Introduction to ERDDAP

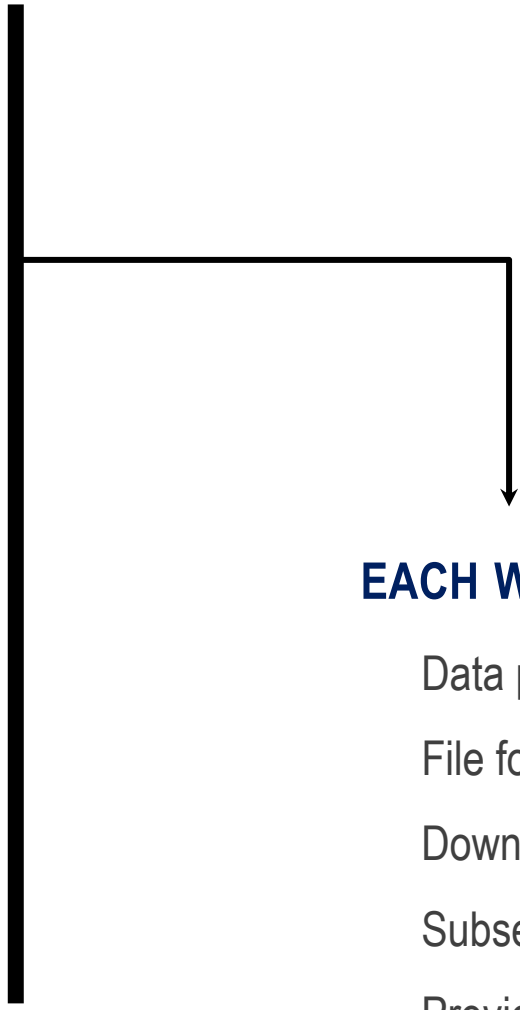
NOAA CoastWatch Satellite Course

Last Updated: 9/9/2020

Accessing satellite data can be challenging

A SHORT LIST OF DATA SERVERS

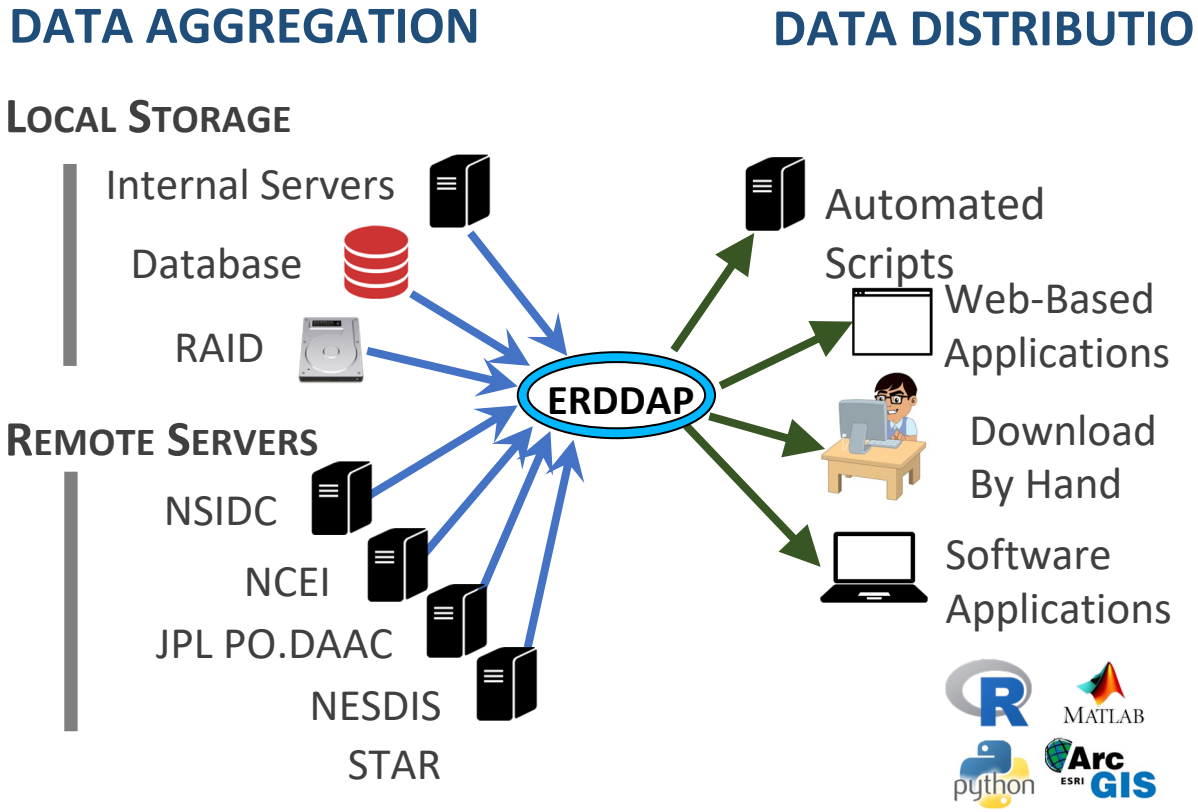
- NOAA CoastWatch Central Operations
- NOAA Center for Satellite Applications and Res.
- NOAA Office of Satellite and Products
- NOAA National Centers for Environmental Info.
- NOAA Comprehensive Large Array-data Stewardship System (CLASS)
- NASA Jet Propulsion Laboratory PO.DAAC
- NASA Ocean Biology (OB.DAAC)
- NASA Goddard Space Flight Center
- European Space Agency
- EUMETSAT
- Japan Aerospace Exploration Agency



EACH WITH ITS OWN

- Data products
- File formats
- Download protocols
- Subsetting abilities
- Previewing abilities

ERDDAP[1] – designed to make data access easier



ERDDAP provides a simple, consistent way to:

- Subset datasets temporally and spatially
- Distribute both gridded and non-gridded (tabular) data
- Download data in > 30 formats
- Data requests defined within URLs, allowing:
  - Access data within analysis tools (R, Matlab, python)
  - Machine-to-machine data exchange

Over 85 ERDDAPs exist worldwide

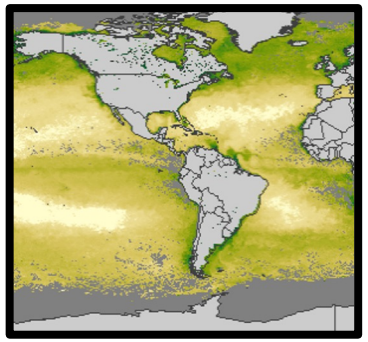
Over a dozen different ERDDAPs in NOAA

ERDDAP is one of the recommended data servers in NOAA's Data Access Procedural Directive

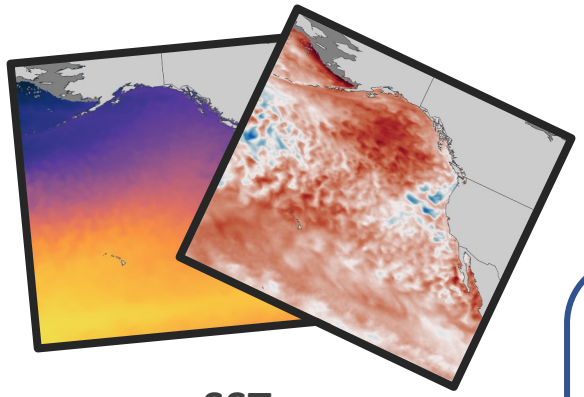
Search for data across multiple ERDDAPs at erddap.com

[1]ERDDAP was developed at NOAA/NMFS/SWFSC/ERD by Bob Simons

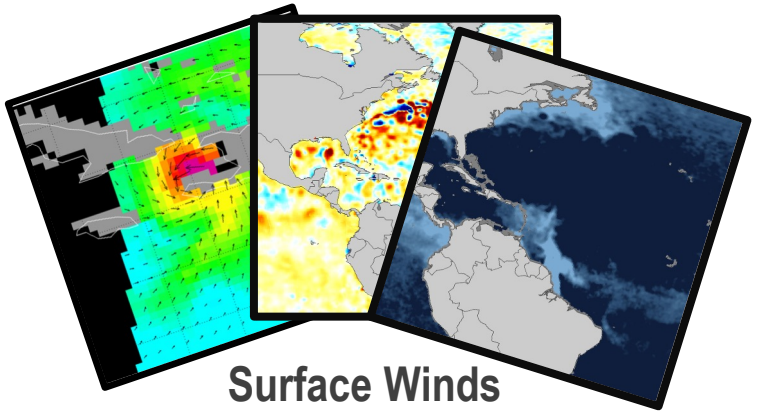
NOAA/ERD ERDDAP contains > 1000 satellite datasets



Chlorophyll
Primary Productivity



SST
SST Anomaly



Surface Winds
Sea Surface Salinity
Sea Surface Height and Anomaly

0.5 – 1 million data requests per day

- Daily, weekly, and monthly composites
- Blended products
- Interpolated products (gap free)
- All level 3 or 4 products (i.e. on a regular XY grid)

This ERDDAP is maintained jointly by the SWFSC Environmental Research Division and the West Coast Node(WCN) of NOAA's CoastWatch program

ERD ERDDAP data catalog has >400 non-satellite datasets

In Situ Measurements

- Animal Telemetry Network
- ARGO floats
- TAO/TRITON, RAMA, & PIRATA Buoys
- IOOS In Situ Sensors
- Glider Data
- Global Temperature and Salinity Profile Programme
- HF Radar Currents
- GLOBEC Northeast Pacific
- NOAA CO-OPS Sensors
- NDBC buoys

Field Sampling

- CalCOFI
- California Fish Landings
- Farallon Island Seabirds
- NWFSC Habitat Use
- SWFSC Rockfish

Underway Data

- NOAA Vessels
- UNOLS Vessels

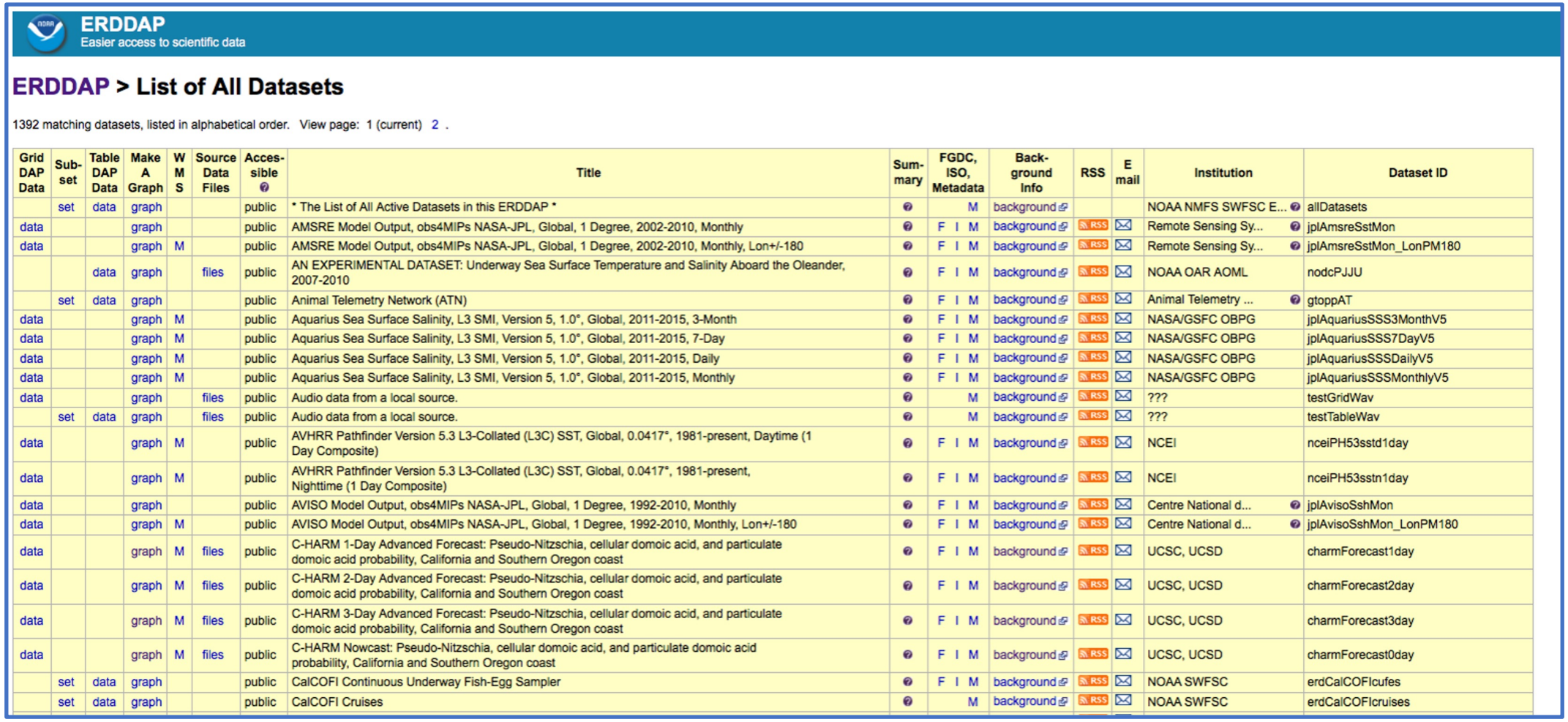
Models, Climatologies

- OSCAR Sea Surface Velocity
- SODA Model

Models, Climatologies (cont.)

