HYCOM Data Service

New Datasets, Functionality and Future Development

Ashwanth Srinivasan, (FSU)
Steve Hankin (NOAA/PMEL)

Major contributors:
Jon Callahan (Mazama Consulting)
Roland Schweitzer (Weathertop Consulting),
Ansley Manke (NOAA/PMEL)
Jeremy Malczyk (UW/JISAO)
Peter Cornillon (URI)

HYCOM NATIONAL MEETING – APRIL 2007

Three data mgmt themes

1. help you with day-to-day operations
2. promote collaboration across the Consortium
3. help Consortium to reach broader classes of users

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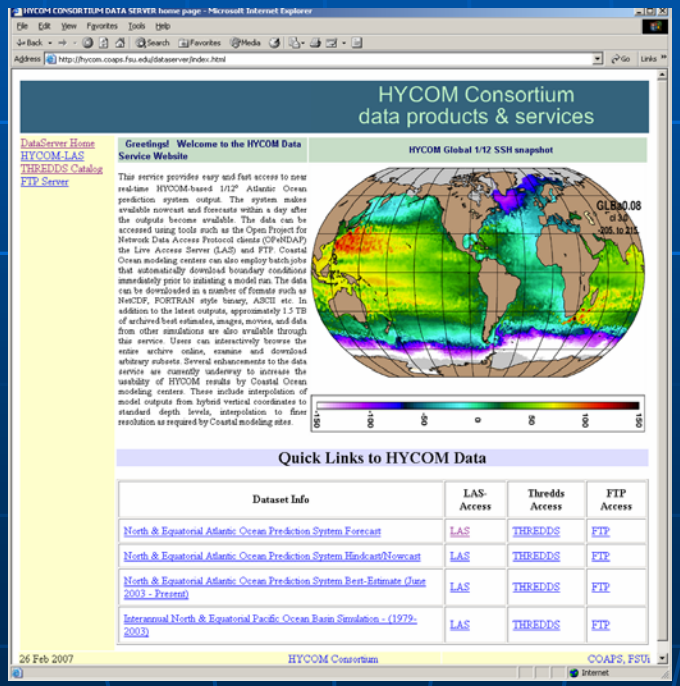


Home Page
(soon to be replaced)

HYCOM Data Service: History and Current Status

- Launched in 2002 in Miami.
  Served HYCOM Outputs via FTP, LAS & OPeNDAP
- Started Serving Near Real Time Atlantic data in 2003
- Hosted ~3 TB of data until Dec, 2006
- Jan, 2007 – moved to FSU.
  Expanded to a 100 TB SAN.
- Ready to serve global near real time outputs.

Recent Additions and Available Datasets

Now: 1/12 Global Free Run output 2003-2005

Now: 1/12 Global Assimilative Run 2003/10-2004/05

Soon: Near real-time 1/12° global prediction system output

Soon: Several 1/12° Gulf of Mexico Simulations for inter-comparing data assimilation schemes (HYDAE)

Near real-time 1/12° Atlantic Ocean prediction system output (June 2003 – Present)

Monthly mean 1/12° Pacific Ocean Simulation output (1979-2003)

HYCOM outputs for MERSEA/GODAE (sub-sampled outputs interpolated to depth levels)

TOP 5 Data Management Priorities

1. The HYCOM data services should include a reliable capability to deliver custom netCDF subsets (user specifies region and variables) – done

2. Procedures to better inform the HYCOM Consortium members of new data management capabilities, new datasets, etc.
   – Data shopper catalog. Mailing list. Updated website soon.

3. The HYCOM data services should provide OPeNDAP, LAS, and FTP access to all data. Outputs should be available on native grids as well as engines for format transfer and regriddin
   – done (native grid and regridded to standard depth levels)

4. In order to make "nesting" from HYCOM to HYCOM models simpler provide "packaged access" (ability to request a tar file) of all files needed to set up the nested run
   - tested. Will be implemented shortly

5. Provide access to detailed model run metadata – model domain; source code configuration; forcing fields, BCs, ICs; PI name - blkdat.input, regional.grid,regional.depth and info available

Moving the Data Service: Timeline

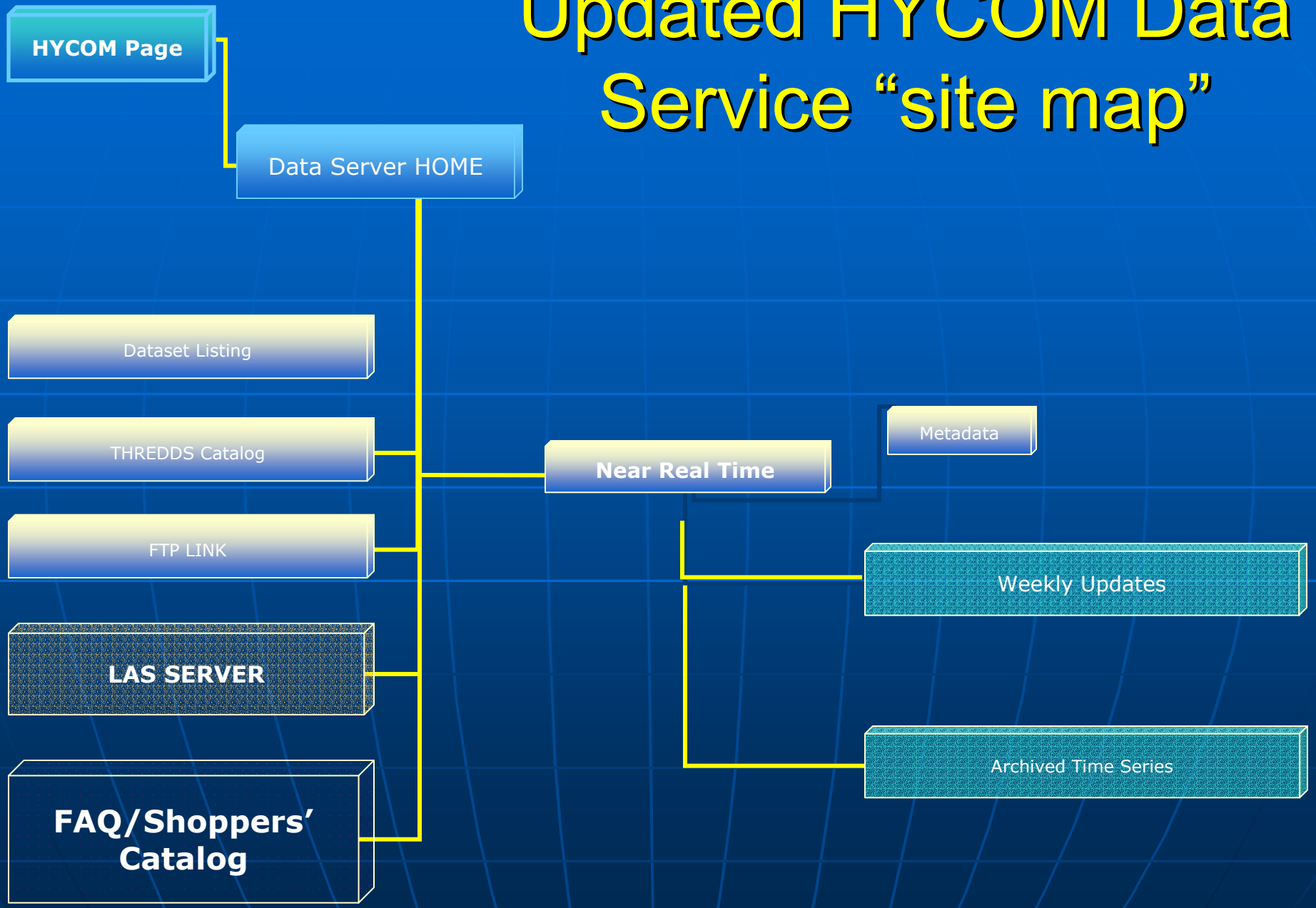
- Dec-2006
  - Installed and tested the new hardware/OS etc. at FSU
- Jan-April, 2007
  - Downloaded 13 TB of data from NAVO and Miami -- Global, Atlantic and Pacific (*Thanks to Skinman and Joe Metzger for suggesting ways to speed up the transfer from NAVO!*)
  - Software installation
  - Rewrite of the programs that update the server weekly due to changes in the THREDDS server configuration
- April-20-22, 2007
  - FSU service completely operational. Global data added. Website updated.

Hardware

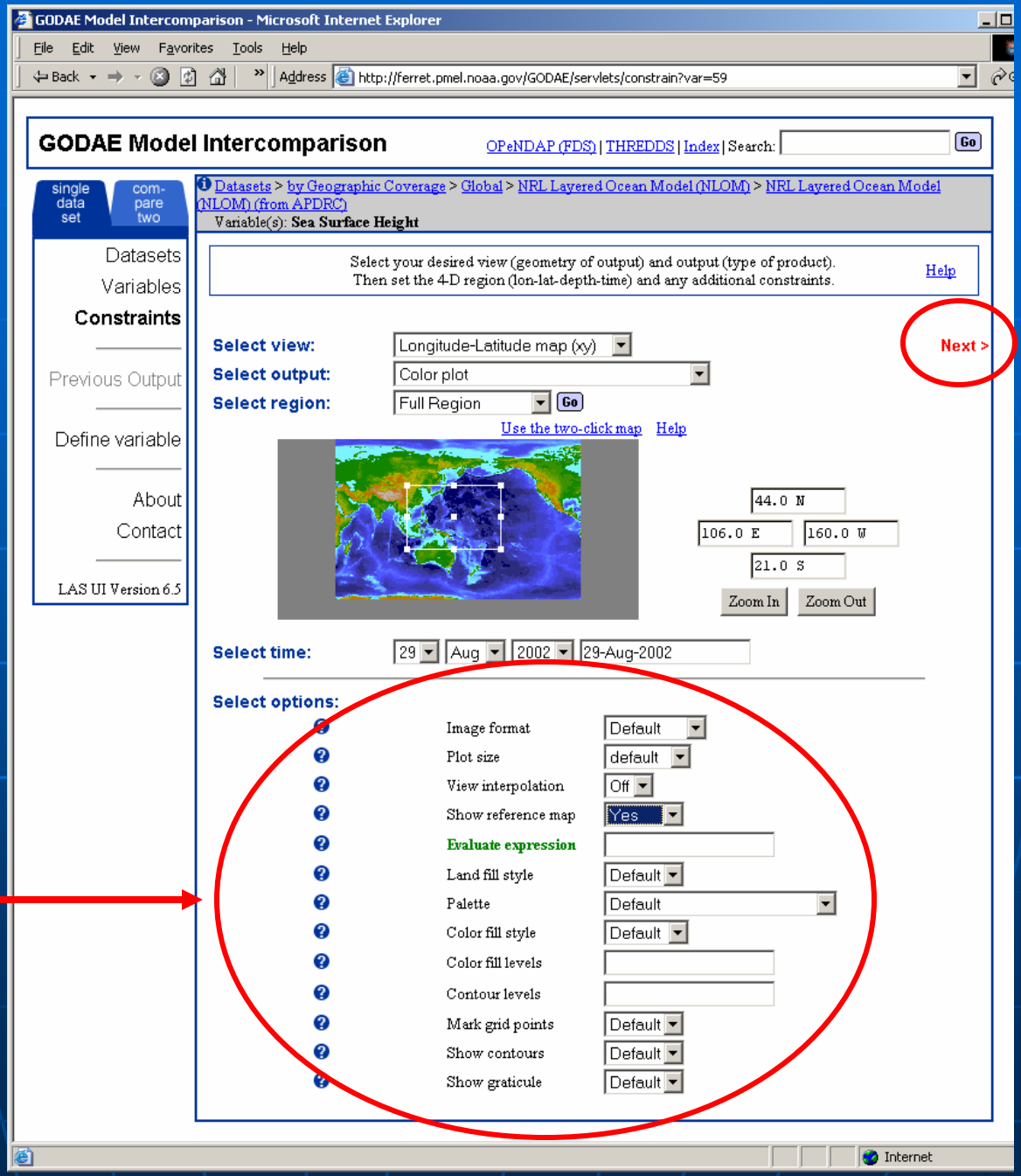
- 100 TB Fibre Channel SAN
- Three 8 CPU machines
- 32 GB RAM/machine
- Network throughput: 50 GB/hr

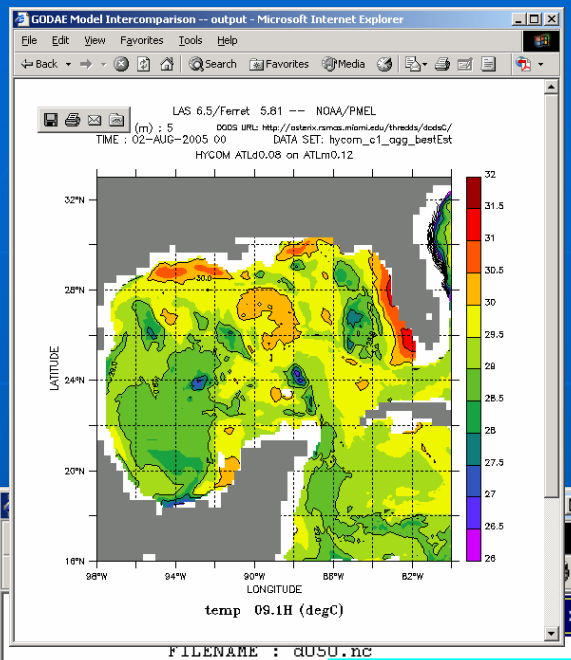
  - ***Software***
  - Red Hat Linux
  - Red Hat cluster suite and Global File System
  - Apache Web Server
  - THREDDS
  - LAS Server
  - Vsftpd server

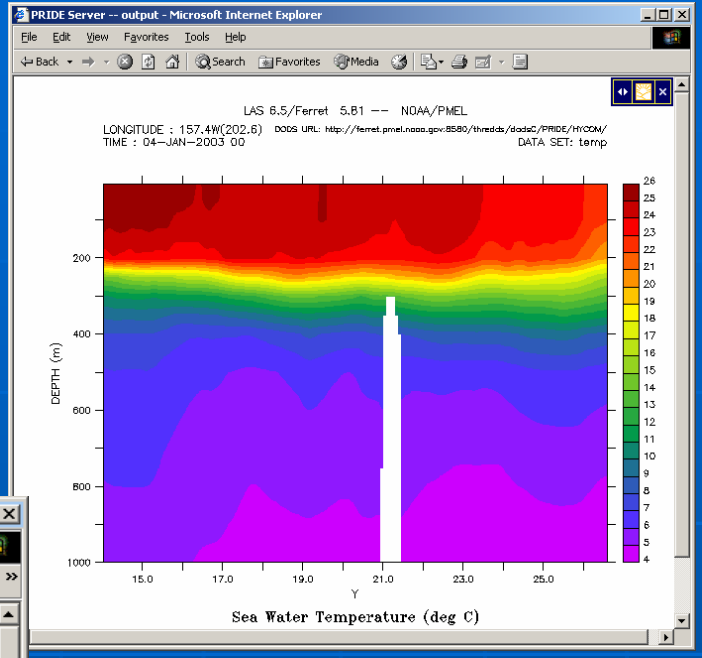
Updated HYCOM Data Service "site map"

