



Sea Surface Temperature Distribution from the Physical Oceanography DAAC

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<http://podaac.jpl.nasa.gov>

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Columbia, MD
30 Apr 2014





Outline

- * Physical Oceanography DAAC organization
- * MODIS SST datasets
- * Web site for dataset discovery
- * Tools and web services
- * Examples of use
- * Summary and Future



MODIS SST data

- * Level 3
 - * Daily/Weekly/Monthly/Annual 4km/9km 4 μ m/11 μ m SST from Aqua and Terra
 - * Identical to SST datasets distributed by NASA OBPG
 - * Also ChlA from Aqua as “remote” dataset
- * Level 2
 - * GHRSSST L2P Aqua/Terra 5 minute granules
 - * Full suite of uncertainty statistics
 - * Joint production via JPL/OBPG/RSMAS



MODIS SST data

- * Level 4
 - * L2 MODIS SST appears in a number of daily global merged datasets
 - * 1 km Multiscale Ultrahigh Resolution (MUR)
 - * 9km REMMS mw+ir_oi
 - * Different approaches to blending: optimal interpolation vs. resolution preserving wavelets (and others, e.g. 3D VAR etc.)
 - * MODIS is the only sensor that gives 1 km global daily coverage



Redesigned Web portal

A screenshot of the redesigned PODAAC web portal. The page has a dark blue header with the PODAAC logo and navigation links. The main content area is divided into several sections: a large featured image of a surfer, a search sidebar, an announcements section, an ocean stories section, an image of the day section, and a spotlight section. The design is clean and modern, with a focus on visual storytelling and easy navigation.

podaac
Physical Oceanography Distributed Active Archive Center

Follow Us: Data Search

Home Dataset Discovery Data Access Measurements Missions Multimedia Community About

Search
Access
Visualize
Help

Waves and Satellites: Chasing the Big Ones (January 2014)
To support surfers in determining where and when to surf, multiple services have developed detailed surf forecast products for popular and remote surf locations throughout the world.

Announcements

NAVO Data
Friday, March 28, 2014

UPDATE: ASCAT wind products unavailable due to EPS ground segment anomaly
Thursday, March 27, 2014

ASCAT wind products unavailable due to EPS ground segment anomaly
Wednesday, March 26, 2014

More >

Events
System Alerts

Ocean Stories Dataset Highlights Images Animations

Waves and Satellites: Chasing the Big Ones (Januar...
Tue, 01/14/2014
To support surfers in determining where and when to surf, multiple services have developed detailed surf forecast products for popular...

AQUARIUS detects effects of an extreme Mississipp...
Mon, 11/11/2013
The Mississippi River is the largest river in North America, draining ~41% of the contiguous United States. More than half of the...

More Ocean Stories >

Image of the Day

Sea Surface Height Anomaly: SARAL and Jason-2 Measurements from 22-Mar-2014 to 01-Apr-2014

Spotlight

MISSING FLIGHT 370 **KATHLEEN BOHAN** **Research Captain 63244**

Creator of PO.DAAC's OSCAR dataset on NBC News
How ocean currents play into the efforts to find the Malaysia Airlines Flight 370.

More Spotlights >>



Web portal – Data discovery

The screenshot displays the PODAAC web portal interface. At the top, a navigation menu includes links for Home, Dataset Discovery, Data Access, Measurements, Missions, Multimedia, Community, and About. A search bar is located in the top right corner.

The main content area is divided into several sections:

- Left Sidebar:** Contains navigation options: Search, Access, Visualize, and Help.
- Filter Panel:** A vertical list of filter categories: Parameter, Collections, Platform, Sensor, Spatial Coverage, and Latency.
- Dataset List:** Titled "Datasets grouped by the instrument used to acquire data." It lists various sensors with their respective dataset counts:
 - InSitu (16)
 - JMR (20)
 - LRA (7)
 - MODIS (63) - A red arrow points to this entry.
 - MTSAT 1R Imager (2)
 - MTSAT 2 Imager (2)
 - Model (1)
 - NSCAT (9)
 - OSCAT (1)
 - POSEIDON ALTIMETER (14)
- Search Box:** A text input field labeled "Search for Datasets:" with a placeholder "Enter Dataset Keyword" and a search button.
- Announcements:** A section with a yellow header containing news items:
 - OSI SAF Service message - wind product outage 29 april due to planned in-plane manoeuvre (Monday, April 28, 2014)
 - Aquarius v2.0 March 2014 data now available (Tuesday, April 15, 2014)
 - Discontinuation of OSCAT Data Retrieval (Thursday, April 10, 2014)
- Events and System Alerts:** Two sections below the announcements.
- Bottom Row:** Three featured content blocks:
 - Ocean Stories:** Includes a tabbed interface with "Dataset Highlights" selected. A story titled "How can ocean currents help with finding a missing..." is visible.
 - Image of the Day:** Displays a global map with a color-coded overlay representing ocean data.
 - Spotlight:** Shows a photograph of people gathered around a computer monitor, likely in a meeting or presentation.



