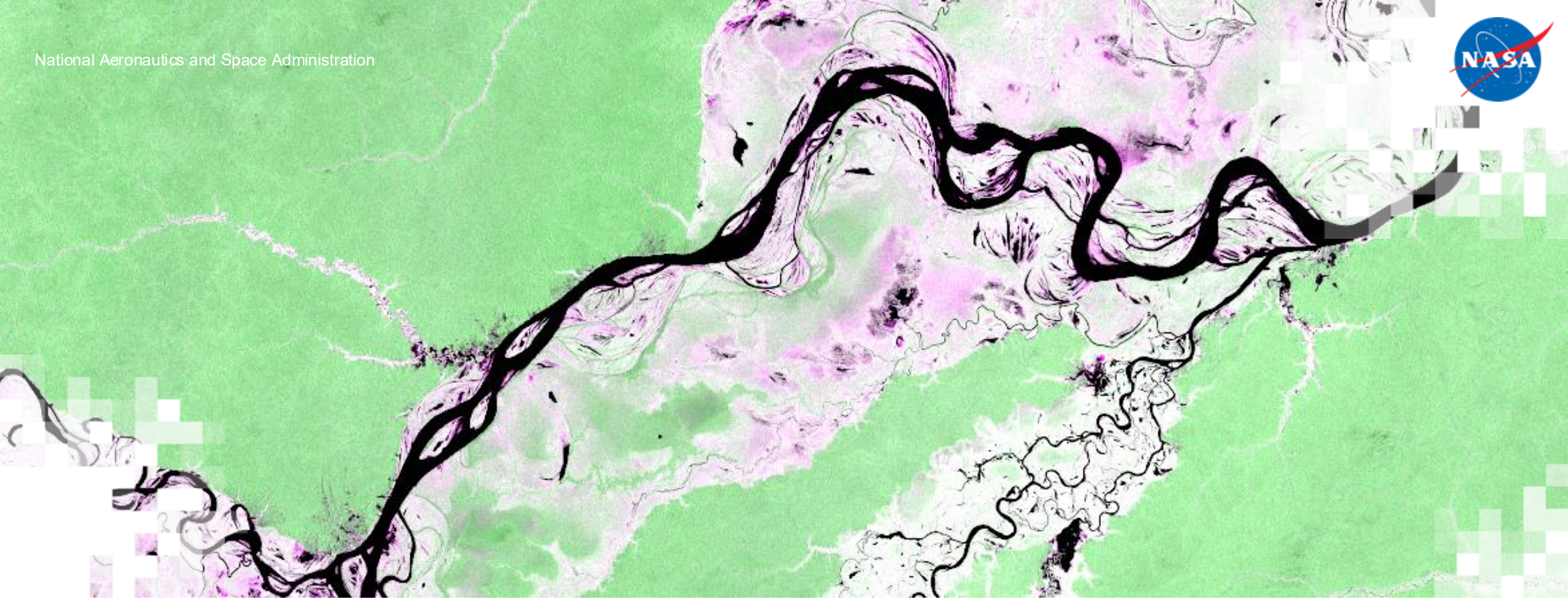




Monitoring Surface Water with SAR for Water Resource Management

Part 2: Water Surface Extent from OPERA

ARSET Trainer: Renato Frasson (JPL, California Institute of Technology)

ARSET Host: Erika Podest, (JPL, California Institute of Technology)

October 27, 2026



Training Outline

Session 1

Mapping
Inundation with
NISAR

October 20, 2026

11:00 a.m. - 1:00
p.m. EDT(1500-1700
UTC)

Session 2

Water Surface
Extent from OPERA

October 27, 2026

11:00 a.m. - 1:00
p.m. EDT(1500-1700
UTC)

Homework

Opens Oct. 27, 2026 – Due Nov. 17– Posted on the Training Webpage

A certificate of completion will be awarded to those who attend both live sessions and complete the homework assignment by the due date.



Session 2 Objectives

By the end of this session, participants will be able to:

- Recognize the capabilities and appropriate applications of the OPERA Surface Water Extent product for water resource monitoring.
- Evaluate when it is more appropriate to generate a flood map from NISAR observations versus using the OPERA Surface Water Extent product.
- Interpret OPERA Surface Water Extent products for flood and surface water monitoring applications.

How to Ask Questions

- To ensure we see your question, please locate the three dots ... to the bottom right of your training window.
- You will see a Slido/Q&A option. You may also see a standalone Slido tab or app.
- Please write your questions there and we will answer them during the Q&A session.
- We will try to respond all of the questions during the Q&A session. The remaining questions will be answered in the Q&A document, which will be posted to the training website in about a week.

