

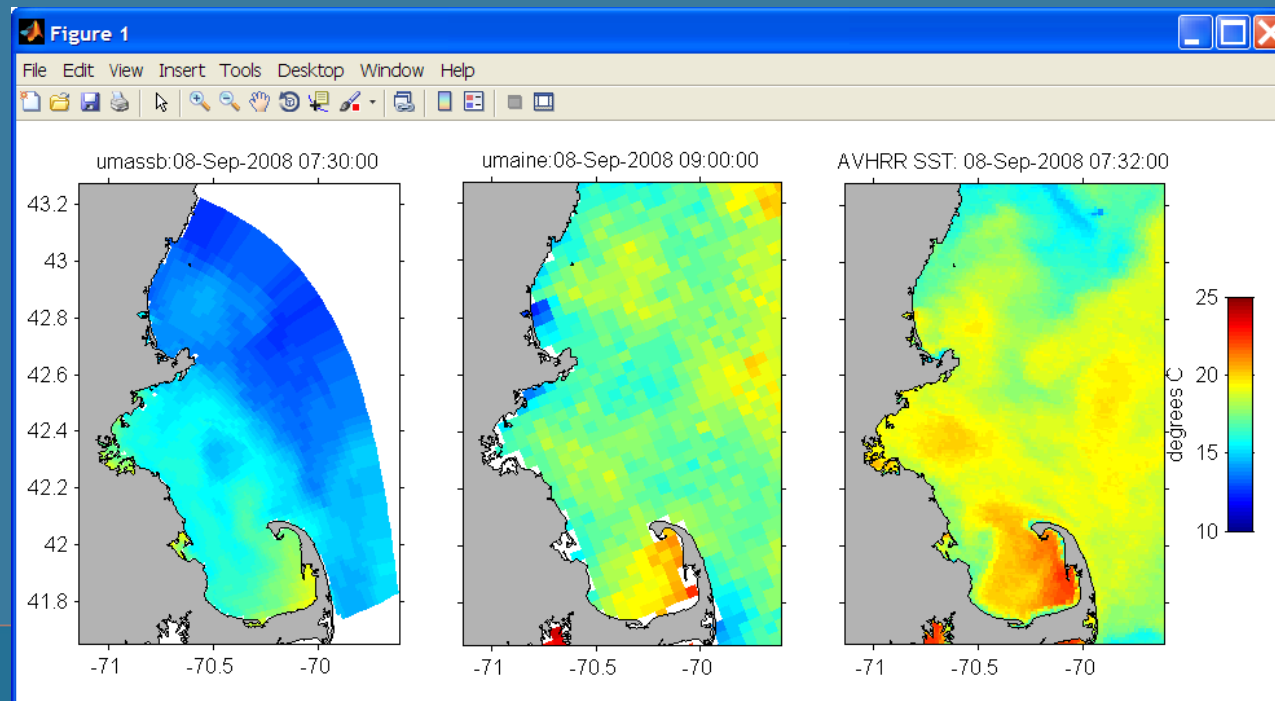
# Ocean, Atmosphere & Climate Model Assessment for Everyone

Rich Signell

USGS Woods Hole, MA

Unidata 2014 DeSouza Award Presentation

Boulder, CO : Sep 15, 2014





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## NetCDF: A Public-Domain-Software Solution to Data-Access Problems for Numerical Modelers

by **Harry L. Jenter** and **Richard P. Signell**

pp. 72-82

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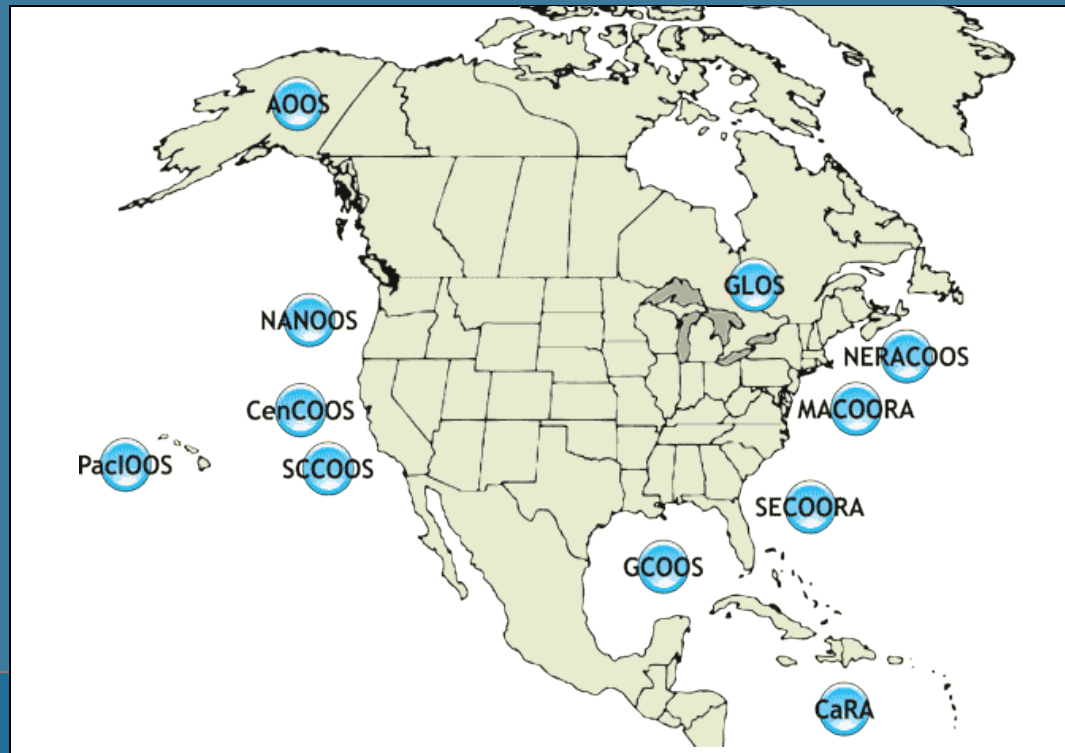
**Document type:** Conference Proceeding Paper  
**Part of:** Estuarine and Coastal Modeling (1991)

- ASCE Subject Headings:**
- Computer software
  - Data processing
  - Databases

# US Integrated Ocean Observing System (IOOS<sup>®</sup>)

IOOS<sup>®</sup> Plan defines:

- Global Component
- Coastal Component
  - 17 Federal Agencies
  - 11 Regional Associations

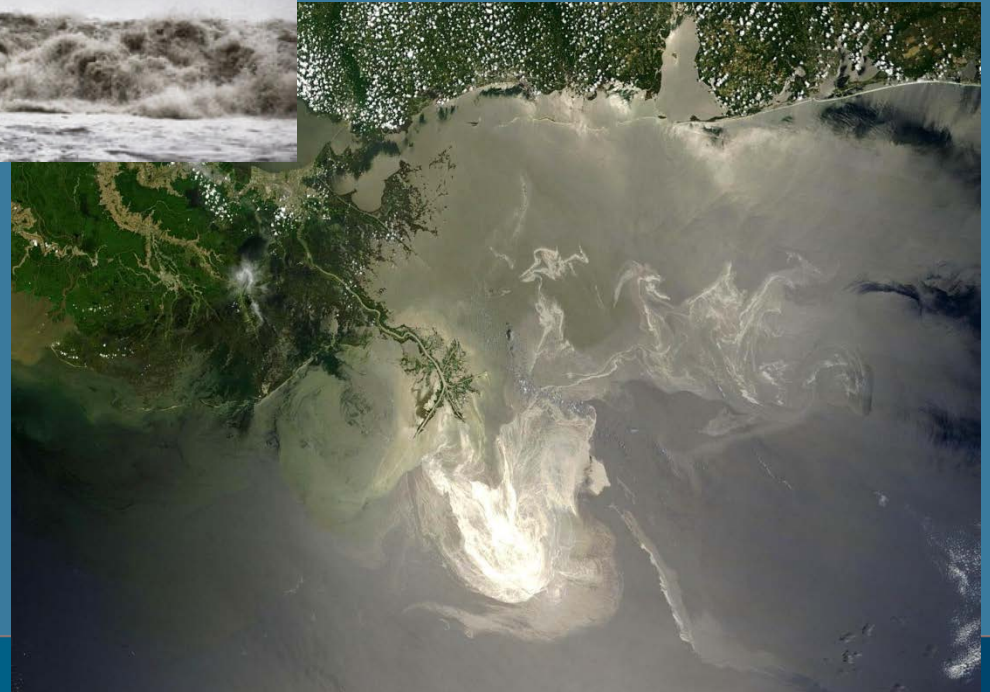


# How well do models simulate events?



Hurricane Sandy, Ocean Grove Pier -  
New Jersey, October 29, 2012 -  
Photograph by Bob Bowné

Deepwater Horizon Oil Spill, Northern  
Gulf of Mexico, May 24, 2010. Image  
from MODIS on NASA's Terra Satellite.



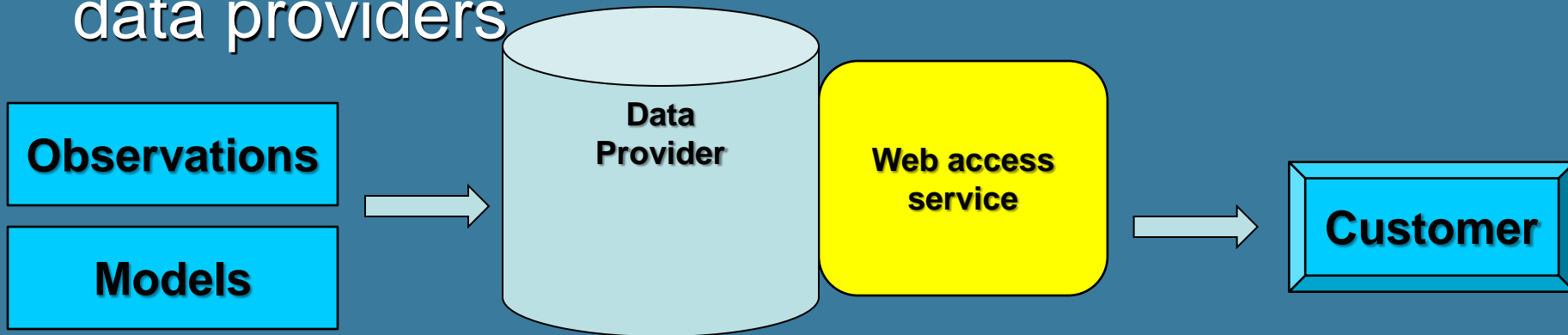


# IOOS Core Principles

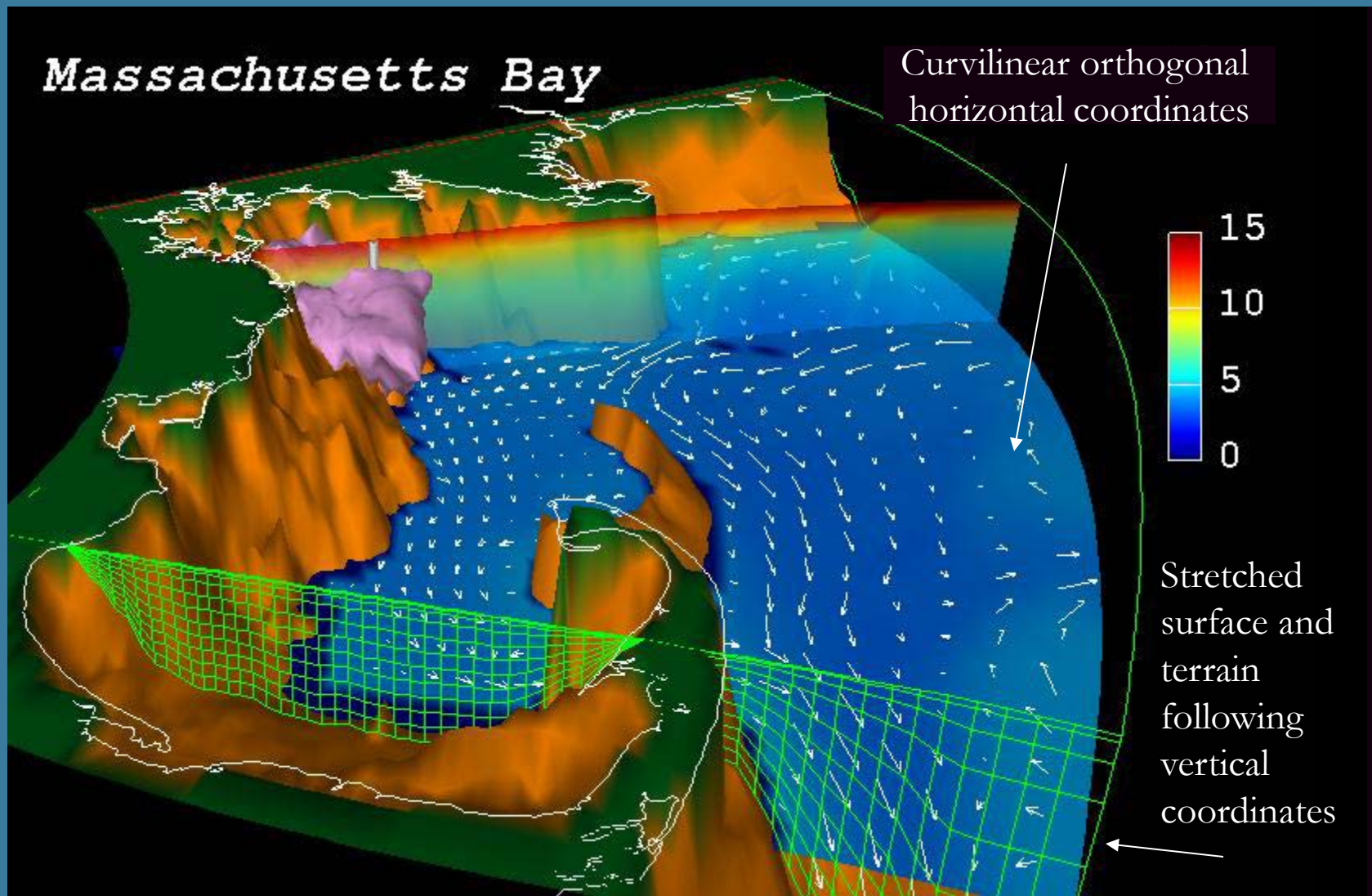
- Adopt open standards & practices



- Avoid customer-specific stovepipes
- Standardized access services implemented at data providers

