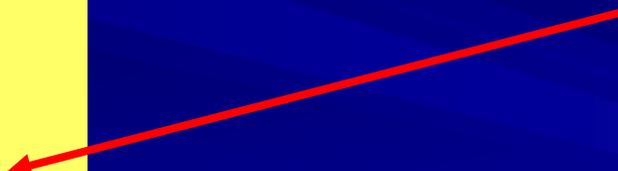


The Unified Access Framework (UAF)

(a pretentious title for some simple ideas)

Kenneth.Casey@noaa.gov
Julie.Bosch@noaa.gov
Tina.Chang@noaa.gov
Scott.Cross@noaa.gov
Roy.Mendelssohn@noaa.gov
Steven.C.Hankin@noaa.gov
Jordan.Alpert@noaa.gov
Jeff.deLaBeaujardiere@noaa.gov
Ted.Habermann@noaa.gov
John.Relph@noaa.gov
Bob.Simons@noaa.gov
David.Neufeld@noaa.gov
Upendra.Dadi@noaa.gov
rsignell@usgs.gov
Phil.Cogbill@noaa.gov
Glenn.Rutledge@noaa.gov
Mike.Grogan@noaa.gov
Jeff.Budai@noaa.gov
Lewis McCulloch
Lewis.Mcculloch@noaa.gov
Matthew.Austin@noaa.gov

Presenter: Steve Hankin (PMEL),
for the UAF team





Enterprise-wide integration of data is a very hard problem!

(i.e. adopting shared IT strategies
to achieve data interoperability)



Why?

Within each field folks have developed IT solutions that make sense to them.

➔ Getting people (and organizations) to change habits is difficult!



The NOAA 'enterprise'

- weather forecast (time critical)
- fisheries management (regulatory concerns)
- nautical charting
- climate, ocean, atmosphere research

... the list goes on ...



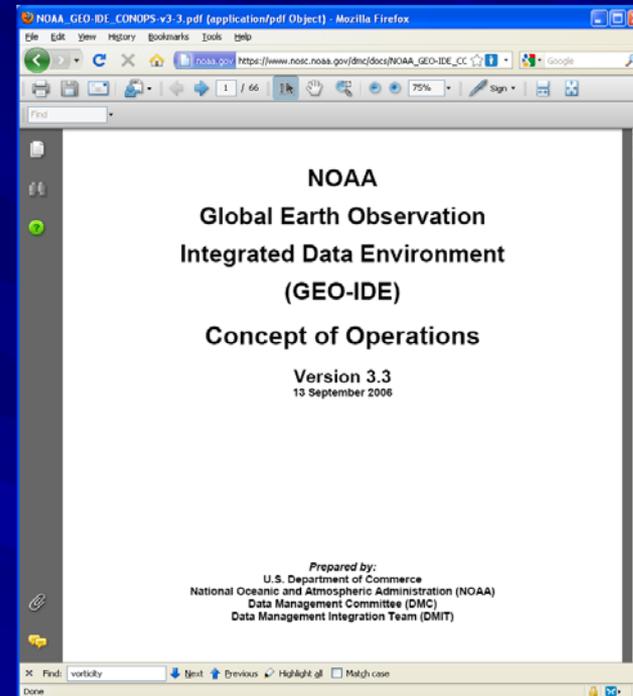
The accepted approach: build a “system of systems”

“Wrap” existing systems with loosely
coupled, standardized services

→ a Service Oriented Architecture

Global Earth Observation Integrated Data Environment

- NOAA's GEO-IDE
Con-ops is such a plan
- 2005-06, 66 pages
(by "DMIT")



Not the first nor the last such plan ...



finally
Seed funding ^ available last year

Question:

How do you approach a very big
problem with a very small amount of
money?

Tried and true approach ...

1. Assemble a writing team
2. Generate use cases
3. Define requirements
4. Write a Concept of Operations
5. ... and an Implementation Plan
6. Assemble volunteer implementation teams

NOT !

An alternative ('agile') approach

Don't Solve Problems -- Copy Success



*"Switch: How to Change Things When Change Is Hard",
Chip and Dan Heath (psychologists), 2010*

Projects: (too many to name)

Data formats:

netCDF

GRIB

HDF

...

Service stack:

netCDF-CF-DAP-THREDDS-WMS

Applications: Matlab ArcGIS Ferret NCL NCO GODIVA

W&Clim Toolkit GrADS Google Earth IDV LAS ERDDAP CDAT...

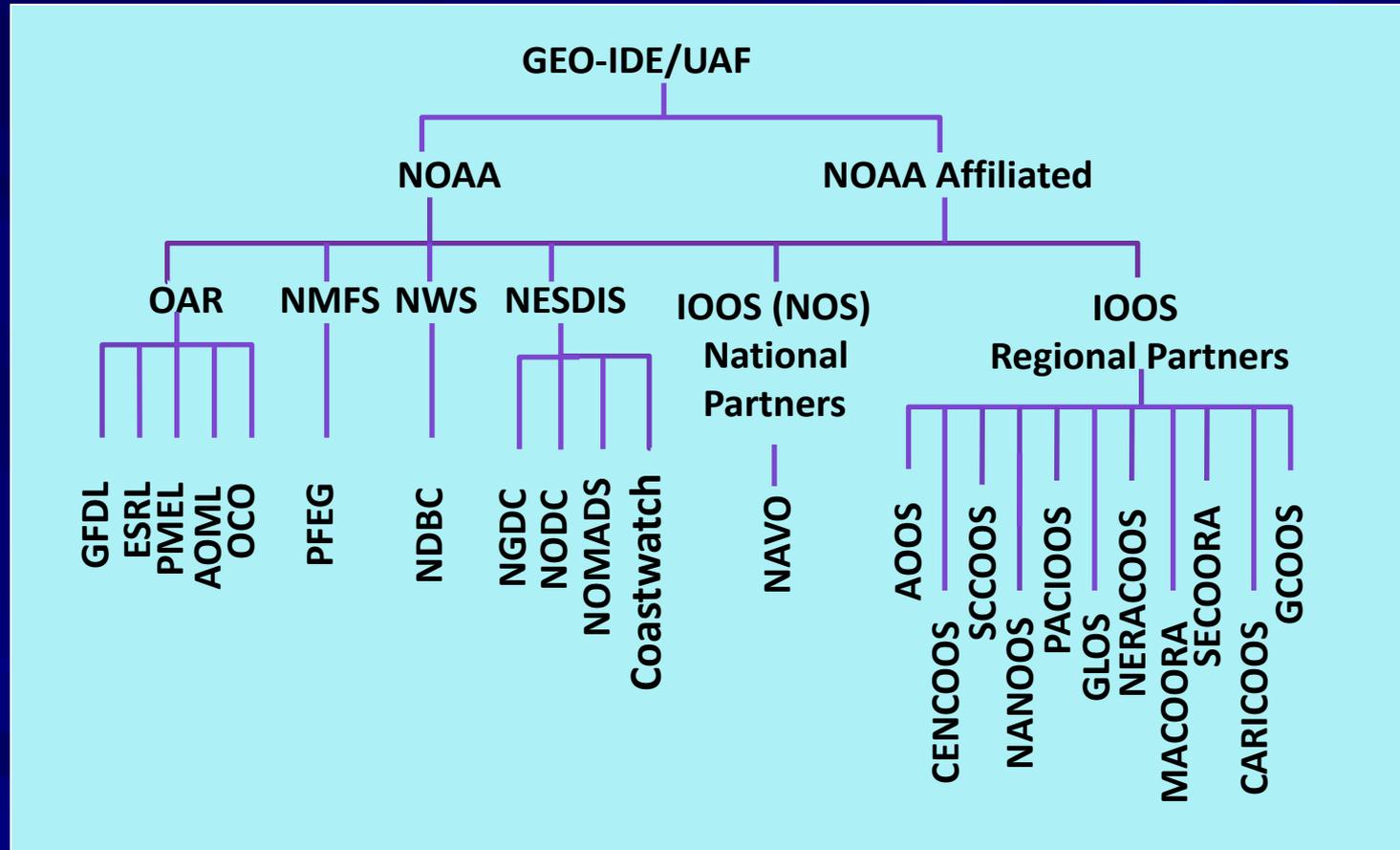
Users:

