



Satellite Sea Ice Data

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NOAA CoastWatch Virtual Satellite Course

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Versioning

- Sevadjian & Robinson, May 2021, Apr 2020, Apr 2019
- Robinson, 2018



Outline

Introduction

Background | Challenges associated with sea ice data

Finding/choosing a dataset

Where to get data? | What products are available?

Projections

Working with multiple projections

Workflow integration

Integrating sea ice data



Who needs sea ice data and why?

Using sea ice data is unique to polar and subpolar applications

Many data providers do not carry sea ice data

Important for multiple applications

Fisheries management, safety at sea, navigation, transportation, tourism, and recreation

Polar regions are very inaccessible

Using satellites to monitor sea ice is important due to inaccessibility of these regions



There are challenges associated with using sea ice data

How can I find the data? Where can I get it?

- There are many data providers: NSIDC¹, NIC², ESA³ Copernicus, NCEI⁴
- Issues: products made for limited user base, limited data formats, limited access

How do I choose a data product?

- What are the differences among products?

There are many map projections.

- Usually not the projection I use.

How do I integrate the data into my workflow?

¹NSIDC - National Snow and Ice Data Center

²NIC - National Ice Center

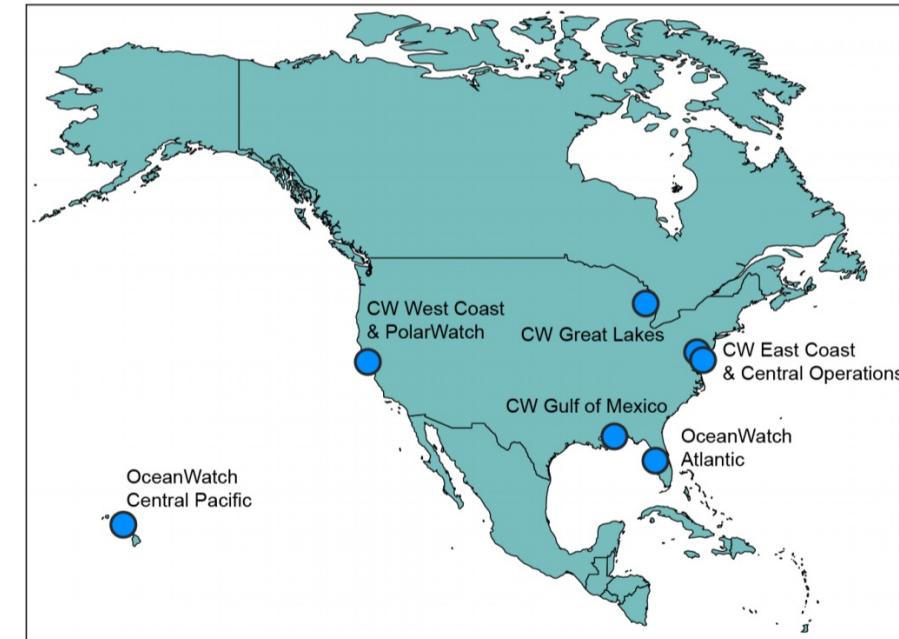
³ESA – European Space Agency

⁴NCEI - National Centers for Environmental Information



Where to get data: Introduction to PolarWatch/CoastWatch

- PolarWatch is a NOAA CoastWatch Node
- value added provider that collaborates with key data providers and users:
CoastWatch Central, NSIDC¹, NIC², NMFS³, NESDIS⁴
- facilitate discovery and access to satellite data covering polar and subpolar regions.



