



Tools for using satellite data

Dale Robinson

Operations Manager, West Coast Node

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Versioning:

-Robinson, 2020

-Tomlinson and Vogel, 2018

-Abecassis and Howell, 2018

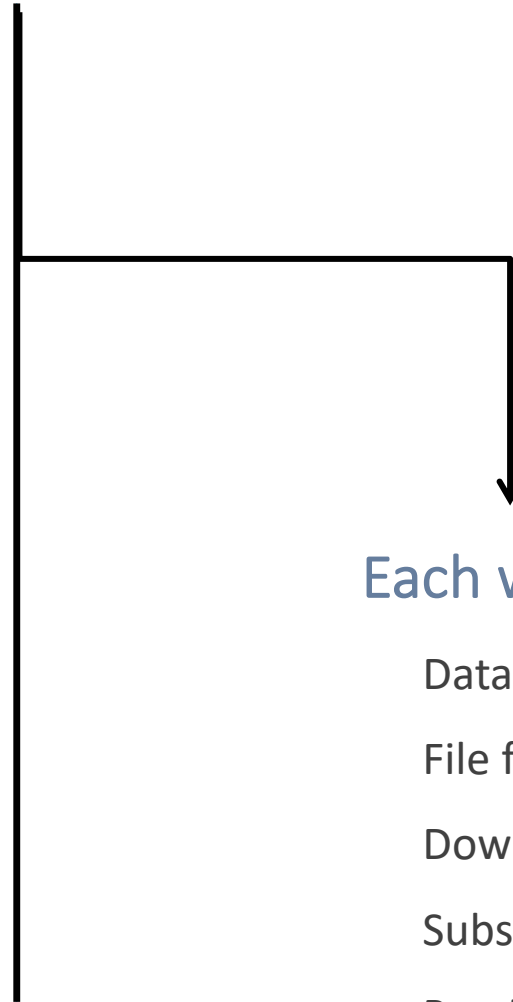
-Robinson, 2019



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 Res.
NOAA CoastWatch Central Operations
NOAA Office of Satellite and Products
NOAA National Centers for Environmental Info.
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

Getting data should not be difficult

THE TOPICS TO COVER IN THIS PRESENTATION

Data viewers and file formats

Introduction to tools for the course

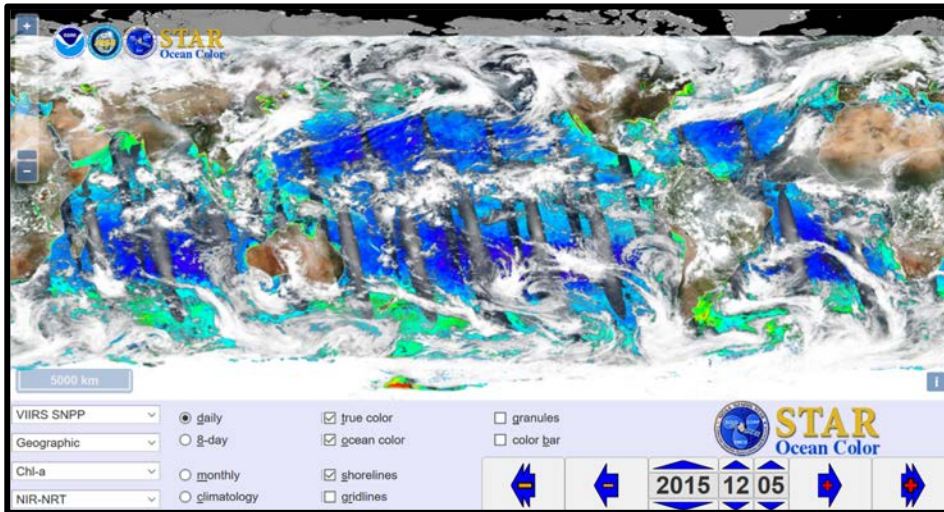
Advanced tools

Class participation – Using the ERDDAP data server



Data Viewers are a good place to start for exploring data

OCView



CoastWatch Data Viewer

coastwatch.noaa.gov/cw_html/cwViewer.html

OCView (NOAA/NESDIS STAR)

star.nesdis.noaa.gov/sod/mecb/color/ocview/ocview.html

State of the Ocean - SOTO (NASA PO.DAAC)

podaac-tools.jpl.nasa.gov/soto/

Worldview (NASA EOSDIS)