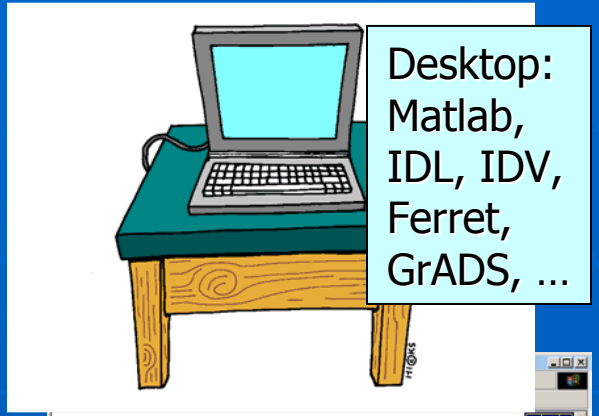


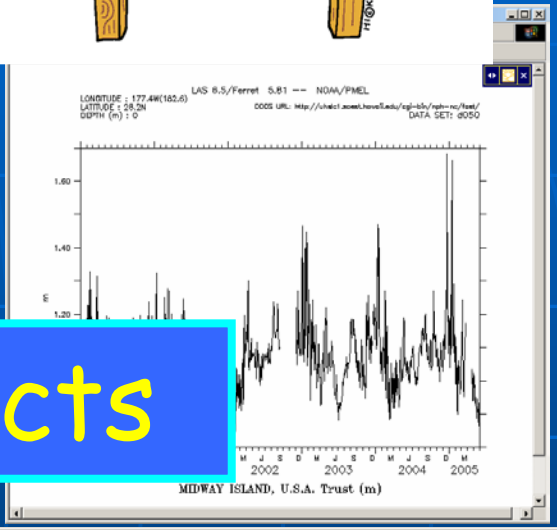
Review of LAS …







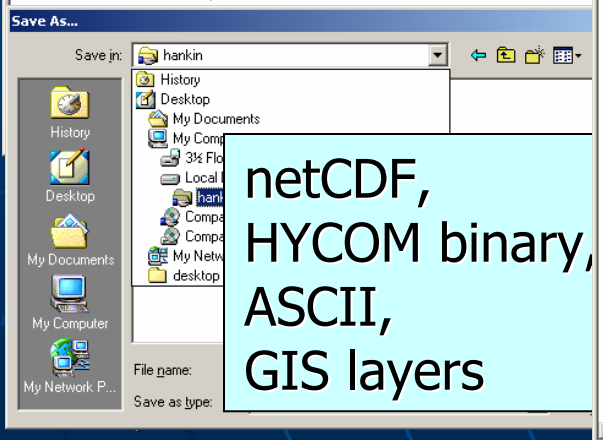




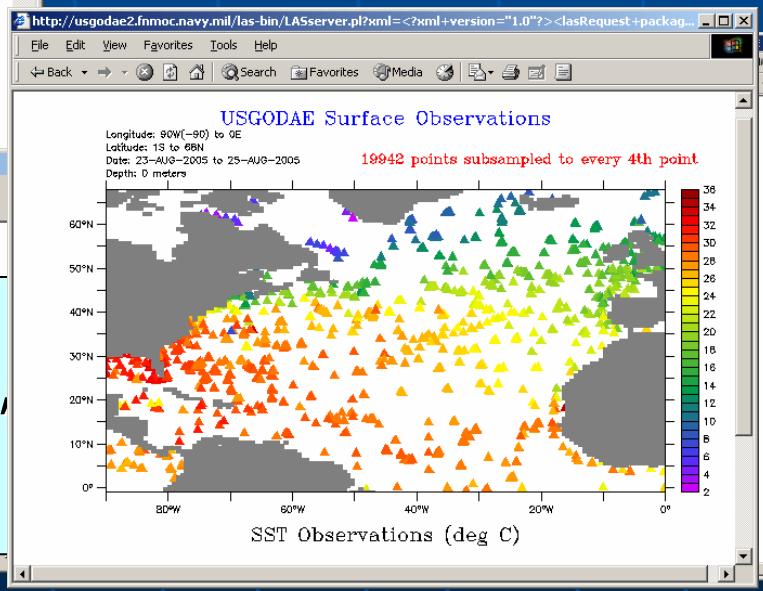
Information Products

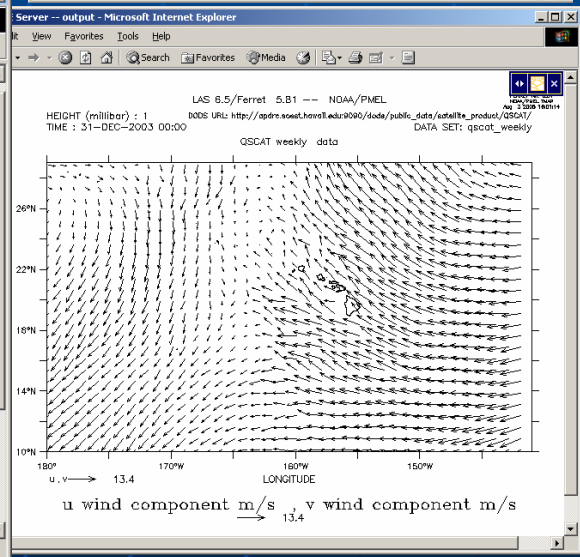
```
FILENAME : dOSO.nc
FILEPATH : htt
SUBSET   : 149
LONGITUDE: 177
LATITUDE : 28.
DEPTH (m): 0
           17

01-JAN-2005 12 / 7306:   1.119
02-JAN-2005 12 / 7307:   1.136
03-JAN-2005 12 / 7308:   1.081
04-JAN-2005 12 / 7309:   1.047
05-JAN-2005 12 / 7310:   1.040
06-JAN-2005 12 / 7311:   1.116
07-JAN-2005 12 / 7312:   1.258
```

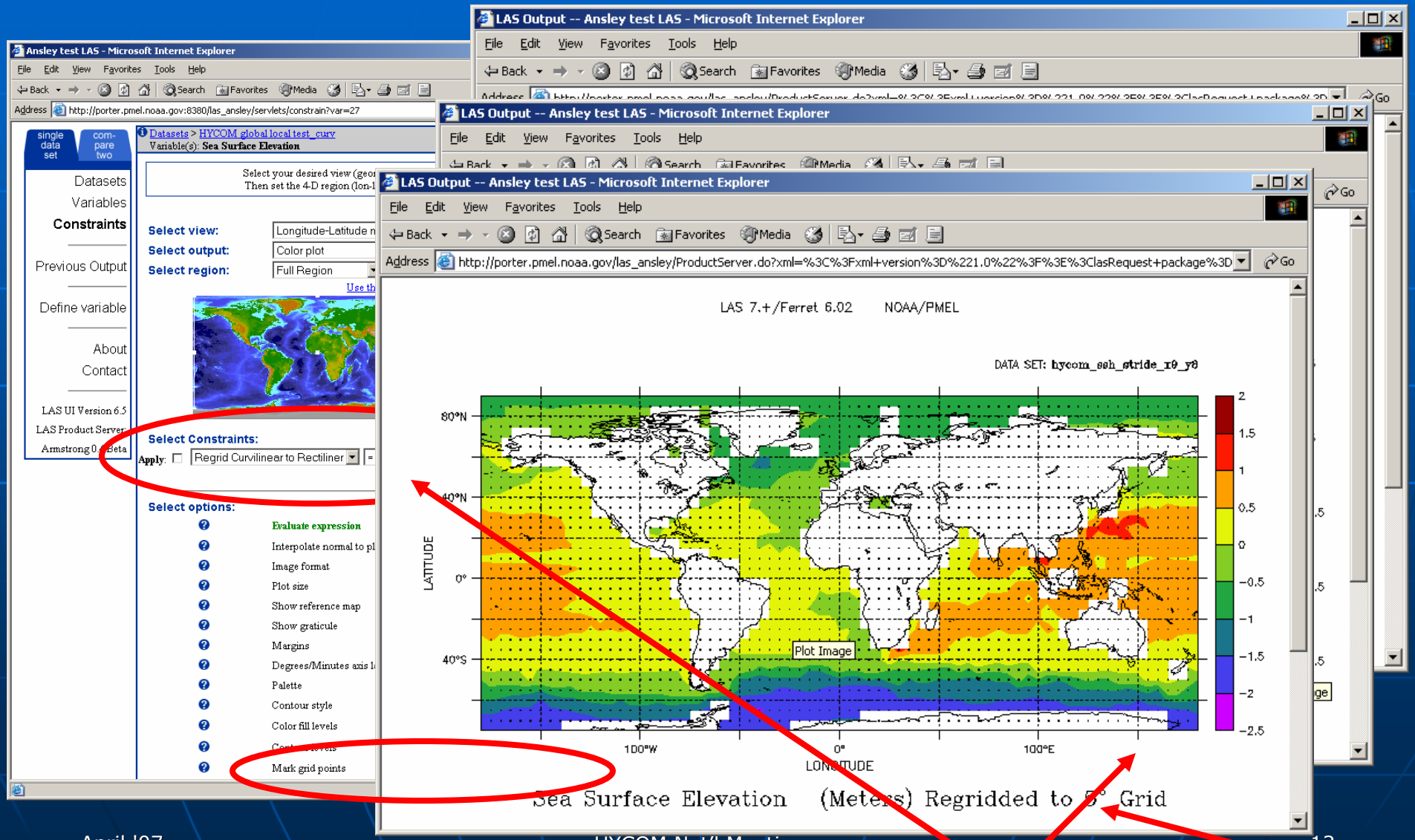


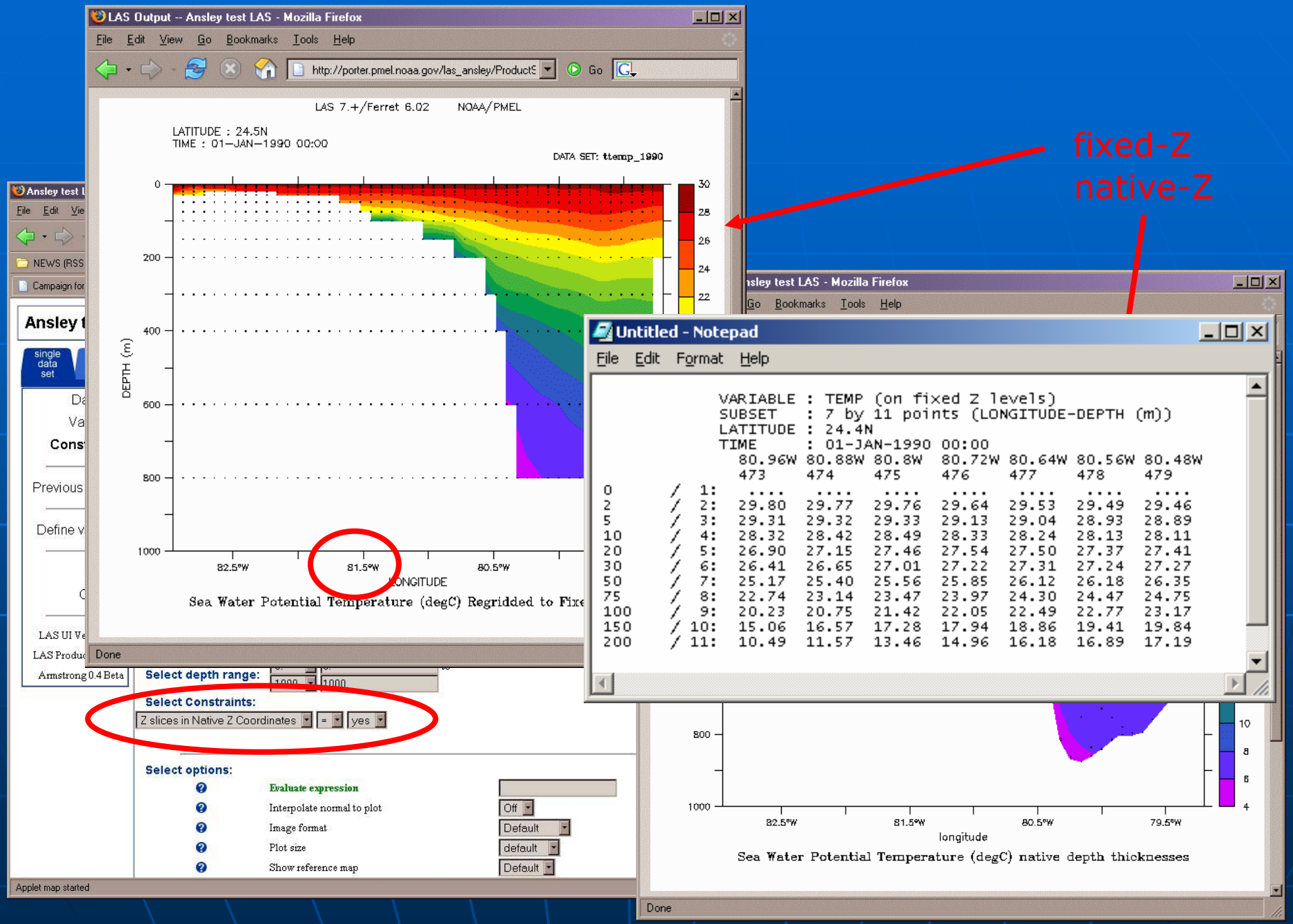
netCDF,
HYCOM binary,
ASCII,
GIS layers





Access to native coordinates and regridded fields




LAS Output -- Ansley test LAS - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://porter.pmel.noaa.gov/las_ansley/Product
LAS 7.+/Ferret 6.02 NOAA/PMEL
LATITUDE : 24.5N
TIME : 01-JAN-1990 00:00
DATA SET: ttemp_1990
DEPTH (m)
0
200
400
600
800
1000
30
28
26
24
22
82.5°W
81.5°W
80.5°W
LONGITUDE
Sea Water Potential Temperature (degC) Regridded to Fixe
Done
fixed-Z
native-Z
Untitled - Notepad
File Edit Format Help
VARIABLE : TEMP (on fixed Z levels)
SUBSET : 7 by 11 points (LONGITUDE-DEPTH (m))
LATITUDE : 24.4N
TIME : 01-JAN-1990 00:00
80.96W 80.88W 80.8W 80.72W 80.64W 80.56W 80.48W
473 474 475 476 477 478 479
0 / 1: ....
2 / 2: 29.80 29.77 29.76 29.64 29.53 29.49 29.46
5 / 3: 29.31 29.32 29.33 29.13 29.04 28.93 28.89
10 / 4: 28.32 28.42 28.49 28.33 28.24 28.13 28.11
20 / 5: 26.90 27.15 27.46 27.54 27.50 27.37 27.41
30 / 6: 26.41 26.65 27.01 27.22 27.31 27.24 27.27
50 / 7: 25.17 25.40 25.56 25.85 26.12 26.18 26.35
75 / 8: 22.74 23.14 23.47 23.97 24.30 24.47 24.75
100 / 9: 20.23 20.75 21.42 22.05 22.49 22.77 23.17
150 / 10: 15.06 16.57 17.28 17.94 18.86 19.41 19.84
200 / 11: 10.49 11.57 13.46 14.96 16.18 16.89 17.19
Select depth range:
Select Constraints:
Z slices in Native Z Coordinates
yes
Select options:
Evaluate expression
Interpolate normal to plot
Off
Image format
Default
Plot size
default
Show reference map
Default
Applet map started
800
1000
82.5°W
81.5°W
80.5°W
79.5°W
longitude
Sea Water Potential Temperature (degC) native depth thicknesses
Done