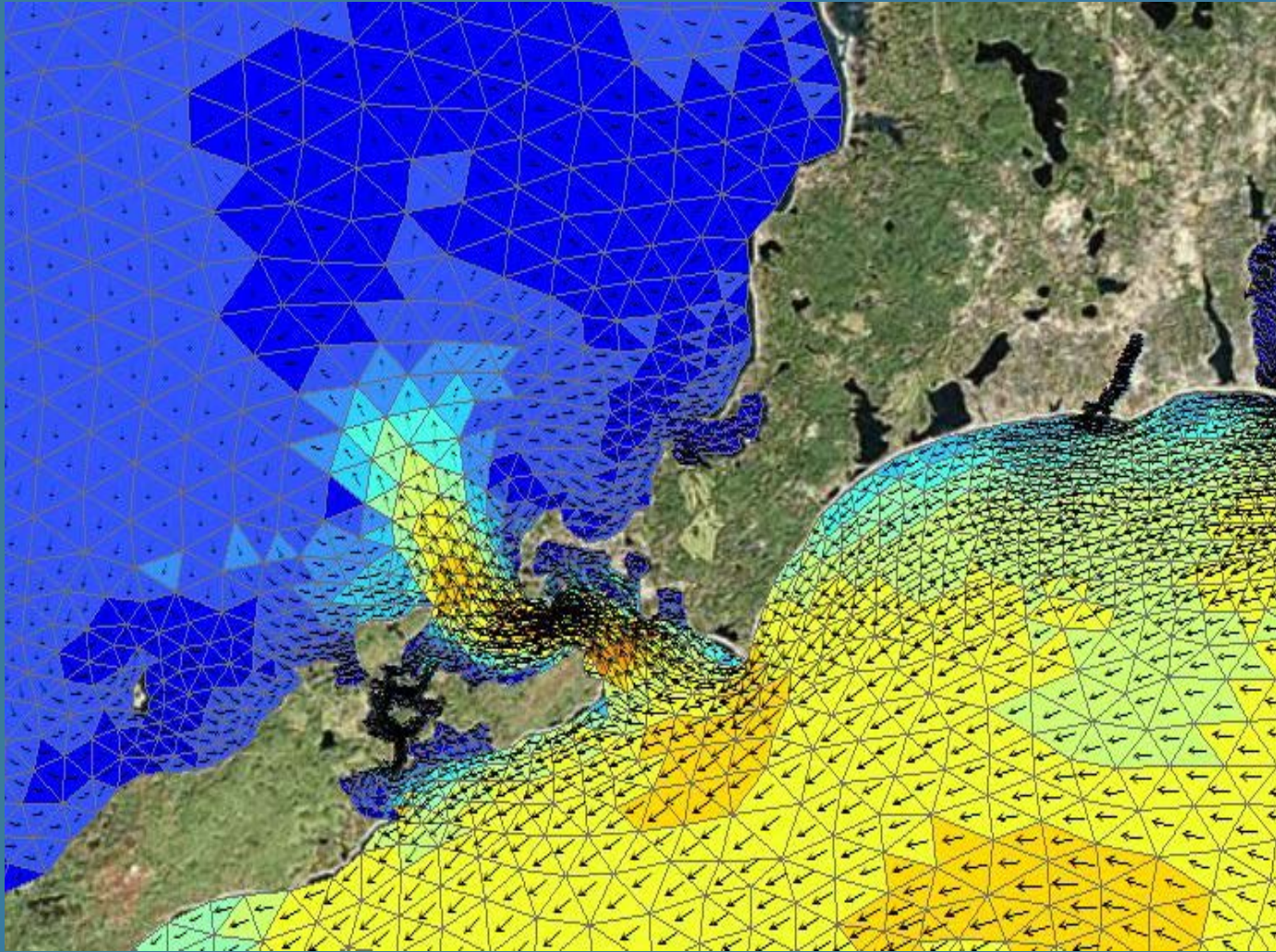


# Issue: Ocean grids are not regularly spaced!

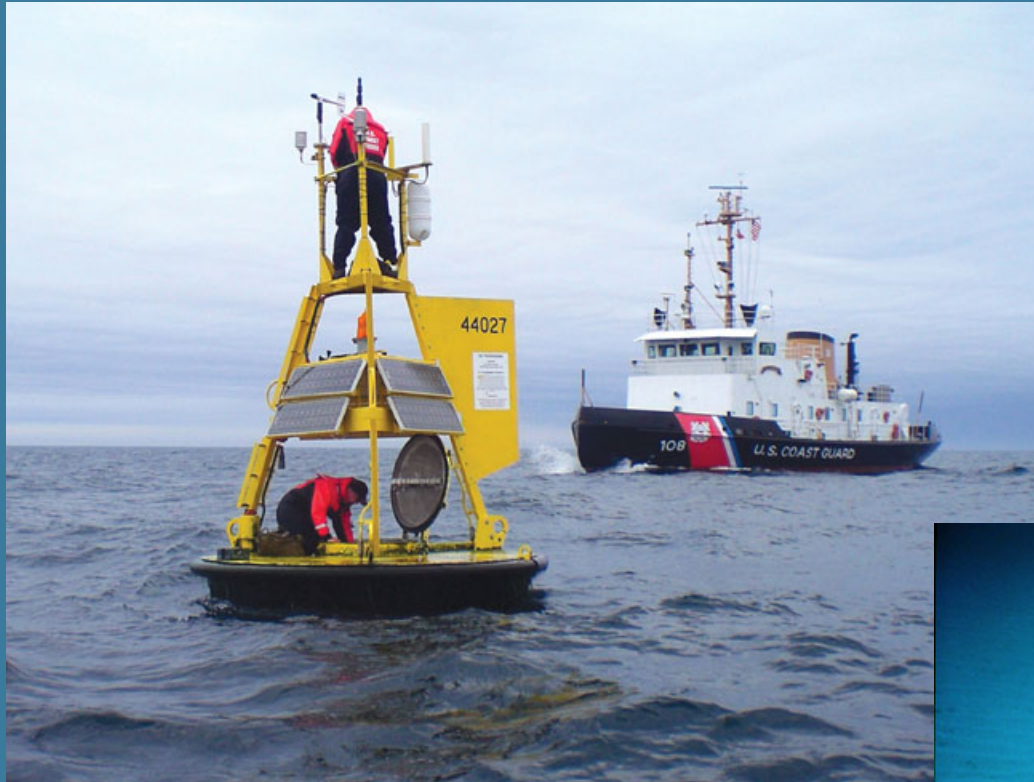




# Unstructured (e.g. triangular) grid



# Time Series, Trajectories



Meteorology and Wave Buoy in the Gulf of Maine. Image courtesy of NOAA.

Ocean Glider. Photo by Dave Fratantoni, Woods Hole Oceanographic Institution





# NetCDF Climate and Forecast (CF) Conventions provide a solution

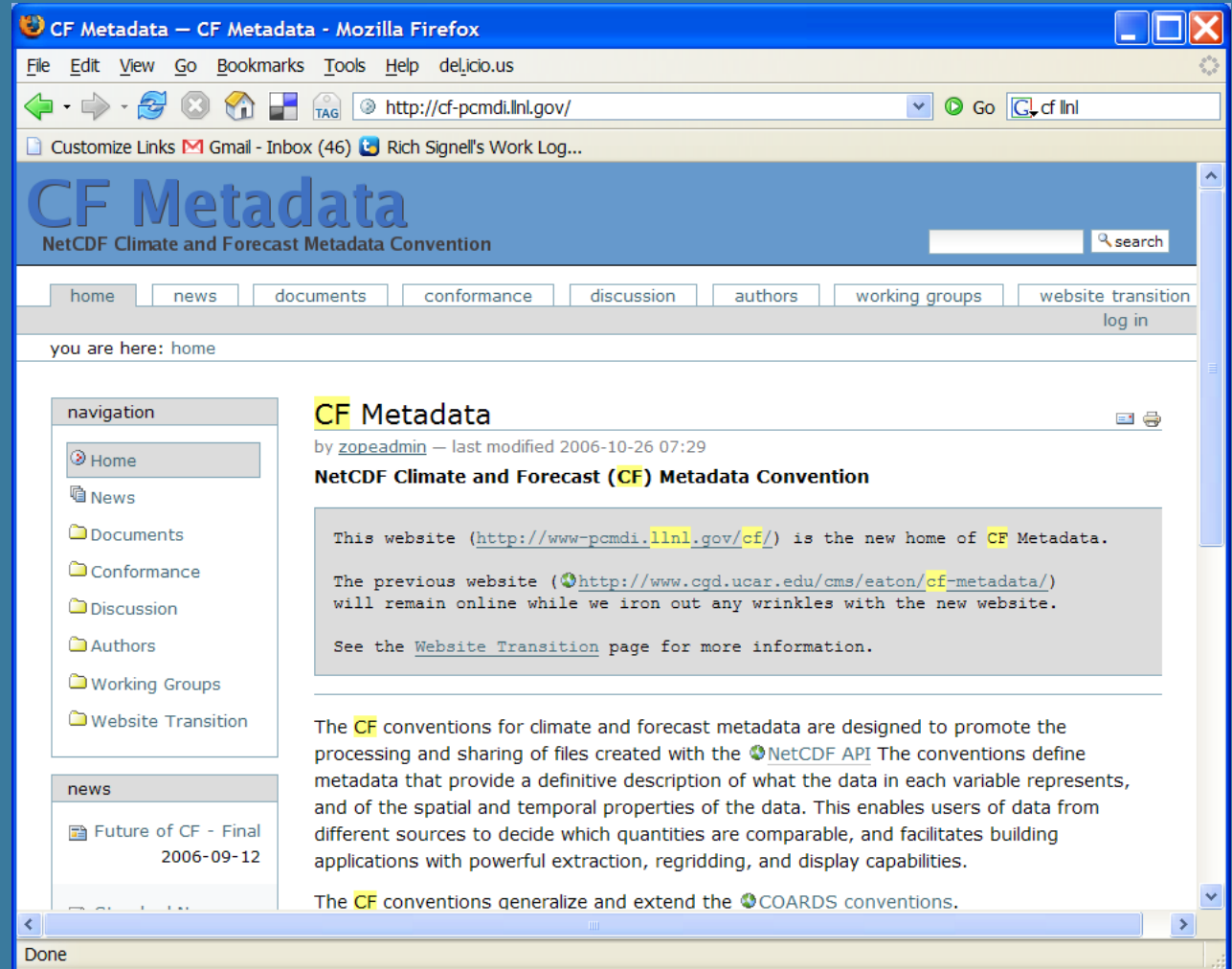
Groups using CF:

**GO-ESSP:** Global Organization for Earth System Science Portal

**IOOS:** Integrated Ocean Observing System

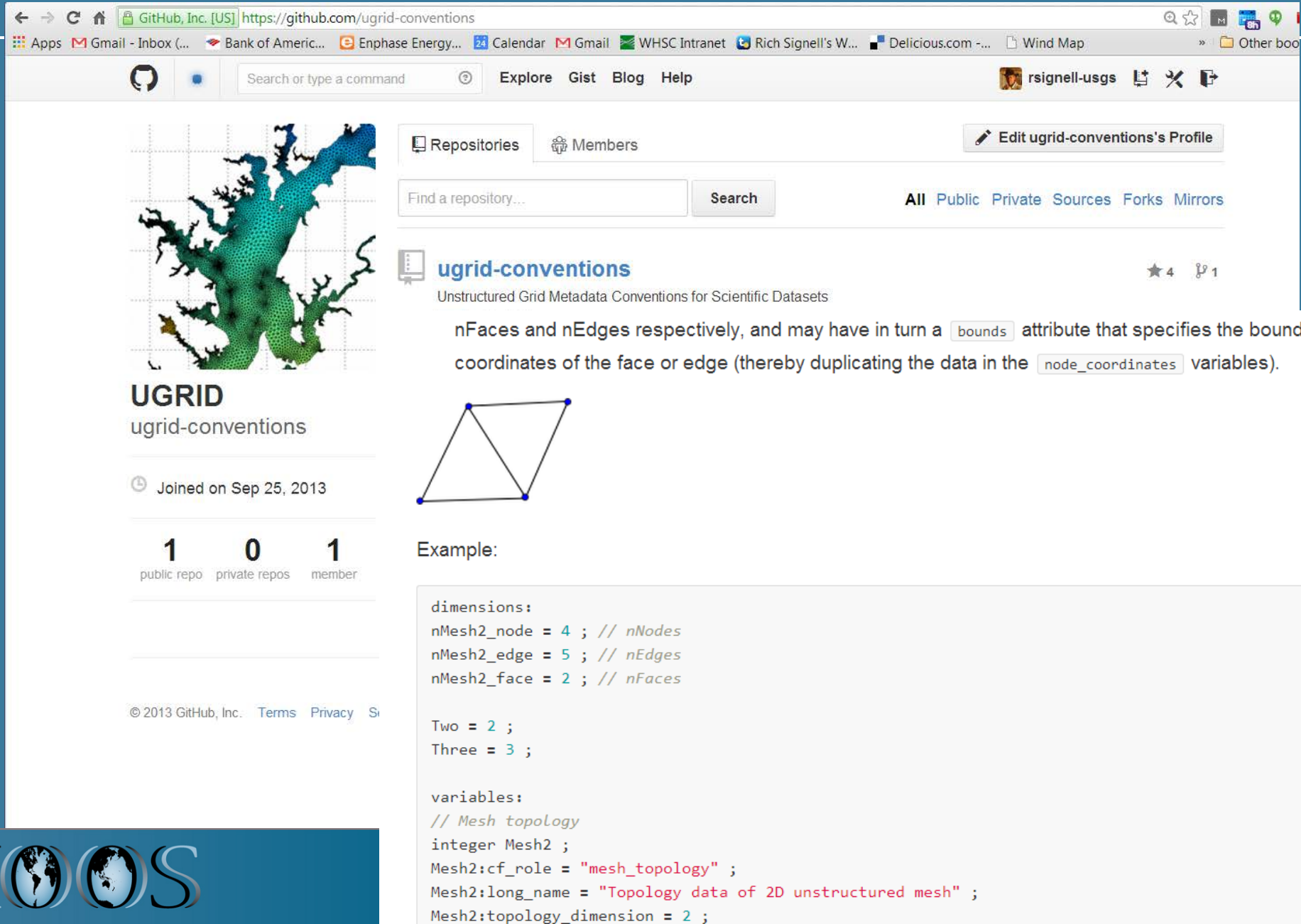
**ESMF:** Earth System Modeling Framework

**OGC:** Open Geospatial Consortium (GALEON: WCS profile)



The screenshot shows a Mozilla Firefox browser window displaying the CF Metadata website. The address bar shows the URL <http://cf-pcmdi.llnl.gov/>. The page title is "CF Metadata - CF Metadata - Mozilla Firefox". The website header includes the title "CF Metadata" and the subtitle "NetCDF Climate and Forecast Metadata Convention". A search bar is visible on the right. The navigation menu includes links for "home", "news", "documents", "conformance", "discussion", "authors", "working groups", and "website transition". A "log in" link is also present. The main content area features a "CF Metadata" heading, a byline "by zopeadmin — last modified 2006-10-26 07:29", and the title "NetCDF Climate and Forecast (CF) Metadata Convention". A text box contains the following information: "This website (<http://www-pcmdi.llnl.gov/cf/>) is the new home of CF Metadata. The previous website (<http://www.cgd.ucar.edu/cms/eaton/cf-metadata/>) will remain online while we iron out any wrinkles with the new website. See the [Website Transition](#) page for more information." Below this, a paragraph explains that the CF conventions are designed to promote the processing and sharing of files created with the NetCDF API, defining metadata for data representation and properties. A final paragraph states that the CF conventions generalize and extend the COARDS conventions. The browser's status bar at the bottom shows "Done".

# UGRID Conventions on GitHub



The screenshot shows the GitHub repository page for 'ugrid-conventions'. The repository is owned by 'rsignell-usgs' and was created on September 25, 2013. It has 1 public repository, 0 private repositories, and 1 member. The repository description is 'Unstructured Grid Metadata Conventions for Scientific Datasets'. The page shows the repository name, a search bar, and a list of repositories. The repository 'ugrid-conventions' is highlighted, showing its description and a diagram of a mesh topology. The diagram shows a quadrilateral mesh with four nodes and five edges. The example code defines the mesh topology and variables.