¹NSIDC - National Snow and Ice Data Center

²NIC - National Ice Center

³NCEI - National Centers for Environmental Information

⁴NESDIS - National Environmental Satellite, Data, and Information Service



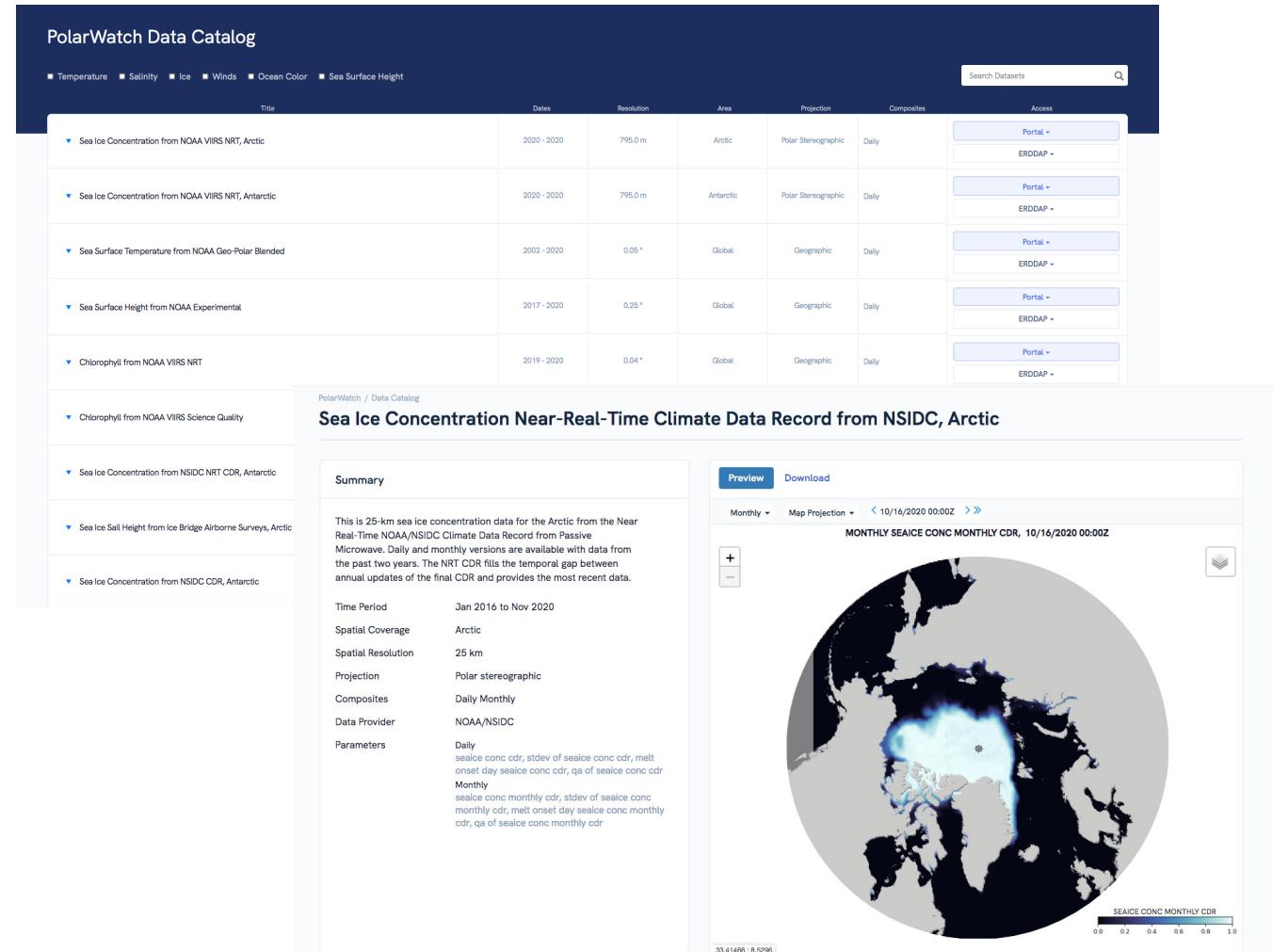
Where to get data: PolarWatch

PolarWatch provides access to near real-time and historical satellite observations including:

Sea ice, water temperature, ocean color, salinity and winds

PolarWatch addresses the challenges of integrating sea ice data:

- Making data available in common formats with easy access
- Curating quality datasets,
- Making it easier to quickly determine differences between datasets,
- Previews of data before downloading



Satellite Sea Ice Datasets

There are many available datasets, we will cover some highlighted products

Some things to consider when choosing a dataset:

Intended use	Gaps, interpolation
Coverage	Timeliness
Resolution	Reliability

Reach out to us with any questions about data sets

PolarWatch User Support

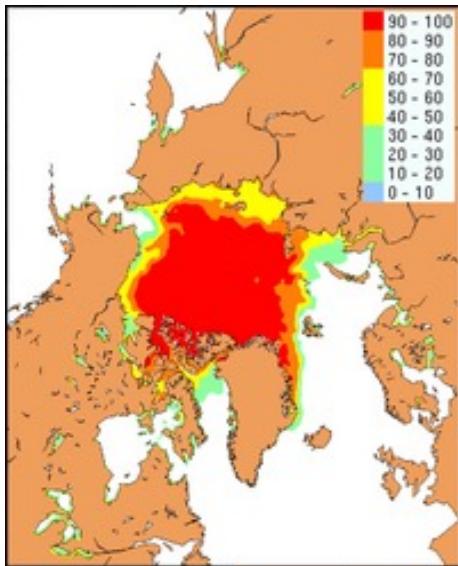
Jennifer.sevadjian@noaa.gov



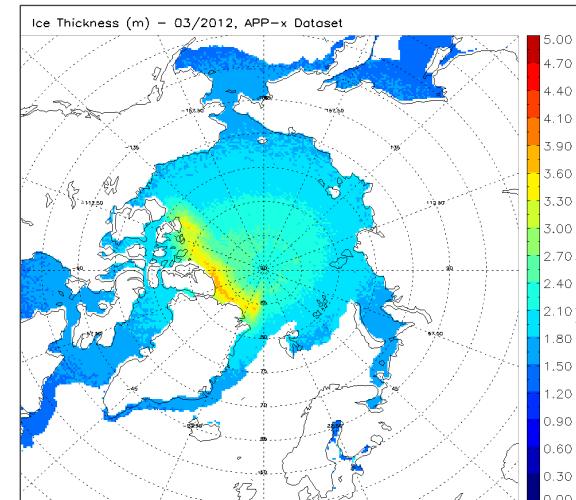
Datasets: Sea Ice Properties

Many sea ice properties can be monitored by satellites

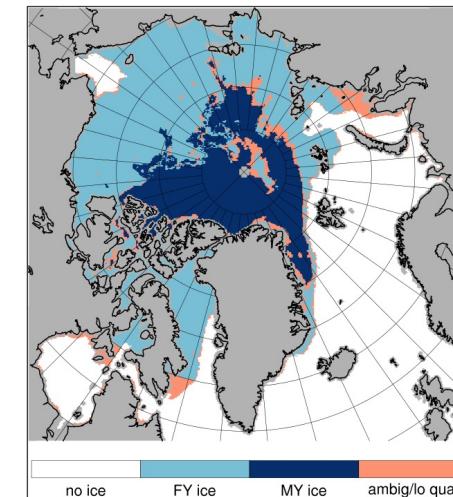
Sea Ice Concentration



Sea Ice Thickness



Ice Type/Age



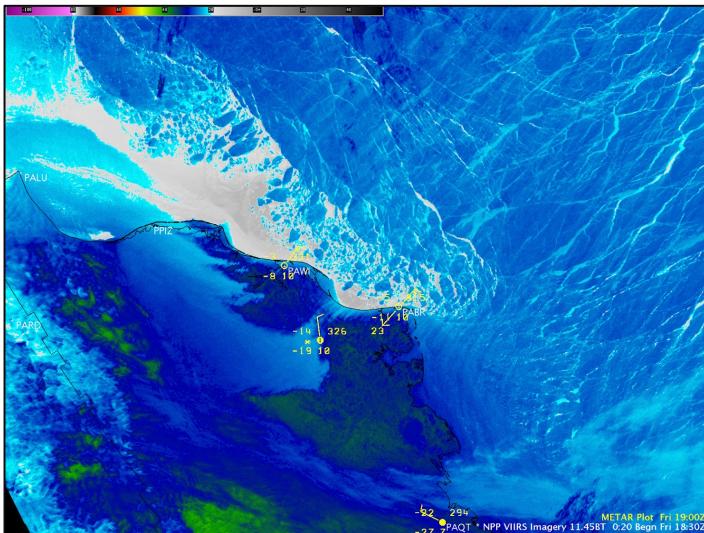
Ice Edge



Datasets: Satelite Sensors

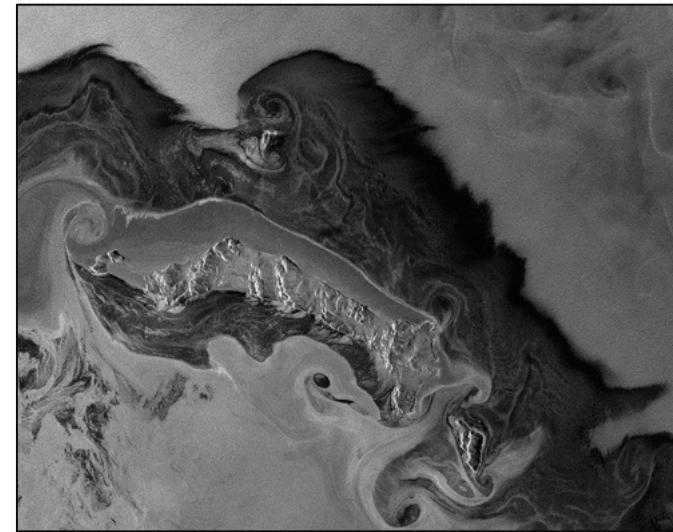
Many different satellite sensors can measure sea ice

Infrared



VIIRS Infrared Image

Microwave
(Passive and Active)



Active Microwave SAR Image

Visible



MODIS Visible Image



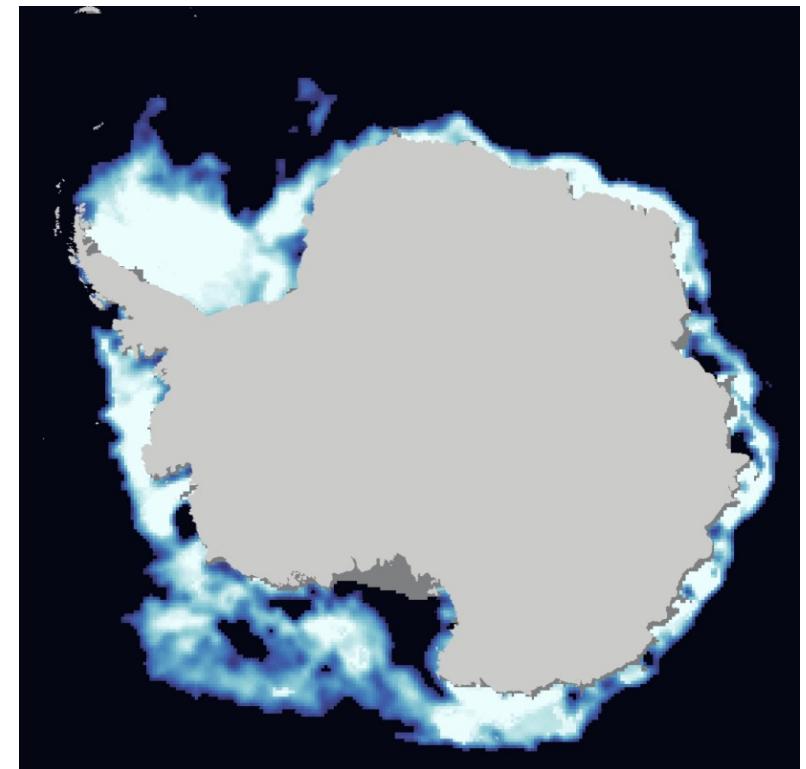
NOAA/NSIDC Ice Concentration Climate Data Record Products

Coverage: Arctic and Antarctic

Long Time Series: 1978 – present

Spatial Resolution: 25km

Temporal Resolution : Daily, Monthly



NSIDC: Download and Information:

<https://nsidc.org/data/g10016>

PolarWatch: View and ERDDAP Download :

