Content standards for geospatial metadata and their use

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Abstract

*-2mm Among the many GIS standards that provide interoperability of (geo)spatial data and related web services, we can identify a limited but important group of standards, intended to catalog spatial data sets and services. Many of currently used standards are based on international ISO 19115 series and their national profiles. Among them are two Russian national standards developed by the Technical Committee (TC) 394 Geographic information/Geomatics of the Federal Agency on Technical Regulating and Metrology (Rosstandart): the GOST R 57668-2017 "Spatial data. Metadata. Part 1. Fundamentals" and the GOST R 57656-2017 "Spatial data. Metadata. Part 2. Extensions for imagery and gridded data". The analysis of Russian, foreign and international geoportals with metadata editing, validation and publishing functions has been carried out, including using ISO 19115, FGDC-STD-001-001-1998, DIF, Dublin Core and open source software GeoNode, GeoNetwork, GeoServer, etc. The results of the analysis can be useful in selecting effective spatial metadata management systems in the scientific geoportals.

Keywords

Spatial data, spatial metadata, web services, geoportal, standards.

1. Introduction

The development of any information system should be supported by information technology standards. International, national and industry standards ensure that spatial data is well handled and managed. The process of unification and standardization of both spatial data and the rules of their circulation initiated long ago, in the era of mass use of geographic information systems (GIS) for GIS products and services, and the development of the GIS market. The importance of geo-information standards in geographic information management is highlighted in a relatively recent review of ISO/TC 211 Geographic information/Geomatics, International Hydrographic Organization (IHO) and Open Geospatial Consortium (OGC) [1].

Among the many GIS standards, we specify spatial metadata content standards, being understood as the properties of spatial data that are necessary and sufficient to identify, effectively search, evaluate, and use. The search tool is usually a geoportal. The term geoportal in Russian-language scientific literature is understood both as a geoportal for data search in the traditional sense, and a means of web mapping, a tool of their cartographic visualization on the Web. It was suggested, therefore, to distinguish between geoportals for search, search and visualization, and visualization only [2].

Geoportal is a convenient object for analyzing the use of GIS standards. The purpose of the paper is to review and evaluate the current state of development and use of Russian and

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international standards for the content of spatial metadata, including the creation of inventory mechanisms and effective search for data and services on their geographic metadata as the primary function of spatial data infrastructures (SDIs) and access to them [3].

The problem is particularly urgent in the context of Russia's transition to the digital economy [4], given its reluctance for the full implementation of SDI technologies [5, 6].

2. Historic review

Interest in similar establishment in Russia emerged towards the end of the last century, when in 1998 non-profit Russian GIS Association in its Information Bulletin has organized a wide public discussion of the draft Russian content standard of metadata of electronic maps, developed by the TC 051 of Rosstandart. Text of this draft drew a lot of criticism, both in its substance and in view of the fact that it has completely ignored the experience of developing de facto international standard FGDC-STD-001-1998 [8]. However, the GOST R 51353-99 on "Geoinformatic mapping. Metadata of electronic maps. Composition and content" has been approved and put into effect on January 7, 2000. Its practical applications are still unknown.

The internationally recognized ISO standard 19115:2003 Geographical Information — Metadata was developed by ISO/TC 211 Geographic Information/Geomatics and published in 2003. It fully complied with the European standard EN ISO 19115:2005 produced by Technical Committee CEN/NC 278 Geographic information. Following it, TC 394 has developed its Russian profile, the GOST R 52573-2006 "Geographic Information. Metadata". Later there appeared a standard for its implementation in XML (eXtensible Markup Language) — ISO 19139:2007 Geographic information — Metadata — XML schema implementation.

This standard is long since out of date, splitting into two separate ones: the ISO 19115-1:2014 Geographic information — Metadata — Part 1: Fundamentals, successive to basic content of ISO 19115:2003, and the ISO 19115-2:2009 Geographic information — Metadata — Part 2: Extensions for imagery and gridded data. The latter allows you to most effectively describe the spatial data sets presented in raster formats, such as remote sensing data, and similar (but not identical to them) data ordered in regular grids, such as grid-based digital elevation models. They correspond to the already mentioned GOST R 57668-2017 and GOST R 57656-2017. National Standardization Program for year of 2020 set out the development of two standards similar to ISO 19115-2:2019 Geographic information — Metadata — Part 2: Extensions for acquisition and processing, what included a revision of the GOST R 57656-2017, and the GOST R standard based on ISO 19119:2016 Geographic Information — Services.