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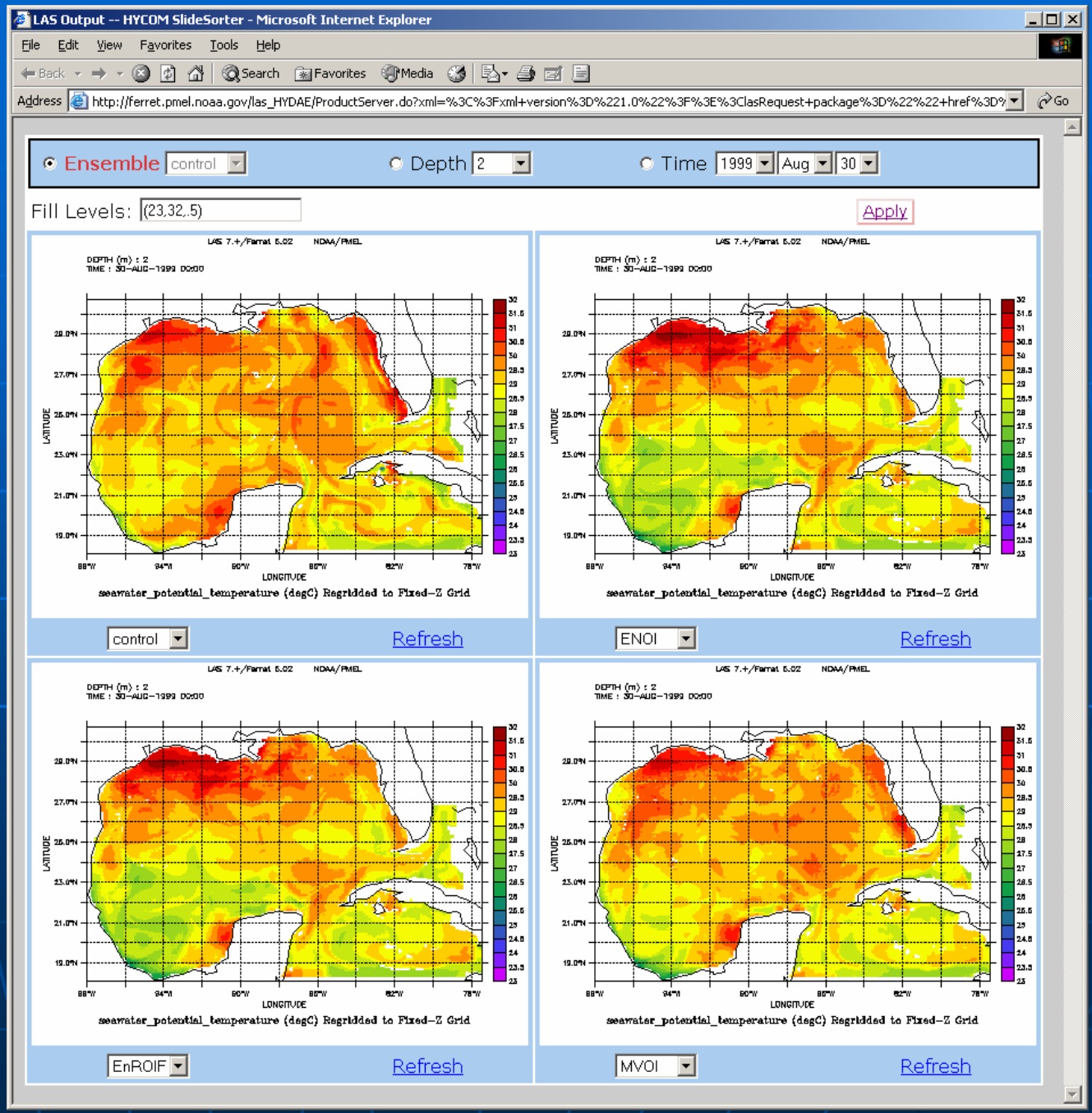
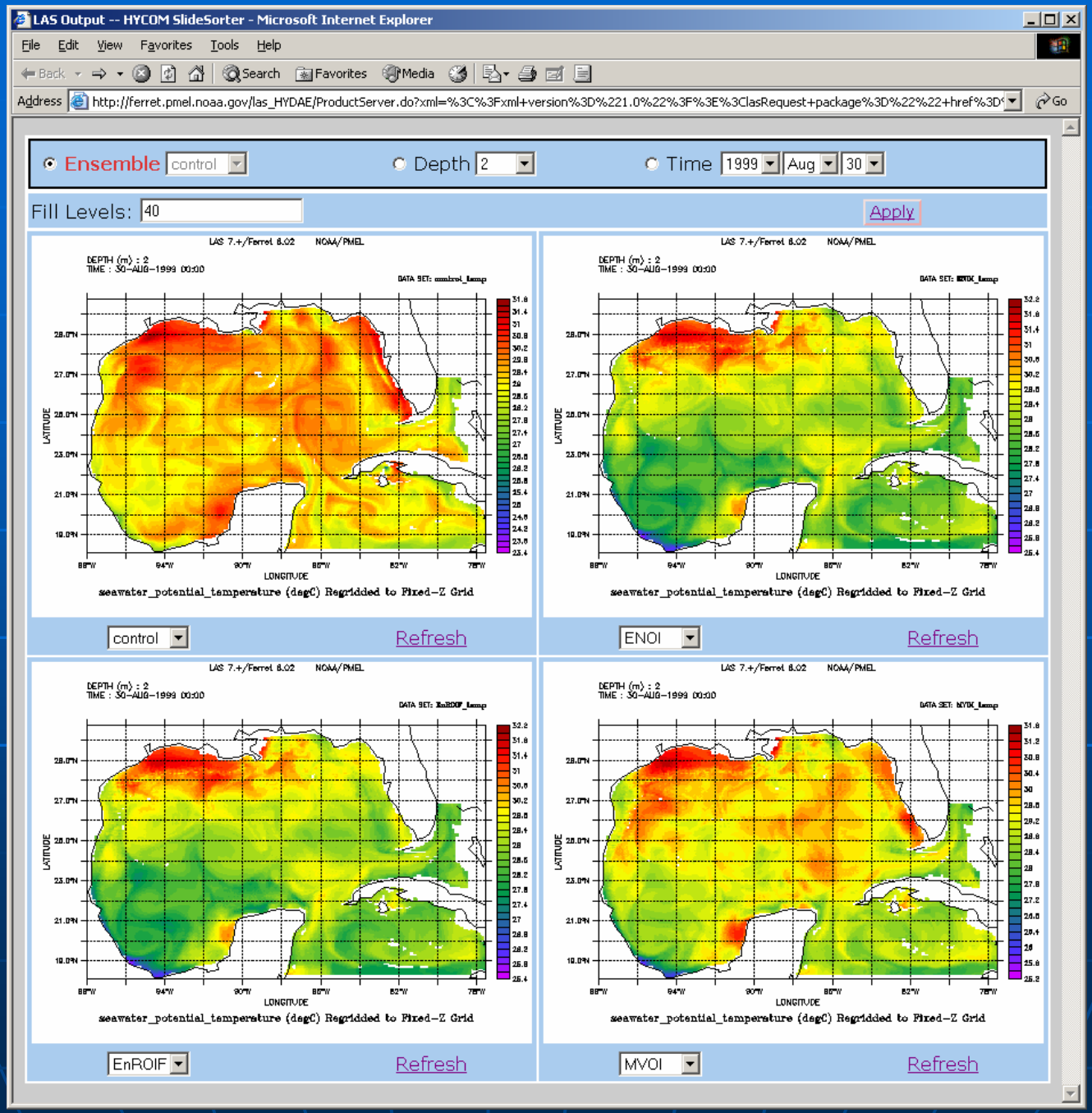
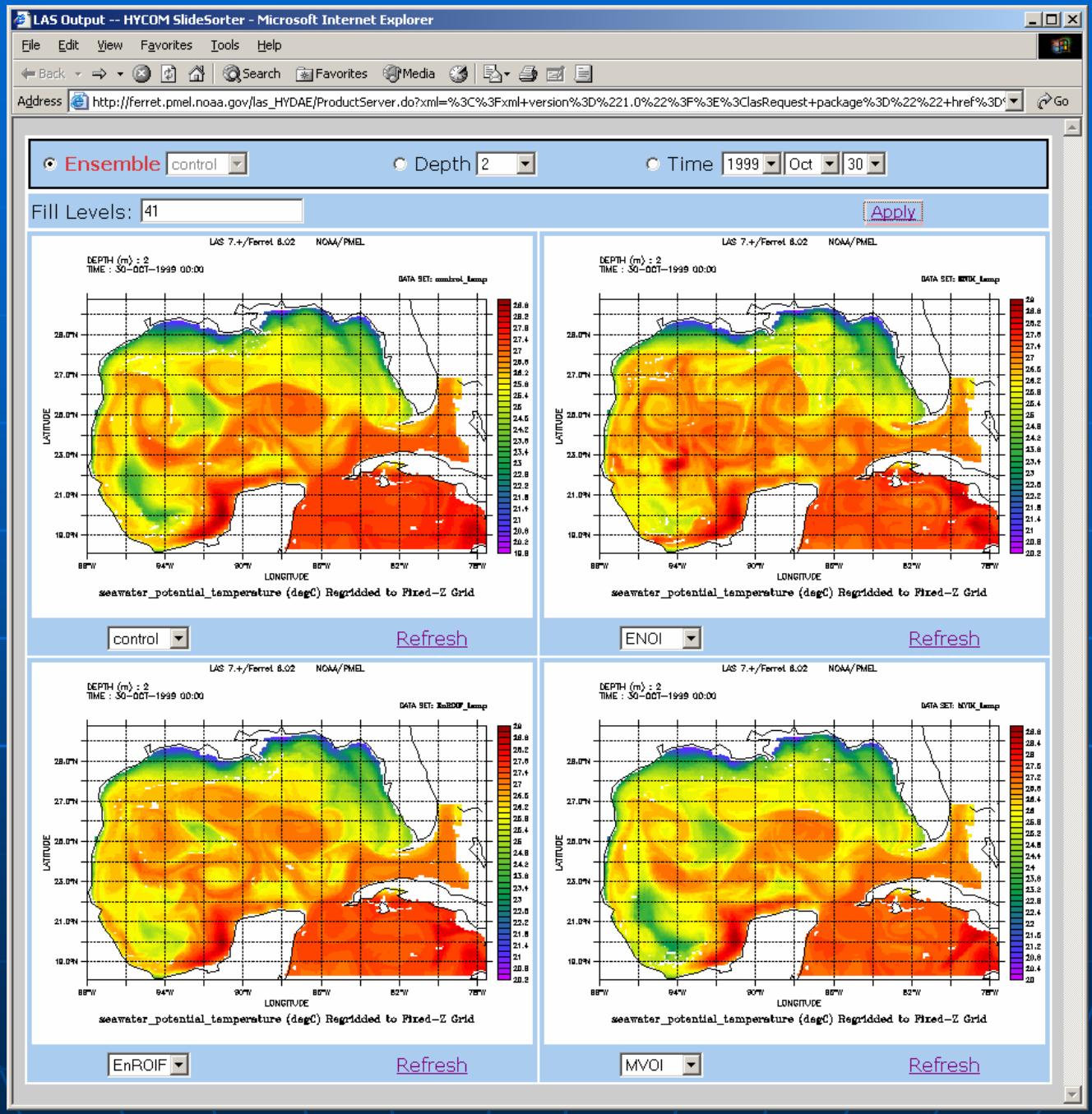
3. help Consortium to reach broader classes of users

HYDAE model intercomparison

On-line Demo




LAS Output -- HYCOM SlideSorter - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://ferret.pmel.noaa.gov/las_HYDAE/ProductServer.do?xml=%3C%3Fxml+version%3D%221.0%22%3F%3E%3ClasRequest+package%3D%22%22+href%3D
Ensemble control
Depth 2
Time 1999 Aug 30
Fill Levels: 40
Apply
LAS 7.+/Ferret 6.02 NOAA/PMEL
DEPTH (m) : 2
TIME : 30-AUG-1999 00:00
LATITUDE
LONGITUDE
seawater_potential_temperature (degC) Regridded to Fixed-Z Grid
control
Refresh
ENOI
Refresh
EnROIF
Refresh
MVOI
Refresh