(too many to name)

Rough spots in the real world

- a lot of “imperfect” (to be diplomatic) CF datasets
- too often unaggregated files rather than logical datasets
- metadata are often weak
- non-CF files (“trash”) mixed into the tree

UAF's foundation: the 'clean catalog' (an XML tree of distributed, well-formed CF datasets)



Make clean virtual files using NcML tools

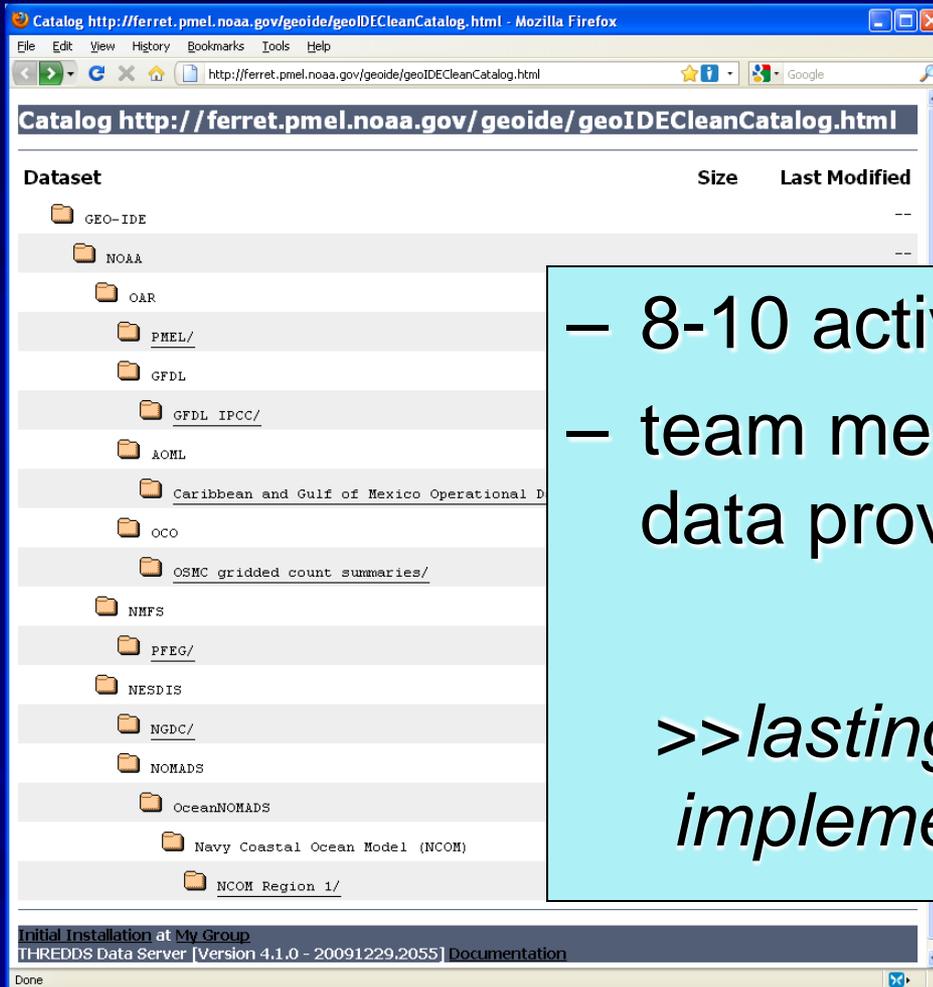
e.g. adding "standard_name" attribute to GRIB data

```
<variable name="vorticity">  
  <attribute  
    name="standard_name"  
    value="atmosphere_absolute_vorticity"/>  
</variable>
```

e.g. aggregation

```
<aggregation type="joinExisting"  
  dimName="TimeAxis">  
  <netcdf location="year1.nc" ncoords="365"/>  
  <netcdf location="year2.nc" ncoords="365"/>  
  <netcdf location="year3.nc" ncoords="365"/>  
</aggregation>
```

The UAF Team



- 8-10 active “volunteers”
- team members as coaches to data providers

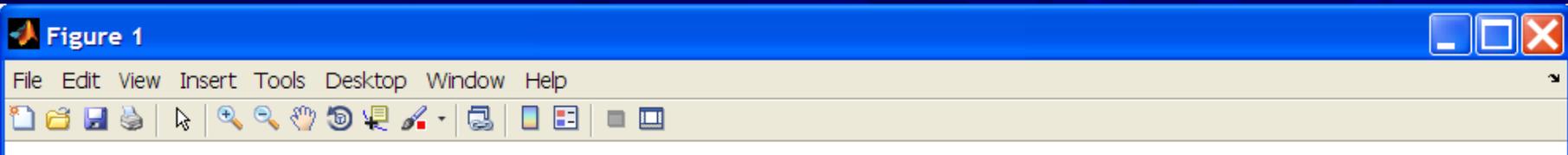
>>lasting solutions must be implemented by providers<<