<https://polarwatch.noaa.gov/catalog/?ice=y&searchFor=NSIDC%20CDR>



AMSR-2 and AMSR-E Ice Concentration Products

NEWEST, HIGHEST RESOLUTION MICROWAVE SENSOR DATA

Coverage : Arctic

Time Series: 1978 – present

Spatial Resolution: 10km

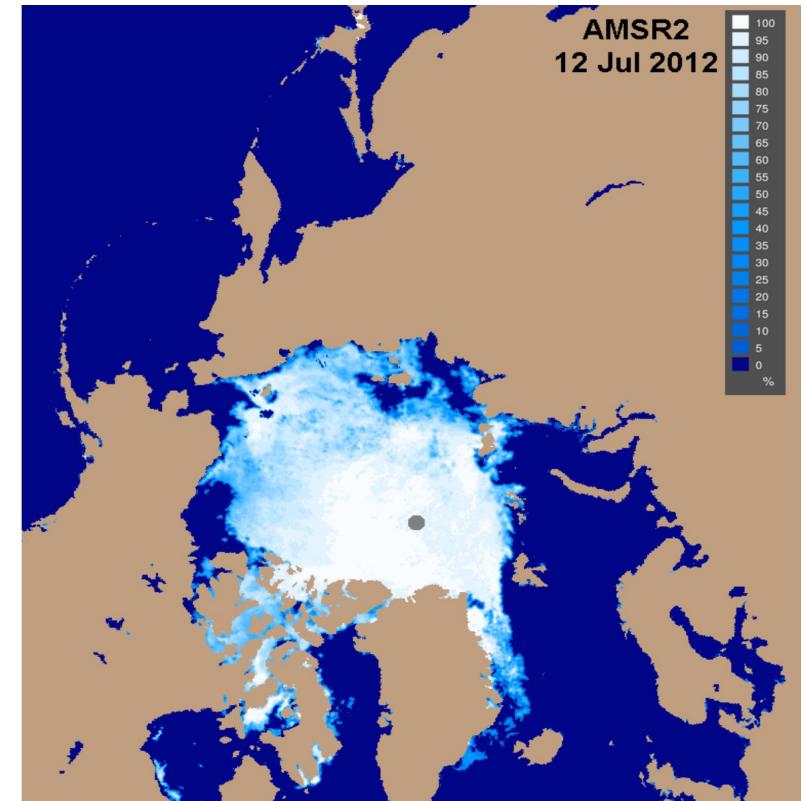
Temporal Resolution : Daily, Monthly

NSIDC: Download and Information:

https://nsidc.org/data/amsre_amsr2

PolarWatch: View and ERDDAP Download

<https://coastwatch.noaa.gov/cw/satellite-data-products/sea-ice/amsr2-sea-ice-concentration.html>