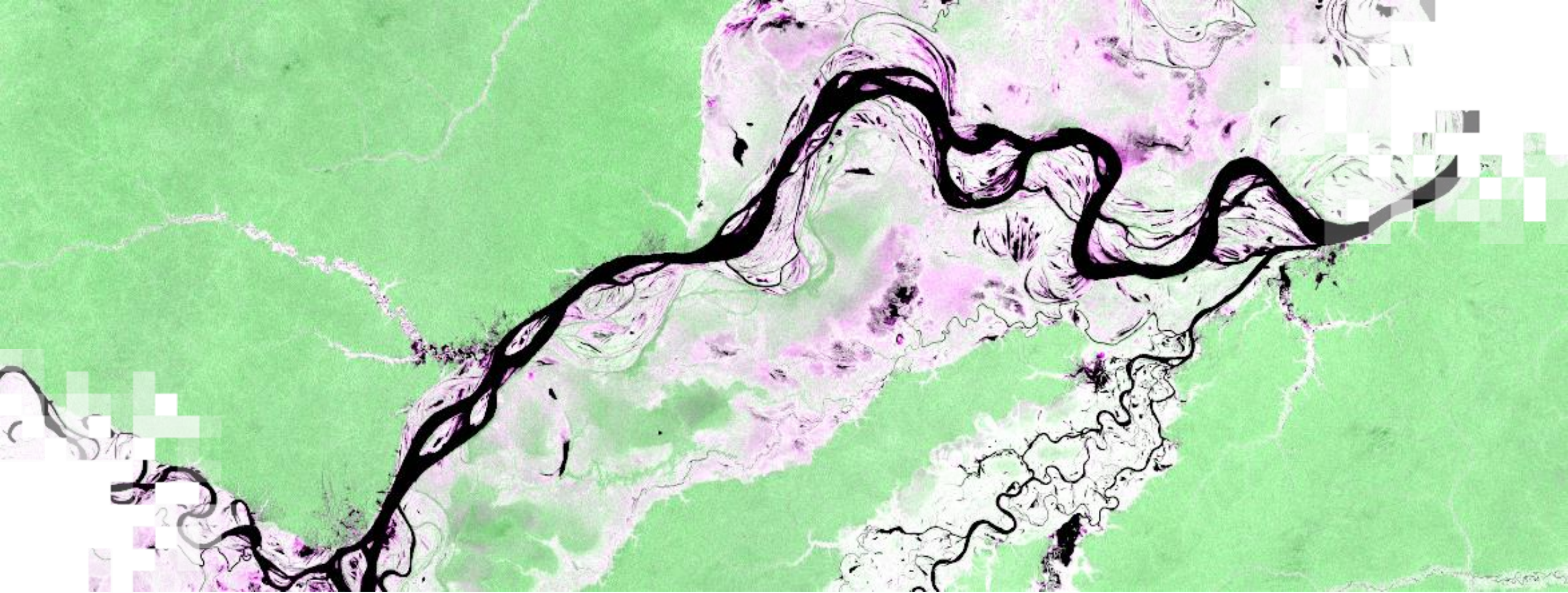
Session 2 – Instructor

Dr. Renato Frasson

Research Scientist

NASA Jet Propulsion Laboratory/Caltech





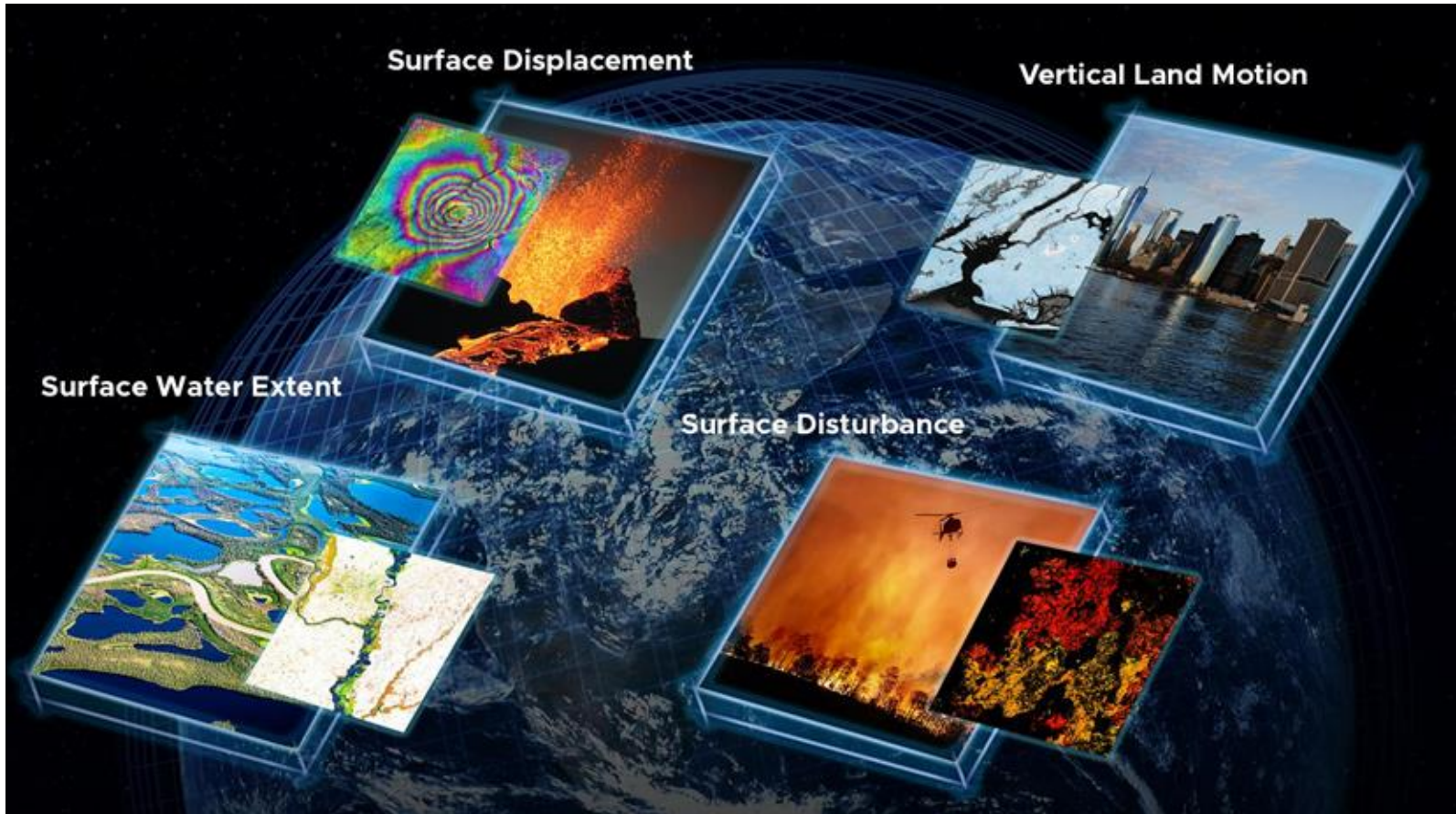
Session 2: Water Surface Extent from OPERA

Outline

1. Introduction to OPERA Products
2. The Characteristics of the Dynamic Surface Water Extent Suite of Products
3. Data Organization, Distribution, and Format
4. Measurement Principle of each Water Product, Measurement Principle, How to Choose the Most Appropriate Product
5. Live Demonstration of Worldview for Data Visualization
6. Strategies for Data Discovery and Acquisition
7. Importing the Data into QGIS
8. Showing More Capabilities: Building a Time Series of Surface Area in a Transient Waterbody
9. Resources for Programmatic Access to Data and Conclusion



Observation Products for End-users from Remote Sensing Analysis (OPERA)



OPERA Datasets:

- Funded by the Satellite Needs Working Group, responding to well-defined end-user needs
- Free and open, low-latency, ready-to-use data to support disaster response, recovery, damage assessments, and others
- Multi-layer design allows users to choose from simple to use layers to more advanced, diagnostic layers

OPERA Products

Level-3 Products

DSWx Surface Water Extent

Lake Mead, NV, USA
Lake level in 2016 (light blue) compared to 2022 lake level (dark blue).

- **Description:** Maps surface water using optical (HLS) and SAR imagery (S1, NISAR)
- **Coverage:** Near-global
- **Temporal resolution:** every few days
- **Spatial Resolution:** 30 m
- **Product Record Begins:** Apr. 2023 (HLS), Sep. 2024 (S1), soon in 2026 (NISAR)

Available now!

DIST Surface Disturbance

Mosquito Fire, CA, USA
Red areas show vegetation loss from California's largest wildfire of 2022.

- **Description:** Maps vegetation disturbance using optical (HLS) and SAR imagery (S1)
- **Coverage:** Near-global
- **Temporal resolution:** every few days
- **Spatial Resolution:** 30 m
- **Product Record Begins:** Feb. 2023 (HLS), Mar. 2026 (S1)

Available now!

DISP Surface Displacement

Mauna Loa, HI, USA
Surface deformation map showing how much the ground moved following the 2022 eruption. Colors show contours of displacement.