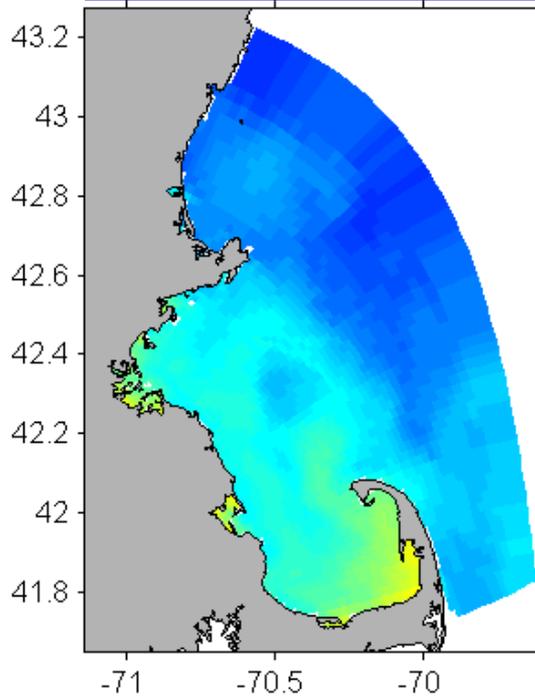
How to reach users?

Through their preferred tools

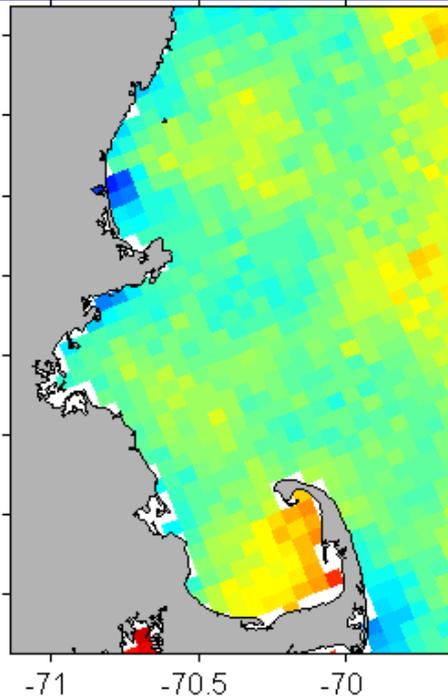
(without downloading files)



