West Coast Ocean Data Portal Knowledge Base

Release 1

West Coast Ocean Data Portal Team

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CHAPTER 1

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1.1 Introduction

1.1.1 What is the West Coast Ocean Data Portal?

The West Coast Ocean Data Portal is a tool that facilitates geospatial data **discovery** and data **sharing** for people and organizations who work on regional ocean and coastal management, policy, and planning on the West Coast of the United States. You can read more about the West Coast Ocean Data Portal here: http://portal.westcoastoceans.org/about/.

The West Coast Ocean Data Portal (WCODP) is a project of the West Coast Governors Alliance on Ocean Health (WCGA). The WCGA and the WCODP promote communication and knowledge sharing between West Coast ocean data managers, partners, and users, known as the West Coast Ocean Data Network.

The West Coast Ocean Data Portal is a unique and valuable resource on the West Coast because it focuses on regional data sets for cross-boundary, multi-discipline, and multi-agency issues such as marine debris, sea-level rise adaptation, ocean acidification, and marine spatial planning.

The WCODP does not store a copy of data sets or metadata. Instead, it displays key descriptive information about the data and points users to the original source using the metadata as the "road map."

1.1.2 How to Use the Knowledge Base

The West Coast Ocean Data Portal Knowledge Base is a *technical* resource for data managers and data partners who would like to participate and share their geospatial metadata, data and/or web services with the larger community of West Coast ocean data users.

This Knowledge Base describes:

- Steps to register data in the WCODP;
- Tips, tools, and best practices for developing good metadata and web mapping services;
- Interoperability of web catalog services; and
- Details about the technology behind the WCODP.

This Knowledge Base is *not* a user guide for end users of the WCODP.

1.1.3 Questions?

If you don't find the information you're looking for in this knowledge base, or have additional questions, feel free to contact us:

- West Coast Ocean Data Portal Administrator, portal@westcoastoceans.org
- Todd Hallenbeck, Program Coordinator, todd.r.hallenbeck@westcoastoceans.org
- Andy Lanier, ACT Co-Chair, andy.lanier@state.or.us
- Steve Steinberg, ACT Co-Chair, steves@sccwrp.org

We also encourage you to join the West Coast Ocean Data Network to find out about training and networking opportunities, as well as to connect with other members of the network to share resources, questions, and ideas.

1.2 Contribute

1.2.1 Why Register Your Data?

Registering your metadata with the West Coast Ocean Data Portal (WCODP) is an excellent way to promote your data or web services to the ocean and coastal data community on the West Coast.

Some benefits of data registration in the WCODP include:

- Wider advertisement of data holdings to new user groups and stakeholders.
- Inclusion of your data in decision-making for regional issues like sea level rise adaptation, ocean acidification, and marine planning.
- Accessibility to non-traditional users and audiences.
- Demonstration of regional collaboration and sharing often required by grant funding agencies.

1.2.2 Criteria for Inclusion

Data Themes and Geographic Scope

The focus of the WCODP is regional data that depict coastal and ocean characteristics (biological, physical) as well as human uses, management, and potential impacts. Therefore, the following data types are the highest priority for registration:

- Data that are state or regional in scale
- Data that meet one of more priority needs of the West Coast Governors Alliance.

Technical Prerequisites

Because metadata provides the details needed to display the record in the WCODP, a well-formed, standards-compliant metadata is a prerequisite for data registration. In addition, a primary goal of the WCODP is data sharing and collaboration, so it is a best practice to provide links to data and web services that are easily accessible and available in commonly-used geospatial formats.

Specifically,

- The data must be geospatial, ideally in a GIS format, but may be in a tabular format that includes coordinates.

- The data must have an on-line metadata record, preferably in Federal Geographic Data Committee (FGDC) or ISO format.
- The metadata should link to web services and/or a URL to download the data.
- It is highly recommended that web services be OGC-compliant or exist as an ArcGIS version 10.x REST service.

1.2.3 Relationship to Other Portals

The WCODP regularly harvests select records from a number of regional, state, and federal data portals and clearinghouses. If appropriate, we encourage you to register your data with one of the portals listed below for ease of access by the WCODP, as well as to reach a broader audience. You can view the current data contributors here: http://portal.westcoastoceans.org/contributors/ or under the Sources tab on the Discover page: http://portal.westcoastoceans.org/discover/

State and Regional Portals, Registries, and Clearinghouses

National Portals

- Data.gov: http://www.data.gov/ocean/
- Marine Cadastre http://marinecadastre.gov/data/

State Registries

- California Geoportal: http://portal.gis.ca.gov/geoportal/catalog/main/home.page
- Oregon Spatial Data Library: http://spatialdata.oregonexplorer.info/geoportal/catalog/main/home.page
- Washington State Geospatial Clearinghouse: http://metadata.gis.washington.edu/geoportal/catalog/main/home.page

Oceanographic Data Portals

- SCCOOS: http://www.sccoos.org/interactive-map/
- CeNCOOS: http://139.121.160.34/CeNCOOS/DataPortal.html
- NANOOS: http://nvs.nanoos.org/

Seafloor Mapping Data Portals

- PaCOOS: http://pacoos.coas.oregonstate.edu/help.html
- SeafloorMapping.net: http://seafloormapping.net/sf_data
- California SeaFloor Mapping Program: http://seafloor.otterlabs.org/csmp/csmp.html

1.2.4 How to Register Data With the West Coast Ocean Data Portal

If you have geospatial data, metadata, and web services that you would like to make accessible via the West Coast Ocean Data Portal, follow the steps below:

1. **Identify the geospatial data and/or web mapping service(s) that you would like to share.**
    - Use the *Criteria for Inclusion* to help you determine if your data or services are a good fit
2. **Create standards-compliant metadata for your geospatial data and/or web mapping service(s).**
    - Include the URLS for the data download location and/or web mapping service, or other ways for users to access the information.
    - Validate your metadata

3. Publish your metadata via a Web Accessible Folder (WAF) or a Catalog Service (CSW) or through a regional portal or clearinghouse.
4. Complete the form on the Contributor page of the WCODP, or contact the WCODP Administrator (portal@westcoastoceans.org) about your data set(s).