- NOAA Coastal Relief Model
- NOAA RTOFS Forecast Model
- NOAA RTOFS Nowcast Model
- NOAA World Ocean Atlas
- NOAA Seafloor Topography
- SWFSC Upwelling Index
- Navy NAVGEM Model
- Navy NOGAPS Model
- NCEP/NCAR Reanalysis
- USGS Topography
- NASA/NOAA CCMP Wind Atlas
- Navy HYCOM Model
- Navy FNMOC Forecast Model

The ERDDAP interface is functionally beautiful



ERDDAP
Easier access to scientific data

ERDDAP > List of All Datasets

1392 matching datasets, listed in alphabetical order. View page: 1 (current) 2 .

Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	WMS	Source Data Files	Acces-sible	Title	Sum-mary	FGDC, ISO, Metadata	Back-ground Info	RSS	E mail	Institution	Dataset ID
	set	data	graph			public	* The List of All Active Datasets in this ERDDAP *		M	background			NOAA NMFS SWFSC E...	allDatasets
data			graph			public	AMSRE Model Output, obs4MIPs NASA-JPL, Global, 1 Degree, 2002-2010, Monthly		F I M	background	RSS		Remote Sensing Sy...	jplAmsreSstMon
data			graph	M		public	AMSRE Model Output, obs4MIPs NASA-JPL, Global, 1 Degree, 2002-2010, Monthly, Lon+/-180		F I M	background	RSS		Remote Sensing Sy...	jplAmsreSstMon_LonPM180
		data	graph		files	public	AN EXPERIMENTAL DATASET: Underway Sea Surface Temperature and Salinity Aboard the Oleander, 2007-2010		F I M	background	RSS		NOAA OAR AOML	nodcPJJU
	set	data	graph			public	Animal Telemetry Network (ATN)		F I M	background	RSS		Animal Telemetry ...	gtoppAT
data			graph	M		public	Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, 3-Month		F I M	background	RSS		NASA/GSFC OBPG	jplAquariusSSS3MonthV5
data			graph	M		public	Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, 7-Day		F I M	background	RSS		NASA/GSFC OBPG	jplAquariusSSS7DayV5
data			graph	M		public	Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, Daily		F I M	background	RSS		NASA/GSFC OBPG	jplAquariusSSSDailyV5
data			graph	M		public	Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, Monthly		F I M	background	RSS		NASA/GSFC OBPG	jplAquariusSSSMonthlyV5
data			graph		files	public	Audio data from a local source.		M	background	RSS		???	testGridWav
	set	data	graph		files	public	Audio data from a local source.		M	background	RSS		???	testTableWav
data			graph	M		public	AVHRR Pathfinder Version 5.3 L3-Collated (L3C) SST, Global, 0.0417°, 1981-present, Daytime (1 Day Composite)		F I M	background	RSS		NCEI	nceiPH53sstd1day
data			graph	M		public	AVHRR Pathfinder Version 5.3 L3-Collated (L3C) SST, Global, 0.0417°, 1981-present, Nighttime (1 Day Composite)		F I M	background	RSS		NCEI	nceiPH53sstn1day
data			graph			public	AVISO Model Output, obs4MIPs NASA-JPL, Global, 1 Degree, 1992-2010, Monthly		F I M	background	RSS		Centre National d...	jplAvisoSshMon
data			graph	M		public	AVISO Model Output, obs4MIPs NASA-JPL, Global, 1 Degree, 1992-2010, Monthly, Lon+/-180		F I M	background	RSS		Centre National d...	jplAvisoSshMon_LonPM180
data			graph	M	files	public	C-HARM 1-Day Advanced Forecast: Pseudo-Nitzschia, cellular domoic acid, and particulate domoic acid probability, California and Southern Oregon coast		F I M	background	RSS		UCSC, UCSD	charmForecast1day
data			graph	M	files	public	C-HARM 2-Day Advanced Forecast: Pseudo-Nitzschia, cellular domoic acid, and particulate domoic acid probability, California and Southern Oregon coast		F I M	background	RSS		UCSC, UCSD	charmForecast2day
data			graph	M	files	public	C-HARM 3-Day Advanced Forecast: Pseudo-Nitzschia, cellular domoic acid, and particulate domoic acid probability, California and Southern Oregon coast		F I M	background	RSS		UCSC, UCSD	charmForecast3day
data			graph	M	files	public	C-HARM Nowcast: Pseudo-Nitzschia, cellular domoic acid, and particulate domoic acid probability, California and Southern Oregon coast		F I M	background	RSS		UCSC, UCSD	charmForecast0day
	set	data	graph			public	CalCOFI Continuous Underway Fish-Egg Sampler		F I M	background	RSS		NOAA SWFSC	erdCalCOFIcufes
	set	data	graph			public	CalCOFI Cruises		M	background	RSS		NOAA SWFSC	erdCalCOFIcruises

Online interface to create custom graphs

Graph Type:

Maps (surface)

Time-series (lines)

Hovmöller (surface)

Vectors (vectors)

Color:

Choose variable in dataset

Scale:

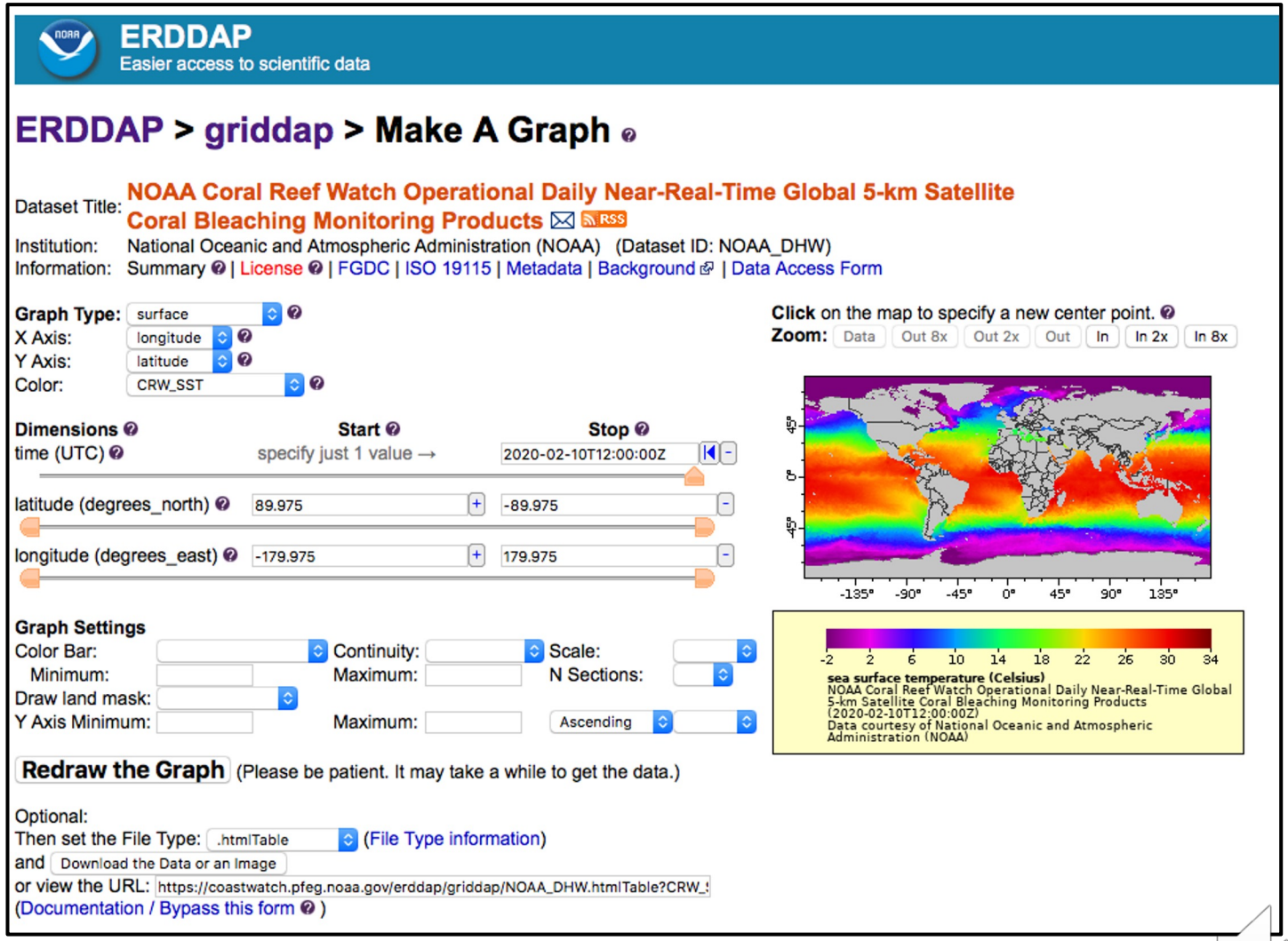
Choose linear or log

Color Bar:

Choose from > 40 color palettes

File Type:

Choose from > 40 file formats (data and graphics)



