

Introduction to ORNL DAAC THREDDS Data Server

Outline

- THREDDS Data Server (TDS)
 - How to Use TDS
 - TDS Architecture
 - Publish: THREDDS Catalog
 - Deliver: Data Access Protocol
 - OPeNDAP
 - NetCDF Subset Service
 - OGC WCS
 - HTTP Server
- ORNL DAAC THREDDS Data Server

THREDDS Data Server (TDS)

- The THREDDS Data Server (TDS) is a web server that provides metadata and data access for scientific data sets, using OPeNDAP, OGC WCS, HTTP, and other data access protocols.
- Major Components:
 - Publish data sets: THREDDS Catalog
 - Deliver data sets: Data access protocols (OPeNDAP, etc.)
- TDS Clients: Generic Web Browser, IDV, Ferret, etc. [[more info](#)]

How to Use TDS



Catalog http://thredds.daac.ornl.gov/thredds/ornl_catalog//daac.xml

Dataset

- Field Campaign Data/
- Land Validation Data/
- Regional and Global Data/

THREDDS Data Server Version 3.16.13 Build Date = 2007-06-25 18:42:15 [Documentation](#)

Browse THREDDS Catalog



Action: [Get ASCII](#) [Get Binary](#) [Show Help](#)

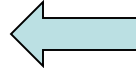
Data URL: <http://thredds.daac.ornl.gov/thredds/s2kc130/s2kc130/6784mfd.nc>

Global Attributes:

```
Flight_Number: "A704"  
Flight_Date: "02-SEP-00"  
ppa02: 81160  
ppa04: 163320  
ppa08: 324640  
ppa16: 649280
```

Variables:

- PARA0515:** Array of 32 bit Reals [ppa01 = 0.40579]
ppa01
long_name: "SECS FROM MIDNIGHT"
short_name: "SECS"
units: "SECS"
frequency: 1
- PARA0515FLAG:** Array of 8 bit Bytes [ppa01 = 0.40579]
ppa01
long_name: "SECS FROM MIDNIGHT FLAG"
short_name: "QUALITY"
units: "QUALITY"
frequency: 1
- PARA0517:** Array of 32 bit Reals [ppa01 = 0.40579]
ppa01
long_name: "TRUE AIR SPEED"
short_name: "TAS"
units: "M S-1"
frequency: 1
- PARA0517FLAG:** Array of 8 bit Bytes [ppa01 = 0.40579]
ppa01
long_name: "TRUE AIR SPEED FLAG"
short_name: "QUALITY"
units: "QUALITY"
frequency: 1