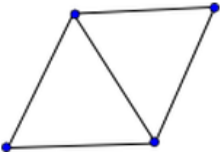
Repositories Members [Edit ugrid-conventions's Profile](#)

Find a repository... Search All Public Private Sources Forks Mirrors

**ugrid-conventions** ★ 4 1

Unstructured Grid Metadata Conventions for Scientific Datasets

nFaces and nEdges respectively, and may have in turn a `bounds` attribute that specifies the bounding coordinates of the face or edge (thereby duplicating the data in the `node_coordinates` variables).



Example:

```
dimensions:  
nMesh2_node = 4 ; // nNodes  
nMesh2_edge = 5 ; // nEdges  
nMesh2_face = 2 ; // nFaces  
  
Two = 2 ;  
Three = 3 ;  
  
variables:  
// Mesh topology  
integer Mesh2 ;  
Mesh2:cf_role = "mesh_topology" ;  
Mesh2:long_name = "Topology data of 2D unstructured mesh" ;  
Mesh2:topology_dimension = 2 ;
```

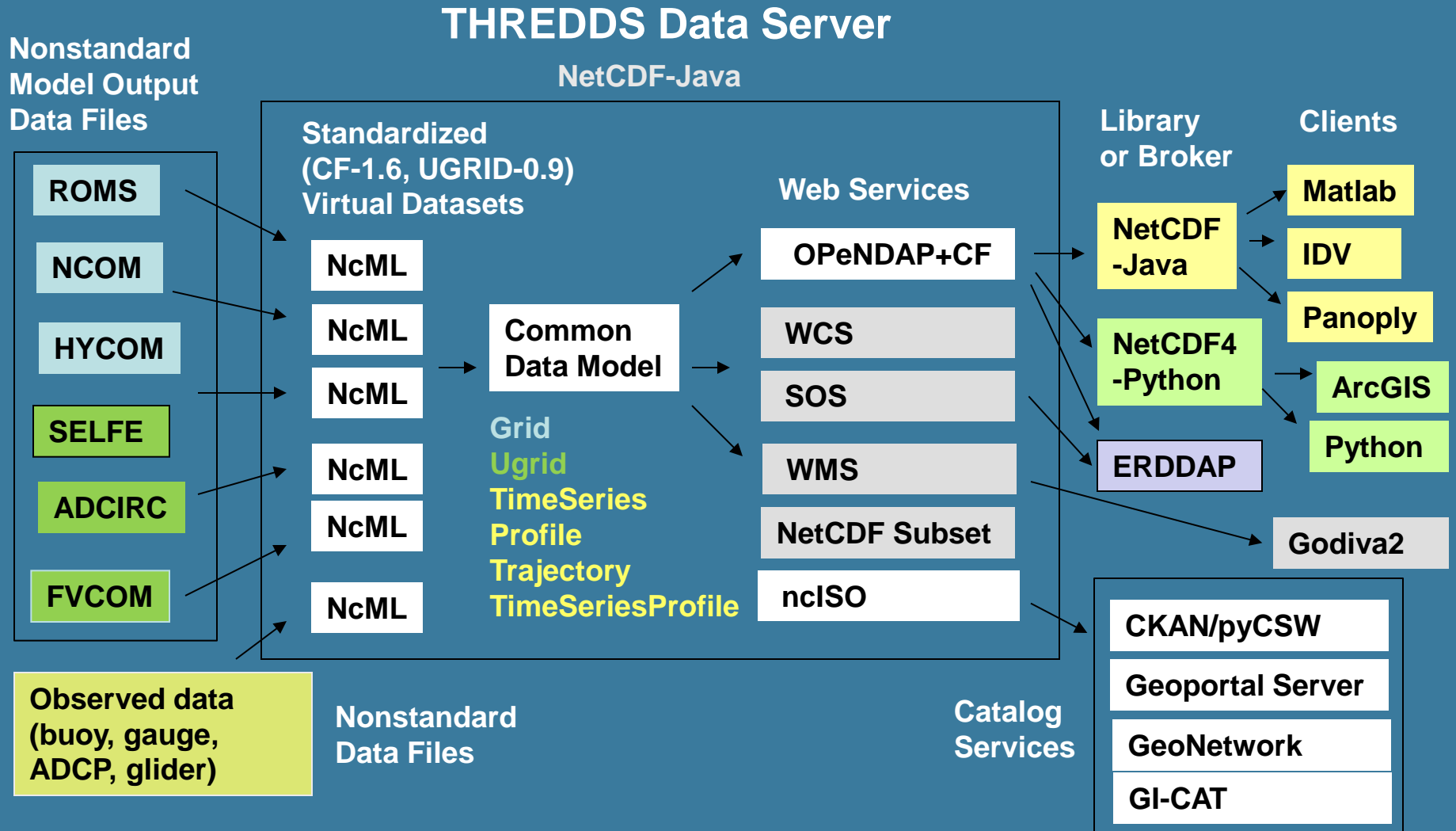
# Example NcML (on StackOverflow)

Here's an example:

```
<variable name="v" shape="time2 sigma node" type="float">
  <attribute name="standard_name" value="barotropic_northward_sea_water_velocity"/>
  <attribute name="mesh" value="selfe_mesh"/>
  <attribute name="location" value="node"/>
  <attribute name="coordinates" value="y x"/>
  <attribute name="units" value="m/s"/>
</variable>
<aggregation type="union">
  <netcdf xmlns="http://www.unidata.ucar.edu/namespaces/netcdf/ncml-2.2">
    <aggregation dimName="time" type="joinExisting">
      <scan
        location="/data/ftp/upload/Inundation/vims/selfe_tropical/runs/Rita/3D_varied_ro
        regexp=".*[0-9]{1}_WaterLevel\.nc$"/>
      </aggregation>
    </netcdf>
    <netcdf xmlns="http://www.unidata.ucar.edu/namespaces/netcdf/ncml-2.2">
      <aggregation dimName="time" type="joinExisting">
        <scan
          location="/data/ftp/upload/Inundation/vims/selfe_tropical/runs/Rita/3D_varied_ro
          regexp=".*[0-9]{1}_SigWaveHeight\.nc$"/>
        </aggregation>
      </netcdf>
    </netcdf>
  </aggregation>
</netcdf>
```



# IOOS Model Data Interoperability Design



# WMS Browsing with THREDDS/ncWMS

← → ↻ 🏠 [geoport.whoi.edu/thredds/godiva2/godiva2.html?server=http://geoport.whoi.edu/thredds/wms/coawst\\_](http://geoport.whoi.edu/thredds/godiva2/godiva2.html?server=http://geoport.whoi.edu/thredds/wms/coawst_) ☆ M NB ☰

Apps Gmail - Inbox (... Bank of Americ... Enphase Energy... 27 Calendar WHSC Intranet » Other bookmarks

Auto-zoom on select Refresh

[? ? ?](#)  
stress  
wind-induced, bottom v-momentum stress  
max wave and current bottom stress magnitude  
sediment median grain diameter size  
sediment median grain density  
sediment median grain settling velocity  
sediment median critical erosion stress  
bottom ripple length  
bottom ripple height  
bed wave excursion amplitude  
default bottom roughness length  
apparent bottom roughness length  
erosion flux  
erosion or deposition  
sea\_surface\_wave\_significant\_height  
wind-induced mean wavelength  
wind-induced wave direction  
wind-induced peak surface wave Period  
wind-induced bottom wave Period  
wind-induced bottom orbital velocity

Layer: WHCMSC Sediment Transport Group > COAWST Forecast System : USGS : US East Coast and Gulf of Mexico (Experimental) > sea\_surface\_wave\_significant\_height  
Units: meter

Date/time: 28 Aug 2014 00:00:00 UTC [first frame](#) [last frame](#)

[Fit layer to window](#)

August, 2014						
« < 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

5

3.333

boxfill  
linear  
auto  
lock  
1.667

0

100%

[test image](#) [Open in Google Earth](#)

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Reading e-Science Centre

# Matlab NCTOOLBOX

<https://github.com/nctoolbox>

- Objective: Make it simple to access CF data
- Example function:
- `[t, geo]=nj_tslice(URL,'temp',1);`
- `t = 22x120x180 single`
- `geo =`
  - `lat: [120x180 single]`
  - `lon: [120x180 single]`
  - `z: [22x120x180 double]`
  - `time: 733582 (matlab datenum)`
- `nj_tslice` works identically for ROMS, POM, ECOM, WRF, Wavewatch3
- URL can be: local NetCDF, remote NetCDF, NcML, OpenDAP Data URL



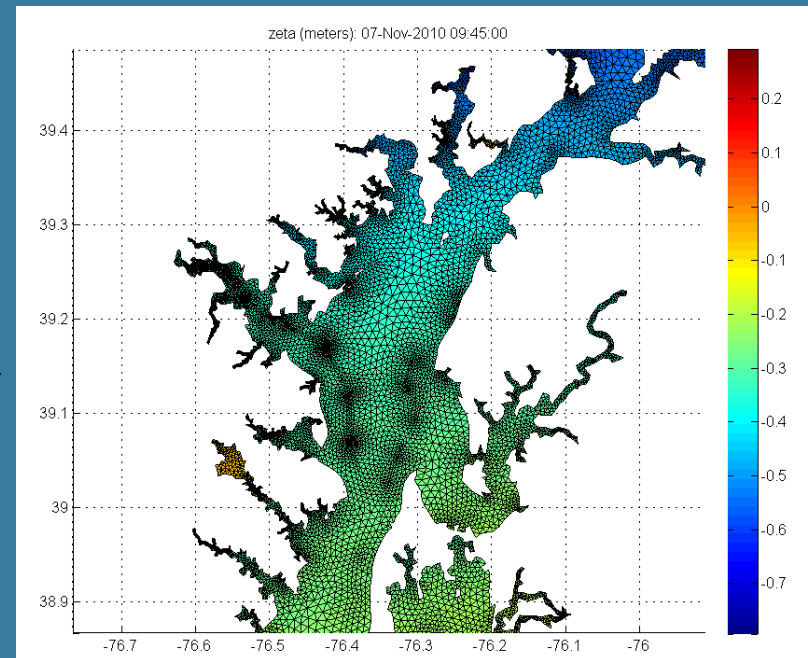
# Matlab NCTOOLBOX

<https://github.com/nctoolbox>

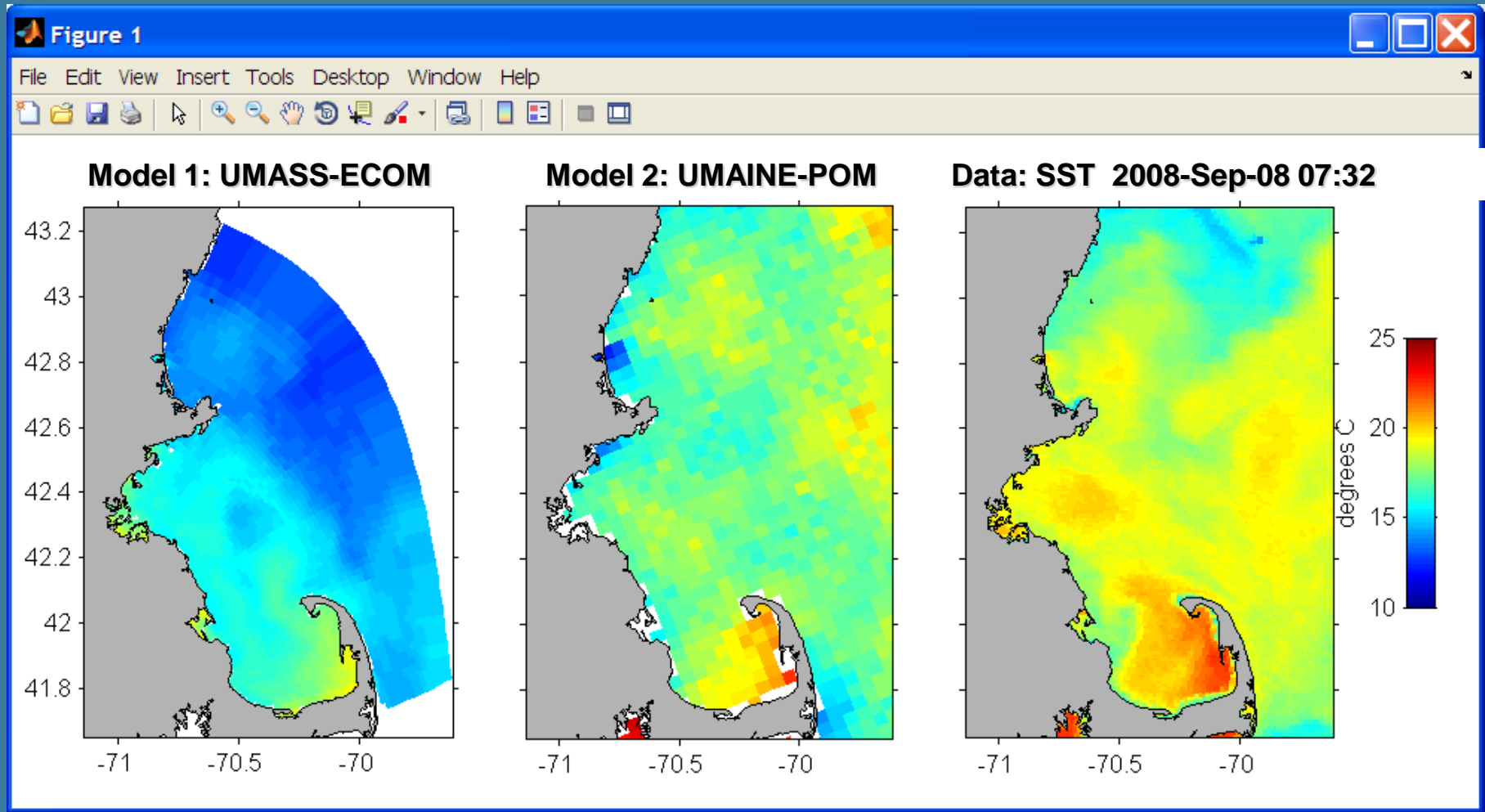
```
nc = ncugrid(dap_url)
ncvar = nc.uvariable('zeta')
z = ncvar.data(itime,:)
grid = ncvar.grid(itime,:)
```

```
z = 26441x1 single
grid =
```