Online interface to download data

Ca
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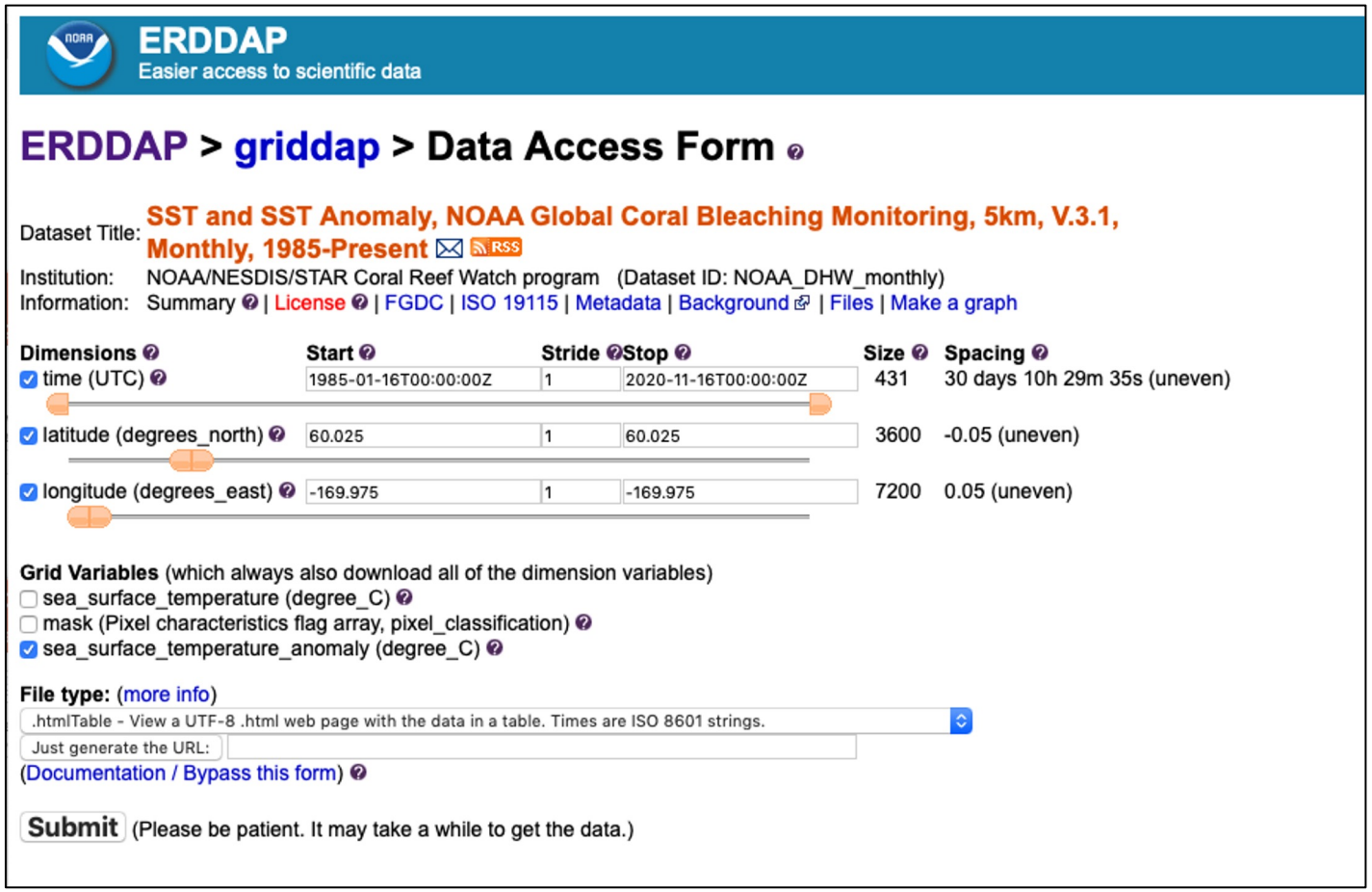
Fil

.asc - View OPeNDAP-style ISO-8859-1 comma-s
.csv - Download a ISO-8859-1 comma-separated
.csvp - Download a ISO-8859-1 .csv file with line
.csv0 - Download a ISO-8859-1 .csv file without c
.das - View the dataset's metadata via an ISO-885
.dds - View the dataset's structure via an ISO-885
.dods - OPeNDAP clients use this to download the
.esriAscii - Download an ISO-8859-1 ESRI ASCII fi
.fgdc - View the dataset's UTF-8 FGDC .xml meta
.graph - View a Make A Graph web page.
.help - View a web page with a description of grid
.html - View an OPeNDAP-style HTML Data Acces
.htmlTable - View a UTF-8 .html web page with th
.iso19115 - View the dataset's ISO 19115-2/19139
.itx - Download an ISO-8859-1 Igor Text File. Each
.json - View a table-like UTF-8 JSON file (missing
.jsonlCSV1 - View a UTF-8 JSON Lines CSV file wi
.jsonlCSV - View a UTF-8 JSON Lines CSV file wit
.jsonlKVP - View a UTF-8 JSON Lines file with Key
.mat - Download a MATLAB binary file.
.nc - Download a NetCDF-3 binary file with COARD
.ncHeader - View the UTF-8 header (the metadata
.ncml - View the dataset's structure and metadata
.nccsv - Download a NetCDF-3-like 7-bit ASCII NC
.nccsvMetadata - View the dataset's metadata as
.ncoJson - Download a UTF-8 NCO lvl=2 JSON fil
.odvTxt - Download time,lat,lon,otherVariables as
.timeGaps - View a UTF-8 list of gaps in the time
.tsv - Download a ISO-8859-1 tab-separated text
.tsvp - Download a ISO-8859-1 .tsv file with line 1



Deconstructing an ERDDAP data request URL

NOAA_DHW_monthly.largePng?sea_surface_temperature[(2019-09-21T12:00:00Z)]

coastwatch.pfeg.noaa.gov/erddap/griddap/

[(70):(-10)][(-180):(-100)]

Example of a URL data request

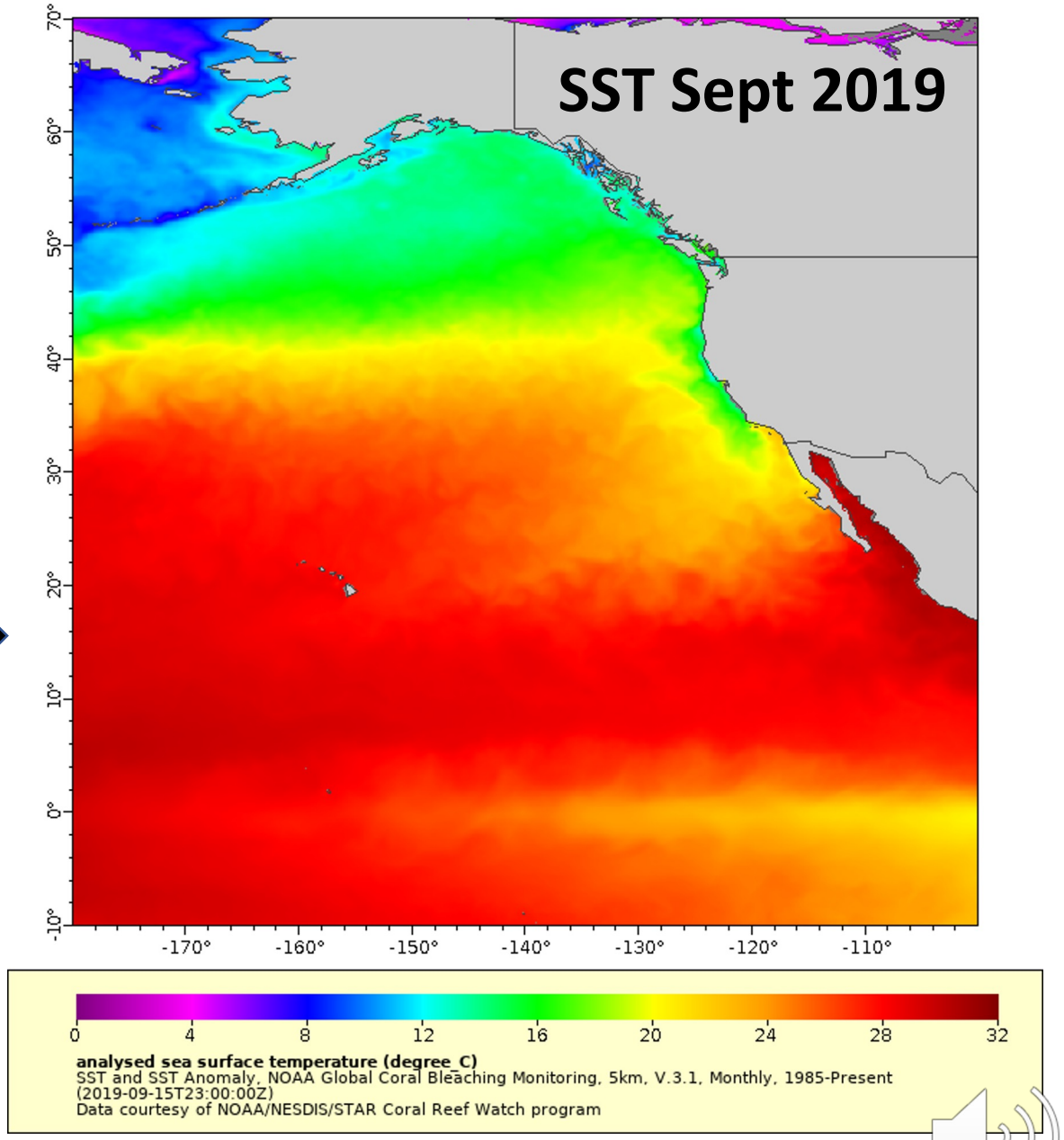
Base URL:	https://coastwatch.pfeg.noaa.gov/erddap/griddap/
Dataset ID:	NOAA_DHW_monthly
File Type:	.largePng (.nc, .mat, .json, .geotif, .kml, .csv…)
Data Request Begins	?
Variable:	sea_surface_temperature
Time range:	[(2019-09-15T12:00:00Z):(2019-09-15T12:00:00Z)]
Latitude Range:	[(70):(-10)]
Longitude Range:	[(-180):(-100)]

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?sea_surface_temperature[(2019-09-15T23:00:00Z)][(70):(-10)][(-180):(-10

This URL:

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.**largePng**?sea_surface_temperature[(2019-09-15)][(70):(-10)][(-180):(-100)]

Produces this figure →



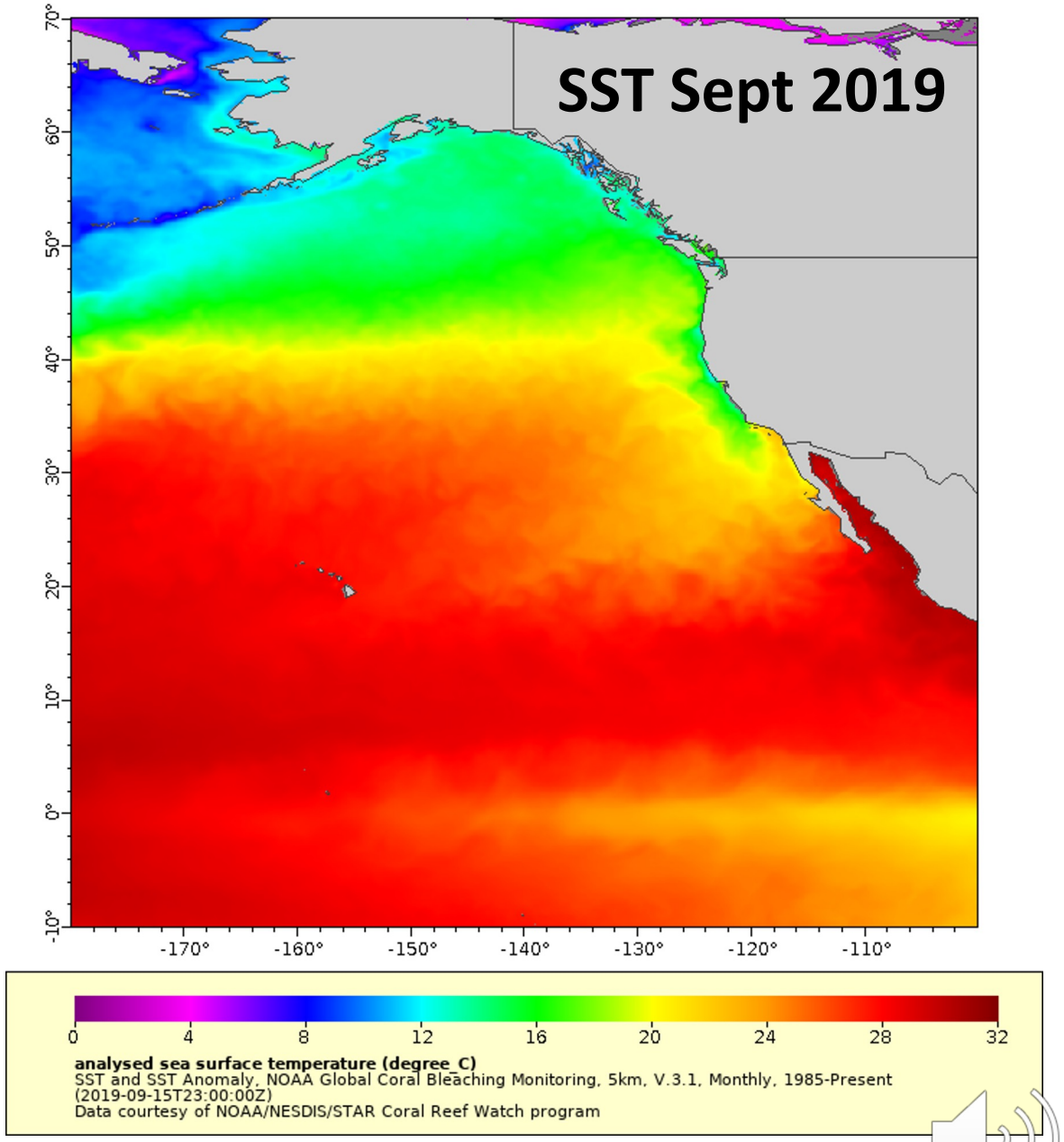
Note:

You can download the data in a netCDF file by changing .largePng to .nc in the URL

Change the variable:

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?sea_surface_temperature[(2019-09-15)][(70):(-10)][(-180):(-100)]

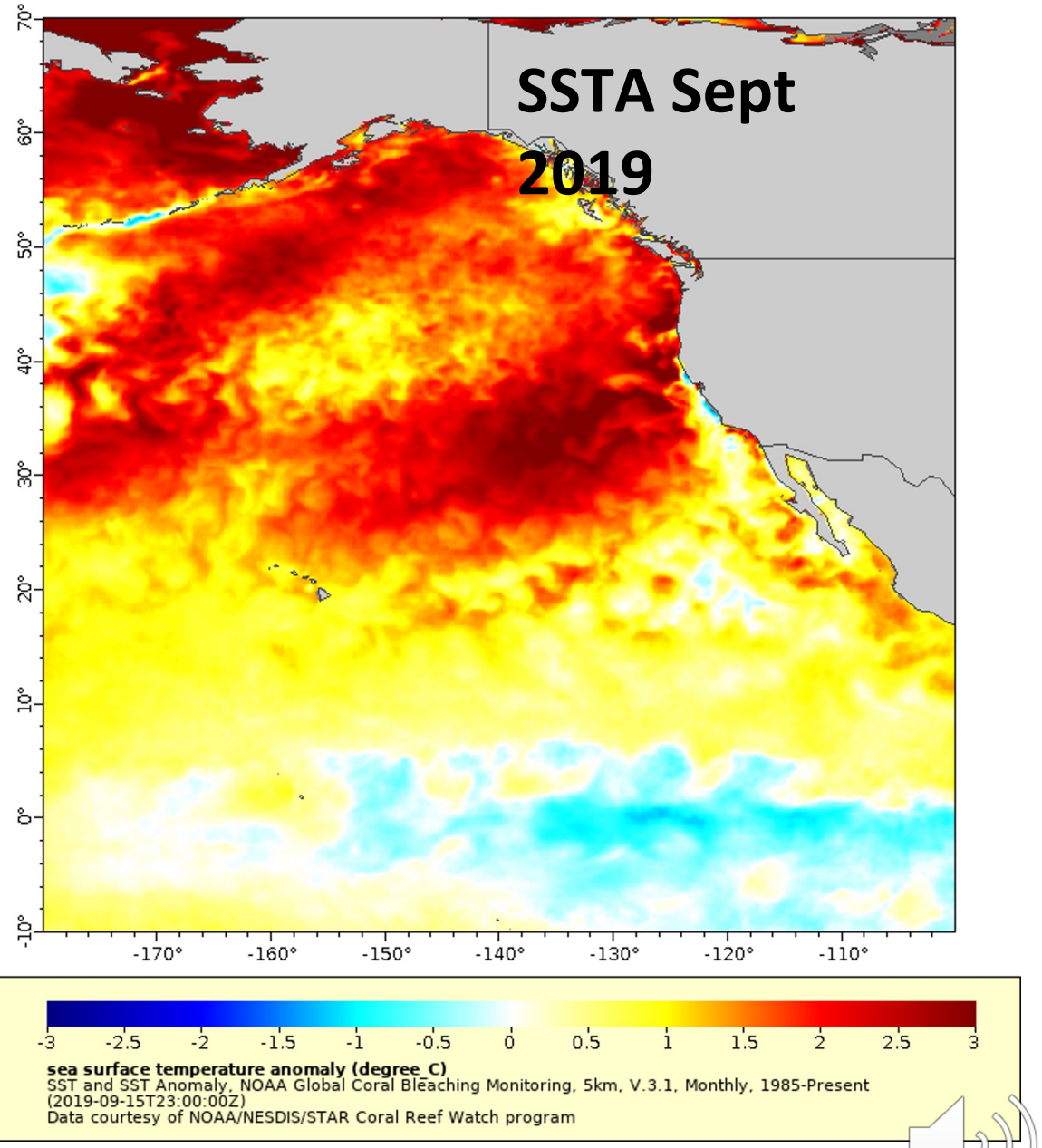
- Change the variable displayed to see the SST anomaly
- For this dataset we will change it to sea_surface_temperature_anomaly



Visualize the Pacific marine heat wave:

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?**sea_surface_temperature_anomaly**[(2019-09-15)][(70):(-10)][(-180):(-100)]

Produces this figure →



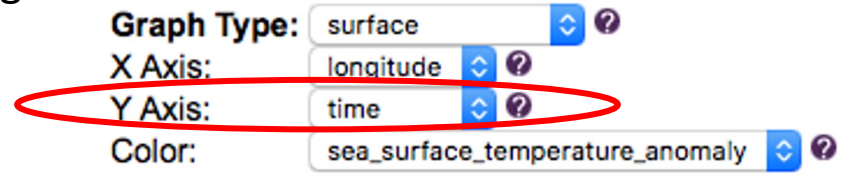
Note: Changing the variable name produces an anomaly because this dataset has a variable with the SST anomaly in it. Most datasets do not have an anomaly variable in them, so this modification will only work for this dataset.

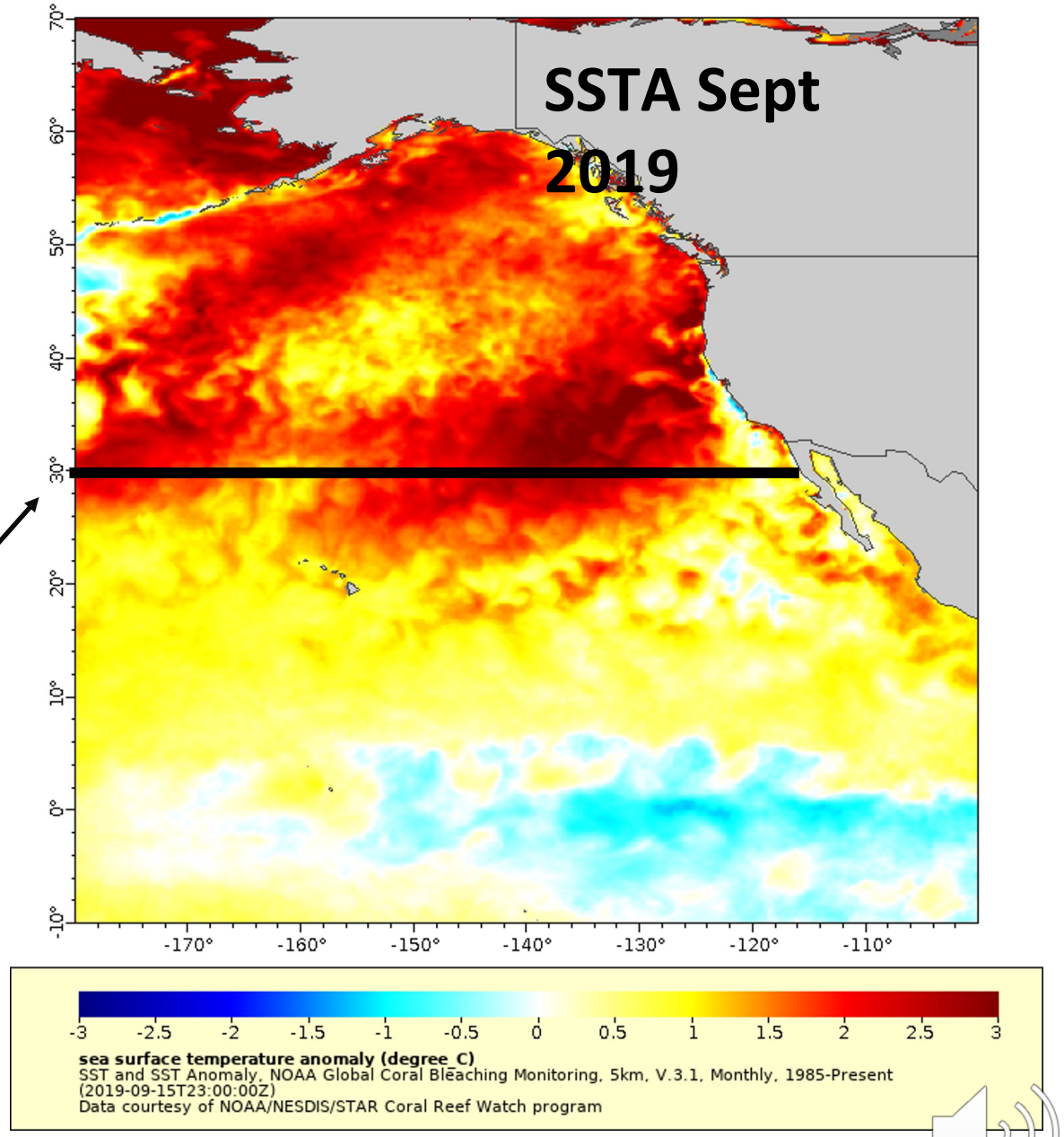
Create a 2D timeseries:

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?**sea_surface_temperature_anomaly**[(2019-09-15)][(70):(-10)][(-180):(-100)]

Next we will examine the temporal evolution of the warm "blob" by making a Hovmöller diagram, a hybrid map with time on one axis, and latitude or longitude on the other. We will make a slice through 30°N.

We can do this by setting the y-axis to time on the "Make a Graph" page:

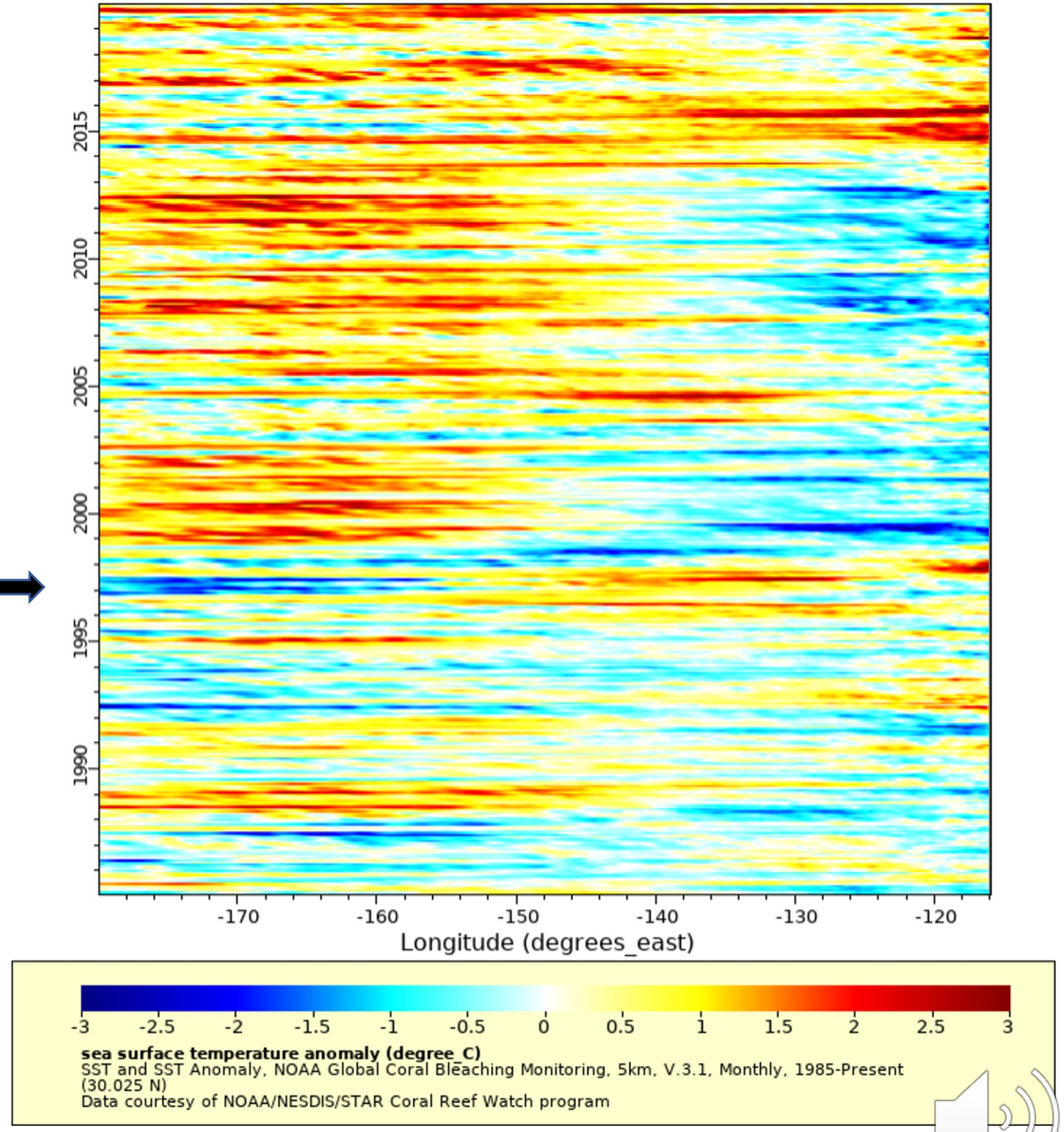




Generate a Hovmöller diagram

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?**sea_surface_temperature_anomaly**[(1985-01-15):(2019-12-16)][(30)][(-180):(-116)]

Produces this figure →

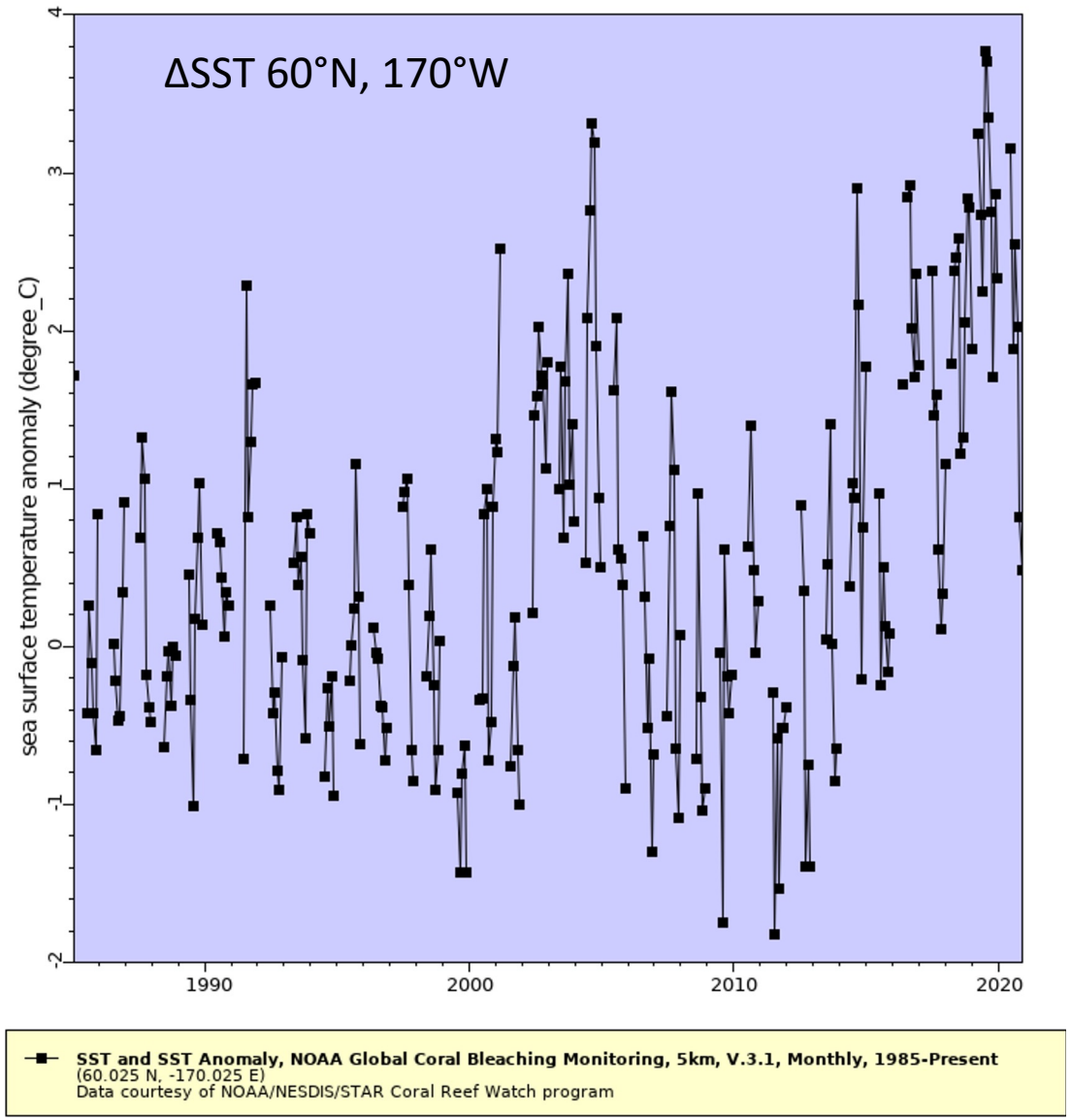


While most of the last 20 years the N. Pacific (at 30°N) has experienced warmer than usual temperatures, only in the past few years has this phenomena spread to coast (east of 120°W).

Generate a Timeseries

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?sea_surface_temperature_anomaly[(1985-01-16T00:00:00Z):(2020-12-16T00:00:00Z)][(60)][(-170)]

Produces this figure

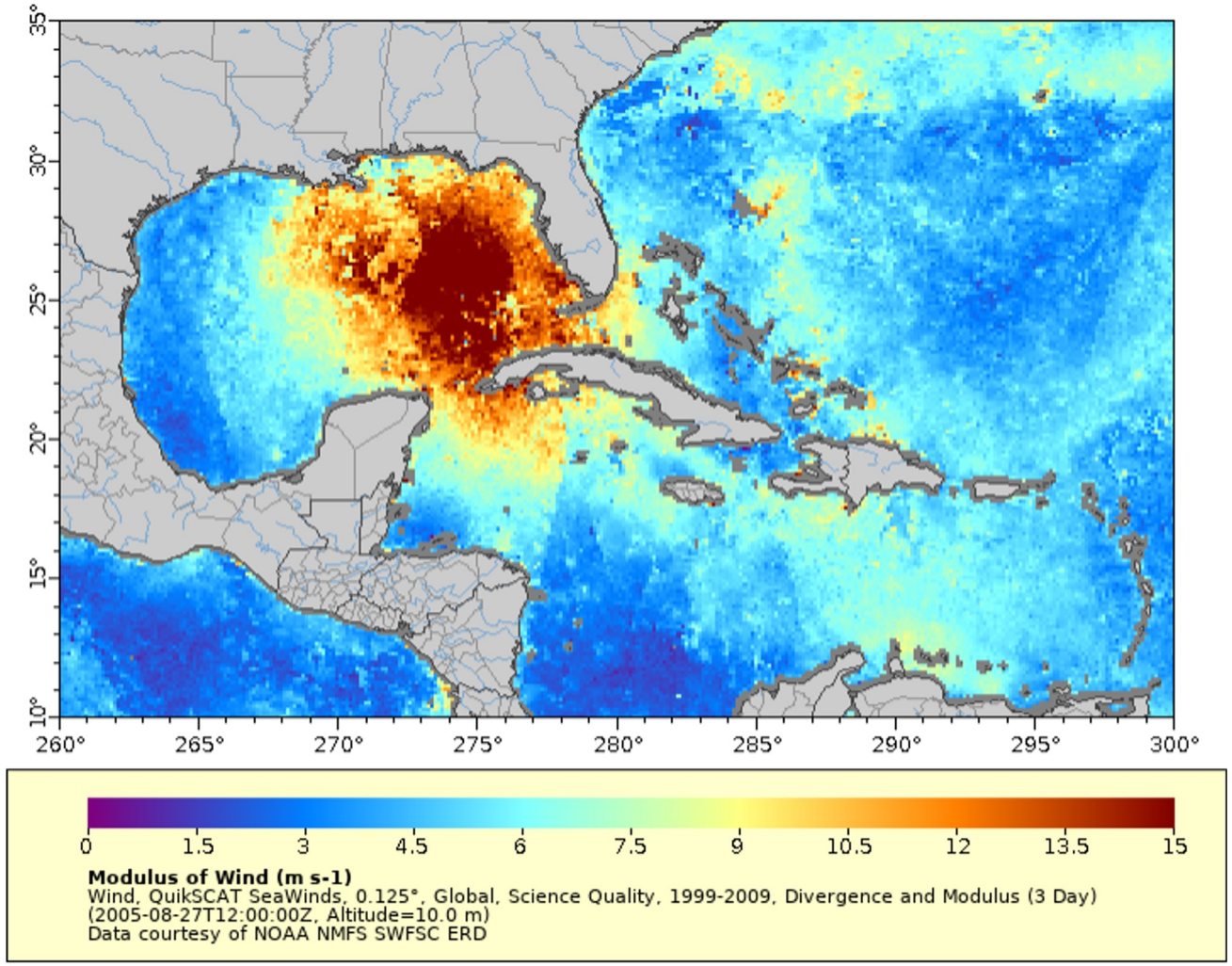


Select 'linesAndMarkers' under Graph Type on the Make a Graph page (.graph) to create a timeseries at any point in the dataset

Visualize wind speeds produced by Hurricane Katrina

https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdQSdivmod3day.largePng?mod[(2005-08-27)][(10)][(10):(35)][(260):(300)]]