Catalog <http://thredds.daac.ornl.gov/thredds/catalog/s2kc130/catalog.xml>

Dataset

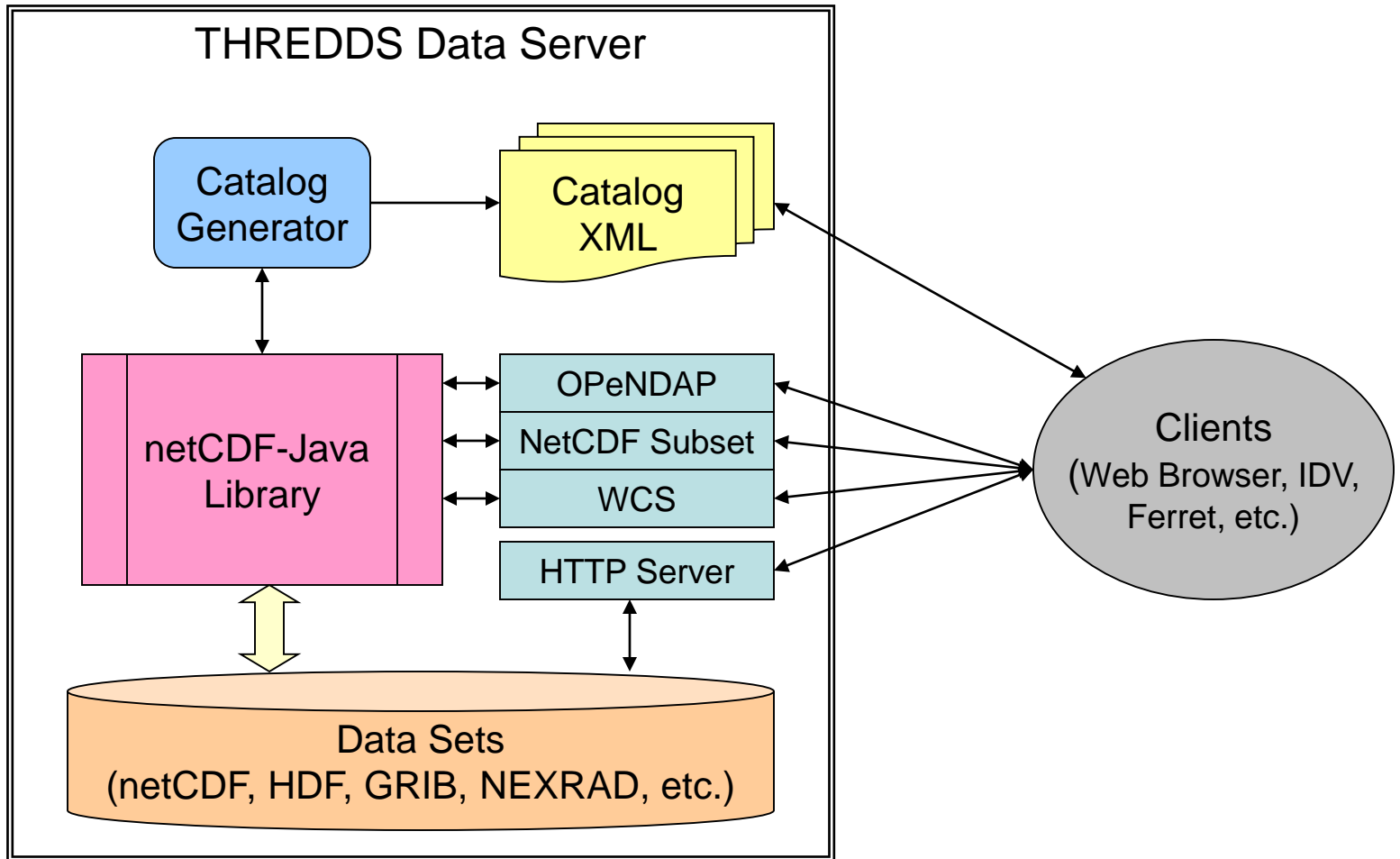
- SAFARI-2K C-130 Aerosol And Meteorological Data
 - [a784mfd.nc](#)
 - [a785mfd.nc](#)
 - [a793mfd.nc](#)
 - [a786mfd.nc](#)
 - [a787mfd.nc](#)
 - [a789mfd.nc](#)
 - [a790mfd.nc](#)
 - [a785mfd.nc](#)
 - [a792mfd.nc](#)
 - [a791mfd.nc](#)

THREDDS Data Server Version 3.16.13 Build Date = 2007-06-25 18:42:15 [Documentation](#)

Select Data Set

Obtain Data Set via OPeNDAP etc.

TDS Architecture



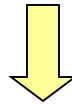
THREDDS Catalog

- THREDDS Catalogs are logical directories of on-line data resources, encoded as XML documents, which provide a place for annotations and other metadata about the data resources to reside. This is how THREDDS-enabled data consumers find out what data is available from data providers.


Valued Feature: Catalog References

- It can be useful to break up large catalogs into pieces in order to separately maintain each piece. One way to do this is to use build each piece as a separate and logically complete catalog, then create a master catalog using catalog references.

```
-<catalog name="ORNL DAAC THREDDS CATALOG" version="1.0.1">  
  <catalogRef xlink:href="field_campaign.xml" xlink:title="Field Campaign Data" name=""/>  
  <catalogRef xlink:href="land_validation.xml" xlink:title="Land Validation Data" name=""/>  
  <catalogRef xlink:href="regional_global.xml" xlink:title="Regional and Global Data" name=""/>  
</catalog>
```




Catalog http://thredds.daac.ornl.gov/thredds/ornl_catalog//daac.xml

Dataset	Size	Last Modified
 Field Campaign Data/		--
 Land Validation Data/		--
 Regional and Global Data/		--