worldview.earthdata.nasa.gov/

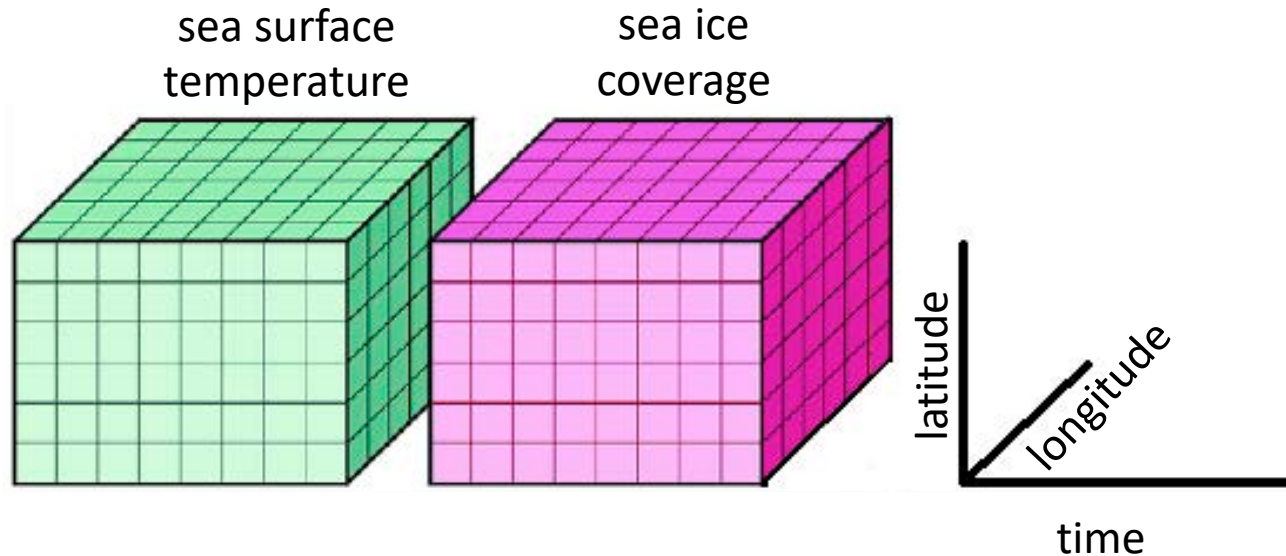
OceanViewer (CoastWatch Caribbean/Gulf of Mexico Node)

cwcgom.aoml.noaa.gov/cgom/OceanViewer



NetCDF¹ file format: Most satellite data are distributed in NetCDF

WHY?