That's it! The WCODP Administrator will be in touch to let you know that the harvest of your metadata was successful, or to work with you to make modifications if there were any problems.

WCGA Data Sharing Policy

General Statement

The WCGA and the West Coast Ocean Data Portal seek to promote and advocate the spirit of "open data" to ensure that data products are made freely and readily accessible to our stakeholders and the public in machine readable formats.

Data/Metadata Format and Standards

WCGA and West Coast Ocean Data Portal (WCODP) Action Coordination Team (ACT) will ensure compatibility with federal requirements, and any data generated through grant activities be required to complete ISO or FGDC metadata and generate OGC Services.

Data Authorship and Citation

The WCGA will strive to advertise information related to the original authors of the data that is discoverable through our portal. It is vitally important to recognize contributions from our partners by providing the original source and citation for any data.

Data Stewardship and Preservation

Contracting Institutions and state agencies will work with their respective state data network and Geoportal to identify long term hosting and publishing custodians for any original data created. This will include the requirement that such custodians have the ability to publish metadata and WMS in a way accessible to the West Coast Data Registry (Catalog standard, Web accessible folders, etc). The custodians will also be required to notify the West Coast Ocean Data Portal Coordinator of new data made available to their state geoportal so that the West Coast Ocean Data Portal Coordinator can target that new dataset for inclusion in the Data Registry. Similarly, and data development or enhancement projects will be subject to the same requirements (i.e. custodians are identified at the state or partner level, metadata and WMS are generated and published online, West Coast Ocean Data Portal Coordinator is contacted).

Access

Access to original data will be made available through both the respective state or Network geoportal as well a West Coast Data Registry. The West Coast Registry will then republish resources for harvesting by the federal ocean.data.gov.

1.3 Metadata

1.3.1 Why Create Metadata?

Metadata helps potential users of your geospatial data to answer the questions:

- What
- Why
- When

- Who
- Where
- How

Metadata in the WCODP

The primary use of metadata in the West Coast Ocean Data Portal is data discovery and access.

There are a variety of purposes for creating metadata, including

- Discovery
- Exploration and Documentation
- Archive
- Access and Retrieval

Most metadata serves multiple purposes, but it is helpful to understand what level and type of information is needed to meet your primary purpose(s). Much of the metadata created for geospatial data, especially in the natural resources and scientific domains, has focused on documenting the details of data sets: what is the purpose of the data, how it was created, what do the attributes mean, etc.

We are now experiencing a transition that emphasizes metadata's role in data discovery and retrieval by other systems and people. This function of metadata is becoming critical as web services and data download linkages are increasingly packaged with the metadata.

See also:

The business case for metadata https://www.fgdc.gov/metadata/metadata-business-case

1.3.2 What Information Is Required?

For the purposes of data discovery and access, the West Coast Ocean Data Portal requires only a minimal set of information from the metadata. The following information is displayed in the portal, some of which is accessed when users filter or search for data of interest:

- Title
- Abstract / Description
- Use Limitations / Constraints
- Bounding Box Coordinates in Latitude/Longitude (decimal degrees)
- Keywords
- Date Published
- **Contacts**
  - Originator
  - Publisher
  - Distributor
- URLs for data download, web services, kml, web application, documentation

If the metadata meets the requirements of the Federal Geographic Data Committee (FGDC) endorsed standards, (https://www.fgdc.gov/metadata/geospatial-metadata-standards), it will definitely meet the requirements of the West Coast Ocean Data Portal.

1.3.3 Metadata Standards and Formats

Use of standard metadata formats is critical for interoperability and access by other automated systems and web catalogs for geospatial data discovery and sharing. There are a large number of metadata standards which address the needs of particular user communities. NOAA and FGDC have a broad catalog of resources about metadata standards.

- http://www.fgdc.gov/metadata/geospatial-metadata-standards
- http://www.ncddc.noaa.gov/metadata-standards/

See also:

- http://www.dcc.ac.uk/resources/briefing-papers/standards-watch-papers/what-are-metadata-standards

The following standards can be used for data discovery via the West Coast Ocean Data Portal:

ISO 19115:2003

ISO 19115:2003(E) - Geographic Information: Metadata

ISO 19115 was developed by the geospatial community to address specific issues relating to both the description and the curation of spatial data. This standard can be used for describing digital or physical objects or datasets which have a spatial dimension. The standard also includes methodologies for creating application profiles, metadata extensions and hierarchical metadata and provides implementation examples. Geospatial professionals have developed a number of profiles of this standard to fit particular uses: for example, the Australia New Zealand Land Information Council (ANZLIC) Metadata Profile, the North American Profile (NAP), and the UK GEMINI profile. The standard's accompanying XML schema, ISO/CD TS 19139 Geographic information — Metadata — enables interoperable XML expression of ISO 19115 compliant metadata.