NSIDC MASAM2 Ice Concentration Products

ADDS THE VALUE OF MASIE RELIABLE ICE EDGE

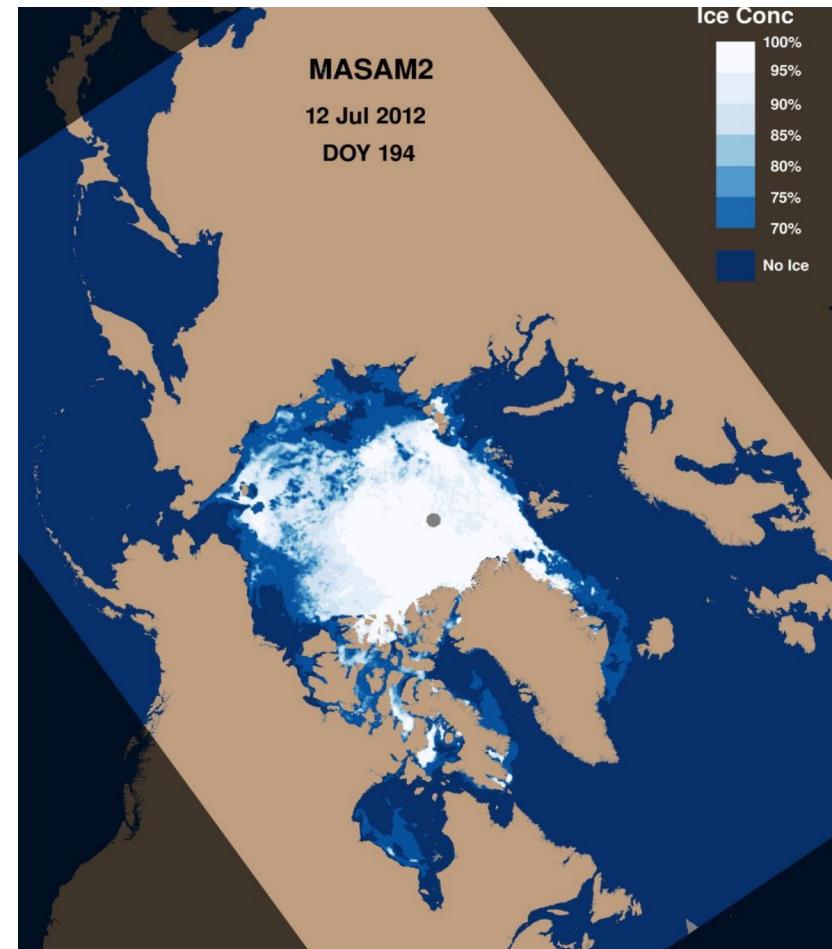
Coverage : Arctic

Time Series: 2012 – present

Spatial Resolution: 4km

Temporal Resolution: Daily

NSIDC: Download and Information:
<https://nsidc.org/data/g10005>



VIIRS High Resolution Infrared Ice Products

Coverage : Arctic

Time Series: 1978 – present

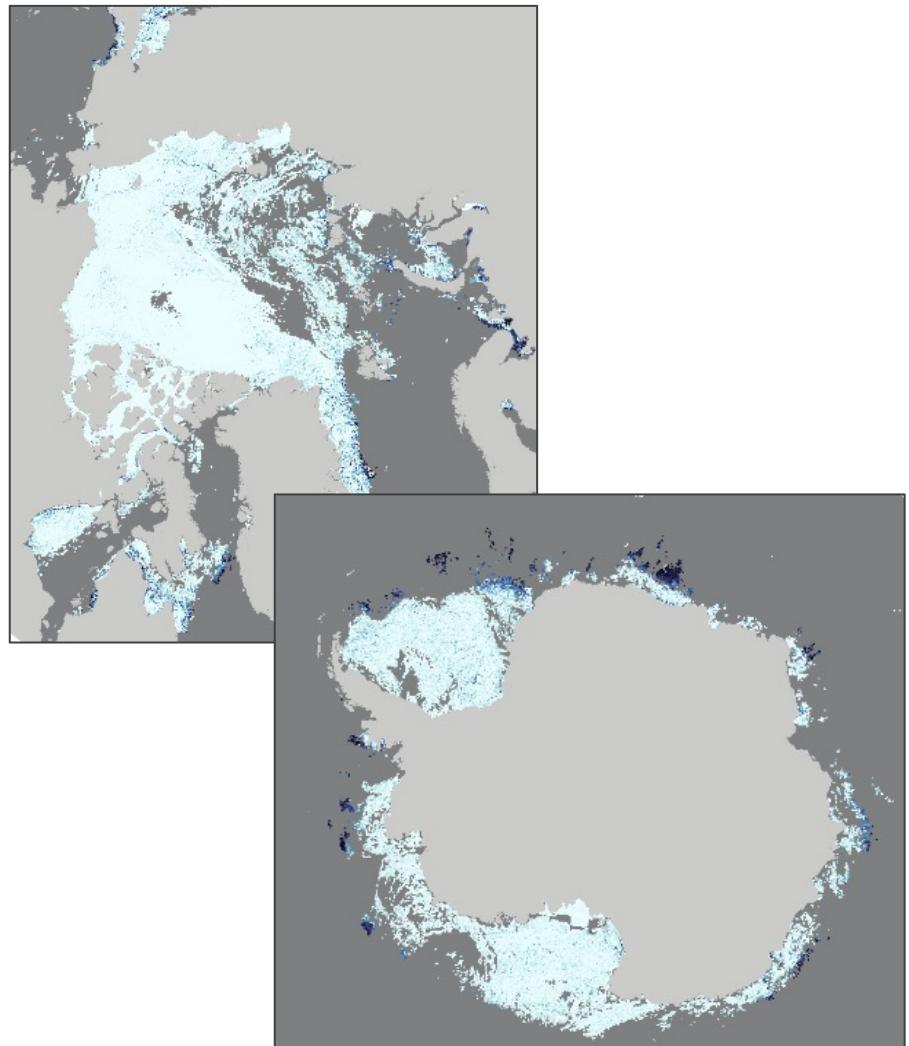
Spatial Resolution: 750m

Temporal Resolution : Daily, 4-day

- Measurements:
- Ice concentration
- Ice thickness
- Ice surface temperature

PolarWatch Catalog VIIRS Ice Datasets

<https://polarwatch.noaa.gov/catalog/?ice=y&searchFor=viirs+ice>



Ice Edge Products

NIC IMS

Highly accurate maps of extent of snow and ice coverage

Integrates multiple sensors, manually created daily by analyst

Shape file, image, geotiff, kml, grib2

Arctic, Daily

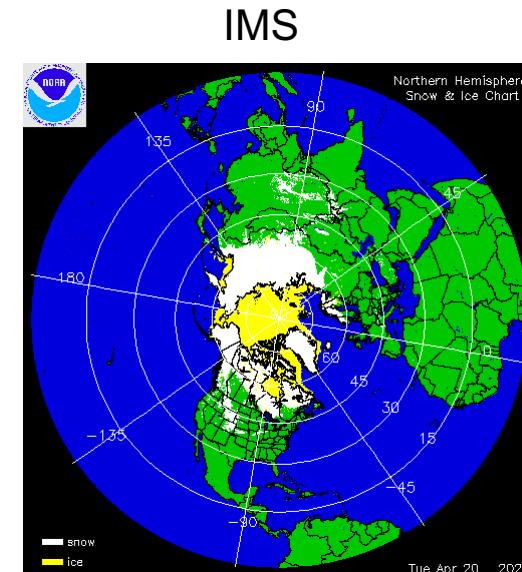
<https://usicecenter.gov/Products/lmsHome>

Dates Available

25km: since 1997

4km: since 2004

1km: since 2014



MASIE - NH



NSIDC MASIE

IMS product sea ice in additional data formats/products.

Regional products - GeoTIFFs, .pngs and time series plots

Arctic, Daily

<https://nsidc.org/data/masie>

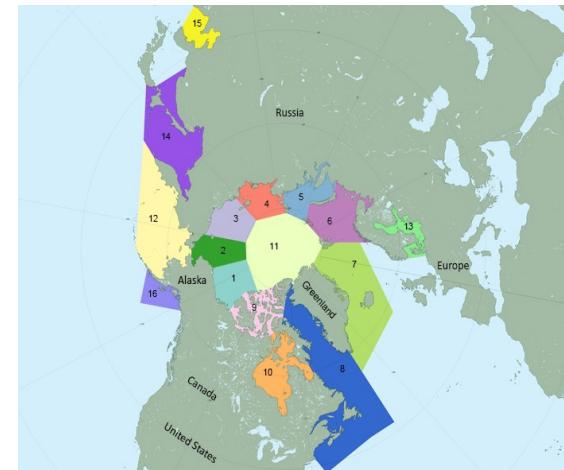
Dates Available

1km – since 2014

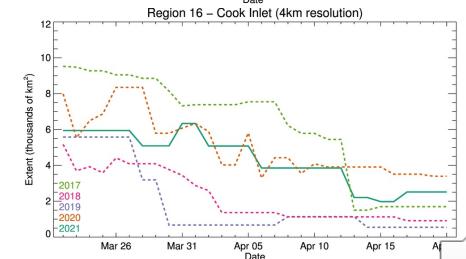
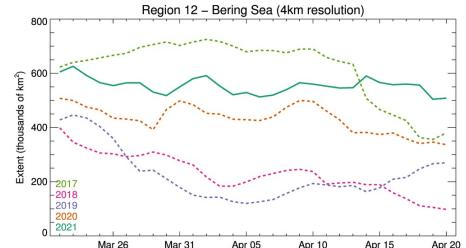
4km – since 2006

