



OceanWatch Central Pacific

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**NOAA
FISHERIES**

PIFSC

Overview of Satellite Data Tools

Adapted from:

- Cara Wilson, Dale Robinson:
CoastWatch/OceanWatch West Coast Node (NMFS)
- Shelly Tomlinson, Ron Vogel:
CoastWatch/OceanWatch East Coast Node (NOS/NESDIS)

2018



Last updated: 11/15/2018

Accessing satellite data can be challenging

A short list of data servers

NASA Jet Propulsion Laboratory PO.DAAC

NASA Ocean Biology (OB.DAAC)

NASA Goddard Space Flight Center

NOAA Center for Satellite Applications and Research

NOAA CoastWatch Central Operations

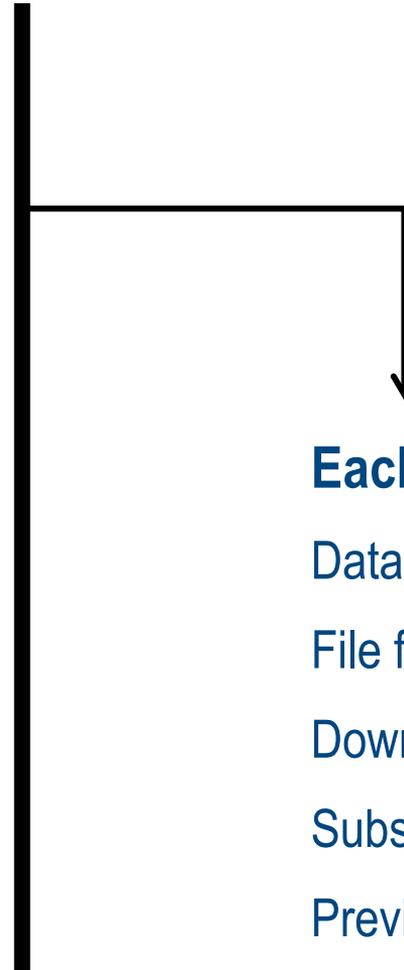
NOAA Office of Satellite and Products

NOAA National Centers for Environmental Information

NOAA Comprehensive Large Array-data Stewardship System

European Space Agency

Japan Aerospace Exploration Agency



Each with its own

Data products

File formats

Download protocols

Subsetting abilities

Previewing abilities



Tools are available! (a very small sampling)

Data Viewers

Voyager*

OceanViewer

Worldview

OCView

*Covered in hands-on portion of this class

**Will be covered in the upcoming ArcGIS workshop

All software listed here is free and open-source

Data Access

CoastWatch Data Discovery

ERDDAP*

Data Analysis

Marine Geospatial Ecology Toolbox**

R: rerddap*, rxtractomatic*

Tools are available! (a very small sampling)

Data Viewers

Voyager	pacioos.hawaii.edu/voyager/oceanwatch.html
OceanViewer	cwcgom.aoml.noaa.gov/cgom/OceanViewer
Worldview	worldview.earthdata.nasa.gov
OCView	star.nesdis.noaa.gov/sod/mecb/color/ocview/ocview.html

