

## **Webinar: NOAA PolarWatch**

*STAR Seminar Series, August 29, 2019*

NOAA PolarWatch is the newest satellite data distribution portal of NOAA's CoastWatch program. The portal offers a single location for federal agencies, research groups, and private industry to obtain the most recent and historical satellite observations of Arctic and Antarctic waters, including measurements of sea ice cover, ocean temperature, and winds.

We will provide an overview of the data and services provided by PolarWatch with examples that demonstrate supporting safety at sea, navigation, fishing, transportation, tourism, and recreation. We will also highlight user training materials and training courses that are designed to encourage the use of polar satellite data by broad audiences.

[www.polarwatch.noaa.gov](http://www.polarwatch.noaa.gov)



## ***NOAA PolarWatch Seminar Agenda***

***Thursday, August 29, 2019 - 11:30am - 12:30pm EDT***

### ***Facilitators:***

- Stacy Bunin, NESDIS STAR, College Park, MD
- Cara Wilson, NOAA PolarWatch Principal Investigator, Monterey, CA

### ***Presenters:***

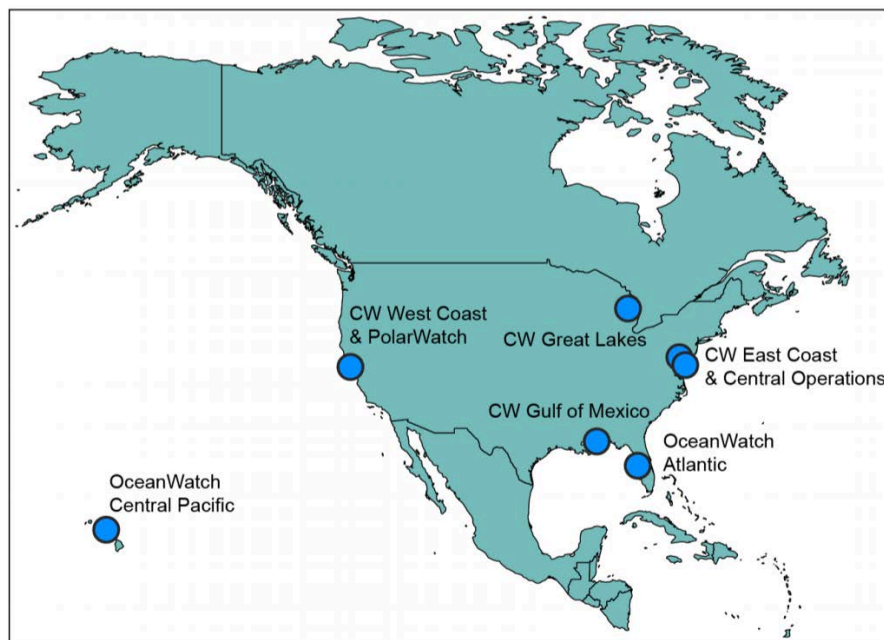
- Jennifer Sevadjian, NOAA PolarWatch Operations Manager, La Jolla, CA

- 
- **Webinar Introduction, by Stacy**
  - **Webinar Agenda/Introduction by Cara**
  - **Introduction to the PolarWatch Program (5 minutes)**
  - **PolarWatch Users and Applications (5 minutes)**
  - **Demonstration of PolarWatch Catalog, data discovery, preview, download (10 minutes)**
  - **Demonstration of PolarWatch ERDDAP data server access (10 minutes)**
  - **Tools, training and resources (10 minutes)**
  - **Q & A (10 minutes)**

## NOAA CoastWatch

- PolarWatch is the newest regional satellite data distribution portal of NOAA's CoastWatch program
- CoastWatch provides global and regional satellite data products
- Regional nodes provide focused support to regional users

PolarWatch offers a single location to obtain the most recent and historical satellite observations of Arctic and Antarctic waters, including measurements of sea ice cover, ocean temperature, and winds



# PolarWatch and our Collaborators

## PolarWatch at NOAA Fisheries

Jennifer Sevadjan, La Jolla

Cara Wilson, Monterey

Dale Robinson, Santa Cruz

## CoastWatch/OceanWatch

Paul DiGiacomo

Veronica Lance

Michael Soracco

Heng Gu

Phillip Keegstra

## NESDIS | STAR | SOCD

Sinead Farrell

Sheekela Baker-Yeboah

Eric Leuliette

Laurence Connor

Sean Helfrich

## National Ice Center

Kevin Berberich

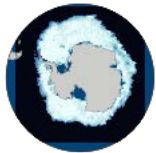
Bryan Brasher

Walter Clark

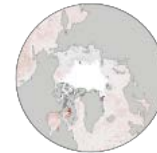
## National Snow and Ice Data Center

Florence Fetterer

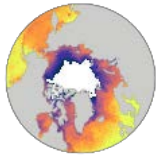
## Over 100 satellite datasets available through the PolarWatch ERDDAP