Web portal – Data documentation

Home **Dataset Discovery** Data Access Measurements Missions Multimedia Community About

Parameter Collections Platform Sensor Spatial Coverage Latency

Select Filter

Processing Levels

Any processing level

- Level-2 (Swath) (2)
- Level-3 (Grid) (50)
- Level-4 (Blended) (11)

Swath Spatial Resolution

Any swath spatial resolution

- 1 km (2)

Grid Spatial Resolution

Any grid spatial resolution

- 0.01 degree(s) (7)
- 0.03 degree(s) (1)
- 0.04 degree(s) (26)
- 0.05 degree(s) (1)
- 0.08 degree(s) (26)

Temporal Resolution

Any temporal resolution

- 8 days (12)
- Annual (12)
- Daily (24)
- Monthly (13)

Parameter

All Products > Sensor: MODIS

Dataset Discovery

Found **63** matching dataset(s).

[Need help selecting a dataset?](#)
[Contact a PO.DAAC Data Engineer](#)

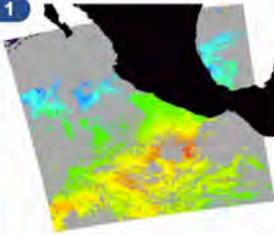
[Advanced search](#)

View mode:  

Sort By

Prev **1** 2 3 4 5 6 7 Next

1



GHRSSST Level 2P Global Skin Sea Surface Temperature from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Aqua satellite (JPL-L2P-MODIS_A)

Ocean Temperature

Platform/Sensor: AQUA/MODIS

Processing Level: 2P

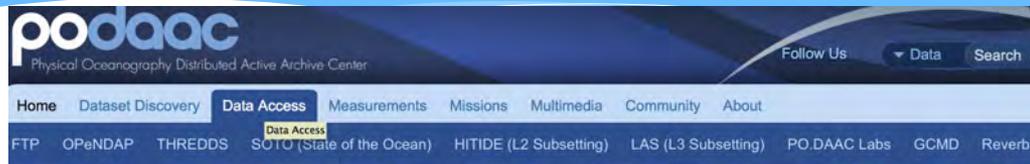
Along/Across Track Resolution: 1 km x 1 km

Start/End Date: 2006-Jun-30 to Present

Description: The Moderate-resolution Imaging Spectroradiometer (MODIS) is a scientific instrument (radiometer) launched by NASA in 2002 on board the Aqua satellite platform (a second series is on ... [more](#))



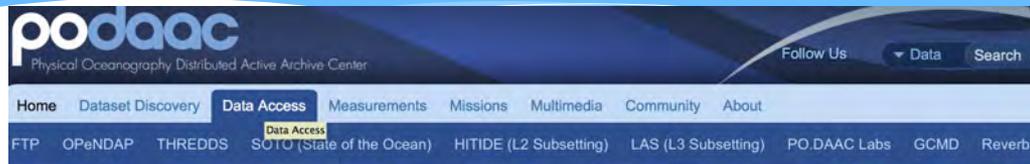
Distribution/Tools/Services



- * FTP: still serves the majority of our users, although number of users are dropping
- * OPeNDAP and THREDDS increasing users
- * Web services are becoming more important, familiar and widely used



Other Tools and Services



- * Live Access Server (LAS) for L3/L4 subsetting
- * HiTIDE for GUI-based L2 subsetting
- * SOTO (State of the Ocean) for visualization
- * “Chained” PO.DAAC Web Services of data discovery, metadata, extraction, subsetting and visualization
- * Webification for data extraction (subset by value)
- *upcoming technologies in PO.DAAC “Labs”



HiTIDE Level 2 Subsetter



PO.DAAC Subsetter

PHYSICAL OCEANOGRAPHY
DISTRIBUTED ACTIVE ARCHIVE CENTER

Version 1.2.0

Filters

- DataSets +
 - JPL-L2P-MODIS_A
- Region +
 - (113.0, -43.0) to (153.0, -10.0)
- DateRange +
 - 2014-04-21 to 2014-04-29

Data Preview

* Displaying the first 10 items

<input type="checkbox"/>	Granule Name	Start Time	End Time	Lower Bou...	Upper
<input type="checkbox"/>	20140428-MODIS_A-JPL-L2P-A2014118172000.L2_LAC_GHRSST_N-v...	2014-04-28T17:20:0...	2014-04-28T17:21:2...	109.85 -47.51	116.3
<input checked="" type="checkbox"/>	20140428-MODIS_A-JPL-L2P-A2014118171500.L2_LAC_GHRSST_N-v...	2014-04-28T17:15:0...	2014-04-28T17:20:0...	102.58 -44.25	132.4
<input checked="" type="checkbox"/>	20140428-MODIS_A-JPL-L2P-A2014118171000.L2_LAC_GHRSST_N-v...	2014-04-28T17:10:0...	2014-04-28T17:15:0...	110.07 -25.11	135.9
<input type="checkbox"/>	20140428-MODIS_A-JPL-L2P-A2014118154500.L2_LAC_GHRSST_N-v...	2014-04-28T15:48:5...	2014-04-28T15:48:5...	0.0 -71.6	115

[▶ Get Next 10](#) [⬇ Download Selected](#) [⬇ Download All](#)