LAS Output -- HYCOM SlideSorter - Microsoft Internet Explorer
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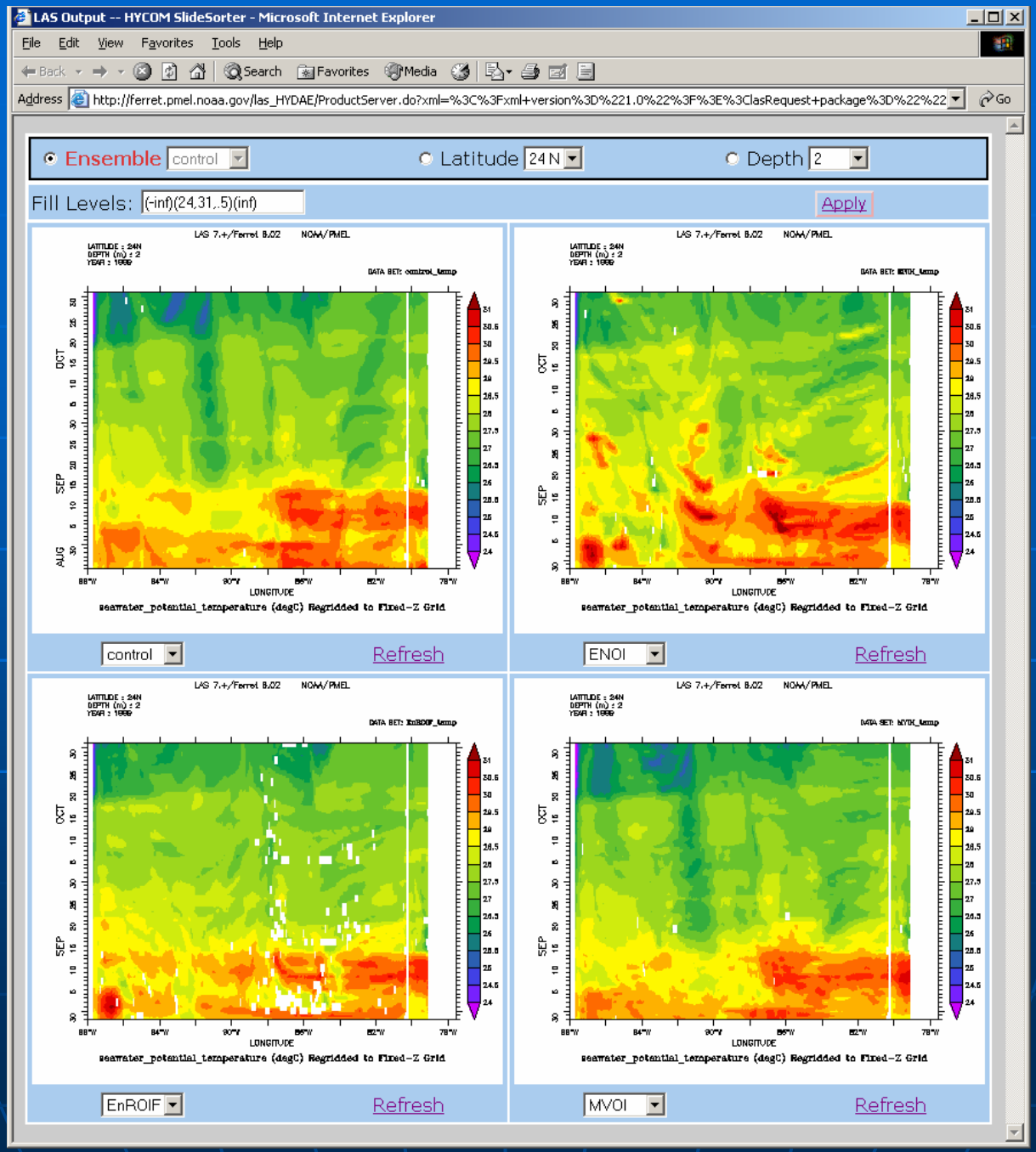
Back Search Favorites Media
Address http://ferret.pmel.noaa.gov/las_HYDAE/ProductServer.do?xml=%3C%3Fxml+version%3D%221.0%22%3F%3E%3ClasRequest+package%3D%22%22+href%3D
Ensemble control
Depth 2
Time 1999 Oct 30
Fill Levels: 41
Apply
LAS 7.+/Ferret 6.02 NOAA/PMEL
DEPTH (m) : 2
TIME : 30-OCT-1999 00:00
LATITUDE
LONGITUDE
seawater_potential_temperature (degC) Regridded to Fixed-Z Grid
control
Refresh
ENOI
Refresh
EnROIF
Refresh
MVOI
Refresh


LAS Output -- HYCOM SlideSorter - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://ferret.pmel.noaa.gov/las_HYDAE/ProductServer.do?xml=%3C%3Fxml+version%3D%221.0%22%3F%3E%3ClasRequest+package%3D%22%22
Go
Ensemble control
Latitude 24 N
Depth 2
Fill Levels: (-inf)(24,31,.5)(inf)
Apply
LAS 7.+/Ferret 6.02 NOAA/PMEL
LATITUDE : 24N
DEPTH (m) : 2
YEAR : 1999
DATA SET: control_temp
DATA SET: ENOI_temp
DATA SET: EnROIF_temp
DATA SET: MVOI_temp
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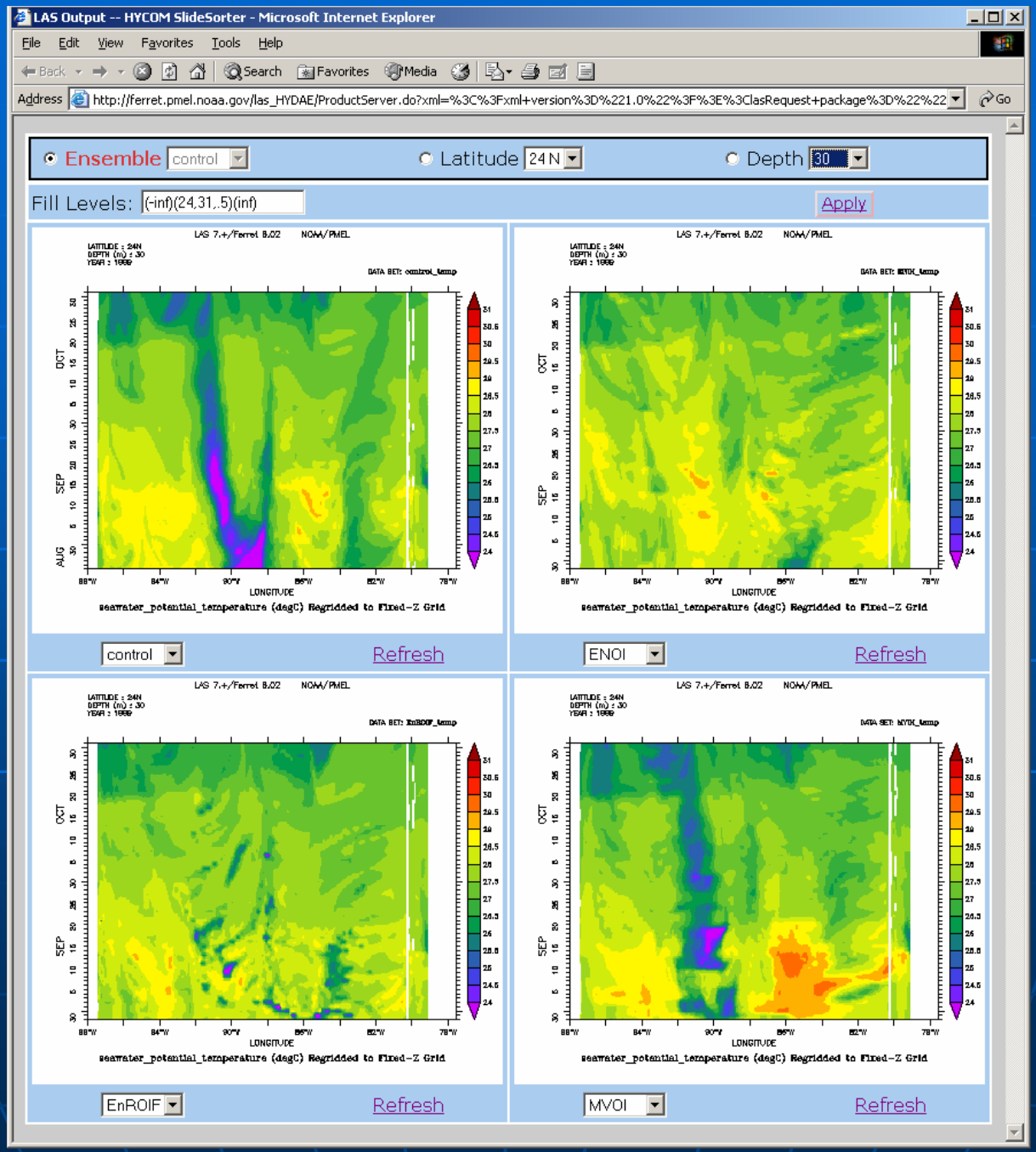
seawater_potential_temperature (degC) Regridded to Fixed-Z Grid
control
Refresh
ENOI
Refresh
EnROIF
Refresh
MVOI
Refresh


LAS Output -- HYCOM SlideSorter - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://ferret.pmel.noaa.gov/las_HYDAE/ProductServer.do?xml=%3C%3Fxml+version%3D%221.0%22%3F%3E%3ClasRequest+package%3D%22%22
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Ensemble control
Latitude 24 N
Depth 30
Fill Levels: (-inf)(24,31,.5)(inf)
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LAS 7.+/Ferret 6.02 NOAA/PMEL
LONGITUDE
seawater_potential_temperature (degC) Regridded to Fixed-Z Grid
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Refresh
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EnROIF
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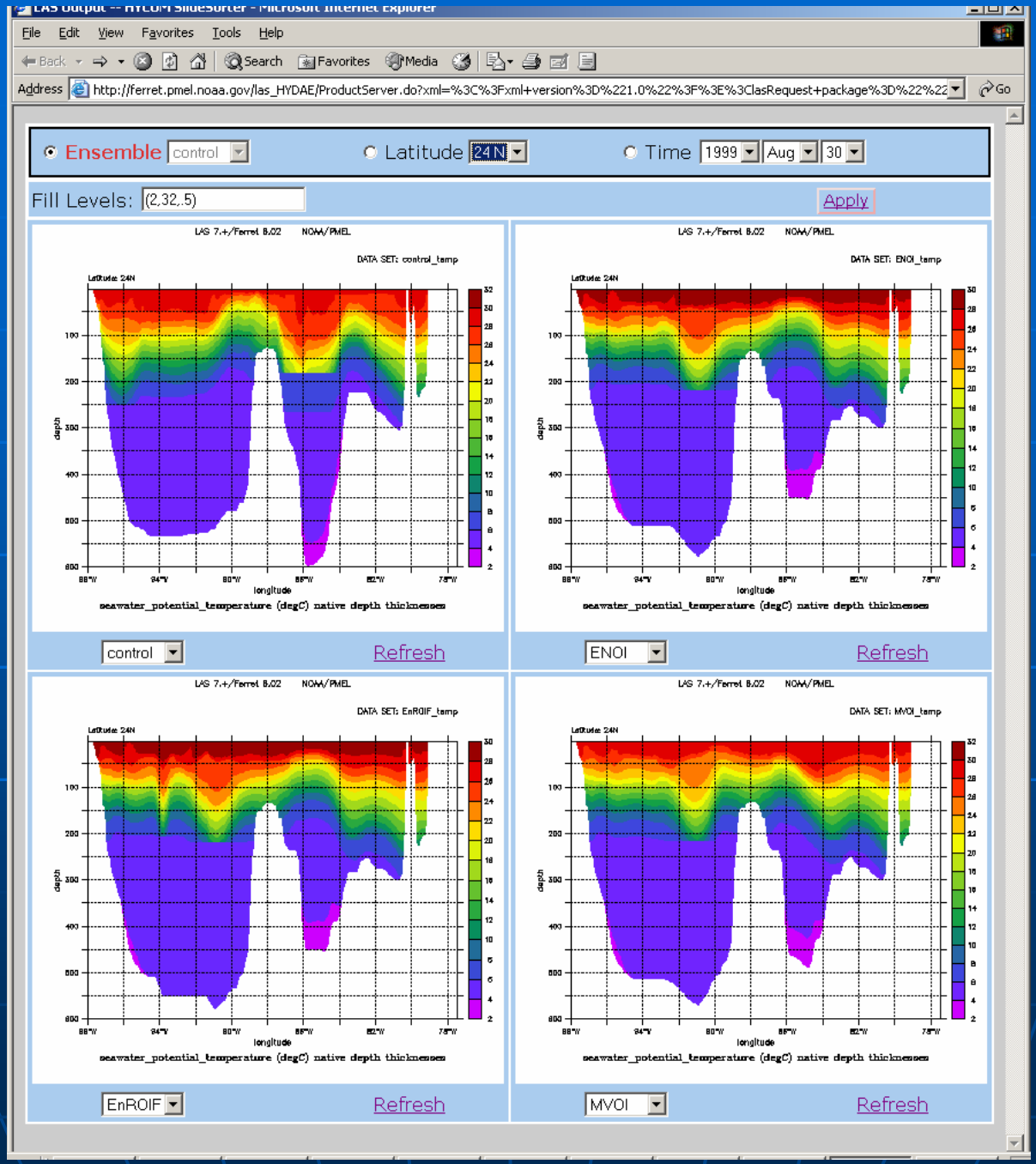
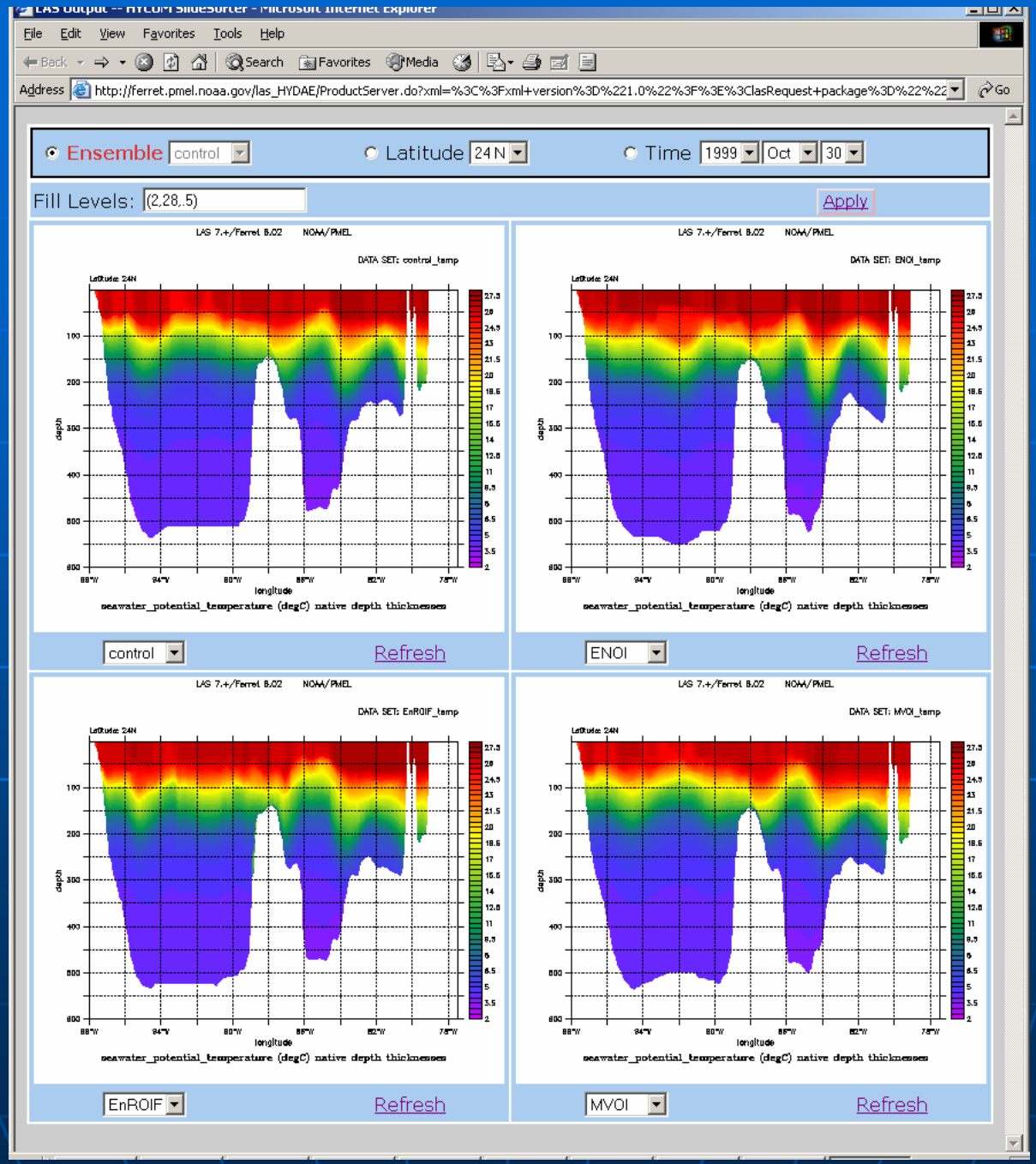
MVOI
Refresh