- **Description:** Maps surface displacements in LOS (S1 and NISAR)
- **Coverage:** North America*
- **Temporal resolution:** 6, 12, or 24 days
- **Spatial Resolution:** ≤ 30 m
- **Product Record Begins:** Apr. 2014 (S1), NISAR validated record.
- **Production Begins:** Dec. 2024 (S1), soon in 2026 (NISAR)

Available now!

VLM Vertical Land Motion

New York City, NY, USA
Vertical land motion map, indicating areas where the ground has either sunk (in blue) or risen (in red) between 2016 and 2023.

- **Description:** Maps surface displacements in vertical + horiz. (S1 and NISAR)
- **Coverage:** North America*
- **Temporal resolution:** 6, 12, or 24 days
- **Spatial Resolution:** ≤ 30 m
- **Product Record Begins:** Apr. 2014 (S1), NISAR validated record.
- **Production Begins:** Apr. 2028 (S1 + NISAR)

Available in 2028

Level-2 Products

RTC Radiometric Terrain Corrected

Los Angeles, CA, USA
RTC image showing radar backscatter variations in urban (white/pink), vegetated (green), and water (black) areas.

- **Description:** S1 radar backscatter corrected for the topography. Basis for the DSWx-S1 products.
- **Coverage:** Near-global
- **Spatial Resolution:** 30 m
- **Product Record Begins:** Oct. 2023

Available now!

CSLC CSLC Coregistered Single-Look Complex

San Gabriel Mountains, CA, USA
CSLC radar intensity image covering a mountainous region.

- **Description:** Geocoded and coreg. SLC (S1, NISAR). Basis for all the DISP products.
- **Coverage:** North America*
- **Spatial Resolution:** ≤ 10 m
- **Product Record Begins:** Jul. 2016 (S1) and TBD (NISAR)
- **Production Begins:** Oct. 2023 (S1), TBD (NISAR)

Available now!

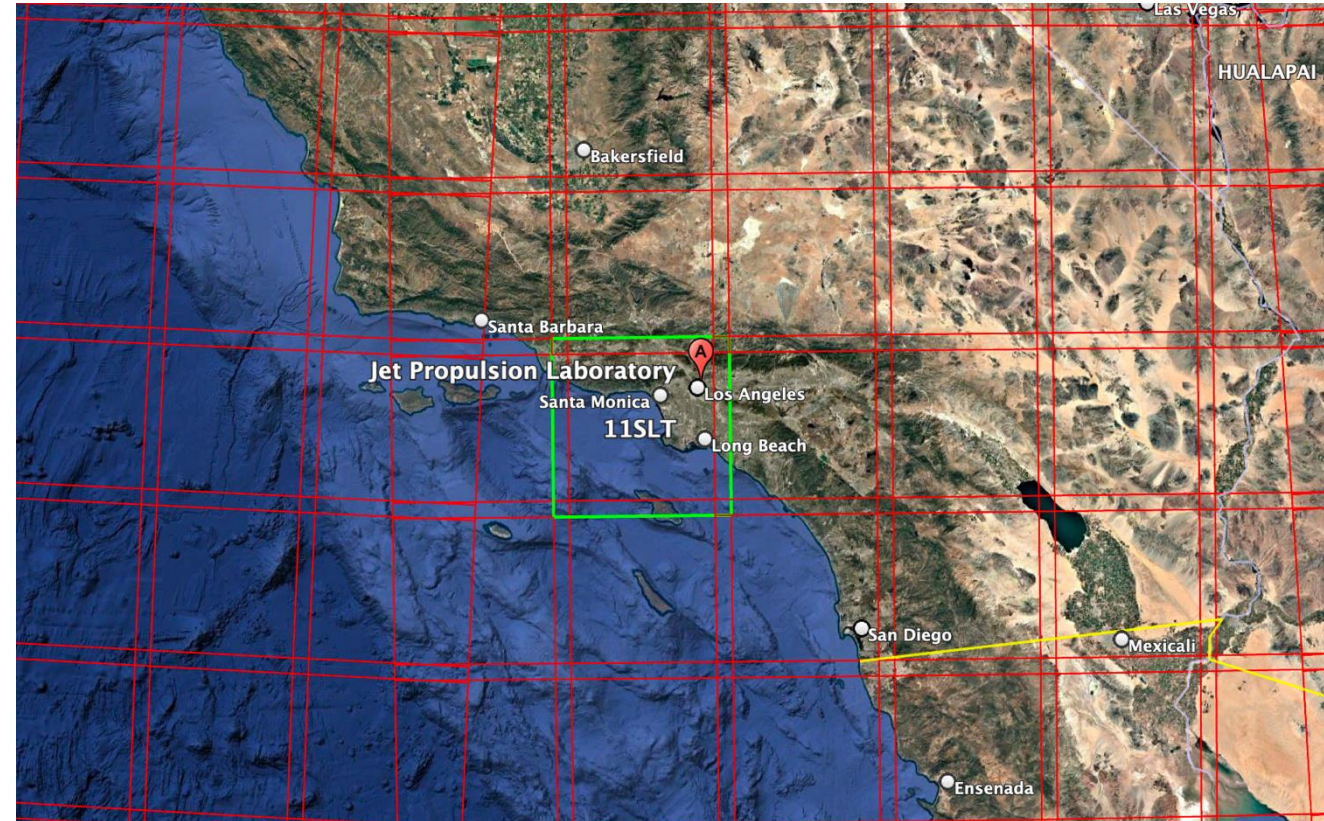
OPERA data is available through the [SNWG data portal](#).