Coverage Preview

Generate Image Preview Legend

(lon,lat) : 29.54° W , 9.45° S

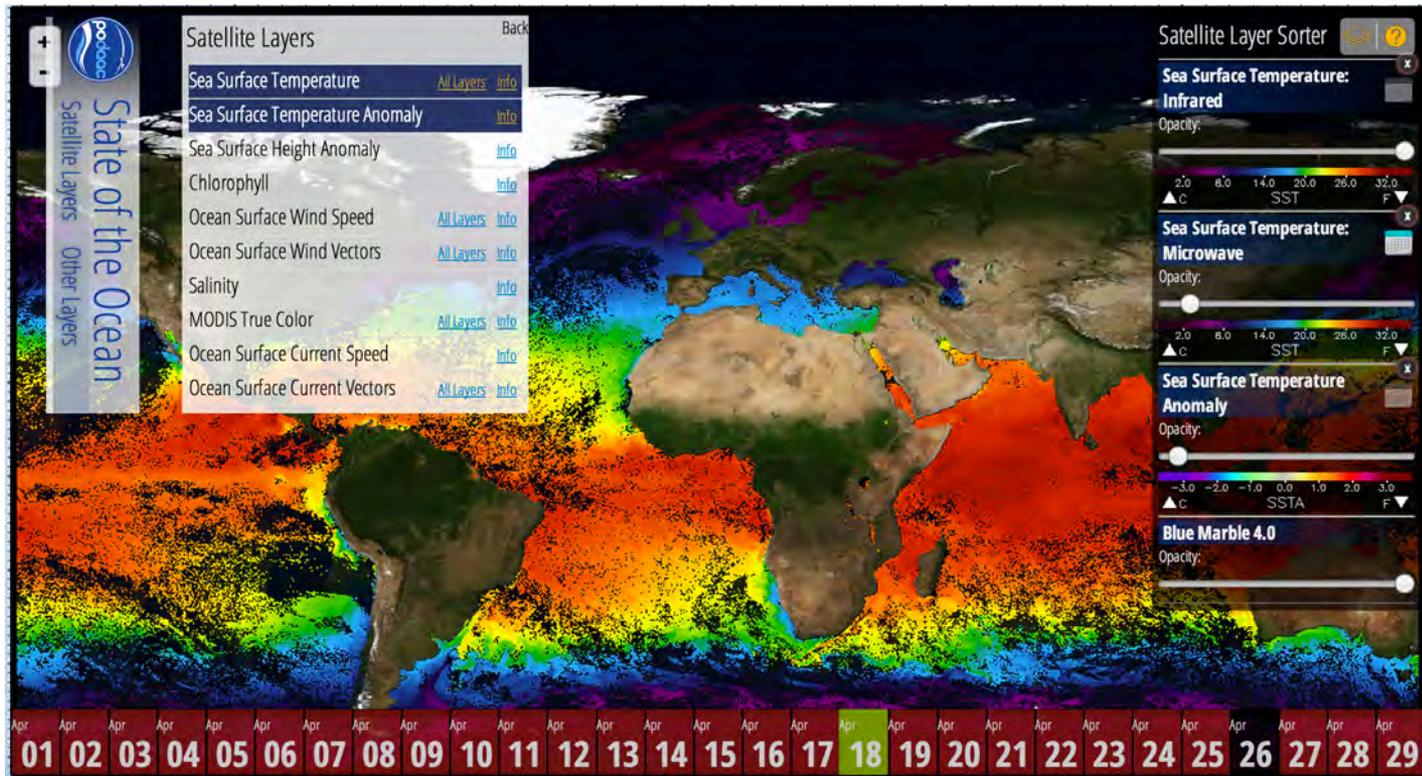


Saved Filters

Empty list



SOTO 2D -- Visualization



Web services



- PO.DAAC Web Services are for software interaction
 - Discover dataset info
 - Discover granules
 - Subset and extract granules
 - Visualize
- Through Application Programming Interface
- “Chained” ...so output of one service can input to the next