Example: Use Generic Web Browser as TDS Client to Browse a Catalog

```
<catalog version="1.0.1">
  <service name="dods-file" serviceType="Compound" base="">
    <service name="opendap" serviceType="OPENDAP" base="/thredds/dodsC/">
    <service name="filehttp" serviceType="HTTPServer" base="/thredds/fileServer/">
  </service>
  <dataset name="SAFARI-2K C-130 Aerosol And Meteorological Data" ID="safari2kc-130Scan">
    <serviceName>dods-file</serviceName>
    <metadata inherited="true">
      <serviceName>dods-file</serviceName>
    </metadata>
    <dataset name="a784mfd.nc" ID="safari2kc-130Scan/a784mfd.nc" urlPath="s2kc130/a784mfd.nc">
      <dataSize units="Mbytes">16.46</dataSize>
      <date type="modified">2007-09-13 13:11:14Z</date>
    </dataset>
    <dataset name="a788mfd.nc" ID="safari2kc-130Scan/a788mfd.nc" urlPath="s2kc130/a788mfd.nc">
      <dataSize units="Mbytes">16.39</dataSize>
      <date type="modified">2007-09-13 13:11:17Z</date>
    </dataset>
    <dataset name="a793mfd.nc" ID="safari2kc-130Scan/a793mfd.nc" urlPath="s2kc130/a793mfd.nc">
      <dataSize units="Mbytes">17.58</dataSize>
      <date type="modified">2007-09-13 13:11:23Z</date>
    </dataset>
    <dataset name="a786mfd.nc" ID="safari2kc-130Scan/a786mfd.nc" urlPath="s2kc130/a786mfd.nc">
      <dataSize units="Mbytes">13.12</dataSize>
      <date type="modified">2007-09-13 13:11:15Z</date>
    </dataset>
    <dataset name="a787mfd.nc" ID="safari2kc-130Scan/a787mfd.nc" urlPath="s2kc130/a787mfd.nc">
      <dataSize units="Mbytes">15.09</dataSize>
      <date type="modified">2007-09-13 13:11:16Z</date>
    </dataset>
    <dataset name="a789mfd.nc" ID="safari2kc-130Scan/a789mfd.nc" urlPath="s2kc130/a789mfd.nc">
      <dataSize units="Mbytes">14.91</dataSize>
      <date type="modified">2007-09-13 13:11:19Z</date>
    </dataset>
    <dataset name="a790mfd.nc" ID="safari2kc-130Scan/a790mfd.nc" urlPath="s2kc130/a790mfd.nc">
      <dataSize units="Mbytes">15.52</dataSize>
      <date type="modified">2007-09-13 13:11:20Z</date>
    </dataset>
    <dataset name="a790mfd.nc" ID="safari2kc-130Scan/a790mfd.nc" urlPath="s2kc130/a790mfd.nc">
      <dataSize units="Mbytes">15.52</dataSize>
      <date type="modified">2007-09-13 13:11:20Z</date>
    </dataset>
    <dataset name="a785mfd.nc" ID="safari2kc-130Scan/a785mfd.nc" urlPath="s2kc130/a785mfd.nc">
      <dataSize units="Mbytes">10.27</dataSize>
      <date type="modified">2007-09-13 13:11:15Z</date>
    </dataset>
    <dataset name="a792mfd.nc" ID="safari2kc-130Scan/a792mfd.nc" urlPath="s2kc130/a792mfd.nc">
      <dataSize units="Mbytes">16.16</dataSize>
      <date type="modified">2007-09-13 13:11:22Z</date>
    </dataset>
    <dataset name="a791mfd.nc" ID="safari2kc-130Scan/a791mfd.nc" urlPath="s2kc130/a791mfd.nc">
      <dataSize units="Mbytes">15.44</dataSize>
      <date type="modified">2007-09-13 13:11:21Z</date>
    </dataset>
  </dataset>
</catalog>
```