Both IMS and MASIE are coming soon to the PolarWatch portal

MASIE - Regions



MASIE – Time-Series

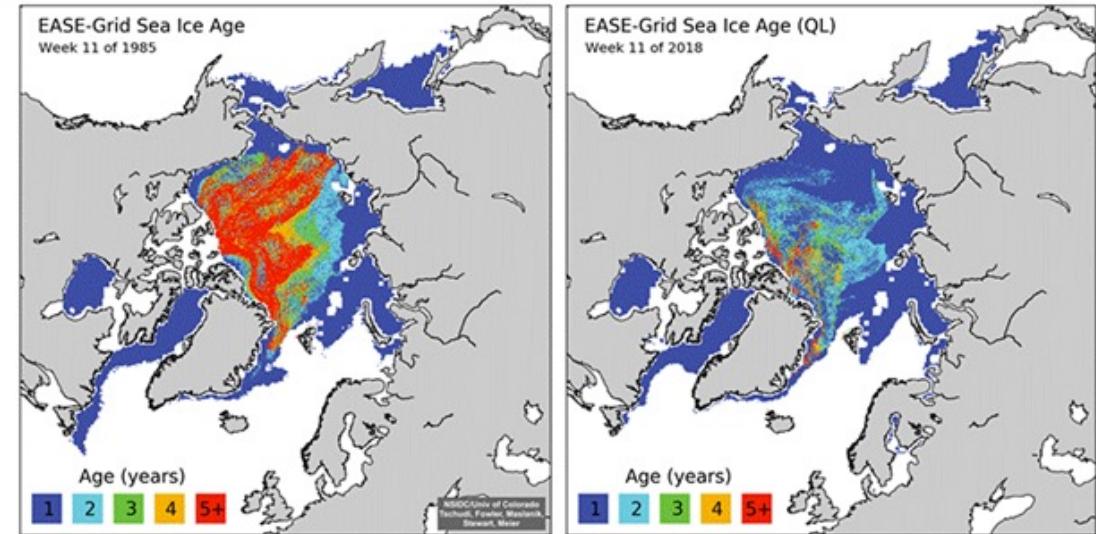


Datasets: Ice Type (Age) Products

CATEGORIES OF ICE: NO ICE, FIRST YEAR ICE , MULTI-YEAR ICE

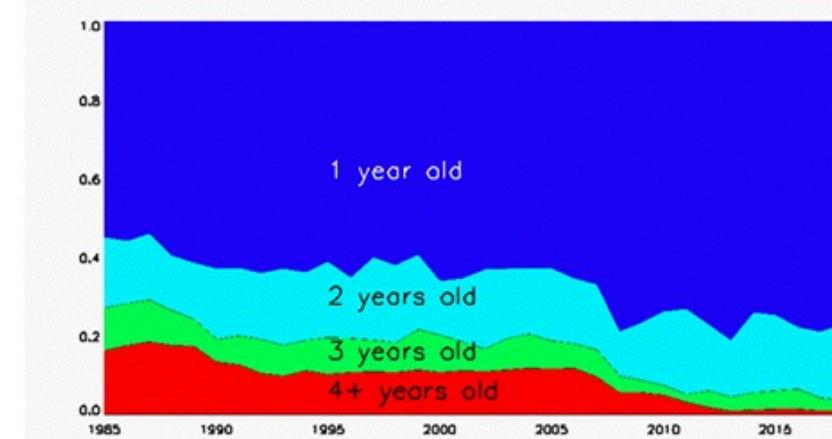
EASE-Grid Sea Ice Age, Version 3

- <https://nsidc.org/data/nsidc-0611>
- 1984 to Present
- Arctic Coverage (North of 48.4°)
- 12.5-km resolution
- Weekly



OSI-SAF EUMETSAT IceType Product

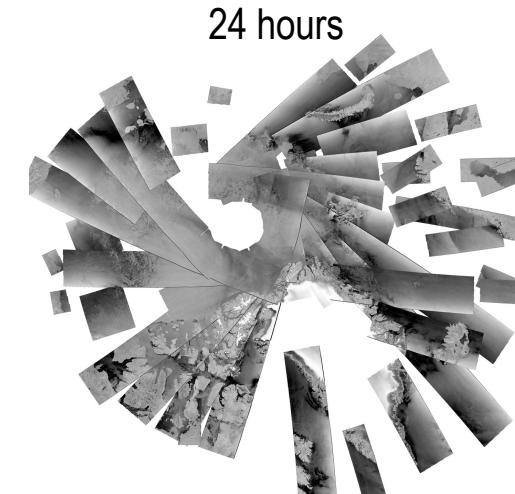
- http://osisaf.met.no/p/ice/edge_type_long_description.html
- 2005 to present
- Arctic
- 10-km resolution
- Daily



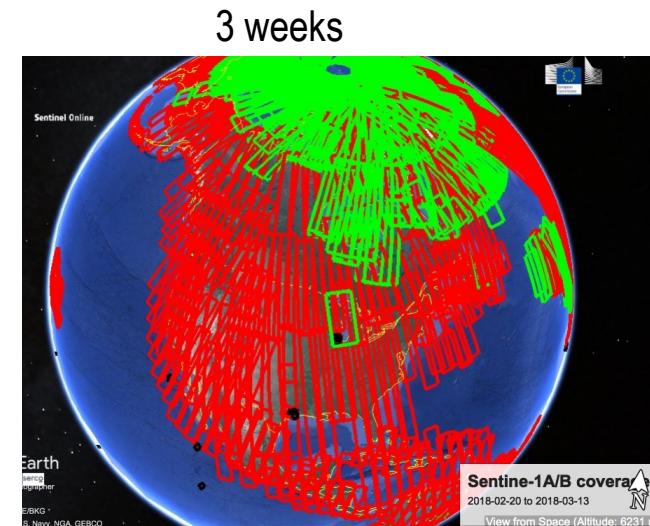
Datasets: SAR Imagery Overview

- **Coverage:** Arctic and Antarctic
- **Resolution:** 1m to 100m resolution
- Small footprint but frequent satellite passes in high latitudes. Level 2 data.
- High-resolution images can be used for detailed information. Not good for long time-series work due to inconsistent coverage