Data Organization and Distribution

The Dynamic Surface Water Extent Products

- Distributed as **granules**
- A **granule** contains data at a **geographical area** at one specific point in **time**.
- **Geographical Extent:** Tile as defined by the [Military Grid Reference System](#) at a 5-character level:
 - JPL is at 11SLT
 - First 2 characters: Universal Transverse Mercator (UTM) projection
 - Last 3 characters pinpoint the location
- **Timing:** defined by the orbit of the satellites that acquire the source data (data acquisition time)



The Dynamic Surface Water Extent – Harmonized Landsat/Sentinel-2 (HLS)



- **Description:** Maps surface water using optical (HLS) and SAR imagery (S1, NISAR)
- **Coverage:** Near-global
- **Temporal resolution:** every few days
- **Spatial Resolution:** 30 m
- **Product Record Begins:** Apr. 2023 (HLS), Sep. 2024 (S1), soon in 2026 (NISAR)

Available now!

Sample DSWx-HLS Granule:

Download Files

AWS S3 Access

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B01_WTR.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B02_BWTR.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B03_CONF.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B04_DIAG.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B05_WTR-1.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B06_WTR-2.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B07_LAND.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B08_SHAD.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B09_CLOUD.tif

OPERA_L3_DSWx-HLS_T56LPN_20260517T235741Z_20260519T134553Z_S2C_30_v1.1_B10_DEM.tif

DSWx-HLS:

- File Name:
 - OPERA_L3_DSWx-HLS
 - T56LPN: Military Grid Reference System (MGRS) Tile ID
 - 20260517T235741Z: Acquisition date and time
 - 20260519T134553Z: Production time
 - S2C: Produced with Sentinel-2C imagery. Other values: L8, L9, S2A, S2B
 - 30: Spatial resolution in meters
 - B01 through B10: Product layers
 - We will cover B01 WTR (basic water occurrence layer)

DSWx [Direct Link](#)
DSWx [Documentation](#)



The Dynamic Surface Water Extent – Sentinel-1



- **Description:** Maps surface water using optical (HLS) and SAR imagery (S1, NISAR)
- **Coverage:** Near-global
- **Temporal resolution:** every few days
- **Spatial Resolution:** 30 m
- **Product Record Begins:** Apr. 2023 (HLS), Sep. 2024 (S1), soon in 2026 (NISAR)

Available now!

Sample DSWx-S1 Granule:

[Download Files](#)

[AWS S3 Access](#)

`OPERA_L3_DSWx-S1_T36JXT_20260519T030158Z_20260520T060722Z_S1A_30_v1.0_B01_WTR.tif`

`OPERA_L3_DSWx-S1_T36JXT_20260519T030158Z_20260520T060722Z_S1A_30_v1.0_B02_BWTR.tif`

`OPERA_L3_DSWx-S1_T36JXT_20260519T030158Z_20260520T060722Z_S1A_30_v1.0_B03_CONF.tif`

`OPERA_L3_DSWx-S1_T36JXT_20260519T030158Z_20260520T060722Z_S1A_30_v1.0_B04_DIAG.tif`

DSWx-S1:

- File Name:
 - OPERA_L3_DSWx-S1
 - T36JXT: MGRS Tile ID
 - 20260519T030158Z: Acquisition date and time
 - 20260520T060722Z: Production time
 - S1A: Produced with Sentinel-1A radar imagery. Other Values: S1C, S1D.
 - 30 m: Spatial resolution
 - B01 through B04: Product layers
 - We will cover B01 WTR (basic water occurrence layer)

DSWx [Direct Link](#)
DSWx [Documentation](#)



The Dynamic Surface Water Extent – NISAR



- **Description:** Maps surface water using optical (HLS) and SAR imagery (S1, NISAR)
- **Coverage:** Near-global
- **Temporal resolution:** every few days
- **Spatial Resolution:** 30 m
- **Product Record Begins:** Apr. 2023 (HLS), Sep. 2024 (S1), soon in 2026 (NISAR)

Available now!