Produces this figure



Visualize wind vectors produced by Hurricane Katrina

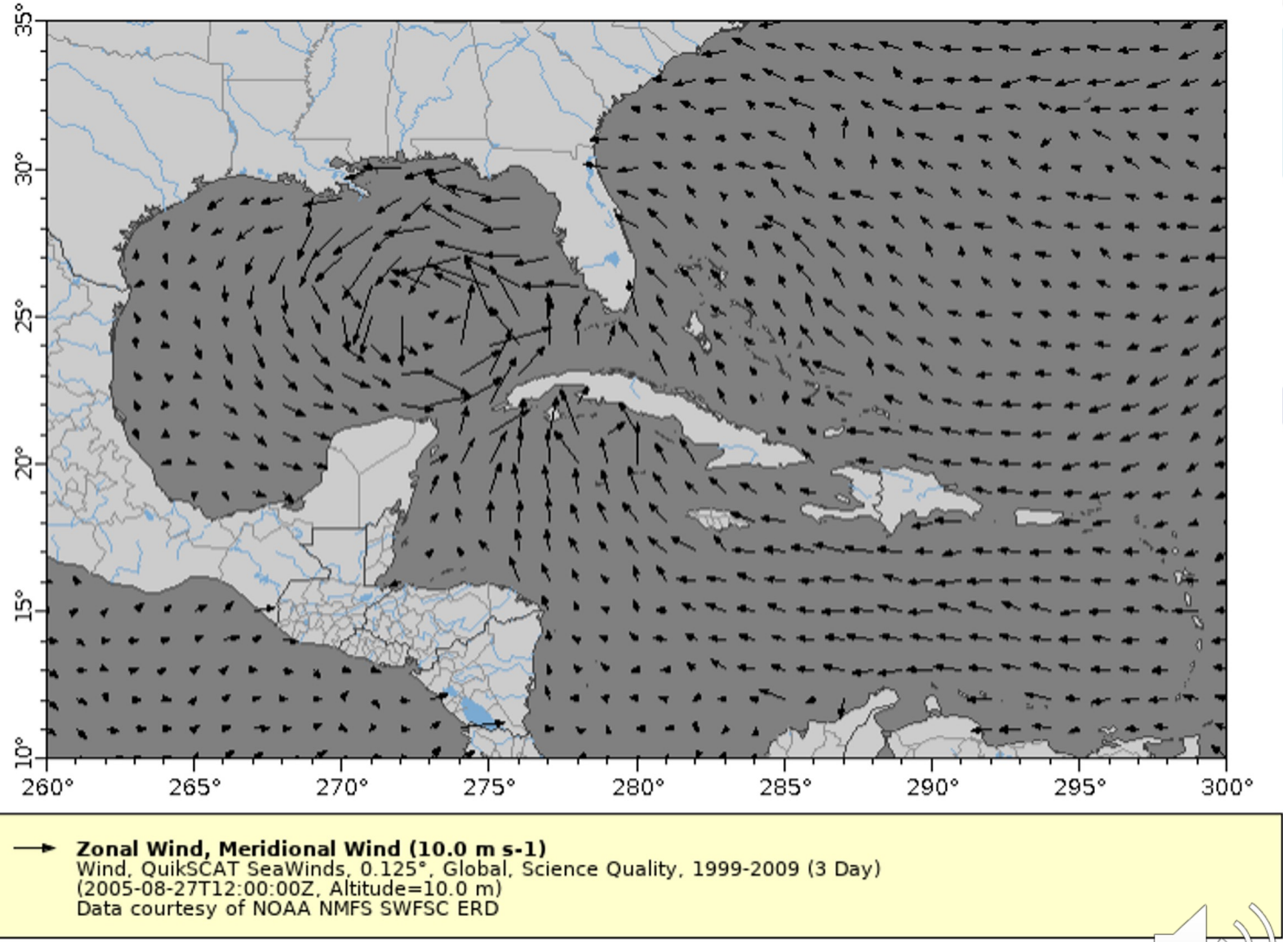
Visualize wind vectors produced by Hurricane Katrina

ERDDAP
Easier access to scientific data

ERDDAP > griddap > M

Dataset Title: **Wind, QuikSCAT SeaWin**
Institution: NOAA NMFS SWFSC ERD (Dat
Information: Summary | License | FGDC |

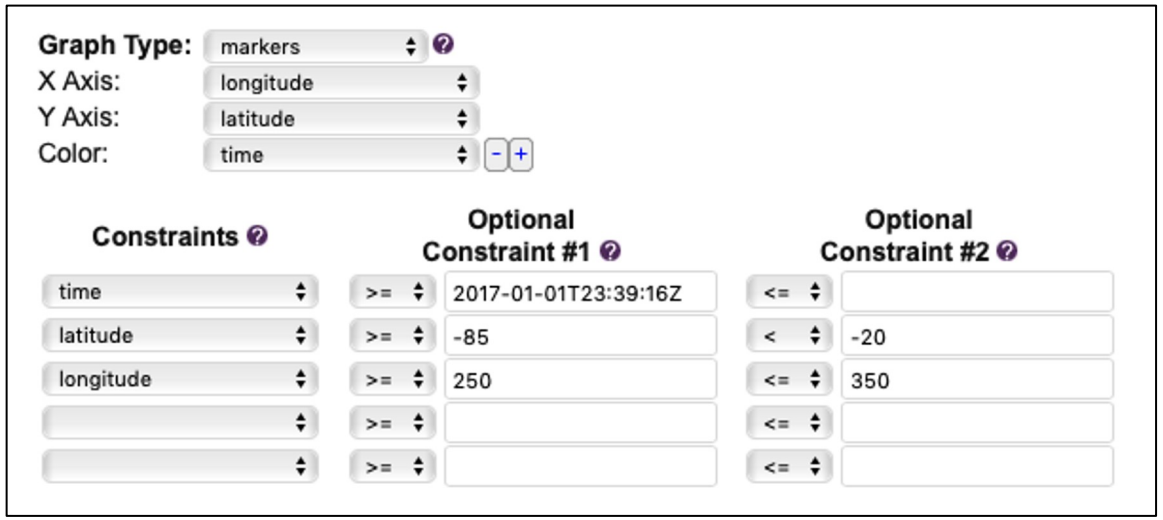
Graph Type: vectors
X Axis: longitude
Y Axis: latitude
Vector X: x_wind
Vector Y: y_wind

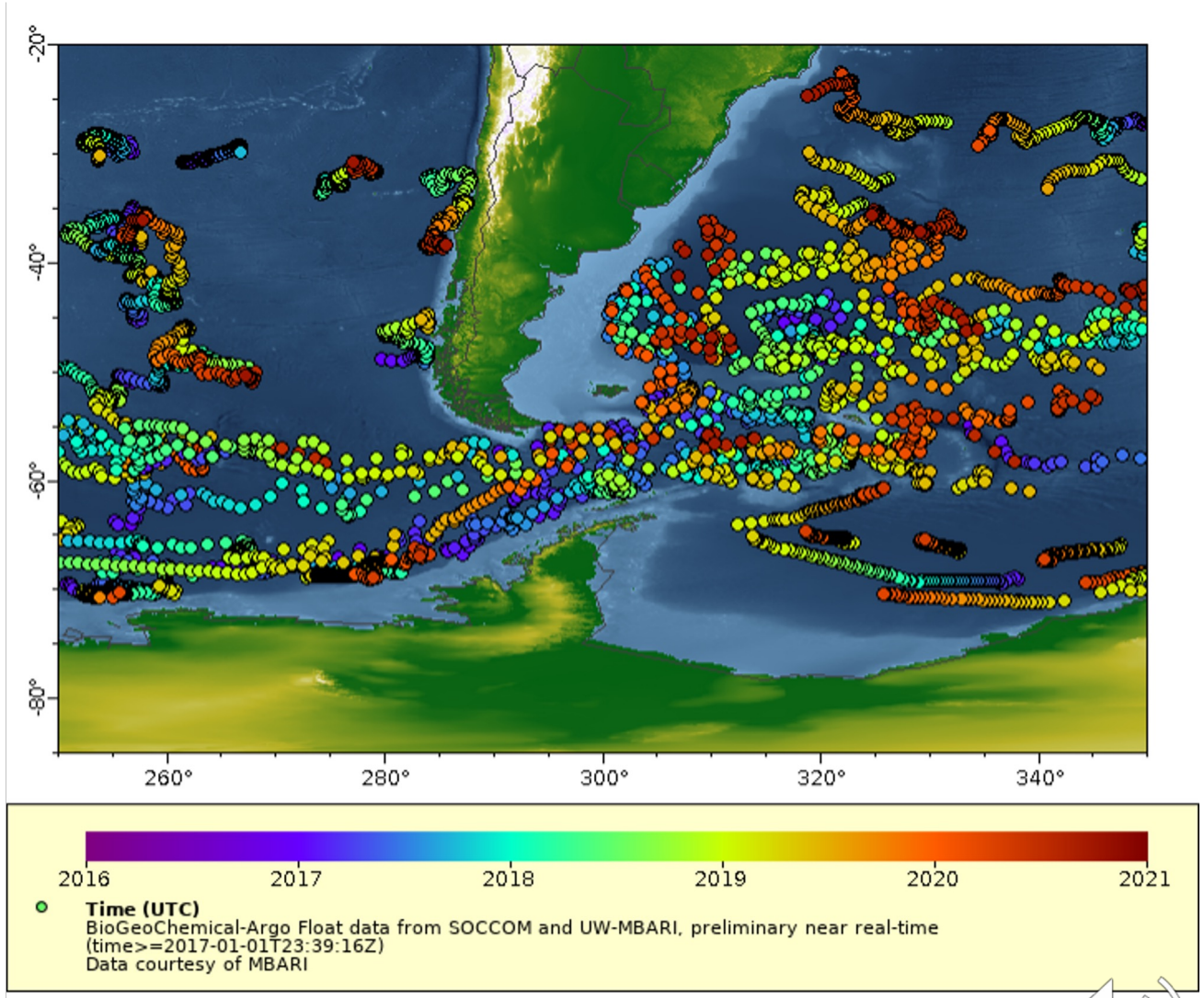


Access tabular data like BGC-Argo Float data

Map of all BGC-Argo floats since 2017-01-01 in the Southern Ocean around South America. Float profiles are colored by date.

https://polarwatch.noaa.gov/erddap/tabledap/SOCCOM_BGC_Argo.graph



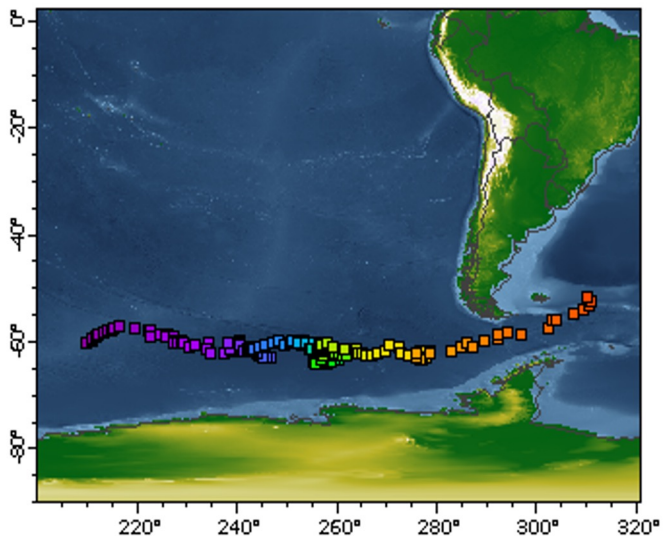


Visualizations of tabular data

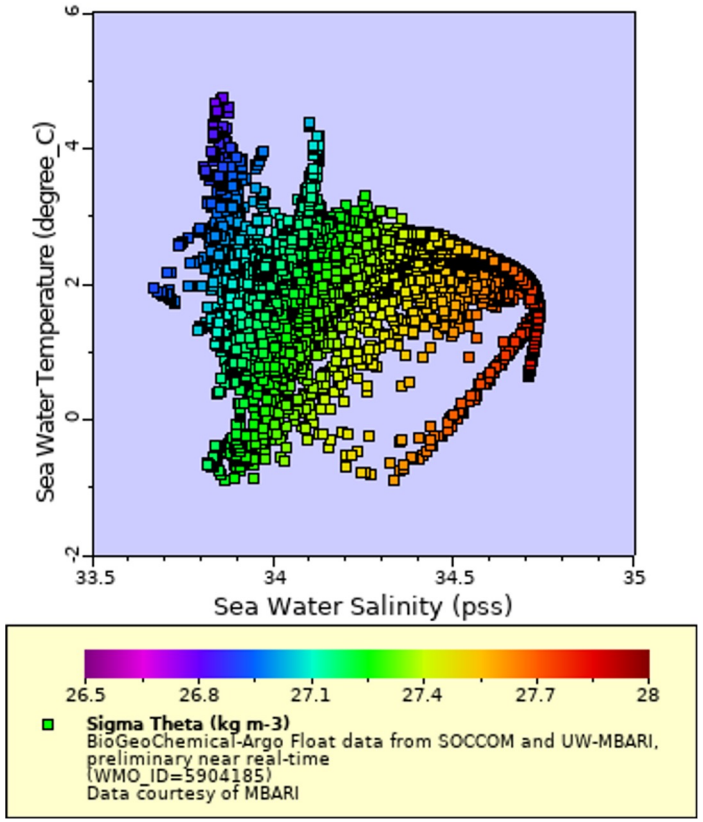
https://polarwatch.noaa.gov/erddap/tabledap/SOCCOM_BGC_Argo.graph

