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Extending THREDDS middleware to serve OGC communit

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1 Introduction

The netCDF data model [1] is very popular among scientists in the Earth sciences community. The Open Geospatial Consortium's Web Coverage Service (WCS) [2] can be used to dispatch netCDF datasets via standard protocols to client applications use by a variety of user groups: the scientific digital library community, the GIS community, as well as the broader Earth science research and education community. All these potential user groups benefit by having netCDF as one form of coverage supported by WCS. Among the main reasons for bringing the two together are:

- The netCDF is one of the most commonly used forms for accessing the output of weather and climate forecast models. The output of these models is different from many of the other datasets currently supported by in the GIS community. These datasets represent several parameters (e.g., temperature, pressure, wind speed and direction) that vary in three spatial dimensions and involve two distinct time scales (model run time and forecast times).
- The netCDF interface is evolving in a direction that supports access to many different file formats via several different client/server protocols (e.g., OPeNDAP, HDF5, and ADDE) that are already established in the atmospheric and ocean sciences data provider community.

- OGC's WCS can be successfully used to dispatch netCDF datasets via standardized protocols to many interested groups:
  - the Earth Science information Community (many of whom now use netCDF interfaces);
  - the GIS Information Community;
  - the general public;

Thus the inclusion of netCDF as a WCS format adds only one new data access interface that in turn provides access to collections of forecast model output via a variety of protocols that are already in use in the data provider community.

In the Unidata community framework of client/server data and metadata access systems, there are a number of client/server protocols in use at different data provider sites. At the other end, some client applications can access data via some of the protocols while others can only access data via other protocols. THREDDS catalogs provide information about which datasets are avaiable via with services/protocols [3]. The three main client/server (as opposed to full-file transfer with FTP or GridFTP) protocols for remote data access in use in the community are OPeNDAP, ADDE, and netCDF access via HTTP protocol. In many cases the data access systems are augmented and integrated with THREDDS catalog services which proved inventory list and metadata access. Thus client applications can learn what's available on the site via the THREDDS interface, then access the datasets themselves via OPeNDAP, ADDE, or netCDF/HTTP protocols.

2 Core

The present work presents an interoperability experiment in order to demonstrate the benefits of enhancing THREDDS's middleware by implementing a WCS interface. Such objective is mainly achieved by extending WCS specification to support netCDF format.

To add netCDF as one of the alternative output formats for WCS data access, extensions are needed for both the netCDF interface and the WCS specification. As far as netCDF is concerned, it means to extend the existing netCDF conventions [4] introducing metadata useful to support a GIS view of Earth Sciences data [5]. As far as WCS specification is concerned, it mainly means to add netCDF as one of the supported dataset format.

Furthermore, THREDDS and WCS interoperability addresses the following objectives:

a) to simplify service protocols diversity: to bridge the THREDDS and WCS service protocols; the solution consists in an opportune piece of software: a gateway component which implements an adaptor pattern.

b) to provide a common data model which spans the key elements of exiting data models: differences in the way the two communities (i.e. earth sciences and GIS Communities) think about their data. Indeed, it gives rise to difficulties in integrated analysis and display of datasets from the two disciplines [6]. We conceived and used ncML-GML dialect to tackle such issue [5] by implementing a data model mediation component.

Three use cases have been considered, according to the following interaction steps:

- THREDDS inventory catalogs are accessed and used to generate dataset lists for the getCapabilities response
- NcML-GML metadata from the THREDDS server are used to construct the describeCoverage response.
- netCDF objects are retrieved from the netCDF/OPeNDAP server either directly via the netCDF interface or from an OPeNDAP service.
- The netCDF objects are then transformed into one of the following three forms for transmission back to the client in response to the get coverage request:
  (a) geoTIFF binary file;
  i. ncML-GML document (containing a netCDF/OPeNDAP pointer or data itself);
  ii. netCDF binary file.

3 Conclusions

An interoperability experiment between THREDDS and WCS services is presented. The main objectives of the experiment are to:

- Work with existing WCS client applications to see whether they can make use of the experimental WCS server

- Compare three options for WCS data encoding:
  - geoTIFF
  - NcML-GML
  - netCDF
- Provide a WCS prototype that allows traditional GML client applications to access data in the NcML-GML encoding.
- Provide a WCS prototype that allows traditional netCDF client applications to access data via the WCS protocol.

As far as Earth Sciences is concerned, interoperability between OGC and THREDDS middleware is extremely important to enable enhanced Science Digital Library applications.

4 References

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