Coverage Example for the Arctic



24 hours



3 weeks



Datasets: SAR Imagery Products

Sentinel 1A/B, Sentinel 2, RadarSat

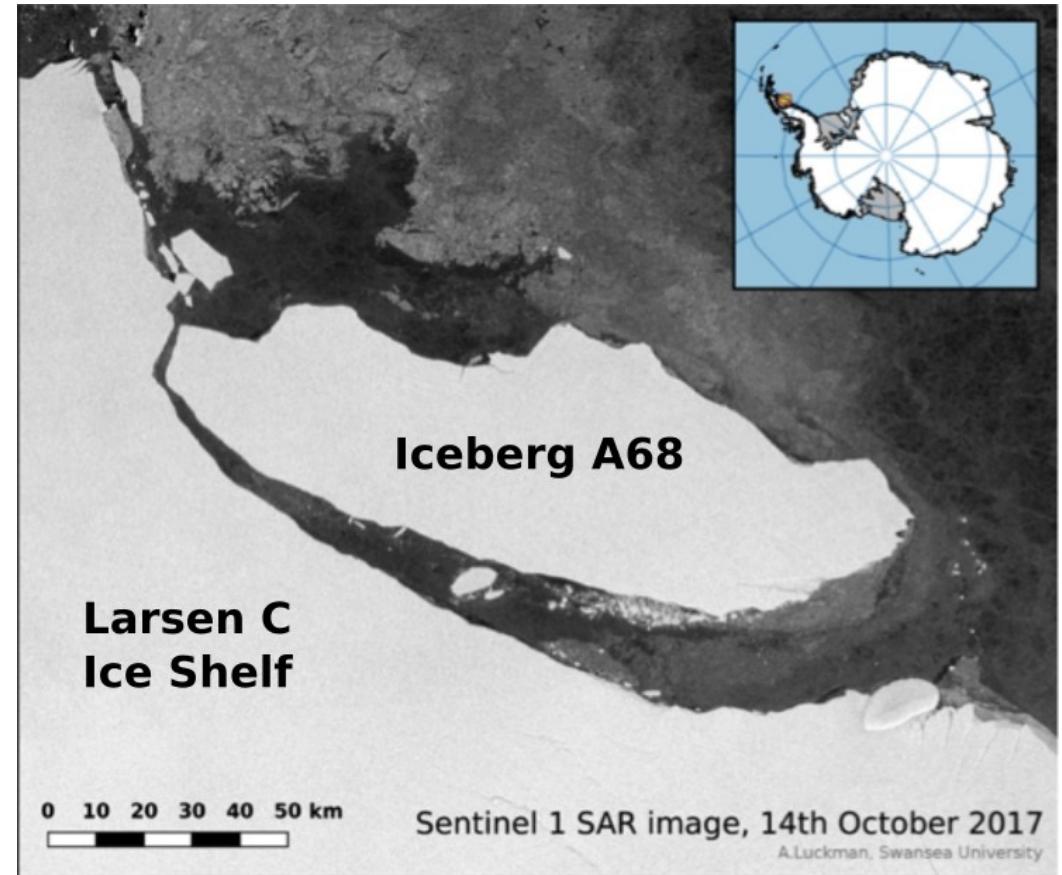
Find and download NRT images with PolarView

<https://www.polarview.aq/arctic>

CoastWatch SAR data landing page

[https://coastwatch.noaa.gov/cw/satellite-data-products/...](https://coastwatch.noaa.gov/cw/satellite-data-products/)

More products are coming through CoastWatch.



Break up of the Larson Ice Shelf. A68 sets sail from Larsen C. Sentinel 1 SAR image [Credit: Adrian Luckman, Swansea University].



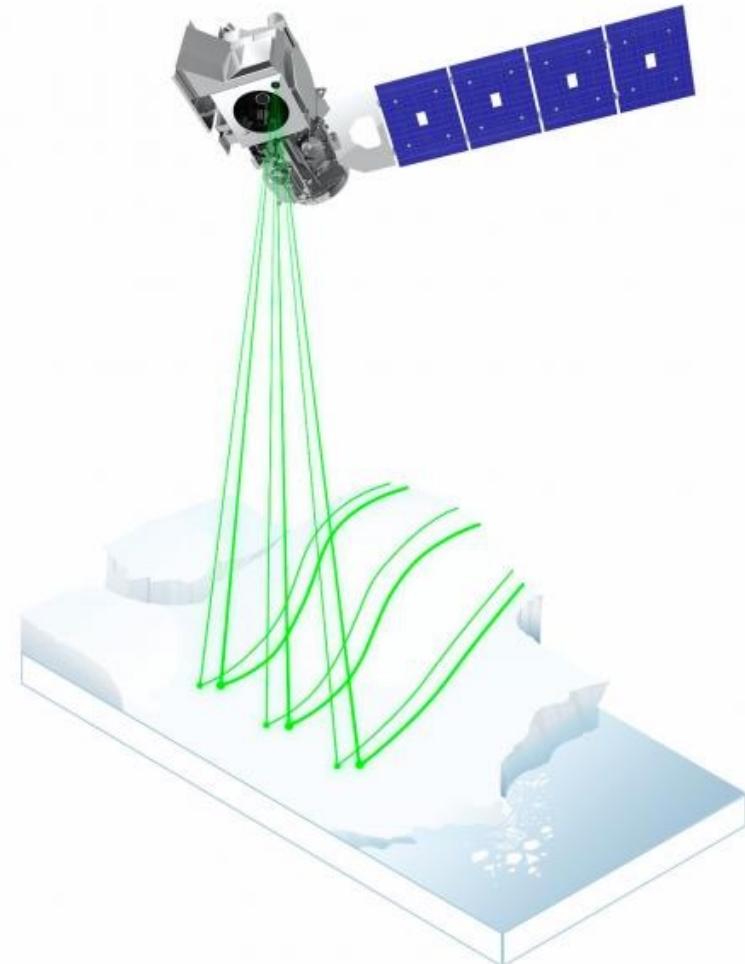
Datasets: ICESAT-2 launched Sep 2018

Level 3 data now available

High-resolution laser altimetry data products

Small footprint, coverage area

Sea ice thickness, freeboard, land ice height,
land and canopy elevation, sea surface height.



NSIDC: Download and Information:
<https://nsidc.org/data/icesat-2>

Image courtesy NASA.