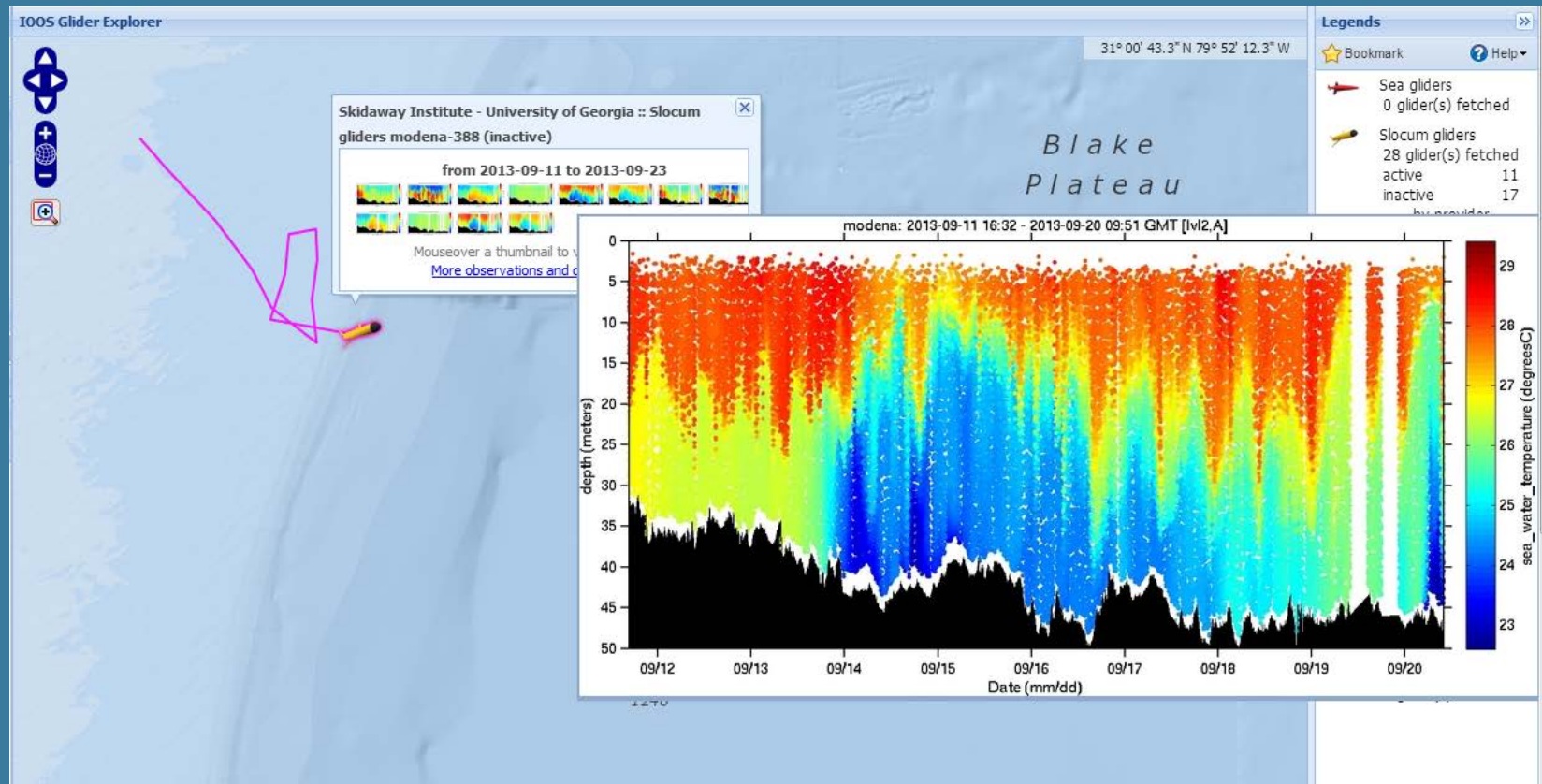
```
lat: [26441x1 single]
lon: [26441x1 single]
time: 730970 (matlab datenum)
connectivity: [52025x3 int32]
```



# Comparing Models with Data in Matlab

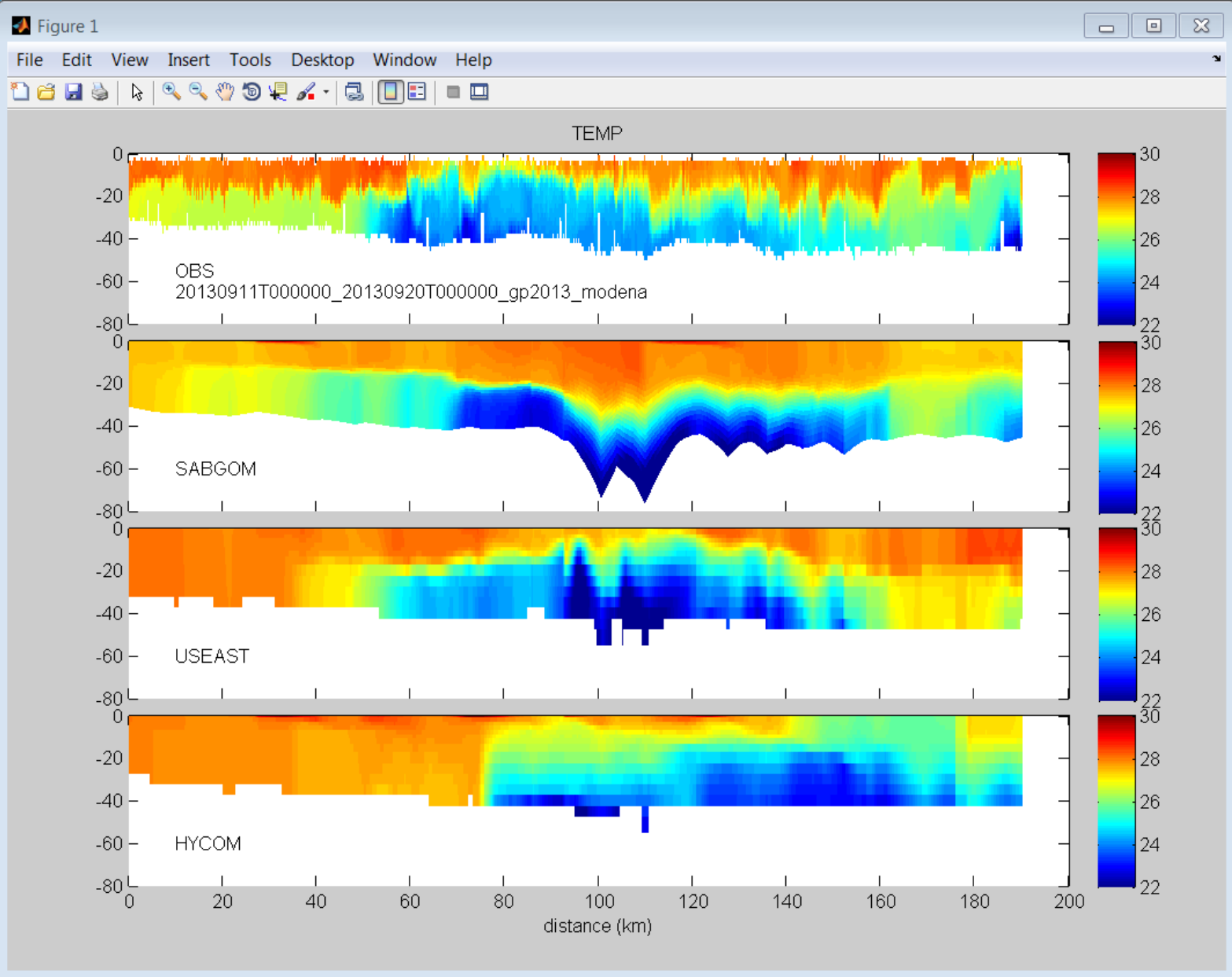


# Skidaway modena glider (Sep 11-23)

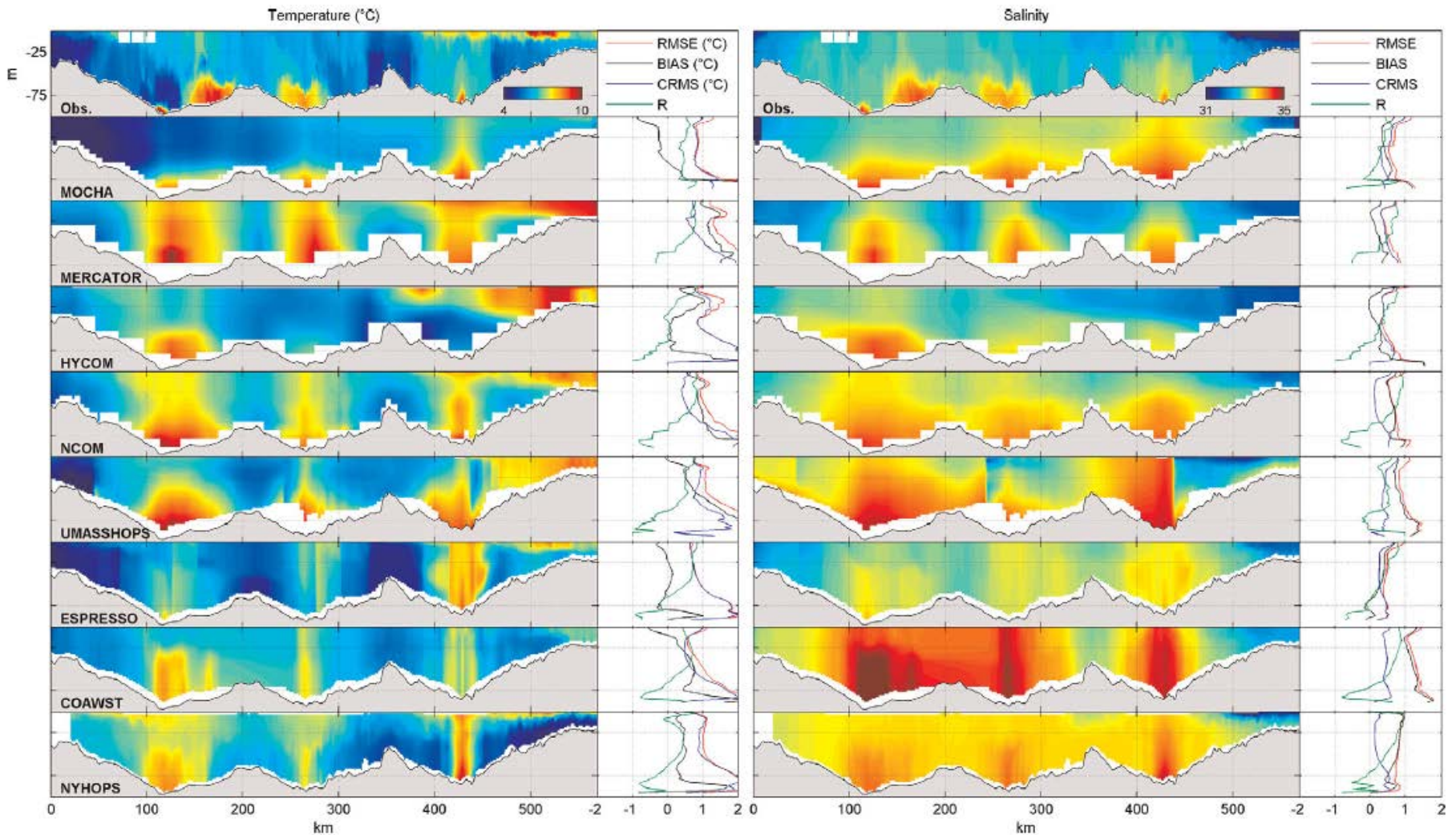




# compare\_secoora\_model\_sections.m (using nc\_genslice.m)



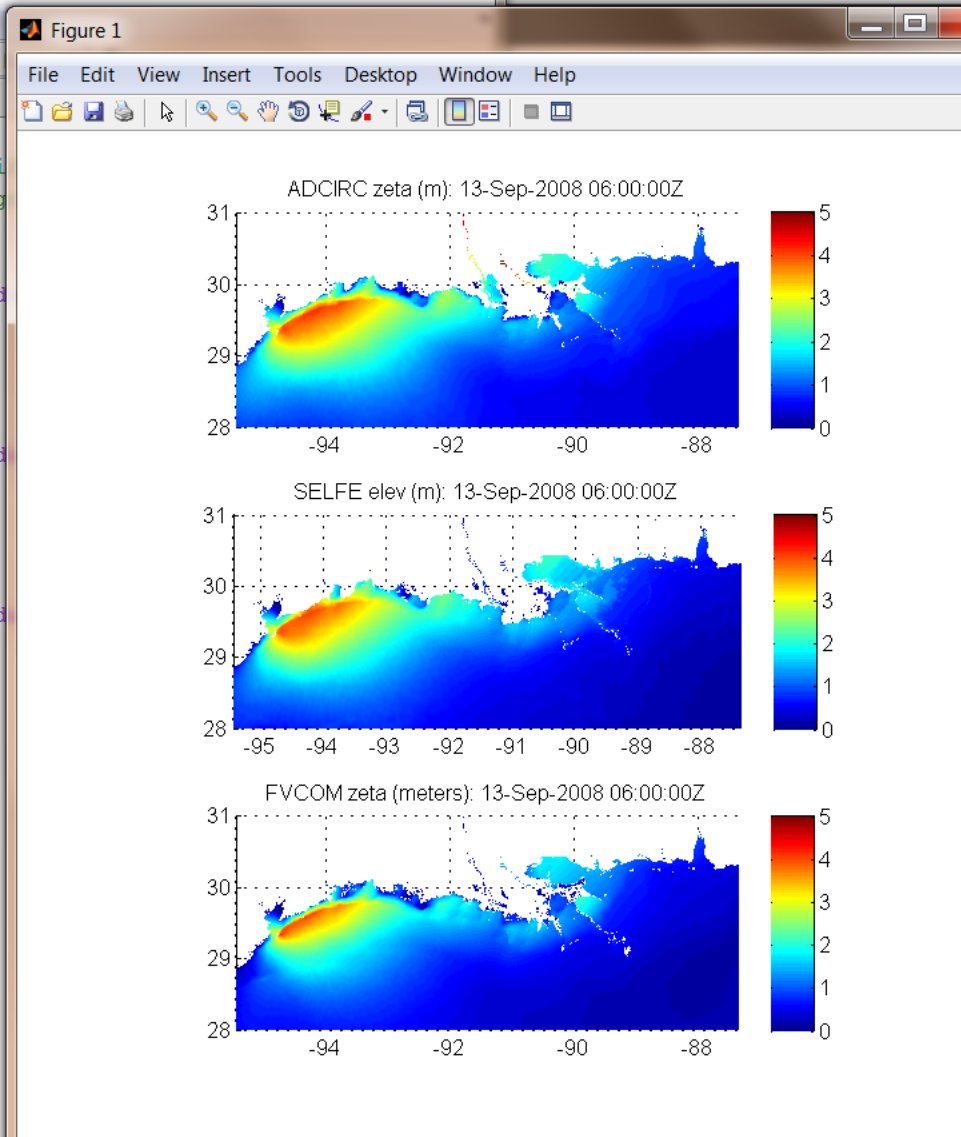
# WILKIN AND HUNTER: MID-ATLANTIC BIGHT MODELS SKILL ASSESSMENT



**Figure 2.** (left) Temperature and (right) salinity versus along-track distance and depth for the MAB AUGV deployment of 04/2010 (see Figure 1 for trajectory). Top row : reduced resolution observation set