Self-Describing

Contains the information and metadata that you need to use the data

Portable

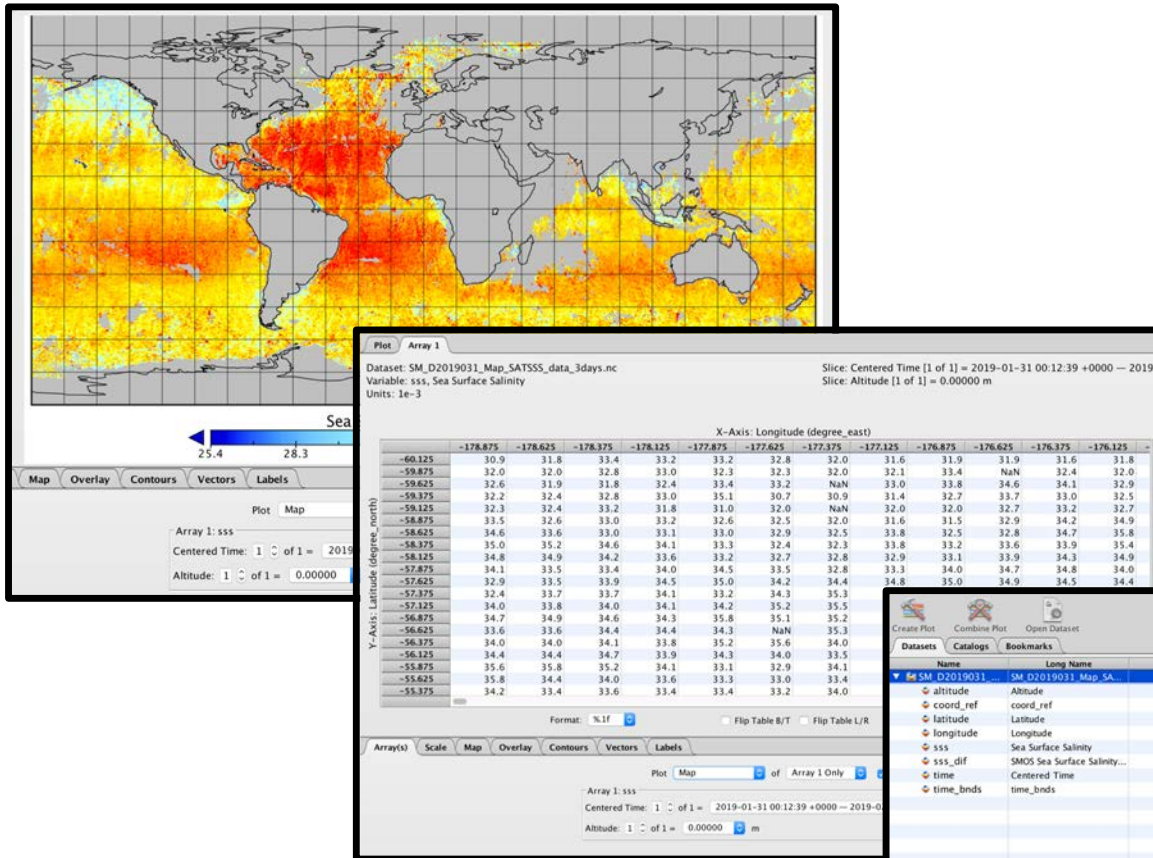
Can be used by all computer platforms (Mac, OC, Linux)

Compact

Binary data and compressible

¹Network Common Data Format

Software for visualizing NetCDF files – NASA Panoply



Visualize data from netCDF and HDF files

Reproject the visualization

View the metadata

View the data

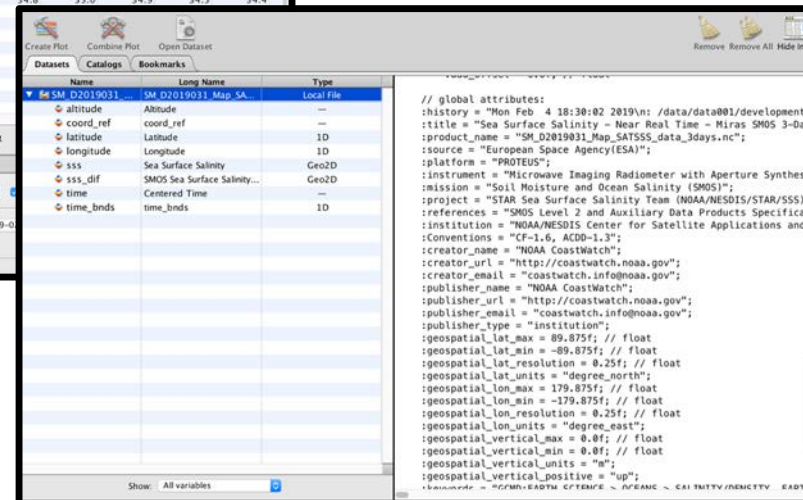
Freeware

Example netCDF salinity file

([SM_D2019031_Map_SATSSS_data_3days.nc](https://coastwatch.pfeg.noaa.gov/SM_D2019031_Map_SATSSS_data_3days.nc))