Example of a search return to find MODIS SST granules



```

podaac.jpl.nasa.gov/ws/search/granule/?shortName=JPL-L2P-MODIS_T&startTime=2014-01-06T01:01:00Z&itemsPerPage=100
2PJ01&format=fgdc" rel="enclosure" title="FGDC Metadata" type="text/xml"/>
<link href="http://podaac-opendap.jpl.nasa.gov/opendap/allData/ghrsst/data/L2P/MODIS_T/JPL/2014/006/20140106-MODIS_T-JPL-L2P-T2014006074500.L2_LAC_GHRSSST_N-v01.nc.bz2.html" rel="enclosure" title="OPeNDAP URL" type="text/html"/>
<link href="ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/L2P/MODIS_T/JPL/2014/006/20140106-MODIS_T-JPL-L2P-T2014006074500.L2_LAC_GHRSSST_N-v01.nc.bz2" rel="enclosure" title="FTP URL" type="application/x-netcdf"/>
<podaac:datasetId>                PODAAC-GHMDT-2PJ01                </podaac:datasetId>
<podaac:shortName>                JPL-L2P-MODIS_T                </podaac:shortName>
<georss:where>
  <gml:Envelope>
    <gml:lowerCorner>                -165.58700561523438 30.945999145507812                </gml:lowerCorner>
    <gml:upperCorner>                -131.61000061035156 52.43199920654297                </gml:upperCorner>
  </gml:Envelope>
</georss:where>
<time:start>                2014-01-06T07:45:08Z                </time:start>
<time:end>                2014-01-06T07:50:07Z                </time:end>
</entry>
<entry>
  <title>                20140106-MODIS_T-JPL-L2P-T2014006074000.L2_LAC_GHRSSST_N-v01.nc                </title>
  <updated>                2014-01-06T07:40:09Z                </updated>
  <id>                PODAAC-GHMDT-2PJ01:20140106-MODIS_T-JPL-L2P-T2014006074000.L2_LAC_GHRSSST_N-v01.nc                </id>
  <link href="http://podaac.jpl.nasa.gov/ws/search/granule?full=true&granuleName=20140106-MODIS_T-JPL-L2P-T2014006074000.L2_LAC_GHRSSST_N-v01.nc&datasetId=PODAAC-GHMDT-2PJ01" rel="enclosure" title="PO.DAAC Metadata" type="application/atom+xml"/>
  <link href="http://podaac.jpl.nasa.gov/ws/metadata/granule?granuleName=20140106-MODIS_T-JPL-L2P-T2014006074000.L2_LAC_GHRSSST_N-v01.nc&datasetId=PODAAC-GHMDT-2PJ01&format=iso" rel="enclosure" title="ISO-19115 Metadata" type="text/xml"/>
  <link href="http://podaac.jpl.nasa.gov/ws/metadata/granule?granuleName=20140106-MODIS_T-JPL-L2P-T2014006074000.L2_LAC_GHRSSST_N-v01.nc&datasetId=PODAAC-GHMDT-2PJ01&format=fgdc" rel="enclosure" title="FGDC Metadata" type="text/xml"/>
  <link href="http://podaac-opendap.jpl.nasa.gov/opendap/allData/ghrsst/data/L2P/MODIS_T/JPL/2014/006/20140106-MODIS_T-JPL-L2P-T2014006074000.L2_LAC_GHRSSST_N-v01.nc.bz2.html" rel="enclosure" title="OPeNDAP URL" type="text/html"/>
  <link href="ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/L2P/MODIS_T/JPL/2014/006/20140106-MODIS_T-JPL-L2P-T2014006074000.L2_LAC_GHRSSST_N-v01.nc.bz2" rel="enclosure" title="FTP URL" type="application/x-netcdf"/>
  <podaac:datasetId>                PODAAC-GHMDT-2PJ01                </podaac:datasetId>
  <podaac:shortName>                JPL-L2P-MODIS_T                </podaac:shortName>
  <georss:where>
    <gml:Envelope>
      <gml:lowerCorner>                -156.18299865722656 13.454000473022461                </gml:lowerCorner>
      <gml:upperCorner>                -128.96200561523438 34.51300048828125                </gml:upperCorner>
    </gml:Envelope>
  </georss:where>
  <time:start>                2014-01-06T07:40:09Z                </time:start>
  <time:end>                2014-01-06T07:45:07Z                </time:end>
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<entry>
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  <updated>                2014-01-06T07:35:09Z                </updated>
  <id>                PODAAC-GHMDT-2PJ01:20140106-MODIS_T-JPL-L2P-T2014006073500.L2_LAC_GHRSSST_N-v01.nc                </id>

```

http://podaac.jpl.nasa.gov/ws/search/granule/?shortName=JPL-L2P-MODIS_T&startTime=2014-01-08T01:01:00Z&itemsPerPage=100

Webification



Open specification:

<http://w10n.org>

Summary:

- Resource is viewed as a tree of nodes and leaves.
- They have semantic URLs, accessible through HTTP.
- Meta info exchange format is JSON, by default.
- Full ReSTful style request/response. Read/Write.

Disciplines:

Earth science (NetCDF, HDF 4/5, GRIB)

Planetary Science (VICAR/PDS)

Astronomy (FITS) and more



Use Case – Quality filtering the SST observations

- * Subset a L2P granule (by value!)
 - * `http://host:port/path/2013/123/20130503-MODIS_T-JPL-L2P-T2013123065500.L2_LAC_GHRSSST_N-v01.nc.bz2/sea_surface_temperature[-130<lon<-120,35<lat<45]?output=format`
- * Apply quality filter
 - * `http://host:port/path/2013/123/20130503-MODIS_T-JPL-L2P-T2013123065500.L2_LAC_GHRSSST_N-v01.nc.bz2/sea_surface_temperature[quality_flag>=4]?output=format`
- * Quality filter, wind screen, subset all in one step !
 - * `http://host:port/path/2013/123/20130503-MODIS_T-JPL-L2P-T2013123065500.L2_LAC_GHRSSST_N-v01.nc.bz2/sea_surface_temperature[quality_flag>=4,wind_speed>6,-130<lon<-120,35<lat<45]?output=format`