**Sea Ice**



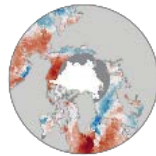
**Sea Surface Height**



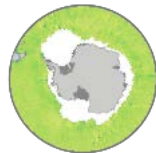
**Sea Surface Temperature**



**Ocean Color**

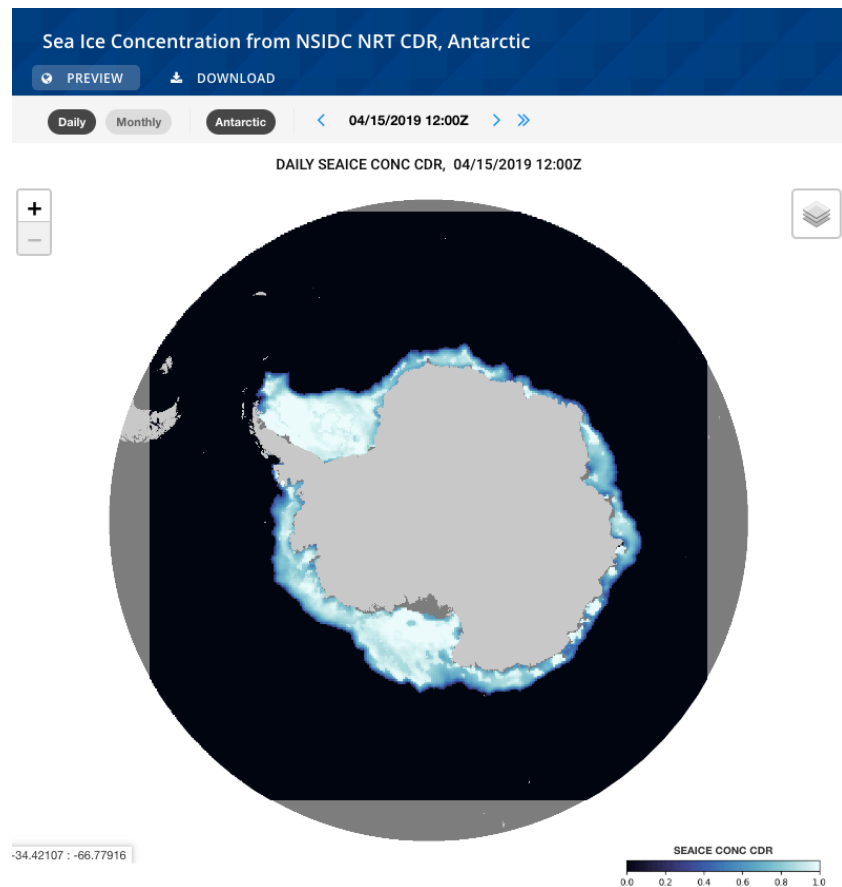


**Winds**



**Salinity**

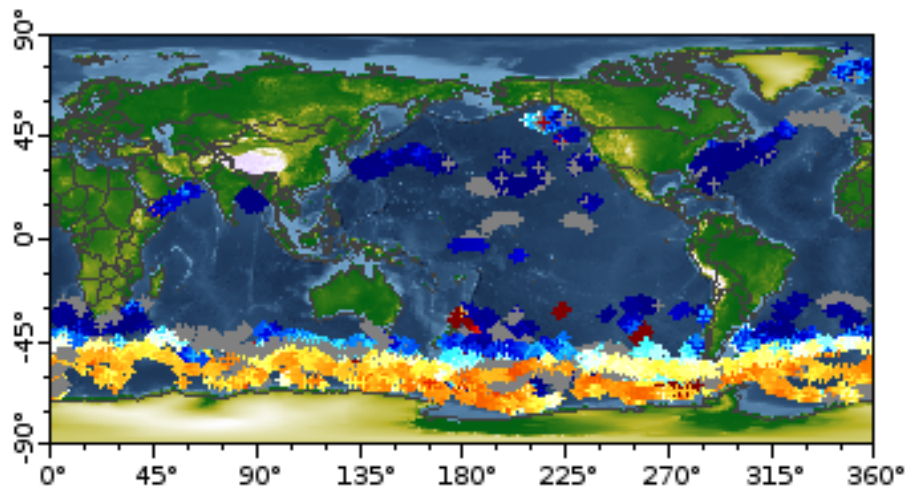
## NSIDC Sea Ice Concentration Climate Data Record



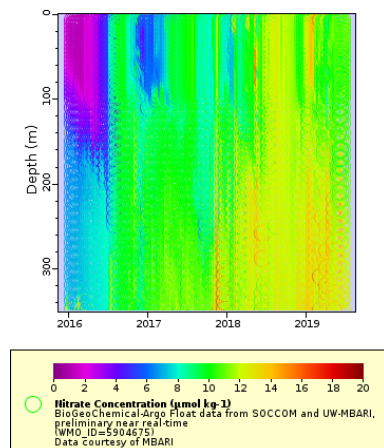
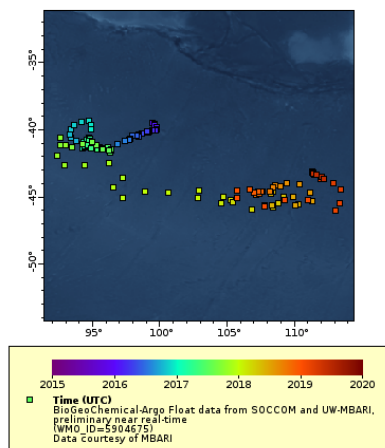
- New data access through the PolarWatch ERDDAP data server
- New visualization/previews through the PolarWatch catalog
- Eight datasets that comprise the NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 3 and the near real-time version of the Climate Data Record
- Long term science quality sea ice concentration records for the Arctic and Antarctic dating back to 1978
- Provides demonstration integration of a dataset with projected coordinates

## SOCOM BioGeoChemical ARGO Float Data

Southern Ocean Carbon and Climate Observations and Modeling (SOCOM) BGC-Argo float data is now available on the PolarWatch ERDDAP



- Augments conventional Argo floats with biogeochemical sensors to measure carbon (pH), nutrients (nitrate), and oxygen
- ~ 200 autonomous floats provide coverage over the Southern Ocean
- Vertical coverage deep into the water column
- Allows for easy inter-comparison with satellite data