Information and download

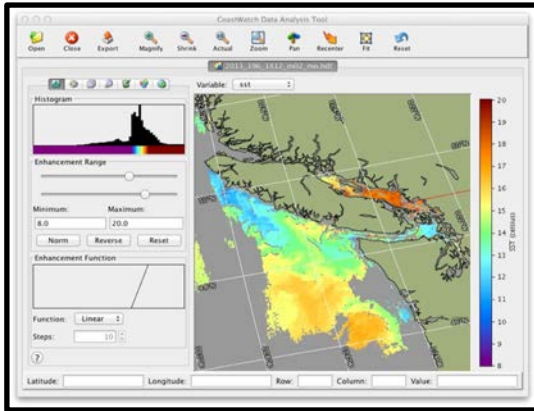
www.giss.nasa.gov/tools/panoply/



Advanced tools for data processing

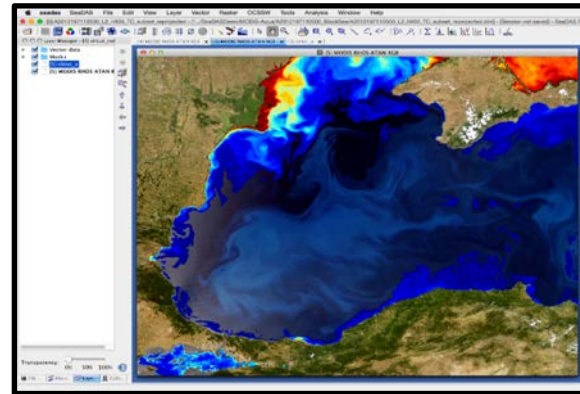
COMPREHENSIVE SOFTWARE PACKAGES

NOAA CoastWatch Utilities



[coastwatch.noaa.gov/cw/
user-resources/coastwatch-
utilities.html](http://coastwatch.noaa.gov/cw/user-resources/coastwatch-utilities.html)

NASA SeaDAS



seadas.gsfc.nasa.gov

Comprehensive software packages for satellite data:

- Processing
- Graphics and Visualization
- Analysis
- Format conversions
- Quality control

NOAA COASTWATCH UTILITIES TRAINING SESSION THURSDAY



The ERDDAP data server simplifies data access

ERDDAP
Easier access to scientific data

ERDDAP > griddap > Make A Graph

Dataset Title: **Aquarius Sea Surface Salinity, Version 2, Global, 3-Month** [RSS](#)
Institution: NASA/GSFC OBPG (Dataset ID: jplAquariusSSS3Month)
Information: [Summary](#) | [License](#) | [EGDC](#) | [ISO 19115](#) | [Metadata](#) | [Background](#) | [Data Access Form](#)

Graph Type:
X Axis:
Y Axis:
Color:
Dimensions:
time (UTC)
latitude (degrees_north)
longitude (degrees_east)
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 [Download the Data or an image](#)
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

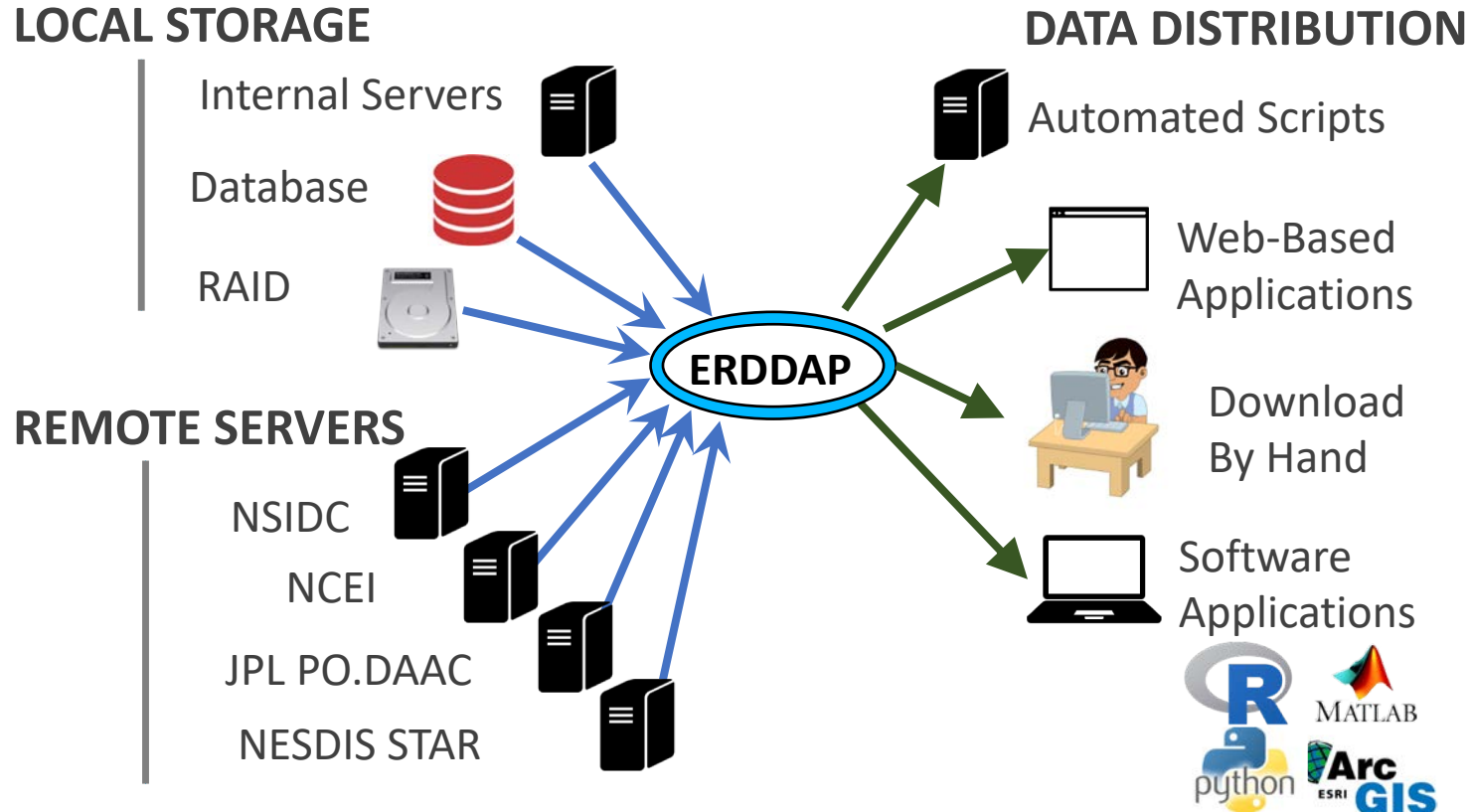
WC Node's ERDDAP server gives you:

A simple, consistent way to download data

- For the area and time period of interest
- In the format that works with your analysis tools

ERDDAP works for humans and machines

ERDDAP allows one-stop data shopping



**FLEXIBLE DISTRIBUTION IS
POSSIBLE BECAUSE DATA
QUERIES ARE COMPLETELY
DEFINED WITHIN A URL**

Deconstructing the ERDDAP URL

griddap/erdVHsstaWS3day.largePng?sst[(2016-10-21T12:00:00Z):(2016-10-21T12:00:00Z)][(0.0):(0.0)]

Example of a URL data request

Base URL: <https://coastwatch.pfeg.noaa.gov/erddap/griddap/>

Dataset ID: erdVHsstaWS3day

File Type: .largePng (.nc, .mat, .json, .geotif, .kml, .csv...)

Data Request Begins ?

Variable: sst

Time range: [(2016-10-21T12:00:00Z):(2016-10-21T12:00:00Z)]

Altitude range [(0.0):(0.0)]

Latitude Range: [(41.75):(30.86)]

Longitude Range: [(-128.25):(-114.75)]

[https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVHsstaWS3day.largePng?sst\[\(2016-10-21T12:00:00Z\):\(2016-10-21T12:00:00Z\)\]\[\(0.0\):\(0.0\)\]\[\(41.75\):\(30.86\)\]\[\(-128.25\):\(-114.75\)\]](https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdVHsstaWS3day.largePng?sst[(2016-10-21T12:00:00Z):(2016-10-21T12:00:00Z)][(0.0):(0.0)][(41.75):(30.86)][(-128.25):(-114.75)])



The structure of ERDDAP's URL makes it easy to build your own data request in any language

THIS EXAMPLE IS IN R

1. GENERATE URL PARTS WITH R (MATLAB, PYTHON...)

```
baseurl <- 'http://coastwatch.pfeg.noaa.gov/erddap/griddap/'  
data_id <- 'erdVHsstaWS3day'  
file_type <- '.nc'  
Data_var <- '?sst'  
time <- '[(2016-10-21T12:00:00Z):1:(2016-10-21T12:00:00Z)]'  
alt <- [(0.0):(0.0)]  
lat <- '[(41.75):1:(30.86)]'  
lon <- '[(128.25):(-114.75)]'
```

2. PUT TOGETHER PARTS TO BUILD CUSTOM URL

```
erddapURL <- paste(baseurl, data_id, data_var, time, alt, lat, lon, sep="")
```

