

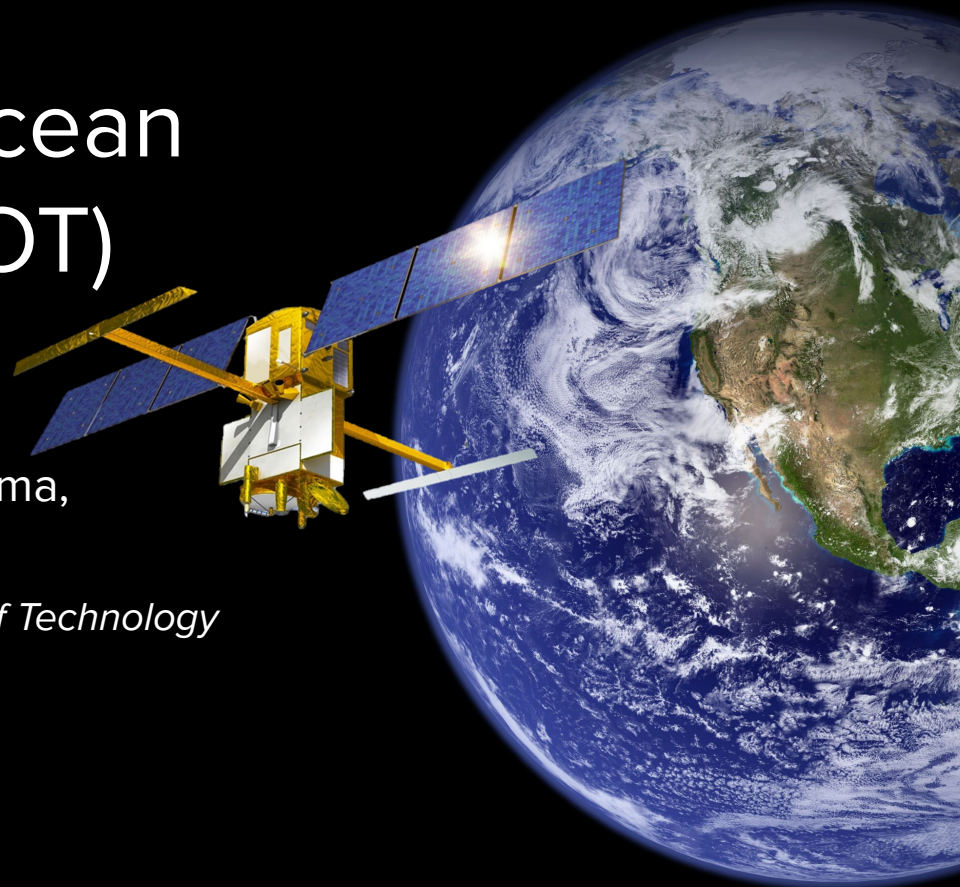


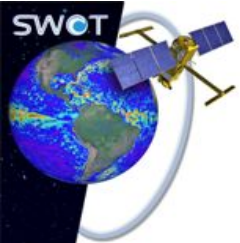
# Surface Water & Ocean Topography (SWOT) Applications

Cassie Nickles, Matthew Bonnema,  
Angelica Rodriguez

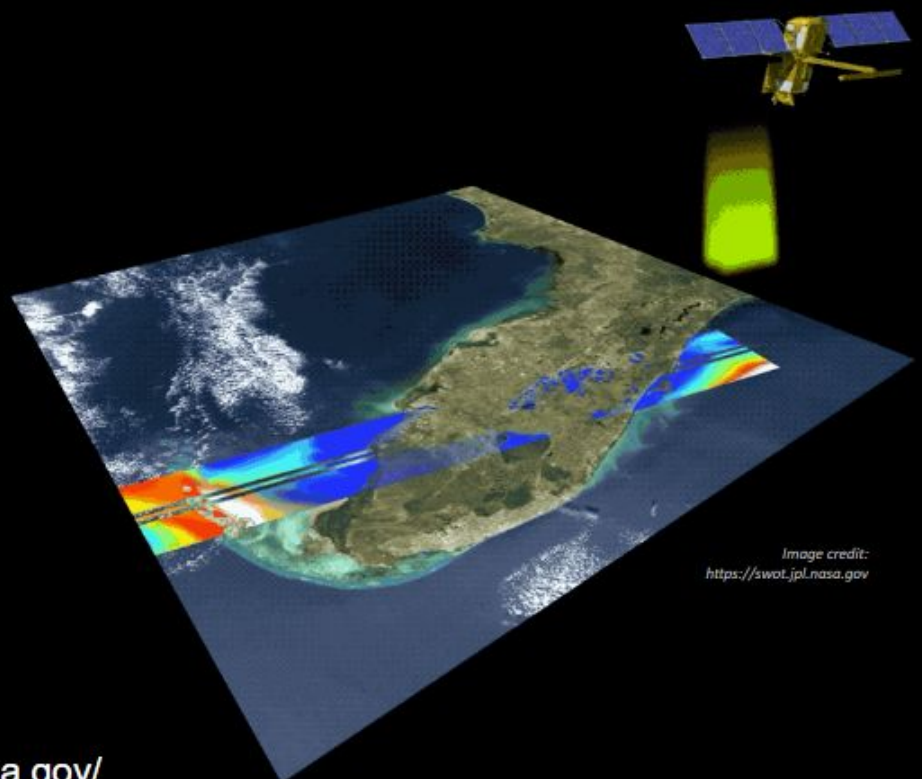
*Jet Propulsion Laboratory, California Institute of Technology*

*2024 Annual Meeting of the  
Western Water Applications Office (WWAO)  
May 1, 2024*





**SWOT**  
measures  
global **ocean**  
surface  
topography  
and **land**  
**surface water**  
extents &  
elevation with  
great accuracy  
using  
interferometry.

A composite image showing the SWOT satellite in orbit above a 3D visualization of Earth's surface. The satellite is a gold-colored spacecraft with two large blue solar panels. Below it, a vertical column of light transitions from yellow at the top to green at the bottom. The main visualization is a 3D map of a coastal region, showing the ocean surface with a color gradient from blue (low elevation) to red (high elevation). A white line indicates the satellite's orbital path and the swath of water it is measuring. The background is black.

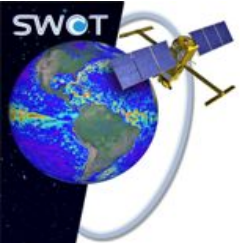
**SWOT**  
**Launched**  
**Dec 2022!**

**21-day orbit**  
**cycle**  
(average 2  
observations  
per cycle)

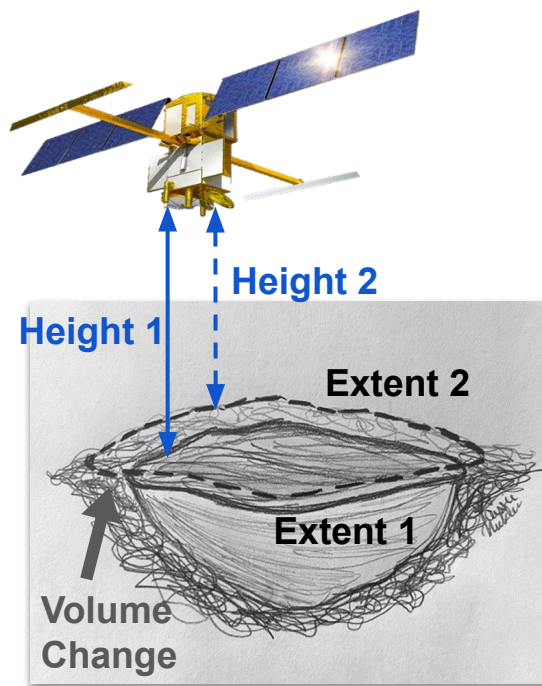
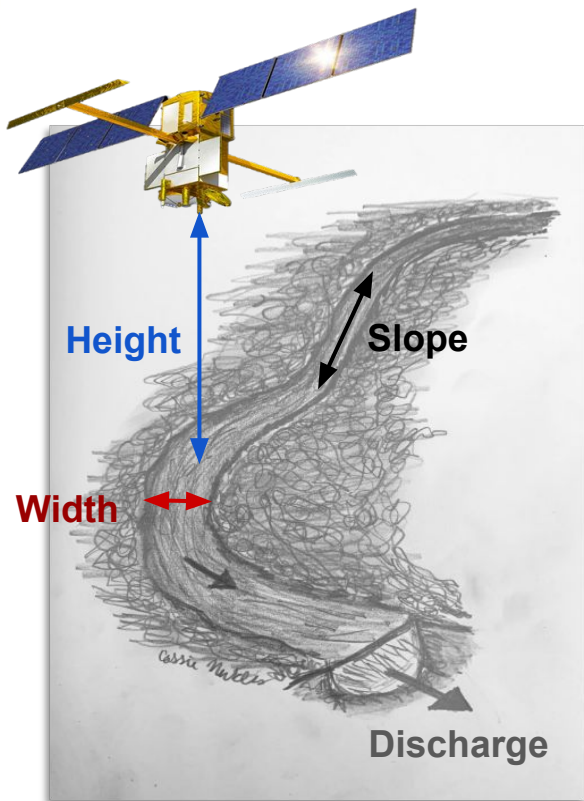
**78 N/S**  
**coverage**

Image credit:  
<https://swot.jpl.nasa.gov>

<https://swot.jpl.nasa.gov/>



# Hydrology Measurements Simplified



*Requirements:*  
*Rivers > 100 m wide*  
*Lakes > 250 m<sup>2</sup>*

## Future Derived Products:

- River flow (i.e. discharge)
- Lake/reservoir volume change

# SWOT River Reaches 21 Day Global Cycle

February 1st - 21st 2024  
Water Surface Elevation (WSE) Meters

Fill Value	WSE Range (Meters)
Lightest Blue	-1500 - 300
Light Blue	301 - 800
Medium Blue	801 - 2300
Dark Blue	2301 - 5000

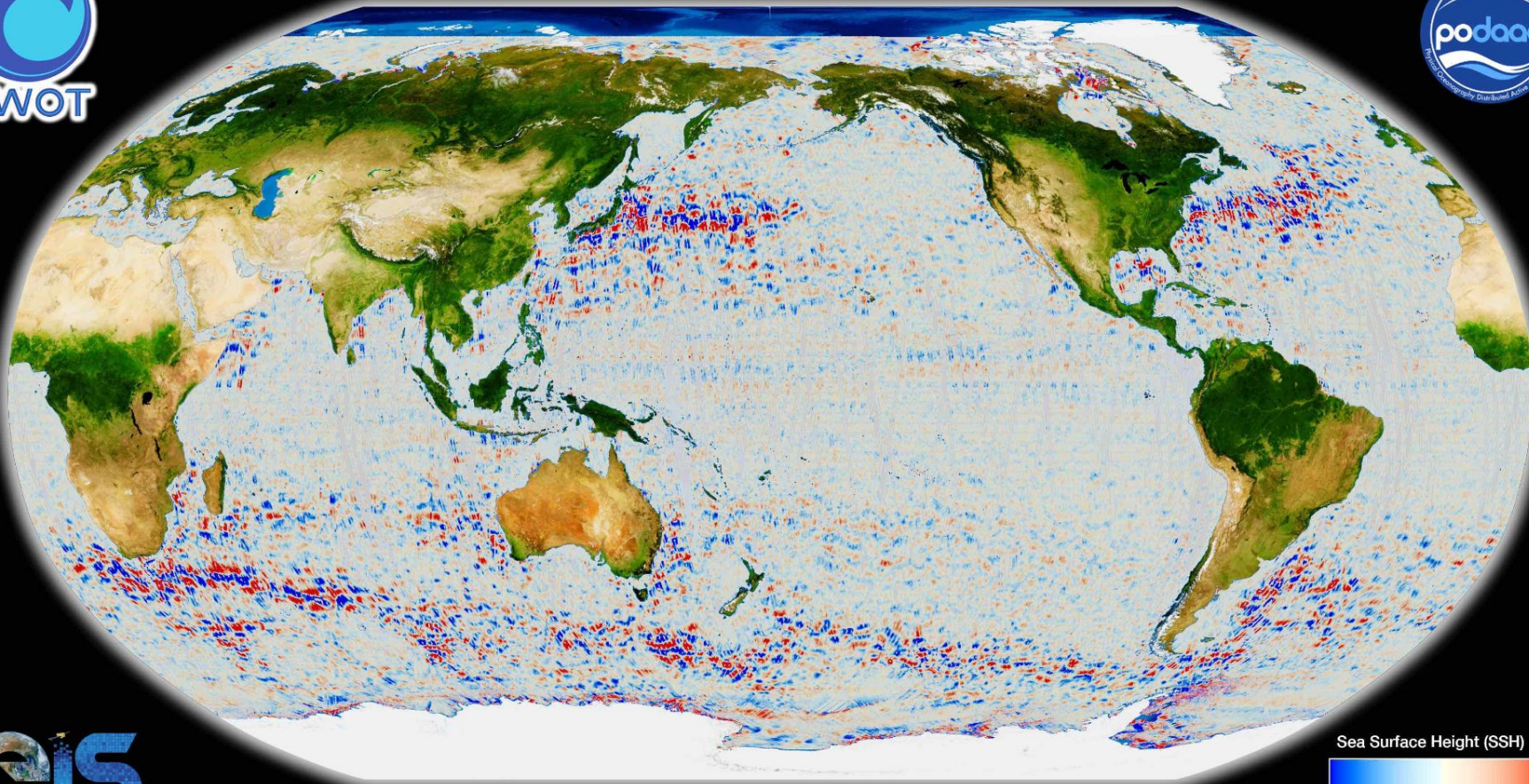
Rivers > 100 m wide



Source: Esri, TomTom, FAO, NOAA, USGS

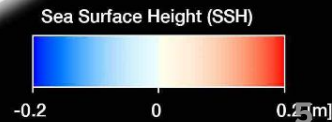


# Oceanography - Sea Surface Height





Resolutions below 10 km!

