILE_PAA_Data_and_Information.pdf)
- [2] "The Importance of Going Open – an OGC White Paper," The Open Geospatial Consortium, July 5, 2005. [http://portal.opengeospatial.org/files/?artifact\\_id=6211&version=2&format=pdf](http://portal.opengeospatial.org/files/?artifact_id=6211&version=2&format=pdf)
- [3] "Welcome to the OGC Website," <http://www.opengeospatial.org/>
- [4] "OGC Reference Model," Version: 2.0, The Open Geospatial Consortium, Document 08-062r4, 11 November 2008. <http://www.opengeospatial.org/standards/orm>
- [5] "OpenGIS® Standards and Related OGC documents", <http://www.opengeospatial.org/standards>
- [6] "OGC Sensor Web Enablement Architecture," an OGC Best Practice, Document 06-021r4, 2008. [http://portal.opengeospatial.org/files/?artifact\\_id=29405](http://portal.opengeospatial.org/files/?artifact_id=29405)
- [7] "OWS-6 Geoprocessing Workflow Architecture," Bastian Schäffer, OGC Engineering Report, Document 09-053r5. [http://portal.opengeospatial.org/files/?artifact\\_id=34968](http://portal.opengeospatial.org/files/?artifact_id=34968)
- [8] "The OGC Interoperability Program", <http://www.opengeospatial.org/ogc/programs/ip>
- [9] "GEOSS Architecture Implementation Pilot," <http://www.ogcnetwork.net/AI/pilot>
- [10] "GEO – The Group on Earth Observations." <http://www.earthobservations.org/>