3. SEND A REQUEST TO ERDDAP USING THE URL

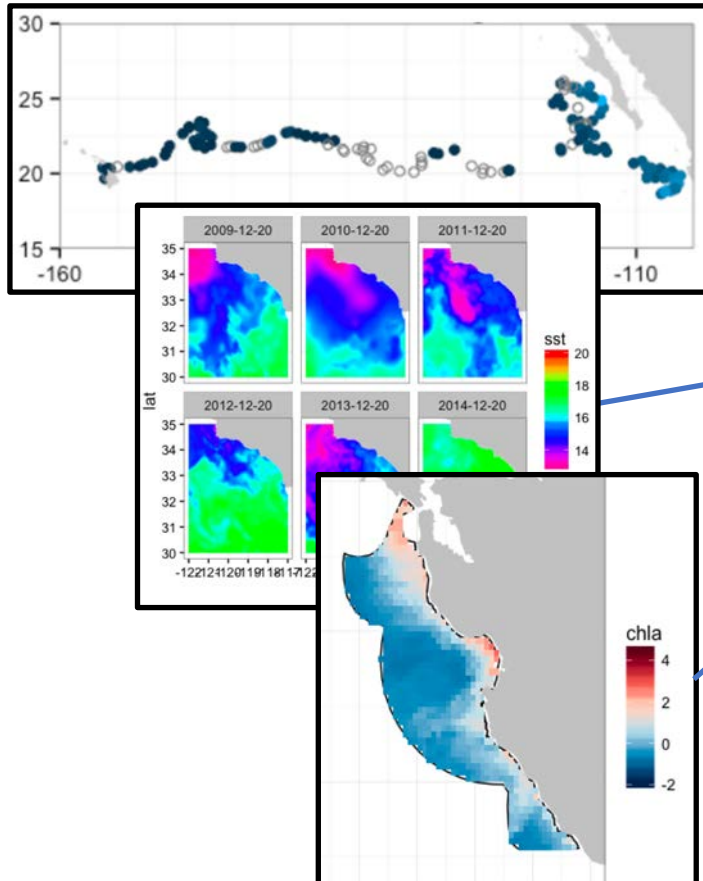
```
download.file(url=erddapURL, destfile="myDataFile.nc")
```

4. CREATE DATA OBJECT AND USE THE DATA

```
dataObject <- ncdf4::nc_open("myDataFile.nc")
```

Tools for the workshop – Xtractomatic R scripts talk to ERDDAP for you

CREATE AND EXECUTE ERDDAP DATA REQUESTS - DO COMMON TASKS



Premade scripts that perform common functions

Extract data around ship stations or animal tracks

Extract data for rectangular area over time

Extract data for any area (polygon) over time

R XTRACTOMATIC TRAINING SESSION THURSDAY
PYTHON CODE EXAMPLES SESSION THURSDAY

Tools for the workshop – Plug-in for ArcGIS users



Environmental Data Connector: a Plug-in for ArcGIS

Free graphical interface for browsing, sub-setting, and downloading data from OPeNDAP, SOS, THREDDS, and ERDDAP

User guide and download


coastwatch.pfeg.noaa.gov/EDC/index.html

Tutorial

www.youtube.com/watch?v=czr6M0877gE

ARCGIS TRAINING SESSION THURSDAY

ERDDAP's interface for downloading data by hand

**ERDDAP**
Easier access to scientific data

Brought to you by NOAA NMFS SWFSC

ERDDAP > griddap > Make A Graph

Dataset Title: **Global SST & Sea Ice Analysis, L4 OSTIA, UK Met Office, Global, 0.05°, Daily, 2013-present** [✉](#) [RSS](#)

Institution: UKMO (Dataset ID: jplUKMO_OSTIAv20)

Information: [Summary](#) | [License](#) | [FGDC](#) | [ISO 19115](#) | [Metadata](#) | [Background](#) | [Data Access Form](#)

Graph Type: [?](#)

X Axis: [?](#)

Y Axis: [?](#)

Color: [?](#)

Dimensions [?](#)

time (UTC) [?](#) **Start** [?](#) specify just 1 value → [?](#) **Stop** [?](#)

latitude (degrees_north) [?](#) [+](#) [-](#)

longitude (degrees_east) [?](#) [+](#) [-](#)

Graph Settings

Color Bar: [?](#) Continuity: [?](#) Scale: [?](#)

Minimum: Maximum: N Sections: [?](#)

