CNR Consiglio Nazionale delle Ricerche

ISMAR Istituto di Scienze Marine

A standard-based distributed framework for ocean models assessment

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OPEN International ACCESS WEEK

Motivations from the met/ocean community

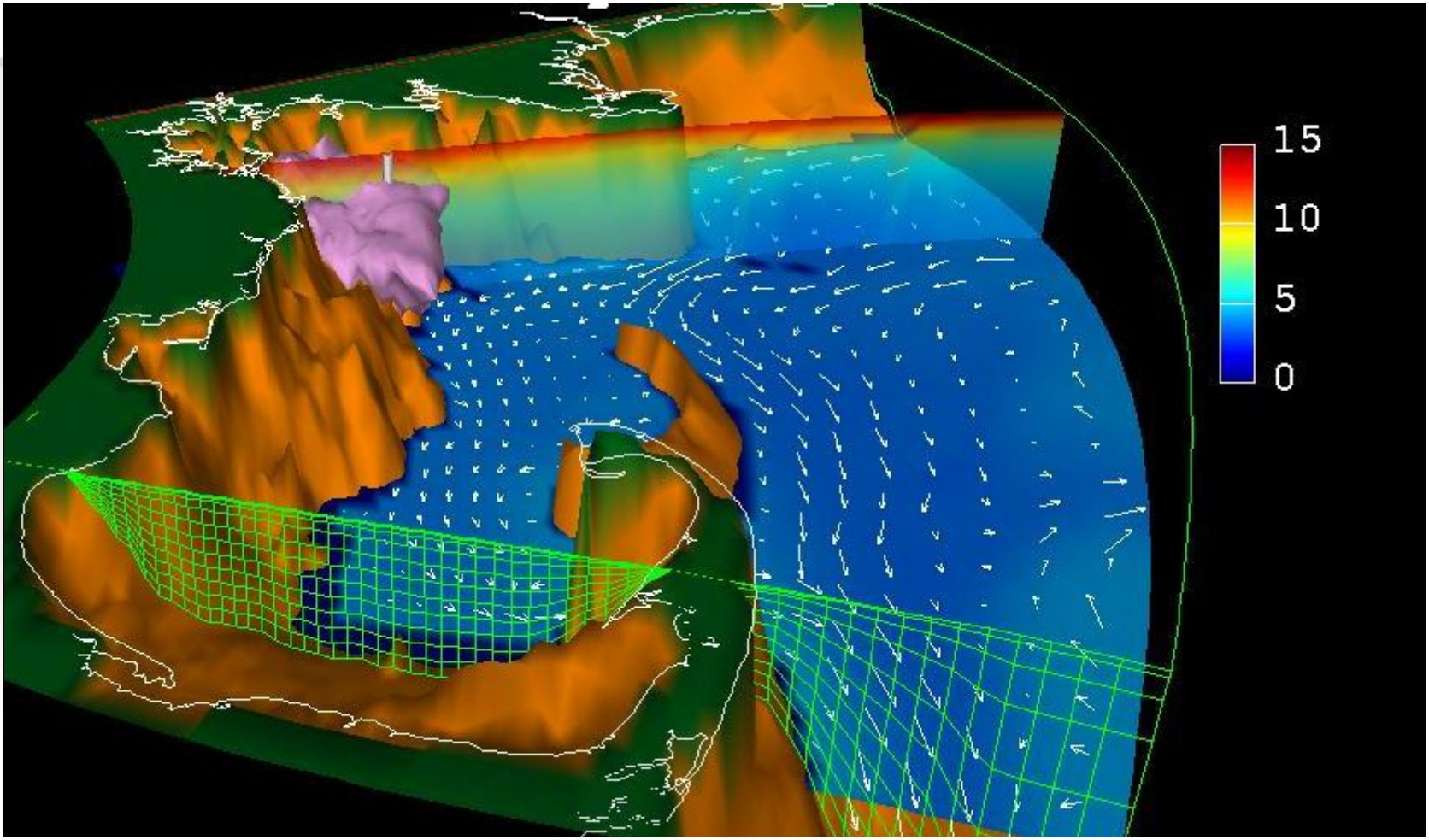
- *Growing ocean and coupled numerical model output (and data from observatories) production in the coastal environment and in the deep sea regions ("big data" problem)*

- *There is a lack of efficiency in data retrieving and exchange among scientists*

- *There is a strong need for a common platform for a more efficient data management and exploitation*

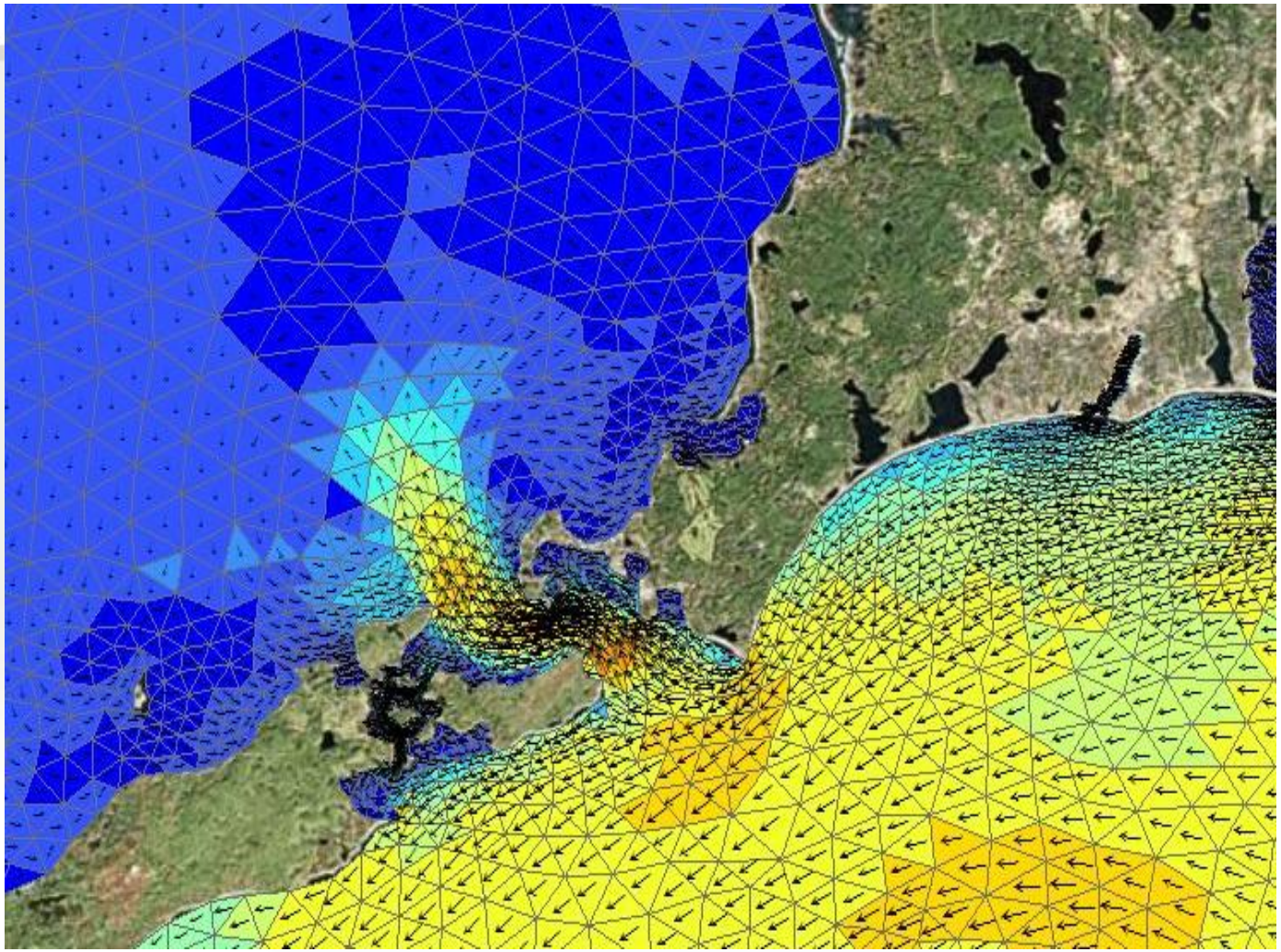
- *We face an increasing request of quick data/model visualization from third parties*