Data start: 2023-07-26T14:12:39  
end: 2023-08-16T14:17:18

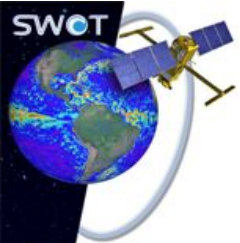




# SWOT Applications Areas

 An icon showing three houses of varying sizes partially submerged in blue waves, representing flooding.	<b>Floods</b>	 An icon showing a large cargo ship passing under a bridge over blue waves, representing river commerce.	<b>River Commerce</b>
 An icon showing a dam with water behind it and a power transmission tower, representing reservoirs.	<b>Reservoirs</b>	 An icon showing a person walking on a path with a tree and a sun, representing climate.	<b>Climate</b>
 An icon showing a tractor in a field with sparse trees, representing drought.	<b>Drought</b>	 An icon showing an offshore oil rig and a small boat on blue waves, representing marine operations.	<b>Marine Operations</b>
 An icon showing a water tap with a drop of water falling into a bottle, representing transboundary rivers.	<b>Transboundary Rivers</b>	 An icon showing a bird on a nest with reeds and waves, representing coastal zone management.	<b>Costal Zone Management</b>
 An icon showing a lighthouse on an island with waves, representing insurance.	<b>Insurance</b>	 An icon showing two fish swimming in blue waves, representing fisheries.	<b>Fisheries</b>

<https://swot.jpl.nasa.gov/applications/applications-areas/>



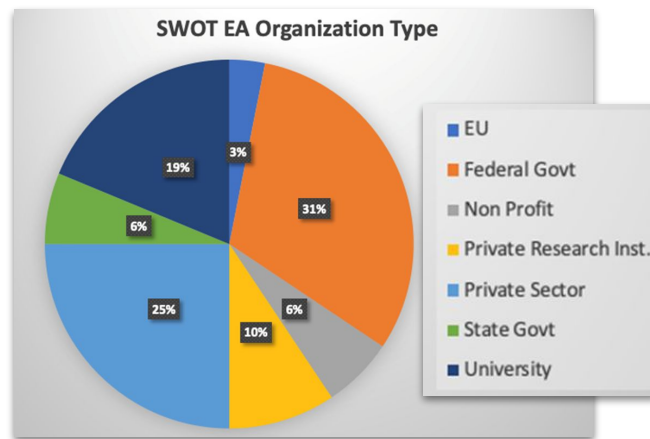
# SWOT Early Adopters Program

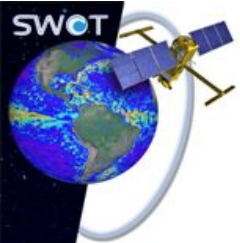
- SWOT Applications Program since 2012
- 40 SWOT Early Adopters
- U.S. and International leadership – NASA/CNES

<https://swot.jpl.nasa.gov/applications>



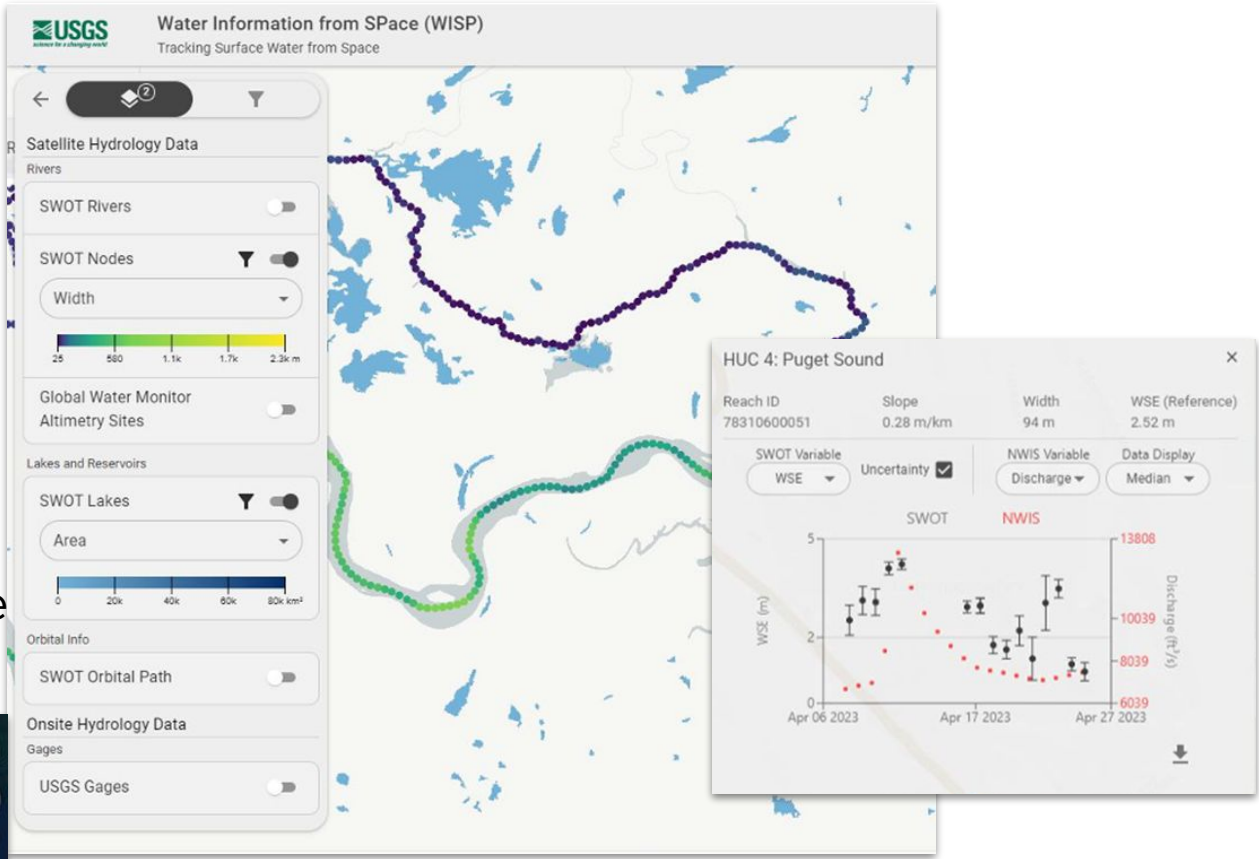
**Figure 2.** Forty SWOT Early Adopter teams span the globe with a wide range of operational and applied science project topics. Visit [swot.jpl.nasa.gov/applications/early-adopters/](https://swot.jpl.nasa.gov/applications/early-adopters/) for information about all SWOT EA projects.



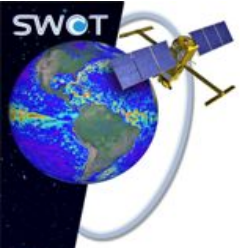


# Water Information from SPace (WISP) Dashboard

- SWOT River data timeseries alongside USGS gauge data
- Uses Hydrocron tool developed by PO.DAAC
- Not yet publicly available, but in the works!



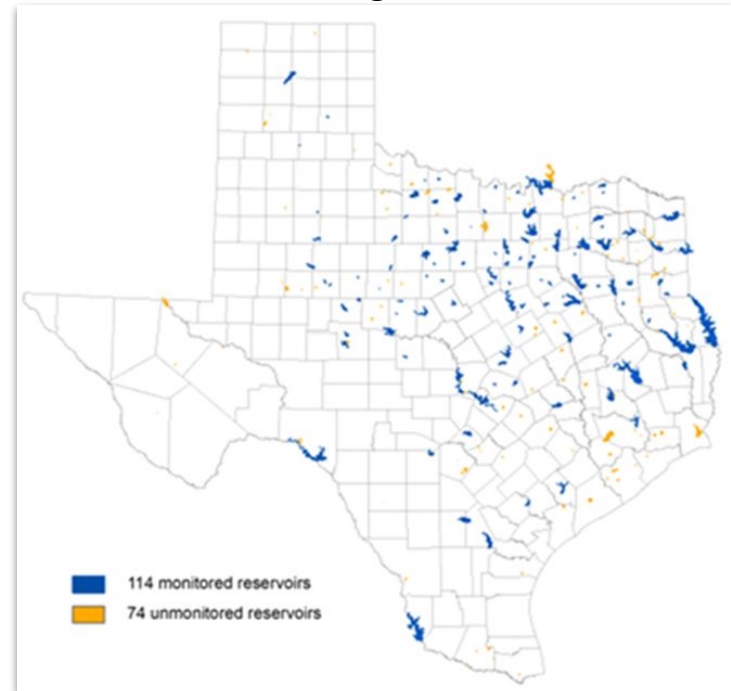


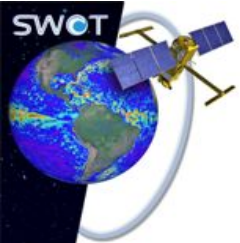


# Texas Water Development Board (TWDB), Austin, TX

Major Texas reservoirs (capacity is greater than 5,000 acre-feet); ~200.

