Easy Online Visualization of Oceanographic Data Using NOAA's ERDDAP Data Servers

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NOAA CoastWatch West Coast Node (WCN)

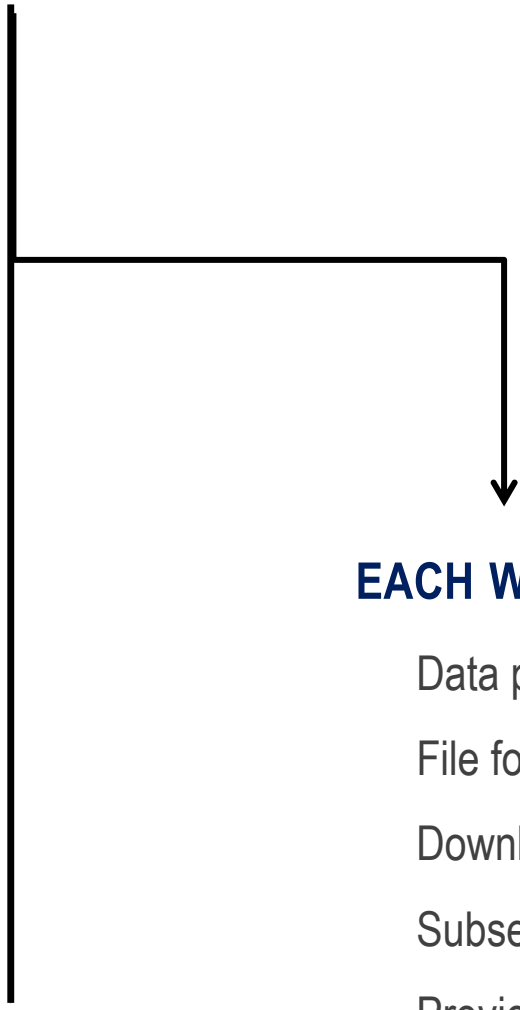
NOAA CoastWatch Satellite Course

Online Version

Accessing satellite data can be challenging

A SHORT LIST OF DATA SERVERS

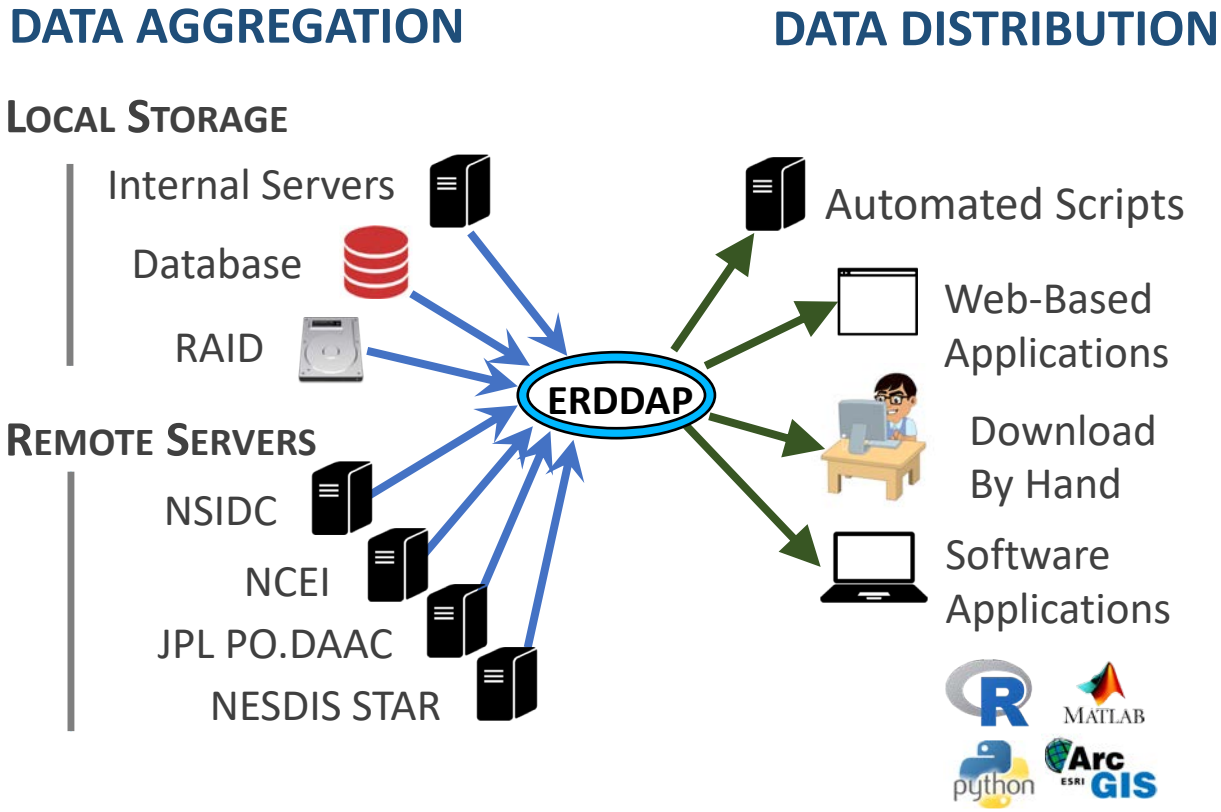
- NOAA CoastWatch Central Operations
- NOAA Center for Satellite Applications and Res.
- NOAA Office of Satellite and Products
- NOAA National Centers for Environmental Info.
- NOAA Comprehensive Large Array-data Stewardship System (CLASS)
- NASA Jet Propulsion Laboratory PO.DAAC
- NASA Ocean Biology (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
- 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 80 ERDDAPs exist worldwide

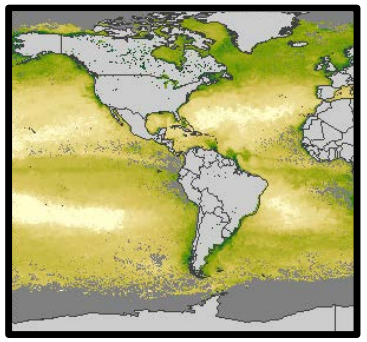
Over a dozen different ERDDAPs in NOAA

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

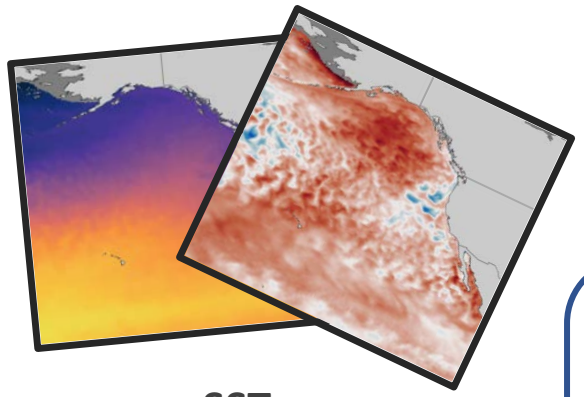
Search for data across multiple ERDDAPs at erddap.com