e.g.: grids not regularly spaced…



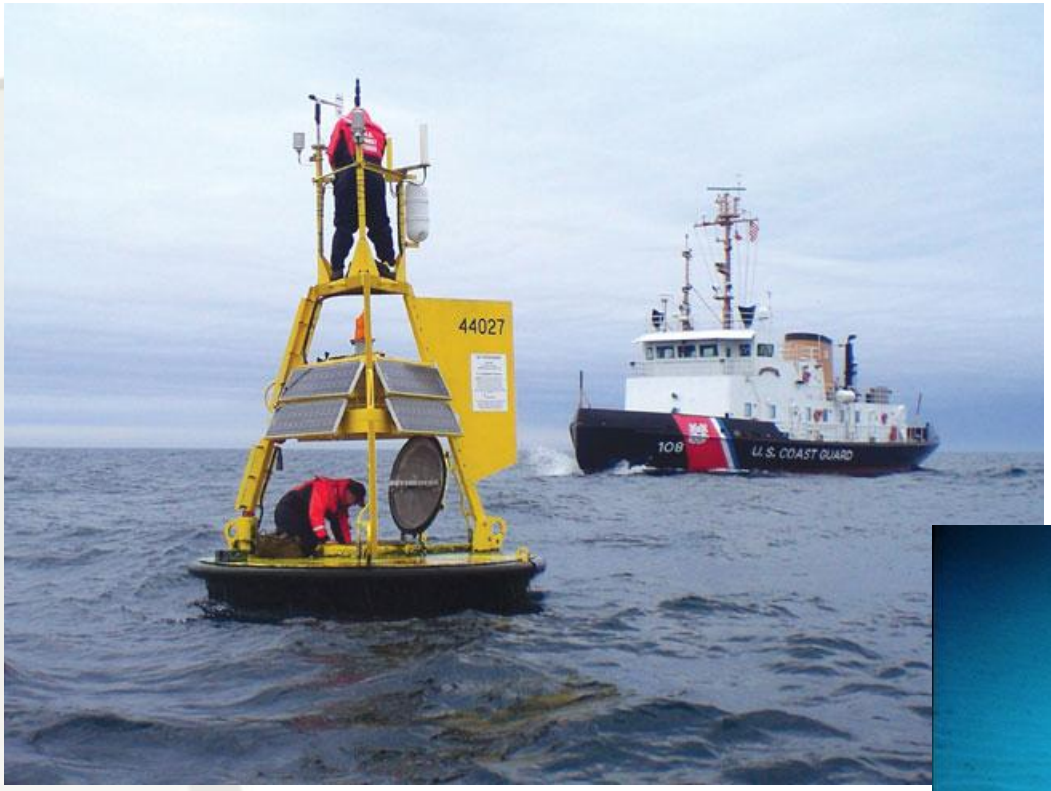
Courtesy of R. Signell

...sometimes unstructured...



Courtesy of R. Signell

...growing time series, at different positions...



Courtesy of R. Signell

Possible inspiring strategy: IOOS

IOOS® INTEGRATED OCEAN OBSERVING SYSTEM

- *Worldwide net of technician and technologies, allowing a common and standardized approach to data and protocols*
- *Effort to reach this goal at inter-national scale (in our case, improve the Mediterranean situtation)*
- *For: coastal, marine resources, emergency managers; physical and ecological oceanographers; local, international "policymakers"; anybody using the sea for recreational purposes!*

IOOS core principles

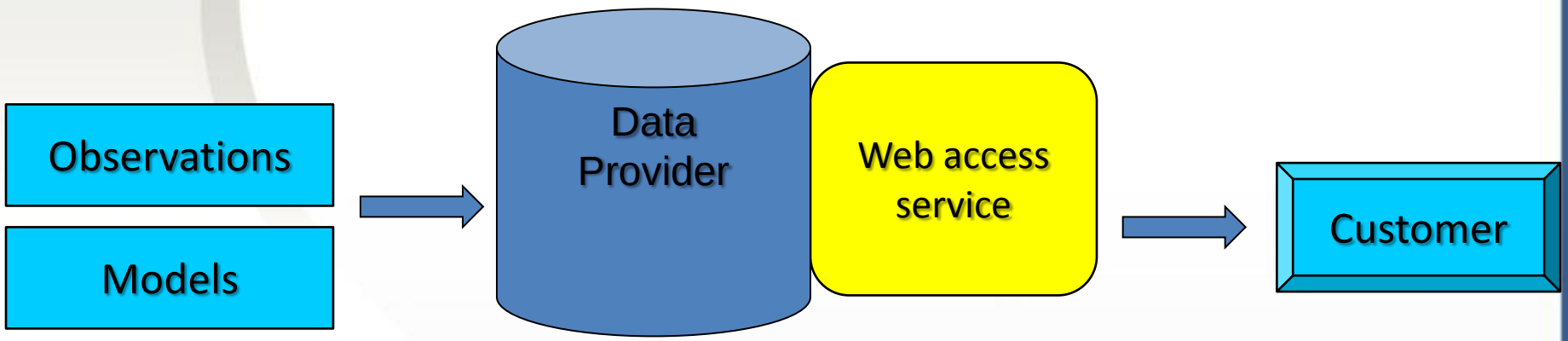
- **Adopt open standards & practices**

OGC® Open Geospatial Consortium, Inc.