- Estimation of Volumetric Evaporative Water Loss from Unmonitored Reservoirs in Texas
- SWOT provides surface area for reservoirs and TWDB plans to compute “statewide” evaporation losses (evaporation - precipitation)
- Leads: Nelun Fernando & John Zhu



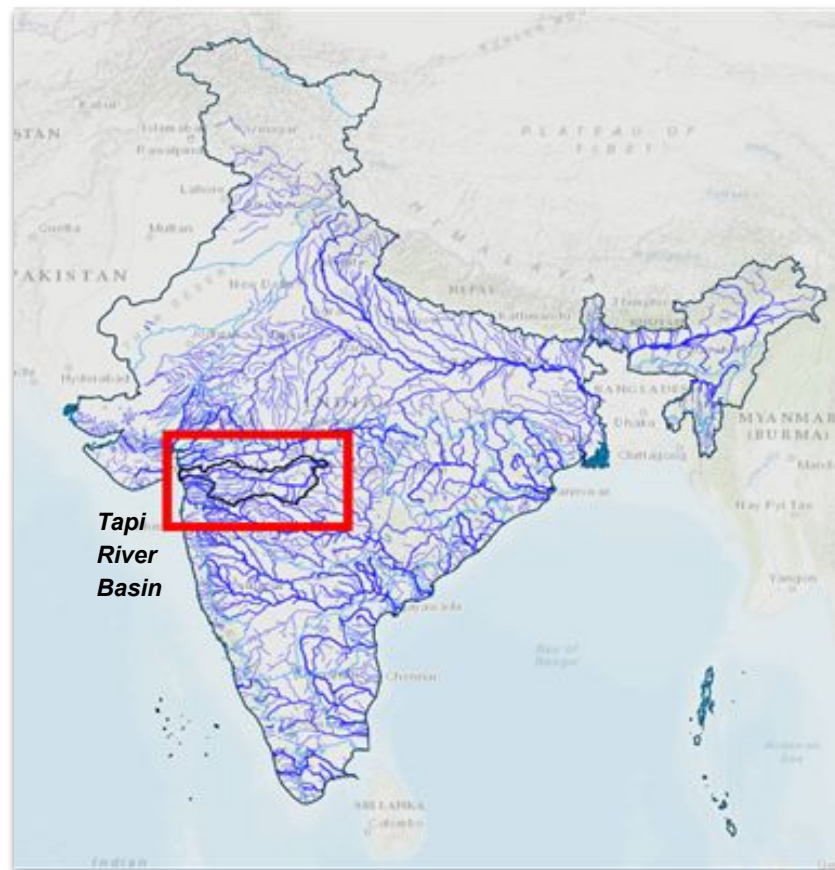


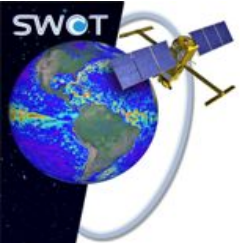
# IIT - Bombay

Work in Progress:

- Lake Data Inventory
- Floods on Indian Rivers through Discharge Estimation
- Extending historical gauge network over Indian river reaches
- Hydrologic model calibration over the Indian Basin
- Sentinel-1 based Inland water dynamics Mapping System (SIMS) Toolkit

Leads: Indu Jaya & Manu Soman

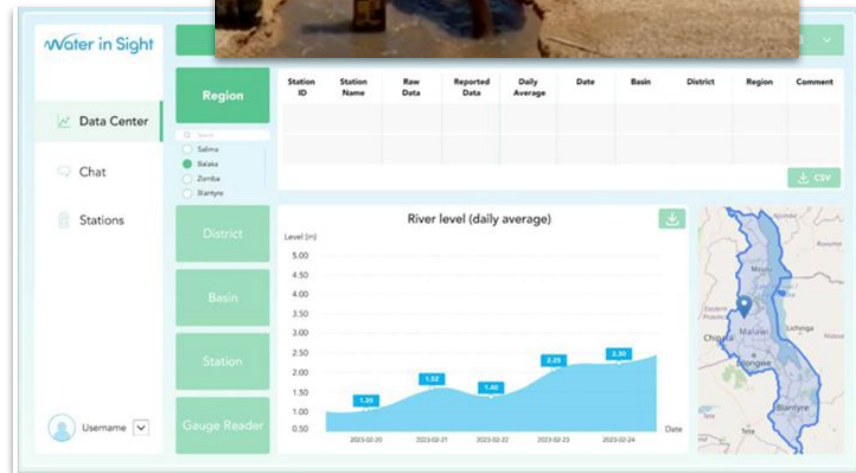


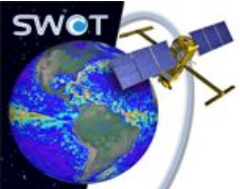


# Water in Sight

## Swedish startup

- Developed SMS & WhatsApp for hydro gauge readers in Least Developed Countries (LDC)
- SWOT EA project area – Africa (Malawi, Mozambique, Sierra Leone)
- Smartphone observations of river & rainfall levels sent to database for govt operational agencies, compare to SWOT
- Flood thresholds & equipment inventory



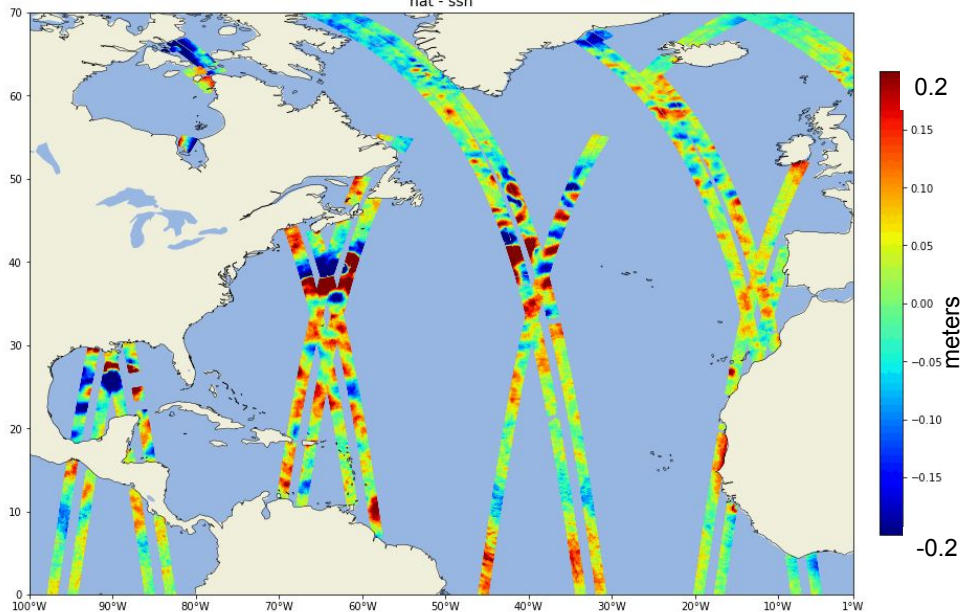


# SWOT Ocean Early Adopters

Satellite and GDR: all all

nat - ssh

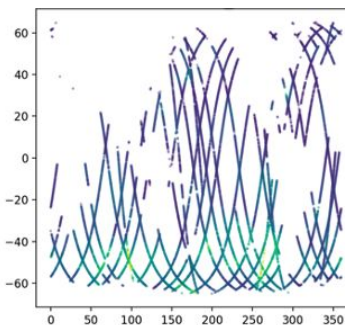
Target Date: 2023-09-10  
Creation Time: 2023-11-12 21:16:59



- SWOT Ocean swath data and nadir data already integrated!

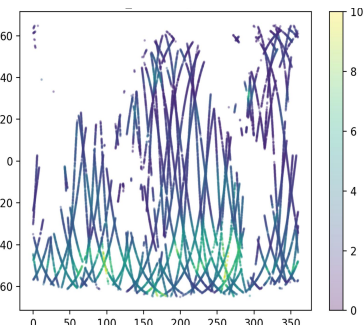
24 hrs Altimeter Data

11,962 obs



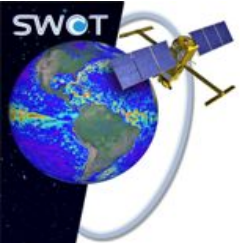
24 hrs Altimeter Data with SWOT

19,303 obs



- Ocean weather forecasts to reduce fuel and emissions for maritime shipping
- Adding SWOT gives 50-100% more observations






# Data Products Overview



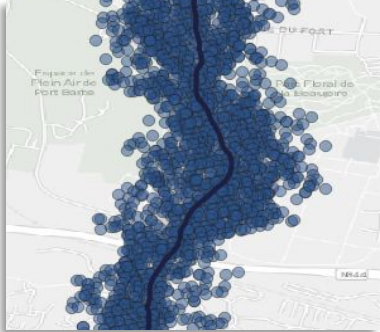
# Hydrology-Relevant Level 2 SWOT Products

- Water Mask Pixel Cloud NetCDF
  - Pixel Cloud Vector Attribute NetCDF
  - Raster NetCDF
  - River Vector Shapefile
  - Lake Vector Shapefile
  - Cycle Average River Vector Shapefile
  - Cycle Average Lake Vector Shapefile
  - Floodplain Digital Elevation Model
- 
- |  |                       |
|--|-----------------------|
|  | <b>L2_HR_PIXC</b>     |
|  | <b>L2_HR_PIXCVec</b>  |
|  | <b>L2_HR_Raster</b>   |
|  | <b>L2_HR_RiverSP</b>  |
|  | <b>L2_HR_LakeSP</b>   |
|  | <b>L2_HR_RiverAvg</b> |
|  | <b>L2_HR_LakeAvg</b>  |
|  | <b>L2_HR_FPDEM*</b>   |

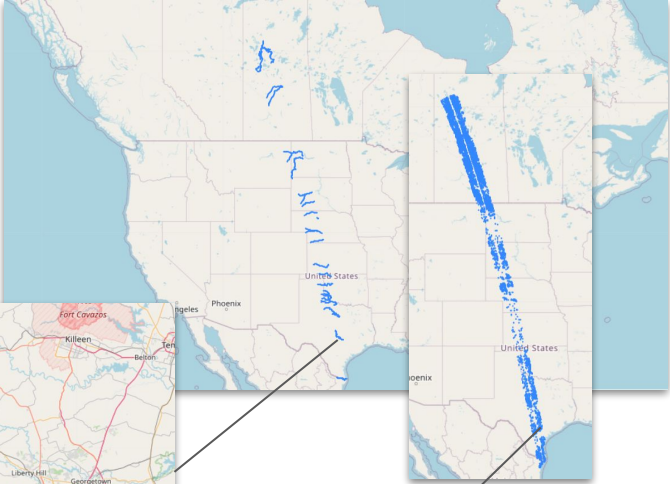
\* available ~2 years after launch

# Hydrology-Relevant Level 2 SWOT Products

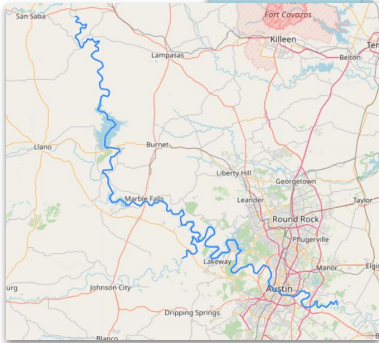
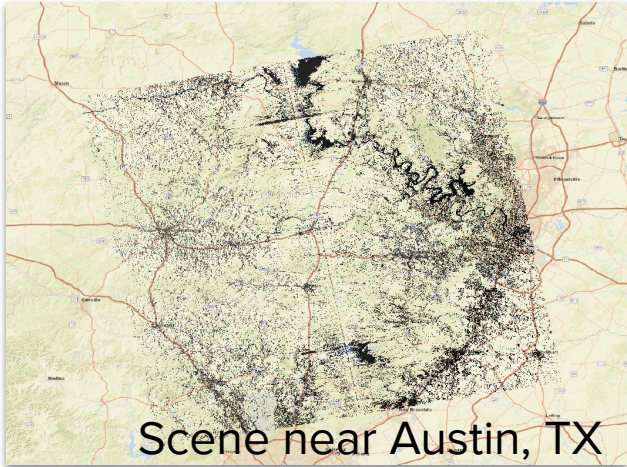
Pixel  
Cloud  
NetCDF



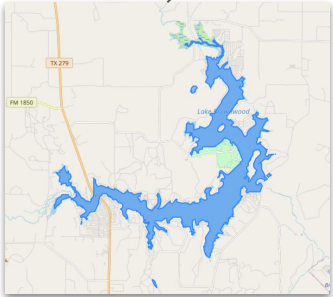
River Vector  
Shapefile



Raster  
NetCDF



Lake Vector  
Shapefile



# Oceanography-Relevant SWOT Products

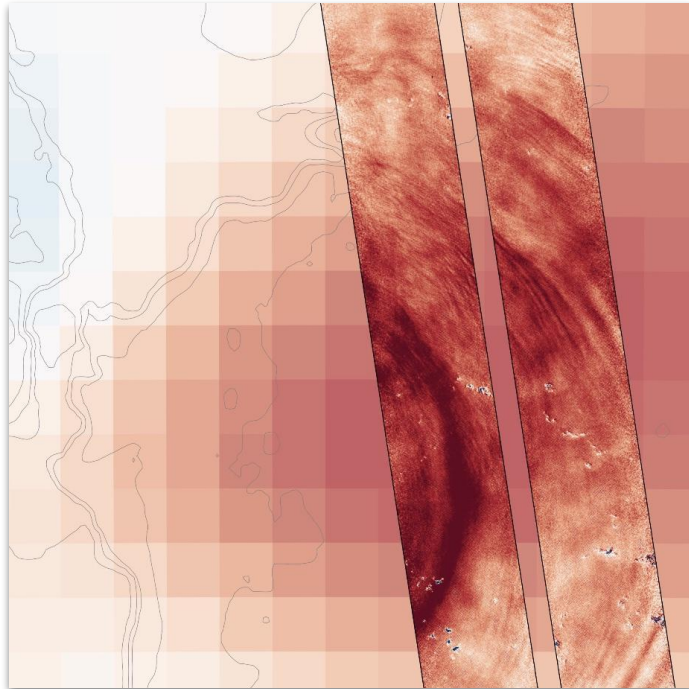
- Operational Radiometer NetCDF
- Interim Radiometer NetCDF
- Radiometer NetCDF
- Operational Nadir Altimetry NetCDF
- Interim Nadir Altimetry NetCDF
- Nadir Altimetry NetCDF
- KaRIn Sea Surface Height NetCDF