File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://ferret.pmel.noaa.gov/las_HYDAE/ProductServer.do?xml=%3C%3Fxml+version%3D%221.0%22%3F%3E%3ClasRequest+package%3D%22%22
Go
Ensemble control
Latitude 24N
Time 1999 Aug 30
Fill Levels: (2,32,.5)
Apply
LAS 7.+/Ferret 6.02 NOAA/PMEL
DATA SET: control_temp
DATA SET: ENOI_temp
DATA SET: EnROIF_temp
DATA SET: MVOI_temp
depth
longitude
seawater_potential_temperature (degC) native depth thicknesses
control
ENOI
EnROIF
MVOI
Refresh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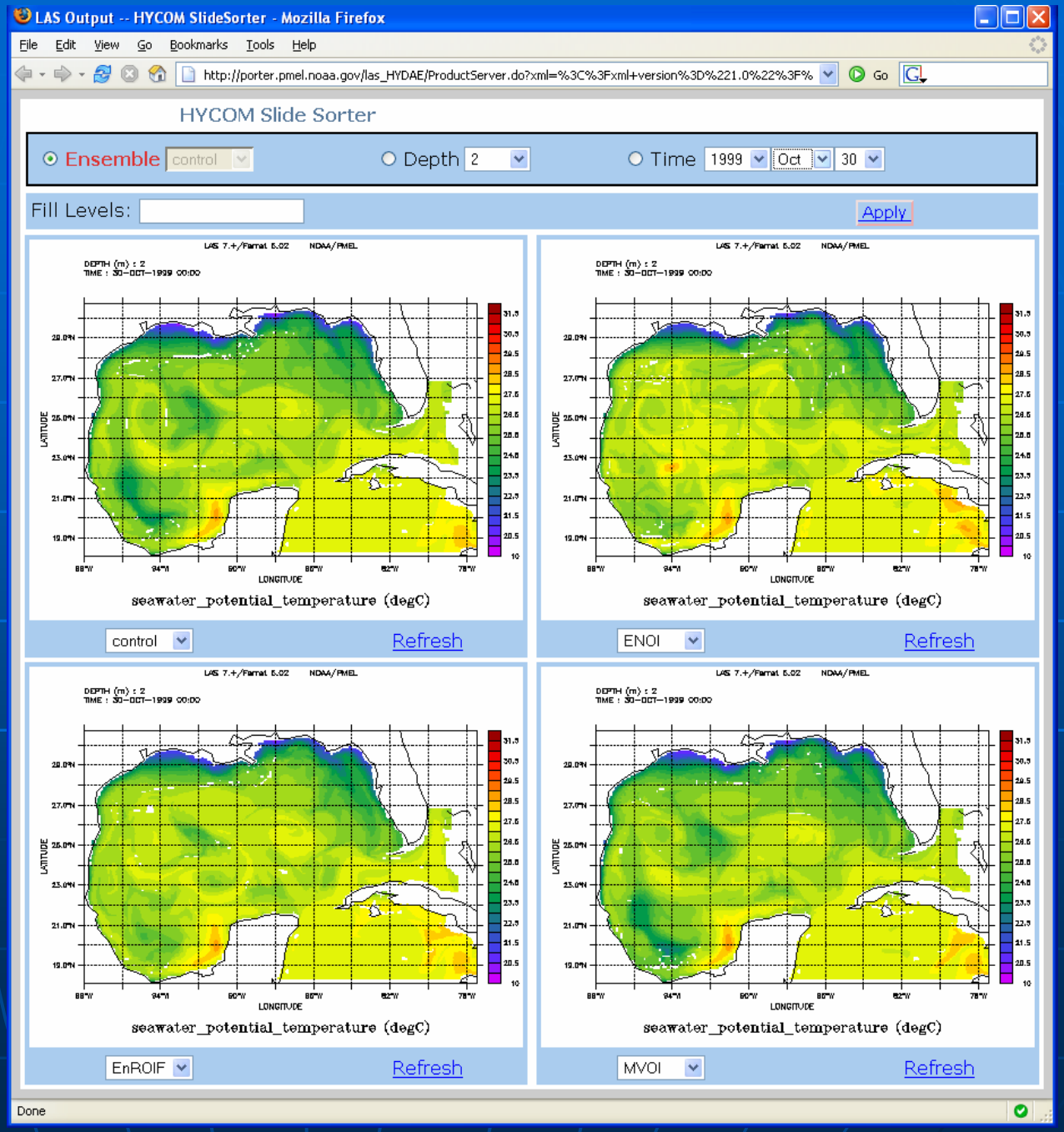
Back Search Favorites Media
Address http://ferret.pmel.noaa.gov/las_HYDAE/ProductServer.do?xml=%3C%3Fxml+version%3D%221.0%22%3F%3E%3ClasRequest+package%3D%22%22
Go
Ensemble control
Latitude 24 N
Time 1999 Oct 30
Fill Levels: (2,28,.5)
Apply
LAS 7.+/Ferret 6.02 NOAA/PMEL
DATA SET: control_temp
DATA SET: ENOI_temp
DATA SET: EnROIF_temp
DATA SET: MVOI_temp
Latitude 24N
depth
longitude
seawater_potential_temperature (degC) native depth thicknesses
control
ENOI
EnROIF
MVOI
Refresh

HYDAE model intercomparison



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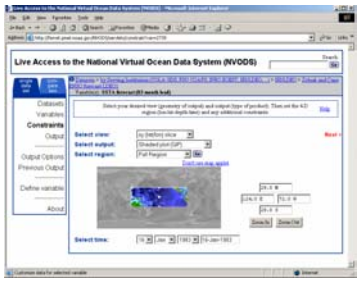
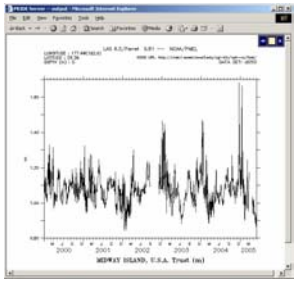


user



product

LAS

User Interface Server

Product Server

Metadata (XML)

Backend Service

Backend Service

Backend Service

Local Data

Remote Data

metadata

product request XML (REST)

back end request (SOAP)

New LAS Architecture

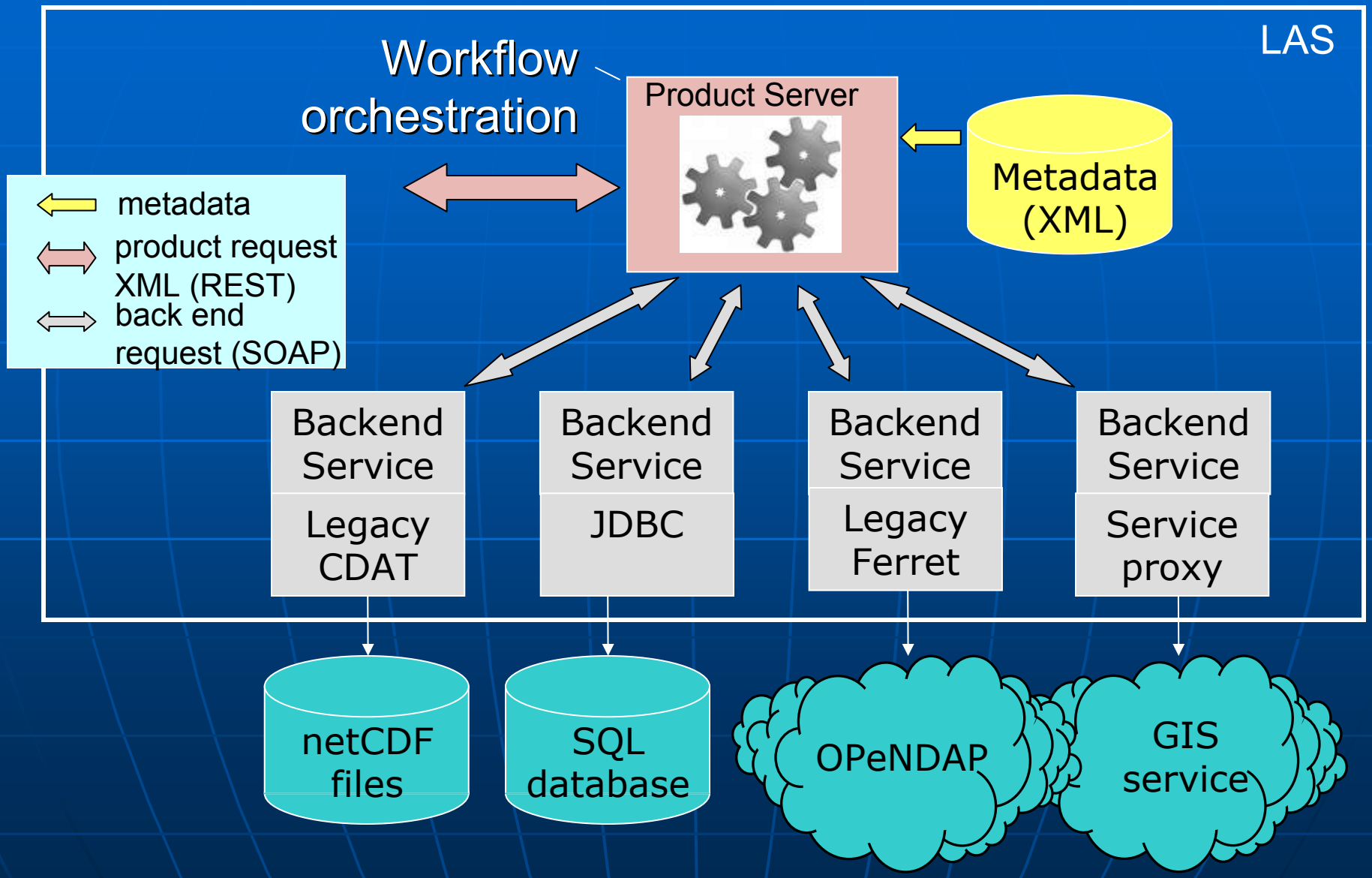
All-Java

– more flexible and much faster -

How does LAS work? (cont'd)

- Back-end services can also perform special functions, such as accessing data from a database.
- Services can be chained together into work-flows.