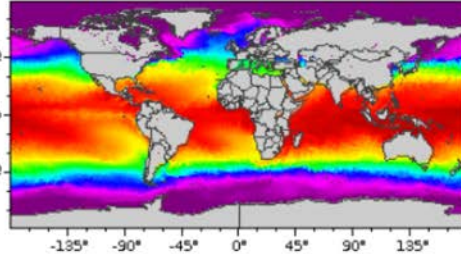
Draw land mask: [?](#)

Y Axis Minimum: Maximum: [?](#)

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

Click on the map to specify a new center point. [?](#)

Zoom:



analysed sea surface temperature (degree C)
Global SST & Sea Ice Analysis, L4 OSTIA, UK Met Office,
Global, 0.05°, Daily, 2013-present
(2020-01-23T12:00:00Z)
Data courtesy of UKMO



CoastWatch West Coast Node

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

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ERDDAP: live demo and hands-on session

Please do the following

OPEN UP A BROWSER AND BRING UP ERDDAP AT THIS URL

- <http://coastwatch.pfeg.noaa.gov/erddap>

IN A SECOND BROWSER WINDOW, OPEN THIS TUTORIAL

- <http://coastwatch.pfeg.noaa.gov/projects/erddap>
- We will work through chapters 2 and 3

Questions?

VISIT THE COASTWATCH WEST COAST WEBSITE FOR INFORMATION, TUTORIALS, SOFTWARE, AND MORE

coastwatch.pfeg.noaa.gov/index.html

HOME DATA ACCESS TOOLS & TRAINING ABOUT CONTACT QUICK LINKS

NOAA COASTWATCH
WEST COAST REGIONAL NODE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Providing near real-time satellite data for the coastal ocean

Environmental Data
View and download over 800 regional and global datasets, including satellite data, model output, and in situ measurements from field sensors.
[Data Catalog](#) [Coastal Conditions](#)

ERDDAP Data Server
The ERDDAP data server provides a simple, consistent way to subset and download environmental datasets in common file formats with options to make graphs and maps.
[Features](#) [Get Data](#)

Software
The Environmental Data Connector (EDC) and Xtractomatic data extraction scripts make it easy to discover and extract data from online servers and download them directly into ArcGIS, R, MatLab, and Excel.
[EDC](#) [Xtractomatic](#)

News and Events ([archive](#))

- ERDDAP server and the CoastWatch West Coast website shutdown scheduled for Tuesday Oct. 18 from 4:30pm to 10:30pm PDT. [17 Oct. 2016](#)
- GHRSSST Multi-scale Ultra-high Resolution (MUR) SST monthly anomaly product is available on ERDDAP [3 Oct. 2016](#)
- Environmental Data Connector update - Instructions for [downloading and installing](#) are available [30 Sep. 2016](#)
- Jennifer Patterson joins the CoastWatch team as the coordinator of the new PolarWatch program. Welcome aboard, Jenn! [26 Sep. 2016](#)
- ERDDAP update - [Version notes](#) and instructions for [downloading and installing](#) are available for ERDDAP ver. 1.72 [20 May 2016](#)
- The [2016 NOAA Ocean Satellite Data Course](#) will be held in Seattle at the University of Washington Aug 30 - Sept 1 2016 [9 May 2016](#)
- POES Global Area Coverage SST and SST anomaly products are no longer being produced [9 May 2016](#)

NOAA HOME WEATHER OCEANS FISHERIES CHARTING SATELLITES CLIMATE RESEARCH COASTS CAREERS

coastwatch.pfeg.noaa.gov



Please do the following before the live demonstration

Please do the following

OPEN UP A BROWSER AND BRING UP ERDDAP AT THIS URL

- <http://coastwatch.pfeg.noaa.gov/erddap>
- Or Google it with “ERDDAP” “west coast”

IN A SECOND BROWSER WINDOW, OPEN ERDDAP TUTORIAL LOCATED AT THIS URL :