ISO International Organization for Standardization

unidata

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



Courtesy of R. Signell

NetCDF Climate and Forecast (CF) conventions can provide a solution

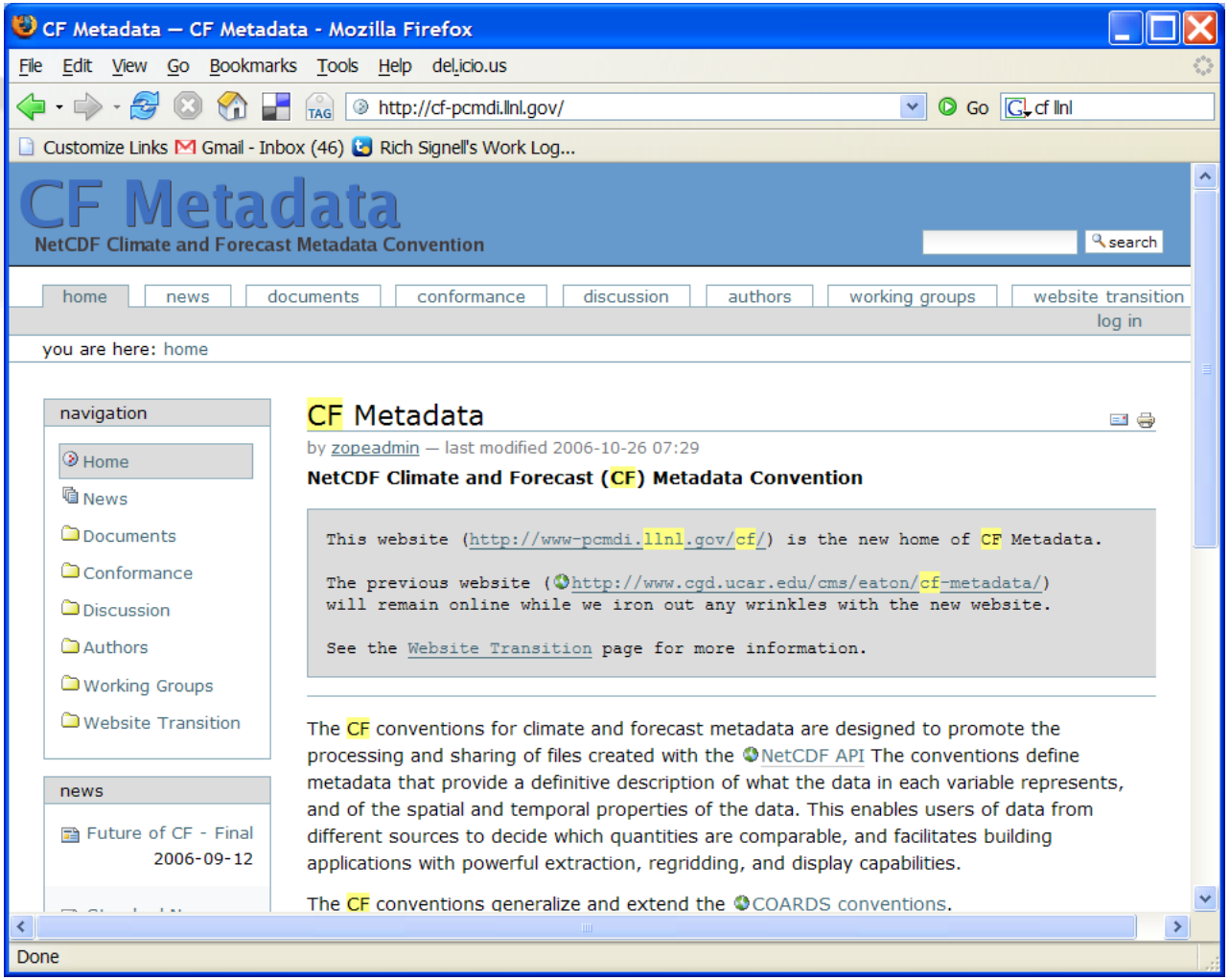
Groups using CF:

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)



CF Convention Draft Spec for Unstructured Grid: http://bit.ly/ugrid_cf

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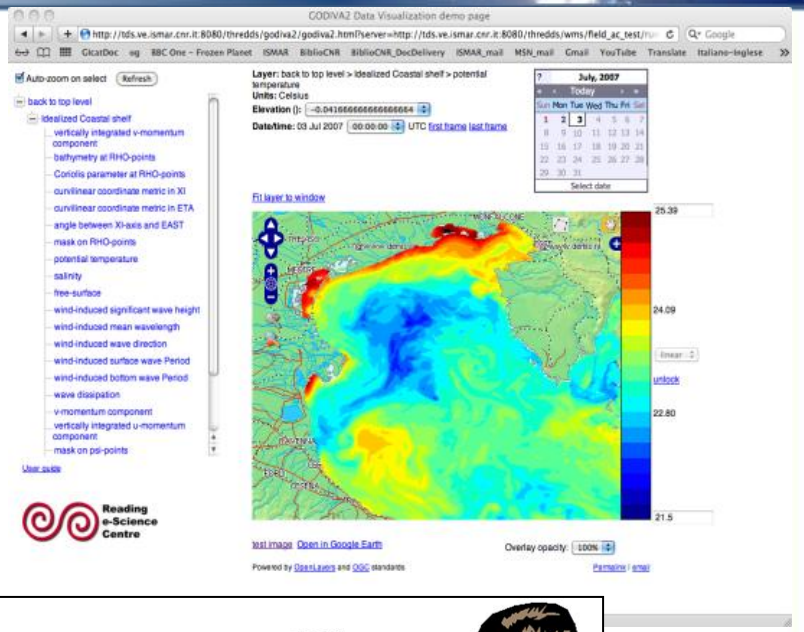
From standardized data to THREDDS

-To mitigate the lack of efficiency in data retrieving and exchange among scientists

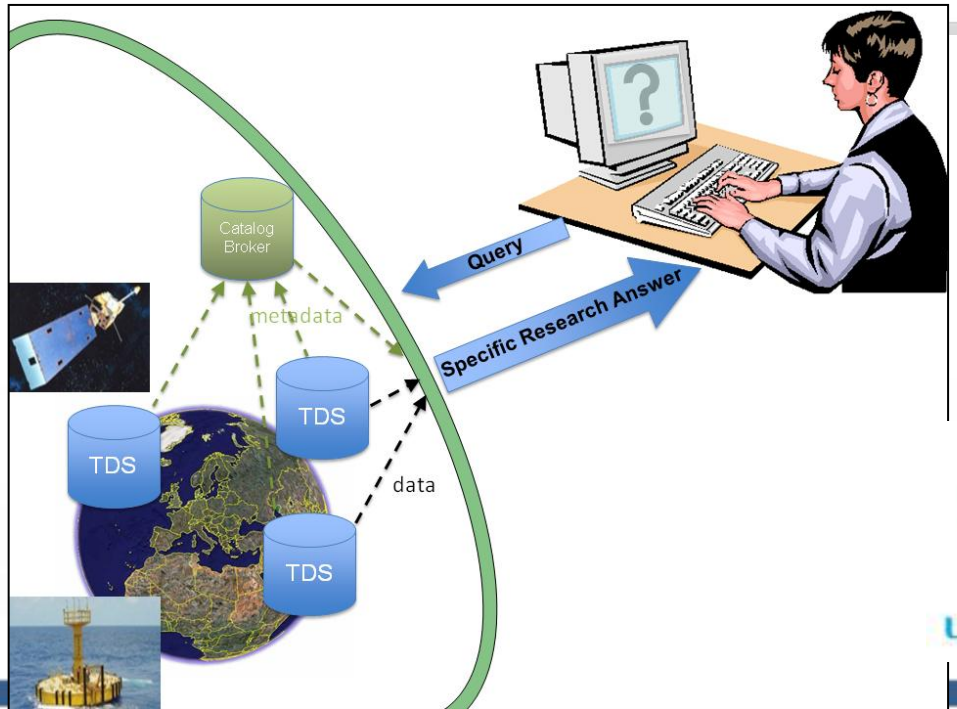
-To aim at common platform for data management

THREDDS (Thematic Real-time Environmental Distributed Data Services)

Middleware to bridge the gap between data producers and data users



THREDDS



USGS science for a changing world

unidata

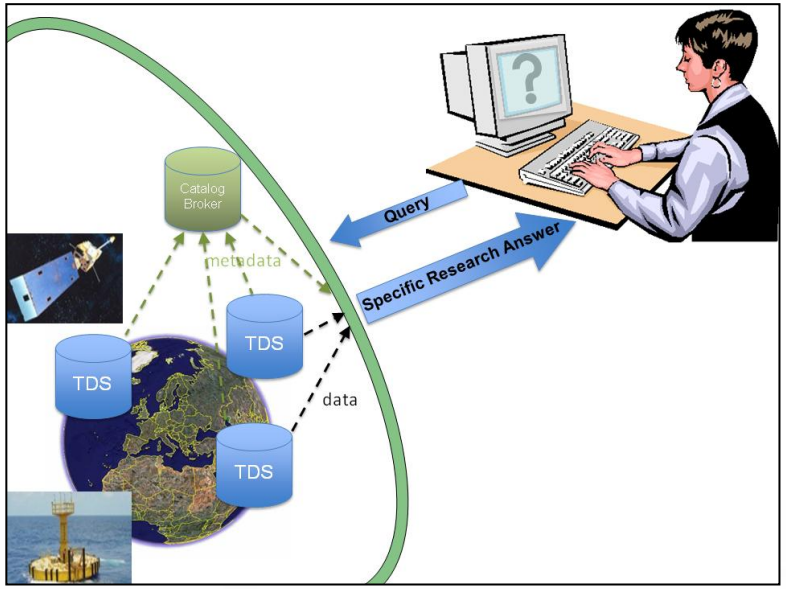
THREDDS Data Server?