Catalog <http://thredds.daac.ornl.gov/thredds/catalog/s2kc130/catalog.xml>

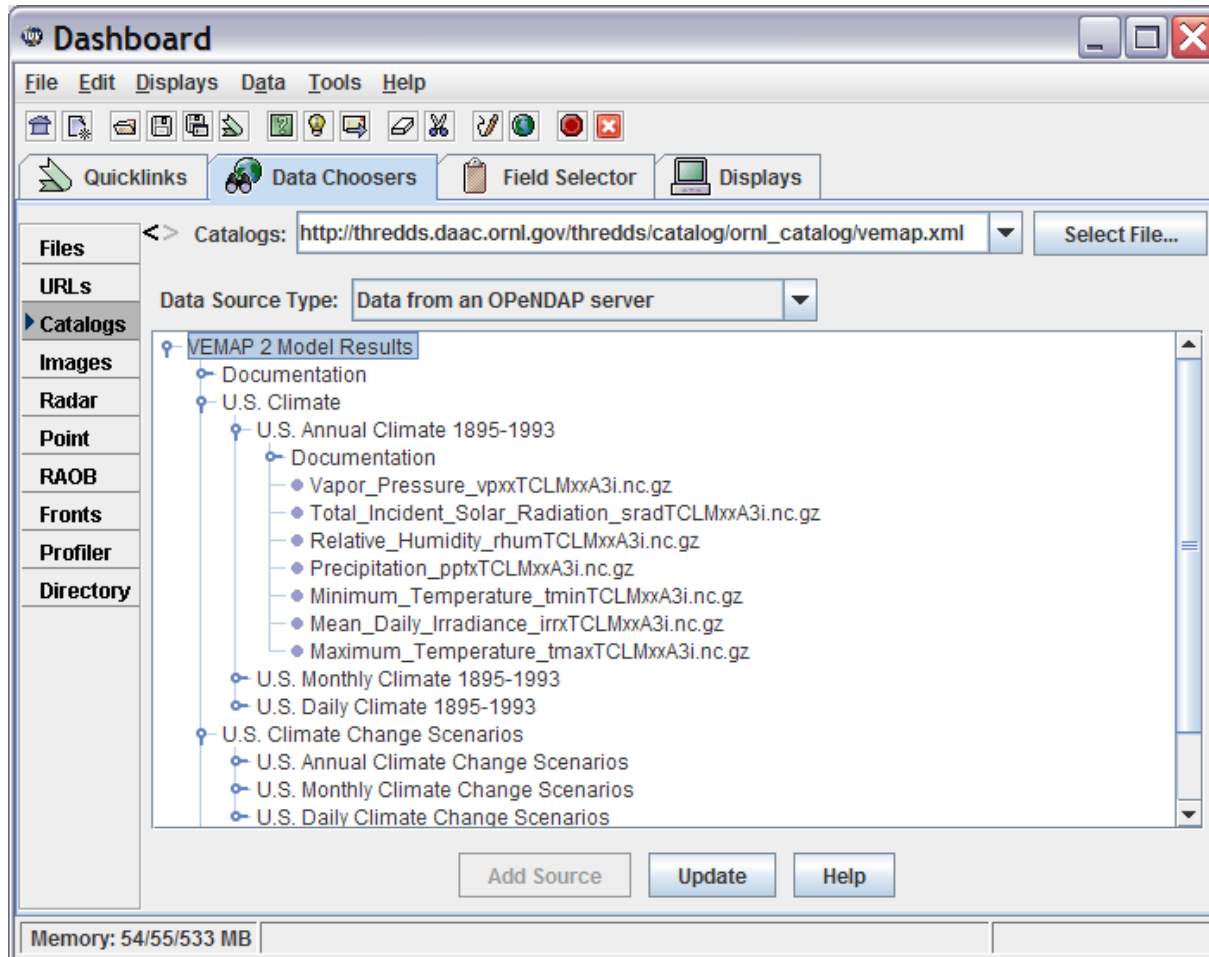
Dataset	Size	Last Modified
 SAFARI-2K C-130 Aerosol And Meteorological Data		--
a784mfd.nc	16.46 Mbytes	2007-09-13 13:11:14Z
a788mfd.nc	16.39 Mbytes	2007-09-13 13:11:17Z
a793mfd.nc	17.58 Mbytes	2007-09-13 13:11:23Z
a786mfd.nc	13.12 Mbytes	2007-09-13 13:11:15Z
a787mfd.nc	15.09 Mbytes	2007-09-13 13:11:16Z
a789mfd.nc	14.91 Mbytes	2007-09-13 13:11:19Z
a790mfd.nc	15.52 Mbytes	2007-09-13 13:11:20Z
a785mfd.nc	10.27 Mbytes	2007-09-13 13:11:15Z
a792mfd.nc	16.16 Mbytes	2007-09-13 13:11:22Z
a791mfd.nc	15.44 Mbytes	2007-09-13 13:11:21Z

THREDDS Data Server Version 3.16.1 Date = 2007-06-25 18:42:15 Documentation

What you see through web browser

XML describing a THREDDS catalog

Example: Use IDV as TDS Client to Browse a Catalog



Example: Use Generic Web Browser as TDS Client to View Metadata of a Data Set



The screenshot shows a Mozilla Firefox browser window titled "Catalog Services - Mozilla Firefox". The address bar displays the URL <http://thredds.daac.ornl.gov/thredds/cat>. The page content includes the THREDDS Data Server logo and the UNIDATA logo. The main heading is "Catalog http://thredds.daac.ornl.gov/thredds/catalog/globalClimate/Global_Climatology_20th_Century/catalog.xml". Below this, the dataset is identified as "Dataset: [Global_Climatology_20th_Century/climate_1901.nc](#)".