Example 1: MODIS vs AVHRR gradient detection

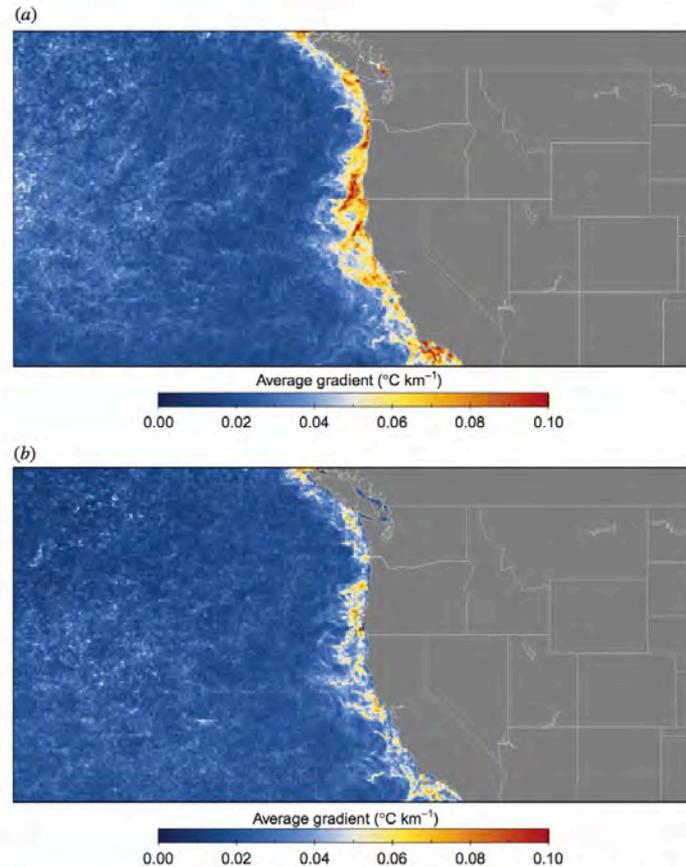
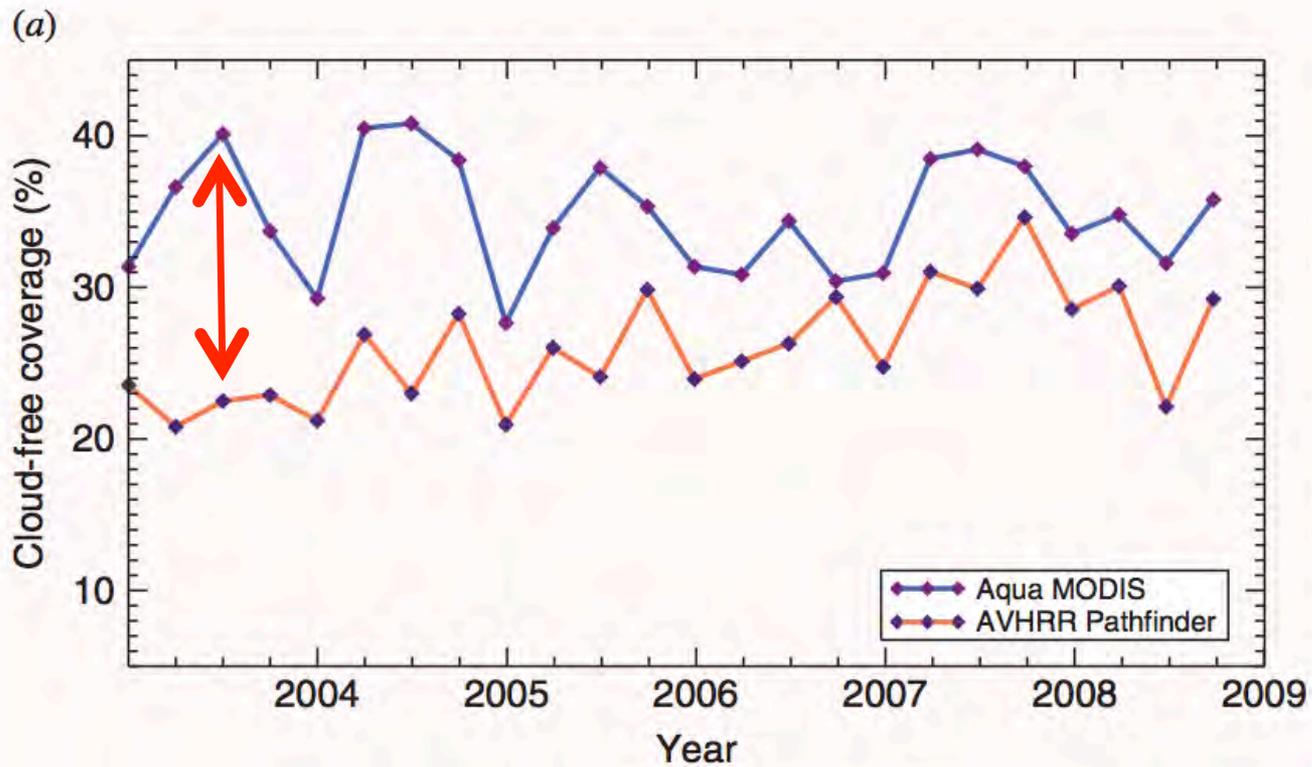


Figure 3. (a) CCS gradients in summer 2007 as seen from MODIS Aqua. (b) CCS gradients in summer 2007 as seen from Pathfinder AVHRR.

