Leveraging metadata standards in ArcGIS to support Interoperability

David Danko and Aleta Vienneau
Leveraging Metadata Standards in ArcGIS for Interoperability

- Why metadata and metadata standards?
- Overview of metadata standards
- ArcGIS for Desktop standards support
- Notes for specific metadata styles
- Customizing the metadata editor
- What’s next for ArcGIS
We use maps every day not knowing much about them.
With property, money, or lives at stake – we need to know more
Always need/use metadata
Abstracting geographic knowledge

Encapsulating real world knowledge

Interoperability

Visualization, Analytics, Decision support...

Models
Maps
Geodata
Metadata
Abstracting geographic knowledge

Metadata

Global Map: http://www.N
Abstract: vector data
NOAA Weather: http://www.N
Abstract: point feature
Landsat: http://www.N
Abstract: 30m satellite
Why metadata and metadata standards?

Metadata is useful!

- Communicate the assumptions, limitations, approximations, simplifications
  - Enables understanding
- Support decisions, discovery, and reuse
- Identify a resource’s worth
- Archive information
Why metadata and metadata standards?

Why follow metadata standards?

- Content checklist for authors
- Common understanding of geospatial data
  - Between countries
  - Between communities
- Publish to metadata catalogs
- Consistent terminology for global search
Why metadata and metadata standards?
Tim Berners-Lee Five Star Deployment Scheme for Open Data

- Published
- Structured
- Accessible
- Discoverable
- Associations

Good
Better
Best

Leveraging Metadata Standards for Supporting Interoperability in ArcGIS
Overview of Metadata Standards
## Metadata standards

<table>
<thead>
<tr>
<th>Content Standard for Digital Geospatial Metadata (FGDC 1992)</th>
<th>Defines metadata elements and content for describing geospatial datasets</th>
<th>FGDC standard</th>
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## ISO Metadata related standards

<table>
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<tr>
<th>Name of Standard</th>
<th>Description</th>
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<tbody>
<tr>
<td>ISO 19109:2005 Rules for application schema</td>
<td>Defines the general feature model and rules for creating and documenting application schemas for modeling features and their properties allowing physical applications to understand and share data</td>
<td>Under revision: Sent to ISO for publication</td>
</tr>
<tr>
<td>ISO 19110:2005 + Amendment 1 Methodology for feature cataloguing</td>
<td>Catalogue defining features and properties for a domain of interest and/or a dataset and a schema for encoding in XML</td>
<td>Under revision: FDIS 2014-7, IS 2016-02</td>
</tr>
<tr>
<td>ISO 19111:2007 Spatial referencing by coordinates</td>
<td>Metadata about/defining a coordinate reference system</td>
<td>International standard</td>
</tr>
<tr>
<td>ISO 19111-2:2009 Spatial referencing by coordinates-Extension for parametric value</td>
<td>Metadata about/defining a coordinate reference system using parametric values</td>
<td>International standard</td>
</tr>
<tr>
<td>ISO 19112:2003 Spatial referencing by geographic identifiers</td>
<td>Metadata about/defining a reference system which uses spatial unit identifiers other than coordinates i.e. gazetteer, postal code, etc.</td>
<td>International standard</td>
</tr>
<tr>
<td>ISO 19113:2002 Quality principles</td>
<td>Defines the principles, the elements/sub-elements of data quality</td>
<td>Superseded by 19157</td>
</tr>
<tr>
<td>ISO 19114:2003 Quality evaluation procedures</td>
<td>Defines procedures for determining data quality</td>
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<td>ISO 19115:2003 Geospatial metadata</td>
<td>Defines metadata elements and schema describing geospatial datasets</td>
<td>Superseded by 19115-1</td>
</tr>
<tr>
<td>ISO 19115-1:2014 Geospatial metadata fundamentals</td>
<td>Revision of ISO19115 which defines metadata elements and schema describing geospatial resources i.e. datasets and services</td>
<td>International standard</td>
</tr>
<tr>
<td>ISO 19115-3: XML schema implementation metadata fundamentals</td>
<td>Provides a schema for implementing ISO 19115-1 in XML</td>
<td>Under development: TS 2015-09</td>
</tr>
<tr>
<td>ISO 19119:2005 Services</td>
<td>Provides a framework and defines the metadata for services enabling users to access and process geographic information across a generic computing interface. The metadata portion of this standard has been moved to ISO19115-1</td>
<td>Partially superseded by 19115-1</td>
</tr>
<tr>
<td>ISO 19130:2010 Imagery sensor models for geopositioning</td>
<td>Specifies a sensor model describing the physical and geometrical properties of specific sensors</td>
<td>International standard</td>
</tr>
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## OGC ISO Metadata related standards