See also:

- For more information and to acquire the ISO 19115 documentation, see http://www.iso.org/iso/catalogue_detail.htm?csnumber=26020.
- NOAA, NCDDC workbook for implementing ISO 19115: http://service.ncddc.noaa.gov/rdn/www/metadata-standards/documents/MD-Metadata.pdf

ISO 19115-2

ISO 19115 Part 2: 2009 - Geographic Information - Metadata - Part 2: Extensions

ISO 19115-2:2009 extends ISO 19115:2003 by defining the schema required for describing imagery and gridded data. In practice, this schema is used to document other types of instrumentation beyond imagery as well. It provides information about the properties of the measuring equipment used to acquire the data, the geometry of the measuring process employed by the equipment, and the production process used to digitize the raw data.

See also:

- For more information and to acquire the ISO 19115-2 documentation, see http://www.iso.org/iso/catalogue_detail.htm?csnumber=39229.
- NOAA, NCDDC workbook for implementing ISO 19115-2: http://service.ncddc.noaa.gov/rdn/www/metadata-standards/documents/MI-Metadata.pdf

FGDC CSDGM

Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata (FDGC CSDGM)

The standard commonly referred to as FGDC (although FGDC is the maintenance agency, and "CSDGM" is the actual element set) is a large and early metadata standard for geospatial information created by agencies of the US federal government. The FGDC web site describes the scope of this standard as to allow users to "determine the availability of a set of geospatial data, to determine the fitness [of] the set of geospatial data for an intended use, to determine the means of accessing the set of geospatial data, and to successfully transfer the set of geospatial data." The current production version of FGDC is 2.0, from 1998. Since this time, an international standard for geospatial information (ISO 19115) has emerged. Plans have been announced to create a US national geospatial metadata standard as a profile of ISO 19115, and to create version 3.0 of CSDGM as an implementation of that. This work has not yet been finalized.

See also:

- For more information on the FGDC standards, see http://www.fgdc.gov/metadata/geospatial-metadata-standards.

Dublin Core

Dublin Core Metadata Element Set

The Dublin Core Metadata Element Set (ISO Standard 15836) is a basic standard which can be easily understood and implemented and as such is one of the best known metadata standards. It consists of 15 elements which address the most basic descriptive, administrative and technical elements required to uniquely identify a digital resource. Most resource discovery metadata standards can be mapped to the Dublin Core Metadata Element Set, enabling basic federated searching across metadata created using a number of different standards, without detracting from richer metadata held elsewhere.

See also:

- See http://dublincore.org/ for more information on the Dublin Core Metadata Initiative.

EML

Ecological Markup Language

EML is a specification intended to support the description of any type of ecological information, including raw data, published research papers, rights information, and research protocols. At the highest level, EML models four primary entities: datasets, literature, software, and protocols. The WCODP technical community is working on developing a process for harvesting this format of metadata.

See also:

- For more information about EML, see http://knb.ecoinformatics.org/software/eml/.

1.3.4 How to Create Metadata

There are many different tools available to create geospatial metadata. This knowledge base does not intend to cover all the tools available, but to provide information about some tools that can be used to create valid geospatial metadata that can be successfully harvested and displayed by the WCODP.

Following are some geospatial metadata tools that have been used successfully to author standards-compliant metadata for harvest by the WCODP:

Tool	Type	Standards	Requires	Optional
Esri ArcCatalog	Desktop	FGDC CSDGM	ArcGIS 10	
EPA Metadata Editor (EME) v.3.2	Desktop	FGDC CSDGM	Windows OS	ArcGIS 10
EPA Metadata Editor (EME) v.4.0	Desktop	ISO 19115, 19115-2	Windows OS, MS Access	ArcGIS 10
USGS Metadata Wizard	Desktop	FGDC CSDGM	ArcGIS 10	
MERMAID	Web	FGDC CSDGM, ISO 19115-2 (export only)	web browser, login	
ATRAC	Web	ISO 19115-2	web browser, login	
USGS Online Metadata Editor (OME)	Web	FGDC CSDGM	web browser, login	

Allison Bailey presented a Technical Training Webinar to West Coast Ocean Data Network members highlighting some of these metadata tools, tool capabilities, and tips and tricks for creating metadata that can be easily consumed by the WCODP.

Metadata Creation Tools Webinar Videos (July 2015):

1. Knowledge Base (3:27)
2. EPA Metadata Editor (EME) v.4.0 - ISO 19115 (10:24)
3. EPA Metadata Editor (EME) v.3.2 - FGDC CSDGM (6:41)
4. ATRAC Editor - ISO 19115-2 (8:51)
5. Metadata Validation (3:02)
6. Questions and Wrap-up (11:21)

For ArcGIS users, the FGDC CSDGM Metadata Style (set in ArcCatalog options), can be used to create, edit, and export FGDC-compliant metadata. However, the other ArcCatalog styles for producing ISO metadata (ISO 19139 and North American Profile of ISO 19115 2003), have not been extensively tested with the WCODP, but have so far had mixed results.

If the metadata are simple enough, some metadata creators prefer to use a text editor to edit the XML file directly. This requires a bit of knowledge of both the metadata standard, tags, and XML. The WCODP has an ISO 19115 metadata template that contributors can use.