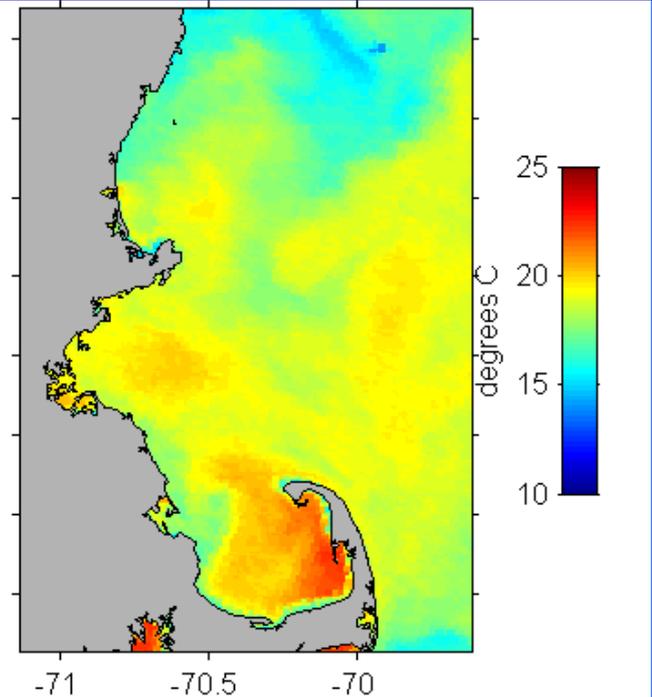
Model 1: UMASS-ECOM



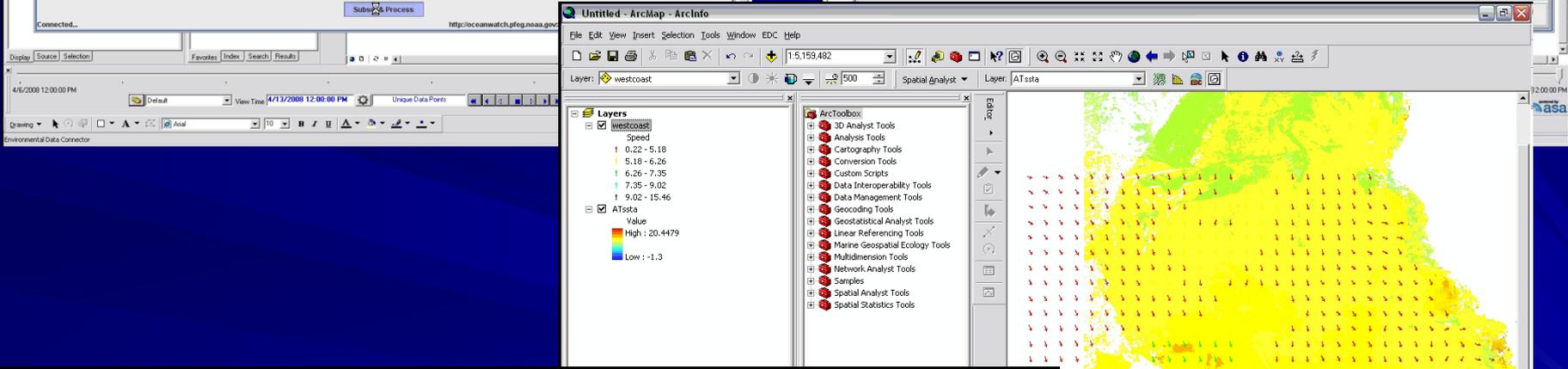
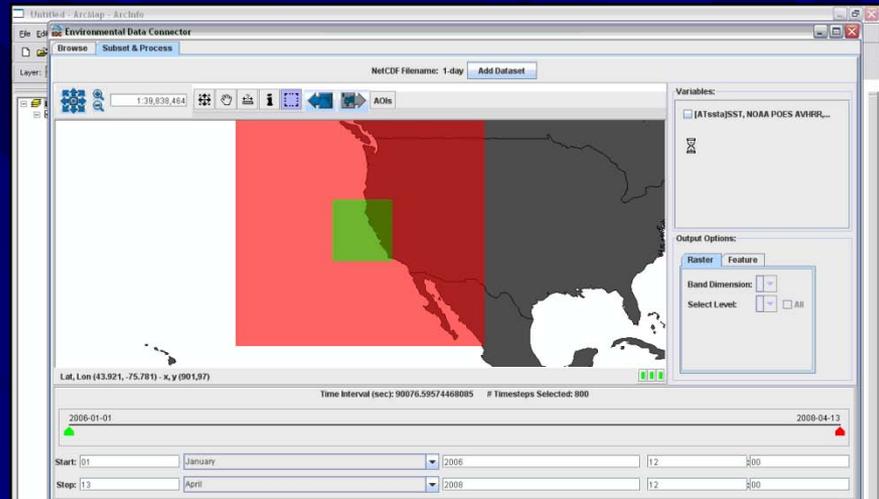
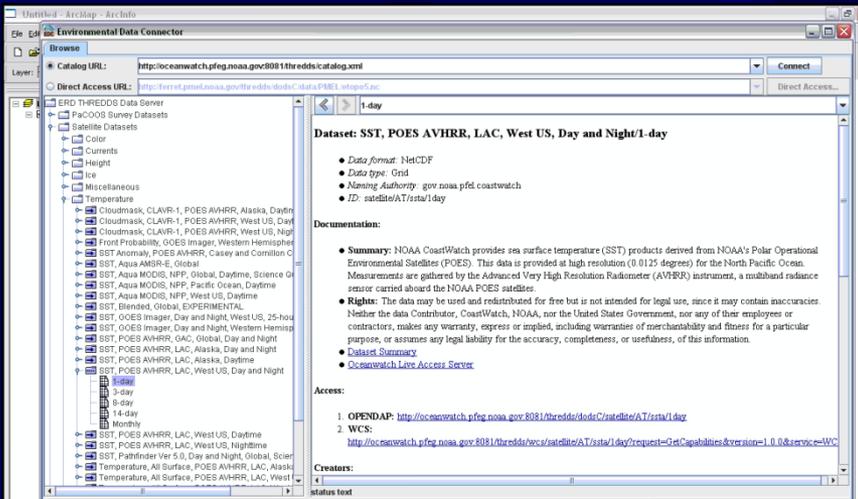
Model 2: UMAINE-POM



Data: SST 2008-Sep-08 07:32



Desktop access in Matlab



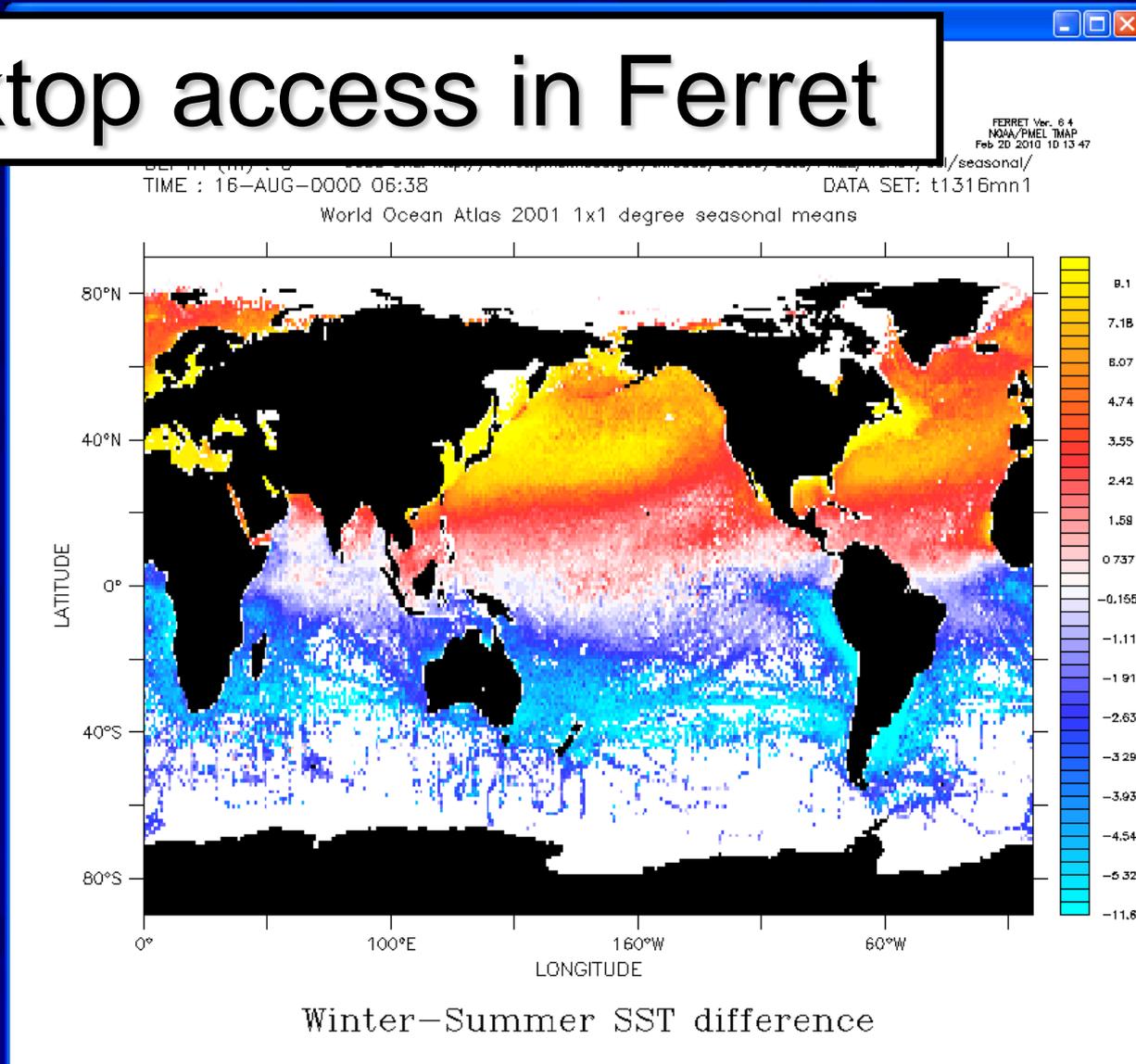
Access in ArcGIS using the Environmental Data Connector (EDC)