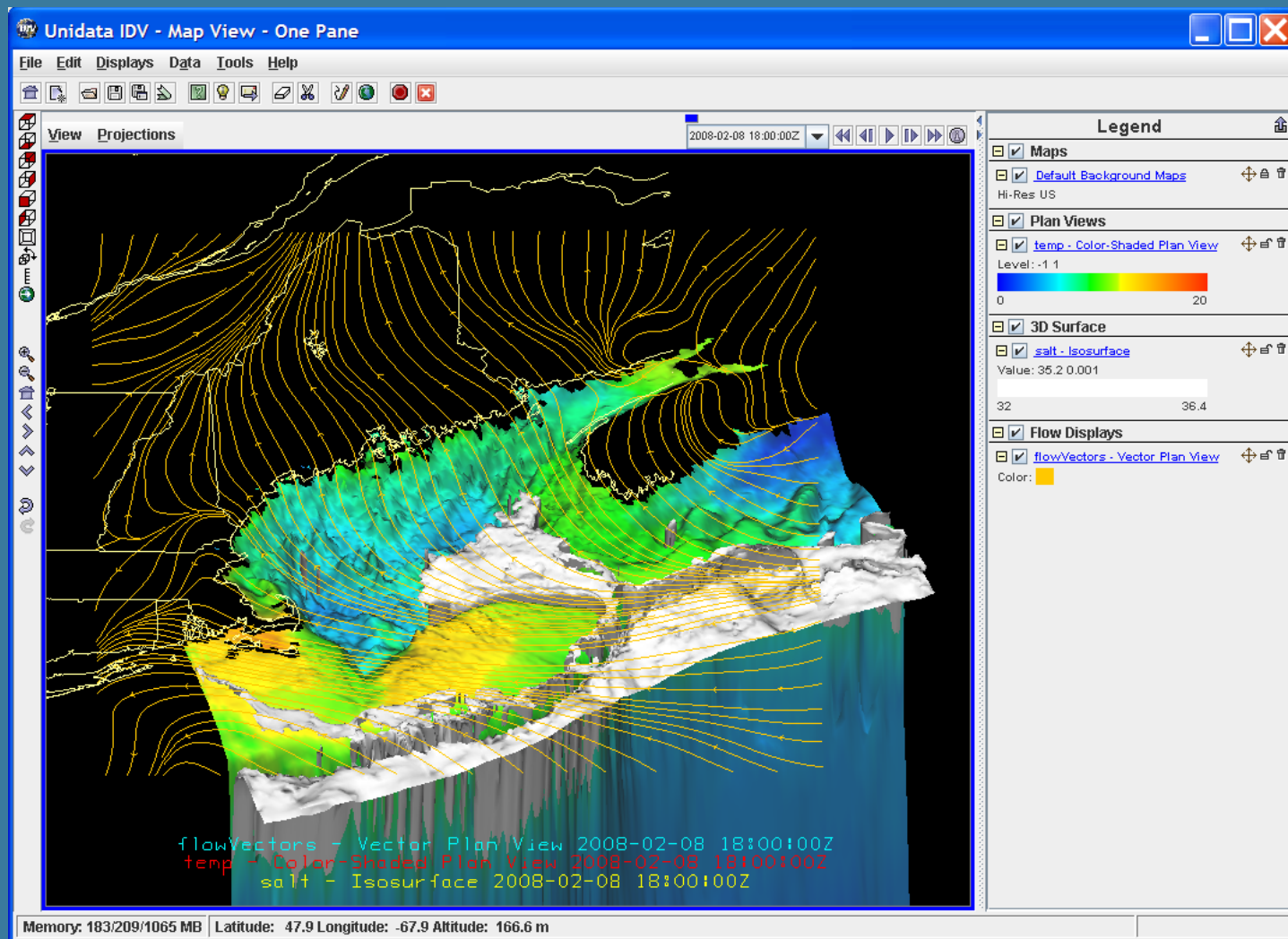
# test\_cf\_ugrid3.m

```
C:\cygwin\home\rsignell\distro\nctoolbox\demos\contrib\test_cf_ugrid3.m
File Edit Text Go Cell Tools Debug Desktop Window Help
+ Stack
- 1.0 + 1.1 x
1 % TEST_CF_UGRID3
2 % Compare water levels from 3 different unstructured grid
3 % models that use UGRID conventions (http://bit.ly/cf_ugr
4 % comparison with no model specific code
5 titl{1}='ADCIRC';
6 uris{1}='http://testbedapps.sura.org/thredds/dodsc/inund
7 vars{1}='zeta';
8 times{1}=[2008 9 13 06 0 0];
9
10 titl{2}='SELFE';
11 uris{2}='http://testbedapps.sura.org/thredds/dodsc/inund
12 vars{2}='elev';
13 times{2}=[2008 9 13 06 0 0];
14
15 titl{3}='FVCOM';
16 uris{3}='http://testbedapps.sura.org/thredds/dodsc/inund
17 vars{3}='zeta';
18 times{3}=[2008 9 13 06 0 0];
19 % bounding box for figures
20 ax=[-95.4519 -87.3856 28.0 31.0]
21 % color range for figures
22 cax=[0 5];
23
24 % There is nothing model specific in the loop below!
25 for i=1:length(uris)
26 tic
27 % Initialize dataset object
28 nc=ncgeodataset(uris{i});
29 %get geovariable object
30 zvar=nc.geovariable(vars{i});
31 % Find the coordinate variables
32 lon=zvar.getlndata(:);
```





# 3D visualization of data with IDV





# NetCDF Subset Service to CSV



[WHCMSC Sediment Transport Group](#)

[THREDDS Data Server](#)

Catalog [http://geoport.who.edu/thredds/catalog/coawst\\_4/use/fmrc/catalog.html](http://geoport.who.edu/thredds/catalog/coawst_4/use/fmrc/catalog.html)

Dataset: [coawst\\_4\\_use/Best Time Series](#)

- *Data format:* netCDF
- *Data type:* GRID
- *Naming Authority:* gov.usgs.er.whsc
- *ID:* coawst\_4/use/fmrc/coawst\_4\_use\_best.ncd

## Documentation:

- **summary:** Best time series, taking the data from the most recent run available.
- **summary:** ROMS USE Output from COAWST
- [Carolinas Coastal Change Program](#)
- [ReadMe.txt](#)

## Access:

1. **OPENDAP:** [/thredds/dodsC/coawst\\_4/use/fmrc/coawst\\_4\\_use\\_best.ncd](#)
2. **NetcdfSubset:** [/thredds/ncss/grid/coawst\\_4/use/fmrc/coawst\\_4\\_use\\_best.ncd](#)
3. **WMS:** [/thredds/wms/coawst\\_4/use/fmrc/coawst\\_4\\_use\\_best.ncd](#)
4. **ISO:** [/thredds/iso/coawst\\_4/use/fmrc/coawst\\_4\\_use\\_best.ncd](#)
5. **NCML:** [/thredds/ncml/coawst\\_4/use/fmrc/coawst\\_4\\_use\\_best.ncd](#)
6. **UDDC:** [/thredds/udc/coawst\\_4/use/fmrc/coawst\\_4\\_use\\_best.ncd](#)



# NCSS Grids As Point Data ( Gridded Dataset )



Dataset: /thredds/ncss/grid/coawst\_4/use/fmrc/coawst\_4\_use\_best.ncd ( Gridded Dataset Description )

Base Time: 2012-06-25T01:00:00Z

You must select at least one Variable and a Lat/Lon location.

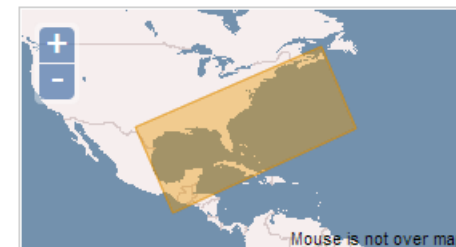
### Select Variable(s):

- angle = angle between XI-axis and EAST
- f = Coriolis parameter at RHO-points
- h = bathymetry at RHO-points
- mask\_psi = mask on psi-points
- mask\_rho = mask on RHO-points
- mask\_u = mask on U-points
- mask\_v = mask on V-points
- pm = curvilinear coordinate metric in XI
- pn = curvilinear coordinate metric in ETA

### Variables with Time coordinate time

- Dwave = wind-induced wave direction
- Hwave = wind-induced significant wave height
- Lwave = wind-induced mean wavelength
- Pwave\_bot = wind-induced bottom wave Period
- Pwave\_top = wind-induced peak surface wave Period
- Uwave\_rms = wind-induced bottom orbital velocity
- Uwind = surface u-wind component
- Vwind = surface v-wind component
- Zo\_app = apparent bottom roughness length
- Zo\_def = default bottom roughness length
- bed\_wave\_amp = bed wave excursion amplitude
- bedload\_Usand\_01 = bed load flux of sand in U-direction, size class 01
- bedload\_Usand\_02 = bed load flux of sand in U-direction, size class 02
- bedload\_Usand\_03 = bed load flux of sand in U-direction, size class 03
- bedload\_Usand\_04 = bed load flux of sand in U-direction, size class 04
- bedload\_Usand\_05 = bed load flux of sand in U-direction, size class 05
- bedload\_Usand\_06 = bed load flux of sand in U-direction, size class 06

### Choose Lat/Lon Location:



Latitude:

Longitude:

**Within Bounding Box:**

north

west   east

south

### Choose Time Subset:

**Time range Single time**

Starting:

Ending:

[reset to full extension](#)

### Choose Vertical Level:

Level:

### Choose Output Format:

Format:



# CSV Time Series from Subset Service

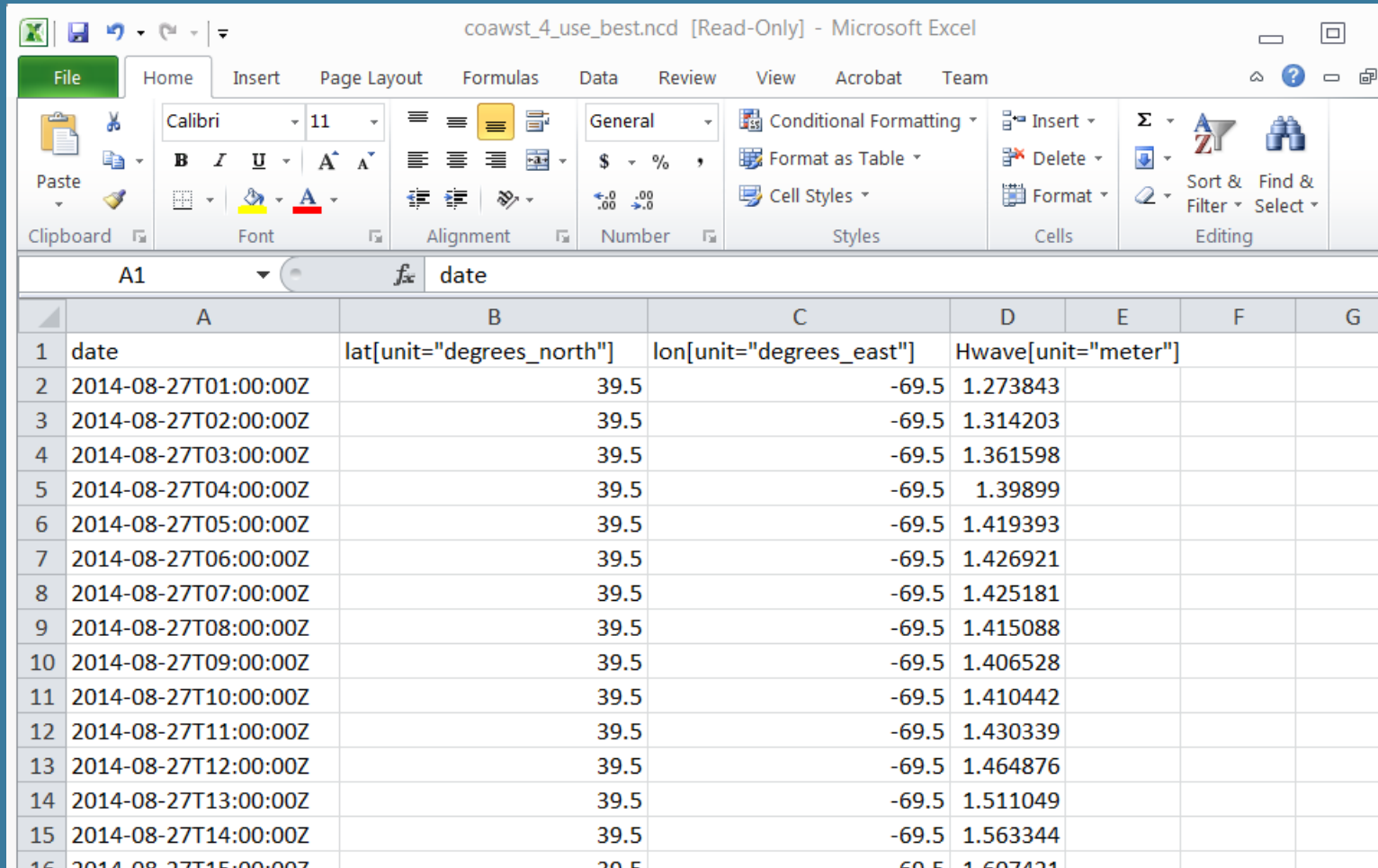
```
date,lat[unit="degrees_north"],lon[unit="degrees_east"],Hwave[unit="meter"]
2014-08-27T01:00:00Z,39.5,-69.5,1.273842692375183
2014-08-27T02:00:00Z,39.5,-69.5,1.3142027854919434
2014-08-27T03:00:00Z,39.5,-69.5,1.3615976572036743
2014-08-27T04:00:00Z,39.5,-69.5,1.398990273475647
2014-08-27T05:00:00Z,39.5,-69.5,1.419392704963684
2014-08-27T06:00:00Z,39.5,-69.5,1.426921010017395
2014-08-27T07:00:00Z,39.5,-69.5,1.4251813888549805
2014-08-27T08:00:00Z,39.5,-69.5,1.4150882959365845
2014-08-27T09:00:00Z,39.5,-69.5,1.406528115272522
2014-08-27T10:00:00Z,39.5,-69.5,1.4104422330856323
2014-08-27T11:00:00Z,39.5,-69.5,1.4303393363952637
2014-08-27T12:00:00Z,39.5,-69.5,1.4648756980895996
2014-08-27T13:00:00Z,39.5,-69.5,1.5110485553741455
2014-08-27T14:00:00Z,39.5,-69.5,1.5633442401885986
2014-08-27T15:00:00Z,39.5,-69.5,1.6074210405349731
2014-08-27T16:00:00Z,39.5,-69.5,1.6265686750411987
2014-08-27T17:00:00Z,39.5,-69.5,1.6184144020080566
2014-08-27T18:00:00Z,39.5,-69.5,1.5933209657669067
2014-08-27T19:00:00Z,39.5,-69.5,1.5608850717544556
2014-08-27T20:00:00Z,39.5,-69.5,1.527510643005371
2014-08-27T21:00:00Z,39.5,-69.5,1.5050616264343262
2014-08-27T22:00:00Z,39.5,-69.5,1.5094025135040283
2014-08-27T23:00:00Z,39.5,-69.5,1.5698728561401367
2014-08-28T00:00:00Z,39.5,-69.5,1.7087903022766113
```

CSV request is a “RESTful” URL:

[http://geoport.who.edu/thredds/ncss/grid/coawst\\_4/use/fmrc/coawst\\_4\\_use\\_best.ncd?var=Hwave&latitude=39.5&longitude=-69.5&time\\_start=2014-08-27T01:00:00Z&time\\_end=2014-08-28T00:00:00Z&vertCoord=&accept=csv](http://geoport.who.edu/thredds/ncss/grid/coawst_4/use/fmrc/coawst_4_use_best.ncd?var=Hwave&latitude=39.5&longitude=-69.5&time_start=2014-08-27T01:00:00Z&time_end=2014-08-28T00:00:00Z&vertCoord=&accept=csv)



# Accessing the CSV data in Excel



The screenshot shows the Microsoft Excel interface with the following data:

	A	B	C	D	E	F	G
1	date	lat[unit="degrees_north"]	lon[unit="degrees_east"]	Hwave[unit="meter"]			
2	2014-08-27T01:00:00Z	39.5	-69.5	1.273843			
3	2014-08-27T02:00:00Z	39.5	-69.5	1.314203			
4	2014-08-27T03:00:00Z	39.5	-69.5	1.361598			
5	2014-08-27T04:00:00Z	39.5	-69.5	1.39899			
6	2014-08-27T05:00:00Z	39.5	-69.5	1.419393			
7	2014-08-27T06:00:00Z	39.5	-69.5	1.426921			
8	2014-08-27T07:00:00Z	39.5	-69.5	1.425181			
9	2014-08-27T08:00:00Z	39.5	-69.5	1.415088			
10	2014-08-27T09:00:00Z	39.5	-69.5	1.406528			
11	2014-08-27T10:00:00Z	39.5	-69.5	1.410442			
12	2014-08-27T11:00:00Z	39.5	-69.5	1.430339			
13	2014-08-27T12:00:00Z	39.5	-69.5	1.464876			
14	2014-08-27T13:00:00Z	39.5	-69.5	1.511049			
15	2014-08-27T14:00:00Z	39.5	-69.5	1.563344			
16	2014-08-27T15:00:00Z	39.5	-69.5	1.607131			



# Access the CSV data in Python, R, etc

Wakari RESTful\_model\_assessment

View Other Bundles by rsignell Download Entire Bundle Download This Notebook [Run/Edit this Notebook](#)

```
var=%s&latitude=%s&longitude=%s&time_start=%s&time_end=%s&rtCoord=&accept=csv' % (var, lat, lon, start, stop)
print(url)

http://geoport.whoi.edu/thredds/ncss/grid/coawst_4/use/fmrc/coawst_4_use_best.ncd?var=Hwave&
de=42.801000&longitude=-70.169000&time_start=2014-08-23T16:01:13Z&time_end=2014-08-28T16:01:13Z&rtCoord=&accept=csv
```

In [11]: #load model data CSV into Pandas DataFrame

```
df_mod = pd.read_csv(url, index_col='date', parse_dates=True)
```

**Plot the time series**

In [12]:

```
fig, ax = plt.subplots(figsize=(12, 4))
ax = df_mod['Hwave[unit="meter"]'].plot(ax=ax, legend=True)
df_obs['wvht'].plot(ax=ax, legend=True)
ax.set_title('Wave Height at Station %s' % station);
```

Date	Hwave [unit="meter"]	wvht
2014-08-24	1.00	1.00
2014-08-25	0.75	0.80
2014-08-26	0.80	1.10
2014-08-27	1.35	1.30
2014-08-28	1.35	1.00



File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

```
In [12]: # DAP URL: 30 year East Coast wave hindcast (Wave Watch 3 driven by CFSR Winds)
cubes = iris.load('http://geoport.whoi.edu/thredds/dodsC/fmrc/NCEP/ww3/cfsr/4m/best');
```

```
In [13]: print cubes
```

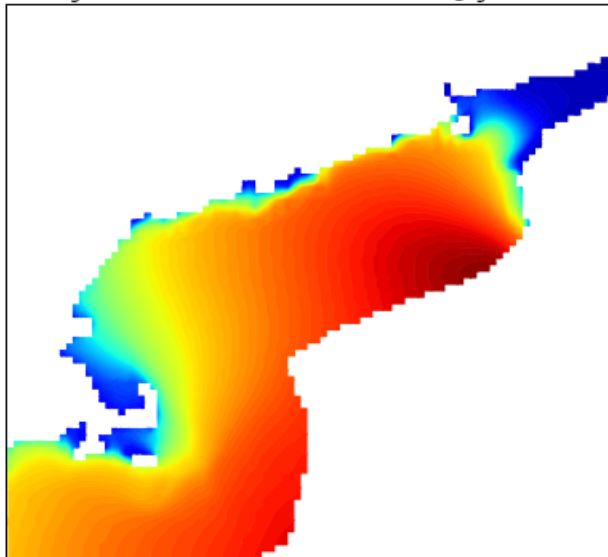
```
0: Significant height of combined wind waves and swell @ Ground or water surface / m (time: 90584; latitude: 481; longitude: 586)
1: u-component of wind @ Ground or water surface / m/s (time: 90096; latitude: 481; longitude: 586)
2: v-component of wind @ Ground or water surface / m/s (time: 90096; latitude: 481; longitude: 586)
3: Primary wave direction (degree true) @ Ground or water surface / unknown (time: 90584; latitude: 481; longitude: 586)
4: Primary wave mean period @ Ground or water surface / s (time: 90584; latitude: 481; longitude: 586)
```

```
In [14]: hsig=cubes[0]
```

```
In [15]: slice=hsig.extract(iris.Constraint(time=tval(hsig,'1989-05-07 21:00'),
longitude=lambda cell: -71.5 < cell < -65.0,
latitude=lambda cell: 39.5 < cell < 46.0))
```

```
In [16]: # make the plot
figure(figsize=(10,10))
qplt.contourf(slice,100);
```

Significant height of combined wind waves and swell @ ground or wat



scitools.org.uk/iris/

Inbox (... Bank of Americ... Enphase Energy... Gmail 28 Calendar » Other



Iris

Fork me on GitHub

Home Download Documentation Community Governance Code Scitools

## A Python library for Meteorology and Climatology

The Iris library implements a data model to create a data abstraction layer which isolates analysis and visualisation code from data format specifics. The data model we have chosen is the CF Data Model. The implementation of this model we have called an Iris Cube.

Iris currently supports read/write access to a range of data formats, including (CF-)netCDF, GRIB, and PP; fundamental data manipulation operations, such as arithmetic, interpolation, and statistics; and a range of integrated plotting options.

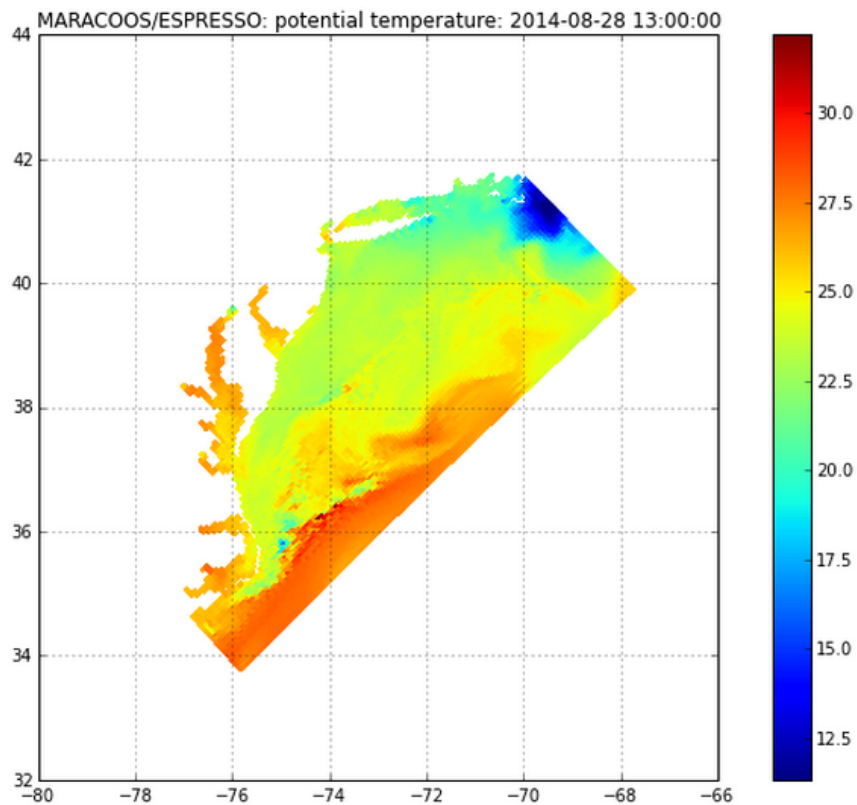
Iris is published under an [LGPLv3](#) licence.



# ESPreSSO model (Rutgers)

```
In [9]: model='MARACOOS/ESPRESSO'  
url='http://tds.marine.rutgers.edu/thredds/dodsC/roms/espresso/2013_da/his_Best/ESPRESSO_Real-Time_v2_History_Best_Available_best.ncd'  
var='sea_water_potential_temperature'  
lev=-1  
slice=var_lev_date(url=url,var=var, mytime=mytime, lev=lev)  
myplot(slice,model=model)
```

slice retrieved in 1.875781 seconds



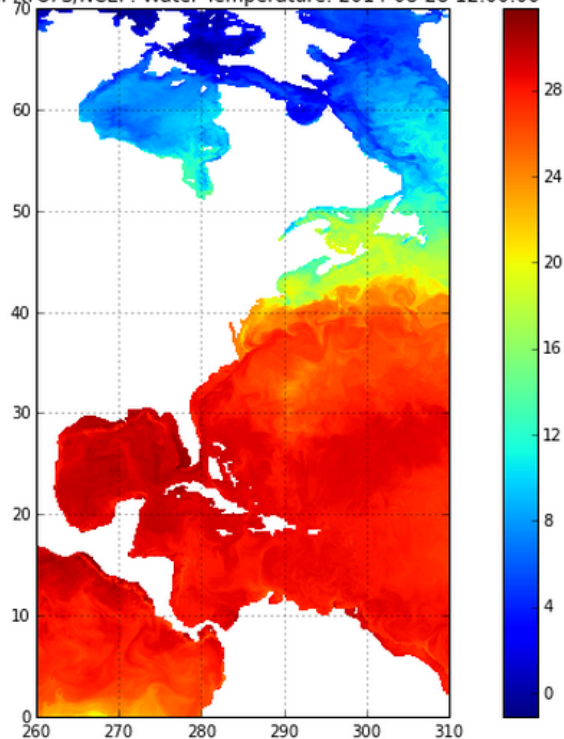
# Global RTOFS (NOAA)

```
In [13]: model='Global RTOFS/NCEP'  
url='http://ecowatch.ncddc.noaa.gov/thredds/dodsC/hycom/hycom_reg1_agg/HYCOM_Region_1_Aggregation_best.ncd'  
var='sea_water_temperature'  
lev=1  
subsample=1  
slice=var_lev_date(url=url,var=var, mytime=mytime, lev=lev, subsample=subsample)  
myplot(slice,model=model)
```

slice retrieved in 1.225454 seconds

```
/opt/anaconda/envs/np18py27-1.9/lib/python2.7/site-packages/iris/fileformats/_pyke_rules/compiled_krb/fc_rules_cf_fc.py:1196: UserWarning: Ignoring netC  
iable 'salinity' invalid units 'psu'  
warnings.warn(msg.format(msg_name, msg_units))
```

Global RTOFS/NCEP: Water Temperature: 2014-08-28 12:00:00





# IOOS Models Notebook on Wakari

← → ↻ 🏠 [https://www.wakari.io/sharing/bundle/rsignell/IOOS\\_Models](https://www.wakari.io/sharing/bundle/rsignell/IOOS_Models)

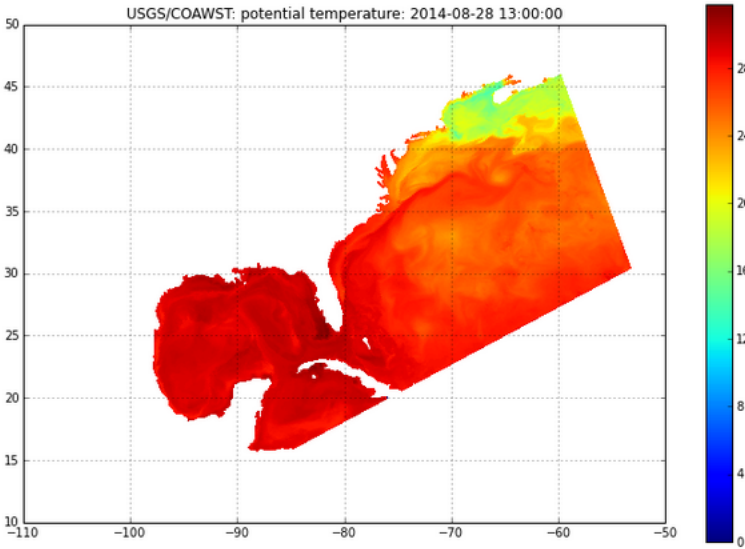
📱 Apps 📧 Gmail - Inbox (... 🏦 Bank of Americ... ⚡ Enphase Energy... 📅 27 Calendar 🌐 WHSC Intranet 🗣️ Rich Signell's W... 👍 Emoji cheat she... 👍 Emoji ch

Wakari IOOS\_Models

[View Other Bundles by rsignell](#) [Download Entire Bundle](#) [Download This Notebook](#) [Run/Edit this Notebook](#)

slice retrieved in 4.816941 seconds


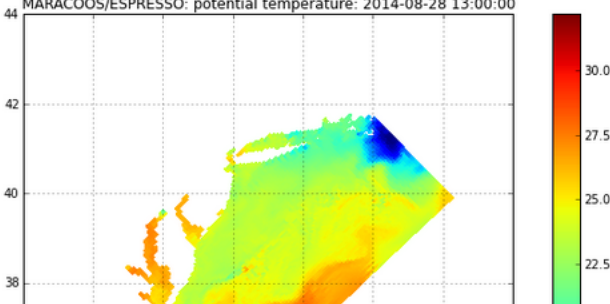
USGS/COAWST: potential temperature: 2014-08-28 13:00:00



```
In [9]: model='MARACOOS/ESPRESSO'  
url='http://tds.marine.rutgers.edu/thredds/dodsC/roms/esspresso/2013_da/his_Best/ESPRESSO_Real-Time_v2_History_Best_Available_best.ncd'  
var='sea_water_potential_temperature'  
lev=-1  
slice=var_lev_date(url=url,var=var, mytime=mytime, lev=lev)  
myplot(slice,model=model)
```

slice retrieved in 1.875781 seconds

MARACOOS/ESPRESSO: potential temperature: 2014-08-28 13:00:00



# 60 minutes to serving your data

1. Install Sun/Oracle Java (10 min)
2. Install/configure Tomcat (15 min)
3. Install/configure the Thredds Data Server (15 min)
4. Put NetCDF (or HDF4, Grib1, Grib2, HDF5 files) in a directory (5 min)
5. Add NcML (XML) files for CF compliance and aggregation (15 min)

# Adding data to THREDDS

```
rsgnell@gam:/usgs/data0/bbleh/tidal$ ls *wide*
```

```
...
```

```
his_bbleh_wide_0048.nc his_bbleh_wide_0100.nc his_bbleh_wide_0152.nc  
his_bbleh_wide_0049.nc his_bbleh_wide_0101.nc his_bbleh_wide_0153.nc  
his_bbleh_wide_0050.nc his_bbleh_wide_0102.nc his_bbleh_wide_0154.nc  
his_bbleh_wide_0051.nc his_bbleh_wide_0103.nc wide.ncml
```

```
$more wide.ncml
```

```
<netcdf xmlns="http://www.unidata.ucar.edu/namespaces/netcdf/ncml-2.2">  
  <aggregation dimName="ocean_time" type="joinExisting">  
    <scan location="." regExp=".*wide.*_[0-9]{4}\.nc$"/>  
  </aggregation>  
</netcdf>
```



[WHCMSC Sediment Transport Group](#)

[THREDDS Data Server](#)