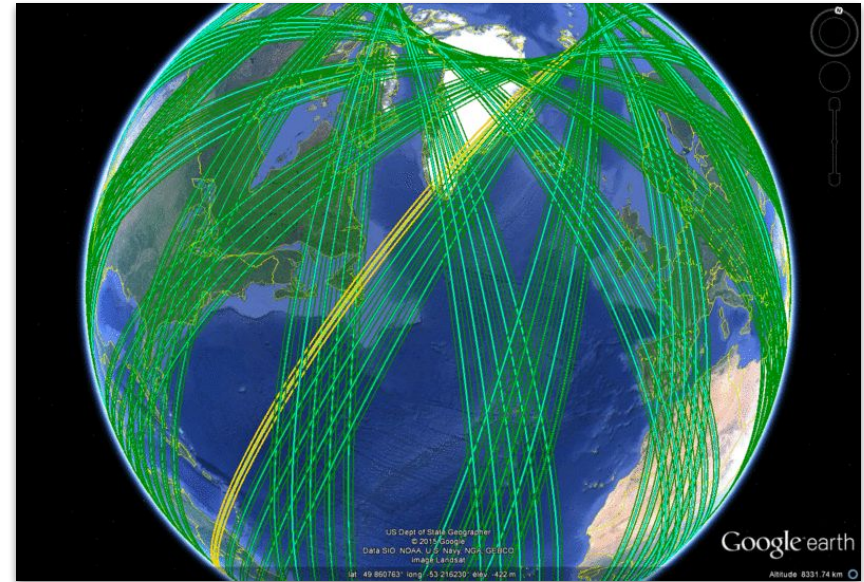
**L2\_RAD\_OGDR**  
**L2\_RAD\_IGDR**  
**L2\_RAD\_GDR**  
**L2\_NALT\_OGDR**  
**L2\_NALT\_IGDR**  
**L2\_NALT\_GDR**  
**L2\_LR\_SSH**



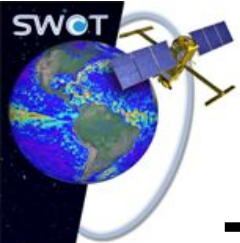
# Oceanography-Relevant SWOT Products



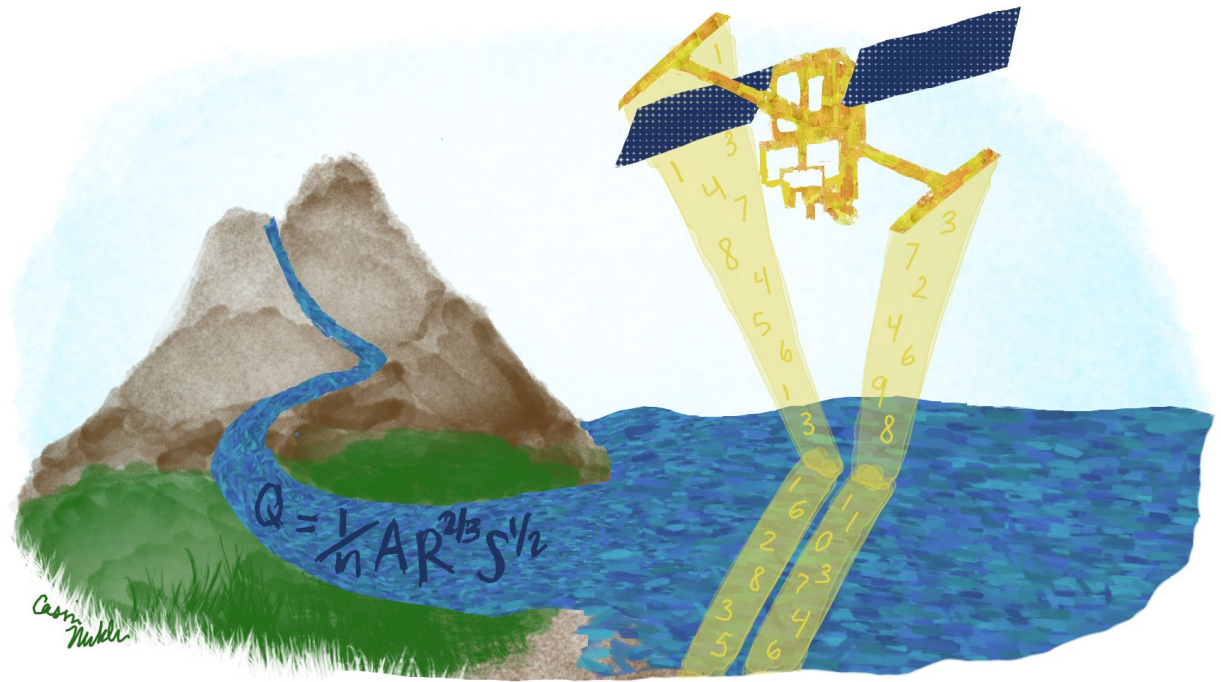
KaRIn Sea Surface Height

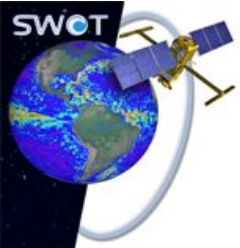


Radiometer & Nadir products

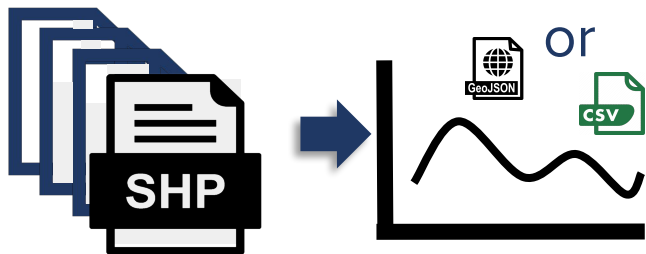


# Tools & Resources





# Hydrocron Timeseries API



podaac/hydrocron

**Input:** Water feature ID (SWOT River reach, node)

Future: lake ID, or geospatial bounding box

**Output:** timeseries in CSV or GeoJSON

**Example Applications:** populate time series in a web dashboard for a river reach, ingest time series into models, faster analysis in programmatic workflows

GETTING STARTED

- Overview
- Examples

API ENDPOINTS

- timeseries

IMPORTANT USAGE NOTES

- Handling Time

RESOURCES

- GitHub Repository
- SWOT Mission Page
- SWOT River Database (SWORD) Explorer
- PO.DAAC Website
- PO.DAAC Cookbook

## Hydrocron Documentation

Hydrocron is an API that repackages hydrology datasets from the Surface Water and Ocean Topography (SWOT) satellite into formats that make time-series analysis easier.

SWOT data is archived as individually timestamped shapefiles, which would otherwise require users to perform potentially thousands of file IO operations per river feature to view the data as a timeseries. Hydrocron makes this possible with a single API call.

Original SWOT data is archived at NASA's [Physical Oceanography Distributed Active Archive Center \(PO.DAAC\)](#).

Datasets included in Hydrocron:

- [SWOT Level 2 River Single-Pass Vector Data Product, Version 1.1](#)

By Physical Oceanography Distributed Active Archive Center (PO.DAAC)  
© Copyright 2022



# GitHub Collaboration Space



## SWOT Community

This is a code space for the global SWOT mission community. We share experience, code, research and much more. Our mission is to increase the value of SWOT.

### SWOT-OpenToolkit Public

Community codes for processing SWOT data. This is a community code repo, does not include the algorithms that belong to the project.



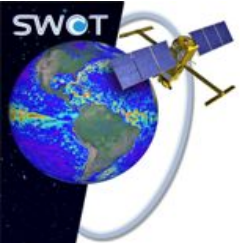
● Python ☆ 29 📄 Apache-2.0 🧑‍🤝‍🧑 7 🕒 0 📁 1 Updated 2 weeks ago

### CNES-AVISO Public



● Jupyter Notebook ☆ 7 📄 BSD-3-Clause 🧑‍🤝‍🧑 1 🕒 0 📁 0 Updated 3 weeks ago

<https://github.com/SWOT-community>



# Resources, Tips, & Tutorials!

## PO.DAAC Cookbook: SWOT Chapter

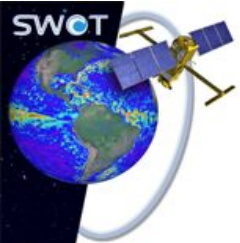


The screenshot shows a web browser window with the URL `podaac.github.io/tutorials/quarto_text/SWOT.html`. The page content includes:

- A navigation sidebar on the left with a search icon and a list of menu items: SWOT, Search, via GUI, Programmatically via Command Line, Spatial Coverage, Tips for SWOT HR, Spatial Search, Access & Visualization, SWOT Hydrology, SWOT Oceanography, GIS Workflows, StoryMap, Shapefile Exploration, Transform Data, Hydrology Time Series, and NetCDF to Geotiff.
- The main content area has a heading **SWOT** followed by the text "SWOT Data Tutorials".
- Below that is a heading **SWOT Background** followed by a paragraph: "The Surface Water and Ocean Topography (SWOT) mission aims to provide valuable data and information about the world's oceans and its terrestrial surface water such as lakes, rivers, and wetlands. SWOT is jointly developed by NASA and Centre National D'Etudes Spatiales (CNES), with contributions from the Canadian Space Agency (CSA) and United Kingdom Space Agency (UKSA). The satellite launched on December 16, 2022. PO.DAAC is the NASA archive for the SWOT mission, and has made data available via the NASA Earthdata Cloud (hosted in AWS) with direct download capabilities available. PO.DAAC hosts a variety of [SWOT data products](#), whose product description documents can be found in the chart listing each dataset. More information can be found on [PO.DAAC's SWOT webpage](#)."
- At the bottom of the main content area is a heading **SWOT Data Resources & Tutorials**.

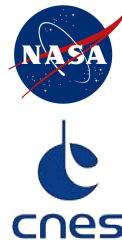
[https://podaac.github.io/tutorials/quarto\\_text/SWOT.html](https://podaac.github.io/tutorials/quarto_text/SWOT.html)





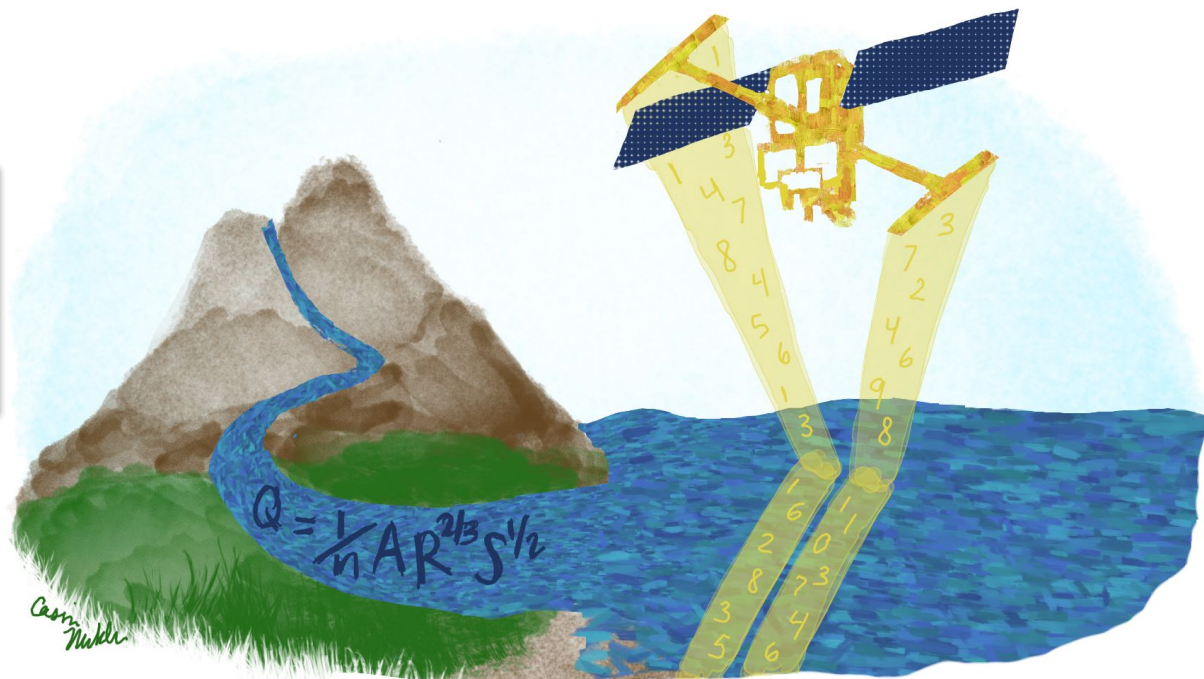
# Thank you! Questions?