May 2011

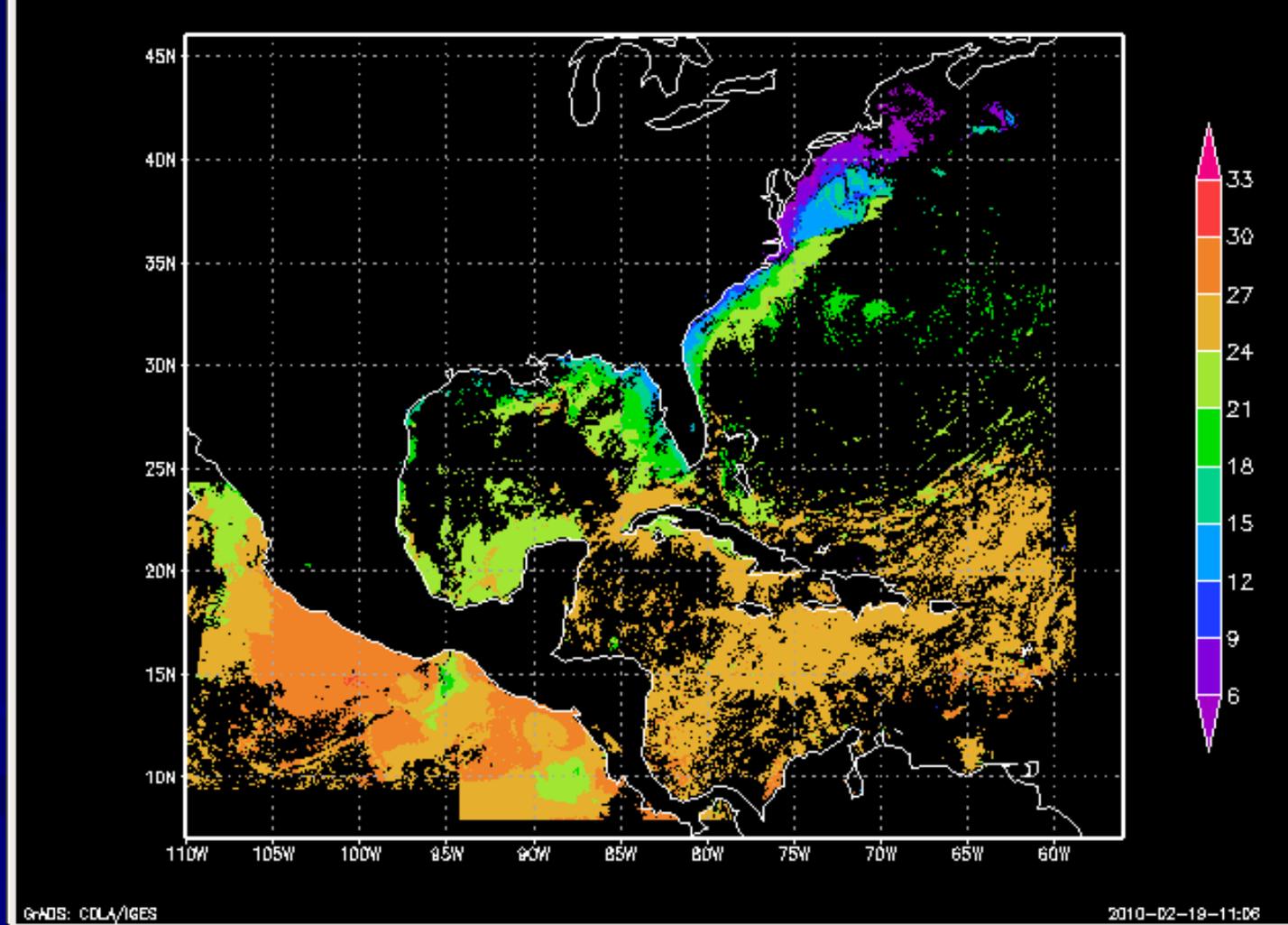
NOAA/UAF



Desktop access in Ferret



Desktop access in GrADS





Google Earth

LAS OUTPUT - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://ferret.pmel.noaa.gov/geoideLAS/ProductServer.do?xml=<%3Fxml+version%3D"1.0"%3F><lasRequest

UAF/GEOIDE LAS LAS OUTPUT

[Ferret:](#)

```
set data "http://ferret.pmel.noaa.gov/geoide/dodsC/las/id-ad3e40aa60
/data_ferret.pmel.noaa.gov_thredds_dodsC_data_PMEL_WO&O1_ocl_monthly_t0112mn1.nc.jnl"
SET REGION/x="195.47":"286.88"/y="4.218":"54.843"/z="0":"0"/t="15-Jan-0001":"15-Jan-0001"
```

[GrADS:](#)

```
sdfopen http://ferret.pmel.noaa.gov/geoide/dodsC/las/id-ad3e40aa60
/data_ferret.pmel.noaa.gov_thredds_dodsC_data_PMEL_WO&O1_ocl_monthly_t0112mn1.nc.jnl
set t 14 14
set level 1 1
set lat 4.218 54.843
set lon 195.47 286.88
```

[Matlab via netCDF-Java Toolbox:](#)

```
url='http://ferret.pmel.noaa.gov/geoide/dodsC/las/id-ad3e40aa60
/data_ferret.pmel.noaa.gov_thredds_dodsC_data_PMEL_WO&O1_ocl_monthly_t0112mn1.nc.jnl';
[t0112mn1,grid]=nj_subsetGrid(url,'t0112mn1',[195.47 286.88 4.218 54.843 ],'15-Jan-0001')
```

[Matlab via loaddods:](#)

```
% Region covered by this URL t=14-JAN:14-JAN z=0:0 y=4.5:54.5 x=195.5:286.5
loaddods(http://ferret.pmel.noaa.gov/geoide/dodsC/las/id-ad3e40aa60
/data_ferret.pmel.noaa.gov_thredds_dodsC_data_PMEL_WO&O1_ocl_monthly_t0112mn1.nc.jnl?t0112mn1[14,14][1,1][95,145]
[196,287])
```

Done

Date : temperature (degC) from World Ocean Atlas 2001 1x1 degree monthly mean(s) temperature (degC) from World Ocean Atlas 2001 1x1 degree monthly mean(s)

Minimum Start date: 0001 Jul

Maximum Start date: 0001 Oct

NOAA/UAF

Windows Inbox for steven.c.h... LAS vizGal - Mozilla Fi... Compose: Re: UAF LAS Hankin-AGU-20...