From Armstrong et al., 2012

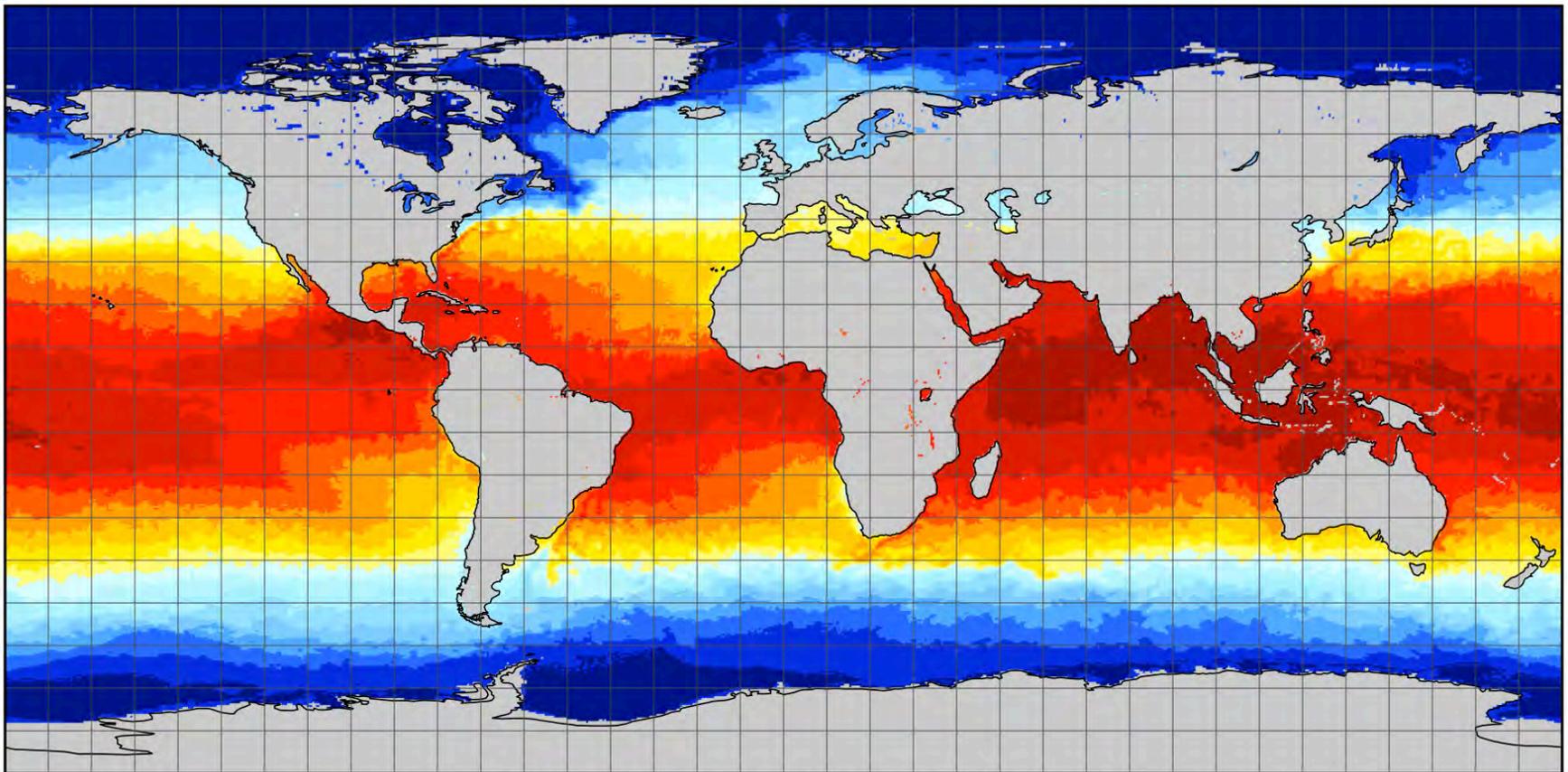
Improved MODIS cloud screening – California

Current System

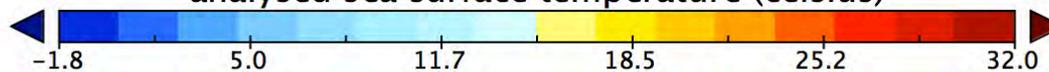


Example 2: MUR SST

Analysed sea surface temperature -- 26 Apr 2014

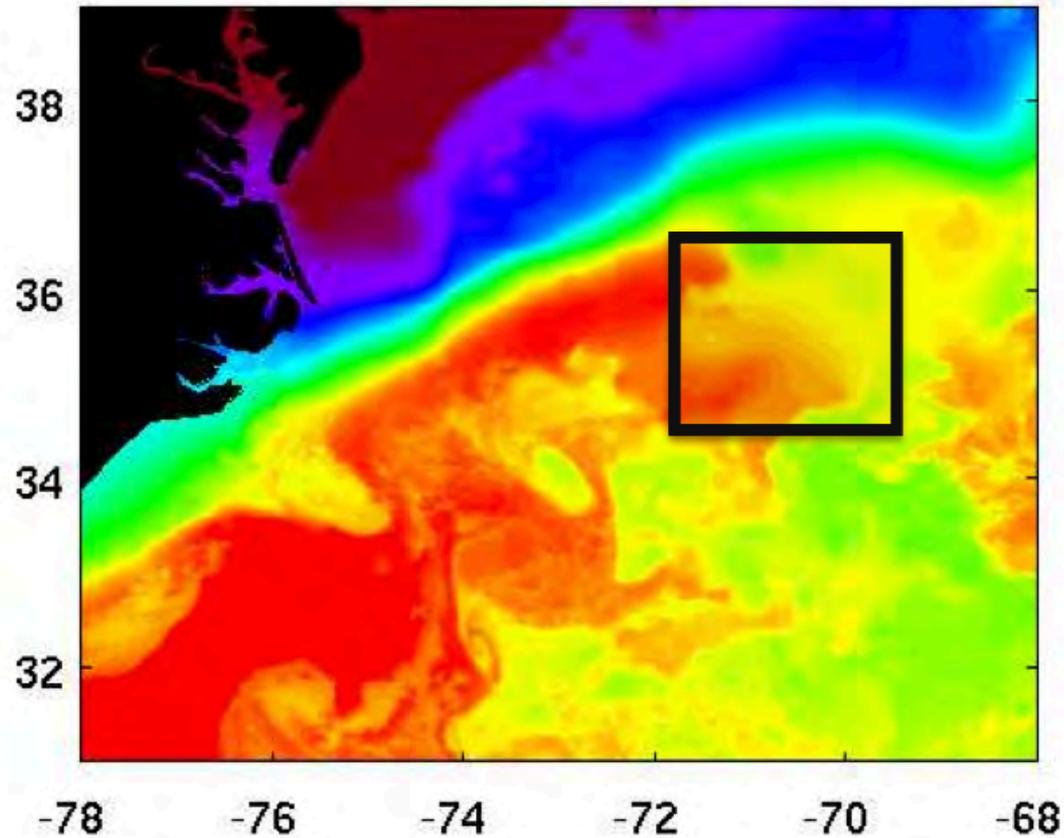


analysed sea surface temperature (celsius)