<https://swot.jpl.nasa.gov/applications>  
<https://swot.cnes.fr/en/search/site/SWOT>



## Contact:

[cassandra.l.nickles@jpl.nasa.gov](mailto:cassandra.l.nickles@jpl.nasa.gov)  
[matthew.g.bonnema@jpl.nasa.gov](mailto:matthew.g.bonnema@jpl.nasa.gov)  
[angelica.rodriguez@jpl.nasa.gov](mailto:angelica.rodriguez@jpl.nasa.gov)





# Extra Slides

# Tools for accessing SWOT data - Cheatsheet



Ocean



Hydro



Coast



## Learn/Information

- PO.DAAC Dataset Mission Page and Landing Pages <https://podaac.jpl.nasa.gov/SWOT?sections=data>
- PO.DAAC Cookbook - SWOT Chapter [https://podaac.github.io/tutorials/quarto\\_text/SWOT.html](https://podaac.github.io/tutorials/quarto_text/SWOT.html)



## Find Data - Map GUI interface

- Search & Access in *Earthdata Search*  
<https://search.earthdata.nasa.gov/search?q=SWOT%20HR&long=-0.0703125>



## Access - Command line/automated scripts

- Subscriber/Downloader [https://podaac.github.io/tutorials/quarto\\_text/SWOT.html](https://podaac.github.io/tutorials/quarto_text/SWOT.html)



## Access & Subset - GUI

- HiTIDE <https://hitide.podaac.earthdatacloud.nasa.gov/>



## Access - Cloud native, Big data, ML

- in-cloud access available: [example for LR ocean](#), [example for HR hydro](#)



## Access & Explore - In development or planning phase:

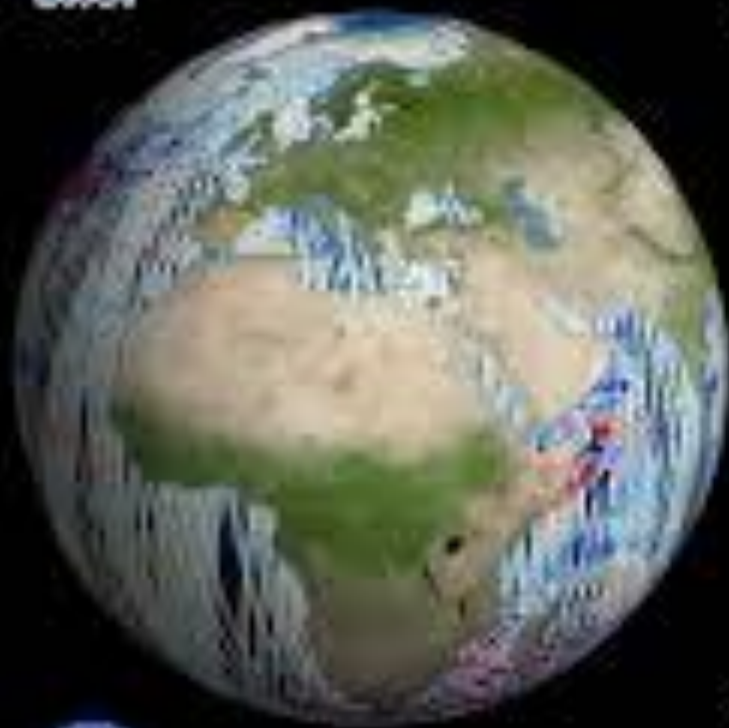
- [Hydrocron](#) Timeseries API
- [SWODLR](#) On-demand Raster - *in development (Beta, Spring 2024)*
- GIS-friendly, e.g. web services (e.g. WFS) - *in development (Beta, mid-2024)*
- QGIS and ArcGIS - local: download and open - *works now*
- Exploratory Analysis in [SOTO by Worldview](#) - *early 2025*







Sea surface height anomaly (SSHA) from SWOT Ka-band Radar Interferometer (KaRIn) over one full 21-day cycle  
Same field, difference perspectives



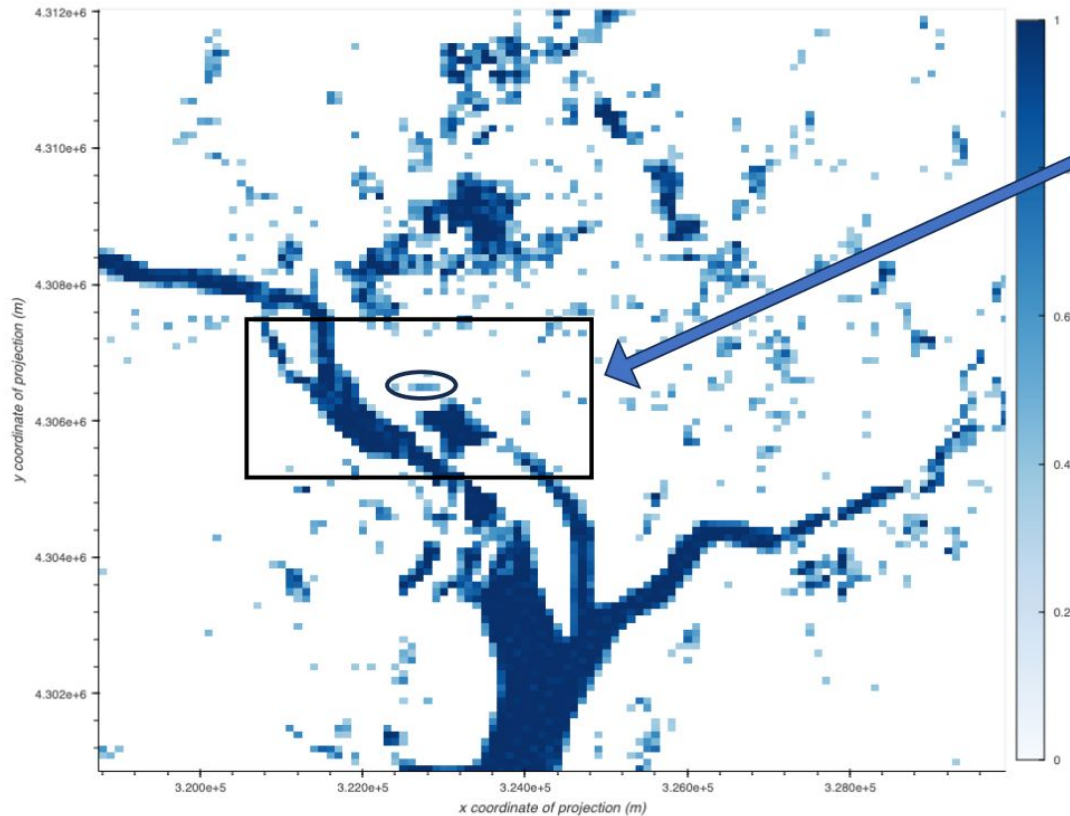
2023-08-24 10:43

Pass: 374

Sea Surface Height Anomaly (SSHA)



# DC Reflective Pool

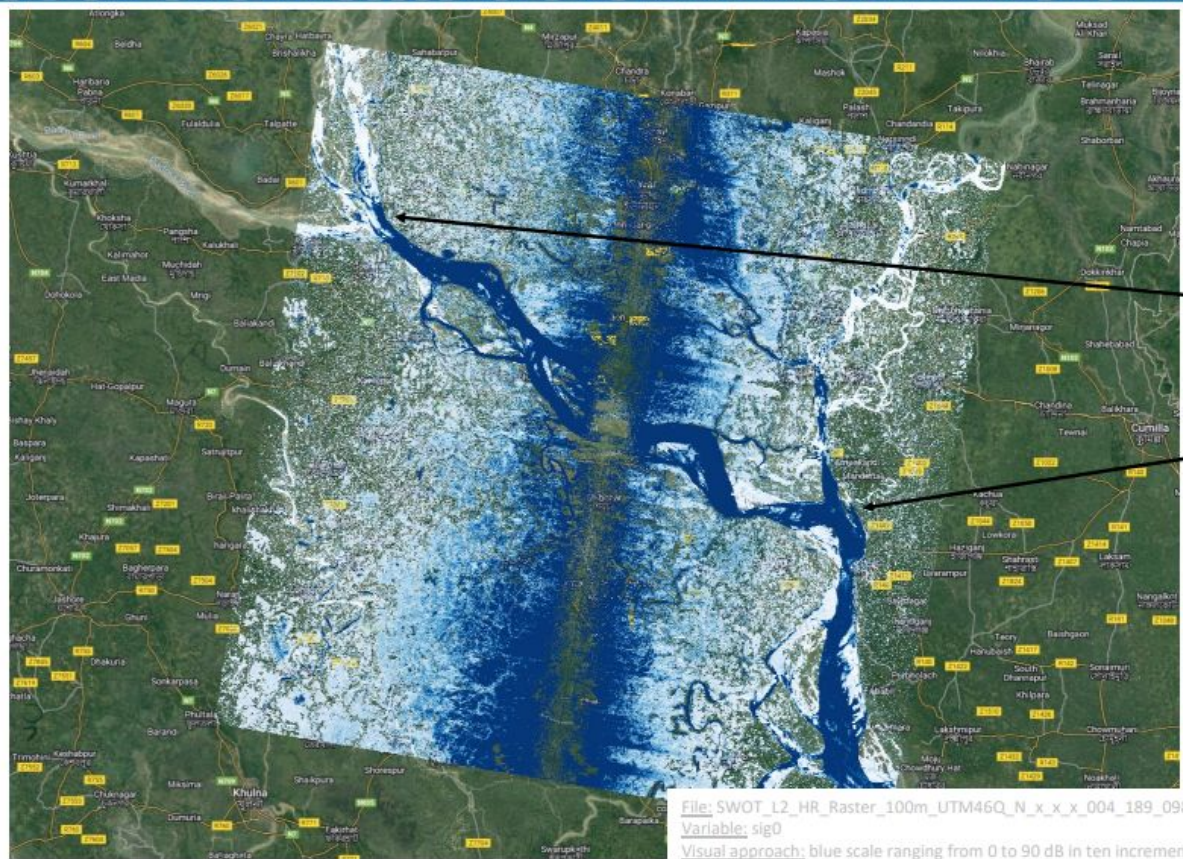


Cycle: 007  
Pass: 091  
Scene: 112F  
Date: 26 Nov 2023

*Approach:* Blue scale  
ranging of "water fraction"  
from 0 to 1

# Confluences of Ganges, Brahmaputra, and Meghna rivers in Bangladesh

SWOT\_L2\_HR\_Raster\_100m\_UTM46Q\_N\_x\_x\_x\_004\_189\_098F\_20230928T133329\_20230928T133350\_PIB0\_01—sig0



*These are South Asia's biggest rivers and together flow to the Bay of Bengal. Flooding is guaranteed every year with the monsoon season*