Data Access

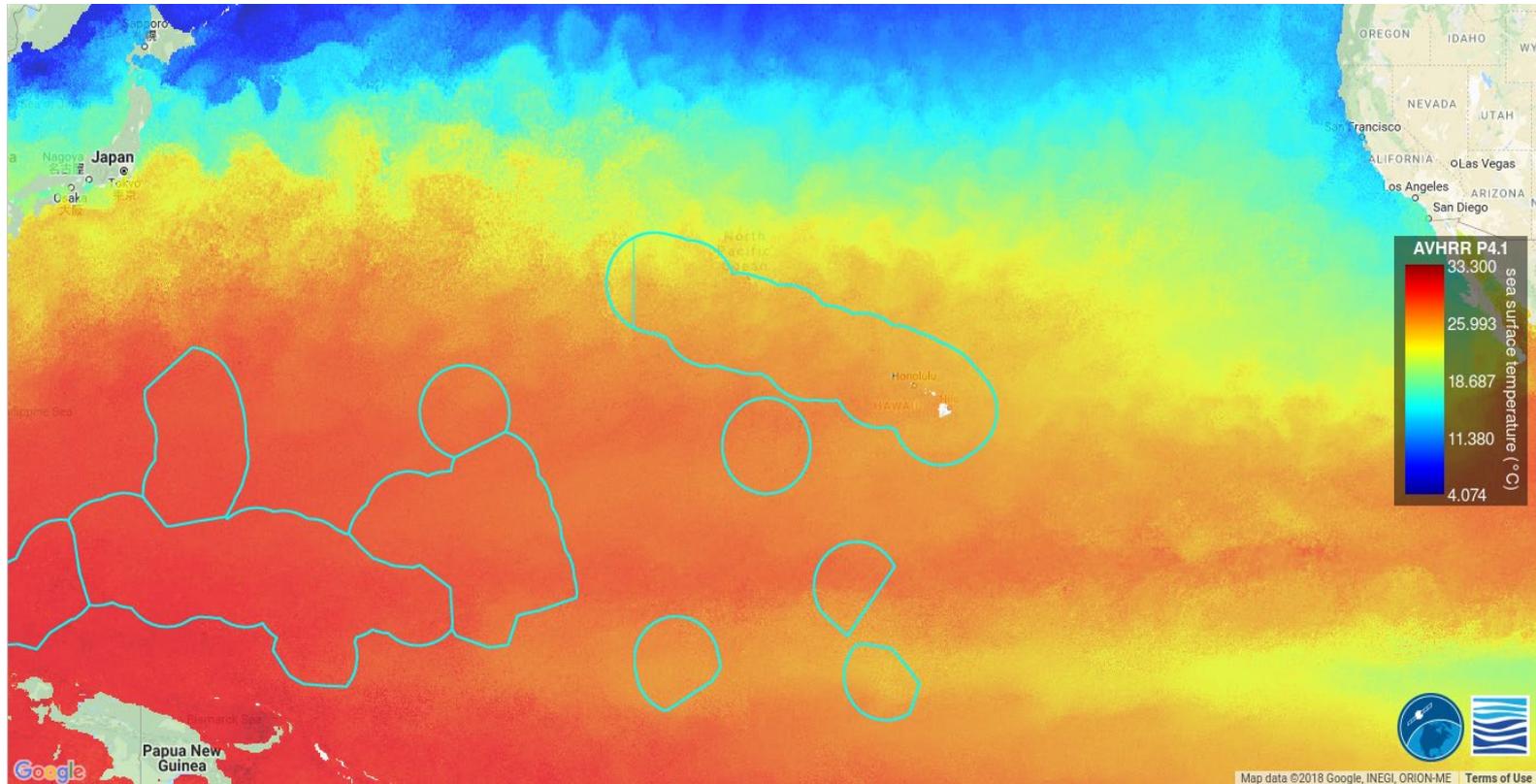
CoastWatch Data Discovery	coastwatch.noaa.gov/cw_html/SatelliteDataProducts.html
ERDDAP*	oceanwatch.pifsc.noaa.gov/erddap

Data Analysis

Marine Geospatial Ecology Toolbox**	mgel.env.duke.edu/mget
R: rerddap*, rxtractomatic*	coastwatch.pfeg.noaa.gov/xtracto
https://cran.r-project.org/web/packages/rerddap/vignettes/Using_rerddap.html	

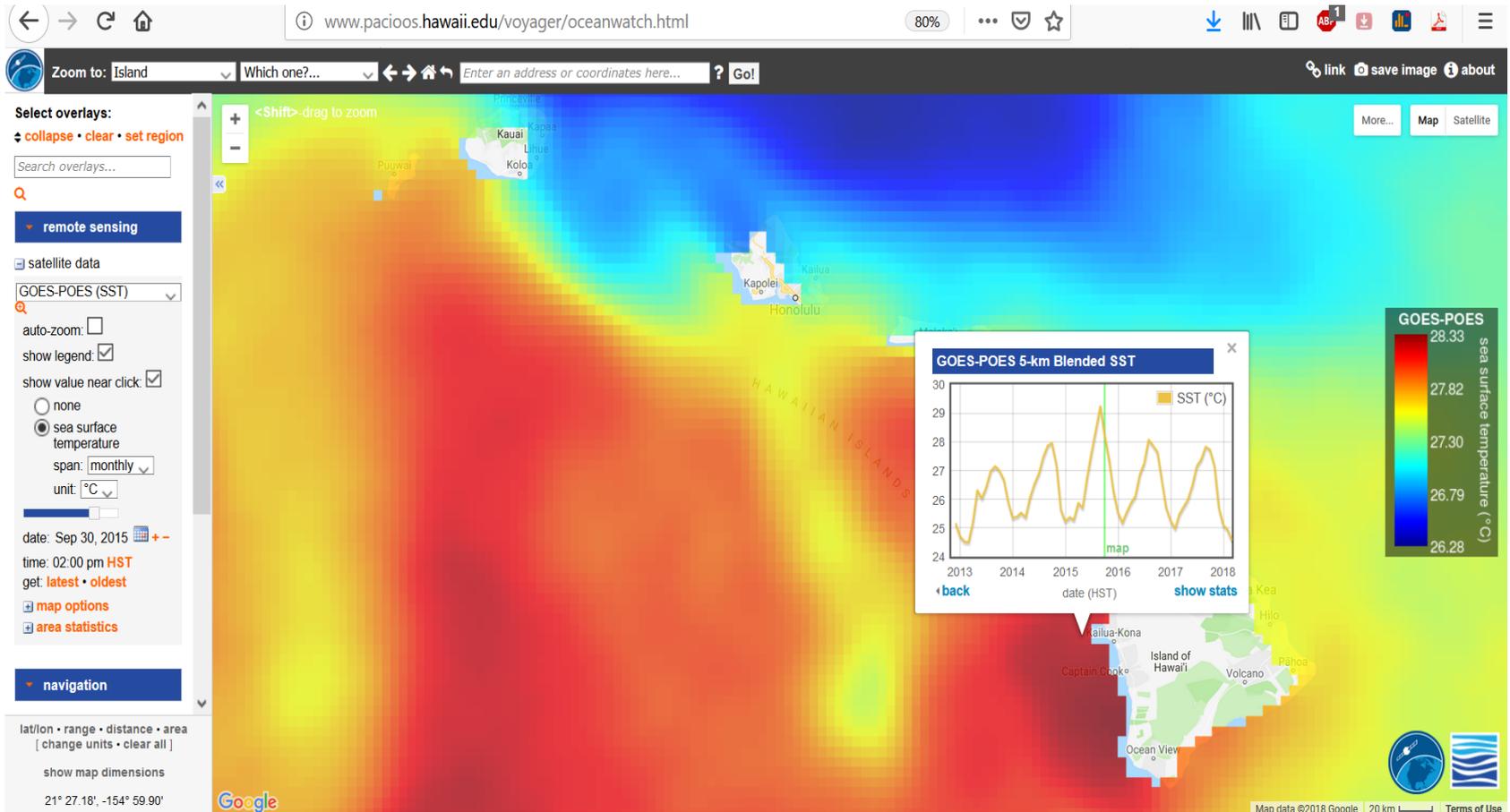
Voyager (OWCP/PacIOOS)