## **NOAA**

Alaska Fisheries Science Center  
Antarctic Ecosystem Research Division  
Alaska Ocean Observing System (AOOS)  
NESDIS Center for Satellite Applications and Research  
National Weather Service  
PMEL

## **Other Government Agencies**

National Park Service

## **Interagency**

CCAMLR  
National Ice Center (NIC)

## **Commercial/Industry**

SailDrone

## **Potential Stakeholders**

U. S. Arctic Observing Network (AON)  
Naval Research Laboratory  
OAR Earth System Research Laboratory (ESRL)  
NOAA Climate Program Office (CPO)  
Southern Ocean Observing System  
NCEP Environmental Modeling Center (EMC)  
EUMETSAT  
Environment & Climate Change Canada  
Finnish Ice Center  
Universities, Academic Partners

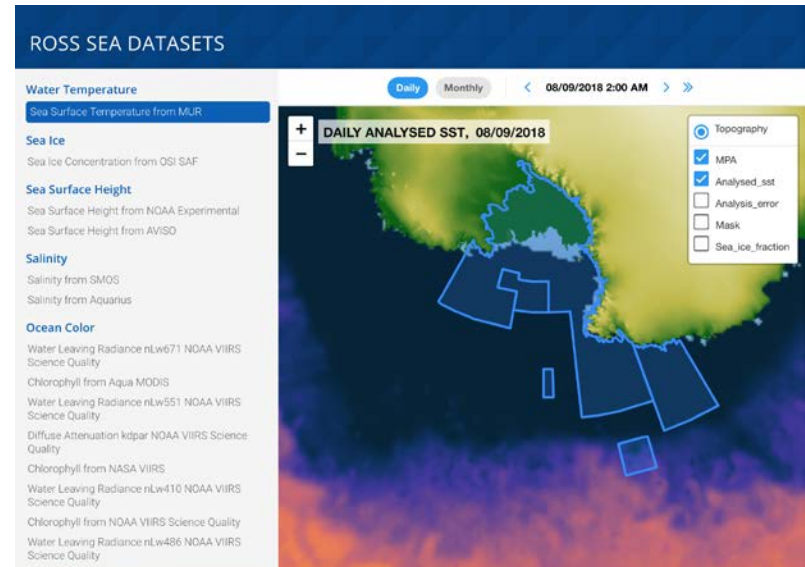


## Antarctic Ecosystem Research Division NOAA Fisheries – SouthWest Fisheries Science Center

Satellite data provides a long time-series of environmental context for fisheries research.

Satellite products commonly used:  
Sea ice, water temperature, salinity, chlorophyll

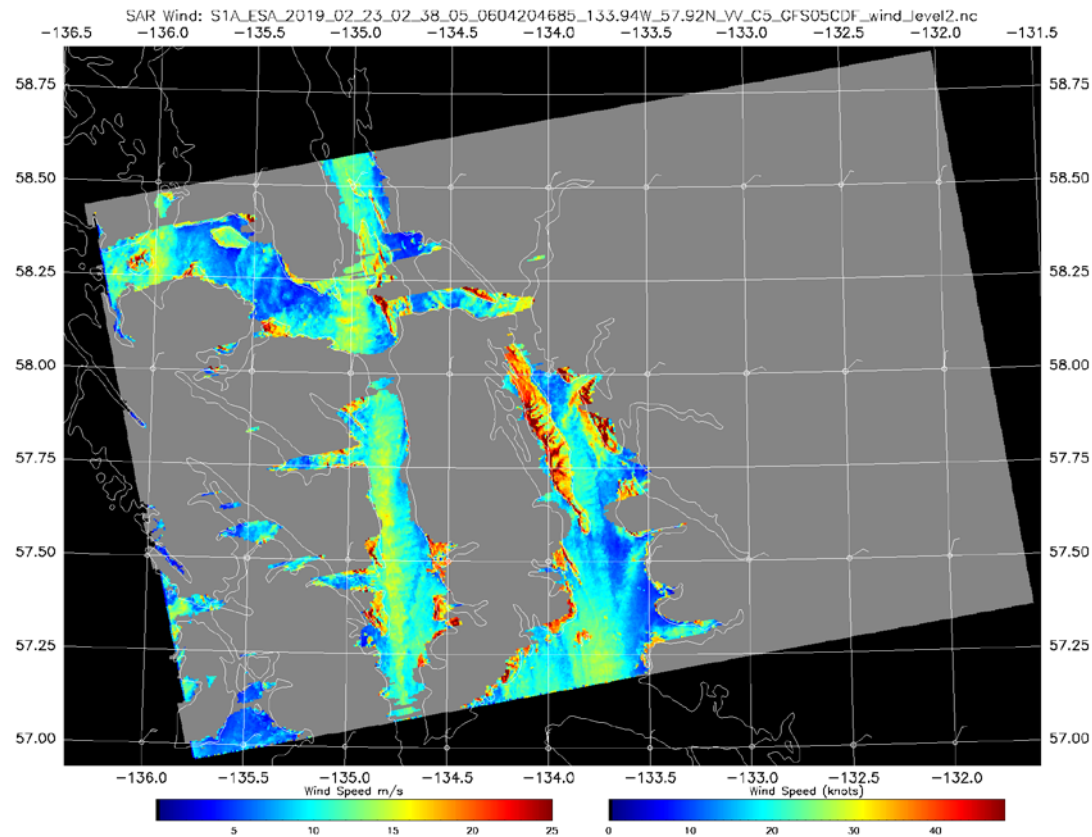
PolarWatch has developed a prototype map-based tool to allow AERD to quickly see what satellite data is available in a region of interest like a CCAMLR region or the new Ross Sea MPA, and preview, subset and download that data.