3. Domestic experience

More than twenty years of experience in the creation and operation of geoportals and similar network services offers different approaches to metadata management. It is presented in numerous scientific publications, manuals, regulatory and technical documentation, in the multiple "best practice" analyses. The chart (see Table below) contains selected examples of network services with a brief description of the features of editing, validation, and displaying of spatial metadata.

Let's start with the analysis of domestic, relatively modest, experience.

Among the current geoportals, the Institute of Volcanology and Seismology in the Far East Branch of the Russian Academy of Sciences (FEB RAS) is the first to mention. It is organized on the fairly popular and functional GeoNetwork platform, as well as another service by the Pacific Institute of Geography FEB RAS, it is a part of the stack of software products with open source OSGeo software (http://www.osgeo.org) known in dozens of its applications abroad (https://geonetwork-opensource.org). The platform maintains ISO 19115/ISO 19139 and metadata elements of ISO 15836:2009 Information and documentation — The Dublin Core metadata element set, providing metadata editing. Its operational integration of volcanological data has been repeatedly discussed in the scientific periodicals [9, 10].

Another "long-lived" service supporting the ISO 19115 metadata description is organized by the Institute of Computational Modeling from the RAS Siberian Branch in Krasnoyarsk, this research team is widely known for its pioneering work among domestic researchers in the web mapping and online web services for various subject areas [11, 12]. This service uses MapServer (https://www.mapserver.org) as a platform, also open source software from OSGeo products. Geoportal resources are grouped according to the GOST R 52573-2006 Topic categories. It is possible to export metadata in the form of XML files under the ISO Standard 19115:2003.

The relatively recent Metalogeny geoportal of the RAS Vernadsky State Geological Museum also supports ISO standards among other spatial data standards, it is equipped with a built-in metadata editor but uses commercial software [13]. Alas, there are not as many services similar to the above mentioned (see Tables 1 and 2), it is eventually worth noting that our chart contains only selected examples, however adequately reflecting the current situation. The last two lines of its first section contains data on two Russian services that cannot be described according to standards, they represent the Komi Republic geoportal and the service for search and visualization of digital maps, spatial data sets and other materials generated by the Federal Spatial Data Fund of the Center of Geodesy, Cartography and SDI.

4. International and foreign experience

An example of a search engine, and at the same time of a appropriate visualization, can be the geoportal of the INSPIRE European program in the second section of the chart [14]. The need to create spatial metadata by European Union countries was enshrined in law in 2008 [15]. Their preparation is governed by technical requirements, including the implementing rules of the European standards EN ISO 19115 taking into account EN ISO 19119 and ISO 19139:2007. Their preparation is governed by technical requirements, including the implementing rules of European standards EN ISO 19115 with proper consideration of the EN ISO 19119 and ISO 19139:2007 standards.

The INSPIRE standard features the inclusion of elements from the ISO 19119:2005 Geographic information — Services known as the ISO 19119:2016 after revision. This is primarily due to the wide distribution of geographic services based on the OGC specifications, including WMS, WFS, WCS, WMC, CSW, GAZ, WCTS, etc. Another feature of the INSPIRE profile is the description not only of spatial data sets, but also of their series, if necessary replacing descriptions of individual (with similar properties) products by descriptions of their collections [16, 17].

Another international example, the Arctic SDI geoportal, also based on ISO 19115/ISO 19139 standards, is built on the GeoNetwork platform.

Table 1
Web resources of spatial data sets and services.

Web resource. URL	Developer/ Owner/ Manager	Standard	Metadata editor available	Comments
		Russian resources		
Geoportal of the Institute of Volcanology and Seismology (IVS FEB RAS). http://geoportal.kscnet.ru	IVS FEB RAS	ISO 19115/ ISO 19139	Yes	GeoNetwork 3.2 platform
Geoportal of the Pacific Geographical Institute FEB RAS (PGI FEB RAS). http://gis.dvo.ru	PGI FEB RAS	ISO 19115/ ISO 19139	Yes	Prototype. GeoNetwork 3.2.0.0 platform: http://gis.tigdvo.ru:9190/geonetwork/srv/rus/catalog.search#/home
Metalogeny geoportal. http://geoportal.sgm.ru (not responding on 05-23.06.2021)	Vernadsky State Geological Museum of RAS	ISO 19115, ISO 19115-2, FGDC, Dublin Core ArcGIS Metadata format	Yes	Geoportal Server 2.6.0 portal by the Esri Company (USA)
Regional geoportal of the Institute of Computational Modeling SB RAS (ICM SB RAS). http://gis.krasn.ru	ICM SB RAS	ISO 19115/ ISO 19139	N/A*	Web server configuration: Apache 2, PHP 5, MapServer 7
Geoportal of the Komi Republic. https://gis.rkomi.ru	State authority Territorial information fund of the Komi Republic	No	No	Catalogue of metadata with the description of 426 resources (as of 29.05.2021). Geoserver platform
Federal Fund of Spatial Data. https://cgkipd.ru/fsdf	State authority Center of Geodesy, Cartography and SDI	No	No	It is possible to search and order resources on a number of criteria: https://order.cgkipd.ru. 86,718,970 storage units (as of 01.01.2021)