See also:

- https://www.fgdc.gov/metadata/geospatial-metadata-tools
- http://service.ncddc.noaa.gov/cdn/metadata-training-materials/Intro-to-ISO/5_ToolsforISOMetadata.pdf
- http://www.fgdc.gov/metadata/iso-metadata-editor-review
- http://www.usgs.gov/datamanagement/describe/metadata.php#advanced-users

1.3.5 Validating Your Metadata

Validating metadata content and format is an essential step to assure that your metadata will be useful to others as well as accessible to various portals and metadata catalogs such as the WCODP

In general, any FGDC CSDGM metadata that can be validated as FGDC-compliant, will successfully validate and display in the WCODP. Because the ISO standards are more comprehensive, more flexible, and more recently adopted, successful validation of an ISO 19115 or ISO 19115-2 record via an external tool, does not always guarantee successful

validation and display in the WCODP. In these cases, some testing and iterations with the WCODP coordinator may be needed.

- USGS FGDC CSDGM Validator: http://geo-nsdi.er.usgs.gov/validation/
- NOAA/NGDC ISO 19115-2 validator: http://www.ngdc.noaa.gov/docucomp/recordServices

1.3.6 How Is the Metadata Displayed?

The table below shows the translation between the metadata tags or Xpaths and where the content is displayed in the WCODP.

Metadata Format	Date Published	Creator	Publisher	Contact Name	Contact Email	Constraints	URL
Dublin Core	DC:Date	DC:Creator	DC:Publisher	DC:Creator		DC:Rights	NA
FGDC CSDGM	idinfo> citation> citeinfo> pubdate	idinfo> citation> citeinfo> origin	distinfo> distrib> cntinfo> cntorgp> cntorg	idinfo> ptcontac> cntinfo> cntorgp> cntper	idinfo> ptcontac> cntinfo> cntemail	idinfo> useconst	idinfo> citation> citeinfo> onlink
ISO 19115	identificationInfo> MD_DataIdentification> citation> CI_Citation> date> CI_Date> date> DateTime	identificationInfo> MD_DataIdentification> pointOfContact> CI_ResponsibleParty> organisationName> CharacterString	contact> CI_ResponsibleParty> organisationName> CharacterString	identificationInfo> MD_DataIdentification> pointOfContact> CI_ResponsibleParty> individualName> CharacterString	contactInfo> CI_Contact> address> CI_Address> electronicMailAddress> CharacterString	identificationInfo> MD_DataIdentification> resourceConstraints> MD_LegalConstraints> otherConstraints> CharacterString	transferOptions> MD_DigitalTransferOptions> onLine> CI_OnlineResource> linkage> url
ISO 19115-2	identificationInfo> MD_DataIdentification> citation> CI_Citation> date> CI_Date> gdate> Date	identificationInfo> MD_DataIdentification> gcitation> CI_Citation> citedResponsibleParty> CI_ResponsibleParty> organisationName> CharacterString	contact> CI_ResponsibleParty> organisationName> CharacterString	identificationInfo> MD_DataIdentification> citation> CI_Citation> citedResponsibleParty> CI_ResponsibleParty> individualName	identificationInfo> MD_DataIdentification> citation> CI_Citation> citedResponsibleParty> CI_ResponsibleParty> contactInfo> CI_Contact> address> CI_Address> electronicMailAddress> CharacterString	identificationInfo> MD_DataIdentification> resourceConstraints> MD_LegalConstraints> useLimitation> CharacterString	transferOptions> MD_DigitalTransferOptions> onLine> CI_OnlineResource> linkage> url

For further detail, the JavaScript code used to extract the metadata content can be viewed here: https://github.com/Ecotrust/wc-data-registry/blob/master/site_raw/_includes/js/services/Metadata.js

1.3.7 Best Practices for Metadata

Content

It is very important to provide good information within your metadata to assist people in understanding what the data are about, how it was created, how they can use it, who to contact with questions, and how to access the data. It may even be helpful to you in the future as the data author to remember key details about creation the data set. It has been said, that "Metadata is a love note to the future."

USGS has a very good resource clearly describing what type of information needs to go into the various elements of FGDC CSDGM standard.

- Metadata in Plain Language: http://geology.usgs.gov/tools/metadata/tools/doc/ctc/

There is also some good information about metadata content in this document for Geospatial Platform/data.gov: https://www.geoplatform.gov/sites/default/files/document_library/MetadataPractices07-2013_Linked_0.pdf

Most advice on content is applicable regardless of the metadata standard you use, but the location of the appropriate content may vary. Focus on what you would like to know if you were interested in discovering and using someone else's data set.

Publishing Great Metadata

Tanya Haddad gave an excellent presentation about publishing great metadata at the 2014 West Coast Ocean Data Network Meeting:

Publishing Great Metadata Presentation Slides

Publishing Great Metadata Presentation Videos:

1. Introduction to Sharing (3:15)
2. Metadata Overview (7:29)
3. Metadata Standards (10:43)
4. Metadata Tools (7:27)
5. Best Practices (7:43)
6. Sharing and Publishing (8:51)
7. Metadata Catalogs (5:16)

Additional Resources

Although both FGDC CSDGM and ISO-191xx standards are currently endorsed by the FGDC, federal agencies are being encouraged to transition from the older, CSDGM standard to ISO metadata as soon as they are able. To share the most current information about experiences, strategies, and resources for implementing ISO metadata, FGDC hosts a monthly webinar and has a library of resources from past webinars.

- https://www.fgdc.gov/metadata/events/iso-geospatial-metadata-implementation-forum

NOAA, National Center for Environmental Information (NCEI), formerly National Coastal Data Development Center (NCDDC), conducts a variety of metadata trainings and has an excellent set of material from these courses:

- http://www.ncddc.noaa.gov/metadata-standards/metadata-training/
- ftp://ftp.ncddc.noaa.gov/pub/Metadata/Online_ISO_Training/

EPA has provides detailed and clear guidance for developing metadata. Some of the information is focused on EPA-specific content, but the general concepts and best practices can be applied to any metadata effort.