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

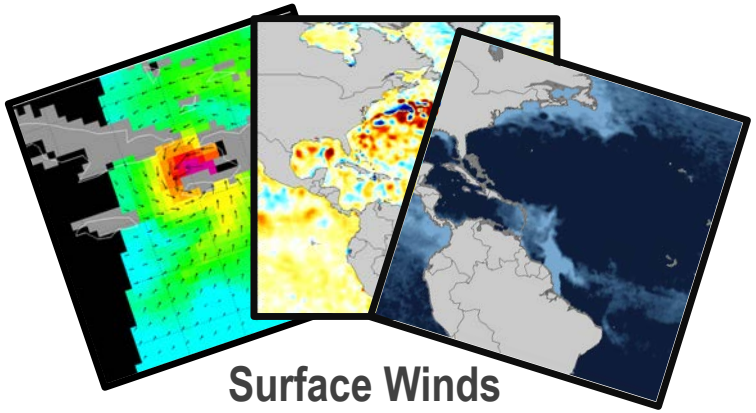
WCN data catalog contains > 1000 satellite datasets



Chlorophyll
Primary Productivity



SST
SST Anomaly

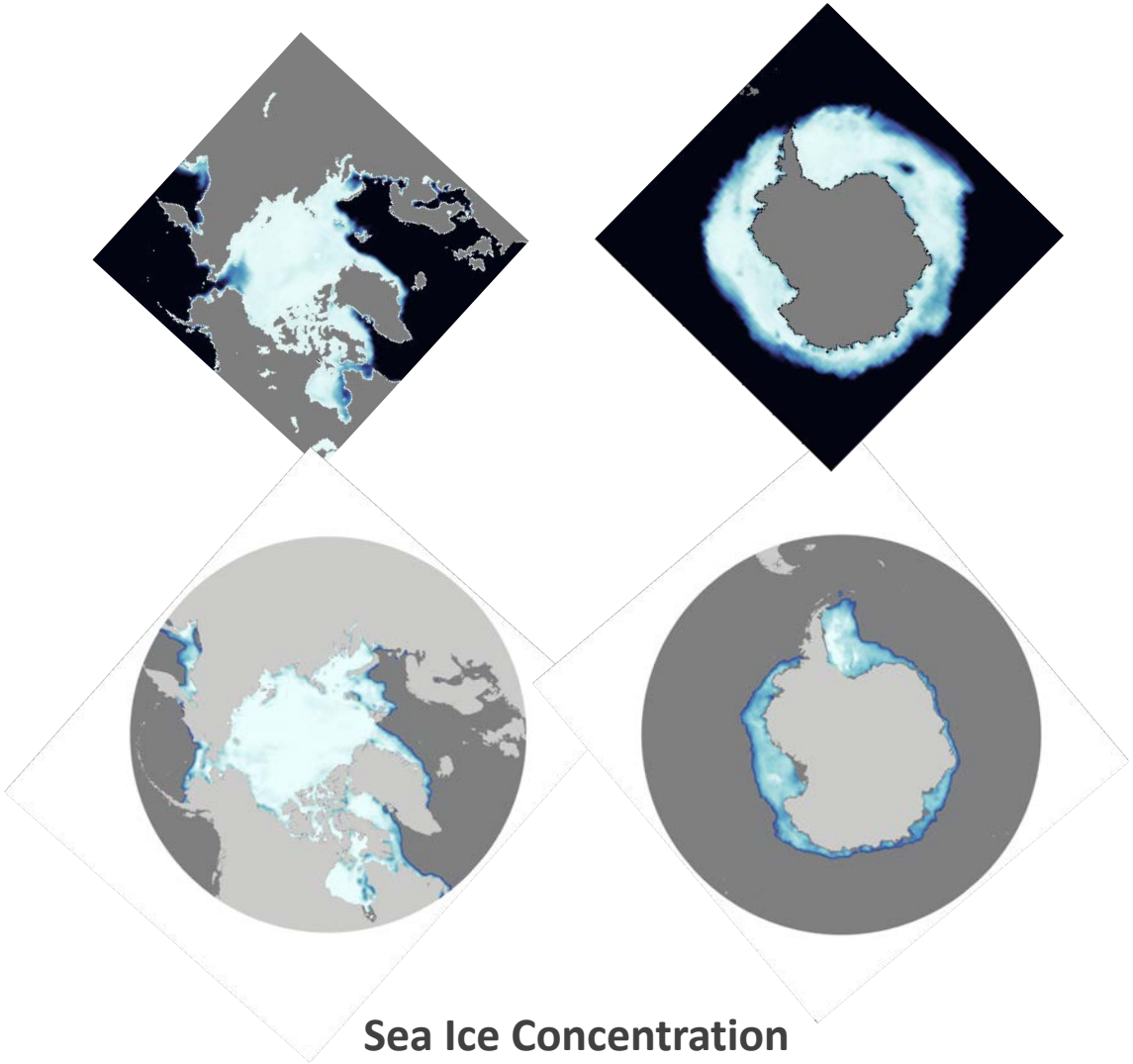


Surface Winds
Sea Surface Salinity
Sea Surface Height and Anomaly

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)

PW data catalog contains > 100 satellite datasets



Sea Ice Concentration

- A curated subset of ~~datasets~~ on the WCN ERDDAP
- Sea Ice datasets
- Projected Datasets
- Sea Ice Pressure Ridge Sail Height (IceBridge)

WCN data catalog has non-satellite data (~400 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