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<tr>
<td>ISO 19130-1 Imagery sensor models for geopositioning</td>
<td>Revision of ISO 19130-1</td>
<td>Under revision: CD 2015-12, DIS 2016-06, IS 2017-06</td>
</tr>
<tr>
<td>ISO 19130-2:2014 Imagery sensor models for geopositioning SAR, InSAR, Lidar and Sonar</td>
<td>Specifies a sensor model describing the physical and geometrical properties for the stated sensors</td>
<td>International standard</td>
</tr>
<tr>
<td>ISO 19138:2006 Data quality measures</td>
<td>Defines commonly used measures for reporting data quality for the sub-elements defined in ISO 19113 and a structure so they may be maintained in a register.</td>
<td>Superseded by 19157</td>
</tr>
<tr>
<td>ISO 19139:2007 Metadata XML Schema implementation</td>
<td>Provides encoding rules and a schema for implementing ISO 19115 in XML.</td>
<td>International standard To be partially superseded by ISO 19115-3</td>
</tr>
<tr>
<td>ISO 19139-1 Metadata XML Schema implementation</td>
<td>This revision will only include the encoding rules for metadata</td>
<td>Under revision: CD 2015-06, DIS 2016-06, TS 2017-06</td>
</tr>
<tr>
<td>ISO 19139-2:2012 Metadata - XML schema for imagery and gridded data</td>
<td>Provides a schema for implementing ISO 19115-2 in XML</td>
<td>International standard</td>
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<td>ISO 19157:2013 Data Quality</td>
<td>Defines the principles and components for describing, evaluating, and the measures used for reporting data quality. Revising and replacing ISO 19113, 19114, 19138.</td>
<td>International standard</td>
</tr>
<tr>
<td>ISO 19157-2 Data Quality XML Schema implementation</td>
<td>Provides a schema for implementing ISO 19157 in XML</td>
<td>Under development: TS 2016-05</td>
</tr>
<tr>
<td>ISO 15836:2009 The Dublin Core metadata element set</td>
<td>Cross domain resource descriptions – not limited to specific resources</td>
<td>International standard</td>
</tr>
<tr>
<td>W3C Data Catalog Vocabulary (DCAT)</td>
<td>An RDF vocabulary designed to facilitate interoperability between data catalogs published on the Web.</td>
<td>International standard</td>
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# Metadata standards

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<th>Metadata Standard</th>
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<tr>
<td>OpenGIS® Catalogue Services Specification</td>
<td>Specifies the interfaces, bindings, and a framework for defining application profiles required to publish and access digital catalogues of metadata for geospatial data, services, and related resource information.</td>
<td>OGC Standard</td>
</tr>
<tr>
<td>OGC® Catalogue Services Standard 2.0 Extension Package for ebRIM Application Profile: Earth Observation Products</td>
<td>Defines the way Earth Observation product metadata resources are organized and implemented in the Catalogue for discovery, retrieval and management.</td>
<td>OGC Standard</td>
</tr>
<tr>
<td>Ordering Services Framework for Earth Observation Products Interface Standard</td>
<td>Specifies the interfaces, bindings, requirements, conformance classes, and a framework for implementing extensions that enable complete workflows for ordering of Earth Observation (EO) data products</td>
<td>OGC Standard</td>
</tr>
<tr>
<td>OGC® OpenSearch Geo and Time Extensions</td>
<td>Specifies the Geo and Time extensions to the OpenSearch query protocol.</td>
<td>OGC Standard</td>
</tr>
<tr>
<td>FGDC CSDGM Application Profile for CSW 2.0 CAT2 AP FGDC</td>
<td>Catalogue Services based on the FGDC Content Standard for Digital Geospatial Metadata (CSDGM).</td>
<td>OGC Best practices</td>
</tr>
</tbody>
</table>
Different categories of standards

Semantic Interoperability

- Definitional/content standards
  - What to write
  - Optionality

ISO 19115-1 Metadata

Title = name by which the resource is known
Different categories of standards

Technical Interoperability

• Encoding/implementation specifications
  - Format
  - Validity
Content Standard for Digital Geospatial Metadata (CSDGM)

Definitional

FGDC CSDGM:1998

Encoding

mp

XML DTD

XML Schema

Leveraging Metadata Standards for Supporting Interoperability in ArcGIS
ISO metadata standards today

**Definitional**
- ISO 19115:2003 - Metadata
- ISO 19113:2002 - Quality principles
- ISO 19114:2003 - Quality eval procedure
- ISO 19110:2005 - Feature Catalogue
- ISO 19115-2:2009 - Metadata-Imagery
- ISO 19119:2005 - Services