- *The THREDDS Data Server (TDS) is a web server that provides metadata (to end users or brokering systems) and access to the scientific datasets content using OPeNDAP, OGC WMS and WCS, HTTP…*
- *Besides providing access to the metadata, the TDS allows to access the data contents as well*
- *The TDS can aggregate several files into virtual datasets, freeing the user from annoying details (e.g. storage and naming) and providing a much easier access to large datasets*

THREDDS Data Server?

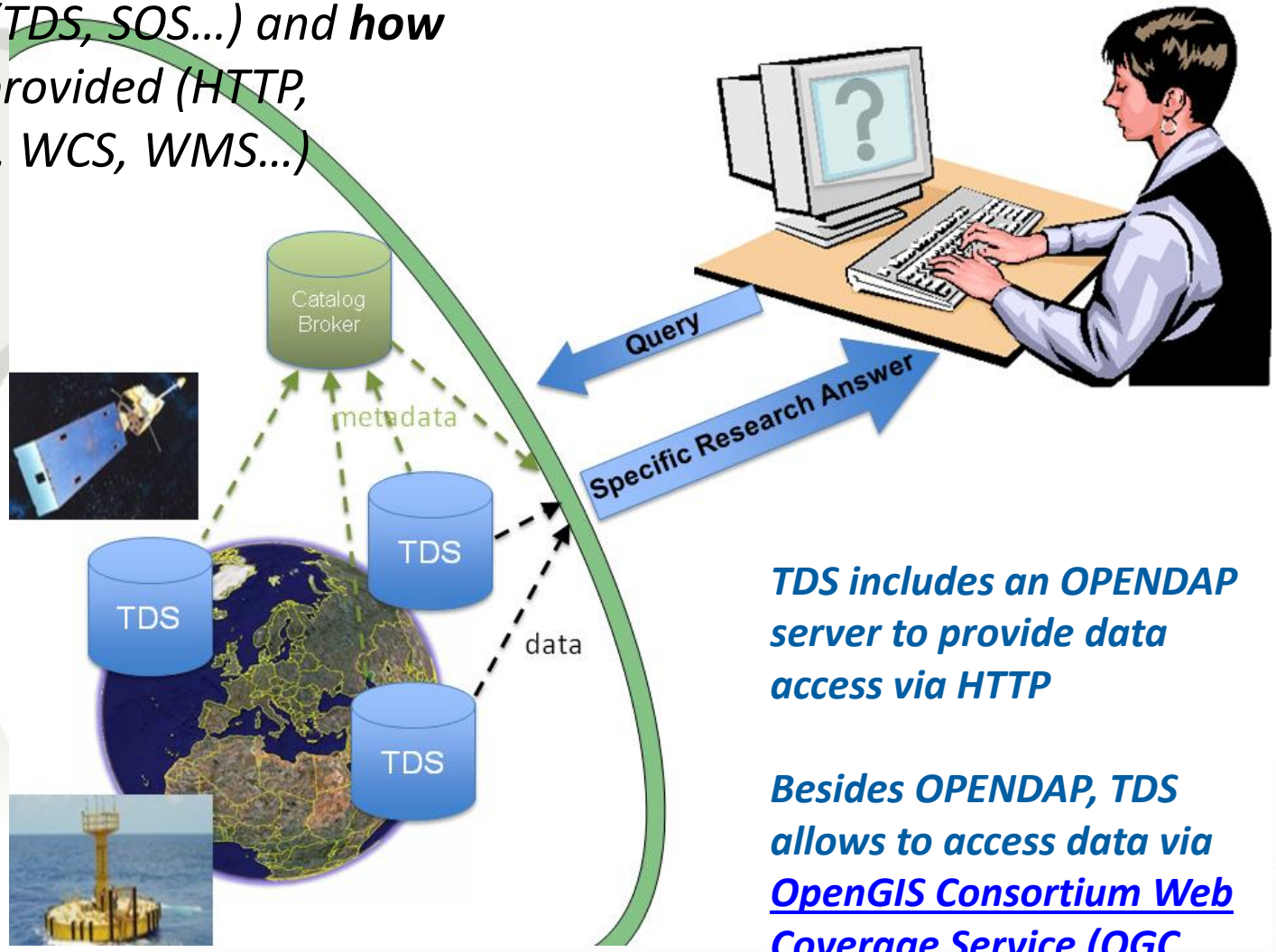
Bottom line: to improve the scientific data access we need a "Common Data Model" (CDM). So I can also talk with a "broker"…

UNIDATA, www.unidata.ucar.edu (US University consortium) developed a common API for different datatype employed by the scientific community



The brokering advantage

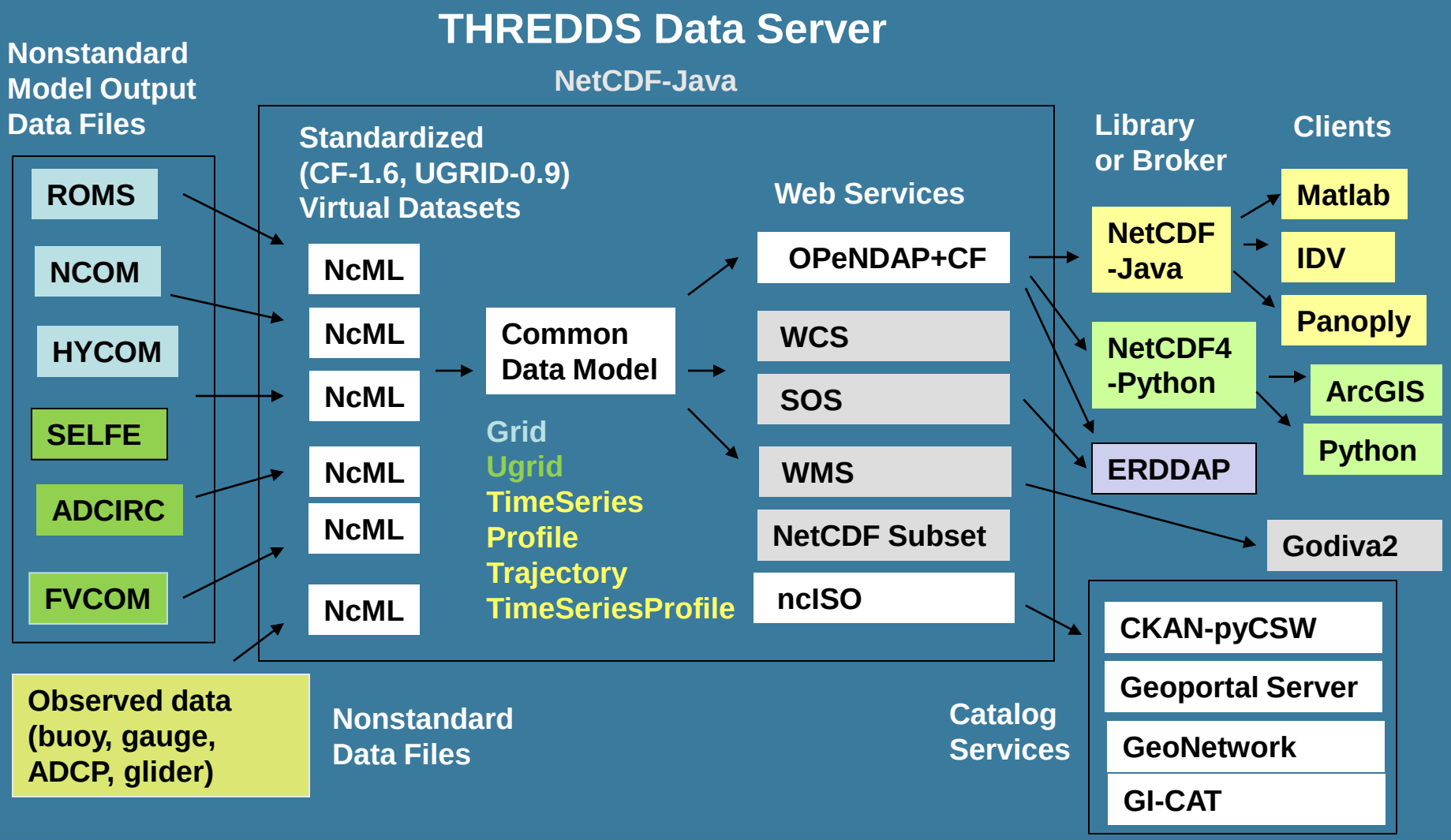
*Gi-CAT: looking for data? I tell you **who** (TDS, SOS…) and **how** they are provided (HTTP, OPENDAP, WCS, WMS…)*