**Catalog <http://geoport.whoi.edu/thredds/catalog/usgs/data0/bbleh/tidal/catalog.html>**

## **Dataset: tidal/wide.ncml**

- *Data size:* 218.0 bytes
- *ID:* usgs/data0/bbleh/tidal/wide.ncml

### **Access:**

1. **OPENDAP:** </thredds/dodsC/usgs/data0/bbleh/tidal/wide.ncml>
2. **HTTPServer:** </thredds/fileServer/usgs/data0/bbleh/tidal/wide.ncml>
3. **NetcdfSubset:** </thredds/ncss/grid/usgs/data0/bbleh/tidal/wide.ncml>
4. **ISO:** </thredds/iso/usgs/data0/bbleh/tidal/wide.ncml>
5. **NCML:** </thredds/ncml/usgs/data0/bbleh/tidal/wide.ncml>
6. **UDDC:** </thredds/uddc/usgs/data0/bbleh/tidal/wide.ncml>
7. **WMS:** </thredds/wms/usgs/data0/bbleh/tidal/wide.ncml>

### **Dates:**

- 2014-06-03T12:44:05Z (**modified**)

### **Viewers:**

- [Godiva2 \(browser-based\)](#)
- [NetCDF-Java ToolsUI \(webstart\)](#)



# Browsing WMS with Godiva2

Auto-zoom on select

WHCMSC Sediment Transport Group

- BBLEH ADCIRC tidal forcing
  - wet/dry mask on V-points
  - vertically integrated v-momentum component
  - bathymetry at RHO-points
  - Coriolis parameter at RHO-points
  - curvilinear coordinate metric in XI
  - curvilinear coordinate metric in ETA
  - angle between XI-axis and EAST
  - mask on RHO-points
  - wet/dry mask on RHO-points
  - free-surface
  - wet/dry mask on U-points
  - vertically integrated u-momentum component
  - mask on psi-points
  - mask on V-points
  - mask on U-points

Layer: WHCMSC Sediment Transport Group > BBLEH ADCIRC tidal forcing > free-surface  
Units: meter

Date/time: 17 Oct 2012 00:00:00 UTC [first frame](#) [last frame](#)

[Fit layer to window](#)

October, 2012  
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

1.000  
0.3333  
-0.3333  
-1.000

boxfill  
linear  
auto  
lock

User guide

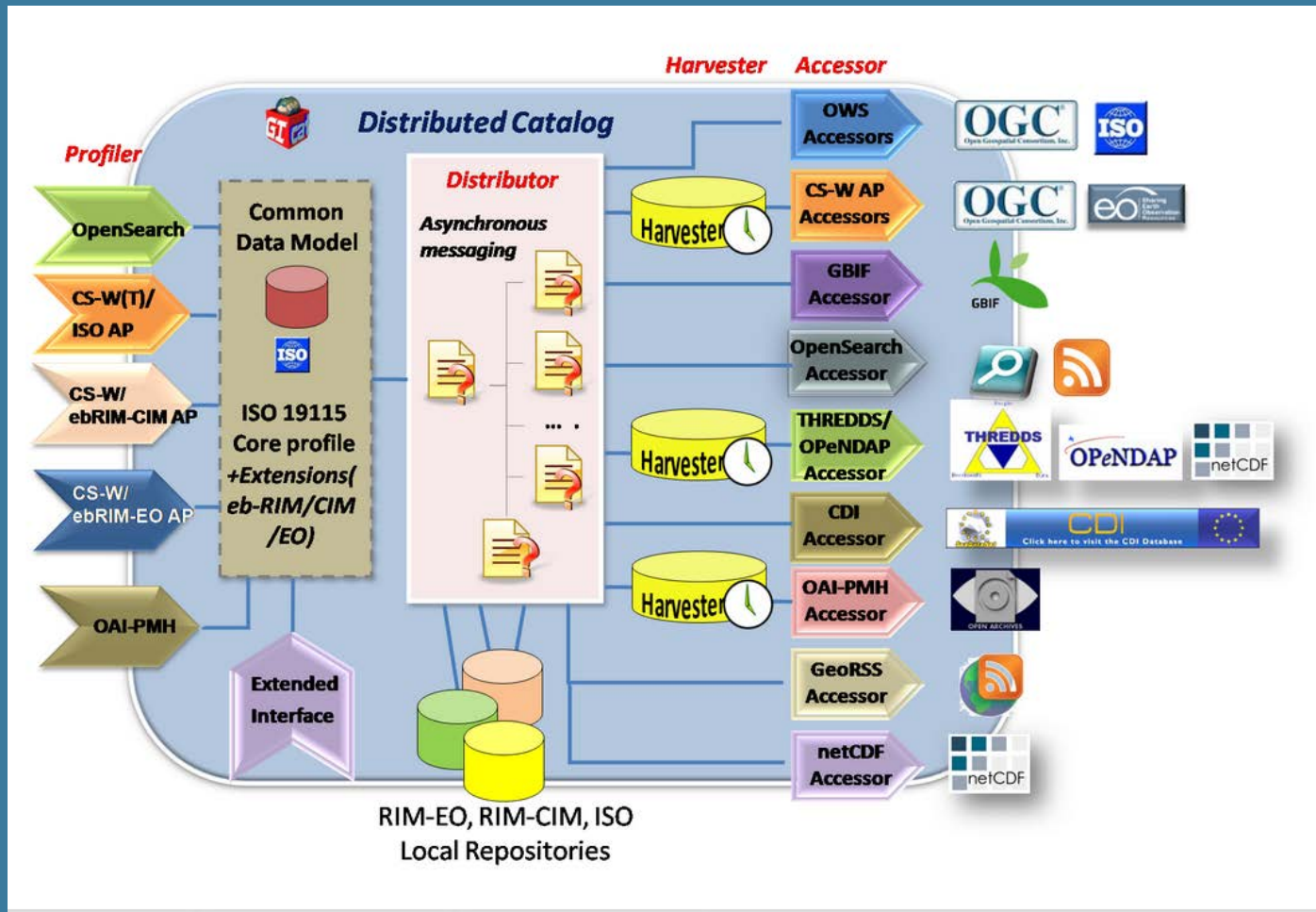
test image

Overlay opacity: 100%

Powered by [OpenLayers](#) and [OGC](#) standards [Permalink](#) | [email](#)

# Searching for Data

## GI-CAT catalog broker service architecture





Login Help About Feedback

SEARCH BROWSE

### Search

Search metadata content, including title, abstract, and keywords

(WRF OR ROMS OR COAWST) NOT NGDC Search

Records: NOAA National Geophysical Data Center Select site or configure search.

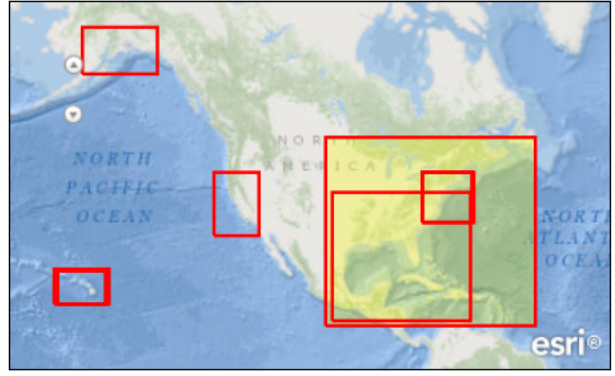
#### Advanced Search Options

Clear

#### WHERE

Anywhere Intersecting Fully within

Location input field with map icon



Results 1-10 of 34 record(s) 1 2 3 4 > Last

Expand results Zoom To Results Zoom To Searched Area

**COAWST Forecast System : USGS : US East Coast and Gulf of Mexico (Experimental)**

Experimental forecast model product from the USGS Coupled Ocean Atmosphere Wave Sediment-Transport (COAWST) modeling system. Data required to drive the modeling system include parametric wave parameters derived from Wave Watch III, wind and atmospheric su...

[Open](#) [Preview](#) [Details](#) [Metadata](#) [WMS](#) [Download](#)  
[OPeNDAP](#) [Zoom To](#)

**ROMS/TOMS 3.0 - South-Atlantic Bight and Gulf of Mexico**

**CeNCOOS/Models/ROMS/California ROMS/California Coastal Regional Ocean Modeling System (ROMS) Nowcast**

**ROMS ESPRESSO Real-Time Operational IS4DVAR Forecast System Version 1 (OLD) 2009-2013 History**

**ROMS ESPRESSO Real-Time Operational IS4DVAR Forecast System Version 2 (NEW) 2013-present FMRC Averages (Best)**

**ROMS ESPRESSO Real-Time Operational IS4DVAR Forecast System Version 2 (NEW) 2013-present FMRC History (Best)**

# IOOS System Test

IP[y]: Notebook

IOOS\_inundation2 Last Checkpoint: Apr 23 04:29 (autosaved)

Logout

File Edit View Insert Cell Kernel Help

Markdown Cell Toolbar: None

## IOOS System Test: Extreme Events Theme: Inundation

Compare modeled water levels with observations for a specified bounding box and time period using IOOS recommended service standards for catalog search (CSW) and data retrieval (OPeNDAP & SOS).

- Query CSW to find datasets that match criteria
- Extract OPeNDAP data endpoints from model datasets and SOS endpoints from observational datasets
- OPeNDAP model datasets will be granules
- SOS endpoints may be datasets (from ncSOS) or collections of datasets (from NDBC, CO-OPS SOS servers)
- Filter SOS services to obtain datasets
- Extract data from SOS datasets
- Extract data from model datasets at locations of observations
- Compare time series data on same vertical datum

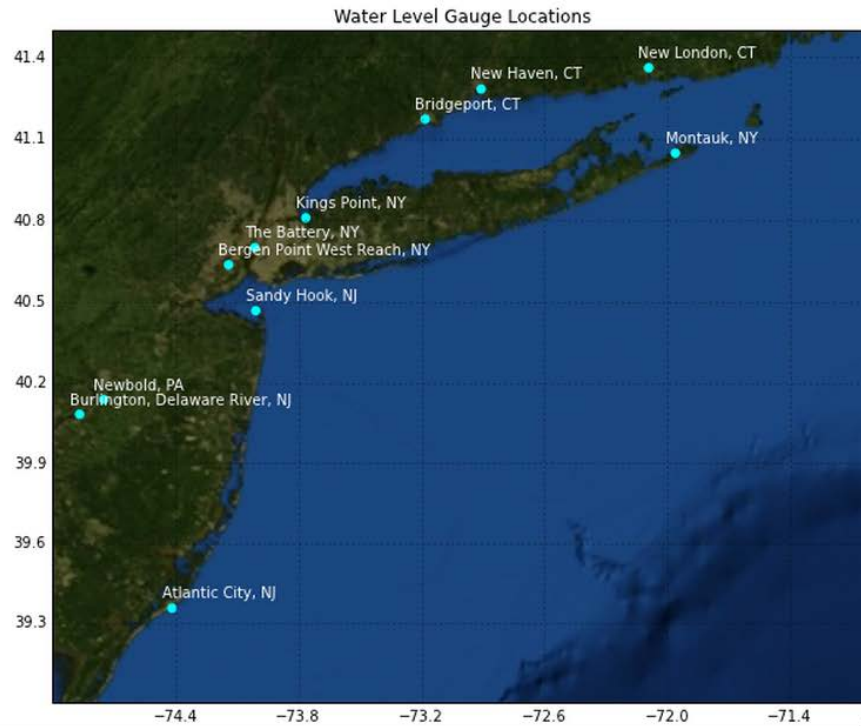
Specify a time range and bounding box of interest:

```
In [2]: # specific specific times (UTC) ...  
  
# hurricane sandy  
jd_start = dt.datetime(2012,10,26)  
jd_stop = dt.datetime(2012,11,2)  
  
# 2014 feb 10-15 storm  
jd_start = dt.datetime(2014,2,10)  
jd_stop = dt.datetime(2014,2,15)
```

**Project Lead: Derrick Snowden**  
**Notebooks: Kyle Wilcox, Andy Bird, Bob Fratantonio, Kelly Knee, Will Koeppen, Hannah Dean**  
**<https://github.com/ioos/system-test>**



```
gl=ax.gridlines(draw_labels=True)  
gl.xlabels_top = False  
gl.ylabel_right = False  
title('Water Level Gauge Locations');
```



# Automated model comparison

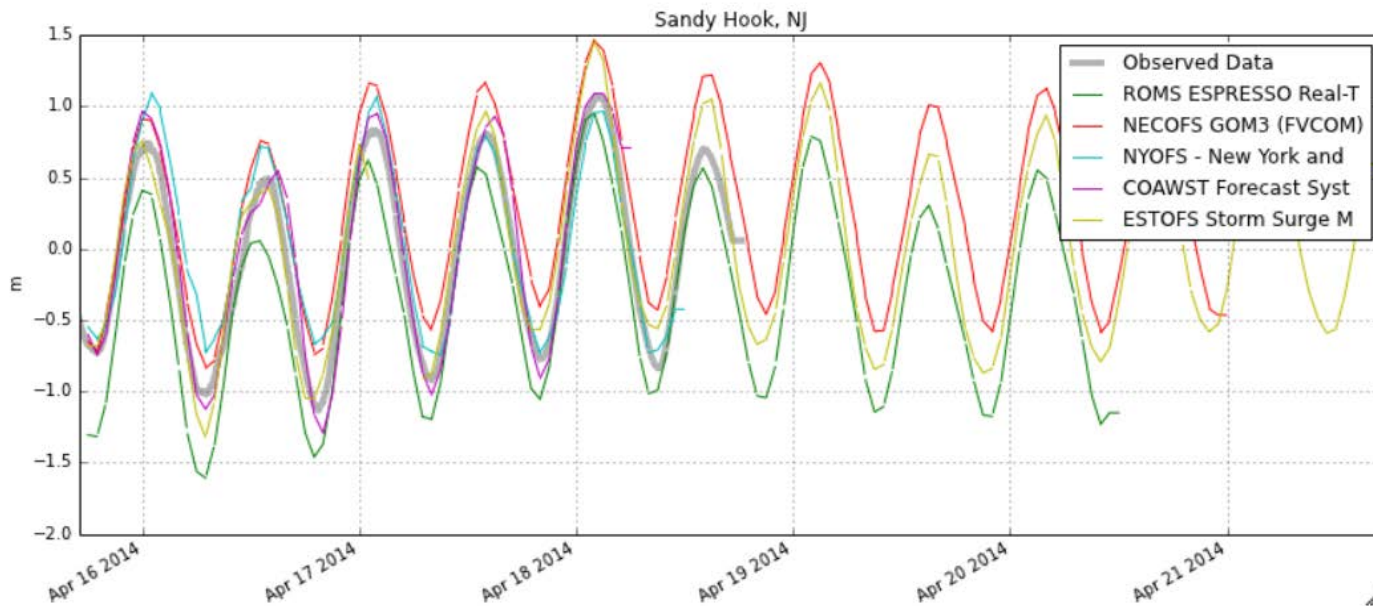
IP[y]: Notebook

IOOS\_inundation Last Checkpoint: Mar 15 16:08 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

```
In [45]: for df in obs_df:  
         df.plot(figsize=(14,6),title=df.name)|  
         ylabel('m')
```