- Data size: 37.33 Mbytes
- Data type: Grid
- ID: [globalClimateScan/Global_Climatology_20th_Century/climate_1901.nc](#)

Access:

1. **OPENDAP:** http://thredds.daac.ornl.gov/thredds/dodsC/globalClimate/Global_Climatology_20th_Century/climate_1901.nc
2. **HTTP Server:** http://thredds.daac.ornl.gov/thredds/fileServer/globalClimate/Global_Climatology_20th_Century/climate_1901.nc
3. **WCS:** http://thredds.daac.ornl.gov/thredds/wcs/globalClimate/Global_Climatology_20th_Century/climate_1901.nc
4. **NetcdfServer:** http://thredds.daac.ornl.gov/thredds/ncss/grid/globalClimate/Global_Climatology_20th_Century/climate_1901.nc/dataset.html

Dates:

- 2007-11-06 21:13:12Z (modified)

Viewers:

- [Integrated Data Viewer \(IDV\) \(webstart\)](#)
- [NetCDF-Java Tools \(webstart\)](#)

This webpage shows basic data set information and lists 4 options to access the data set

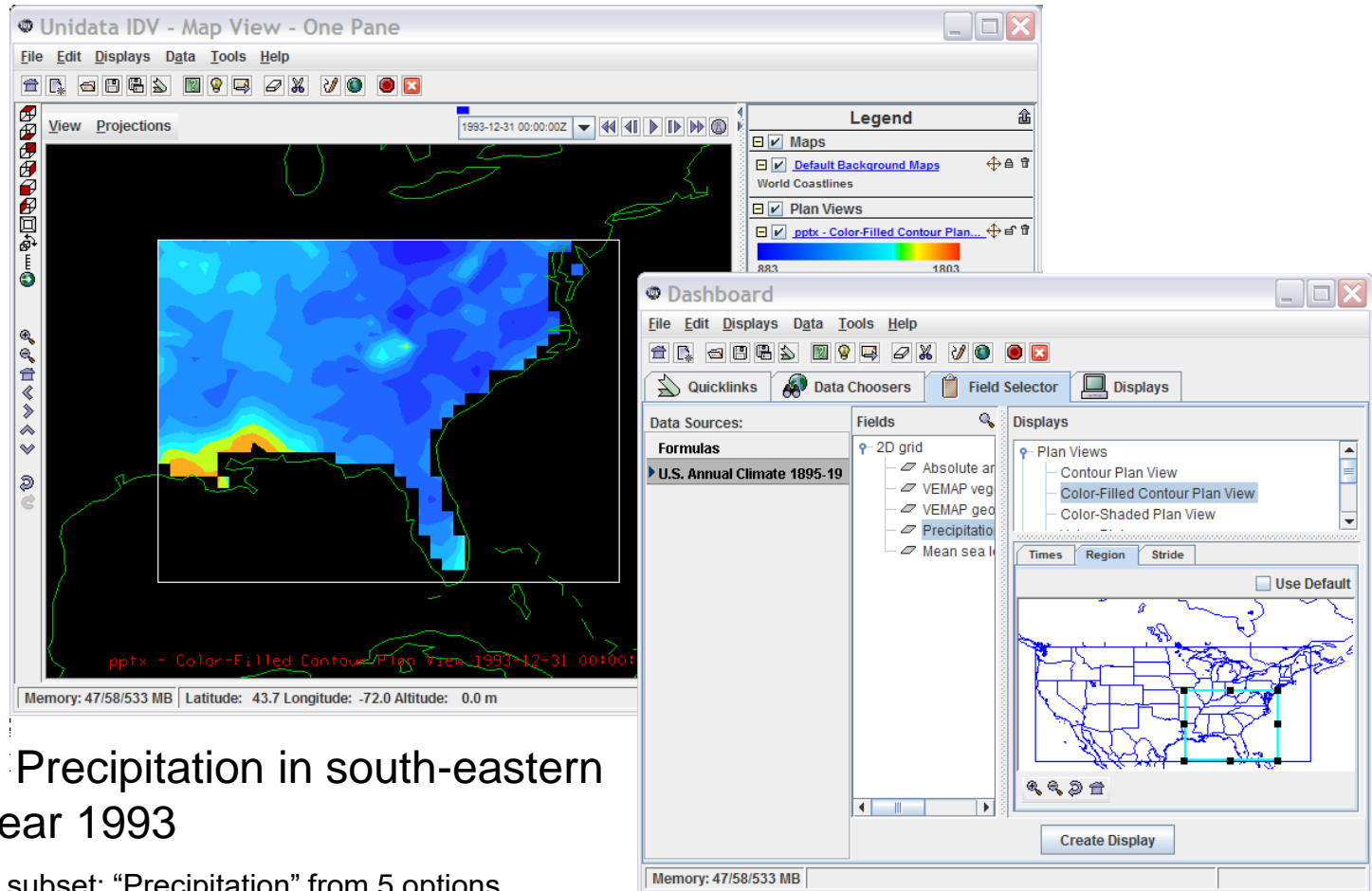
Data Access Protocol: OPeNDAP

- OPeNDAP - Open-source Project for a Network Data Access Protocol
 - Based on HTTP protocol
 - Support spatial*, temporal*, and parameter subset
 - Retrieve data as ASCII or Binary format
- OPeNDAP Clients: Generic Web Browser, Matlab, GrADS, Ferret, IDV, ncBrowse, NCO, pyDAP, etc. [[Full List](#)]

* Spatial and temporal subset are based on data array subset, which means subset range is specified by using array index instead of real spatial and temporal values, e.g.

[http://thredds.daac.ornl.gov/thredds/dodsC/globalClimate/Global_Climatology_20th_Century/climate_1901.nc.dods?WET\[0:1:11\]\[0:1:100\]\[0:1:100\]](http://thredds.daac.ornl.gov/thredds/dodsC/globalClimate/Global_Climatology_20th_Century/climate_1901.nc.dods?WET[0:1:11][0:1:100][0:1:100])