TDS includes an OPENDAP server to provide data access via HTTP

Besides OPENDAP, TDS allows to access data via OpenGIS Consortium Web Coverage Service (OGC WCS) protocol

IOOS Data Infrastructure Diagram



Courtesy of R. Signell

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Some benefits

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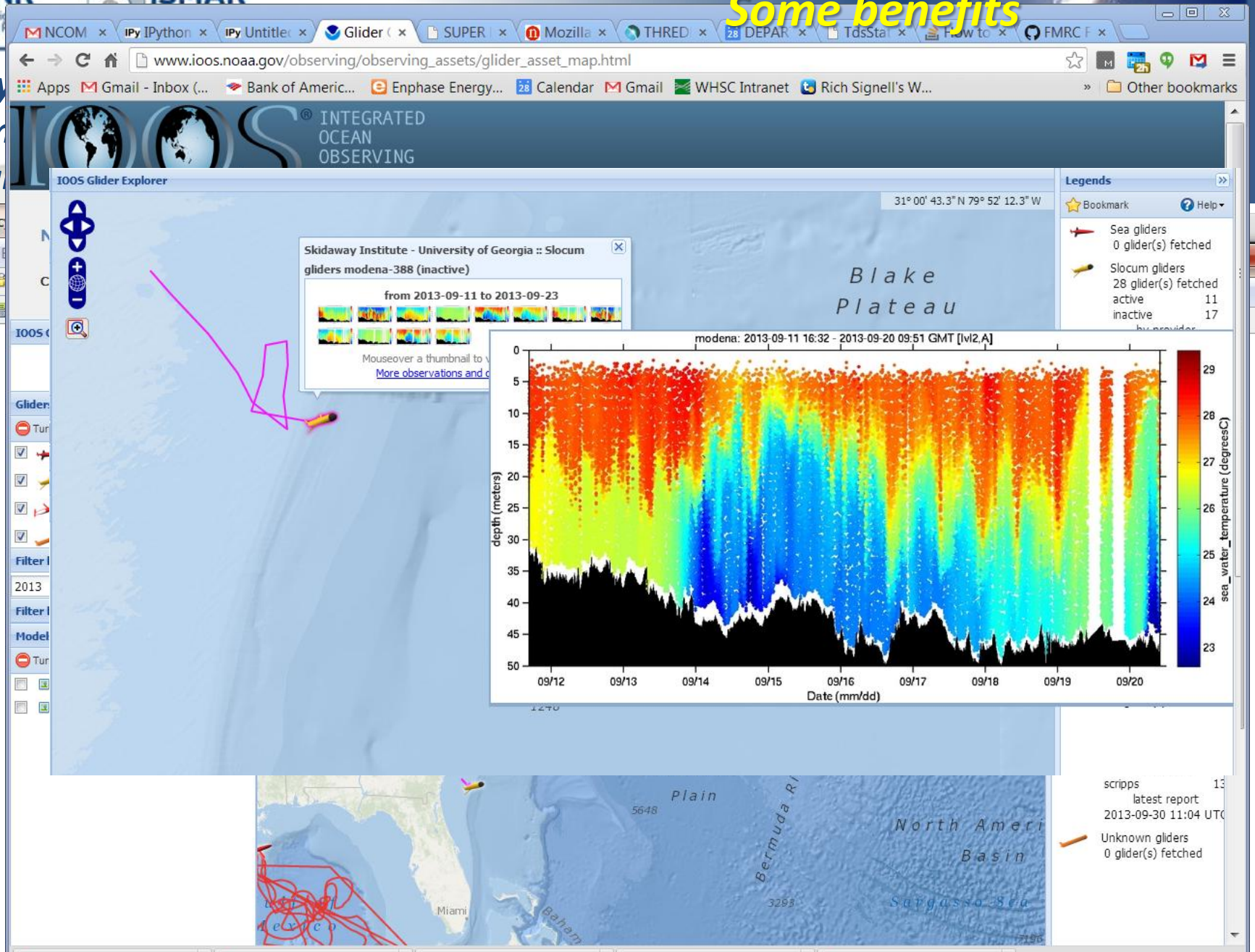

Vantaggio della comunità oceanografica

ELSEVIER

Available online at www.sciencedirect.com
ScienceDirect
Journal of Marine Systems 69 (2008) 154–161

JOURNAL OF MARINE SYSTEMS
www.elsevier.com/locate/jmarsys

Collaboration tools and techniques for large model datasets

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[d] Rudjer Boskovic Institute, Center for Marine and Enviro

10th International Conference on Hydroinformatics
HIC 2012, Hamburg, GERMANY

DISTRIBUTION OF FIELD SURVEY DATA AND "MIKE" MODEL RESULTS - AN APPROACH WITH SQL AND THREDDS

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that are already part of
DDS data server with
CDF files. The same
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Knowledge discovery in large model datasets in the marine environment: the THREDDS Data Server example

A. Bergamasco[a], A. Benetazzo[a], S. Carniel[a*], F.M. Falcieri[a], T. Minuzzo[a], R.P. Signell[b] and M. Sclavo[a]

Ritmare
La ricerca italiana per il mare

5 different actions, all sharing large output modeling products

Most UO agreed on delivering at least NetCDF output file and delivering final model products on a distributed TDS system

Action 1	**NetCDF**	**TDS**	**(1/2 TDS)**
Action 2	**NetCDF**	**TDS**	
Action 3	**NetCDF**	**TDS**	**(3/5 NetCDF, 1/5 TDS)**
Action 4	**NetCDF**	**TDS**	**(1/3 NetCDF, 0/3 TDS)**
Action 5	**NetCDF**	**TDS**	**(1/3 TDS)**
Action 6	**NetCDF**	**TDS**	