Sample DSWx-NI Granule:

[Download Files](#)

[AWS S3 Access](#)

OPERA_L3_DSWx-NI_T18MXV_20260816T103542Z_20260902T082230Z_LSAR_30_v0.4_B01_WTR.tif

OPERA_L3_DSWx-NI_T18MXV_20260816T103542Z_20260902T082230Z_LSAR_30_v0.4_B02_BWTR.tif

OPERA_L3_DSWx-NI_T18MXV_20260816T103542Z_20260902T082230Z_LSAR_30_v0.4_B03_CONF.tif

OPERA_L3_DSWx-NI_T18MXV_20260816T103542Z_20260902T082230Z_LSAR_30_v0.4_B04_DIAG.tif

DSWx-S1:

- File Name:
 - OPERA_L3_DSWx-NI
 - T18MXV: MGRS Tile ID
 - 20260816T103542Z: Acquisition date and time
 - 20260902T082230Z: Production time
 - LSAR: Produced with NISAR
 - 30 m: Spatial resolution
 - v0.4: **Test product (not official yet)**
 - B01 through B04: Product layers

DSWx [Direct Link](#)

DSWx [Documentation](#)



The Dynamic Surface Water Extent – Source Data Comparison

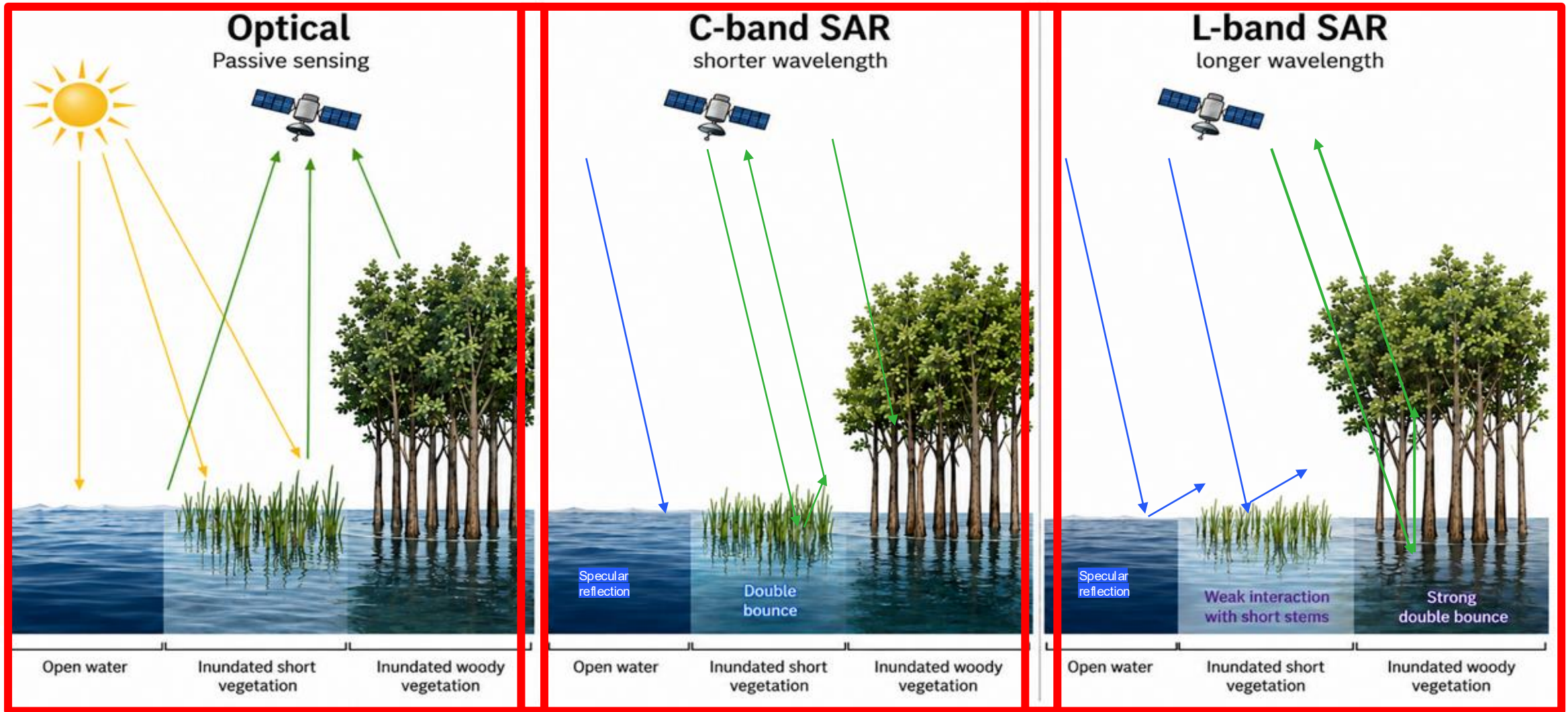
- The DSWx-NI product is designed to have pixel spacing, projection, grid, and file format consistent with DSWx-S1 and DSWx-HLS.