Scripts

Live Access Server (LAS)

GODIVA2 Data Visualization demo page - Mozilla Firefox

File Edit View History Delicious Bookmarks Tools Help

http://rocky.umeoce.maine.edu:8080/ncWMS/godiva2.html#

My ncWMS server

- gomoos_fmrc
 - Salinity
 - Temperature
 - horizontal eddy viscosity
 - eastward_sea_water_velocity
 - northward_sea_water_velocity

Layer: My ncWMS server > gomoos_fmrc > Temperature
Units: Celsius
Depth (1): 0
Date/time: 29 May 2009 00:00:00 UTC [first frame](#) [last frame](#)
[Create animation](#) from 2009-05-08T00:00:00.000Z to 2009-05-29T00:00:00.000Z

May, 2009						
Today						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Select date

21.75
12.41
3.067
-6.274

linear
[auto](#)
[lock](#)

Lon: -66.30255039550781
Lat: 41.599093358750004
Value: 7.474
[Set colour min](#)
[Set colour max](#)
[Create timeseries plot](#)

link to test

Powered by

Permalink | email

Done

NOAA/UAF

S3 Fox

WMS can be used by many GIS applications

GODIVA2

ERDDAP Easier access to scientific data

ERDDAP > griddap > Data Access Form

Dataset Title: SST, Blended, Global, EXPERIMENTAL (Monthly Composite)
 Dataset ID: erdBAsstamday
 Institution: NOAA CoastWatch, West Coast Node
 Information: Summary | Variables | Background | Make A Graph

Dimensions @ Start @ Stride @ Stop @ Size @ Spacing @
 time (Centered Time, UTC) @ 2010-01-16T12:00:00Z | 1 | 2010-01-16T12:00:00Z | 91 | 30 days 10:56:00 (uneven)

altitude (m) @ 0.0 | 1 | 0.0 | 1 | (just one value)

latitude (degrees_north) @ 30 | 1 | 50.0 | 1501 | 0.1 (even)

longitude (degrees_east) @ 220 | 1 | 240.0 | 3601 | 0.1 (even)

Grid Variables (which always also download all of the dimension variables)
 sst (Sea Surface Temperature, degree C) @

File type:

Google Earth Pro

Search: Fly To Find Businesses Directions
 Fly to e.g., Hotels near JFK

Places: Add Content
 My Places
 Starting Location
 Slightseeing
 Select this folder and click on the 'Play' button below, to start the

Layers: Primaries Database
 Geographic Web
 KMLs
 3D Buildings
 Street View
 Borders and Labels
 Traffic
 Weather
 Gallery
 Ocean

.kml

**REST URL access to data subsets
 in several popular formats
 (accessible through home-grown scripting of many types)**

Current Directory: /Users/rmendels/Documents/Matlab

Command Window

```
Warning: Name is inconsistent with MATLAB built-in function.
Warning: Function Application has the same name as a MATLAB builtin. We suggest you rename the function to avoid the potential name conflict.
Warning: Function Application has the same name as a MATLAB builtin. We suggest you rename the function to avoid the potential name conflict.
Warning: Function Application has the same name as a MATLAB builtin. We suggest you rename the function to avoid the potential name conflict.
Warning: Function Application has the same name as a MATLAB builtin. We suggest you rename the function to avoid the potential name conflict.
```

Figure 1

.mat

Copyright (C) 2009 The R Foundation
 ISBN 3-900051-87-0

R is free software and comes with
 absolutely no warranty for the R project with
 Type "contributors()" for more in
 "citation()" on how to cite R or
 the R project.

```
Error in library(lattice) : there
is no file or directory for 'lattice'
download.file(url="http://coast
[[0,0]]:[0,0]]:[0,0]:1:[0,0]]:[0,0]
trying URL 'http://coastwatch.pfe
[[0,0]]:[0,0]]:[0,0]]:[0,0]:1:[0,0]
Content type: application/x-down
loaded 569 Kb
```

.nc

also .csv

NOAA/UAF

the list goes on ...

- Weather and Climate Toolkit
- NCL (NCAR)
- NCO
- CDAT / UVCDAT (DOE)
- ncview
- Giovanni (NASA)
- generic WCS & WMS applications
- ...



Global Earth Observation - Integrated Data Environment | Access Gridded Data - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://geo-ide.noaa.gov/access.html

CVS PMEL LAS Projects pending Webster Ferret Google NOAA Directory trip

Global Earth Observation Integrated Data Environment

Unified Access Framework for Environmental Data

Home Access Data Find Data Contribute Data Learn About UAF UAF in Action GEO-IDE Wiki Contact Us

Access Data

One of the primary benefits of the Unified Access Framework is the ease and flexibility of accessing a large amount of data in ways that YOU, the user, wants. Many options are already available to take advantage of the Unified Access Framework. Click on one of the logos below to learn more...

Interoperability Provided By:

ArcGIS

- [Learn about ArcGIS](#)

(Environmental Data Connector - Access THREDDS Data from within ArcGIS)

YouTube

(Sample Screenshot)

[Privacy Policy](#) | [Disclaimer](#) | [Site Map](#) | [Contact Webmaster](#)

Read i.ytimg.com

of data network.

page
er
ATION

Curator Data Portal at GFDL - Mozilla Firefox

http://data1.gfdl.noaa.gov:8380/lasV72beta/getUI.do?dsid=id-7d37f82019&varid=sfc_hflux-id-7d37f82019

Curator Data Portal at GFDL

Choose dataset Update Plot Set plot options Animate Compare Google Earth Show Values

model output prepared for GFDL Seasonal-Interannual Experimental Forecasts CM2.1U_CDAef_v1.0

Potential Temperature

LAS 7.+ / Ferret 6.64 NOAA/PMEL

TIME : 16-APR-1982 00:00 JULIAN
DATA SET: model output prepared for GFDL Seasonal-Interannual Experimental Forecasts CM2.1U_CDAef_v1.0

Net surface heat flux ($W m^{-2}$)

Viewers:

- NetCDF-Java ToolsUI (webstart)
- Visualize with Live Access Server

• LAS

• ERDDAP

• GODIVA

• ...