SP3-WP4-Az2 RITMARE TDS

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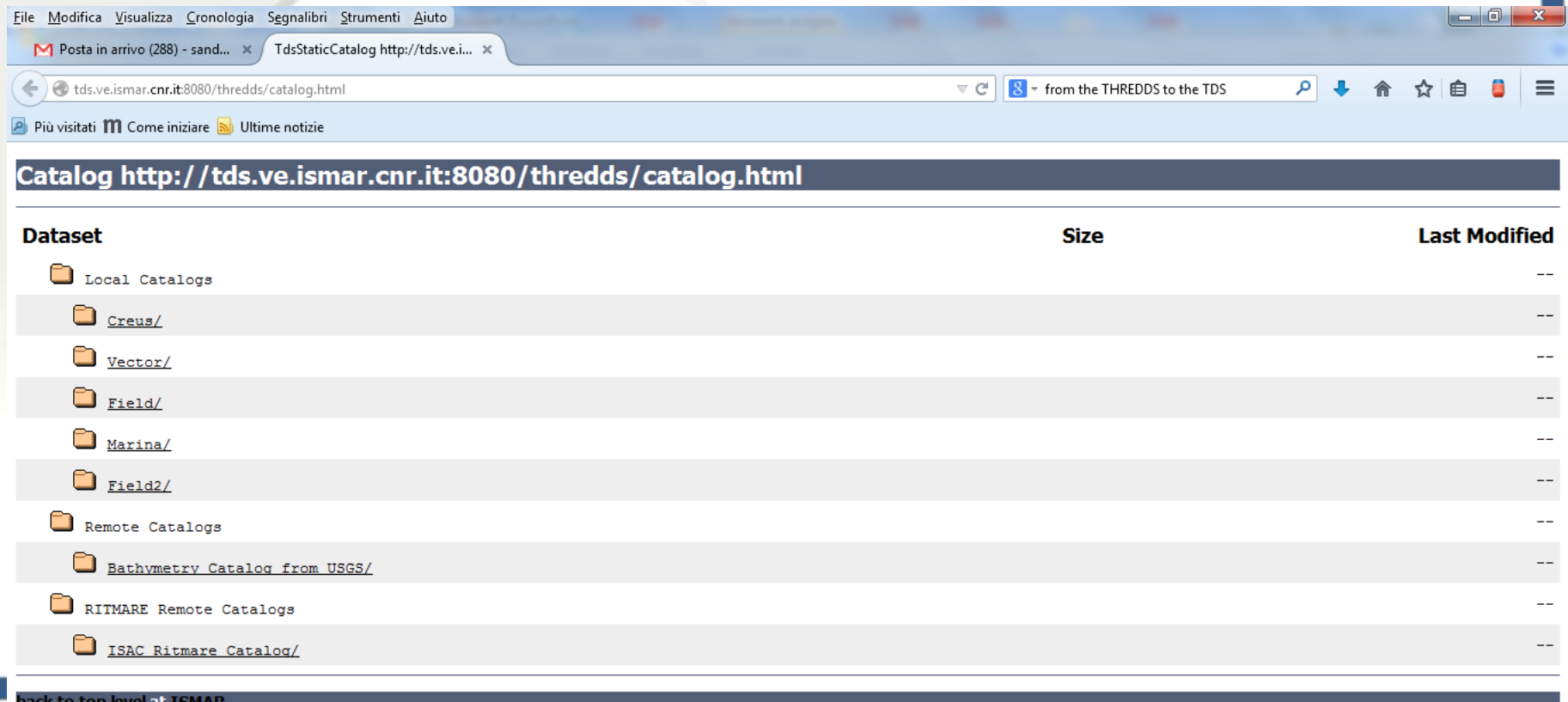
Ritmare
La ricerca italiana per il mare

http://tds.ve.ismar.cnr.it:8080/thredds/catalog.html

http://utmea.enea.it:8080/thredds/catalog/RITMARE/catalog.html



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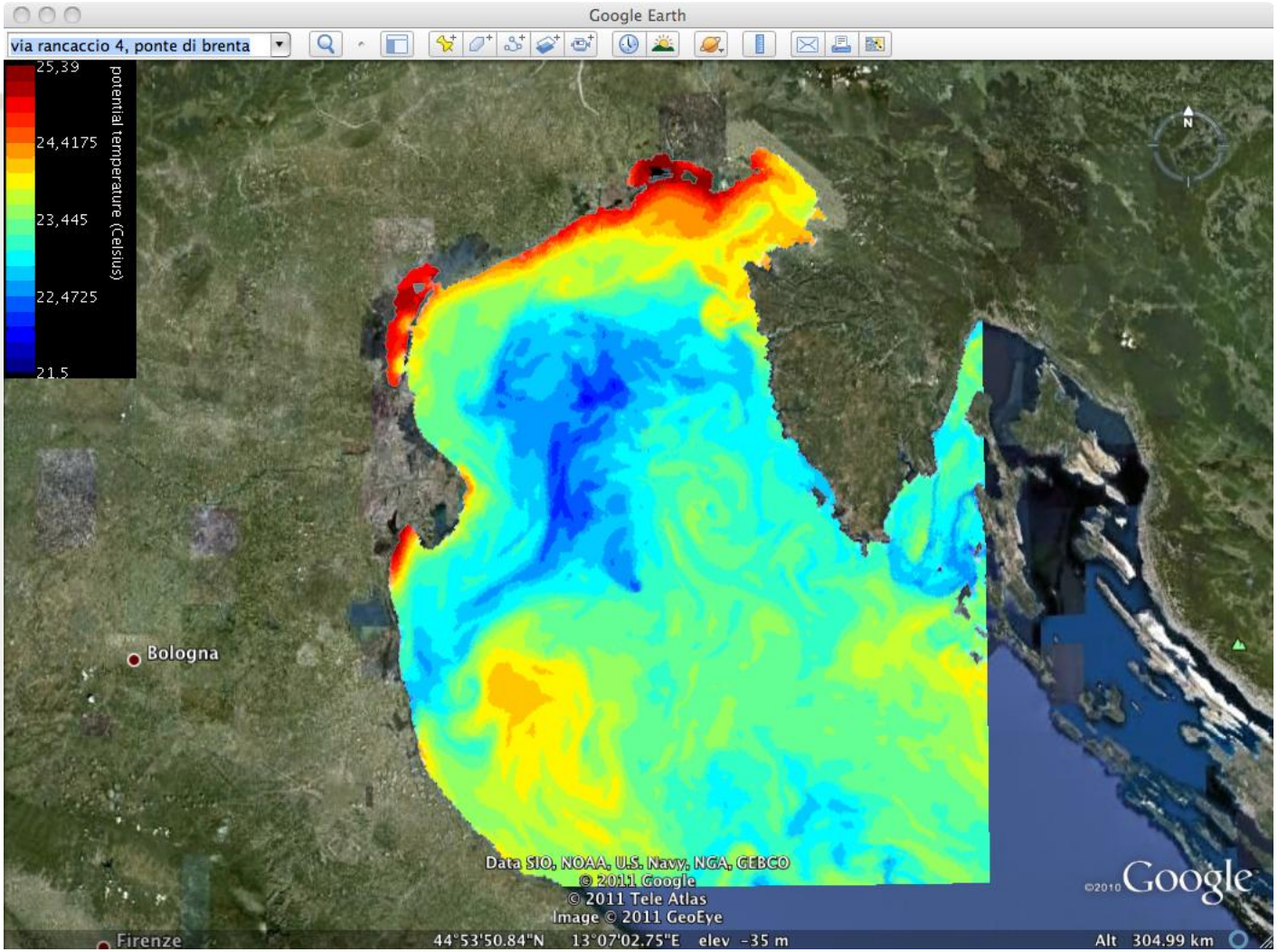
Quick visualization using Google Earth