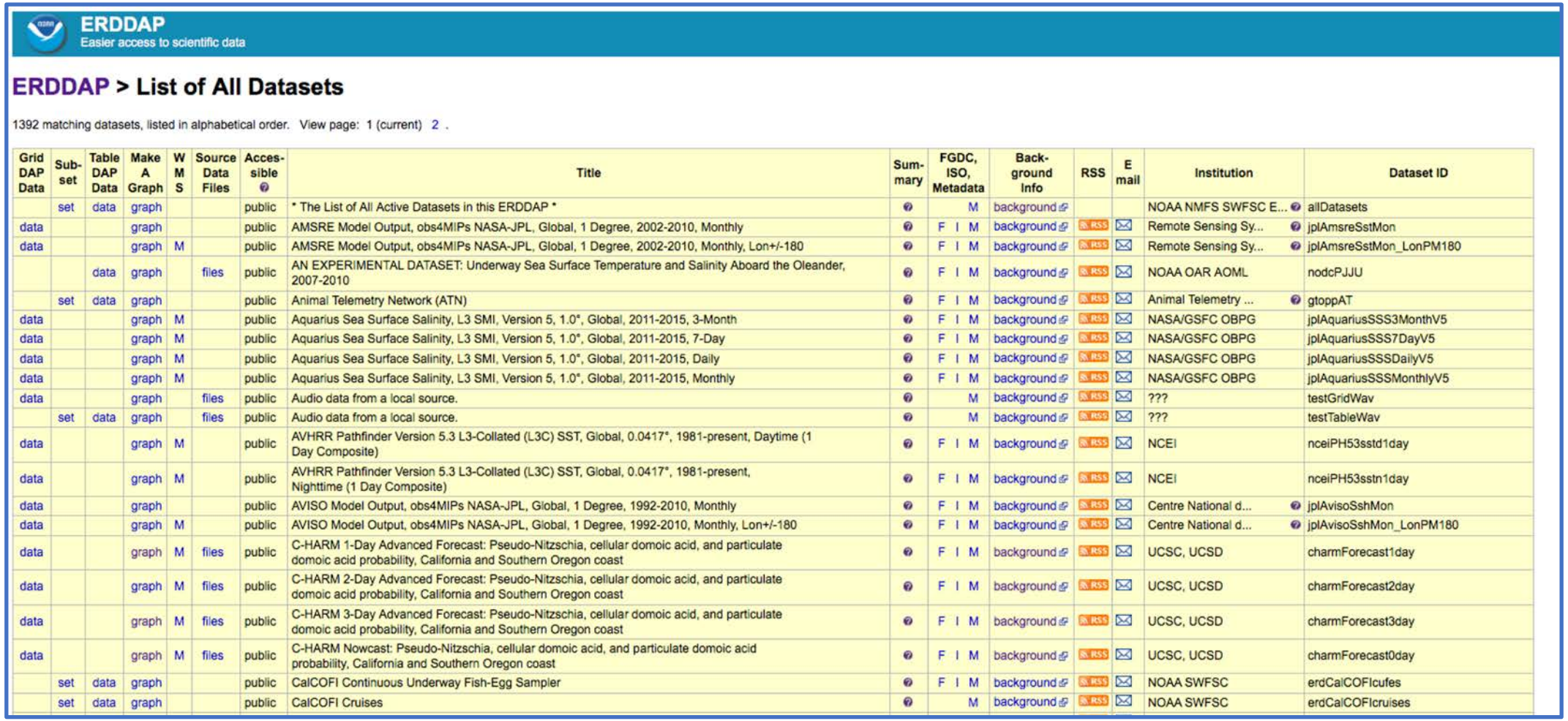
Models, Climatologies

- 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 (not visually) beautiful



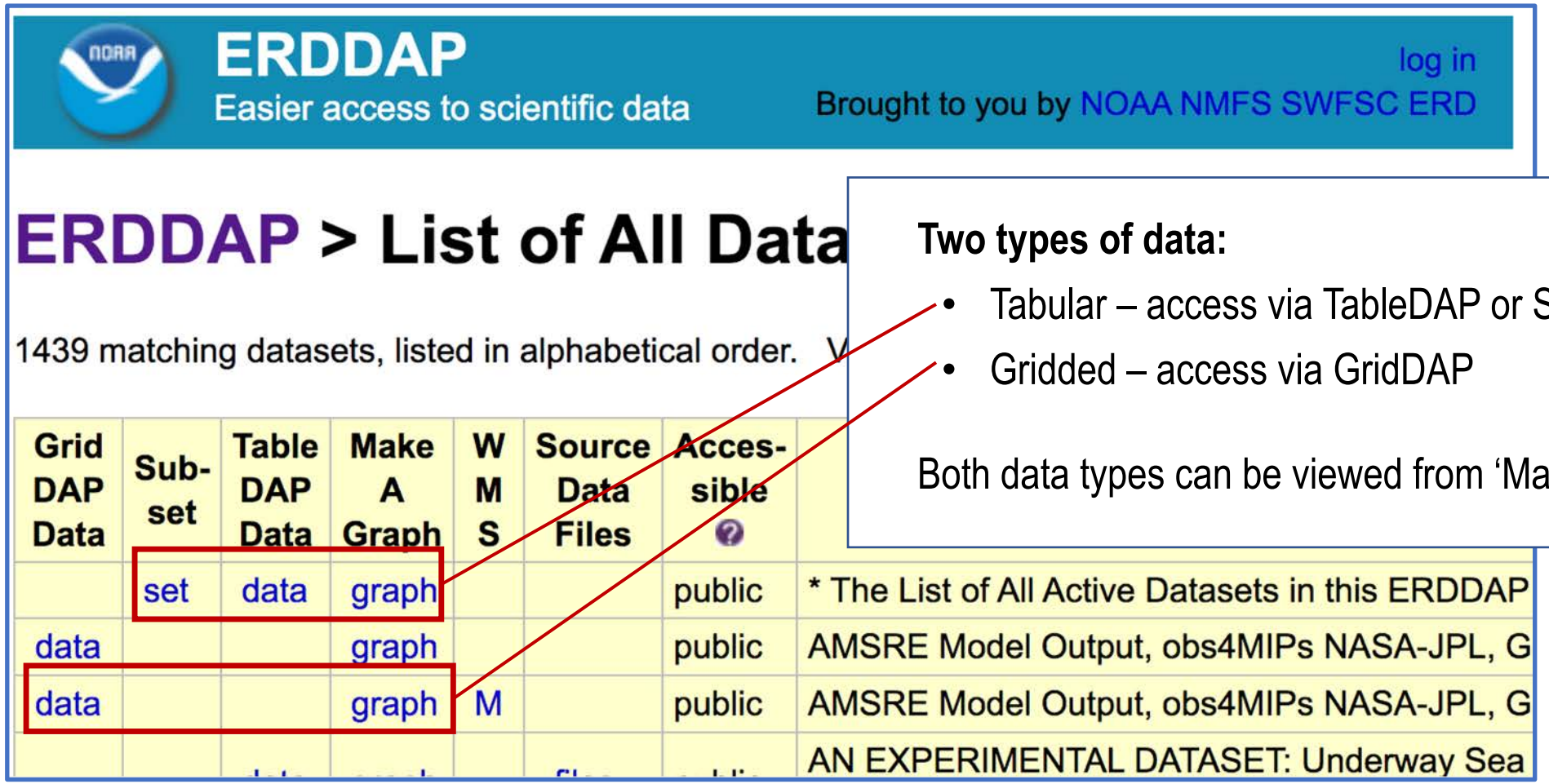
ERDDAP
Easier access to scientific data

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

ERDDAP handles gridded and tabular datasets



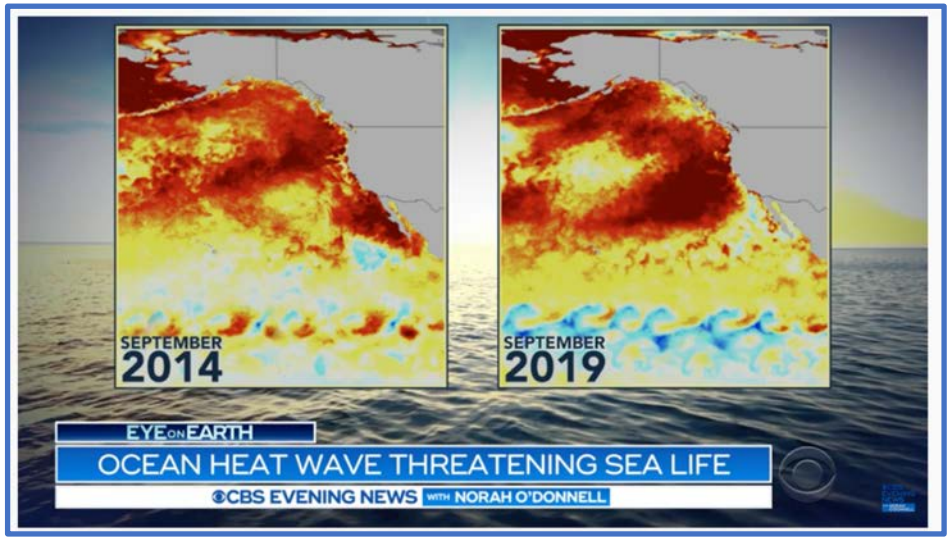
Two types of data:

- Tabular – access via TableDAP or Subset
- Gridded – access via GridDAP

Both data types can be viewed from 'Make a Graph'

The “Blob” or the Pacific Marine Heat Wave

- Large area with warmer than usual temperatures in the Pacific Ocean
- Has had devasting effects on the marine ecosystem.
- A scientific phenomena that has been reported in the general news



Figures made with ERDDAP!

Online Interface to Modify Graphs

Graph Type:

Maps (surface)

Time-series (lines)

Hovmöller (surface)

Vectors (vectors)

Color:

Choose variable in dataset

Scale:

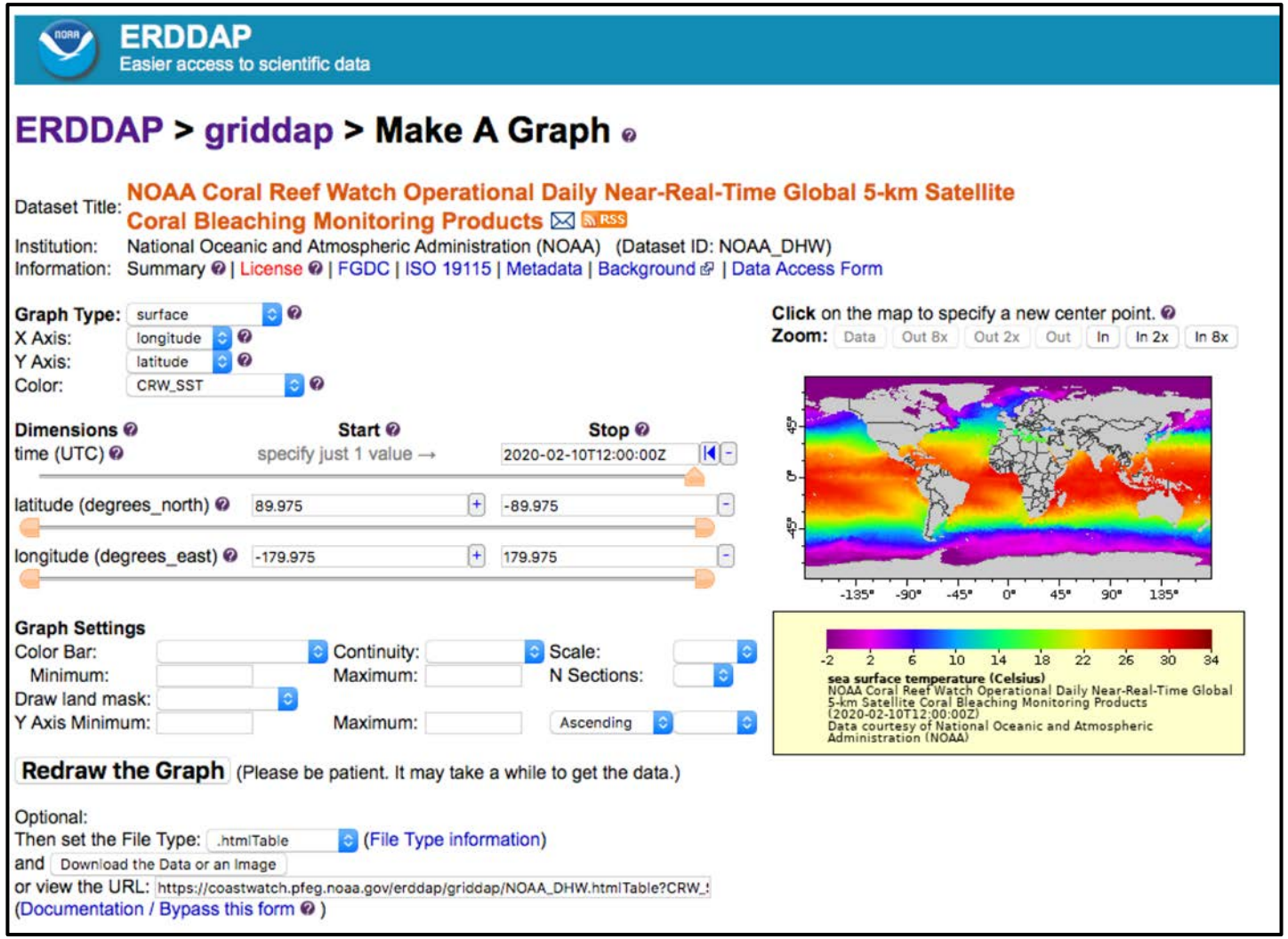
Choose linear or log

Color Bar:

Choose from > 40 color palettes

File Type:

Choose from > 40 file formats (data and graphics)



Deconstructing the ERDDAP URL

coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.largePng?sea_surface_temperature[(2019-09-21T12:00:00Z)][(70):(-10)][(-180):(-100)]