Display satellite data, Zoom to your area, Change the base map or color scale, Download the data file, Save the map as an image. Overlay EEZs, lat/lon grid, ...



Voyager (OWCP/PacIOOS)

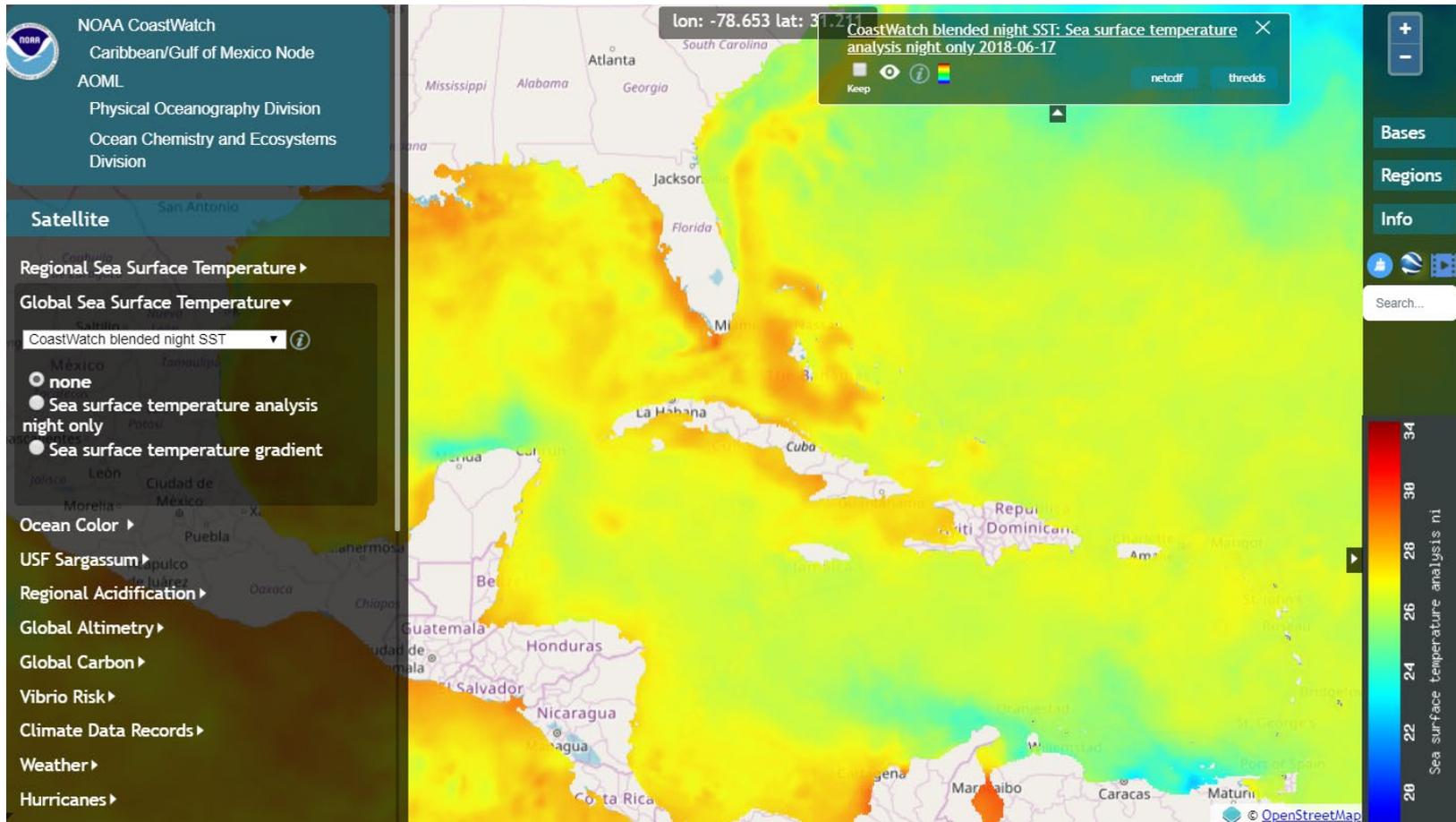
Generate time-series at a location or within a box to look at trends.