- https://edg.epa.gov/EME/pdfs/GenericMetadataGuide.pdf
- https://edg.epa.gov/EME/resources.html

1.4 Web Services

1.4.1 What are Web Services?

A Web service is a method of communication between two electronic devices over a network. It is a software function provided at a network address over the Web with the service always on as in the concept of utility computing. The W3C defines a Web service generally as, "a software system designed to support interoperable machine-to-machine interaction over a network." (from Wikipedia)

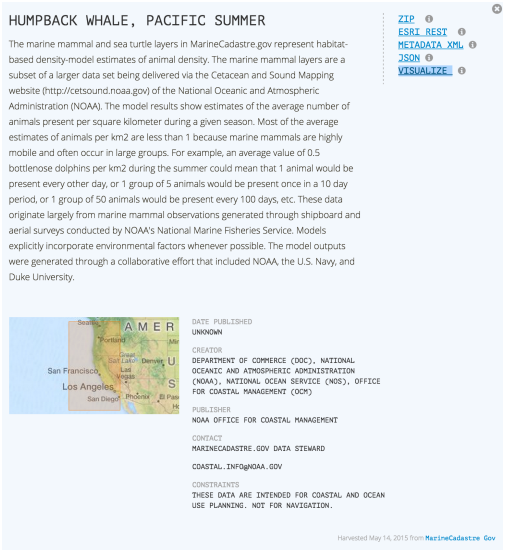
For the WCODP and this knowledge base, we are most interested in web mapping services and catalog services. Web mapping services are web services that allow us to view, query, and manipulate or process geospatial maps and/or data. Catalog services, which are described in the next section, are for publishing and searching metadata.

1.4.2 Why Create Web Services?

Web services provide an open interoperable and highly efficient framework for using distributed data resources in common systems. A web mapping service published by a single data provider, can be used simultaneously by many different users and applications, both web and desktop applications.

Web mapping services give the publisher control over how the data are displayed and the types of capabilities that the end-user can access, such as query, edit, geoprocess, download, etc. Publishing a web mapping service facilitates end-user access to the most current and authoritative data because the web service address (URL) remains unchanged, while data supporting the service can be modified and updated.

In the West Coast Ocean Data Portal (WCODP), web mapping services are used to facilitate data discovery by allowing end-users to preview and visualize the data on a map.



For example, if you selected the VISUALIZE link in the example WCODP record above, it would display the associated web mapping service in the WCODP map viewer.

1.4.3 Types of Web Mapping Services

Web mapping services comprise a lot of different kinds of services, including:

- mapping services - to get a map image
- data services - to get coordinates of map features or attributes about the features
- geocoding or address matching services - to get a coordinate for an address
- geoprocessing services - to get information about feature services or to modify those shapes

Web Mapping Service versus Web Map Service (WMS)

The terminology is a bit confusing because Web Map Service (WMS) refers specifically to the Open Geospatial Consortium (OGC) WMS interface standard. However, some people or software vendors may use the term as a generic description of web services for geospatial data. For this knowledge base, when we are referring to geospatial web services in general, we will use the term *web mapping services*.

The Open Geospatial Consortium (OGC) provides a variety of open source standards for web mapping services which have been broadly adopted by the geospatial community. Some of the commonly used standards are listed below.

- A Web Map Service (WMS) defines an interface that allows a client to get maps of geospatial data and gain detailed information on specific features.
- A Web Feature Service (WFS) allows a client to perform data manipulation operations on one or more geographic features. WFS offers direct fine-grained access to geographic information at the feature and feature property level.
- A Web Processing Service (WPS) provides access to calculations or models which operate on spatially referenced data.
- A Web Map Tile Service (WMTS) provides access to cartographic maps of geo-referenced data. WMTS is commonly used for base maps.
- A Web Coverage Service (WCS) defines a standard interface and operations that enable interoperable access to geospatial coverages consisting of intact, raw data. WCS is commonly used with multidimensional or raster data.

Some additional OGC standards (data formats and services) include: KML, Sensor Observation Service (SOS), GeoPackage, NetCDF, and Catalogue Service (CSW).

ESRI has its own proprietary web mapping services that are usually referred to as ArcGIS REST or ESRI REST services, and can be accessed via the ArcGIS REST API. The ArcGIS REST services have similar capabilities to the OGC services, including,

- Map Service
- Feature Service
- Geoprocessing Service
- Image Service

See also:

Geospatial Standards and Operational Policies (Natural Resources Canada) http://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/8902

1.4.4 How to Create Web Mapping Services

There are a variety of software packages or mapping engines that can be used to create web mapping services.