Example of a URL data request

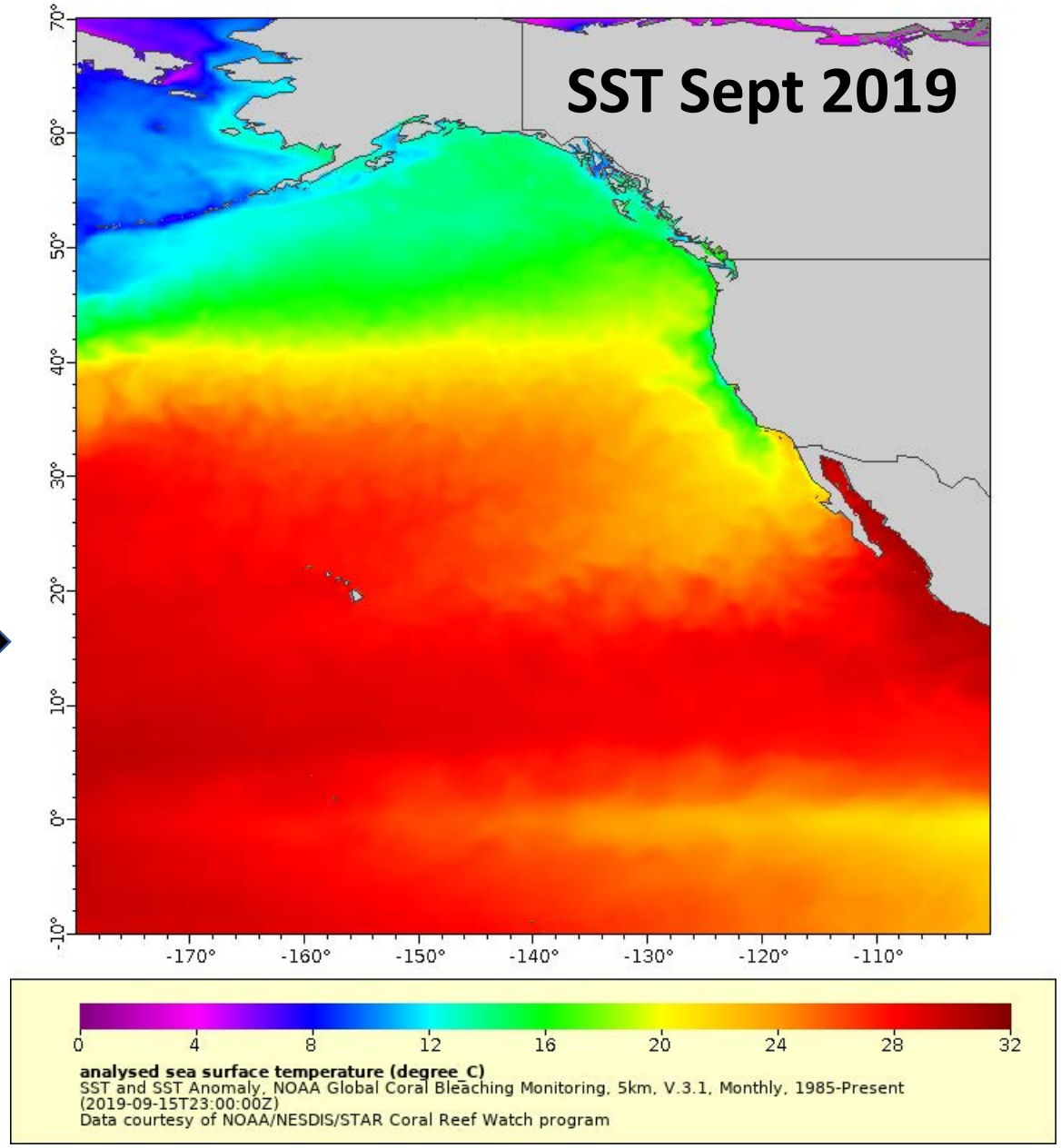
Base URL:	https://coastwatch.pfeg.noaa.gov/erddap/griddap/
Dataset ID:	NOAA_DHW_monthly
File Type:	.largePng (.nc, .mat, .json, .geotif, .kml, .csv…)
Data Request Begins	?
Variable:	sea_surface_temperature
Time range:	[(2019-09-15T12:00:00Z):(2019-09-15T12:00:00Z)]
Latitude Range:	[(70):(-10)]
Longitude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

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 →



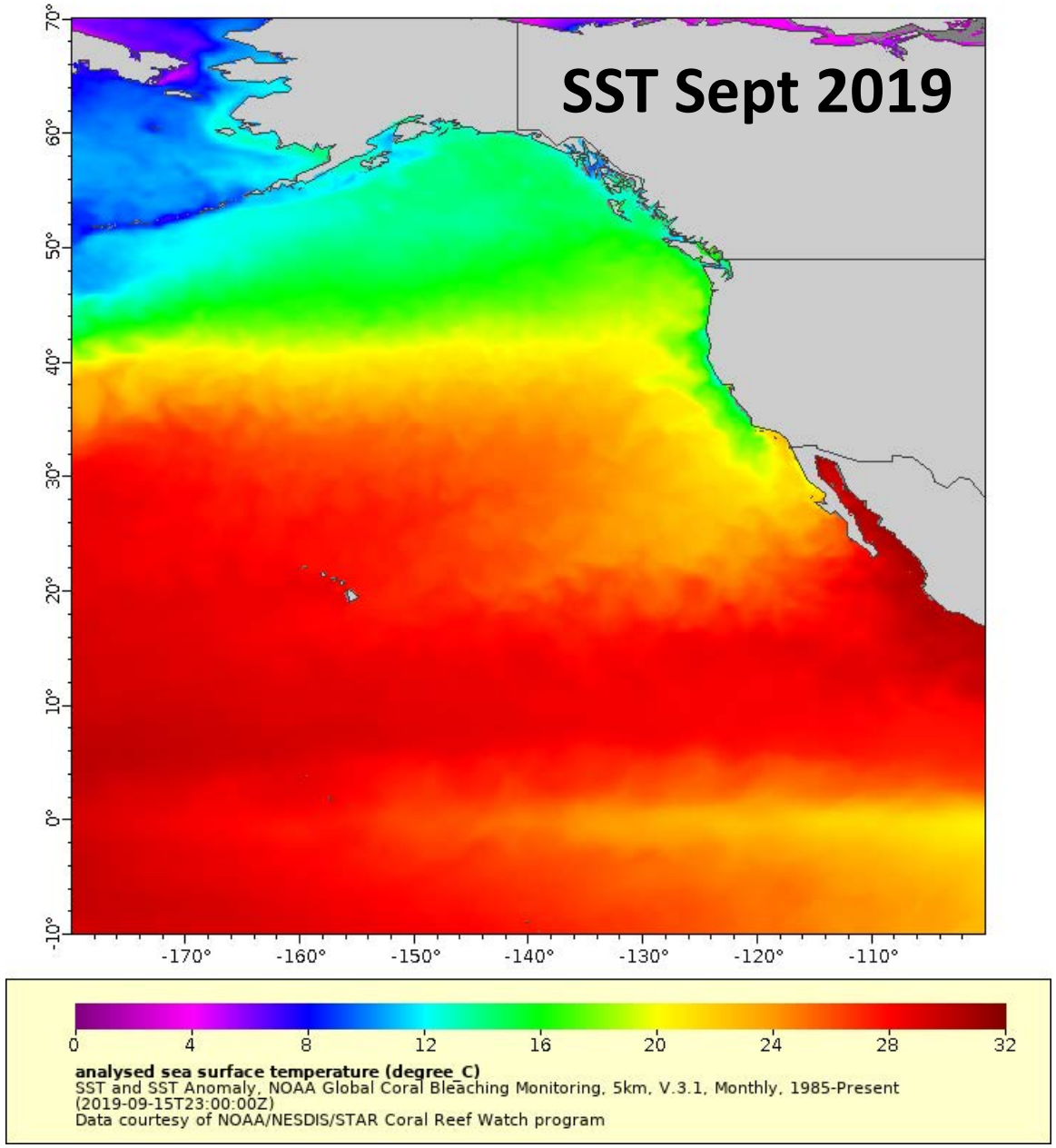
Note:

You can downlownd 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)]