Brian Bezenek  
**National Weather Service**

“As an operational forecaster with the National Weather Service, I will be looking mainly for forecast verification from near real time products of Surface winds and Sea Heights.

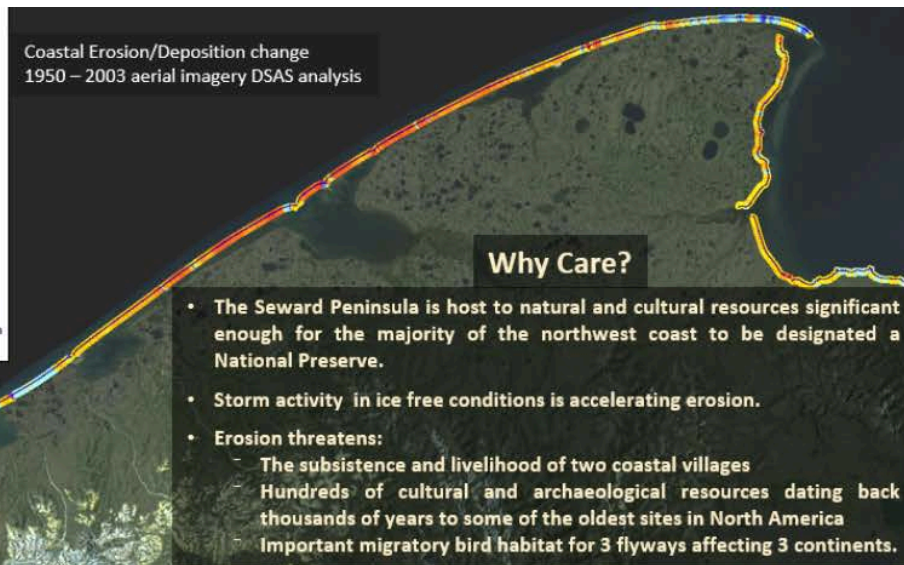
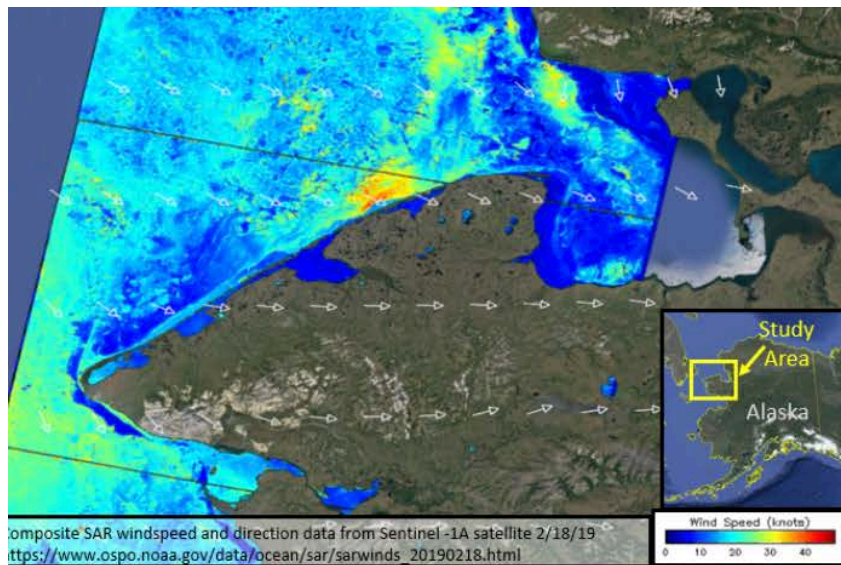
Also will be looking at the research on coastal surge from strong lows as they move inland from the coasts, to develop forecasting tips.”



Processed at QSP0  
 Contains modified Copernicus Sentinel data 2019 Feb 23 07:33:55 UTC

# Tahzay Jones

## National Park Service



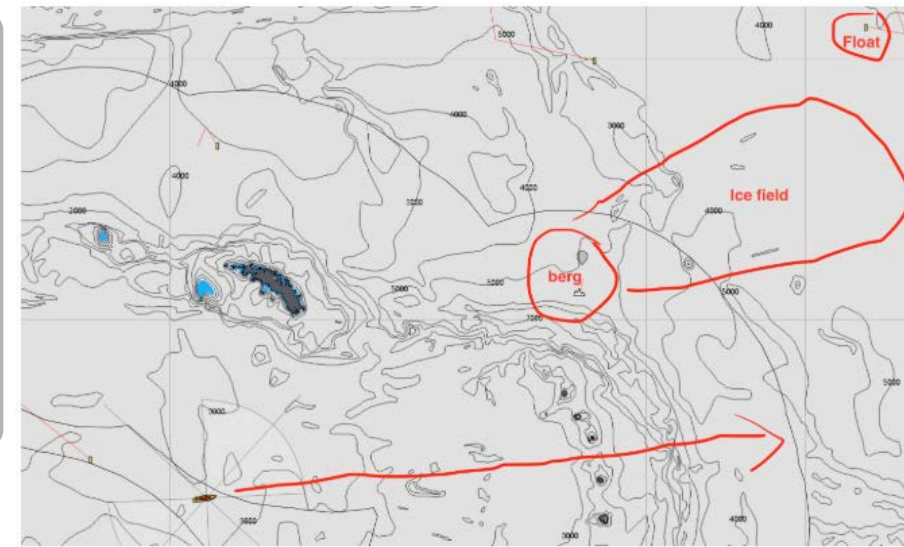
## SailDrone Antarctic Circumnavigations 2019

NOAA partnership with industry in support of science education and outreach missions in the Antarctic

Missions require environmental satellite data both for science and for operational support of the autonomous vehicle navigation

“Are there icebergs near my vehicle path today?”