MUR at various resolutions

MUR L12 ("1km")





Summary

- * MODIS Aqua/Terra SST is one of the prominent SST datasets served by the PO.DAAC. All processing levels:
 - * GHRSSST L2P → GHRSSST L4 data
 - * MODIS is critical component to the popular MUR Level 4 dataset
 - * MODIS L3: More useful than AVHRR.
- * Integrated into a many tools and web services
 - * Discovery/Metadata
 - * Visualization
 - * Subsetting/Extraction
 - * Newer web service technologies such as webification
- * Future:
 - * Improved documentation and provenance
 - * Improved support for interdisciplinary research with accessible data for all ocean parameters
 - * VIIRS SST data...and many others



backup

MUR Level 4 SST

Multi-Resolution Variational Analysis (MRVA)

performs *objective interpolation at different scales*

(20°, 10°, 5°, ... 4km, 2km, 1km):

$$T_{\text{MRVA}} = \bar{T}_{20^\circ} + T'_{10^\circ} + \dots + T'_{2\text{km}} + T'_{1\text{km}}$$

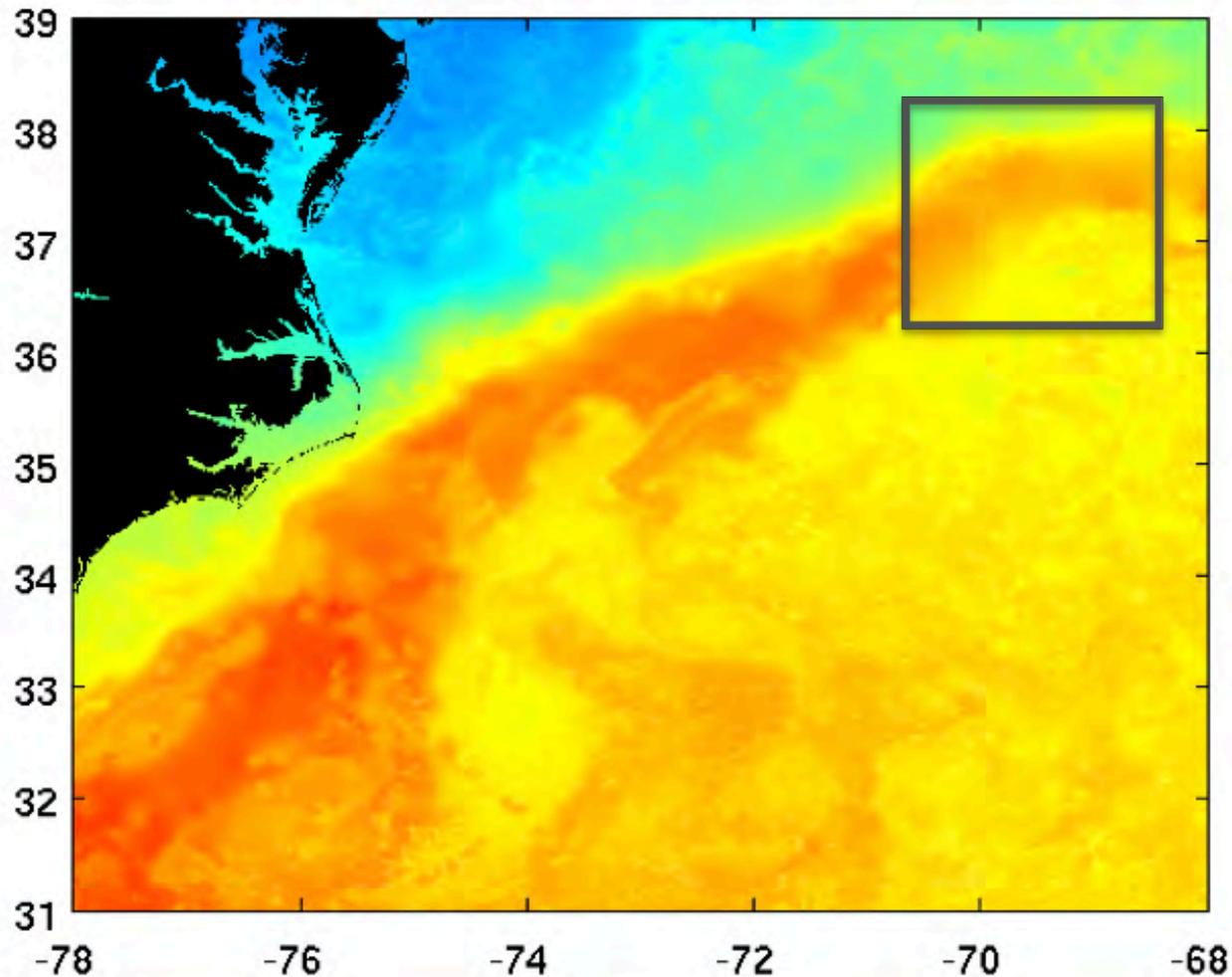
1. uses *orthonormal wavelet decomposition* (~bandpass filters) to **expand the data into scale-dependent components**.
2. **fuses** the multi-sensor data components **in each scale**.
3. sums (**reconstructs**) the analysis from each scale.