- ArcGIS for Server can produce ArcGIS REST services and some OGC services, including WMS, WFS, WPS, WMTS, and WCS.
- ArcGIS Online can also be used to create two types of ArcGIS REST Services, called hosted layers. However, the capabilities of these services are more limited than the analogous service created by ArcGIS for Server.
- Geoserver produces OGC-standard WMS, WCS, WFS, WMTS, WPS, and CSW services.
- Mapserver also produces OCG-standard services, including, WMS, WCS, WFS, and SOS

1.4.5 Best Practices for Creating Services

- **Where possible provide OGC and sector/vendor-specific services to ensure maximum interoperability.**
  - Any data that is served from an ArcGIS for Server as Esri REST services can be easily also served as OGC services without a lot of secondary effort, simply by 'enabling' OGC services in the ArcGIS for Server settings. Whenever possible/practical, both options should be enabled as best practice.
- Web services should specify the version and last update date for the source data, as well as link to the source metadata.
- In order to support the broadest range of user needs, from casual users viewing data through web browser to desktop .NET developers, web services should provide both REST and SOAP-based services.
- Use a map server that supports all OCG standards applicable to the project objectives, preferably WMS, WMTS, and WFS at a minimum. GeoServer and ArcGIS for Server provide two popular options.
- If developing a slippy map, render and serve all data that does not require frequent update as cached tiles, in compliance with the WMTS standard. GeoWebCache, which extends GeoServer, is a popular tile server.
- If serving a single map image or data that requires frequent update but not feature queries, provide a standards-compliant WMS.
- If serving data with individual features that may be queried or changed by the client, provide a standards-compliant WFS.
- If providing multiple data sources and/or services to the public, also provide a CSW with ISO-compliant metadata for each service.

Publishing Great Web Services

Anna Verrill gave an excellent presentation about publishing great web services at the 2014 West Coast Ocean Data Network Meeting.

Publishing Great Web Services Presentation Slides

Publishing Great Web Services Presentation Videos:

1. Intro and Data Management (5:03)
2. Map Preparation (8:25)
3. Web Services Overview (2:56)
4. Best Practices (3:51)
5. Conclusion (1:57)

Projection/Coordinate System

The base maps for most web mapping applications use the Web Mercator projection, EPSG:3857. Although web mapping services can be projected on-the-fly to match the base map, your mapping service will have the best performance if all the layers are in the same projection. Therefore, it is recommended to use Web Mercator (EPSG:3857) for your web mapping services. In ArcGIS software, it is referred to as WGS 1984 Web Mercator (Auxiliary Sphere).

Cartography

Cartographic advice for web services goes here.

Additional Resources

- Tools and Best Practices for Coastal Web Maps
- **Authoring web maps using ArcGIS/ESRI products:**
  - Map Authoring Considerations - ArcMap
  - Authoring Content for Web Maps - ArcGIS
  - ArcGIS Online Best Practices for Layers
  - Best Practices for Designing Effective Map Services (video)

1.5 Catalogs

1.5.1 Importance of Catalogs

Catalog services are a type of web service used to discover, browse, and query standardized geospatial metadata records. A key component of the technology underlying the West Coast Ocean Data Portal (WCODP) is ESRI's Geoportal Server, an open source catalog server.

Because of standardized interface specifications, clients of different origins and with potentially different focuses can access this technology and the geospatial metadata to which it provides potential access. Since these interfaces are standardized, a major role in the development of catalog services is left to develpers, defining information models which can be utilized by these interfaces and yet remain independent of the underlying metadata.

1.5.2 Types of Catalogs

Web Accessible Folder

A Web Accessible Folder (WAF) is an HTTP accessible directory of files, typically metadata files in XML format, in which all files and their time-stamps are visible to a web browser or client. They represent and easy and lightweight way to share metadata, although they are limited in their ability to support higher level search and harvesting of records.

If your organization has a website, it should be fairly easy to set up a folder (WAF) to store the metadata XML files you would like to make available to the West Coast Ocean Data Portal or other catalogs and portals, such as Data.gov or your state's geospatial portal.

Below are some example metadata WAFs harvested by the WCODP:

- Bureau of Ocean Energy Management (BOEM), Pacific Region WAF

- Marine Cadastre WAF
- United States Geologic Services (USGS) West Coast WAF

Catalog Service for the Web

Catalog Service for the Web (CSW) is a standard for exposing a catalog of geospatial records on the internet (over HTTP). CSW is one part (or profile) of the Open Geospatial Consortium (OGC) Catalog Service, which defintes common interfaces to discover, browse, and query metadata about data, services, and other potential resources

The catalog is made up of metadata records that describe these types of data:

- geospatial data (e.g. KML, shapefiles)
- geospatial services (e.g. WMS)
- other related resources

The format of each metadata record is defined in the standard only as XML, but is typically an encoding of Dublin Core, ISO 19139, or FGDC CSDGM metadata with UTF-8 character encoding. Whatever format is used, each record must contain a set of core fields, such as Title, Format, Type (e.g. Dataset, Dataset Collection, or Service), Bounding Box (a rectangle of interest, expressed in latitude and longitude), Coordinate Reference System, and Association (a link to another metadata record). These sophisticated metadata sharing approaches support high level search requests of resources within the catalog.

CSW Requests include:

GetCapabilities returns the properties of requests that are accepted by the server

DescribeRecord returns information about the model of records

GetDomain (optional) returns for a given record field, the range of values held by records

GetRecords search for records, returning record IDs

GetRecordsByID returns records, specified by their ID

Harvest (optional) create or updated metadata by asking the surver to 'pull' metadata from somewhere

Transaction (optional) create or edit metadata by 'pushing' the metadata to the server

1.5.3 Catalog Server Software

pycsw

pycsw Sites

- Pacific Islands Ocean Obeserving System (PacIOOS)
- Land Information New Zealand
- Inside Idaho
- OpenDataPhilly

The main focus of pycsw is providing a very lightweight Python CSW server solution. Another goal is to allow you to quickly publish your metadata repository and make your resources discoverable. A number of data catalog projects, including CKAN, are using pycsw to provide their CSW harvesting and serving capabilities.

See also:

pycsw Live Deployments

GeoNetwork

GeoNetwork Site

- Oregon Coastal Atlas

GeoNetwork is a mature data catalog product and is one of the flagship projects of OSGeo. It is populare outside of the United States and has excellent support fo the EU INSPIRE Initiative. GeoNetwork is increasingly developed in lock-step with other open source GIS projects including GeoServer, GeoWebCache, and GeoNode.