* N/A — no information available

Table 2
Web resources of spatial data sets and services.

Web resource. URL	Developer/ Owner/ Manager	Standard	Metadata editor available	Comments
		International and foreign resources		
INSPIRE geoportal. https://inspire-geoportal.ec.europa.eu	Joint Research Centre, Belgium	ISO 19115/ ISO 19139	Yes	A built-in validator to verify compliance with datasets, geographic services and metadata of technical documentation of the INSPIRE program
Arctic SDI geoportal. https://geoportal.arctic-sdi.org	Arctic Council in cooperation with the national survey & mapping services	ISO 19115/ ISO 19139	N/A	GeoNetwork 3.2. platform. Registered users are allowed to embed their own maps
Geoportal of the Caucasus-SDI, Scientific Network for the Caucasus Mountain Region. https://sustainable-caucasus.unepgrid.ch	Swiss National Science Foundation and the Swiss Agency for Development and Cooperation under the SCOPES Program, coordinated by the University of Geneva	Full metadata: Text format, HTML format. Standard Metadata — XML format: Atom, DIF, Dublin Core, ebRIM, FGDC, ISO, ISO with XSL	Yes	GeoNode platform, 2.10.1 version (as of 15.04.2021): http://docs.geonode.org/en/master/tutorials/install_and_admin/quick_install.html
Scientific Data Search. https://nsidc.org	The National Snow and Ice Data Center (NSIDC, USA)	DIF	N/A	Import of data from external sources is supported
GeoPlatform geoportal of the US National Spatial Data Infrastructure. https://www.geoplatform.gov	FGDC	JSON, ISO 19139, ISO 19115-3, ISO 19115-3 GeoPlatform Profile	Yes	ArcGIS Online (AGOL) platform Esri Company, USA
Geoportal of the Infraestructura de Datos Espaciales de España (IDEE). https://www.idee.es	Instituto Geográfico Nacional	ISO 19115/ISO 19139	Yes	GeoNetwork 3.8.2 platform

* N/A — no information available

GeoNode is the other common platform, like the GeoNetwork it is an open source software class; it is used, among many other services, in the Scientific Network for the Caucasus Mountain Region (Caucasus-SDI) geoportal. In addition to the original ISO 19115/ISO 19139 format and text format to display selected metadata elements on geoportal pages, the platform supports the publication of metadata in other formats, including the following ones:

- Atom (Atom Syndication Format), developed by a non-commercial regulating organization of the IETF (Internet Engineering Task Force);
- ebRIM (CSW-ebXML Registry Information Model), profile OGC Catalogue Service;
- DIF (Global Change Master Directory Interchange Format), compatible with the ISO 19115 and CSDGM, applied in the NASA (USA).

The standard DIF format is also used in The National Snow and Ice Data Center (NSIDC).

Two examples of geoportals of national SDIs conclude the table. A selection of foreign regional and national geoportals is contained, in particular, in Appendix A of the GOST R 58570-2019 "Spatial data infrastructure. Fundamentals". Typically, the search for multiple datasets, series, and related geographic services is supported by the group of ISO 19115 standards.

5. Conclusions

The health of the geoportal, like any network service, largely depends on the support of international standards. The analysis reveals that effective search for spatial data resources and related geographic services rests on the use of ISO spatial metadata standards. This statement is true of international and foreign geoportals. None of these Russian geoportals use domestic standards of GOST R 57668-2017 and GOST R 57656-2017. It is worth recalling that the development of an analogue of the ISO/TS 19115-3:2016 Geographic information — Metadata — Part 3: XML schema implementation for fundamental concepts under the national standardization plan is not to be launched until 2021. In the future, we should also revise and evaluate how and to what extent all 19 national standards set for TC 394 Geographic information/Geomatics are operationalised.

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