	DSWx-NI	DSWx-S1	DSWx-HLS
Input Source	Radar NISAR GCOV (L-band)	Radar OPERA RTC-S1 (C-band)	Optical HLS
MGRS Grid Extent	~109.7 km x 109.7 km (3660 x 3660 pixels)		
Pixel Spacing	30 m		
Projection	UTM Coordinate (MGRS)		
File Format	Cloud Optimized GeoTIFF (COG)		
WTR Classes	Not-Water, Open Water, Inundated Vegetation		Not-Water, Open Water, Partial Surface Water

- GCOV: Geocoded Polarimetric Covariance provide calibrated backscatter measurements corrected for both radiometric and terrain distortions, presented as gamma-0 power values.
- RTC: Radiometric Terrain-Corrected presented as gamma-0 power values.
- HLS: Surface reflectance for each of the Landsat 8, 9 and Sentinel-2 bands.



Measurement Principle



The Dynamic Surface Water Extent (DSWx) WTR Layer



- **Description:** Maps surface water using optical (HLS) and SAR imagery (S1, NISAR)
- **Coverage:** Near-global
- **Temporal resolution:** every few days
- **Spatial Resolution:** 30 m
- **Product Record Begins:** Apr. 2023 (HLS), Sep. 2024 (S1), soon in 2026 (NISAR)

Available now!

DSWx [Direct Link](#)
DSWx [Documentation](#)

DSWx-NI:

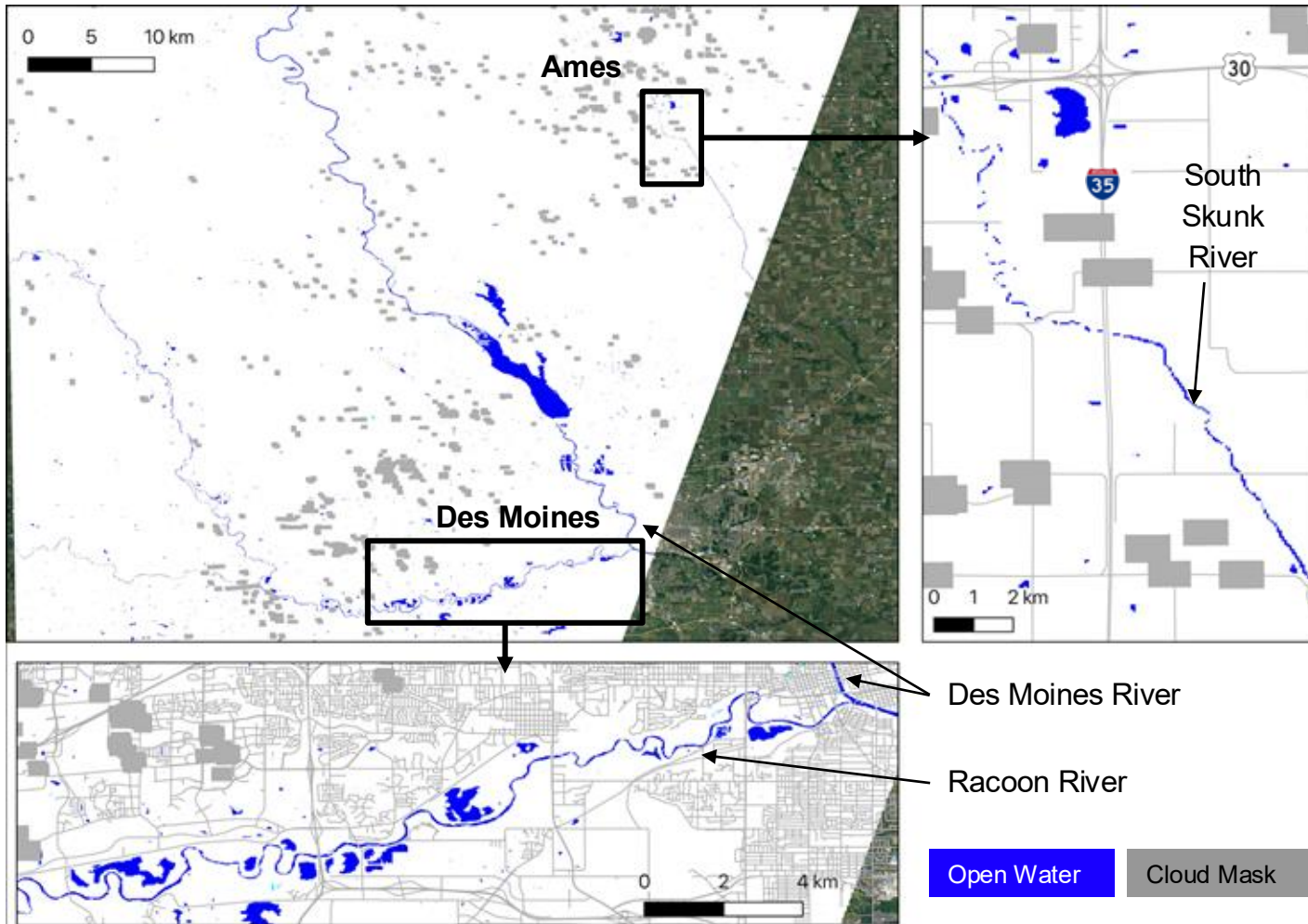
- Based on synthetic aperture radar data collected by Sentinel-1 A and C.
- Algorithm will be open.
- Main Classes:
 - **0:** Not water
 - **1:** open water (100% inundated)
 - **3:** Inundated vegetation
 - **8:** Water edge pixels
 - **250:** Height Above the Nearest Drainage Masked (area with elevation higher than HAND threshold)
 - **251:** Layover or shadow masked
 - **255:** No data