-> Tutorial tomorrow !! Available on the Google drive.

OceanViewer (from CW/OW Atlantic Node)

Display **many** ocean parameters from NOAA & NASA satellites, **AND** in-situ data
Zoom to your area, Change the base map or color scale, Download the data file

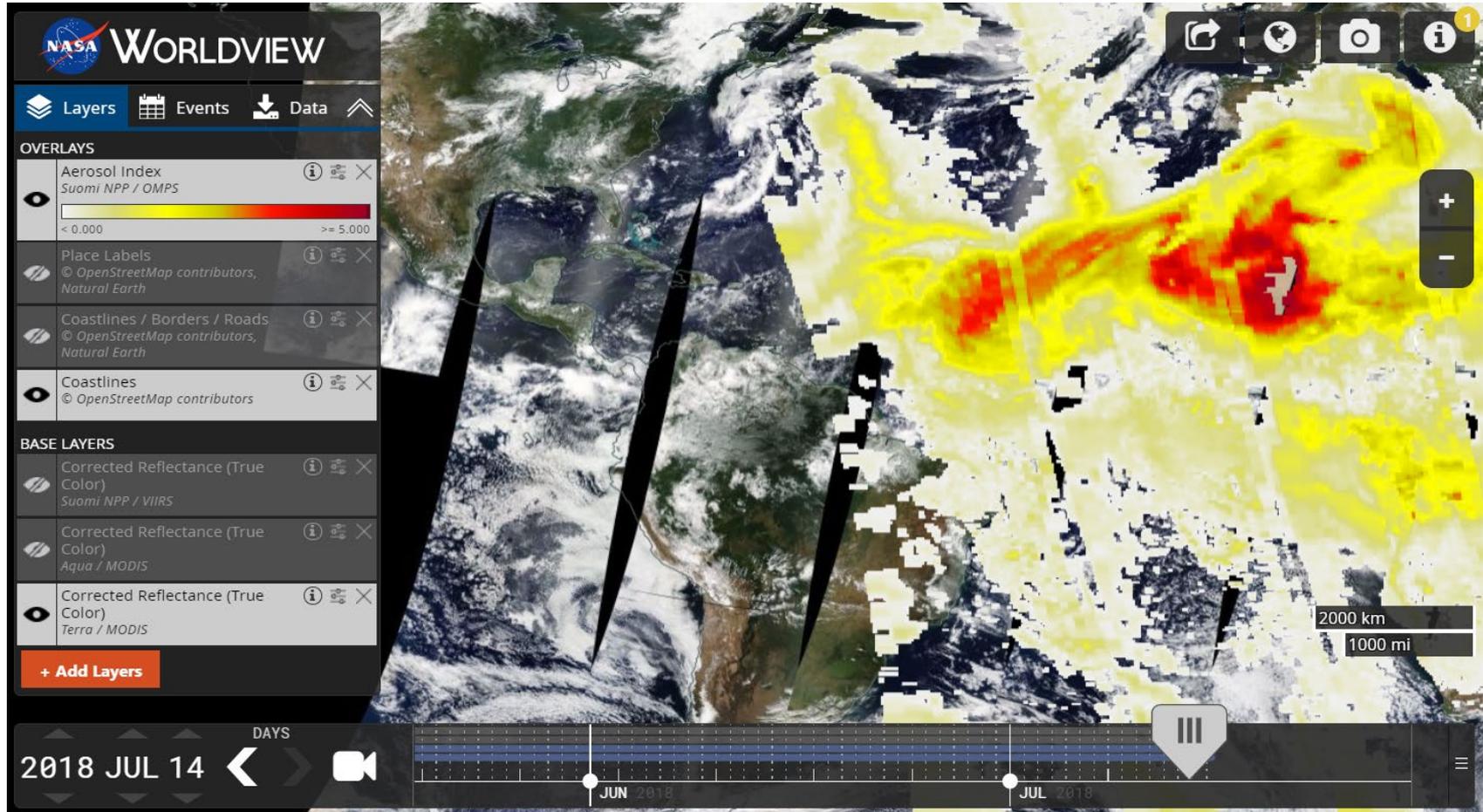


Worldview (from NASA EOSDIS)

Display **many** NASA satellite parameters: ocean, land, atmosphere

Zoom to your area, share your image with a link, take a snapshot

Select different satellite base maps, Create an animation



OCView (from NESDIS/STAR Ocean Color Group)

Multiple ocean color parameter overlays: chlorophyll, nLw, IOPs, PAR, etc
VIIRS, OLCI, GOCI sensors. Daily, 8-day, monthly, climatology. Global composites & zoom to your area. Permalink so you can send or access the image you created to/from anywhere. Statistics for selectable areas and other new features will be available soon.