“Where will the Argo floats be and where can I access their near real-time data?”



## Scenarios for Data Discovery, Visualization and Access

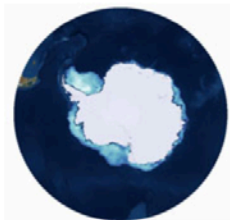
- visualize data over area/time of interest prior to download
- customized access (subset/reformat) data
- programmatically access data repeatedly with the same workflow (R, Python, Matlab)

# Live Demos

# PolarWatch Website overview: polarwatch.noaa.gov

*Providing ocean satellite data for the Arctic and Antarctic*

## Environmental Data Catalog



View and download over 100 datasets, including satellite data, model output, and in situ measurements from field sensors.

[Get Data](#)

## Tools and Training

- Learn about available satellite data software packages
- Learn how to use PolarWatch data services
- Download code examples for common satellite data tasks
- Get info on our annual hands-on satellite data course

[Tools and Training](#)

## ERDDAP Data Server

PolarWatch maintains an ERDDAP server with a large collection of environmental datasets which provides the backbone for our data catalog. 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. Access the data server directly or learn more about it through the following links.

[PolarWatch ERDDAP](#)

[More Info](#)

## News and Events

[View News Archive](#)

### New sea ice datasets added to PolarWatch

Apr 25, 2019

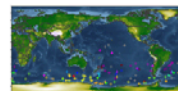


The NOAA/NSIDC Climate Data Record of Passive Microwave Sea Ice Concentration, Version 3 and the near real-time version of the Climate Data Record datasets have been added to the PolarWatch catalog. These datasets provide long term science quality sea ice concentration records for the Arctic and Antarctic dating back to 1978.

[View Data >](#)

### SOCOCM Near-Realtime BGC-Argo data now on PW ERDDAP

Feb 21, 2019



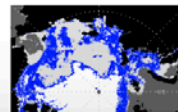
Southern Ocean Carbon and Climate Observations and Modeling (SOCOCM) BGC-Argo float data is now available on the PolarWatch ERDDAP. The SOCOCM project augments conventional Argo floats with biogeochemical sensors to measure carbon (pH), nutrients (nitrate), and oxygen. About 200 autonomous floats

provide coverage over the Southern Ocean, with vertical coverage deep into the water column.

[View Data >](#)

### Visualizing a Decade of Change in the Arctic Sea Ice Cover AGU iPoster

Dec 19, 2018



PolarWatch scientist Sinéad Farrell delivered an interactive poster on visualizing change in Arctic sea ice cover at AGU 2018. The poster highlights NOAA Lab for Satellite Altimetry sea ice data products showing variability in ice type and ice thickness over the

# Data Catalog: Find and Filter

The screenshot displays the NOAA PolarWatch Data Catalog interface. At the top, there are navigation tabs for 'PolarWatch', 'DATA CATALOG', and 'TRAINING'. A search bar is located at the top left, and a notification states: 'This catalog is in active development, for more information see our [roadmap](#).' Below the search bar, it indicates 'Displaying 5 of 23 Listings' and shows a filter for 'ICE'. On the left side, a 'REFINE' panel allows users to filter by category (Temperature, Salinity, Ice, Winds, Ocean Color, Sea Surface Height) and by time, location, and source. The main content area shows five dataset listings, each with a title, date range, resolution, data source, projection, and a thumbnail map. The datasets are: 1) 'Sea Ice Concentration from NSIDC NRT CDR, Antarctic' (Daily/Monthly, Aug 01, 1987 to Aug 26, 2019, 25km resolution, NOAA/NSIDC, EPSG:3412, latest data Aug 26, 2019); 2) 'Sea Ice Concentration from NSIDC CDR, Antarctic' (Daily/Monthly, Jan 02, 1979 to Dec 31, 2017, 25km resolution, NOAA/NSIDC, EPSG:3412, latest data Dec 31, 2017); 3) 'Sea Ice Concentration from NSIDC NRT CDR, Arctic' (Daily/Monthly, Aug 01, 1987 to Aug 26, 2019, 25km resolution, NOAA/NSIDC, EPSG:3411, latest data Aug 26, 2019); 4) 'Sea Ice Concentration from NSIDC CDR, Arctic' (Daily/Monthly, Nov 01, 1978 to Dec 31, 2017, 25km resolution, NOAA/NSIDC, EPSG:3411, latest data Dec 31, 2017); 5) 'Sea Ice Concentration from OSI SAF' (Daily, Jun 01, 2002 to Aug 25, 2019, 382 m resolution, EUMETSAT, EPSG:4326, latest data Aug 25, 2019).