- <http://coastwatch.pfeg.noaa.gov/projects/erddap>

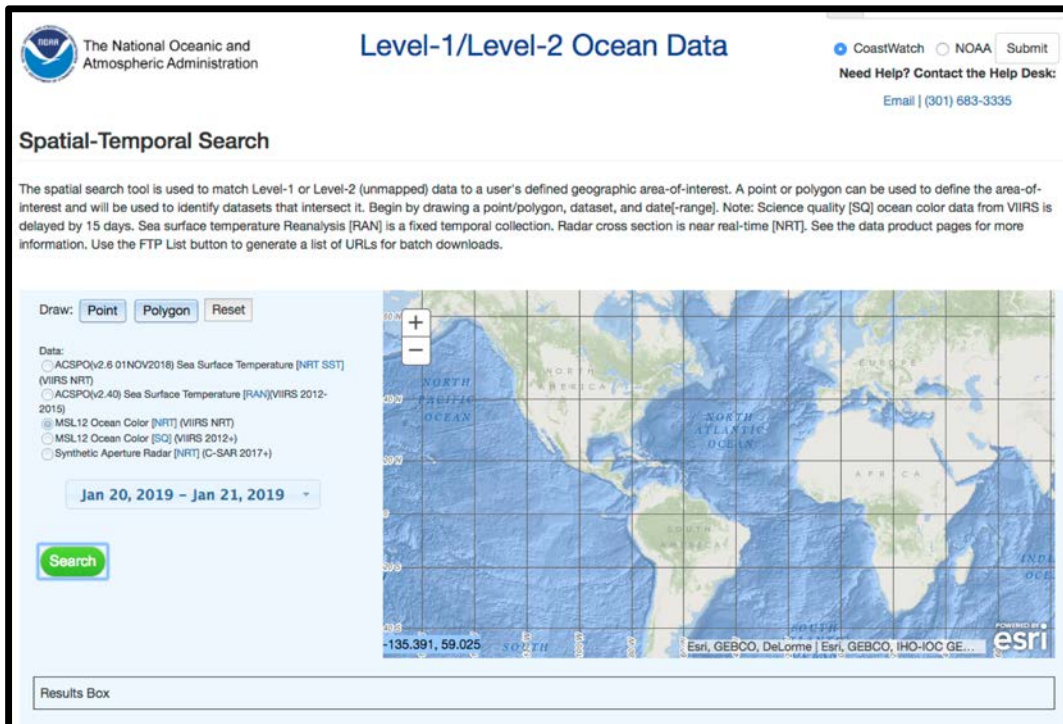
OPTIONAL: OPEN UP A TEXT EDITOR (NOT WORD)

- E.g. Mac – TextEdit or PC – WordPad



Advanced data discovery tools

COASTWATCH CENTRAL DATA DISCOVERY TOOLS



The screenshot shows the "Level-1/Level-2 Ocean Data" search interface. At the top left is the NOAA logo and the text "The National Oceanic and Atmospheric Administration". The title "Level-1/Level-2 Ocean Data" is centered. On the top right, there are radio buttons for "CoastWatch" (selected) and "NOAA", followed by a "Submit" button. Below this is a link: "Need Help? Contact the Help Desk: Email | (301) 683-3335". The main section is titled "Spatial-Temporal Search". A paragraph explains the tool's purpose: "The spatial search tool is used to match Level-1 or Level-2 (unmapped) data to a user's defined geographic area-of-interest. A point or polygon can be used to define the area-of-interest and will be used to identify datasets that intersect it. Begin by drawing a point/polygon, dataset, and date-range. Note: Science quality [SQ] ocean color data from VIIRS is delayed by 15 days. Sea surface temperature Reanalysis [RAN] is a fixed temporal collection. Radar cross section is near real-time [NRT]. See the data product pages for more information. Use the FTP List button to generate a list of URLs for batch downloads." Below the text are "Draw:" buttons for "Point", "Polygon", and "Reset". A "Data:" section lists several options with radio buttons: "ACSPQ(v2.6 01NOV2016) Sea Surface Temperature [NRT SST] (VIIRS NRT)", "ACSPQ(v2.40) Sea Surface Temperature [RAN](VIIRS 2012-2015)", "MSL12 Ocean Color [NRT] (VIIRS NRT)" (selected), "MSL12 Ocean Color [SQ] (VIIRS 2012+)", and "Synthetic Aperture Radar [NRT] (C-SAR 2017+)". A date range selector shows "Jan 20, 2019 - Jan 21, 2019". A green "Search" button is below. To the right is a map of the Atlantic Ocean with a grid. At the bottom left of the map are coordinates "-135.391, 59.025". At the bottom right is the "esri" logo. A "Results Box" is at the very bottom.

L1/L2 Data Data Search

coastwatch.noaa.gov/cw_html/cw_polygon_search.html

Level-1/Level-2 Granule Search

coastwatch.noaa.gov/cw_html/cw_granule_selector.html