5000 km

VIIRS SNPP
Geographic
Chl-a
NIR-NRT

daily
 8-day
 monthly
 climatology

true color
 ocean color
 shorelines
 gridlines

granules
 color bar

2015 12 05

CoastWatch/OceanWatch Data Discovery

The official catalog of data generated and maintained by CW/OW Central:

Multiple NOAA ocean parameters, and NOAA partners e.g. European sensors

Near real-time, Global files or pre-defined regions. Download files by FTP, THREDDS, HTTP, etc. (ERDDAP server coming soon.)



The National Oceanic and Atmospheric Administration

NOAA CoastWatch
• OceanWatch

CoastWatch NOAA

Need Help? Contact the Help Desk:

Email | (301) 683-3335

Near Real Time Search

Search Criteria

Region:

Select a Region ▼

Product:

Sensor:

From: (MM/DD/YYYY)

07/23/2018

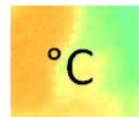
To: (MM/DD/YYYY)

07/24/2018

The Near Real Time Search tool gives the user the ability of selecting OceanWatch data products based on their region of interest, the products associated with that region, the individual sensor used to obtain this data, and a time period of interest. Products can be obtained either by category or by selecting criteria in the Search Criteria panel on the left.



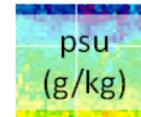
True Color (RGB)



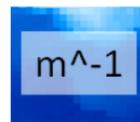
Sea Surface Temperature



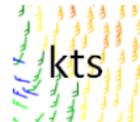
Chlorophyll-a
MODIS & VIIRS | OLCI



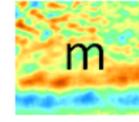
Salinity



Kd490



Surface Winds



Altimetry



NOAA FISHERIES

WE ONLY SAVED THE .SHP FILES, AND
THE ATTRIBUTE TABLES ARE GONE!

GET A GEOPACKAGE SPECIALIST
IN THE AIR! WE NEED TO RETHINK
OUR GIS DATA INTEGRITY!



I WANT TO MAKE A DISASTER MOVIE THAT
JUST SHOWS SCIENTISTS REALISING THE
PITFALLS OF CERTAIN FILE FORMATS.

NetCDF files

Most satellite data is (or should be) distributed as NetCDF files.

NetCDF (network Common Data Form) is:

- **Self-Describing.** A netCDF file includes information about the data it contains.
- **Portable.** A netCDF file can be accessed by computers with different ways of storing integers, characters, and floating-point numbers.
- **Scalable.** A small subset of a large dataset may be accessed efficiently.
- **Appendable.** Data may be appended to a properly structured netCDF file without copying the dataset or redefining its structure.
- **Sharable.** One writer and multiple readers may simultaneously access the same netCDF file.
- **Archivable.** Access to all earlier forms of netCDF data will be supported by current and future versions of the software.

<https://www.unidata.ucar.edu/software/netcdf/docs/faq.html#whatisit>



NetCDF files - Self-Describing: embedded metadata

```
netcdf filename {
dimensions:
  lat = 3 ;
  lon = 4 ;
  time = UNLIMITED ; // (2 currently)

variables:
  float lat(lat) ;
    lat:long_name = "Latitude" ;
    lat:units = "degrees_north" ;
  float lon(lon) ;
    lon:long_name = "Longitude" ;
    lon:units = "degrees_east" ;
  int time(time) ;
    time:long_name = "Time" ;
    time:units = "days since 1895-01-01" ;
    time:calendar = "gregorian" ;
  float rainfall(time, lat, lon) ;
    rainfall:long_name = "Precipitation" ;
    rainfall:units = "mm yr-1" ;
    rainfall:missing_value = -9999.f ;

// global attributes:
  :title = "Historical Climate Scenarios" ;
  :Conventions = "CF-1.0" ;

data:
  lat = 48.75, 48.25, 47.75;
  lon = -124.25, -123.75, -123.25, -122.75;
  time = 364, 730;
  rainfall =
    761, 1265, 2184, 1812, 1405, 688, 366, 269, 328, 455, 524, 877,
    1019, 714, 865, 697, 927, 926, 1452, 626, 275, 221, 196, 223;
}
```