ESRI Geoportal Server

ESRI Geoportal Sites

- Oregon Spatial Data Library
- National Geophysical Data Center Geoportal

ESRI Geoportal is a mature data catalog product created by ESRI, and is now open source. It is in widespread use by state and federal agencies that have traditional GIS departments. It is used on the backend of the West Coast Ocean Data Portal.

See also:

ESRI Geoportal Server Wiki

CKAN

CKAN Site

- Data.gov

CKAN was created by the Open Knowledge Foundation (OKFN) in the United Kingdom and is the data catalog platform behind data.gov.uk. CKAN is now beginning to catch on in the United States. It was chosen to become the data catalog behind data.gov and geo.data.gov. CKAN now employs pycsw as its CSW engine.

THREDDS Data Server (TDS)

THREDDS Sites

- CENCOOS
- SCCOOS
- IOOS

THREDDS Data Server (TDS) is a web server that provides metadata and data access for scientific datasets using OPenDAP, OGC, WMS, and WCS, HTTP, and other remote data access protocols. TDS can be used to create virtual directories of available data and their associated metadata and present a combined file that a user seas and can access as a single file containing data. It is developed by Unidata and is in widespread use by NOAA offices and the Ocean Observing Community.

See also:

http://www.unidata.ucar.edu/software/thredds/current/tds/TDS.html

1.5.4 Best Practices for Catalogs

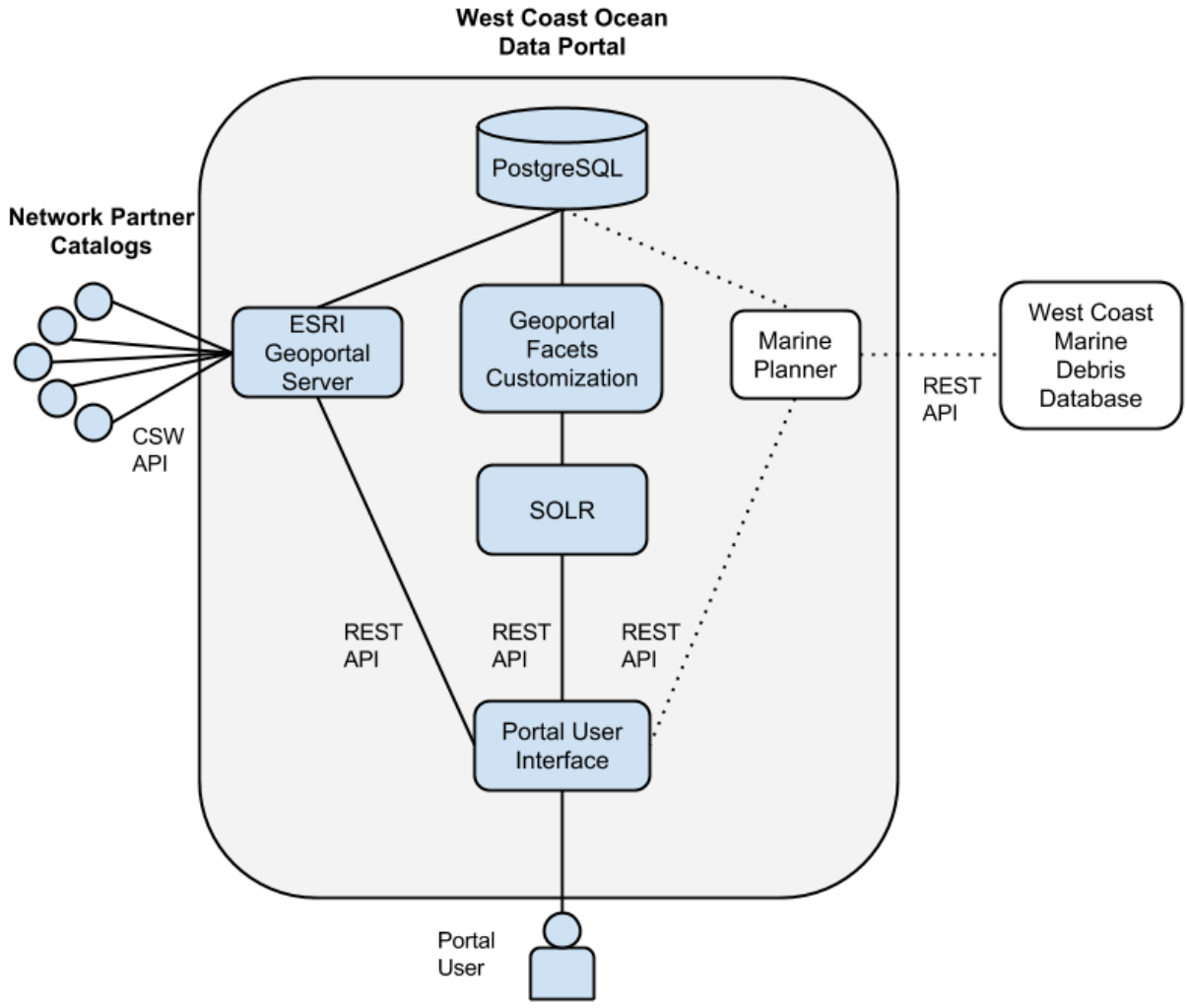
- Advertise your CSW endpoint so that people can readily access it through an 'API' or 'Developer' tab.
- ESRI Geoportal and CKAN both provide comprehensive open source catalog software options that have been adopted by a wide user community and are recommended.
- Publish only your original metadata and data.