Ganges River meets Brahmaputra River

Padma River (Ganges+Brahmaputra) meets Meghna River

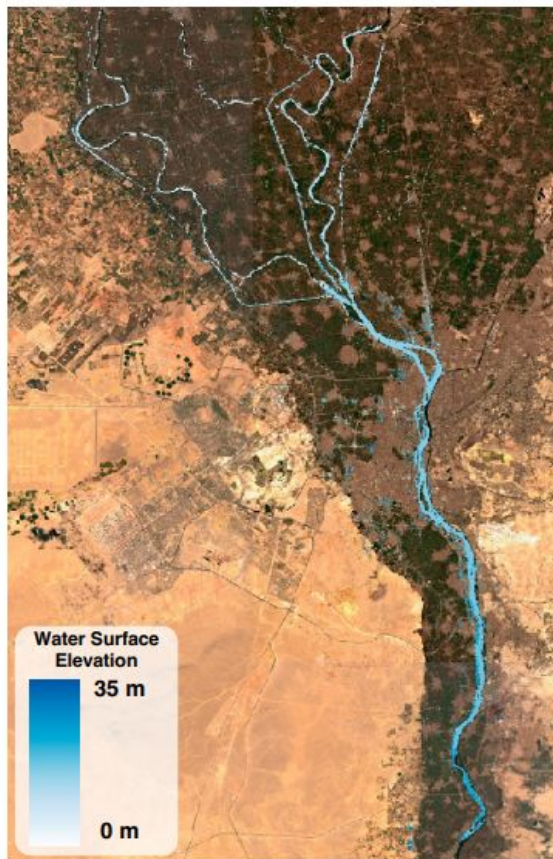
File: SWOT\_L2\_HR\_Raster\_100m\_UTM46Q\_N\_x\_x\_x\_004\_189\_098F\_20230928T133329\_20230928T133350\_PIB0\_01.nc  
Variable: sig0  
Visual approach: blue scale ranging from 0 to 90 dB in ten increments of 10 dB.

# SWOT Captures the Nile River Flowing Through Cairo, Egypt



0 5 10 kilometers

Sentinel-2 imagery produced from ESA remote sensing data (European Space Agency - ESA).



0 5 10 kilometers



0 2.5 5 kilometers

## File Information:

Cycle: 001

Pass: 318

Scene: 051F

Date: 08-01-2023

Time: T133912 - T133933

## Processing Approach:

Show Water Surface Elevation where:

[Dark\_frac > 0 OR Sigma0 > 100]

AND

[Cross\_track > 23,000]



## Forward stream and reprocessed SWOT KaRIn Science Data Products Release:

Encourage users to review the **Release Note** closely to familiarize themselves with the details of the release.

### Section 6: Known Features and Issues - Helpful!

This release includes:

1. **Reprocessed global low rate (LR)** ocean products spanning **Nov 23, 2023 – Jan 25, 2024** and **forward processing** from the science phase (21-day orbit).
2. **Forward processing reprocessed global high rate (HR)** hydrology products from **Jan 25, 2024 onward** from the science phase (21-day orbit).
3. Reprocessing of science data products from March 30, 2023 to January 25, 2024 is ongoing and will be released as they become available.

*Tip: these are data product shortnames!*

### The LR products include:

1. Level 1B KaRIn Low Rate Interferogram Data Product (**SWOT\_L1B\_LR\_INTF\_2.0** (DOI: [10.5067/SWOT-INTF-2.0](https://doi.org/10.5067/SWOT-INTF-2.0)))
2. Level 2 KaRIn Low Rate Sea Surface Height Data Product (**SWOT\_L2\_LR\_SSH\_2.0** (DOI: [10.5067/SWOT-SSH-2.0](https://doi.org/10.5067/SWOT-SSH-2.0)))

### The HR products include:

1. Level 1B KaRIn High Rate Single Look Complex Product (**SWOT\_L1B\_HR\_SLC\_2.0** (DOI: [10.5067/SWOT-SLC-2.0](https://doi.org/10.5067/SWOT-SLC-2.0)))
2. Level 2 KaRIn High Rate Water Mask Pixel Cloud Product (**SWOT\_L2\_HR\_PIXC\_2.0** (DOI: [10.5067/SWOT-PIXC-2.0](https://doi.org/10.5067/SWOT-PIXC-2.0)))
3. Level 2 KaRIn High Rate Water Mask Pixel Auxiliary Cloud Product (**SWOT\_L2\_HR\_PIXCVec\_2.0** (DOI: [10.5067/SWOT-PIXCVEC-2.0](https://doi.org/10.5067/SWOT-PIXCVEC-2.0)))
4. Level 2 KaRIn High Rate River Single Pass Vector Product (**SWOT\_L2\_HR\_RiverSP\_2.0** (DOI: [10.5067/SWOT-RIVERSP-2.0](https://doi.org/10.5067/SWOT-RIVERSP-2.0)))
5. Level 2 KaRIn High Rate Lake Single Pass Vector Product (**SWOT\_L2\_HR\_LakeSP\_2.0** (DOI: [10.5067/SWOT-LAKESP-2.0](https://doi.org/10.5067/SWOT-LAKESP-2.0)))
6. Level 2 KaRIn High Rate Raster Product (**SWOT\_L2\_HR\_Raster\_2.0** (DOI: [10.5067/SWOT-RASTER-2.0](https://doi.org/10.5067/SWOT-RASTER-2.0)))
1. Level 2 KaRIn High Rate River Average Vector Product (**SWOT\_L2\_HR\_RiverAvg\_2.0** (DOI: [10.5067/SWOT-RIVERAVG-2.0](https://doi.org/10.5067/SWOT-RIVERAVG-2.0)))
2. Level 2 KaRIn High Rate Lake Average Vector Product (**SWOT\_L2\_HR\_LakeAvg\_2.0** (DOI: [10.5067/SWOT-LAKEAVG-2.0](https://doi.org/10.5067/SWOT-LAKEAVG-2.0)))
3. Level 2 KaRIn High Rate Floodplain DEM Product\* (**SWOT\_L2\_HR\_FPDEM\_2.0**)

\*available after one year of science orbit products released

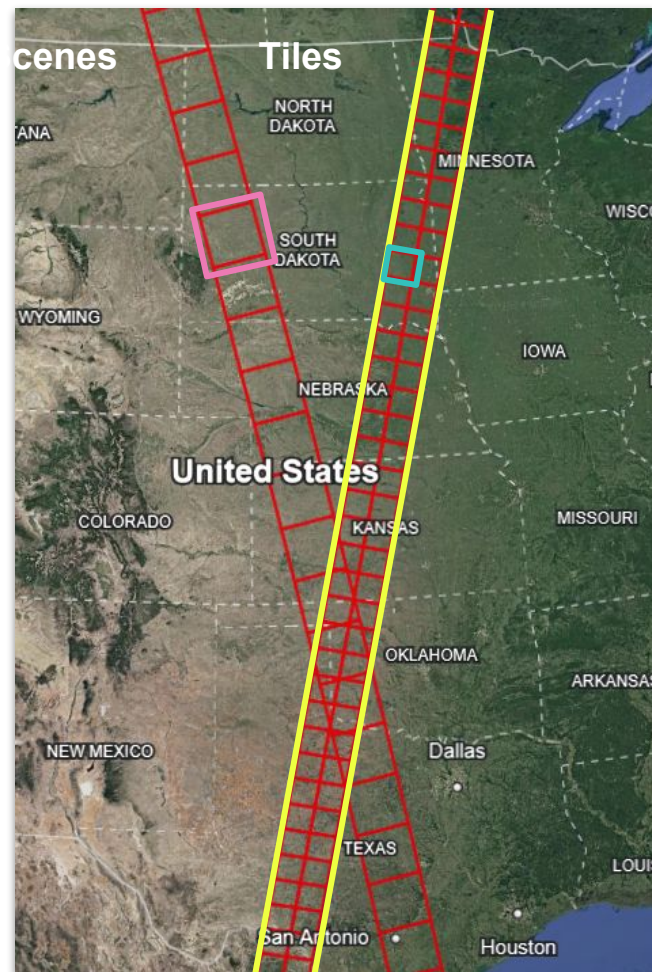
# Spatial Extent Formats

- **Swath** - half-globe orbit track
- **Tile** - 64x64 km<sup>2</sup>; half swath width
- **Scene** - 128x128 km<sup>2</sup>, georeferenced; full swath width

scene number x 2 = tile number

Tip: more here

[https://podaac.github.io/tutorials/quarto\\_text/SWOT.html#tips-for-swot-hr-spatial-search](https://podaac.github.io/tutorials/quarto_text/SWOT.html#tips-for-swot-hr-spatial-search)



# File Naming Conventions!

Product (organized by...)	File Naming Convention	Notes
L2_HR_RiverSP L2_HR_LakeSP (continent- level swaths)	PPP_CC	<p>PPP = pass number (valid range: 001-584) CC = continent code (options listed below)</p> <p>AF - Africa EU - Europe and Middle East SI - Siberia AS - Central and Southeast Asia AU - Australia and Oceania SA - South America NA - North America and Caribbean AR - North American Arctic GR - Greenland</p> <p><i>Ex: 013_NA = pass 013, North America</i></p>

L2_HR_PIXC L2_HR_PIXCVec L1B_HR_SLC (tiles)	PPP_TTTC	<p>PPP = pass number (valid range: 001-584) TTT = tile number (valid range: 001-308) C = character L or R corresponding to left or right swaths</p> <p><i>Ex: 001_120R = pass 001, right swath, tile 120</i></p>
L2_HR_Raster (scenes)	PPP_SSS	<p>PPP = pass number (valid range: 001-584) SSS = scene number (valid range: 001-154)</p> <p>Scenes correspond to 2 x 2 sets of tiles <b>scene number x 2 = tile number</b></p> <p><i>Ex: 001_060 = pass 001, scene 60, corresponding to the same location as the PIXC/PIXCVec tile example above.</i></p>

Find this info in the PO.DAAC Cookbook:

[https://podaac.github.io/tutorials/quarto\\_text/SWOT.html#tips-for-swot-hr-spatial-search](https://podaac.github.io/tutorials/quarto_text/SWOT.html#tips-for-swot-hr-spatial-search)

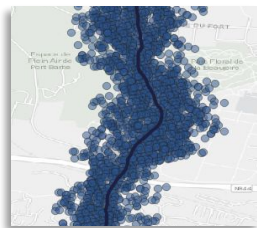
# SWOT\_L2\_HR\_PIXC (netCDF)

**Description:** Point cloud of water mask pixels (“pixel cloud”)

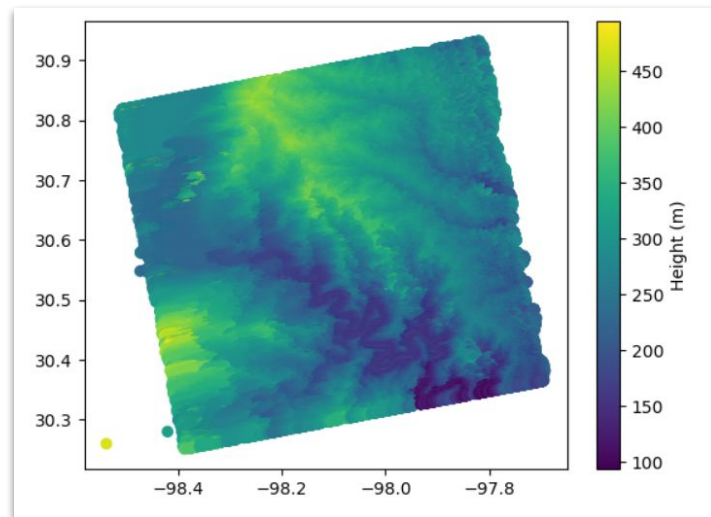
**Spatial Extent Format:** Tile (64x64 km<sup>2</sup>)