From the THREDDS catalog
“viewers” may also be called up

Catalog Services - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.ngdc.noaa.gov/thredds/sstCatalog.html?dataset=SST-Aerosol-

CVS PMEL LAS Projects pending Webster Ferret Google NOAA Directory trip

Curator Data Portal at GFDL Catalog Services

National Geophysical Data Center
THREDDS Data Server

Catalog <http://www.ngdc.noaa.gov/thredds/>

Dataset: SST Catalog/SST Aerosol Aggregation

- Data type: GRID
- ID: SST-Aerosol-Agg

Access:

1. OPENDAP: [/thredds/dodsC/sst-aerosol-aggregation](#)
2. HTTP Server: [/thredds/fileServer/sst-aerosol-aggregation](#)
3. NCML: [/thredds/ncml/sst-aerosol-aggregation](#)
4. UDDC: [/thredds/uddc/sst-aerosol-aggregation](#)
5. ISO: [/thredds/iso/sst-aerosol-aggregation](#)

Viewers:

- Integrated Data Viewer (IDV) (webstart)
- NetCDF-Java ToolsUI (webstart)

Done

Metadata inside files has become accessible from THREDDS catalogs

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.ngdc.noaa.gov/thredds/ncml/sst-aerosol-aggregation

Curator Data Portal at GFDL

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```

--<netcdf location="file:sst-aerosol-aggregation"
  <attribute name="Conventions" value="CF Conventions" />
  <attribute name="standard_name_vocabulary" value="CF Standard Names Table" />
  <attribute name="naming_authority" value="NOAA" />
  <attribute name="geospatial_lon_units" value="degrees_east" />
  <attribute name="geospatial_lat_units" value="degrees_north" />
  <attribute name="geospatial_lon_resolution" value="1" />
  <attribute name="geospatial_lat_resolution" value="1" />
  <attribute name="cdm_data_type" value="grid" />
  <attribute name="creator_url" value="http://www.ngdc.noaa.gov/thredds/ncml/sst-aerosol-aggregation" />
  <attribute name="time_coverage_duration" value="PT1Y" />
  <attribute name="history" value="2010: NPR.ASWK.NP.D1026605 into netCDF" />
  <attribute name="Metadata_Convention" value="CF Conventions" />
  <attribute name="metadata_url" value="http://www.ngdc.noaa.gov/thredds/ncml/sst-aerosol-aggregation" />
  <attribute name="id" value="gov.noaa.class:AERO100" />
  <attribute name="title" value="Aerosol Optical Thickness" />
  <attribute name="summary" value="The optical thickness based on one week's w channel 1 optical thickness retrievals from thickness, or optical depth, is a dimensional beam of radiation undergoes as it passes through function of the density, composition, temperature, defined as suspensions of liquid droplets of sand, volcanic ash, sea spray and smog." />
  <attribute name="keywords" value="Clouds > Atmosphere > Aerosols > Aerosol Optical Depth > Atmosphere > Atmospheric Radiation > Clouds > Cloud Optical Depth > Optics > Optical Depth, CIESIN > Earth Science Keywords, CIESIN Index Standard Name Table" />
  <attribute name="creator" name="value="NOAA" />
  
```

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.ngdc.noaa.gov/thredds/iso/sst-aerosol-aggregation

Curator Data Portal at GFDL

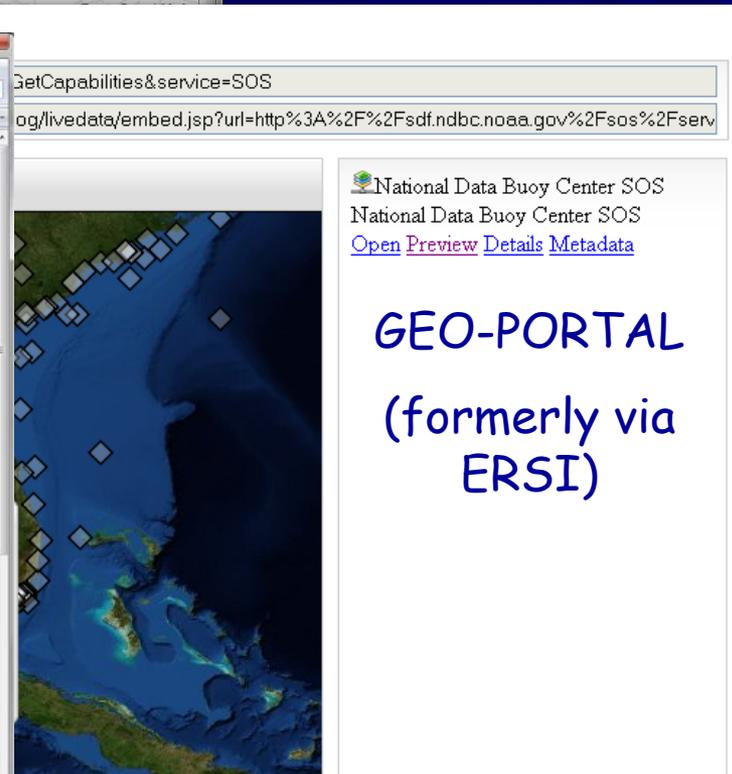
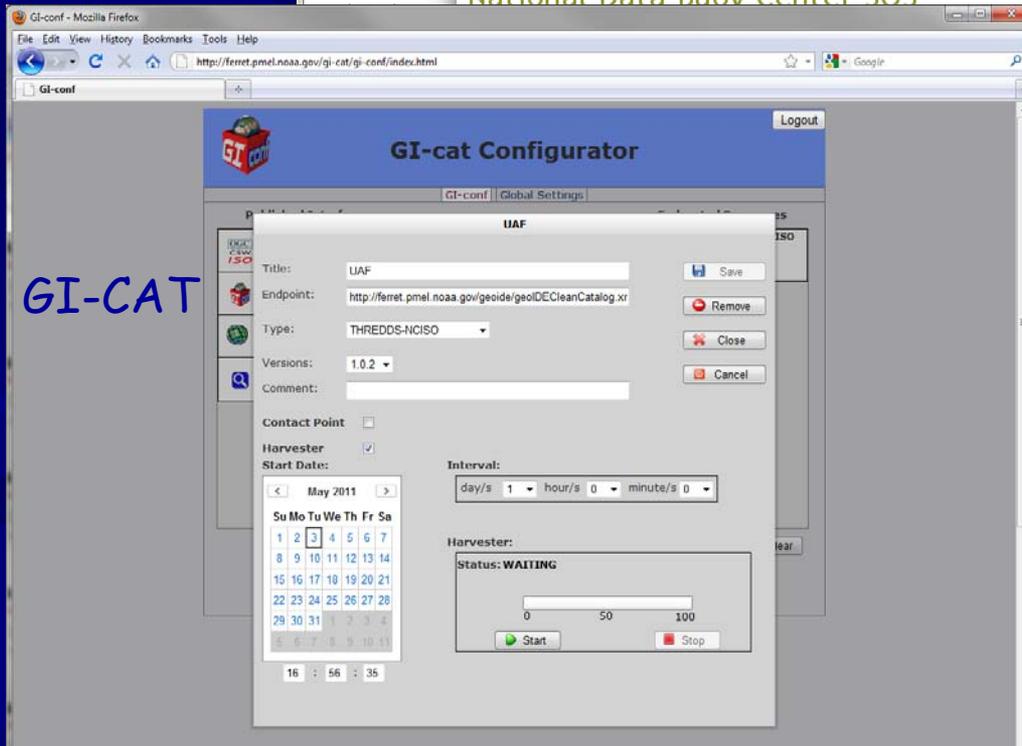
This XML file does not appear to have any style information associated with it. The document tree is shown below.