⇒ Prevents over-fitting to sparsely sampled data.

⇒ Facilitates inter-sensor bias correction.

MUR at various resolutions

MUR (n=0; "1km")





API

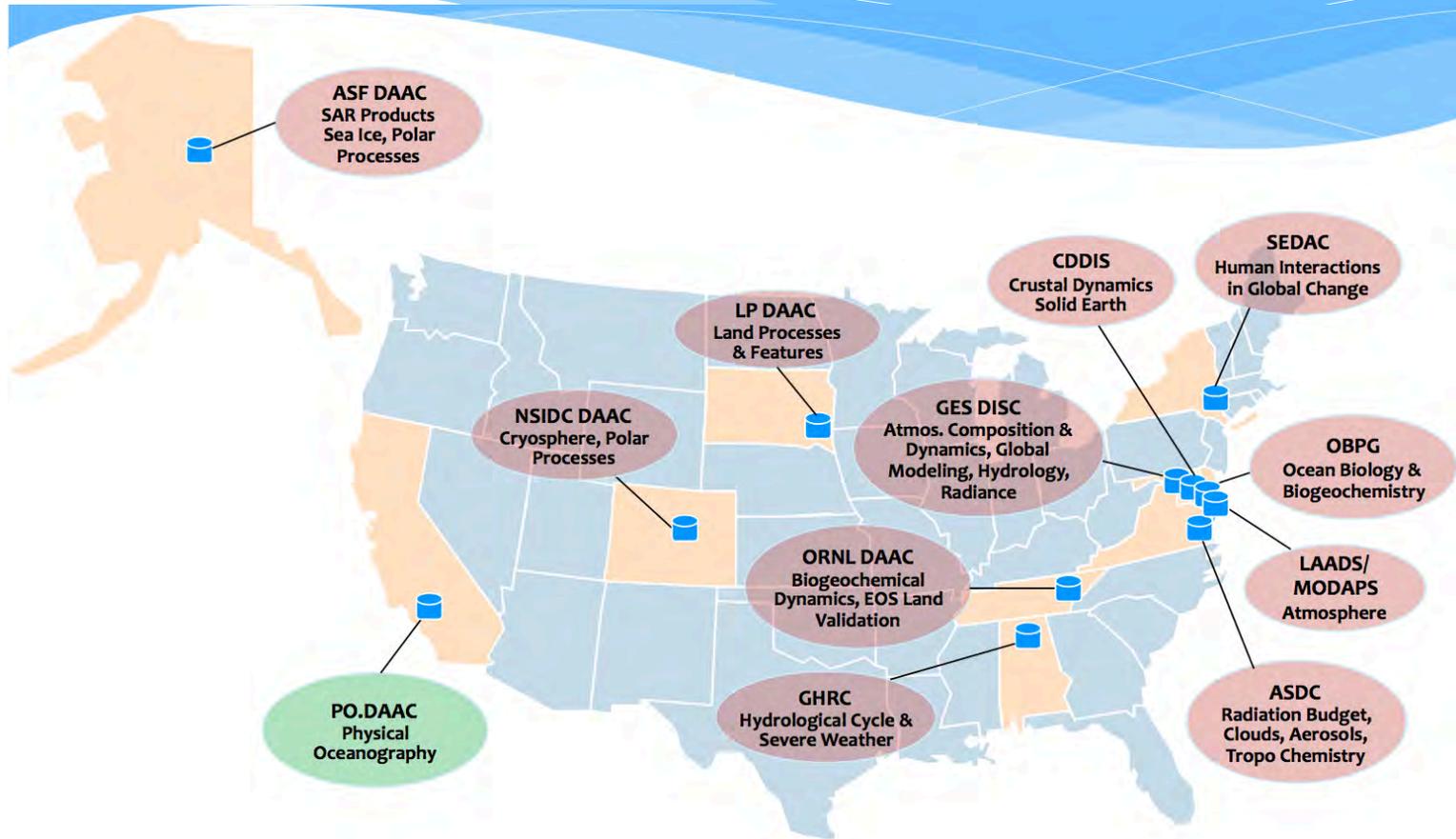
Sample Run

Parameter	Value
datasetId	<input type="text"/> example: PODAAC-MODSA-T8D9N
shortName	<input type="text"/>
granuleName	<input type="text"/>
startTime	<input type="text"/> example: 2000-01-01T01:30:00Z
endTime	<input type="text"/> example: 2012-02-01T01:30:00Z
startIndex	<input type="text"/>
itemsPerPage	<input type="text"/>
sortBy	<input type="text"/> ▾
format	<input type="text" value="html"/> ▾
pretty	<input type="text" value="true"/> ▾

Run



PO.DAAC is one of twelve NASA Data Centers





PO.DAAC Charter

“To maintain NASA’s oceanographic and climate data for future generations and to make these, and synergistic datasets, easily accessible, usable, and understandable for a broad and diverse set of data consumers.”