**Encoding**
- ISO 19139:2007 - Metadata XML encoding
- ISO 19139-2:2012 - Metadata imagery encoding
- OGC services

Extending
ISO metadata standards future

- **ISO 19115-1:2014**
  - Metadata fundamentals
  - Including Services metadata

- **ISO 19115-2**
  - Extending 19115-1 & 15-2

- **ISO 19115-3**
  - Metadata fundamentals XML encoding 9/15

- **ISO 19157-2**
  - Data quality XML encoding 5/16

- **ISO 19110:2015**
  - Feature catalogue 2/16

- **ISO 19139**
  - Metadata XML encoding rules 6/17

- **In work**
  - ISO 19139 Metadata XML encoding rules 6/17
ISO 19115 (-1) Profiles

Australia-New Zealand Profile
North American Profile of ISO 19115:2003 (NAP)
CAN/CGSB-171.100-2009
INCITS 453-2009
INSPIRE Metadata Directive
ISO19115/ISO19119 Application Profile for CSW 2.0
C3Grid ISO 19115 Metadata Profile
Marine Community Metadata Profile of ISO 19115
Energy Industry Profile of ISO 19115-1
USGIN ISO 19139 Profile
DISDI Geospatial Metadata Profile (DGMP)
National System for Geospatial Intelligence Metadata Foundation (NMF)

A metadata profile for precision agriculture based on ISO 19115 standard.
WMO Core Profile of the ISO 19115 Metadata Standard
Transformation of HDF-EOS metadata from the ECS model to ISO 19115-based XML
Draft African metadata profile of ISO19115
Samoa profile
NOKIS – an ISO 19115 Based Metadata System
The UDK and ISO 19115 Standard
Latin American Profile
Núcleo Español de Metadatos (NEM)
UK GEMINI
Biological profile
Coastal zone profile
S100 Metadata profile (IHO)
Comparison of CSDGM and ISO metadata standards

FGDC CSDGM Metadata
1. Identification Information
   - Some coded domain values
2. Data Quality Information
3. Spatial Data Organization Information
   - Some coded domain values
4. Spatial Reference Information
5. Entity and Attribute Information
6. Distribution Information
   - Some coded domain values
7. Metadata Information
8. Citation Information
   - Some coded domain values
9. Time Period Information
10. Contact Information

Extensions for Remote Sensing Metadata

ISO TC 211 content standards
- ISO 19110:2005
- ISO 19115-2:2009
- ISO 19115:2003/Cor.1:2006

ISO metadata community profiles
Comparison of CSDGM and ISO metadata standards

FGDC CSDGM Metadata
1. Identification Information
2. Data Quality Information
3. Spatial Data Organization Information
4. Spatial Reference Information
5. Entity and Attribute Information
6. Distribution Information
7. Metadata Information
8. Citation Information
9. Time Period Information
10. Contact Information

Extensions for Remote Sensing Metadata

ISO 19115-3
Metadata fundamentals XML encoding 9/15

ISO TC 211 content standards

Leveraging Metadata Standards for Supporting Interoperability in ArcGIS
Metadata standard validation

- Implementation specification XML Schemas published on the web by standards organizations
  - Schemas published in several different locations
  - TC 211 recently uploaded XML schemas to new central ISO repository
    - [http://standards.iso.org/iso/](http://standards.iso.org/iso/)
Metadata standard validation

• What are schematrons?
  - Supplement to XML Schemas
  - With to evaluate content standard rules not evaluated by XML Schemas
  - Profiles may provide to evaluate profile-specific rules
  - Run Schematrons as XSLTs to produce a report
Support in ArcGIS for Desktop
Esri is committed to supporting metadata standards

Before formal metadata

Early advocates

FGDC CSDGM 1998

ISO 19115:2003

Early support for drafts

Full support in ArcCatalog

ISO 19139:2007

Full support for compliant XML and profiles

ISO 19115-1:2014

Preparing to support 19115-3

Participate in standards development

Leveraging Metadata Standards for Supporting Interoperability in ArcGIS
ArcGIS standards support

- *Content Standard for Digital Geospatial Metadata (CSDGM)*
ArcGIS standards support

• Profiles
  - North American Profile of ISO 19115:2003 (NAP)
  - INSPIRE Metadata Directive
• Both are based on ISO 19115/19139
• Both reference ISO 19119 content
ArcGIS uses a flexible system to support standards

- Content stored in the ArcGIS metadata format
- Includes all concepts for supported standards and profiles
ArcGIS uses a flexible system to support standards

- Concepts and rules tuned appropriately for your metadata style
  - Pages added to or removed from the ArcGIS metadata editor
  - Elements added to or removed from a page as needed
  - Validation rules indicate, as you type, which elements are required
ArcGIS uses a flexible system to support standards

- Change your metadata standard—change the metadata style
  - Edit metadata, check if other content required
  - Export metadata to another standard format
  - Validate metadata for another standard
  - Publish to another metadata catalog
Export standard-compliant metadata to use outside ArcGIS