A more detailed look at back end services



GODAE Model Intercomparison - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Address http://ferret.pmel.noaa.gov/GODAE/servlets/constrain?var=59 Go

GODAE Model Intercomparison

OPeNDAP (FDS) | THREDDS | Index | Search: Go

single data set | compare two

Datasets
Variables
Constraints

Previous Output

Define variable

About
Contact

Datasets > by Geographic Coverage > Global > NRL Layered Ocean Model (NLOM) > NRL Layered Ocean Model (NLOM) (from APDRC)

Variable(s): **Sea Surface Height**

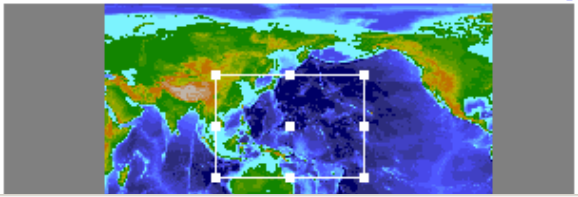
Select your desired view (geometry of output) and output (type of product).
Then set the 4-D region (lon-lat-depth-time) and any additional constraints. Help

Select view: Longitude-Latitude map (xy) Next >

Select output: Desktop application data access scripts

Select region: Full Region Go

Use the two-click map Help



44.0 N

106.0 E 160.0 W

LAS: Desktop Application Data Access Scripts - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Ferret

```
SET DATA "http://ferret.pmel.noaa.gov/GODAE-FDS/LAS/NLOM/ssh"
SHOW DATASET
SET REGION/x="106.0":"200.0"/y="-21.0":"44.0"/k=1/t="29-Aug-2005 00:00:00":"29-Aug-2005 00:00:00"
```

```
loaddods('http://ferret.pmel.noaa.gov/GODAE-FDS/LAS/NLOM/ssh?SSH[1185:1185][0:0][816:1856][796:1866]')
```

HYCOM data at the desktop
(for Matlab, IDL, Ferret, GrADS, …)

F-TDS is an OPeNDAP server

- Based on Unidata's "THREDDS Data Server"
- Analyses and regridding on the server

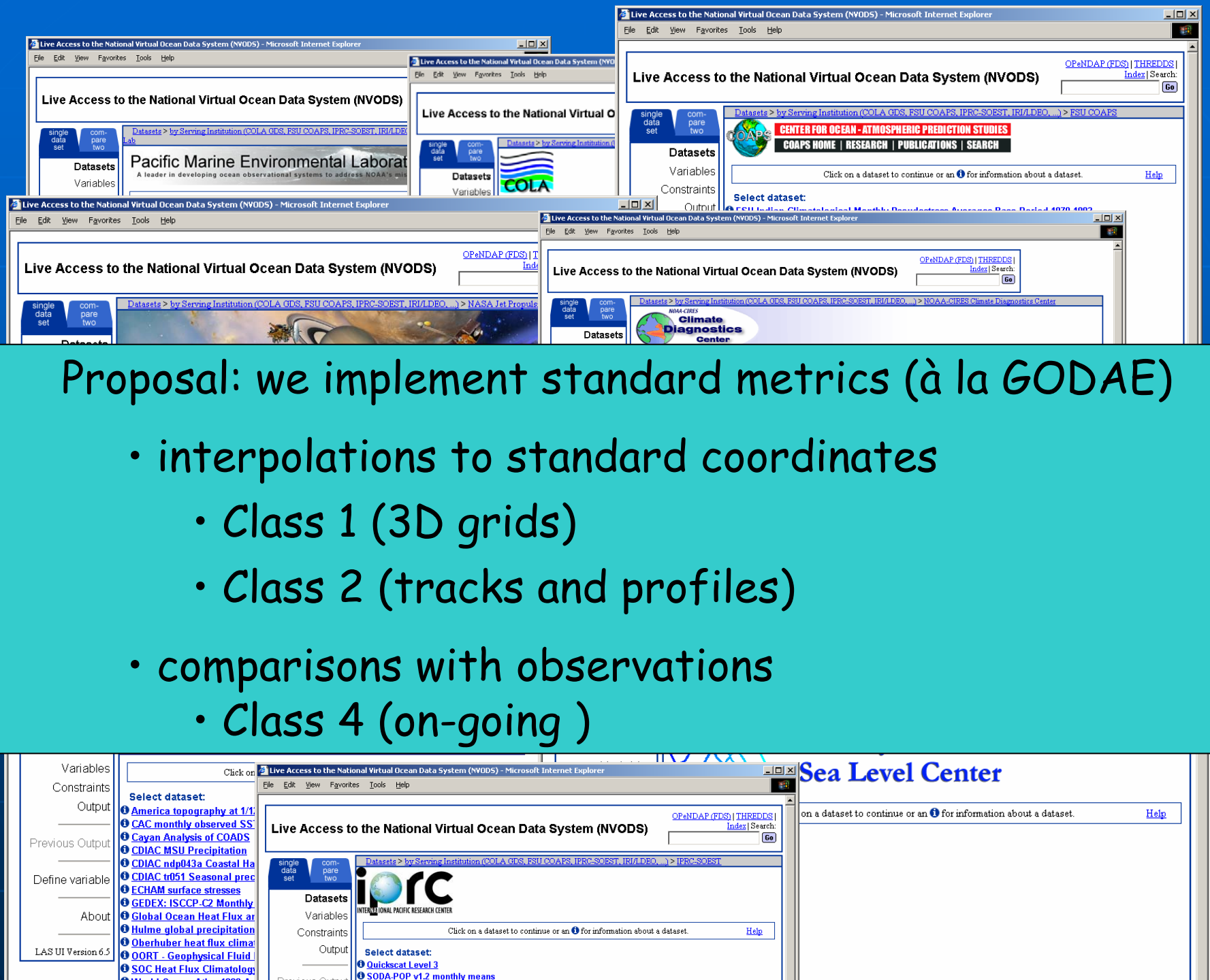
Custom server-side analysis expressed as part of the "filename" (actually, a URL)

E.g. Vertical average of variable "TEMP"

OPEN("http://server/_expr_{model}{Tave=TEMP[Z=@AVE]}")

F-TDS

- Greatly reduces network data volumes
- "Delayed evaluation"
  - Entire domain appears to be transformed
  - Calculations are on-demand, "surgical"
- Regridding on-the-fly



Proposal: we implement standard metrics (à la GODAE)

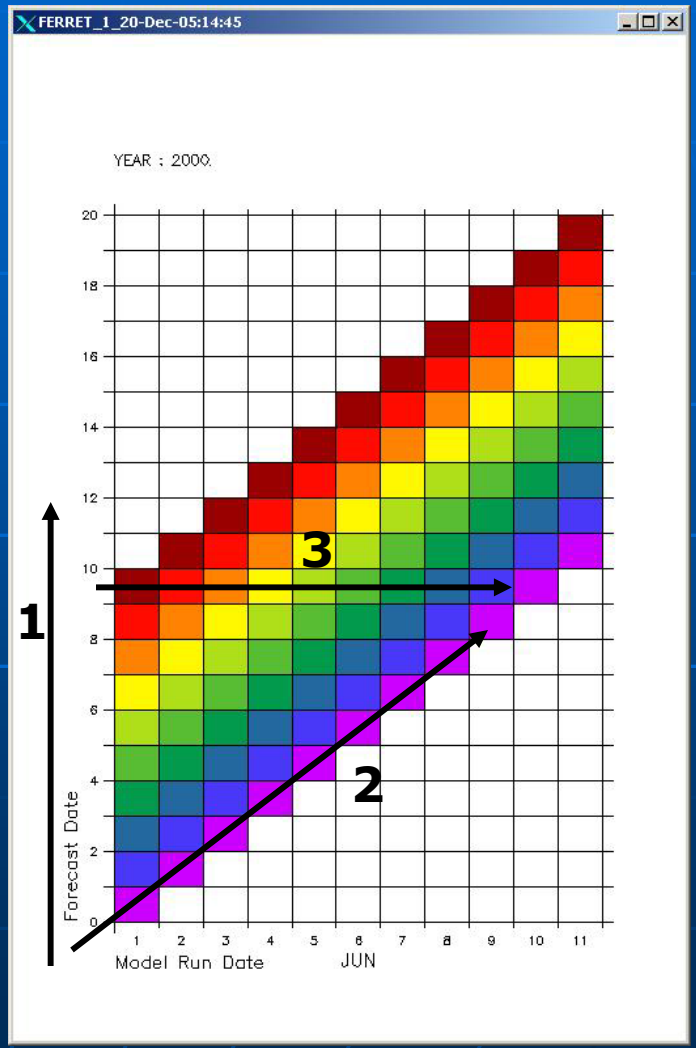
- interpolations to standard coordinates
  - Class 1 (3D grids)
  - Class 2 (tracks and profiles)
- comparisons with observations
  - Class 4 (on-going)

Handling Forecast Data

Forecast aggregation capabilities of TDS …

Soon HYCOM will offer forecast views along 3 types of time axes

http://www.unidata.ucar.edu/software/netcdf/ncml/v2.2/FmrcAggregation.html



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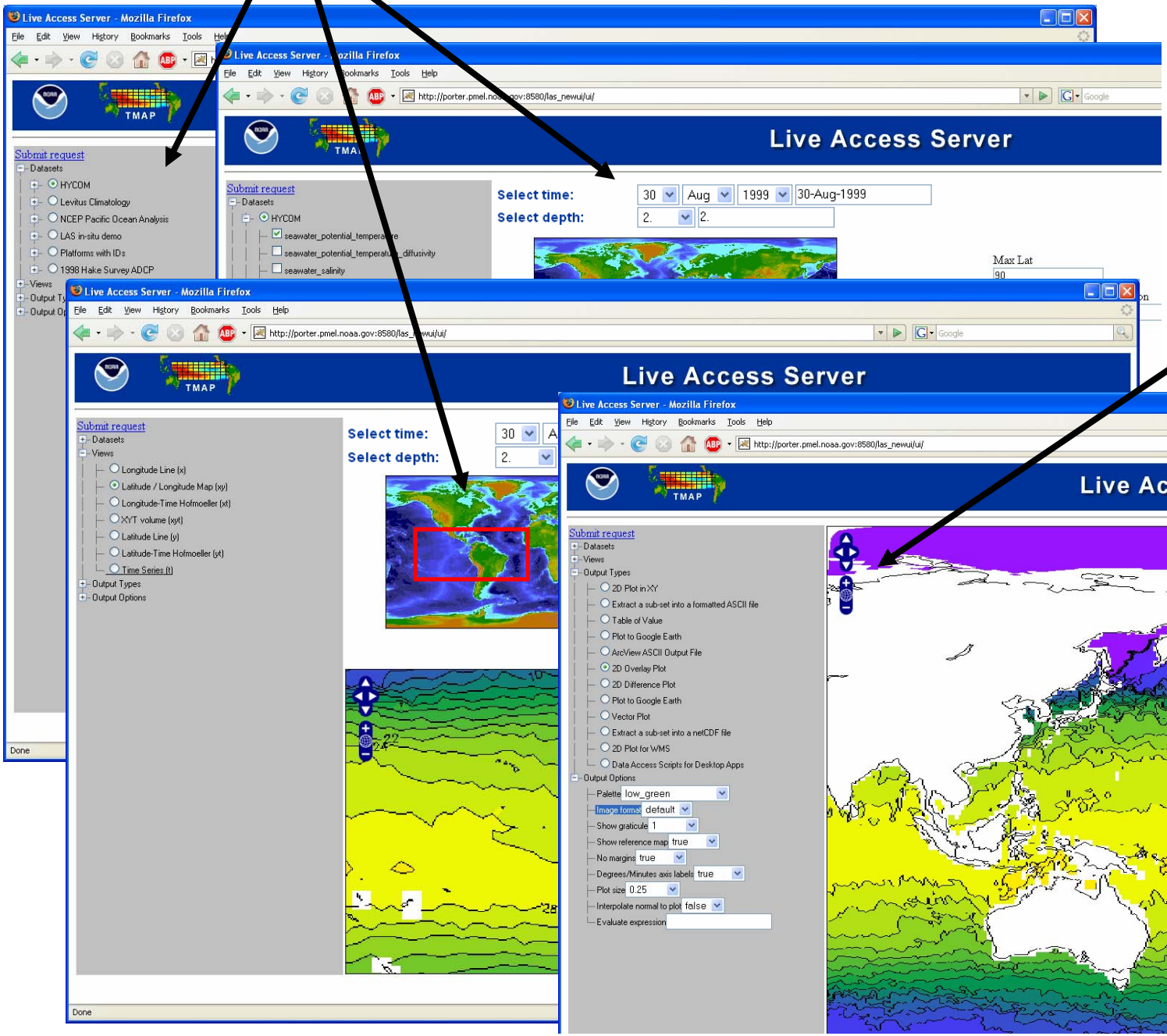
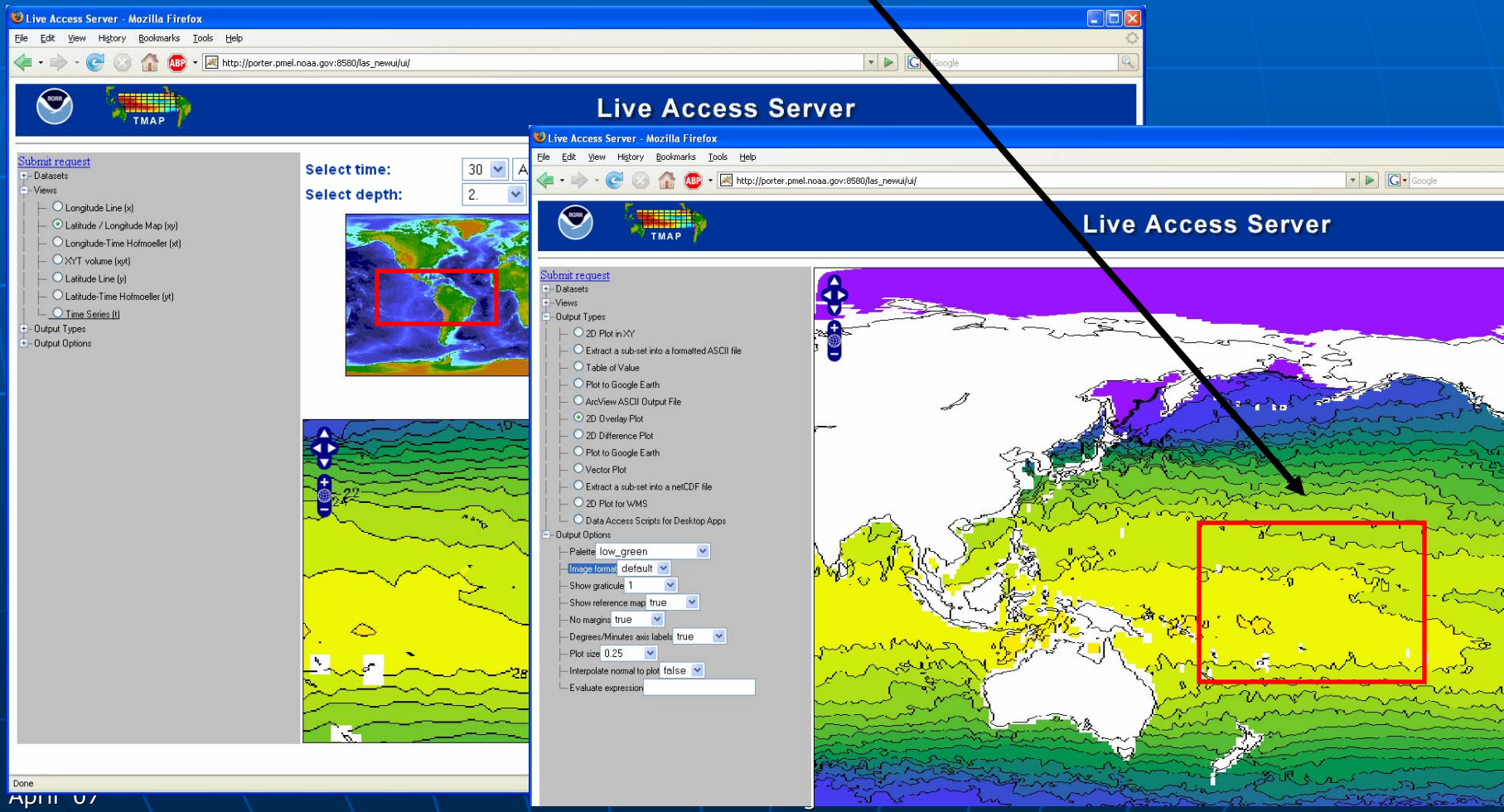
New LAS user interface (currently “alpha” level)