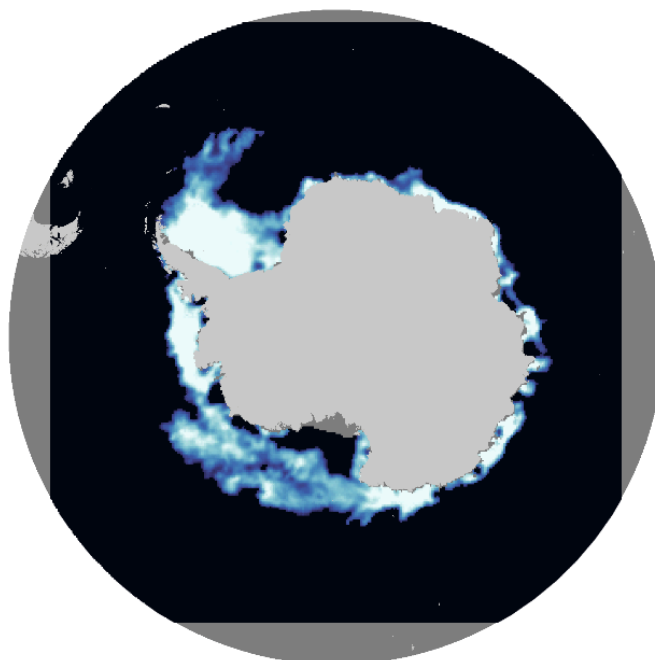
# Data Catalog: Preview/Visualization

Sea Ice Concentration from NSIDC CDR, Antarctic

PREVIEW DOWNLOAD

Daily Monthly Antarctic < 12/31/2017 12:00Z > >>

DAILY SEAICE CONC CDR, 12/31/2017 12:00Z



-23.45815 : -115.53503



This is 25km science quality sea ice concentration data for the Antarctic from the NOAA NSIDC Climate Data Record, Version 3 (G02202). This data set provides a Climate Data Record (CDR) of sea ice concentration from passive microwave data. Daily and monthly versions are available from 1978 to the most recent annual processing.

## Daily Sea Ice Concentration from NSIDC CDR, Antarctic

### Date Range

01/02/1979 - 12/31/2017

### Source

NOAA/NSIDC

### Dataset Id

nsidcCDRiceSQsh1day

### Description

This data set provides a Climate Data Record (CDR) of sea ice concentration from passive microwave data. It provides a consistent, daily and monthly time series of sea ice concentrations from 09 July 1987 through the most recent processing for both the north and south polar regions. In addition, three other sea ice concentration products are included with the CDR that extend the sea ice measurements back to 26 October 1978. However, these three products are not included in the official CDR because processing the older data in a way that follows the standards of a CDR is not currently possible. All data are on a 25 km x 25 km grid. Variables containing standard deviation, quality flags, and projection information are also included.

### Spatial Resolution

25000.0 meters

# PolarWatch data catalog: Download

Sea Ice Concentration from NSIDC CDR, Antarctic

PREVIEW

DOWNLOAD

Choose your area and time frame of interest.

Daily

Monthly

This dataset is provided in projected format. Data downloads are available through this subsetting form as well as full direct file access. Direct file access provides the projection metadata in a format better suited for netcdf data viewers. The projection of this dataset is EPSG:3412.

Download size estimate as configured: < 1MB

## Location

YGRID 735262.30 to 3894789.1 ADD STRIDE

XGRID -3212738.0 to 190470.24 ADD STRIDE

## Dates

Available from Jan 02, 1979 to Dec 31, 2017

Latest Date ⓘ

Custom ▾

09/15/2017 12:00Z to 09/15/2017 12:00Z

ADD STRIDE

## Parameters

seaice\_conc\_cdr  goddard\_merged\_seaice\_conc

stdev\_of\_seaice\_conc\_cdr  goddard\_nt\_seaice\_conc

melt\_onset\_day\_seaice\_conc\_cdr  goddard\_bt\_seaice\_conc

qa\_of\_seaice\_conc\_cdr

## Format

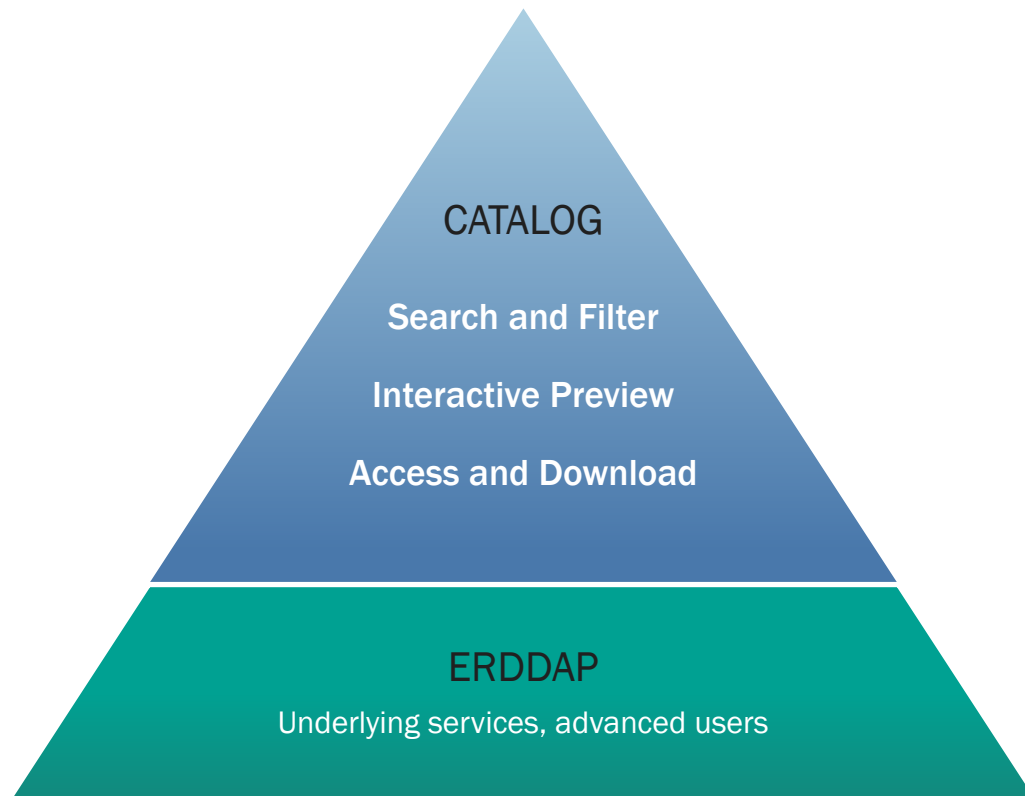
Use ERDDAP for more formats

NetCDF [ .nc ] ▾

DOWNLOAD

VIEW URL

## PolarWatch Data Services



### PolarWatch Catalog

[polarwatch.noaa.gov/catalog](http://polarwatch.noaa.gov/catalog)