Example: Using IDV as OPeNDAP Client to Access THREDDS Data Subset



Data Access Protocol: NetCDF Subset Service

- The NetCDF Subset Service is a RESTful web service for subsetting CDM scientific datasets.
- Unlike OPeNDAP, the subsetting is specified using earth coordinates, such as lat/lon bounding boxes and date ranges, rather than index ranges that refer to the underlying data arrays.
- The data arrays are subsetted but not resampled or reprojected, and preserve the resolution and accuracy of the original dataset.
- Retrieve data as netCDF (CF-1.0), XML, or ASCII format.

Data Access Protocol: OGC WCS Service & HTTP Server

- OGC WCS service is provided for any “gridded” data set whose coordinate system information is complete.
 - Each parameter is converted to a coverage
 - Support spatial and temporal subset
 - Retrieve data in GeoTIFF, GeoTIFFfloat, or NetCDF3 format.
 - LIMITATION
 - No reprojection
 - No resampling
- HTTP server provides access to the original data files.

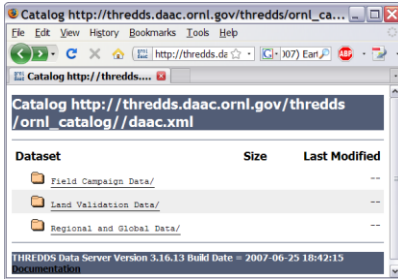
ORNL DAAC THREDDS Data Server

- ORNL DAAC THREDDS Data Server Catalog Service
 - <http://daac.ornl.gov/thredds.shtml>
- Main Catalog XML URL
 - http://thredds.daac.ornl.gov/thredds/ornl_catalog/daac.xml
- Main Catalog HTML Interface URL
 - http://thredds.daac.ornl.gov/thredds/ornl_catalog/daac.html
- Data Access Protocols Supported
 - OPeNDAP
 - OGC WCS v1.0.0 Service
 - NetCDF Subset Service
 - HTTP Server
- Data Available
 - Regional and Global Data:
 - VEMAP
 - ISLSCP 2
 - Global Climatology
 - Field Campaign:
 - LBA,
 - SAFARI 2000
 - Land Validation (selected data):
 - FLUXNET
 - MODIS Subsets