Coordinate variable

Variable attribute

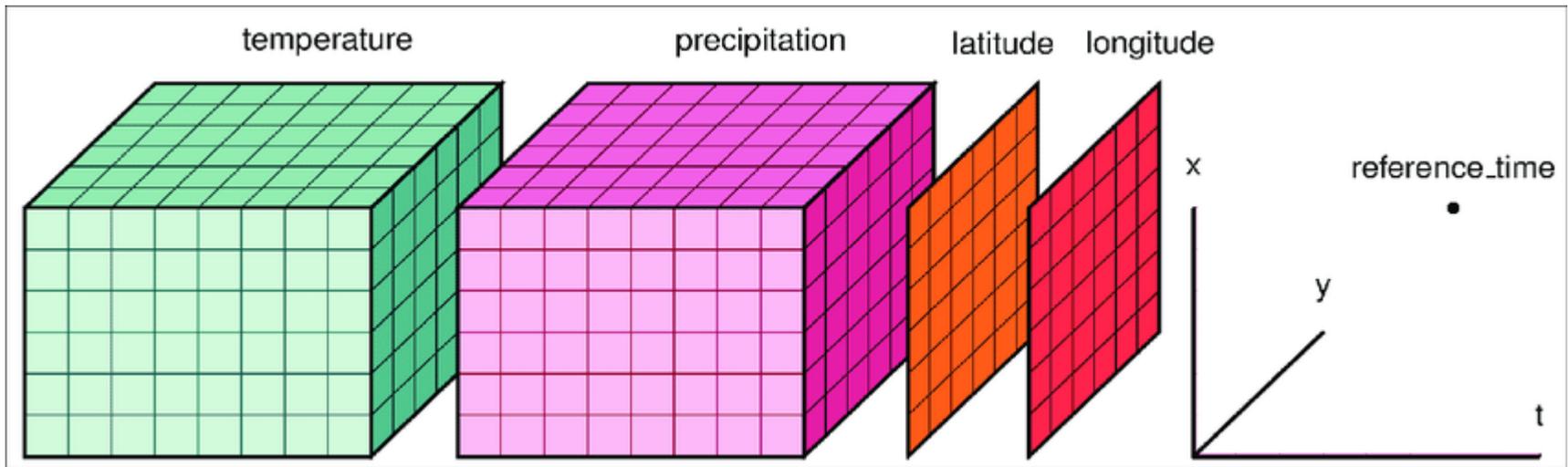
Global attribute

<http://pro.arcgis.com/en/pro-app/help/data/multidimensional/fundamentals-of-netcdf-data-storage.htm>



NetCDF files

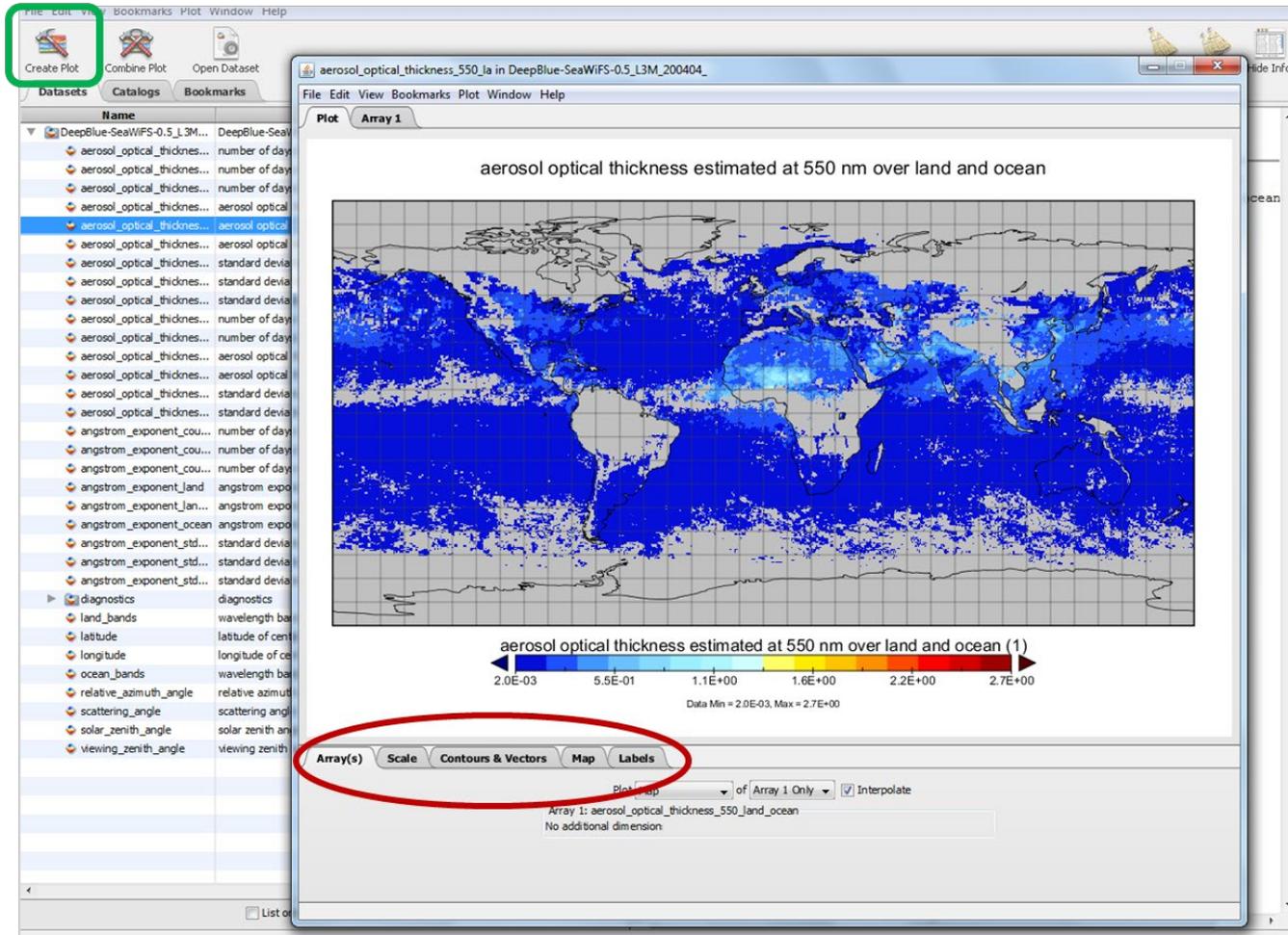
Most satellite data is (or should be) distributed as NetCDF files.