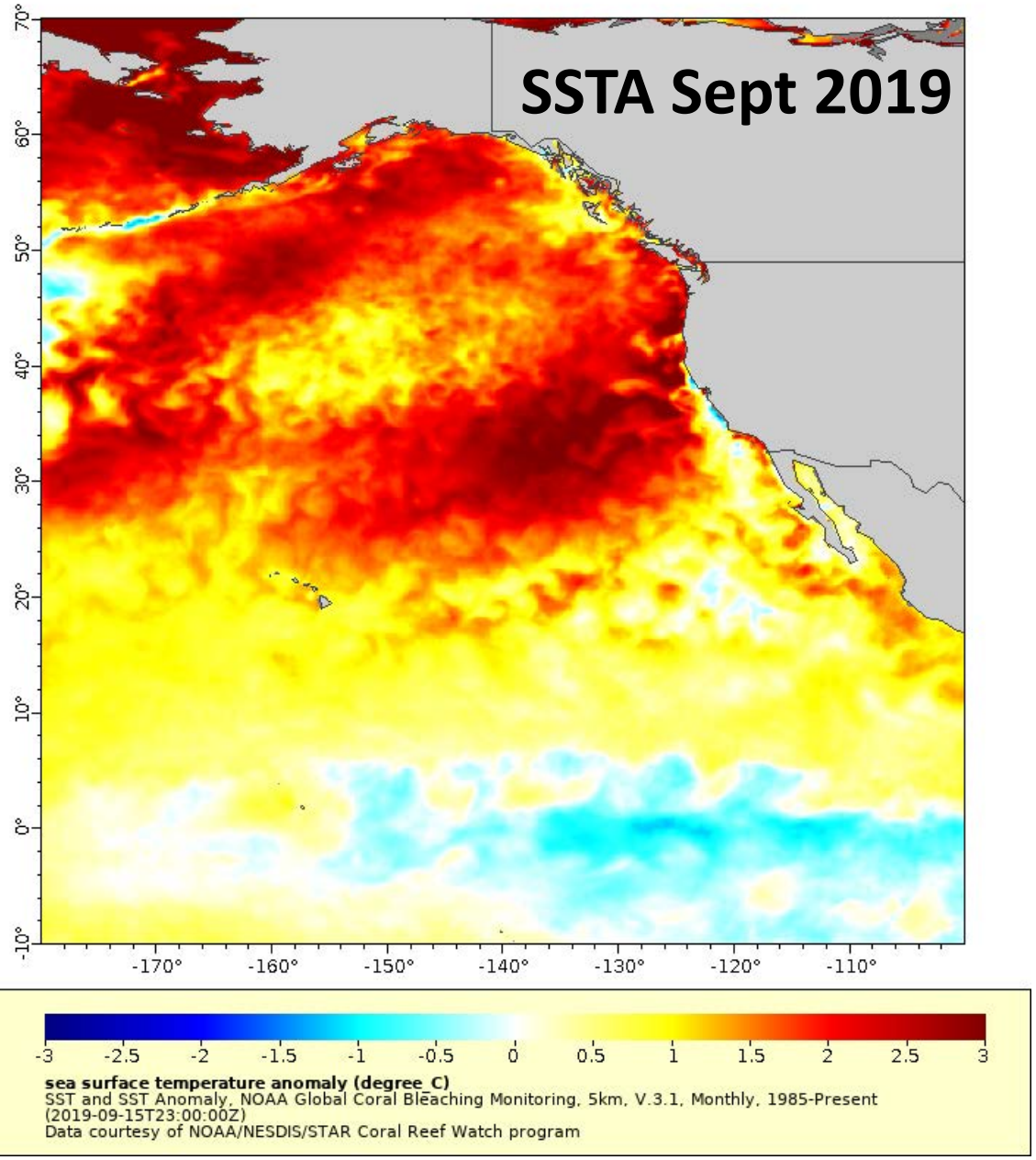
- Change the variable displayed to see the SST anomaly
- For this dataset we will change it to sea_surface_temperature_anomaly



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 →



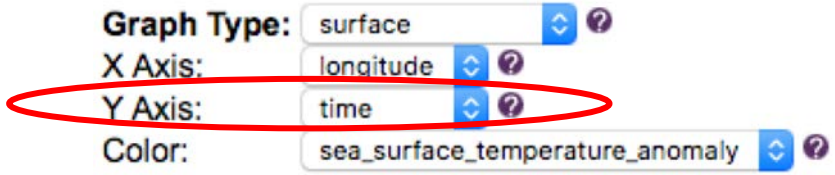
This image doesn't look exactly like the images broadcast on the news as those images were made with a daily product, and this image uses a monthly composite product

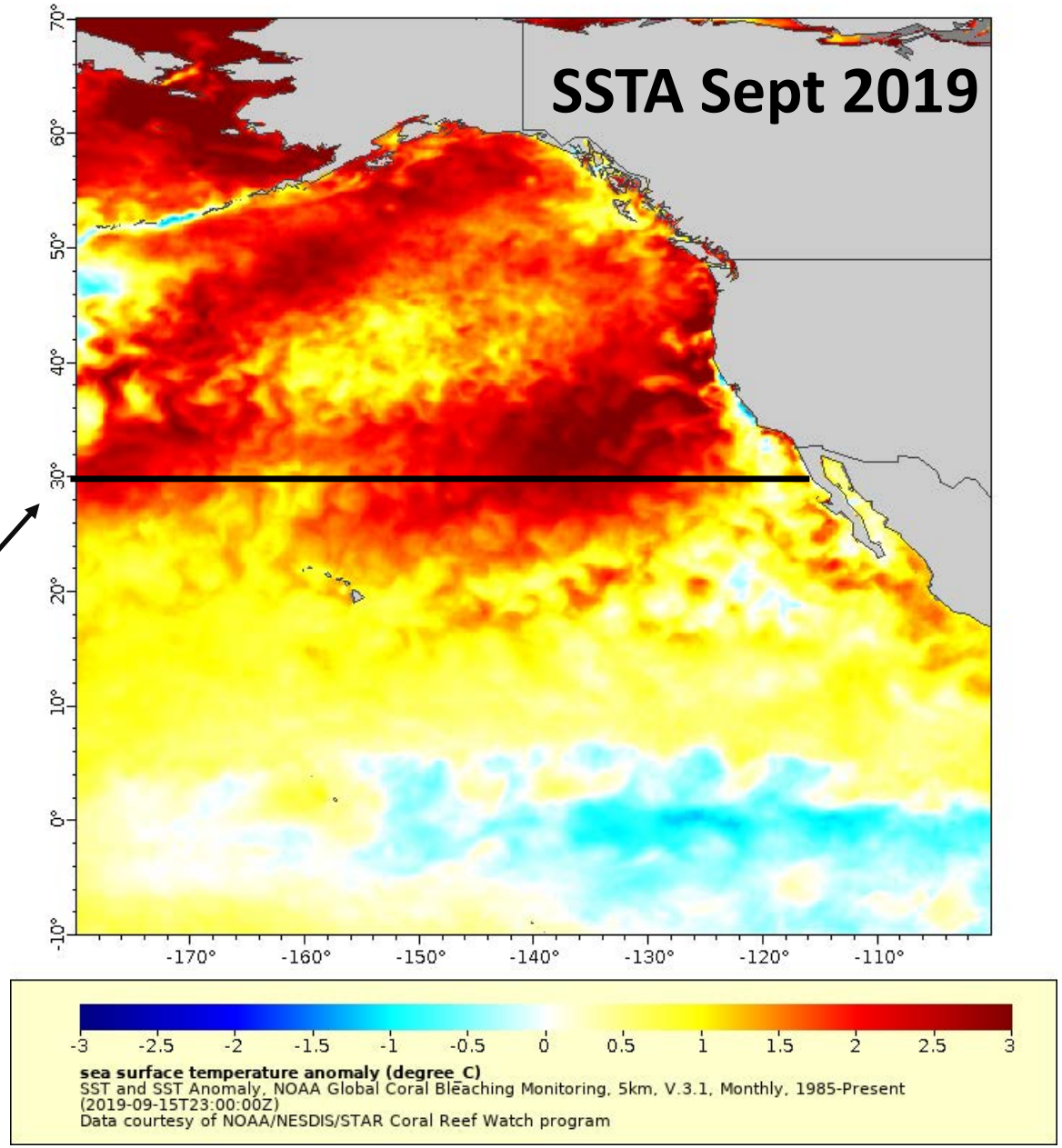
Create a 2D timeseries:

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:

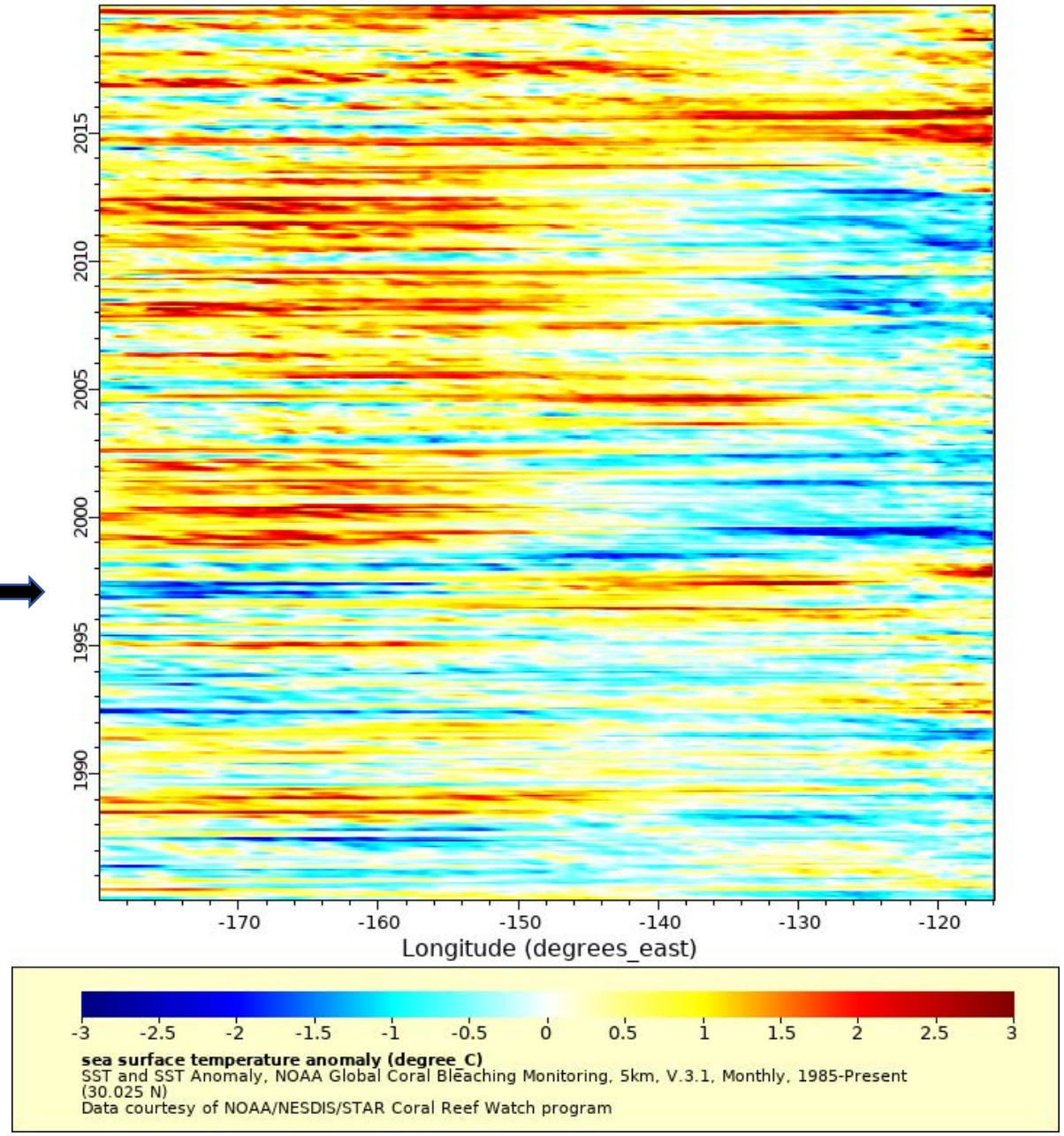




Generate a Hovmöller diagram

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 →

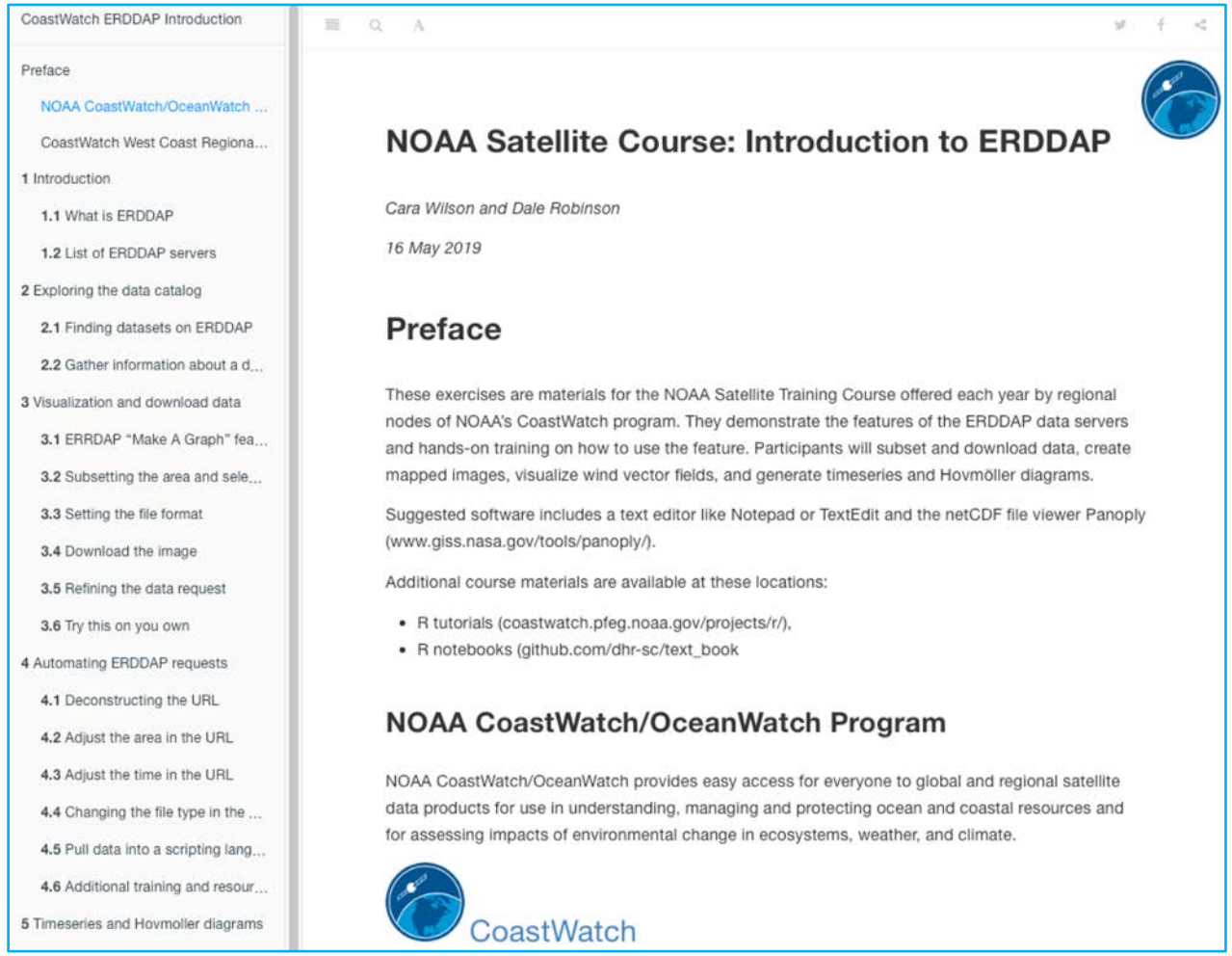


While most of the last 20 years the N. Pacific (at 30°N) has experienced warmer than usual temperatures, only in the past few years has this phenomena spread to coast (east of 120°W).

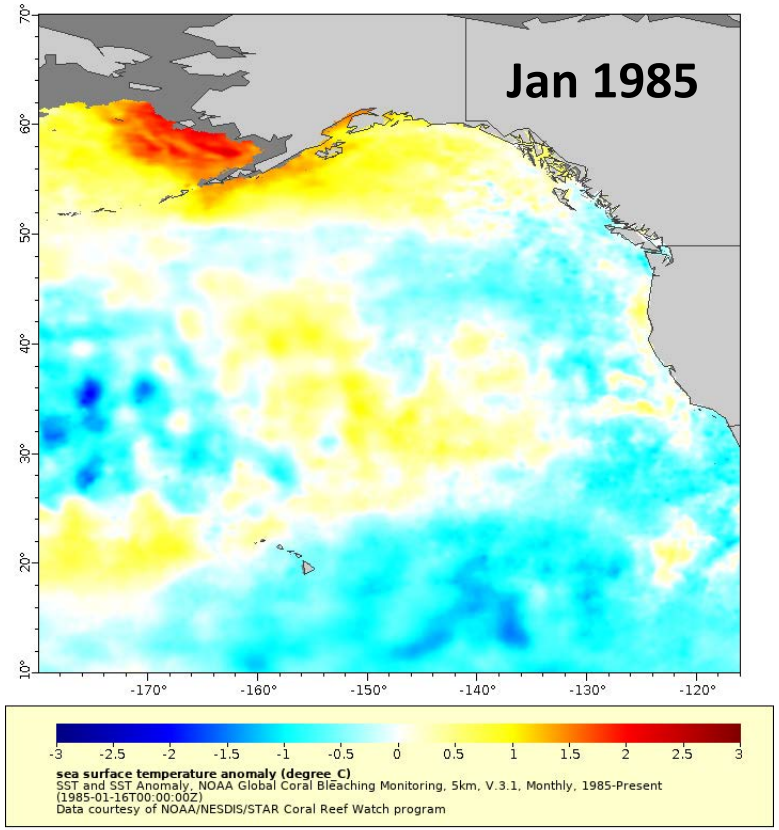