- Export ArcGIS metadata content to a standard format XML file
- Validate exported file using XML schema provided by standards organization
- Use industry standard XML tools to validate
  - Microsoft .NET Framework XML capabilities
  - Provides warning and error messages
Export standard-compliant metadata to use outside ArcGIS

ArcGIS Metadata

- FGDC CSDGM XML
- ISO 19139 (NAP) XML
- ISO 19139 (INSPIRE) XML
- ISO 19115-3 XML
- ISO 19139 XML
Export standard-compliant metadata to use outside ArcGIS

- Publish standard-format XML file to a metadata catalog
  - Some catalogs incorporate validation into the publishing process
  - Consider catalog rules as well as standard rules when editing metadata
ArcGIS standards support

- A flexible system that adapts to changing standards
- Enhances interoperability
FGDC CSDGM Metadata Style

• Prompt to upgrade FGDC CSDGM-format metadata
  - Content appears at the bottom of metadata display
  - Read-only in the Description tab

• Allow ArcGIS to automatically update content
  - Spatial reference properties
  - Vector and raster data properties
FGDC CSDGM Metadata Style

• Search ArcGIS 10.3.x Help with keyword FGDC
• Creating and managing FGDC metadata – walks you through
• Differences between ArcGIS and CSDGM metadata
• Complete illustrated guide
FGDC CSDGM Metadata Style

- Validation with online FGDC-provided XML DTD for validation
- Can validate metadata with mp
  - Export metadata to CSDGM-format XML file
  - Run USGS MP Metadata Translator tool with Conversion Type = None
  - Warning and error messages produced by mp
  - Use a custom model or script to combine export and mp validation
ISO 19139 Metadata Styles

- Two ISO 19139 metadata styles provided since 10.2.1
  - ISO 19139 Metadata Implementation Specification
  - ISO 19139 Metadata Implementation Specification GML 3.2
- Same content and rules, different GML namespace in exported XML file
- Some metadata catalogs or tools may require XML files with one GML namespace or the other
ISO 19139 Metadata Styles

- Validate button: validates using online ISO XML Schemas
- Reference ISO 19139 XML Schemas provided in different locations on the web
  - Original style references online XML Schemas using GML 3.2.0
  - GML 3.2 style references online XML Schemas using GML 3.2.1
- No difference in result for metadata created in ArcGIS for Desktop
North American Profile (NAP) Style

- Additional codelist values and mandatory elements
  - Supports tighter transition from CSDGM
- NAP-specific rules available in the editor
- No NAP-specific XML Schemas
- Exported metadata validates with ISO 19139 for data or CSW for services
INSPIRE Metadata Directive Style

- Supports creating ISO metadata that conforms to the INSPIRE Metadata Directive
- Limited codelist values in the editor as appropriate
- INSPIRE-specific rules available in the editor
- Exported metadata validates with ISO 19139 for data or CSW for services

Leveraging Metadata Standards for Supporting Interoperability in ArcGIS
Other ISO Standards and Profiles

- Complete ISO 19139 content is supported with the ISO 19139 metadata style
- Follow the rules for your standard or profile, ignoring 19139-specific rules as appropriate
Other ISO Standards and Profiles

- Use the ArcGIS Metadata Toolkit to customize the ArcGIS metadata editor
  - Download from support.esri.com
  - Latest version supports 10.3.x
  - Create a custom metadata style
  - Documentation for the ArcGIS metadata format
Other ISO Standards and Profiles

- **Toolkit provides code for all pages in the metadata editor**
  - C# WPF application with XAML forms
  - Modify elements on existing pages
  - Add custom pages
  - Change codelist values
  - Change validation rules
- **Programming guide**
- **Sample project**
What’s next for ArcGIS

• Provide support for creating standard-compliant metadata in ArcGIS Pro
• Improved metadata support across the ArcGIS platform
• Support new ISO metadata standards after XML Schemas are finalized
• Update styles to reference schemas from new repository
Leveraging Metadata Standards in ArcGIS for Interoperability

• Data interoperability requires metadata interoperability
• Metadata important in ArcGIS
• The best metadata tool for anyone concerned with interoperability
Remaining metadata sessions at this UC

• **Working with Metadata in ArcGIS**
  - **Wednesday 1:30 - 2:45** Ballroom 6 D
  - **Thursday 3:15 - 4:30** Room 32 B

• **Metadata Special Interest Group meeting**
  - **Wednesday 5:30 – 7:00** Room 12

Leveraging Metadata Standards for Supporting Interoperability in ArcGIS
Thank you…

- Please fill out the session survey in your mobile app
- Select "Leveraging metadata standards in ArcGIS to support Interoperability" in the Mobile App
  - Use the Search Feature to quickly find this title
- Click “Technical Workshop Survey”
- Answer a few short questions and enter any comments

- Paper surveys
  - Offering ID: 1734
Understanding our world.