- Enhances ERDDAP capabilities
- More user-friendly data discovery interface
- Subset and download projected datasets
- Preview data on polar projected maps

### ERDDAP

[polarwatch.noaa.gov/erddap](http://polarwatch.noaa.gov/erddap)

- Seamlessly integrate data from ERDDAP or aggregated THREDDS services
- Data served in many formats
- Subset data temporally and spatially
- RESTful

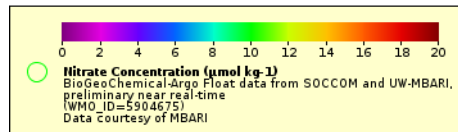
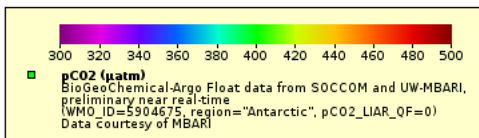
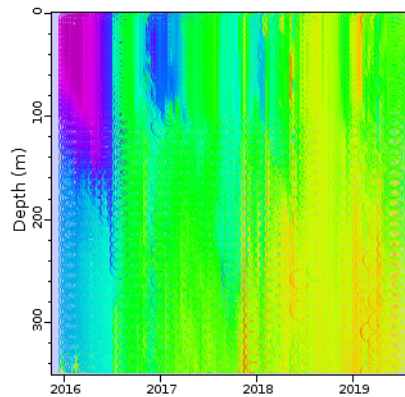
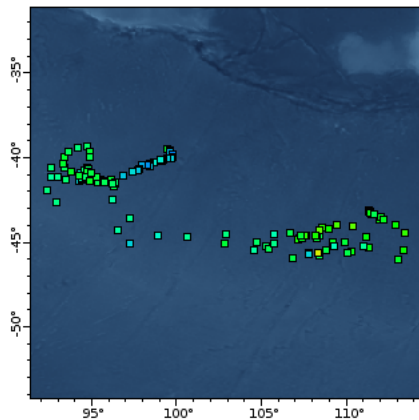
# PolarWatch Data Server - ERDDAP

98 matching datasets, listed in alphabetical order.

Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	W M S	Source Data Files	Title
	set	data	graph			* The List of All Active Datasets in this ERDDAP *
data			graph	M		Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, 3-Month
data			graph	M		Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, 7-Day
data			graph	M		Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, Daily
data			graph	M		Aquarius Sea Surface Salinity, L3 SMI, Version 5, 1.0°, Global, 2011-2015, Monthly
data			graph	M		Chlorophyll, NOAA VIIRS, Near Real-Time, Global, Level 3, 2014-present, EXPERIMENTAL
data			graph	M		Chlorophyll, NOAA VIIRS, Near Real-Time, Global, Level 3, 2014-present, EXPERIMENTAL
data			graph	M		Chlorophyll, NOAA VIIRS, Near Real-Time, Global, Level 3, 2014-present, EXPERIMENTAL
data			graph	M		Chlorophyll, NOAA VIIRS, Science Quality, Global, Level 3, 2012-present, Daily
data			graph	M		Chlorophyll, NOAA VIIRS, Science Quality, Global, Level 3, 2012-present, Monthly
data			graph	M		Chlorophyll, NOAA VIIRS, Science Quality, Global, Level 3, 2012-present, Weekly
data			graph	M		Chlorophyll-a, Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present (1 Day Composite)
data			graph	M		Chlorophyll-a, Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present (1 Day Composite)
data			graph	M		Chlorophyll-a, Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present (1 Day Composite)
data			graph	M		Diffuse Attenuation K490, Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present (1 Day Composite)
data			graph	M		Diffuse Attenuation K490, Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present (8 Day Composite)
						Diffuse Attenuation K490, Aqua MODIS, NPP, L3SMI, Global, 4km, Science Quality, 2003-present (8 Day Composite)

# Using ERDDAP to visualize tabular data

<https://coastwatch.pfeg.noaa.gov/projects/erddap/tabledap.html#visualize-the-buoy-track>



## Chapter 7 Tabular Datasets, BGC-Argo data

notebook filename | 07-Tabledap.Rmd

There are two types of data in ERDDAP, gridded data and tabular data. So far all of our examples have been with gridded data. Working with tabular data is a little different. Here we will explore the Biogeochemical-Argo (BGC-Argo) dataset, which is hosted on the PolarWatch ERDDAP.

### 7.1 Searching for the BGC-Argo datasets

- Enter the following URL into your browser to bring up the PolarWatch ERDDAP:  
<https://polarwatch.noaa.gov/erddap/>
- In the search box type "Biogeochemical-Argo" and click the "Search" button

In the search results, two datasets are displayed: the near-real-time dataset (Dataset ID: SOCCOM\_BGC\_Argo), and a science quality dataset that is updated quarterly (Dataset ID: BGC\_Argo\_Snapshot\_Archive).

Grid	Title	Make	W	Source	Sum	FGDC	Back-	RSS	E	Institution	Dataset ID
Date	Set	DAP	A	M	Data	mary	ground	mail			
Date	Set	URL	Graph	S	Files		Info				
	set	data	graph				background			UCSD & MBARI	SOCCOM_BGC_Argo_031219
	set	data	graph				background			MBARI	SOCCOM_BGC_Argo

SOCCOM search result

We will work with the near-real time dataset, so click "graph" to the left of the near-real-time dataset.