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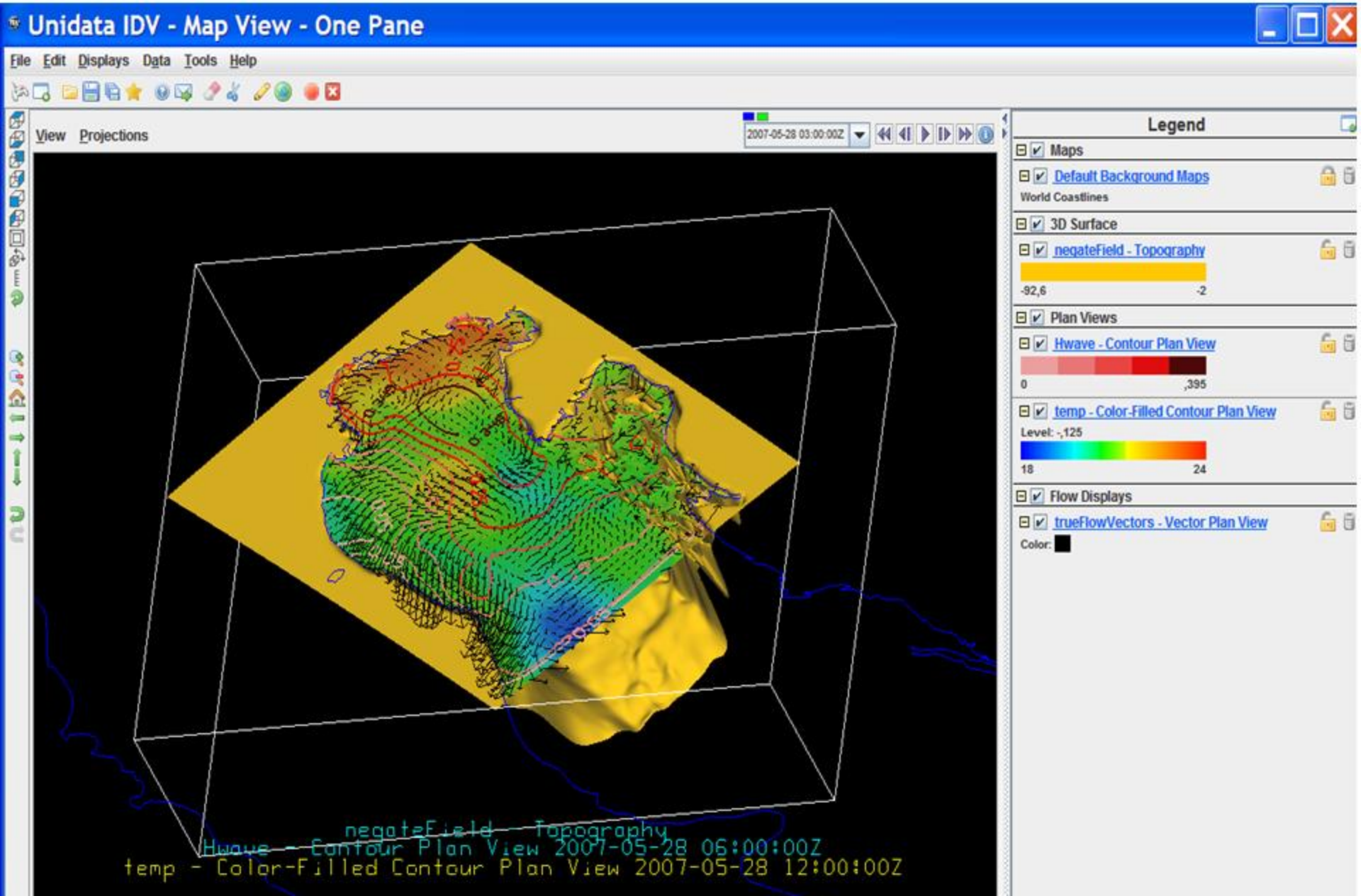
More complex figures using IDV…



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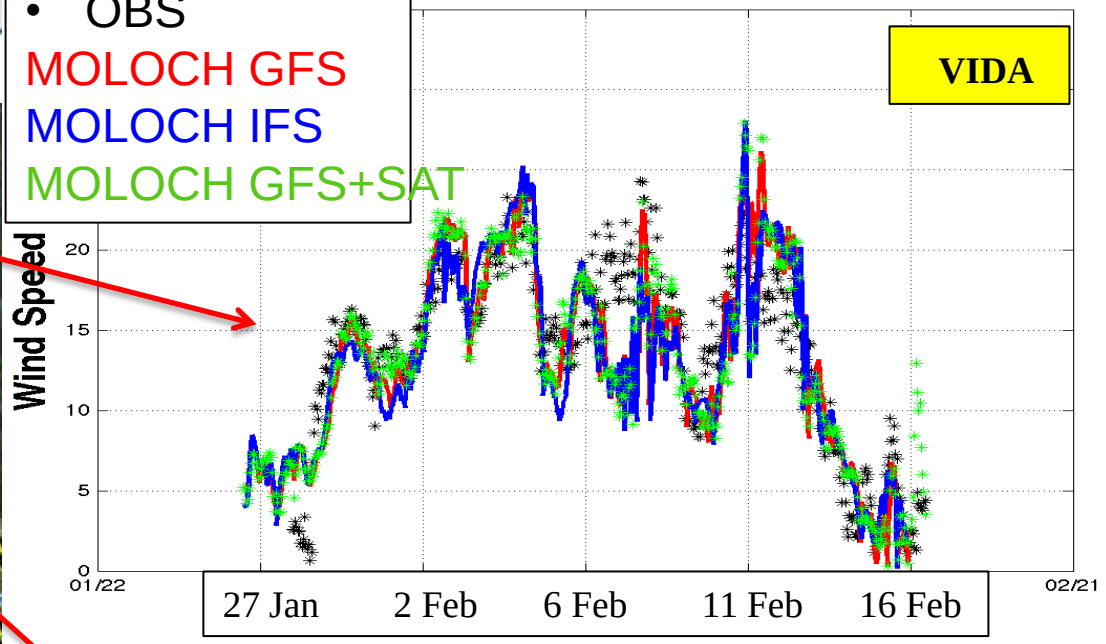
...model comparison