Hoyer & Hamman 2017

Visualizing NetCDF files – NASA Panoply

Available for Linux, Windows and MacOS, free to download.



<https://www.giss.nasa.gov/tools/panoply/>

ERDDAP makes data access easy

ERDDAP gives you: A simple, consistent way to download data, For the area and time period of interest, In the format that works with your analysis tools. Works for humans and machines (automated data access) -> **Tutorial tomorrow!**

**ERDDAP**
Easier access to scientific data

ERDDAP > griddap > Make A Graph

Dataset Title: **Aquarius Sea Surface Salinity, Version 2, Global, 3-Month**  

Institution: NASA/GSFC OBPG (Dataset ID: jplAquariusSSS3Month)
Information: Summary  | License  | [FGDC](#) | [ISO 19115](#) | [Metadata](#)  | [Background](#)  | [Data Access Form](#)

Graph Type: 

X Axis: 

Y Axis: 

Color: 

Dimensions  **Start**  **Stop** 

time (UTC)  specify just 1 value → 2013-09-21T00:00:00Z  

latitude (degrees_north)  89.5  -89.5 

longitude (degrees_east)  -179.5  179.5 

Graph Settings

Color Bar:  Continuity:  Scale: 

Min: Max: N Sections: 

Draw the land mask: 

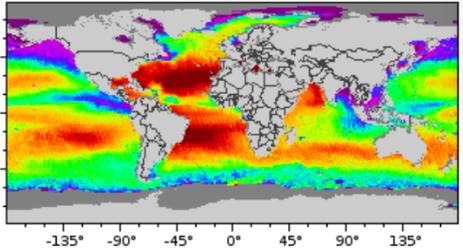
Redraw the Graph (Please be patient. It may take a while to get the data.)

Optional:
Then set the File Type:  and

or view the URL: [\(http://coastwatch.pfeg.noaa.gov/erddap/griddap/jplAquariusSSS3Month.htmlTable?sss\(2013-09-21T00:00:00Z\)\)](http://coastwatch.pfeg.noaa.gov/erddap/griddap/jplAquariusSSS3Month.htmlTable?sss(2013-09-21T00:00:00Z)) ([Documentation](#) / [Bypass this form](#) ) ([File Type information](#))

Click on the map to specify a new center point. 

Zoom:



Sea Surface Salinity (psu)
Aquarius Sea Surface Salinity, Version 2, Global, 3-Month
(2013-09-21T00:00:00Z)
Data courtesy of NASA/GSFC OBPG

Xtractomatic: R and Matlab scripts

Premade scripts that perform common functions

Extract satellite data around ship stations or animal tracks

Extract satellite data for rectangular area over time

Extract satellite data for any area (polygon) over time

Vignettes: Documentation with code examples

Available on CoastWatch West Coast website

<http://coastwatch.pfeg.noaa.gov/xtracto/>

-> R Tutorial tomorrow!

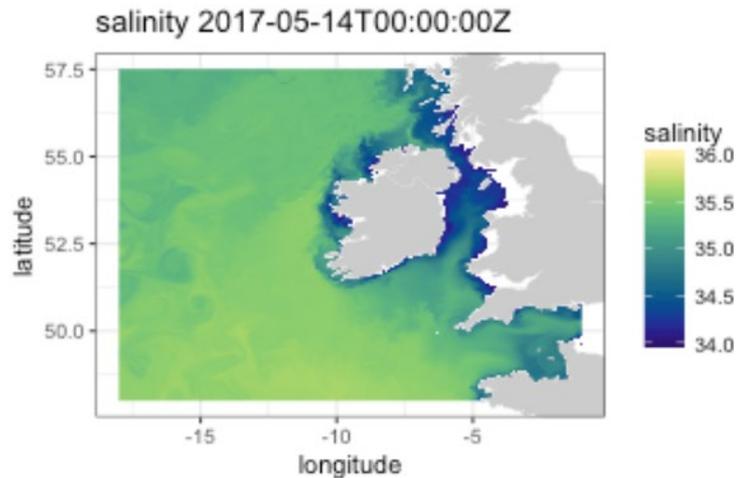


Rerddap: R package

Package designed to interface with ERDDAP from R.