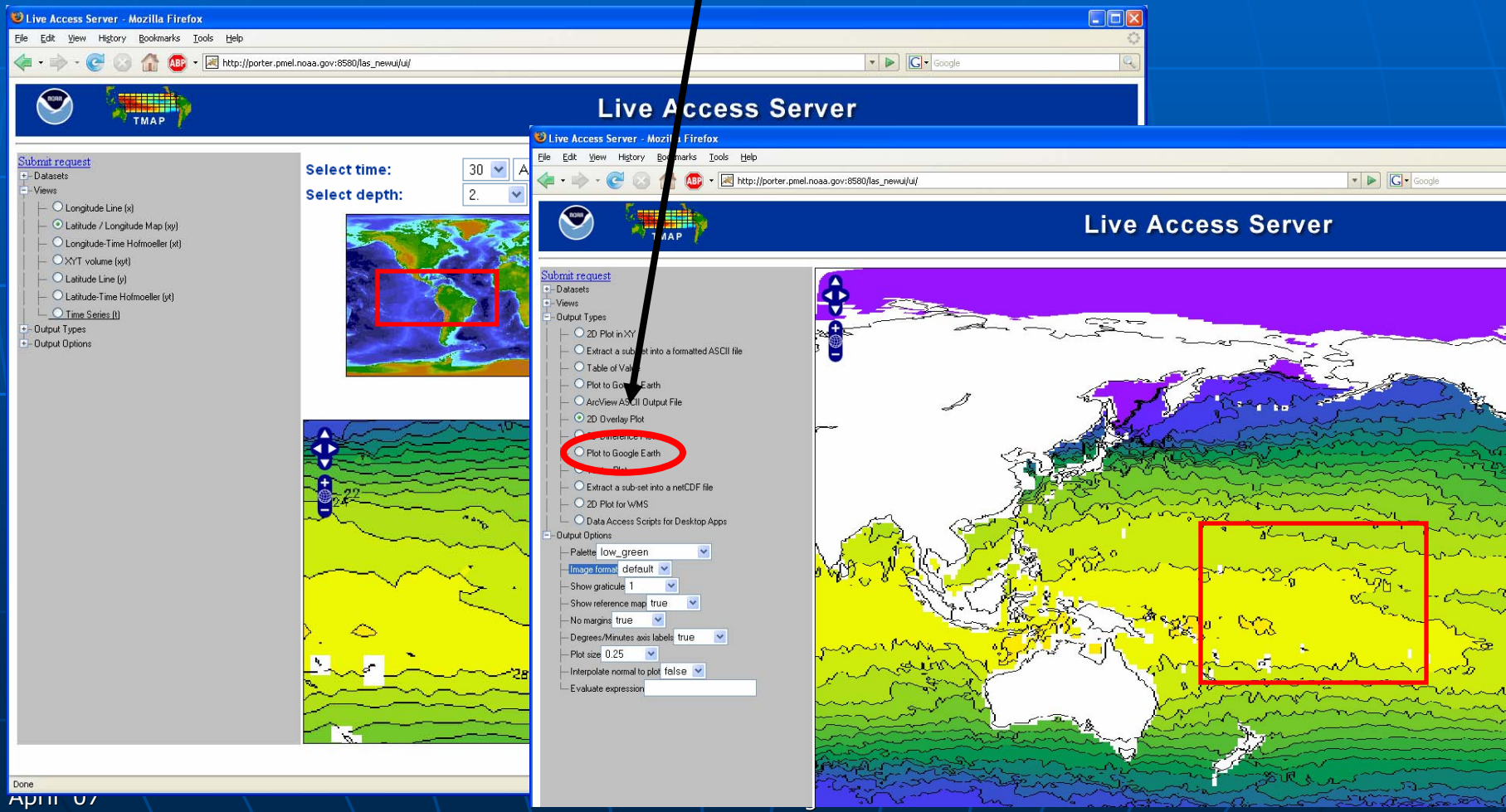


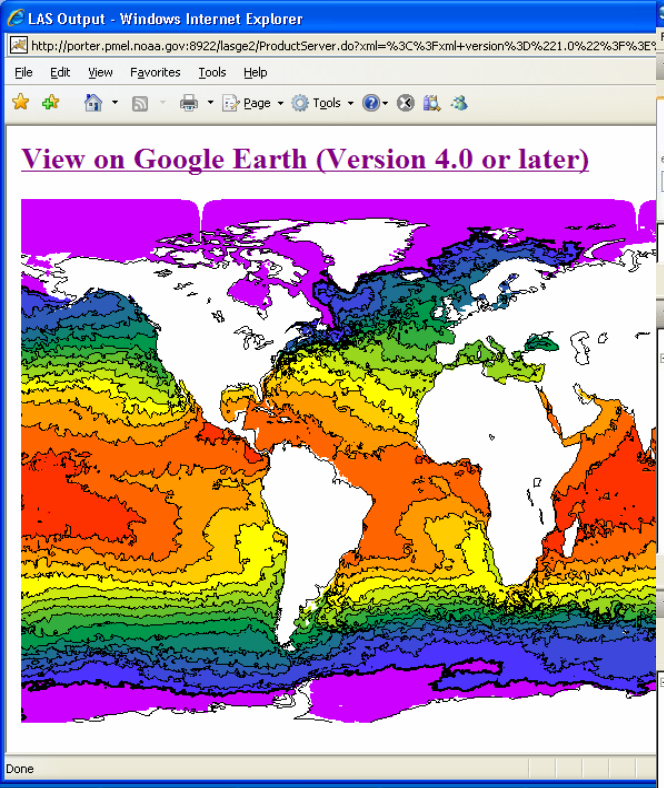
Interact with the graphics

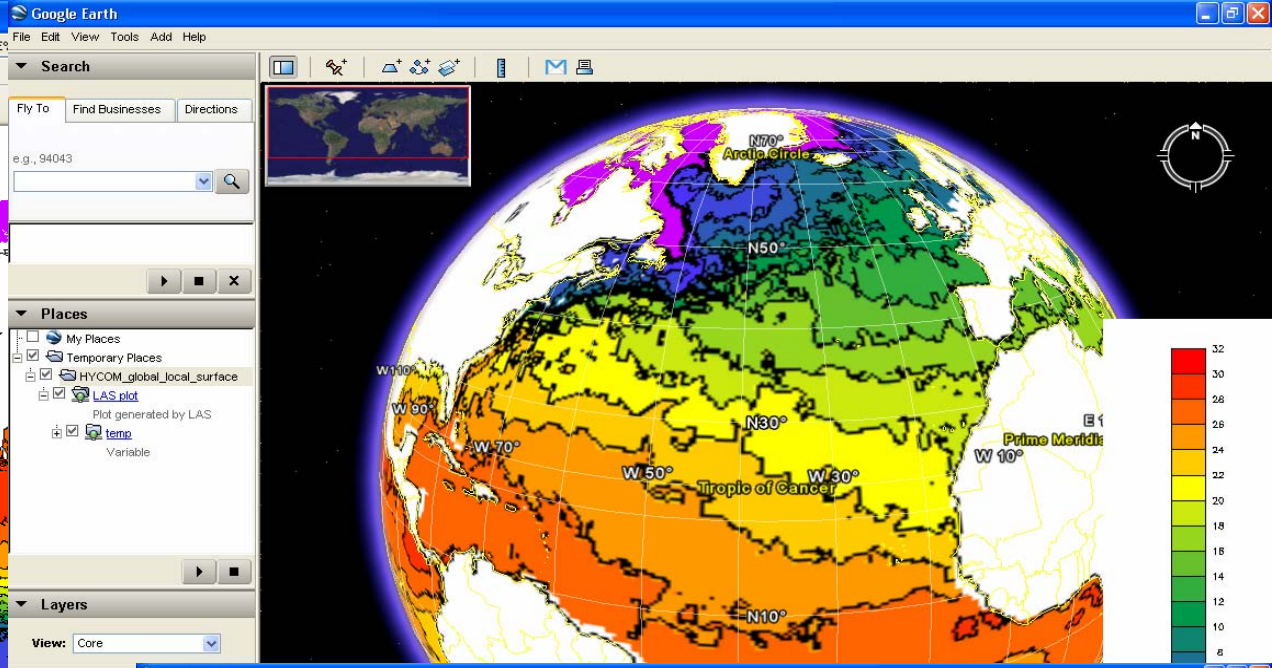
HYCOM output will reach broader community through standard GIS protocols ("WMS" and "WCS")

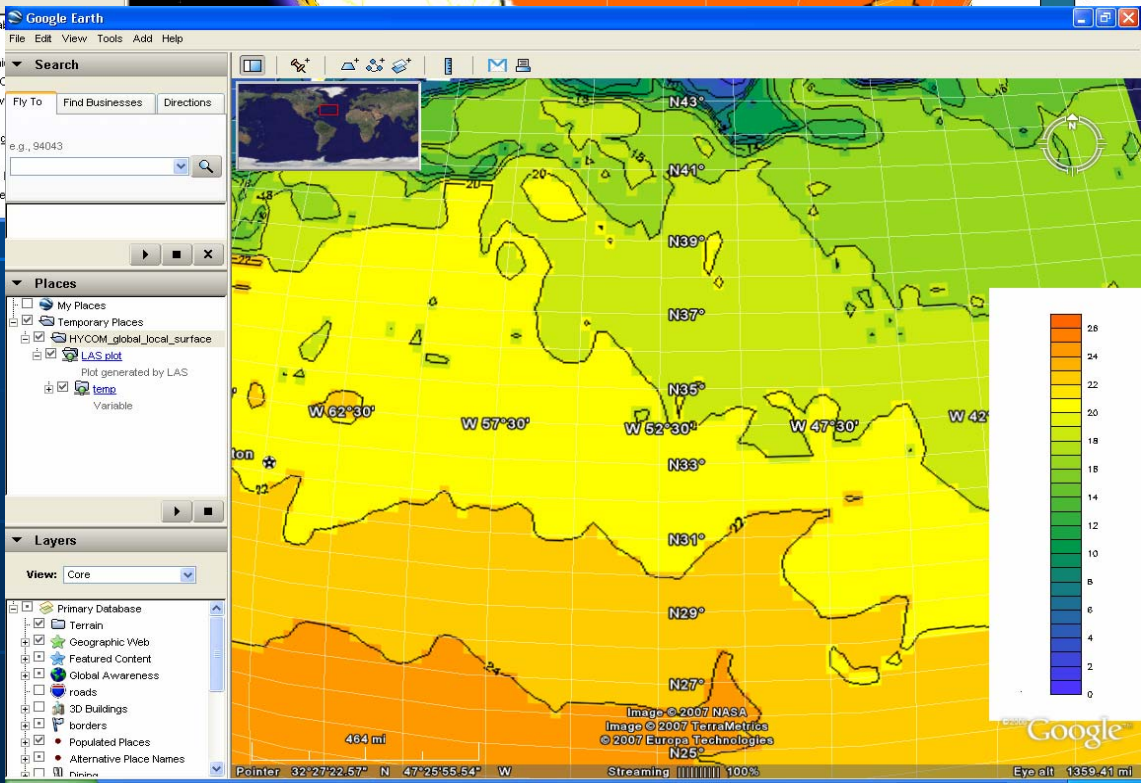


HYCOM output via Google Earth





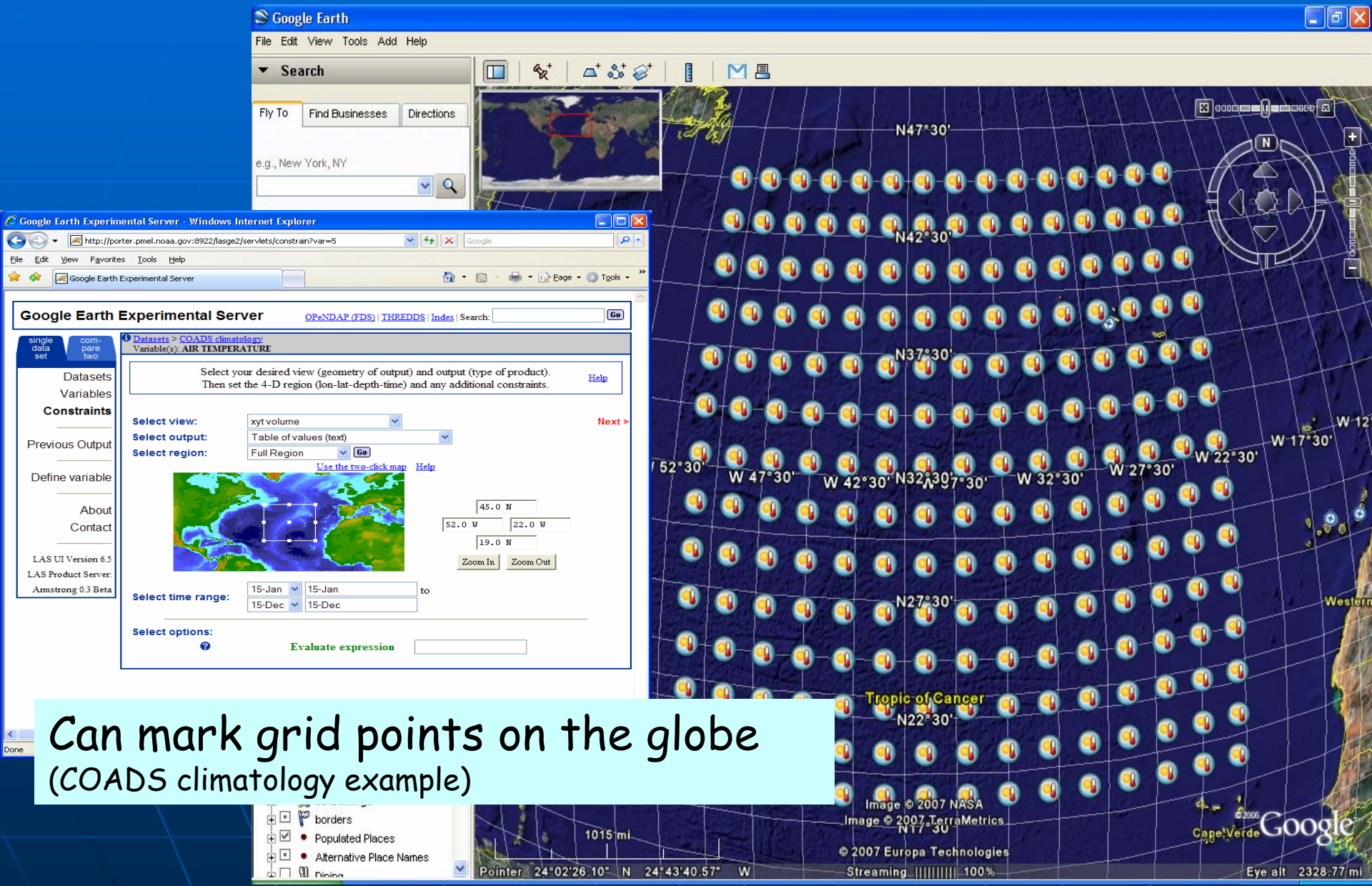




HYCOM plot on Google Earth (Sea Water Potential Temperature)