Float WMO_ID = 5904185

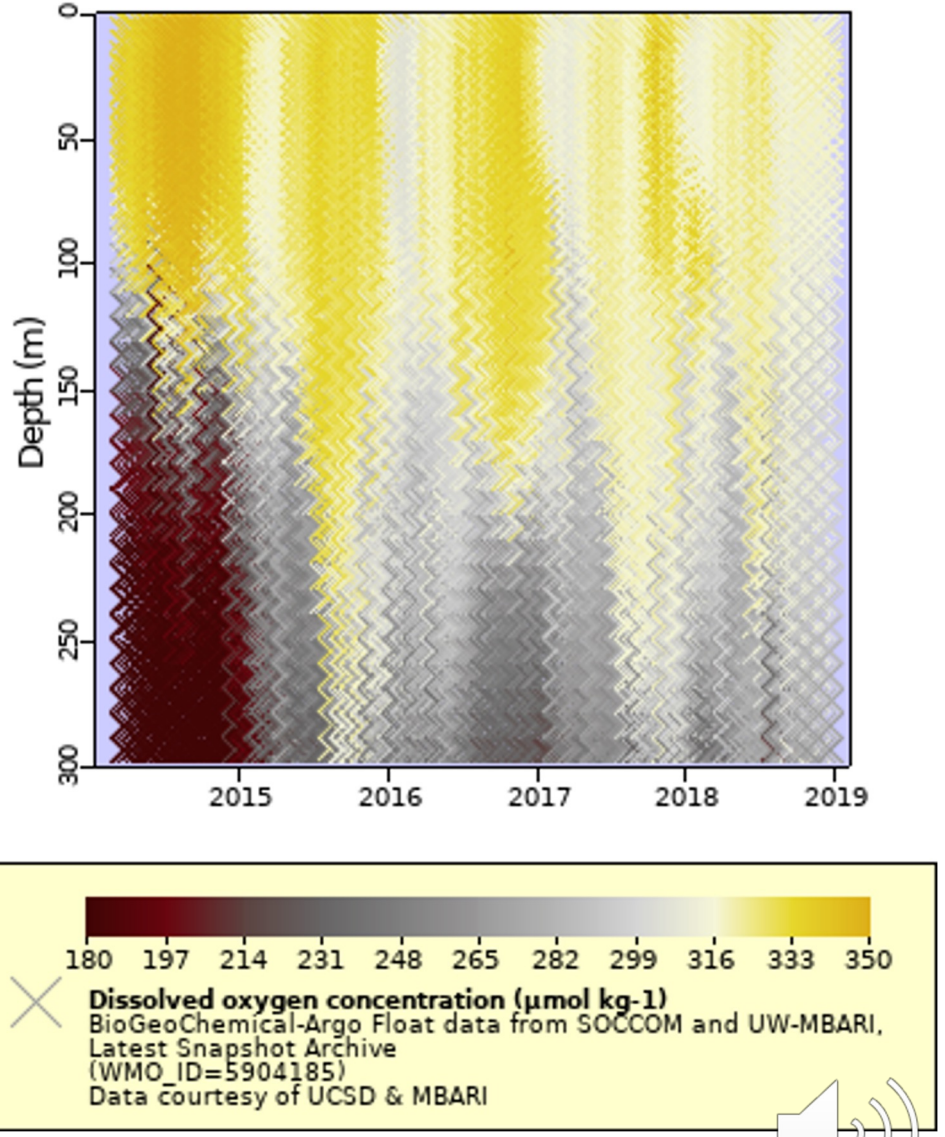
Map of float trajectory



Temperature-Salinity Diagram



Oxygen Section for 0-350 m depth



Downloading Data

NOAA_DHW_monthly.largePng?sea_surface_temperature[(2019-09-21T12:00:00Z)]

coastwatch.pfeg.noaa.gov/erddap/griddap/

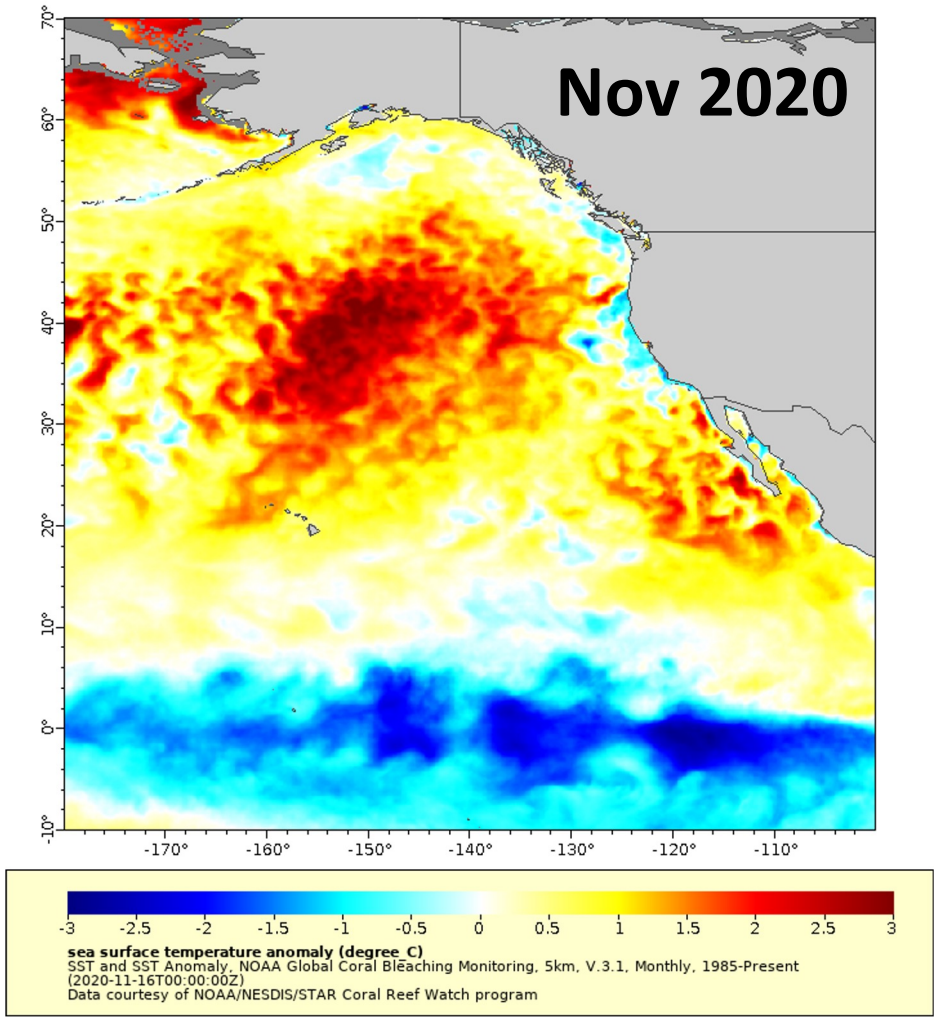
[(70):(-10)][(-180):(-100)]

Example of a URL data request

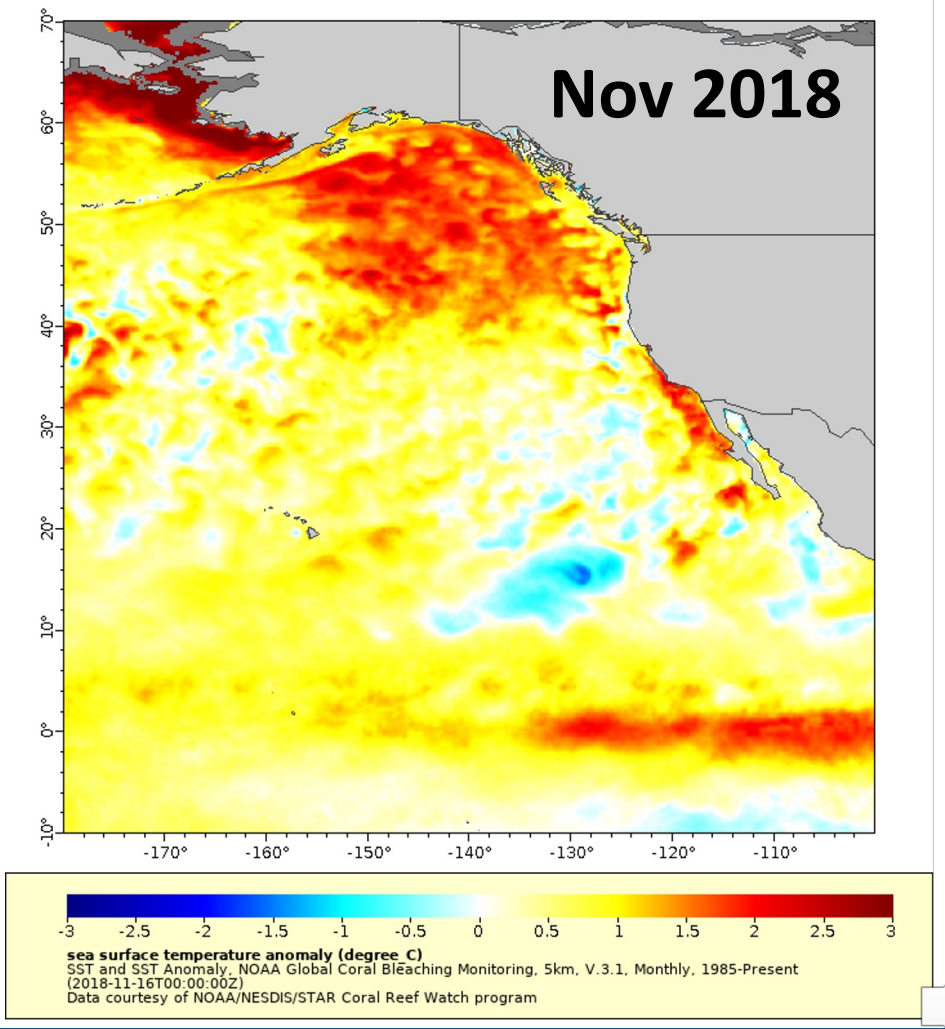
Base URL:	https://coastwatch.pfeg.noaa.gov/erddap/griddap/
Dataset ID:	NOAA_DHW_monthly
File Type:	.largePng (.nc, .mat, .json, .geotif, .kml, .csv…)
Data Request Begins	?
Variable:	sea_surface_temperature
Time range:	[(2019-09-15T12:00:00Z):(2019-09-15T12:00:00Z)]
Latitude Range:	[(70):(-10)]
Longitude Range:	[(-180):(-100)]

“Last” Data

https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?sea_surface_temperature_anomaly[**last**][(70):(-10)][(-180):(-100)]