1.6 Our Technology

The following sections describe the technology and architecture behind the West Coast Ocean Data Portal (WCODP). It is not necessary to understand this information in order to contribute to the portal, but may be of interest to developers, technologists, and those who update, maintain, or troubleshoot the WCODP.

1.6.1 Architecture

The West Coast Ocean Data Portal is comprised of a number of technologies and software components. The following diagram shows a generalized view of the software architecture.



The WCODP relies upon the following technologies:

Nginx HTTP server and reverse proxy

Apache Tomcat 6 Java web server. Tomcat is particularly good for Java-based apps like Geoportal, but is flexible enough to handle most of the other apps as well.

WCGA Data Portal UI WCODP front-end – mostly JavaScript and HTML. The HTML is generated using Jekyll. The JavaScript includes AngularJS, Bootstrap, JQuery, and several other building blocks. This static site pulls data from Geoportal Server and Solr to display the contents and information stored in the Portal

ESRI Geoportal Server An open source geo-data catalog. It allows for the entry or collection ('harvesting') of metadata files. Using these metadata files, Geoportal Server can organize, search, and display all if the information in meaningful, human-readable ways. We are also using the "collections" feature of Geoportal Server to define custom categories and issues, and assign those as attributes of the records we have harvested. This way we can organize the data according to categories that we have determined and applied ourselves, categories that are not defined in the metadata.

Solr Solr is a tool used to aid in the quick searching of large amounts of data. It takes specific attributes of the data, and keeps track of which records shared that attribute, so that when it is requested, it doesn't have to search every record: it already knows. Technically, that work is already done by a software called Lucene, and it is installed with Geoportal Server. Solr is built on top of Lucene and allows for faceted searches. The most visible result of which is the numeric indicator of how many records will match your query if you add specific filters

(like the categories or issues).

GFC Geoportal Facet Customizations. This custom tool was built by ESRI for us specifically to handle some of our needs that were not met by the basic Geoportal Server software. Namely, this is the piece that gets our custom-defined categories and issues indexed by Solr for faceted searches, and exposes the harvest source of each record to Solr as well. As of this writing, it does not yet, but may soon also facilitate in searching which records were harvested from a given source.

PostgreSQL/PostGIS PostgreSQL is a nice database for moderate to heavy traffic websites. It is fast and powerful. PostGIS is built on top of PostgreSQL to handle geographic queries, which Geoportal Server relies on to search by location, bounding box, etc…

Munin Monitoring software. This tool visualizes the status of the server hardware.

See also:

Background on the selection of technologies for the West Coast Ocean Data Portal WCGA RDF Data Registry Design Assessement

1.6.2 Registration / Harvest Process

Registration and metadata harvest into the WCODP is done through the Adminstrative interface of ESRI Geoportal Server. This is generally done by the WCODP Administrator, but can be done by others with administrative access.

If the WAF or Catalog is not yet registered in the WCODP, it must be added via the Register Resource page.

1. Log into ESRI Geoportal (http://portal.westcoastoceans.org/geoportal) as an administrator
2. On the Administration page, click Add, and select Register resource on the network
3. Add the Host URL for the WAF or Catalog (CSW). It's good practice to use the Test button to confirm that the URL works
4. Add a Title – This is what will show up in the Sources list of the WCODP, so make sure it is clear and user-friendly.
5. **If harvesting from a Catalog, select a Profile based on publisher's CSW. WCODP has three custom profiles:**
    - ESRI Geoportal (WCGA RDF ESRI Geoportal (GPT))
    - GeoNetwork APISO (WCGA RDF GeoNetwork APISO)
    - pycsw Custom (pycsw - harvest by dc:identifiers)
6. You can leave all the other information as-is. Create and Close.

After you register the resource for the first time, you must approve and synchronize the resource.

1. Return to the Manage page of the Administration interface.
2. Select the checkbox next to the resource you just registered
3. Select "Set as Approved" in the pull-down menu, and click Execute Action
4. Click on the blue arrow (Synchronize content) icon next to the resource of interest. This may take a minute or two and you may need to manually refresh the page

Review the synchronization results.

1. **Click on the clock icon (History) next to the resource of interest.**
    - This will show the date of the most recent synchronization, the number of records obtained, the number of records validated, and the number of records published.

2. **If the number of records validated or published does not match the number of records obtained,**
    (a) Click on the empty box icon (View report)
    (b) Click the plus sign next to Details to see the validation results which shows the metadata records harvested and the validation errors.

If the harvested resource is a WAF, all valid metadata records in that folder will be harvested.

If the harvested resource is a CSW, it is possible to selectively harvest relevant records through the use of profiles in Geoportal. The unique UUID of each metadata record of interest must be added to a specific XSLT file on the server. The XSLT file corresponding to the profile that you selected when registering the resource is the one to update.

When there are updates or additions to metadata in a WAF or Catalog that is already registered in the WCODP, simply synchronize the resource. For a CSW, you must also add the relevant UUIDs to the profile file prior to synchronization.

After registration and harvest, the portal admin assigns additional attributes to the records using the WCGA-specific controlled vocabulary/taxonomy. This assignment is accomplished either by assigning records to Collections through the Geoportal admin interface, or directly via adding records to the Postgres database. These attributes are used in the Categories tab in the WCODP.

1.6.3 Additional Resources

- Source Code for the West Coast Ocean Data Portal
- Management Guide