Tutorial available here:

https://cran.r-project.org/web/packages/rerddap/vignettes/Using_rerddap.html



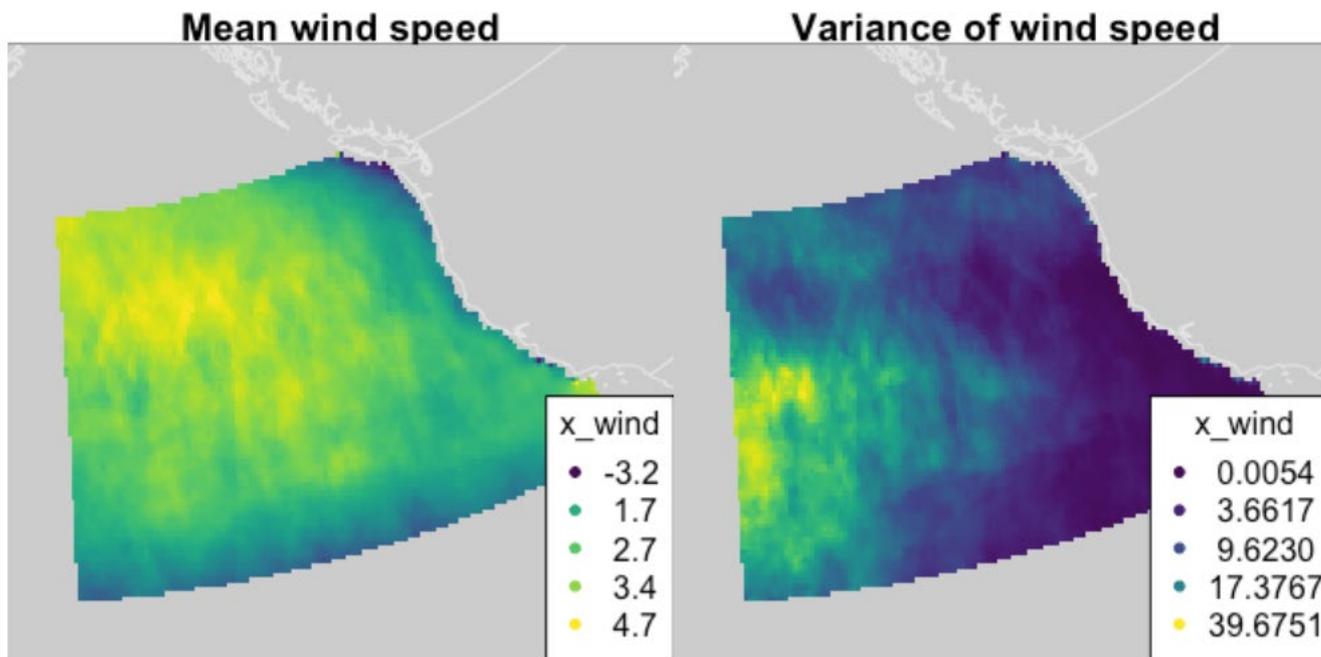
-> R Tutorial tomorrow



plotdap: R package

Package designed to interface with ERDDAP from R and plot data

Tutorial available here: <https://github.com/ropensci/plotdap>

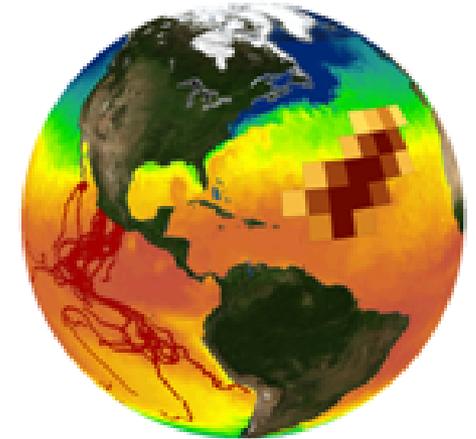


Marine Geospatial Ecology Toolbox (MGET)

from Duke University.

Geoprocessing toolbox that can help solve a wide variety of marine research, conservation, and spatial planning problems

- Plugs into ArcGIS
- Access oceanographic data from ArcGIS
- Identify ecologically-relevant oceanographic features in remote sensing imagery
- Build predictive species distribution models
- Model habitat connectivity by simulating hydrodynamic dispersal of larvae
- Detecting spatiotemporal patterns in fisheries and other time series data



Marine Geospatial Ecology Tools

-> ArcGIS workshop