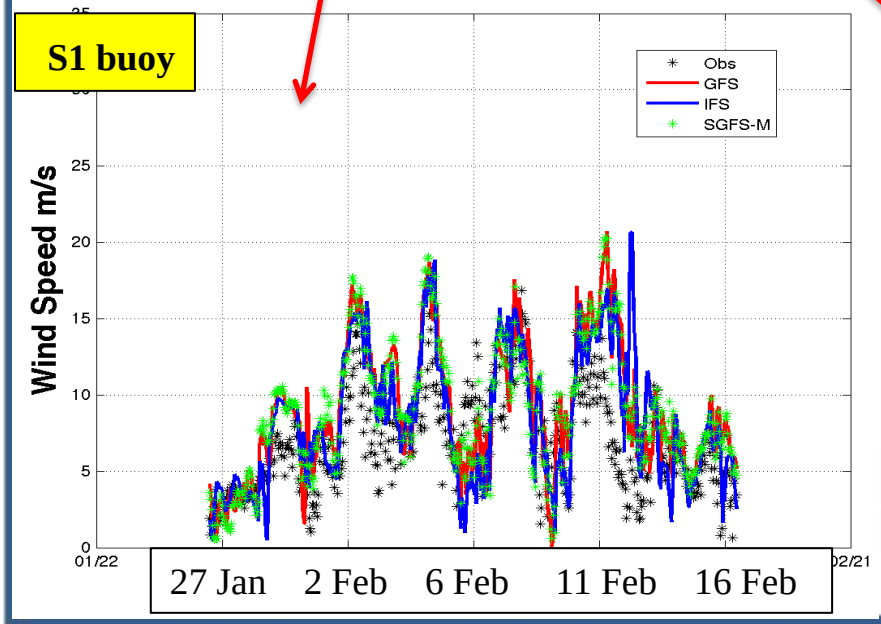
- OBS

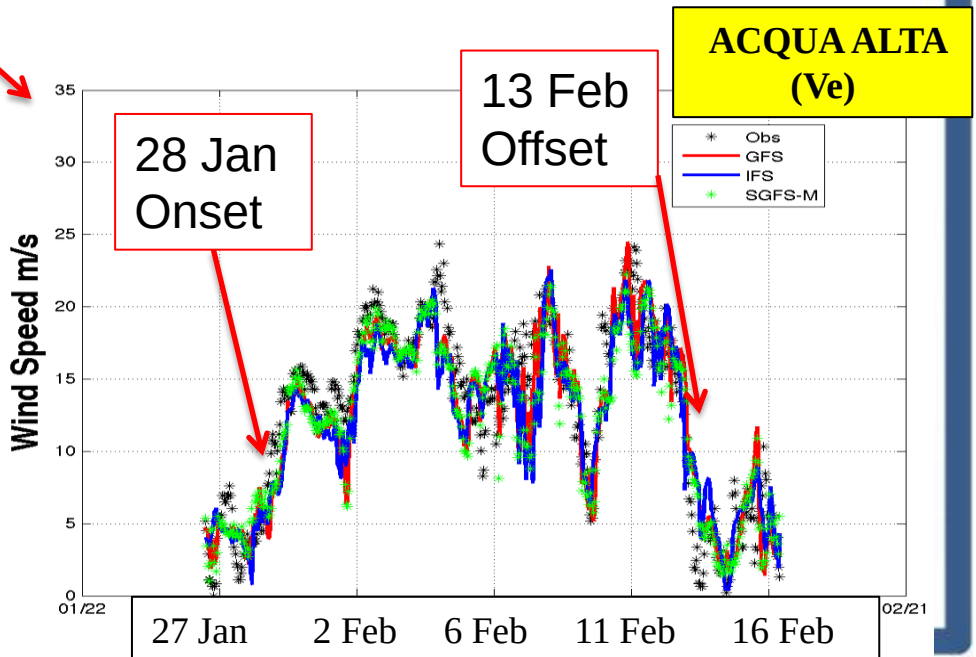
MOLOCH GFS

MOLOCH IFS

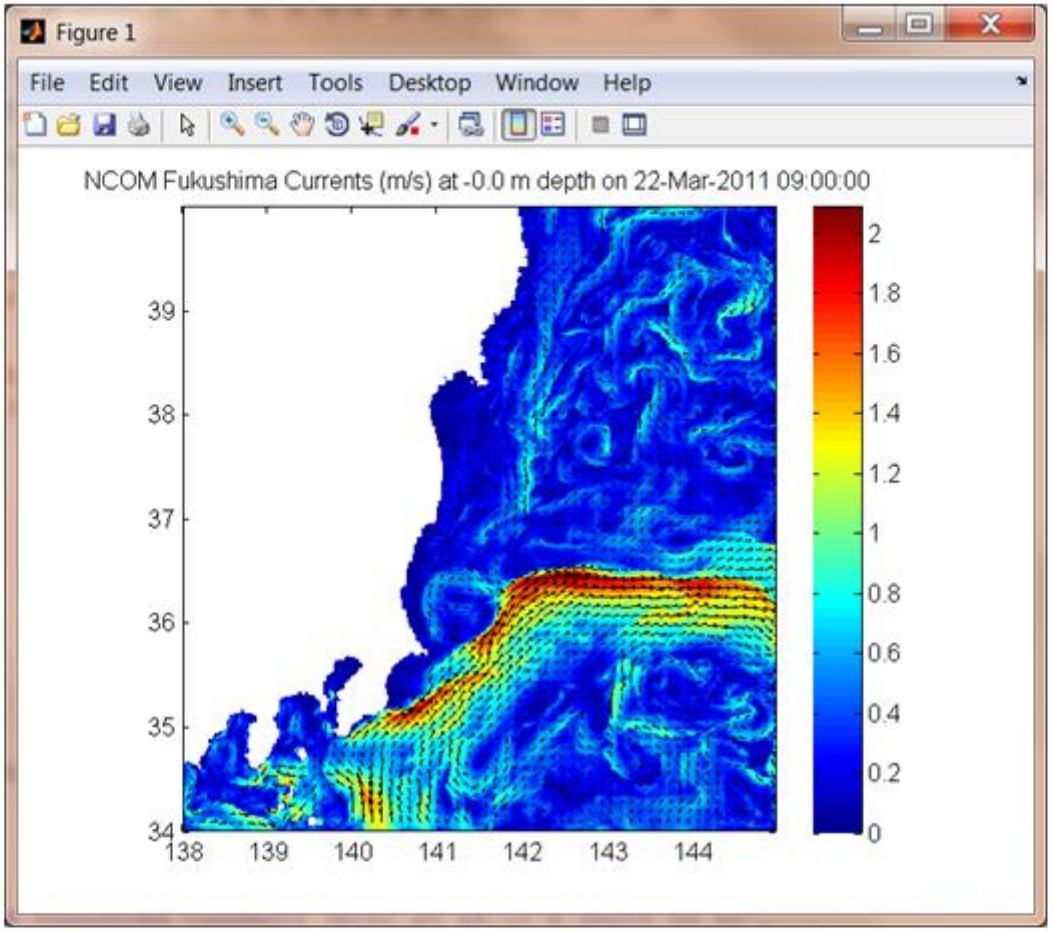
MOLOCH GFS+SAT







...or MATLAB scripts




```
url=['http://edac-dap3.northerngulfinstitute.org/'...
 'thredds/dodsC/ncom_fukushima_agg/Fukushima_best.ncd'];
nc=ncgeodataset(url);
u=nc{'water_u'}(100,1,1:2:end,1:2:end);
v=nc{'water_v'}(100,1,1:2:end,1:2:end);
g=nc{'water_u'}(100,1,1:2:end,1:2:end).grid;
w=double(squeeze(complex(u,v)));
pcolorjw(g.lon,g.lat,abs(w))
```

Bergamasco et al., 2012. AIOL

Final Considerations

We have a standard-based, distributed and robust framework that allows ocean model assessment for everyone ("Reproducible Science")

This framework has been promptly and smoothly adopted in existing projects (e.g. RITMARE SP3-WP4-AZ2)

Results: within RITMARE Project, this allowed:

- a real model interoperability,
- a better use of existing models,
- a much easier output exchange,
- an easier visualization and analysis,

…overall, positive feedback for better models!

Final Considerations

Problems:

different work approach,
real attitude to open data policy,
need to enforce the procedure,
data vs paper relevance in our scientific context,
technical: structured/unstructured grids…
performances…

Ongoing efforts: Ipython Notebook -the user interface is the browser, but the notebook server can run anywhere (free!), and can be placed close to the data (e.g. on your cluster) enabling much more efficient data access for analysis and visualization