Polar Projections

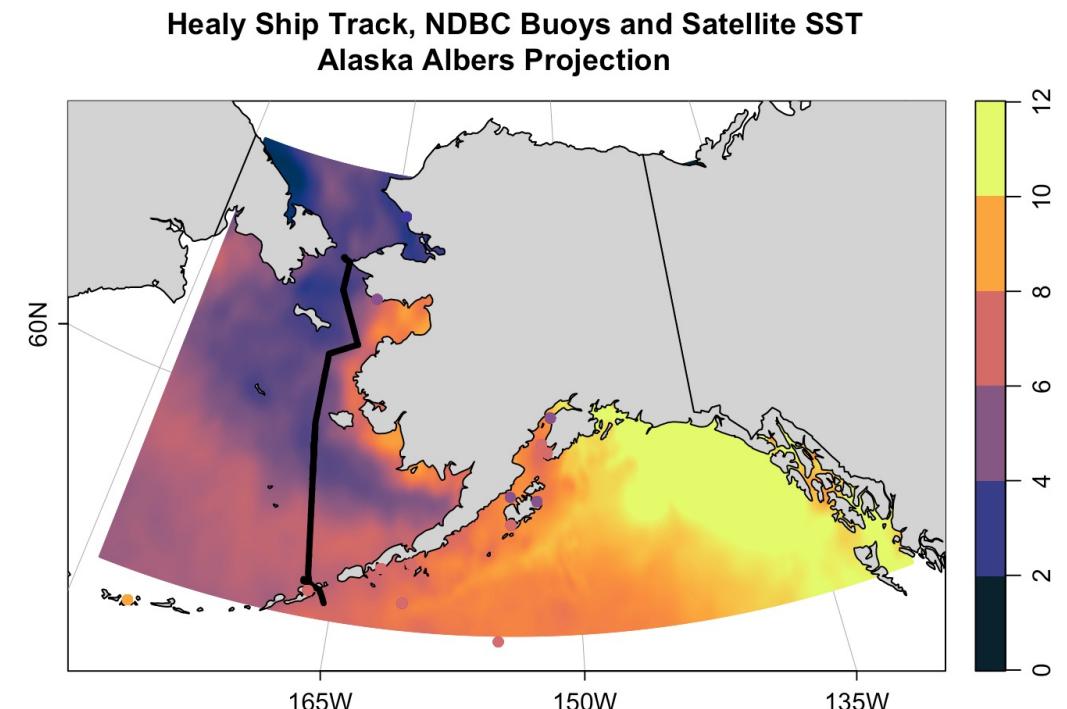
Data products in the polar regions are produced in a number of projections.

There are reasons for multiple projections including intended use and spatial domain.

Open source software can convert between projections and plot data using projections.

Be aware of the implications with reprojecting

PolarWatch provides code examples for working with projected data in python and R.



<https://dale-robinson.gitbook.io/coastwatch-satellite-course-may-2021/tutorials/r-tutorial/chapter-7-reprojecting-satellite-and-buoy-data>



PolarWatch helps with workflow integration

Customized access:

Subset, reformat, file type

Routine data access with the workflow:

R, Python, Matlab

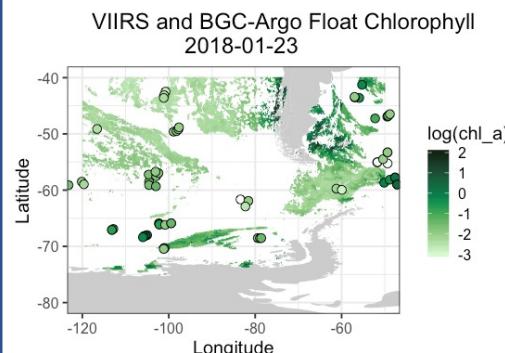
Convert projections

Matchup field data to satellite data

PolarWatch code gallery

Code example scripts in R and Python

Matchup Satellite and Argo Float Data - R Script



In this exercise you will extract in-situ data from an ERDDAP tabular dataset and then extract satellite data that is coincident with the in-situ data.

The exercise demonstrates the following techniques:

- Use the `tabledap` function to extract tabular data from ERDDAP
- Using `rxtracto` to extract satellite data coincident with the in-situ data
- Using `rxtracto_3D` to extract a satellite data grid for a rectangular area
- Using `rerddap` to retrieve information about a dataset from ERDDAP
- Producing xy scatter plots
- Producing satellite data maps and overlaying in-situ data

Extract in-situ data from ERDDAP

Extract data using the `tabledap` function

- The in-situ data will be SOCCOM Biogeochemical Argo Float data
- This dataset has an ERDDAP dataset id of "SOCCOM_BGC_Argo"
- Request all float data between in Jan 22 - Feb 27, 2018
- In the region bounded by -80 to -40 latitude and all longitudes
- request the station, latitude, longitude, time, and chlorophyll parameters

```
argodata <- tabledap('SOCCOM_BGC_Argo', fields=c('WMO_ID', 'latitude', 'longitude',  
'time', 'depth', 'chl_a_corr'), 'time>=2018-01-22', 'time<=2018-02-27', 'latitude>=-8  
0', 'latitude<=-40', 'depth<=10', 'depth>=1', url='https://polarwatch.noaa.gov/erdda  
p/')
```

Extract chlorophyll satellite data for matchups to float data

Examine the metadata for the satellite dataset

* Gather metadata using the `rerddap::info` function and the ERDDAP dataset id

```
satdataInfo <- rerddap::info('nesdisVHNSQchlADaily')  
satdataInfo
```

<https://polarwatch.noaa.gov/tools-training/code-gallery/argo-matchup>



Support and Training

PolarWatch

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Dale Robinson, Deputy Manager
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NSIDC User Services

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Additional PolarWatch Training Resources

[Jupyter Notebook R Tutorial](#)

[Reprojecting Gridded and Tabular Data](#)

[Jupyter Notebook R Tutorial](#)

[Mapping Projected Datasets](#)

[View more tutorials in the PolarWatch code gallery.](#)