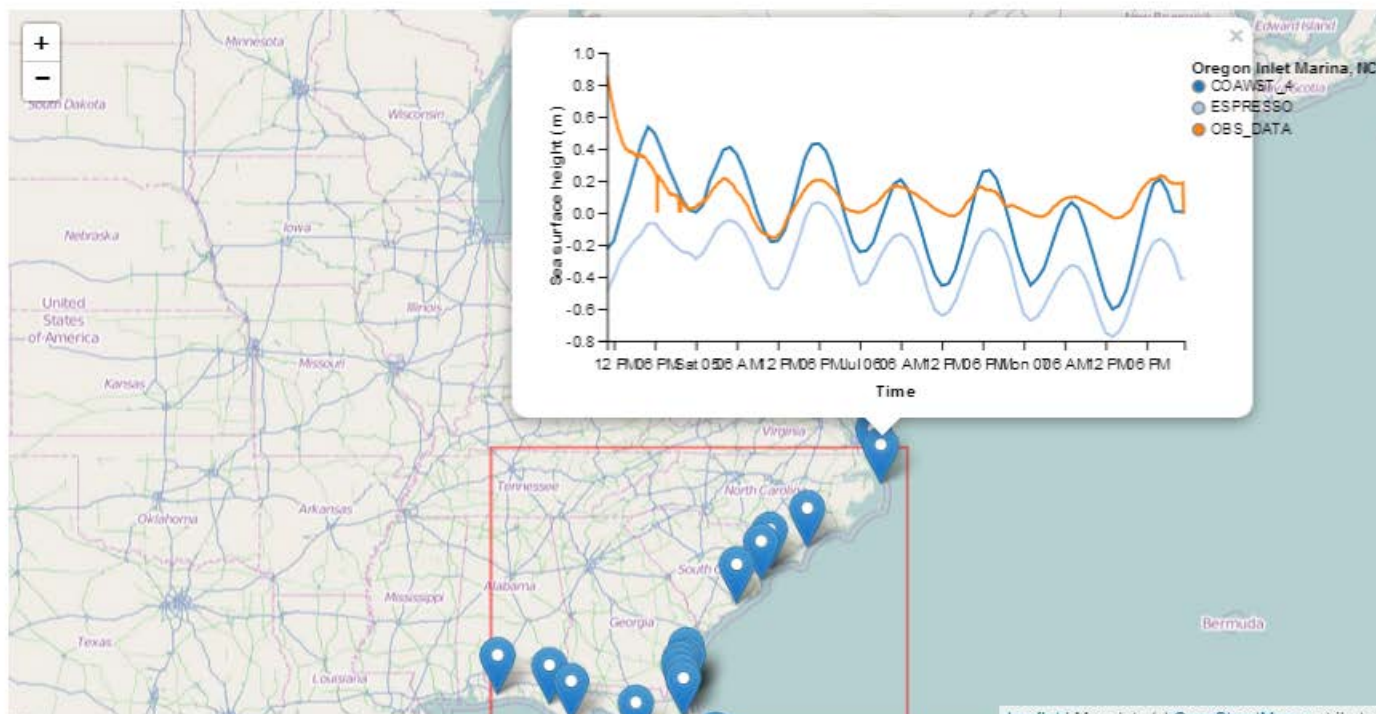


# SECOORA Model Assessment

```
for station in dfs:
    sta_name = get_coops_longname(station)
    df = dfs[station].dropna(axis=1, how='all')
    df.fillna(value=0, inplace=True) # FIXME: This is bad! But I cannot represent NaN with Vega!
    vis = vincent.Line(df, width=400, height=200)
    vis.axis_titles(x='Time', y='Sea surface height (m)')
    vis.legend(title=sta_name)
    json = 'station_%s.json' % station
    vis.to_json(json)
    obs = observations[observations['station'] == station]
    m.simple_marker(location=[obs['lat'].values[0], obs['lon'].values[0]], popup=(vis, json))
    m.create_map(path='inundation.html')
```

inline\_map(m)

Out[17]:



```
with open(fname, 'w') as f:
    f.writelines(table)

to_html(bias.T)
```

**Project Lead: Vembu Subramanian**  
**Notebook: Filipe Fernandes**  
**URL: <https://github.com/ioos/secoora>**

Out [21]:

	COAWST_4	ESPRESSO	ESTOFS	HYCOM	SABGOM
Duck, NC	--	--	0.05	--	0.43
Oregon Inlet Marina, NC	-0.07	0.21	0.00	0.45	--
Wrightsville Beach, NC	-0.03	--	0.07	0.32	0.45
Springmaid Pier, SC	-0.04	--	0.08	--	0.45
Oyster Landing (N Inlet Estuary), SC	--	--	0.18	--	--
Fort Pulaski, GA	--	--	0.13	--	--
Fernandina Beach, FL	--	--	0.04	--	--
Mayport (Bar Pilots Dock), FL	--	--	0.01	--	--
Trident Pier, FL	--	--	-0.13	--	--
Lake Worth Pier, FL	-0.30	--	-0.11	0.07	--
Virginia Key, FL	--	--	-0.06	--	0.25
Vaca Key, FL	--	--	-0.06	--	--
Key West, FL	-0.28	--	-0.08	--	0.14
Naples, FL	--	--	-0.03	--	--
Port Manatee, FL	--	--	0.02	--	--
Clearwater Beach, FL	--	--	0.07	--	--
Cedar Key, FL	-0.10	--	0.09	--	0.18
Apalachicola, FL	-0.04	--	0.15	--	--
Panama City, FL	-0.02	--	--	--	--
Pensacola, FL	0.04	--	--	--	--

[Back to top](#)



# Python & Matlab notebook

```
In [5]: %%matlab -i url -o s -o g
addpath(genpath('/home/filipe/IOOS/nctoolbox'));
nc = ncgeodataset(url);

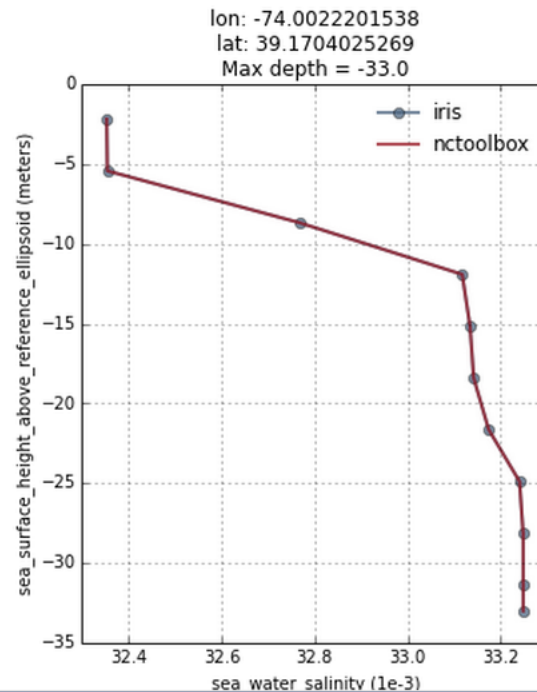
s = nc{'salt'}(1, :, 11, 21);
g = nc{'salt'}(1, :, 11, 21).grid;
```

log4j:WARN No appenders could be found for logger (ucar.nc2.NetcdfFile).  
log4j:WARN Please initialize the log4j system properly.

```
In [6]: kw = dict(linewidth=2, color=(0.6, 0.1, 0.15),
                alpha=0.75, label='nctoolbox')
leg = dict(numpoints=1, loc='best', framealpha=0)

c = cube[0, :, 10, 20]
fig, ax = plot_profile(c)

ax.plot(s, g['z'], **kw)
l = ax.legend(**leg)
```





# Unidata Challenges

- **Community THREDDS Data Servers robustness**
- **Support as popularity increases**
- **UGRID incorporated into Unidata NetCDF-Java**
- **Aggregation of large collections of NetCDF files**
- **Met/Ocean tools developed for Python on top of CF/Ugrid conventions (Iris, libCF)**
- **IDV-like client built on top of Python tools**
- **Participation in standards (e.g. OGC)**
- **Managing community development**

# Community Development

GitHub, Inc. [US] <https://github.com/Unidata/thredds/issues/75>

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This repository Search Explore Gist Blog Help rsignell-usgs + -

Unidata / thredds Watch 22 Star 70 Fork 69

## Update NcISO to specify gmd:protocol for service endpoints #75

Open rsignell-usgs opened this issue 10 days ago · 3 comments

rsignell-usgs commented 10 days ago

As discussed in the pycsw issue here: [geopython/pycsw#269](#), catalog services that rely on OWSlib like pycsw expect to have `gmd:protocol` specified in order to populate the scheme in the references that get returned from a CSW request. Without this, SOS, WMS, OpeNDAP endpoints, etc always come back with scheme of None.

Should just need to modify the `UnidataDD2MI.xsl` file:  
<https://github.com/Unidata/thredds/blob/f902e5a3573583a9b87f1d3c7d2f27a121289fe/tds/src/main/webapp/WEB-INF/classes/resources/xsl/nciso/UnidataDD2MI.xsl>

@pacioos, I know you've addressed this -- can you please submit a PR to fix this?  
I raised the same issue at [ethanrd/threddsIso#2](#) because I wasn't sure what the development path is on ncISO, and maybe we need to fix in both places?

rsignell-usgs commented 10 days ago

@tomkralidis, for populating `gmd:protocol` we should use the `identifier` listed in <https://github.com/OSGeo/Cat-Interop/blob/master/LinkPropertyLookupTable2.csv>, correct?

tomkralidis commented 10 days ago

👍

pacioos commented 9 days ago

OK, I've submitted the PR here: <https://github.com/Unidata/threddsIso/pull/1>  
Cheers,  
John

Labels: None yet

Milestone: No milestone

Assignee: No one assigned

Notifications: Unsubscribe

You're receiving notifications because you authored the thread.

3 participants



# Community Development

The screenshot shows a GitHub pull request page for the repository 'Unidata/threddsIso'. The pull request title is 'Add gmd:protocol, location keywords, & viewer URLs #1'. It was merged by user 'geoneubie' 8 days ago. The page shows a list of comments and a commit history. The commit message is 'Add gmd:protocol, location keywords, & viewer URLs'. The commit hash is '3514ced'. The pull request has 17 watches, 0 stars, and 3 forks. The repository is forked from 'ethand/threddsIso'. The page also shows a sidebar with navigation options like 'Watch', 'Star', and 'Fork'. The main content area shows a comment from 'pacioos' dated 10 days ago, which describes the changes made in the pull request. The comment lists three items: 1) Adding gmd:protocol elements to service end points, 2) Adding GCMD Location Keywords from THREDDS catalog metadata, and 3) Adding 'viewer' entries from the THREDDS catalog metadata. The comment is signed by John Maurer (jmaurer@hawaii.edu). Below the comment is a commit entry for '3514ced' with the message 'Add gmd:protocol, location keywords, & viewer URLs'. Below the commit is a comment from 'tomkralidis' dated 9 days ago, which says '@pacioos huge thumbs up!'. Below the comment is a status entry for 'geoneubie' dated 8 days ago, which says 'closed this'. At the bottom of the page is a merge entry for 'geoneubie' dated 8 days ago, which says 'merged commit 52f1bf8 into Unidata:master from pacioos:patch-1'. The page also shows a sidebar with navigation options like 'Labels', 'Milestone', 'Assignee', 'Notifications', and '4 participants'.

GitHub, Inc. [US] <https://github.com/Unidata/threddsIso/pull/1>

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This repository Search Explore Gist Blog Help rsignell-usgs + -

Unidata / threddsIso  
forked from ethand/threddsIso

Watch 17 Star 0 Fork 3

## Add gmd:protocol, location keywords, & viewer URLs #1

Merged geoneubie merged 1 commit into Unidata:master from pacioos:patch-1 8 days ago

Conversation 2 Commits 1 Files changed 1 +110 -0

**pacioos** commented 10 days ago

This update does three things:

- 1) Adds gmd:protocol elements to all service end points (sv:SV\_ServiceIdentification) identifying them as either OPeNDAP:OPeNDAP, UNIDATA:NCSS, OGC:WMS, OGC:WCS, or OGC:SOS--the appropriate valids from this list: <https://github.com/OSGeo/Cat-Interop/blob/master/LinkPropertyLookupTable2.csv>.
- 2) Add GCMD Location Keywords from THREDDS catalog metadata: all "geospatialCoverage > name" entries.
- 3) Adds each "viewer" entry from the THREDDS catalog metadata as an additional gmd:distributorTransferOptions.

John Maurer [jmaurer@hawaii.edu](mailto:jmaurer@hawaii.edu)

**3514ced** Add gmd:protocol, location keywords, & viewer URLs

**tomkralidis** commented 9 days ago

@pacioos huge thumbs up!

**geoneubie** closed this 8 days ago

**geoneubie** merged commit 52f1bf8 into Unidata:master from pacioos:patch-1 8 days ago

Labels  
None yet

Milestone  
No milestone

Assignee  
No one assigned

Notifications  
Unsubscribe  
You're receiving notifications because you commented.

4 participants



# Why do I promote Unidata technologies?

- **Powerful**
- **Flexible**
- **Easy to install**
- **Free**
- **Supported**
- **Driven by community of users**

















ange  
baby  
PHOTOFANIA  
Bevölkerung

SHINE ON!





# Summary (1 of 2)

- Common data models for “feature types” (structured and unstructured grids, time series, profiles, swaths) (Unidata CDM)
- **Standard web services for delivering these data and metadata (OGC, Unidata)**
- Tools to access and process these services in common analysis environments: R, Matlab, Python, ArcGIS, JavaScript



# Summary (2 of 2)


- **It's easy (1 hour) to deploy free, supported systems that allow for standards-based delivery of aggregated data from native model grids that put little effort on the data provider**
- **What do you get?**
  - Lots of choices for data access (Browser, Matlab, Python, Excel, IDV, R, IDL)
  - More usage of model results by more people
  - Faster feedback to modelers, leading to improved models
  - Shared code base in the community
  - Increased community support for standards-based access
  - Less time wasted messing with data, more time spent on ecosystem based management
- **What should you do? Encourage providers to use these standards, and develop tools that use standardized access**

# More at: [Github.com/rsignell-usgs](https://github.com/rsignell-usgs)

← → ↻ 🏠 [GitHub, Inc. \[US\]](#) <https://github.com/rsignell-usgs> 🔍 ☆ M NB ☰

📧 Apps 📧 Gmail - Inbox (... 📧 Bank of Americ... 📧 Enphase Energy... 📅 27 Calendar 📧 WHSC Intranet 📧 Rich Signell's W... » 📁 Other bookmarks

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**Rich Signell**  
rsignell-usgs

📍 USGS  
📍 Woods Hole, MA  
✉️ [rsignell@usgs.gov](mailto:rsignell@usgs.gov)  
🕒 Joined on Jun 20, 2012

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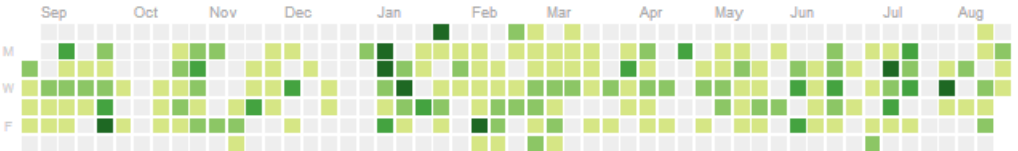
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📁 <a href="#">dap2arc</a> Python tools for bridging the gap betwe...	3 ★
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📁 <a href="#">ioos/conda-recipes</a> conda-recipes for IOOS packages	3 ★
📁 <a href="#">ioos/comt</a> IOOS Coastal and Ocean Modeling Testbed	1 ★

### Contributions



Summary of Pull Requests, issues opened, and commits. [Learn more.](#)   Less [light green] [medium green] [dark green] More

Year of contributions <b>725 total</b> Aug 27 2013 - Aug 27 2014	Longest streak <b>10 days</b> March 10 - March 19	Current streak <b>3 days</b> August 25 - August 27
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