```

<gmi:MI_Metadata xsi:schemaLocation="http://www.isotc211.org/2005/gmi C:\DOCUME~1\haver\MYDOCU~1\NOAA\Metadata\ISOSTA-1\ISO191-3\191395-1.gmi\gmi.xsd">
  <gmd:fileIdentifier>
    <gco:CharacterString>gov.noaa.class:AERO100</gco:CharacterString>
  </gmd:fileIdentifier>
  <gmd:contact>
    <gmd:contactInfo>
      <gmd:role>gco:nilReason="unknown"/>
    </gmd:contactInfo>
  </gmd:contact>
  <gmd:spatialRepresentationInfo>
    <gmd:MD_Georectified>
      <gmd:numberOfDimensions>gco:nilReason="unknown"/>
      <gmd:axisDimensionProperties>
        <gmd:MD_Dimension>
          <gmd:dimensionName>
            <gmd:MD_DimensionNameTypeCode codeList="http://www.isotc211.org/2005/resources/codeList.xml#MD_DimensionNameTypeCode" codeListValue="column">column</gmd:MD_DimensionNameTypeCode>
          </gmd:dimensionName>
          <gmd:dimensionSize>gco:nilReason="unknown"/>
          <gmd:resolution>
            <gco:Measure>1</gco:Measure>
          </gmd:resolution>
          <gmd:MD_Dimension>
            <gmd:dimensionName>
              <gmd:MD_DimensionNameTypeCode codeList="http://www.isotc211.org/2005/resources/codeList.xml#MD_DimensionNameTypeCode" codeListValue="row">row</gmd:MD_DimensionNameTypeCode>
            </gmd:dimensionName>
            <gmd:dimensionSize>gco:nilReason="unknown"/>
            <gmd:resolution>
              <gco:Measure>1</gco:Measure>
            </gmd:resolution>
            <gmd:MD_Dimension>
              <gmd:axisDimensionProperties>
                <gmd:MD_Dimension>
                  <gmd:dimensionName>
                    <gmd:MD_DimensionNameTypeCode codeList="http://www.isotc211.org/2005/resources/codeList.xml#MD_DimensionNameTypeCode" codeListValue="row">row</gmd:MD_DimensionNameTypeCode>
                  </gmd:dimensionName>
                  <gmd:dimensionSize>gco:nilReason="unknown"/>
                  <gmd:resolution>
                    <gco:Measure>1</gco:Measure>
                  </gmd:resolution>
                </gmd:MD_Dimension>
              </gmd:axisDimensionProperties>
            </gmd:MD_Dimension>
          </gmd:axisDimensionProperties>
        </gmd:MD_Dimension>
      </gmd:MD_Georectified>
    </gmd:spatialRepresentationInfo>
  </gmi:MI_Metadata>
  
```

Our current efforts ...

1. evaluating 'mature' discovery portals



How to obtain discovery metadata?

Crawl the UAF clean catalog with

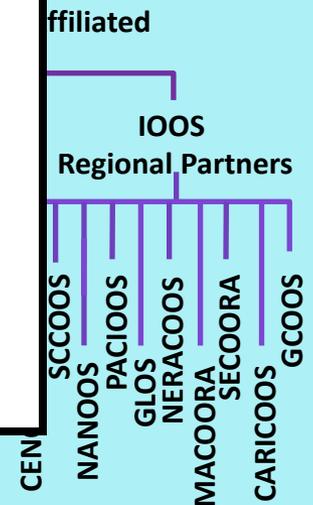
- RAMADDA
- GI-CAT
- ncISO/NGDC
 - also create Web Accessible Folders to join into other frameworks

Our current efforts ...

2. enhancing the “catalog cleaner”
(another THREDDS crawler)

The clean catalog:

- **Uniform services and viewers**
- data access via OPeNDAP as needed
- auto-synchronization (cron-style)
- join-new and join-existing aggregations



Our current efforts ...

3. *in situ* obs collections (“1d grids”)

(development work ...)

1. CF Discrete Geometries spec 
2. ncStream ('cdmRemote') (Caron)
3. ERDDAP (tableDAP REST), LAS (anal & viz)
and after these ...
4. ... IOSP for data base access
5. ... NCML aggregation of 1d file collections

now
official



Summary

The UAF approach is

- simple, open, cheap
- compatible with ESGF, NOMADS, IOOS, Ingrid, Giovanni, OGC (recently), ...

Should it be broader than a NOAA project?

Many OPeNDAP servers provide little user documentation.

→ Send us docs to host on your CF app

If UAF were at a non-agency domain, would you hang your open THREDDS catalog on the UAF tree?



Thank you