Usage Scenario:

Use generic Web browser as TDS client to browse ORNL DAAC THREDDDS catalog and access data using OPeNDAP protocol

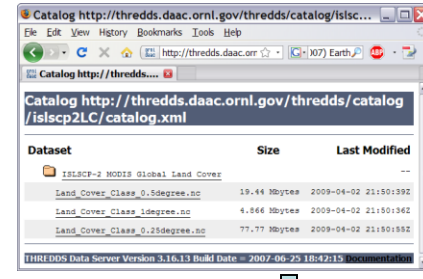
Step 1. Browse main catalog



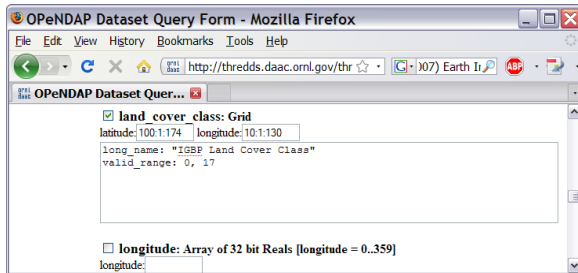
Step 2. Browse sub-catalog



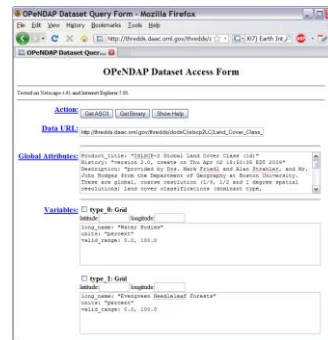
Step 3. Browse sub-catalog again



Step 6. Specify subset option



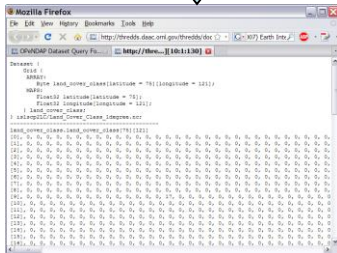
Step 5. Choose OPeNDAP to access data



Step 4. Select one data set



Step 7. Click "Get ASCII" button to get data



Get 1 degree resolution ISLSCP-2 MODIS Land Cover ASCII data in North America (-170, 10, -50, 84) area from ORNL DAAC THREDDDS Data Server

Click on the image to view the corresponding webpage

Acronyms and Resources

- ASCII – American Standard Code for Information Interchange
- CDM – Common Data Model (<http://www.unidata.ucar.edu/software/netcdf/CDM>)
- EPSG – European Petroleum Survey Group
- Ferret – Data analysis and visualization package available from NOAA/PMEL (<http://ferret.pmel.noaa.gov/Ferret>)
- GrADS – The Grid Analysis and Display System (<http://www.iges.org/grads>)
- GRIB – GRIdded Binary, a mathematically concise data format commonly used in meteorology to store historical and forecast weather data
- HDF – Hierarchical Data Format
- HTTP – Hypertext Transfer Protocol
- IDV – Integrated Data Viewer (<http://www.unidata.ucar.edu/software/idv>)
- ncBrowse – A Graphical netCDF File Browser (<http://www.epic.noaa.gov/java/ncBrowse>)
- NCO – netCDF Operator (<http://nco.sourceforge.net>)
- netCDF – network Common Data Format
- NEXRAD – Next-Generation Radar
- OGC – Open Geospatial Consortium (<http://www.opengeospatial.org>)
- OPeNDAP – Open-source Project for a Network Data Access Protocol (<http://opendap.org>)
- ORNL DAAC – ORNL Distributed Active Archive Center (<http://daac.ornl.gov>)
- pyDAP – A pure Python library implementing OPeNDAP (<http://pydap.org>)
- RESFful – Representational State Transfer (http://en.wikipedia.org/wiki/Representational_State_Transfer)
- THREDDS – Thematic Realtime Environmental Distributed Data Services (<http://www.unidata.ucar.edu/projects/THREDDS>)
- THREDDS Fact Sheet - <http://www.unidata.ucar.edu/publications/factsheets/2007sheets/threddsFactSheet-1.doc>
- WCS – Web Coverage Service (<http://www.opengeospatial.org/standards/wcs>)
- XML – Extensible Markup Language