**Select Variables:** geolocated heights, backscatter, geophysical fields, and flags

**Subcollections:** N/A



Example river pixels



Colorado River near Austin, TX



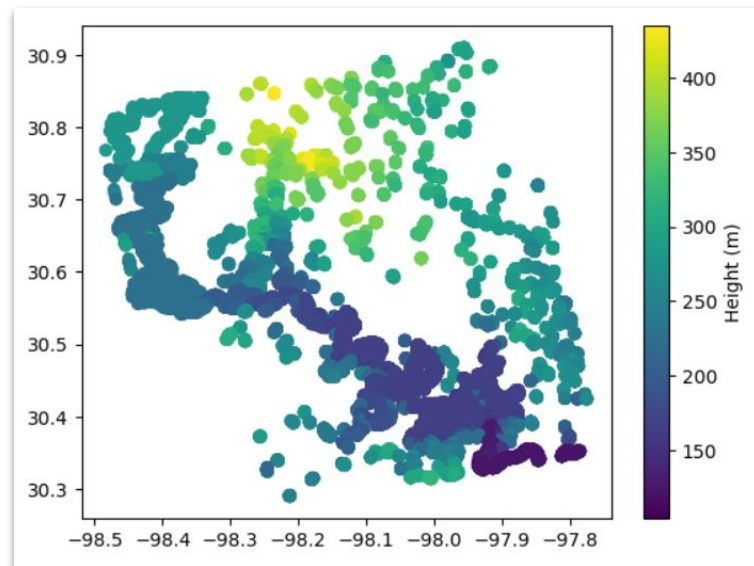
# SWOT\_L2\_HR\_PIXCVec (netCDF)

**Description:** Auxiliary info for pixel cloud product indicating water bodies pixels are assigned

**Spatial Extent Format:** Tile (64x64 km<sup>2</sup>)

**Select Variables:** height-constrained pixel geolocation after reach- or lake-scale averaging.

**Subcollections:** N/A



Colorado River near Austin, TX

# SWOT\_L2\_Raster (netCDF)

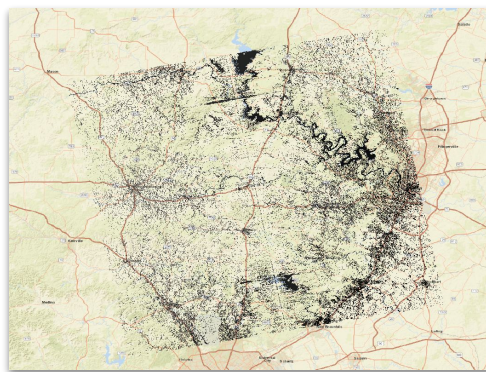
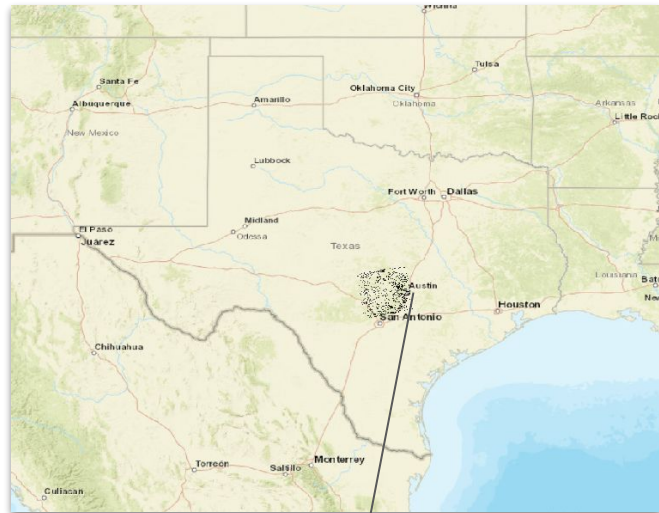
**Description:** Geographically fixed rasterized water surface elevation and inundation extent.

**Spatial Extent Format:** Scene (128x128 km<sup>2</sup>)

**Select Variables:** water surface elevation, area, water fraction, backscatter, geophysical information

## Subcollections:

- SWOT\_L2\_Raster\_100m
- SWOT\_L2\_Raster\_250m



Scene near Austin, TX

# SWOT\_L2\_RiverSP (shapefile)

**Description:** Vectors of river reaches (~10 km long) and nodes (~200 m spacing) in prior river database.

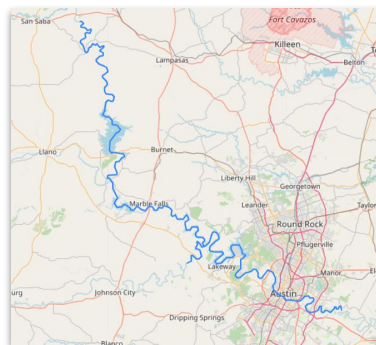
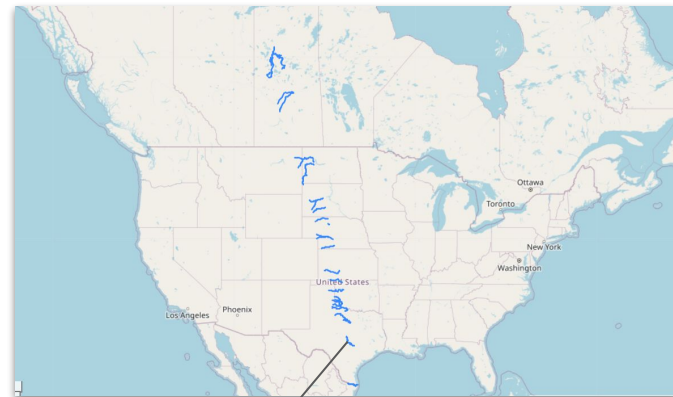
**Extent Format:** continent-scale swath

**Variables:** water surface elevation, slope, width, derived discharge\*

## Subcollections:

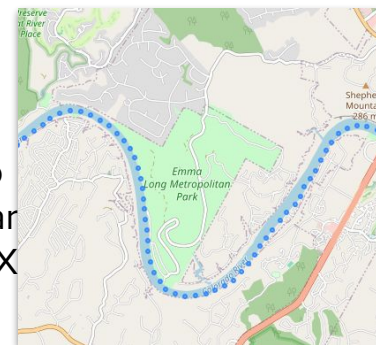
- SWOT\_L2\_RiverSP\_reach
- SWOT\_L2\_RiverSP\_node

\*included ~2 years after launch



Reach file

Colorado River near Austin, TX



Node file

# SWOT\_L2\_LakeSP (shapefile)

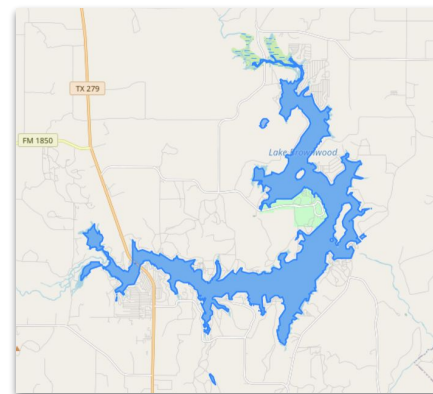
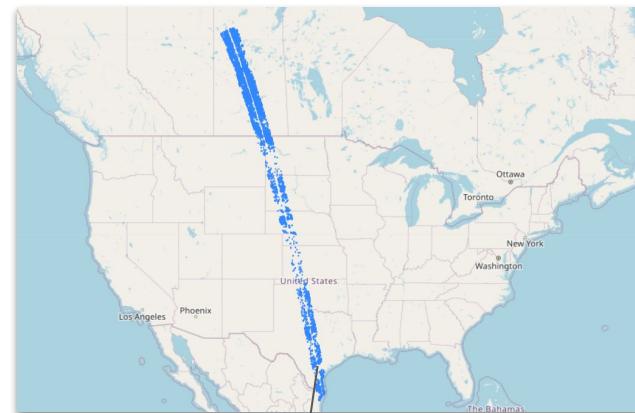
**Description:** Vectors of lakes in prior lake database and detected features not in the prior river or lake databases.

**Extent Format:** continent-scale swath

**Select Variables:** water surface elevation, area, derived storage change

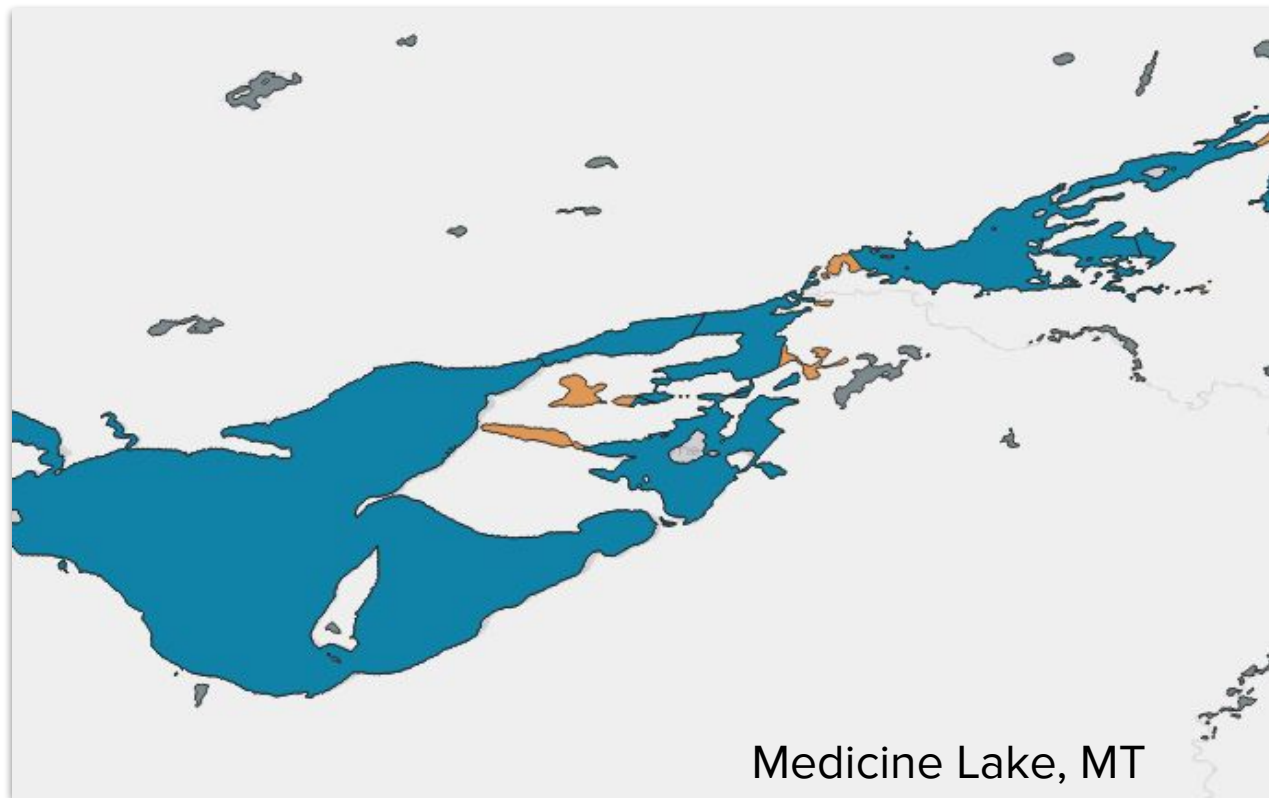
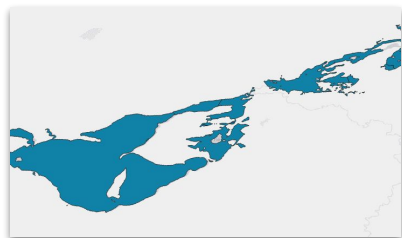
## Subcollections:

- SWOT\_L2\_LakeSP\_obs
- SWOT\_L2\_LakeSP\_prior
- SWOT\_L2\_LakeSP\_unassigned



Lake  
Brownwood,  
TX

# Observed, Prior & Unassigned Lakes



## **L2\_HR\_RiverAvg** (shapefile)

Cycle average and aggregation of river reach pass data within predefined hydrological basins.

## **L2\_HR\_LakeAvg** (shapefile)

Cycle average and aggregation of lake pass data within predefined hydrological basins.

## **L2\_HR\_FPDEM\*** (netCDF)

Flood Plain Digital Elevation Map in raster format, derived from multiple cycles of SWOT acquisitions. (~50m resolution). Provides height and quality flag for each pixel.