**ERDDAP > tabledap > Make A Graph**

Dataset Title: **BioGeoChemical-Argo Float data from SOCCOM and UW-MBARI, preliminary near real-time**

Institution: MBARI (Dataset ID: SOCCOM\_BGC\_Argo)

Range: longitude = 0.001 to 359.999°E, latitude = -75.647 to 83.103°N, depth = -812856.9 to 1981.282m, time = 2007-12-23T02:58:00Z to 2019-06-25T10:10:00Z

Information: Summary | License | FGDC | ISO 19115 | Metadata | Background | Data Access Form

Graph Type:  markers  lines  polygons

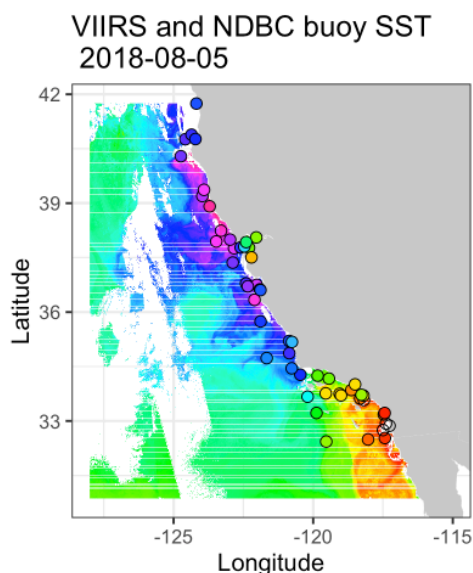
X Axis:

Y Axis:

Click on the map to specify a new center point.

# Matchup Satellite and Buoy Data - R Script Demonstration

<https://coastwatch.pfeg.noaa.gov/projects/r/>



## Chapter 5 Matchup satellite and buoy data

notebook filename | 05-sstbuoy.Rmd  
history | converted to R notebook from SSTandBuoy.R

In this exercise you will extract buoy data from ERDDAP tabular data and then extract satellite data that is coincident with the buoy data.

The exercise demonstrates the following techniques:

- Use the `tabledap` function to extract tubular data from ERDDAP
- Using `xtracto` to extract satellite data coincident with the buoy data
- Using `xtracto_3D` to extract satellite data for a rectangular area
- Using `rerddap` to retrieve information about a dataset from ERDDAP
- Producing xy scatter plots
- Generating linear regressions
- Producing satellite maps and overlaying buoy data

### 5.1 Install required packages and load libraries

```
# Function to check if pkgs are installed, install missing pkgs, and
pkgTest <- function(x)
{
  if (!require(x,character.only = TRUE))
  {
    install.packages(x,dep=TRUE)
    if(!require(x,character.only = TRUE)) stop(x, " :Package not found")
  }
}

pkgTest <- function(x)
{
  if (!require(x,character.only = TRUE))
  {
    install.packages(x,dep=TRUE)
    if(!require(x,character.only = TRUE)) stop("Package not found")
  }
}
```

### 5.5 Create a satellite map and overlay buoy data

Extract VIIRS chlorophyll data for the month of August 2018

```
# First define the box and time limits of the requested data
ylim<-c(30.87,41.75)
xlim<-c(-128,-115)

# Extract the monthly satellite data
SST <- xtracto_3D(dataInfo,xcoord=xlim,ycoord=ylim,parameter=parameter,
                 tcoord=c('2018-08-06','2018-08-06'),zcoord=zcoord)

SST$sst <- drop(SST$sst)
```

Create the map frame for the satellite data and buoy SST overlay

```
mapFrame<- function(longitude,latitude,sst){
  dims<-dim(sst)
  sst<-array(sst,dims[1]*dims[2])
  sstFrame<-expand.grid(x=longitude,y=latitude)
  sstFrame$sst<-sst
  return(sstFrame)
}

sstFrame<-mapFrame(SST$longitude,SST$latitude,SST$sst)
coast <- map_data("worldHires", ylim = ylim, xlim = xlim)
my.col <- colorRampPalette(rev(brewer.pal(11, "RdYlBu")))(22-13)

buoy2<-subset(dailybuoy, month(time)==8 & day(time)==5 & sst > 0)
```

Create the map

```
myplot<-ggplot(data = sstFrame, aes(x = x, y = y, fill = sst)) +
  geom_raster(interpolate = FALSE,na.rm=T) +
  geom_polygon(data = coast, aes(x=long, y = lat, group = group), fi
```

# Satellite Data Training Courses

- Attend a hands-on training course
- Find data
- Downloading and accessing data
- Beginners and advanced users welcome
- Learn to use tools for R, Python, ArcGIS and Matlab
- Multiple courses are offered by regional nodes throughout the year
- PolarWatch and the West Coast node plan to co-host our next class in Alaska Spring 2020.

[https://coastwatch.pfeg.noaa.gov/courses/satellite\\_course.html](https://coastwatch.pfeg.noaa.gov/courses/satellite_course.html)

## CONNECT WITH US!

Cara Wilson (Monterey)

[cara.wilson@noaa.gov](mailto:cara.wilson@noaa.gov)

Jenn Sevadjian (La Jolla)

[jennifer.sevadjian@noaa.gov](mailto:jennifer.sevadjian@noaa.gov)

Dale Robinson (Santa Cruz)

[dale.robinson@noaa.gov](mailto:dale.robinson@noaa.gov)

Sinead Farrell (College Park)

[sinead.farrell@noaa.gov](mailto:sinead.farrell@noaa.gov)

## Acknowledgements

### ERD DATA GROUP

Roy Mendelssohn, Lynn Dewitt, Bob Simons

### COASTWATCH CENTRAL

Veronica Lance, Michael Soracco, Heng Gu, Phil Keegstra