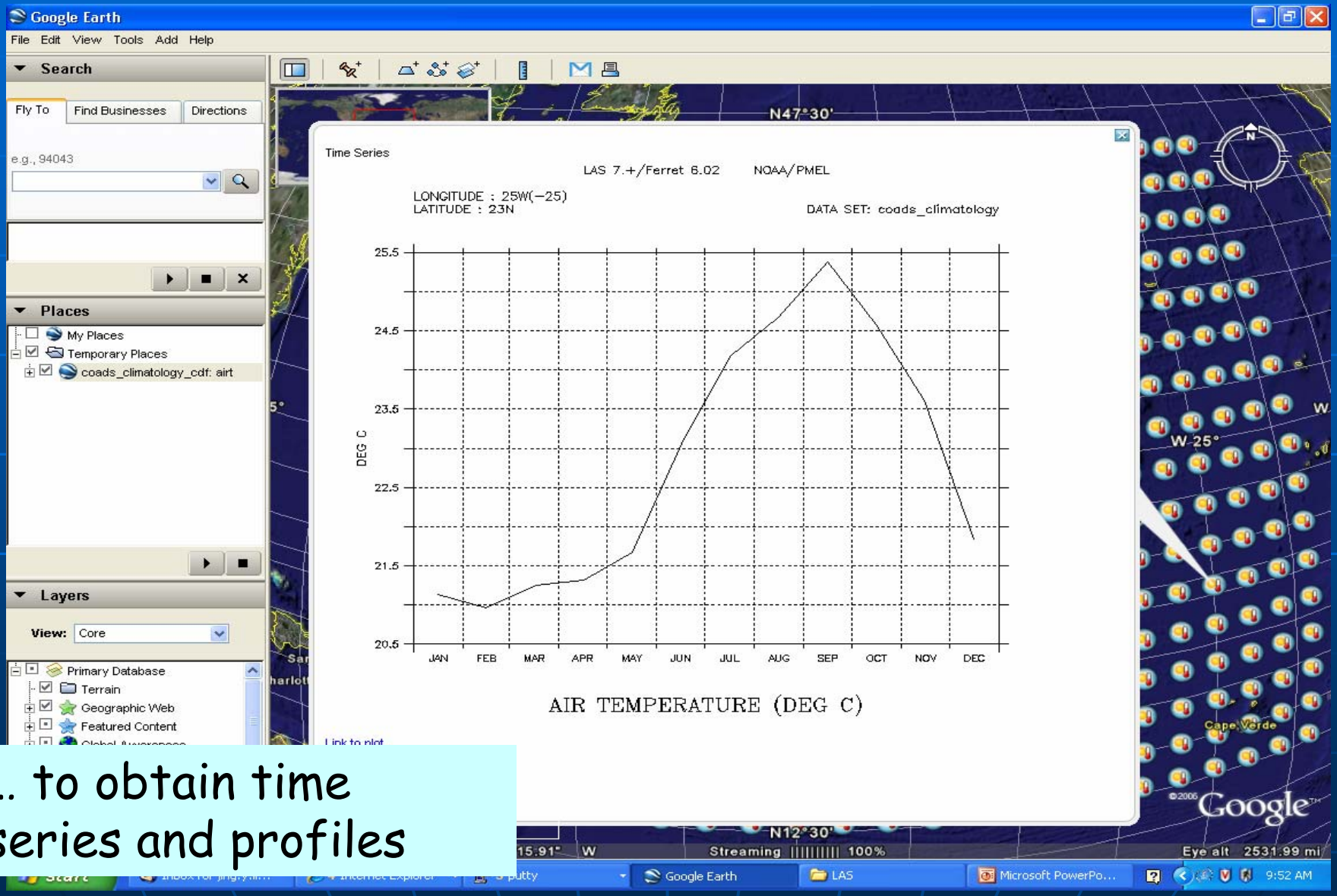
- Fine structure materializes as we zoom in

April '07



Can mark grid points on the globe

(COADS climatology example)



… to obtain time series and profiles

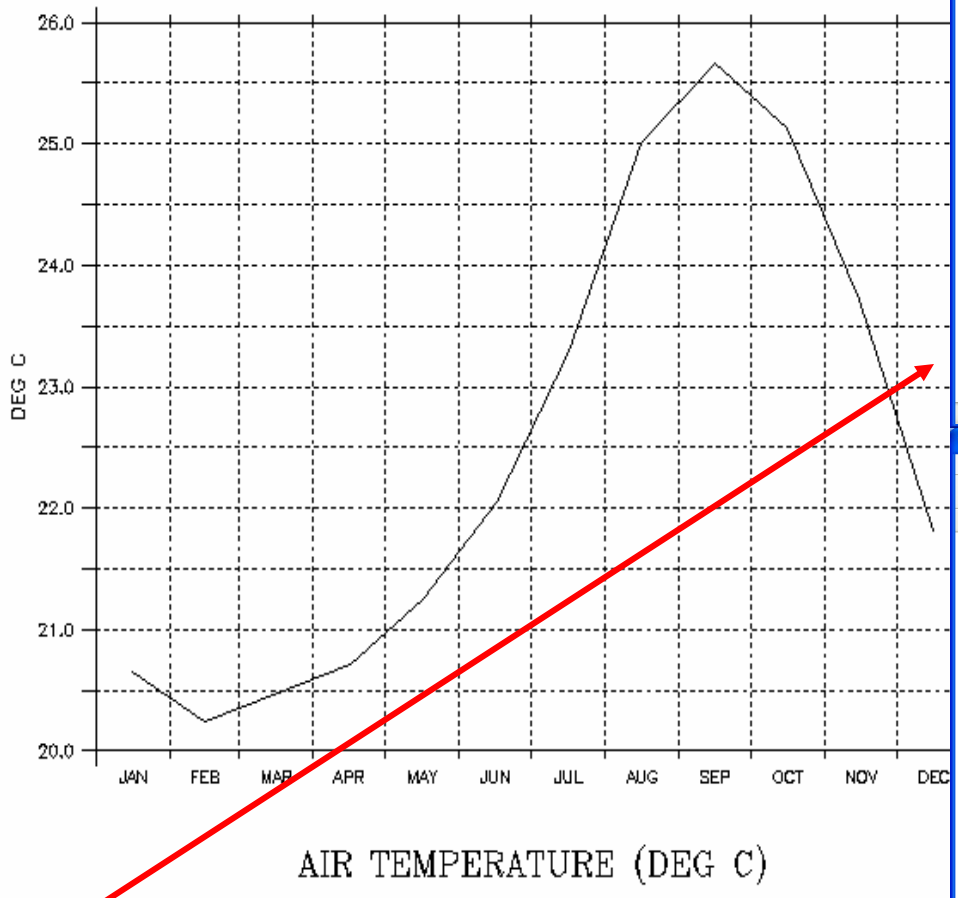
View plot/data on browser

Time Series

LAS 7.+/Ferret 6.02 NOAA/PMEL

LONGITUDE : 21W(-21)
LATITUDE : 19N

DATA SET: coads_climatolo



AIR TEMPERATURE (DEG C)

Link to plot
View data

Directions: To here - From here

GEServlet (GIF Image, 649x560 pixels) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

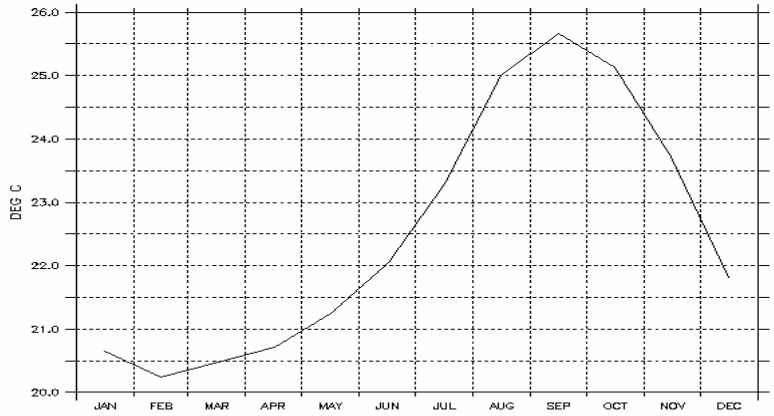
http://porter.pmel.noaa.gov:8922/lasge2/GEServlet

Getting Started Latest Headlines

LAS 7.+/Ferret 6.02 NOAA/PMEL

LONGITUDE : 21W(-21)
LATITUDE : 19N

DATA SET: coads_climatology



AIR TEMPERATURE (DEG C)

Done

Mozilla Firefox

File Edit View History Bookmarks Tools Help

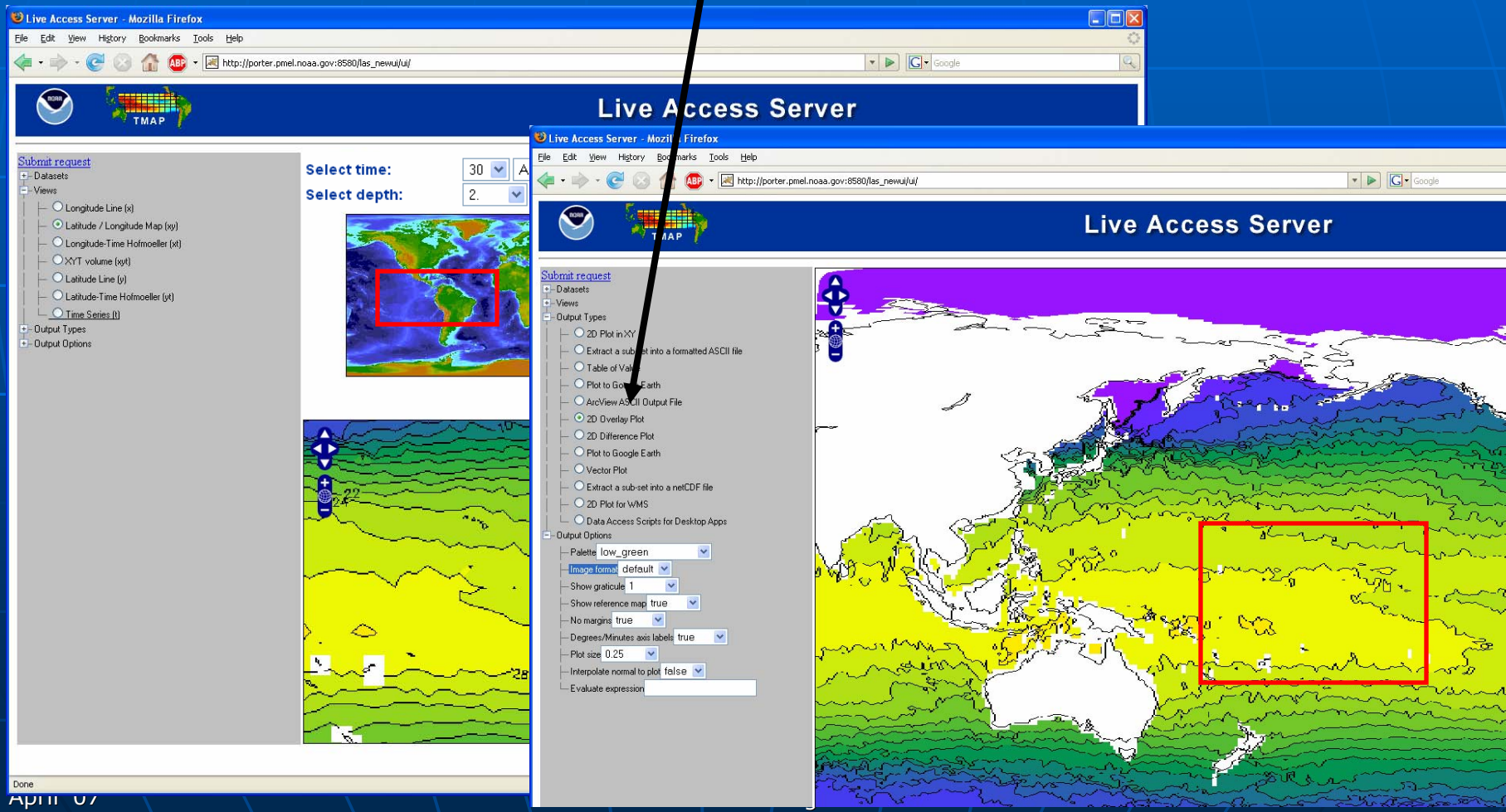
http://porter.pmel.noaa.gov:8922/lasge2/ProductS

Getting Started Latest Headlines

```
                VARIABLE : AIR TEMPERATURE (DEG C)
                FILENAME : coads_climatology.cdf
                FILEPATH : /home/porter/tmap/ferret/linux/fer_dsets/data/
                SUBSET   : 12 points (TIME)
                LONGITUDE: 21W(-21)
                LATITUDE : 19N
                      21W
                      -20
16-JAN          /   1:  20.65
15-FEB          /   2:  20.24
17-MAR          /   3:  20.48
16-APR          /   4:  20.71
16-MAY          /   5:  21.24
16-JUN          /   6:  22.06
16-JUL          /   7:  23.29
16-AUG          /   8:  25.01
15-SEP          /   9:  25.67
16-OCT          /  10:  25.13
15-NOV          /  11:  23.71
16-DEC          /  12:  21.81
```

Done

Future: FTP access can be integrated in. A single, uniform interface for many services.



Priorities for the next year

- Serve 1/12° global HYCOM as available
- Add SlideSorter to HCOM LAS
- Add access via Google Earth, WMS, WCS
- Implement metrics (details tbd)
  - incl. reference fields (e.g. GHRSST, Reynolds)
- Modernize user interface

- Other HYCOM Consortium suggestions …

Thank you