\*available ~2 years after launch

# SWOT\_L2\_RAD\_(O/I)GDR (netCDF)

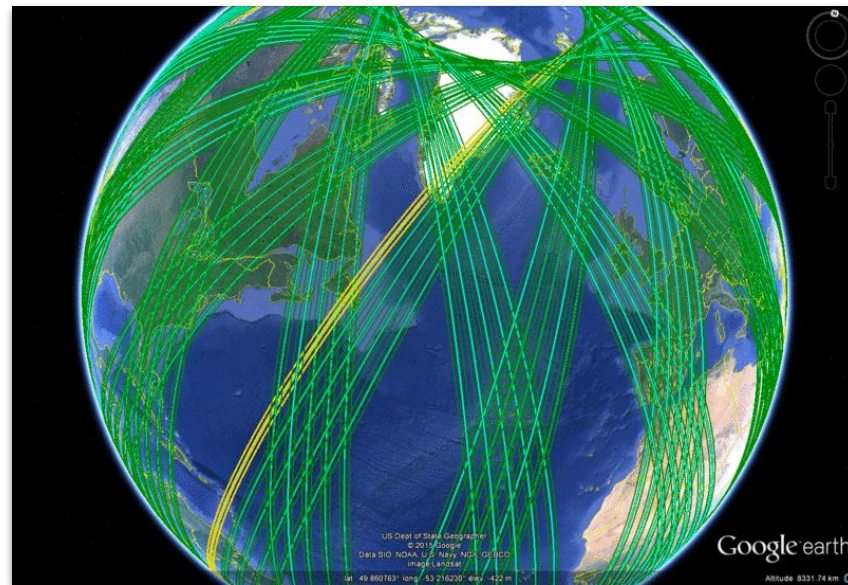
**Description:** Radiometer brightness temperature and troposphere correction data product - (operational/interim) geophysical data record

**Spatial Extent Format:** nadir track -

Left and right sides

**Select Variables:** radiometer wet troposphere correction

**Subcollections:** N/A



# SWOT\_L2\_NALT\_OGDR (netCDF)

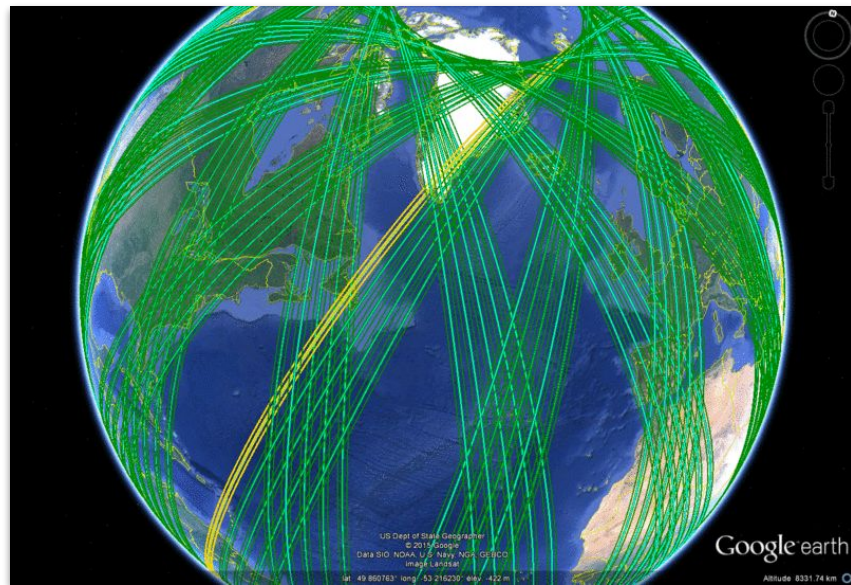
**Description:** Nadir altimetry operational geophysical data record

**Spatial Extent Format:** nadir track

**Select Variables:** sea surface height anomaly, significant wave height

**Subcollections:**

- SWOT\_L2\_NALT\_OGDR\_SSHA
- SWOT\_L2\_NALT\_OGDR\_GDR





# SWOT\_L2\_NALT\_IGDR (netCDF)

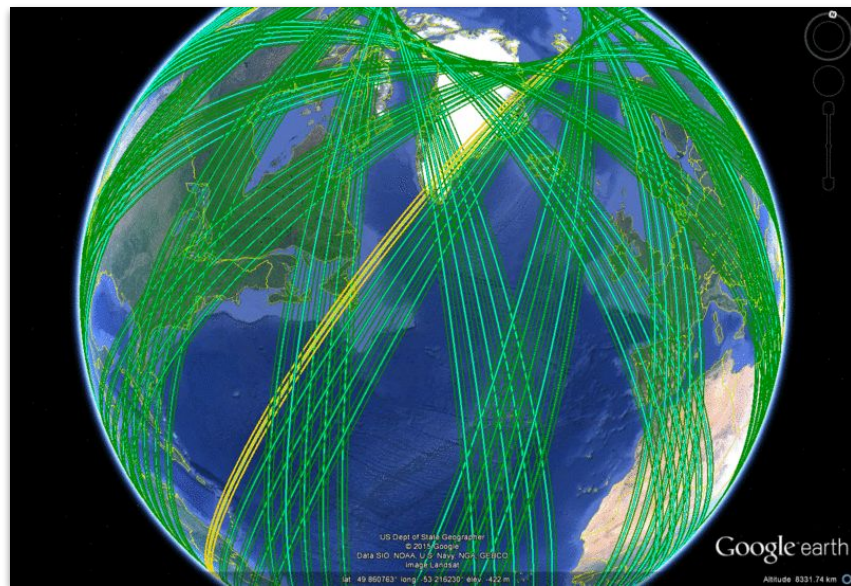
**Description:** Nadir altimetry interim geophysical data record

**Spatial Extent Format:** nadir track

**Select Variables:** sea surface height anomaly, significant wave height

**Subcollections:**

- SWOT\_L2\_NALT\_IGDR\_SSHA
- SWOT\_L2\_NALT\_IGDR\_GDR
- SWOT\_L2\_NALT\_IGDR\_SGDR



# SWOT\_L2\_NALT\_GDR (netCDF)

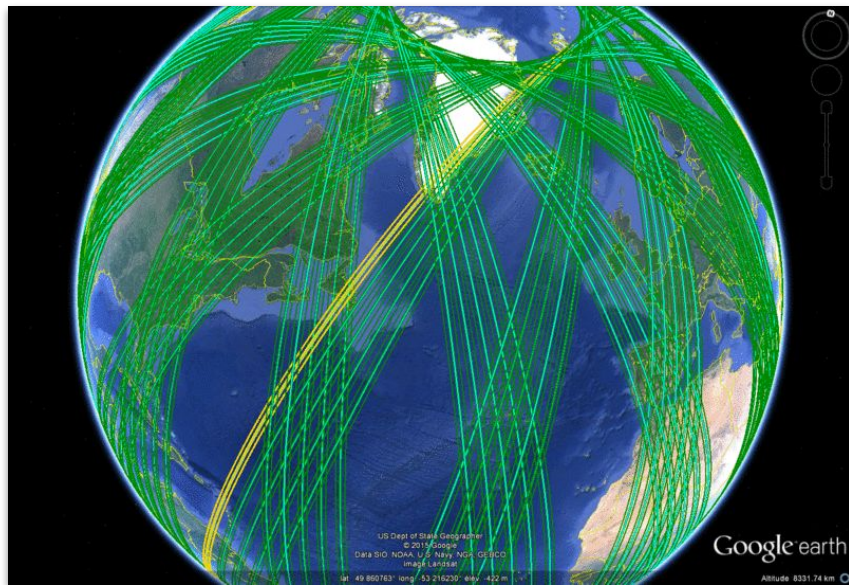
**Description:** Nadir altimetry geophysical data record

**Spatial Extent Format:** nadir track

**Select Variables:** sea surface height anomaly, significant wave height

**Subcollections:**

- SWOT\_L2\_NALT\_GDR\_SSHA
- SWOT\_L2\_NALT\_GDR\_GDR
- SWOT\_L2\_NALT\_GDR\_SGDR



# SWOT\_L2\_LR\_SSH (netCDF)

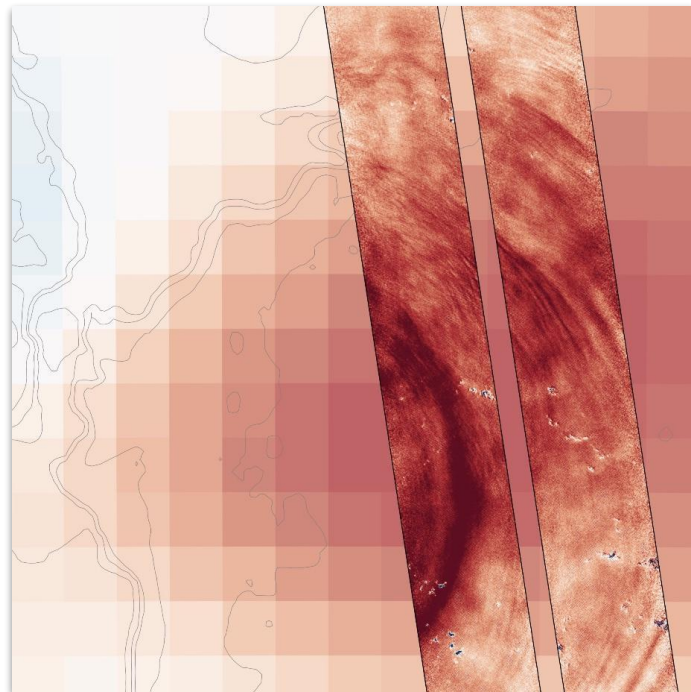
**Description:** Sea surface height (SSH) and significant wave height (SWH) over oceans

**Spatial Extent Format:** 2 km fixed-grid swath (and unsmoothed; 250 m native grid)

**Select Variables:** SSH, SWH

**Subcollections:**

- SWOT\_L2\_LR\_SSH\_Basic
- SWOT\_L2\_LR\_SSH\_WindWave
- SWOT\_L2\_LR\_SSH\_Expert
- SWOT\_L2\_LR\_SSH\_Unsmoothed



# Quality Flags!

SWOT Product	Quality Flag Identifier	Values and Meanings
L2_HR_RiverSP L2_HR_RiverAvg	Var + '_q'  Overall Quality Variables: 'reach_q' or 'node_q'  Bitwise: Var + '_q_b'	0 = good 1 = suspect - may have large errors 2 = degraded - likely to have large errors 3 = bad - may be nonsensical and should be ignored  <i>For discharge parameters: (e.g., 'dschg_c_q')</i> 0 = valid 1 = questionable 2 = invalid
L2_HR_LakeSP L2_HR_LakeAvg	Overall quality Variable: 'quality_f'	0 = good 1 = bad
L2_HR_Raster	Var + '_qual'  Ex: 'wse_qual'  Bitwise: Var + '_qual_bitwise'	0 = good 1 = suspect - may have large errors 2 = degraded - likely to have large errors 3 = bad - may be nonsensical and should be ignored

L2_NALT_GDR	Var + '_qual'	0 = good
L2_NALT_IGDR	Ex:	1 = bad
L2_NALT_OGDR	'rad_water_vapor_qual'	
L2_RAD_GDR		
L2_RAD_IGDR		
L2_RAD_OGDR		
L2_FPDEM		
L2_LR_SSH	Var + '_qual'	Varies, see PDDs
L2_HR_PIXC		
L1B_HR_SLC		
L1B_LR_INTF		

Find this info in the PO.DAAC Cookbook:

[https://podaac.github.io/tutorials/quarto\\_text/SWOT.html#tips-for-quality-flags](https://podaac.github.io/tutorials/quarto_text/SWOT.html#tips-for-quality-flags)

# More Detailed Information

## Product Description Documents (PDDs)



Dataset	Description	Coverage	Format	Product Description Document (PDD)	Algorithm Theoretical Basis Document (ATBD)
L2_HR_PIXC	Point cloud of water mask pixels ("pixel cloud") with geolocated heights, backscatter, geophysical fields, and flags.	Point cloud over tile (approx 64x64 km <sup>2</sup> ); half swath (left or right side of full swath)	netCDF	L2_HR_PIXC Product Description Document	L2_HR_PIXC Algorithm Theoretical Basis Document

...

<https://podaac.jpl.nasa.gov/SWOT?tab=datasets-information&sections=about>