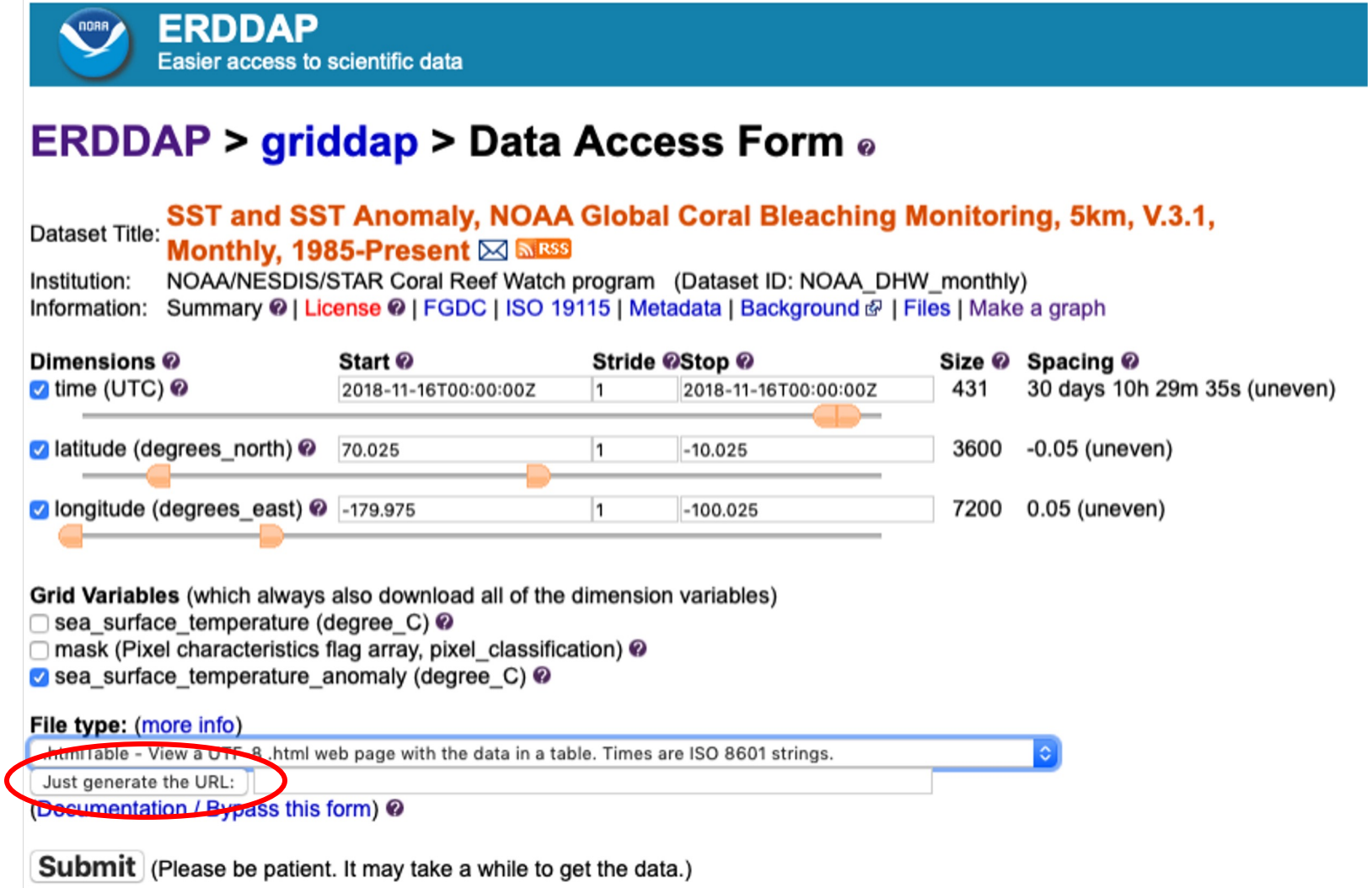


https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?sea_surface_temperature_anomaly[last-24][(70):(-10)][(-180):(-100)]



Data Access Form

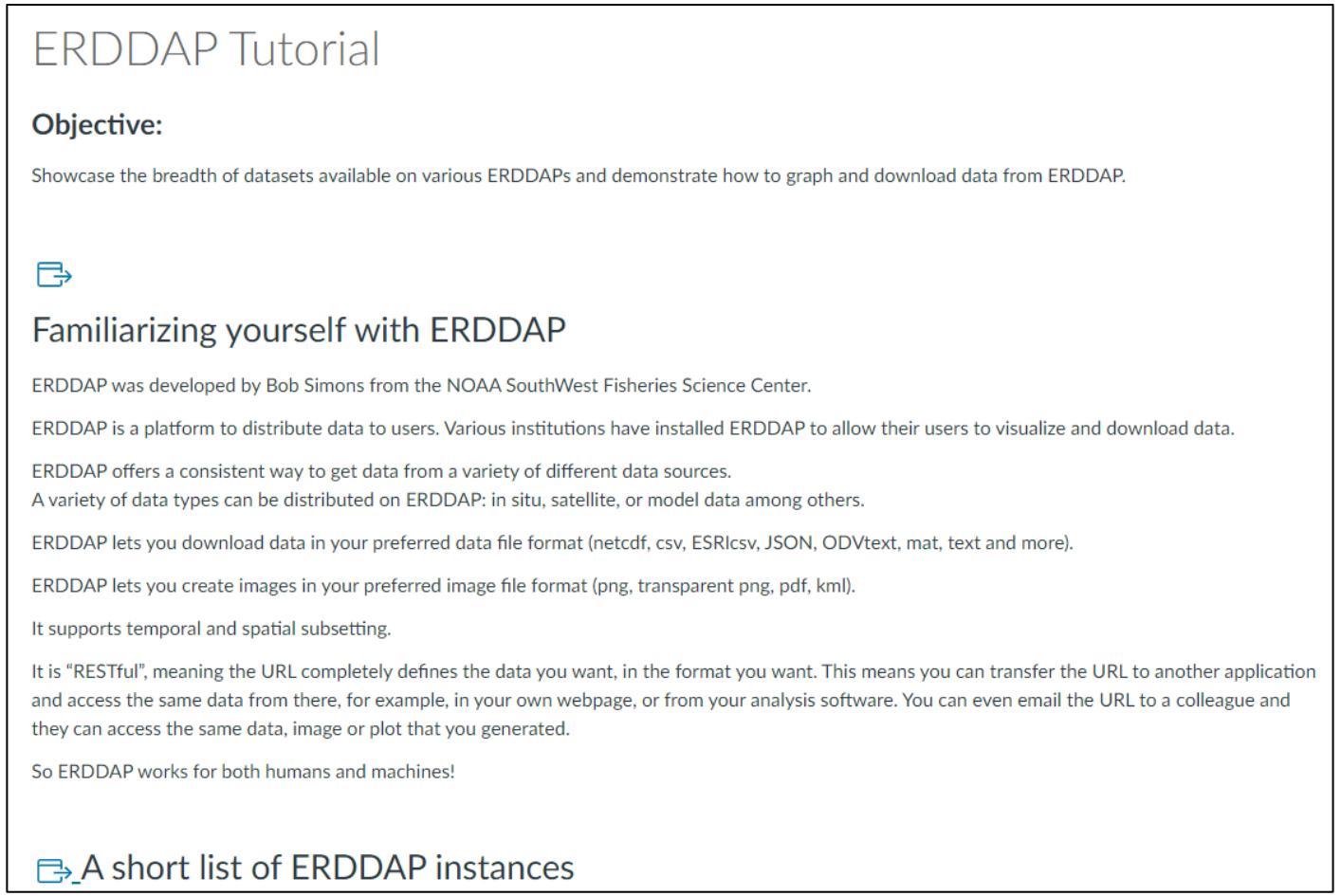
https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.html?sea_surface_temperature_anomaly



Online “Introduction to ERDDAP” provided by NOAA CoastWatch

Online ERDDAP tutorial

- Developed by CoastWatch West Coast Node for the NOAA satellite course https://umd.instructure.com/courses/1336575/pages/erddap-tutorial?module_item_id=11631927
- Walks users through using ERDDAP
- Demonstrates visualizing both gridded and tabular datasets
- Shows how to subset and download datasets in a variety of different formats



ERDDAP Tutorial

Objective:

Showcase the breadth of datasets available on various ERDDAPs and demonstrate how to graph and download data from ERDDAP.

Familiarizing yourself with ERDDAP

ERDDAP was developed by Bob Simons from the NOAA SouthWest Fisheries Science Center.

ERDDAP is a platform to distribute data to users. Various institutions have installed ERDDAP to allow their users to visualize and download data.

ERDDAP offers a consistent way to get data from a variety of different data sources.
A variety of data types can be distributed on ERDDAP: in situ, satellite, or model data among others.

ERDDAP lets you download data in your preferred data file format (netcdf, csv, ESRIcsv, JSON, ODVtext, mat, text and more).

ERDDAP lets you create images in your preferred image file format (png, transparent png, pdf, kml).

It supports temporal and spatial subsetting.

It is “RESTful”, meaning the URL completely defines the data you want, in the format you want. This means you can transfer the URL to another application and access the same data from there, for example, in your own webpage, or from your analysis software. You can even email the URL to a colleague and they can access the same data, image or plot that you generated.

So ERDDAP works for both humans and machines!

A short list of ERDDAP instances

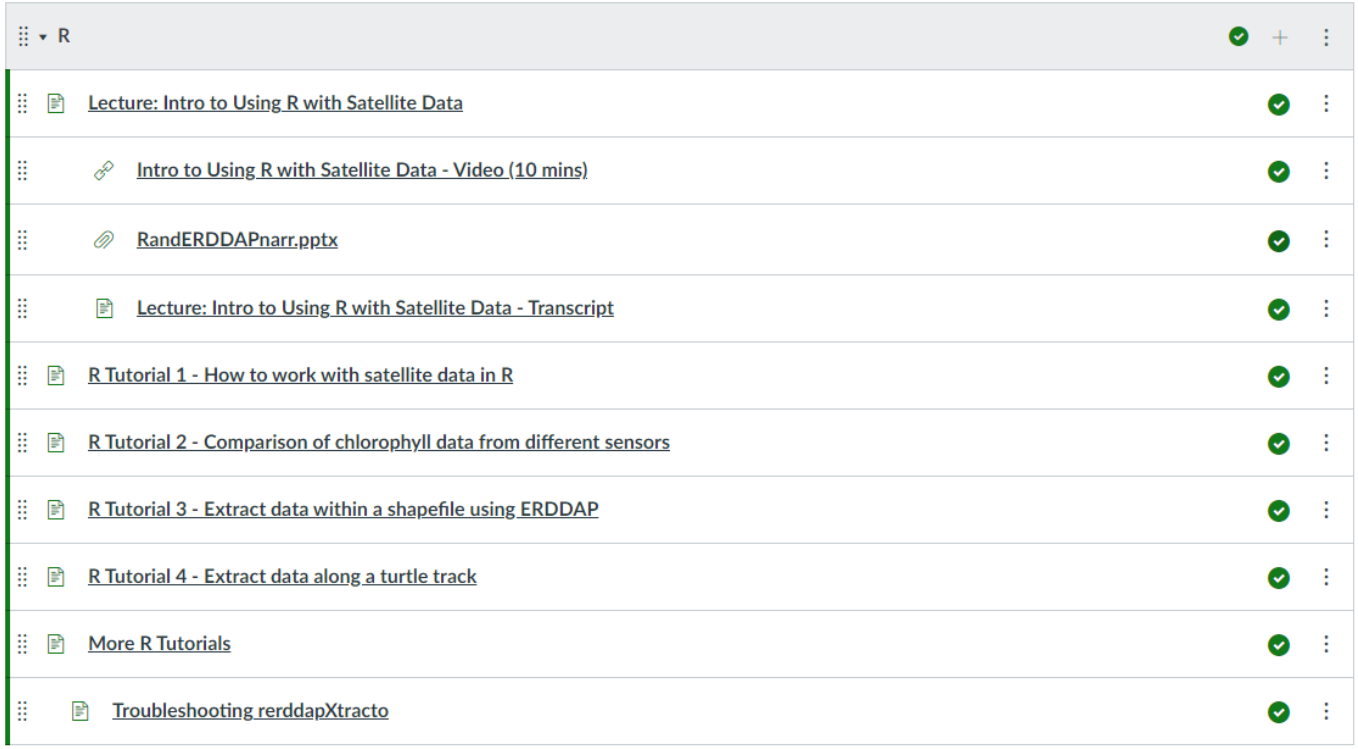
https://umd.instructure.com/courses/1336575/pages/erddap-tutorial?module_item_id=11631927

Online tutorial for using R with ERDDAP provided by NOAA CoastWatch

Online ERDDAP tutorial

- Developed by CoastWatch for the NOAA satellite course https://umd.instructure.com/courses/1336575/modules/1652980

- Demonstrates techniques to extract data from the ERDDAP data servers using the rerddapxtracto library written in R



https://umd.instructure.com/courses/1336575/modules/1652980

NOAA CoastWatch Satellite Course - Narrated Presentations

- Satellite 101 – Part 1
- Satellite 101 – Part 2
- Fundamentals of Ocean Color
- Fundamentals of Sea-Surface Temperature
- Fundamentals of Altimetry, Wind and Salinity
- **Introduction to ERDDAP**
- What Dataset to Choose?
- Bringing Satellite Data into ARCGIS