Online “Introduction to ERDDAP”

Online ERDDAP tutorial

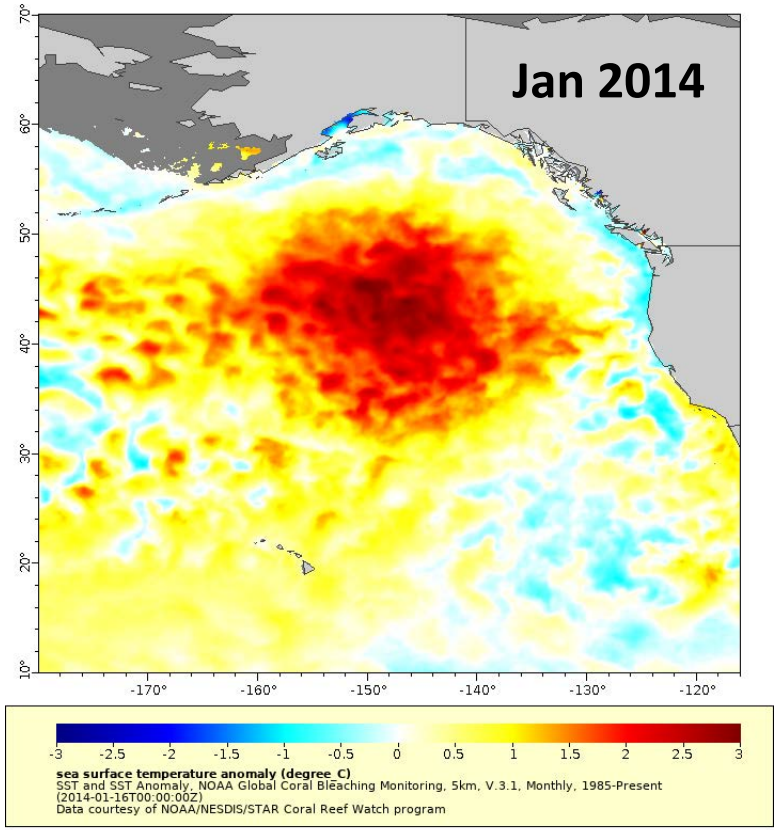
- Developed by CoastWatch West Coast Node for the NOAA satellite course
  coastwatch.noaa.gov/cw/user-resources/satellite-data-training-courses.html
- Walks users through using ERDDAP
- Demonstrates visualizing both gridded and tabular datasets



https://coastwatch.pfeg.noaa.gov/projects/erddap



Questions???



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