DSWx-S1:

- Based on synthetic aperture radar data collected by Sentinel-1 A (legacy), C, D.
- Classification [algorithm](#) is open.
- Main Classes:
 - **0:** Not water
 - **1:** Open water (100% inundated)
 - **3:** Inundated vegetation
 - **250:** Height Above the Nearest Drainage Masked (area with elevation higher than HAND threshold)
 - **251:** Layover or shadow masked
 - **255:** No data



DSWx-HLS Example



Dynamic Surface Water Extent Harmonized Landsat/Sentinel

- Acquisition Date: 13 April 2024
- Image Source: Sentinel-2A
- Right Panel: South Skunk River is near the detection limit.
- Bottom Panel: Des Moines and Racoon Rivers are well observed.
- Bottom Panel: Lakes surrounding the Racoon River are well observed. The product's resolution is fine enough to show that the surrounding lakes are not connected to the Racoon River.



DSWx-S1 Brings All-Weather Capabilities

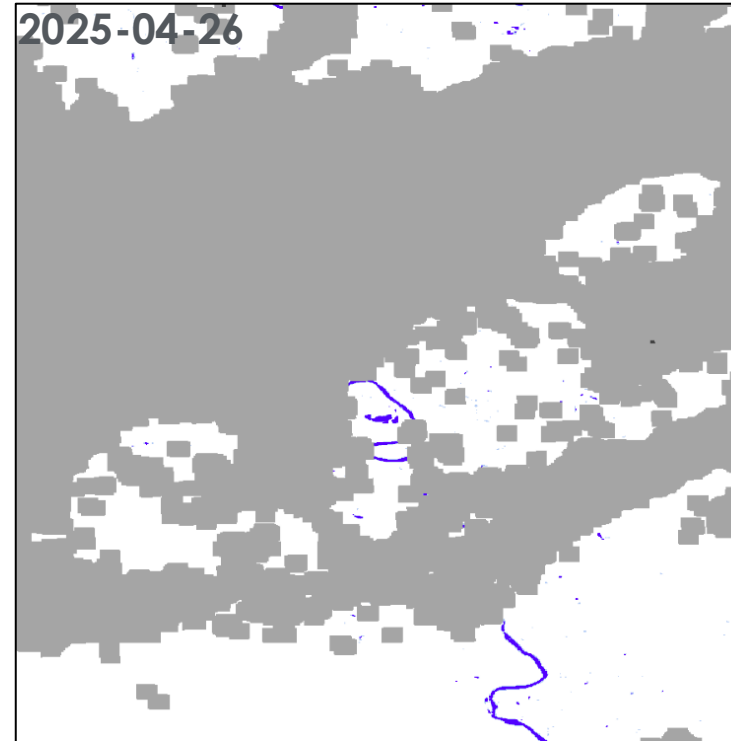
SAR provides a complementary view to optical:

- Provides retrievals under cloudy conditions
- Can partially penetrate through vegetation

A Note on Inundated Vegetation:

- DSWx-S1 C-band data will detect inundated vegetation in herbaceous wetlands.
- DSWx-NISAR L-band data will provide key information in **all wetlands**.

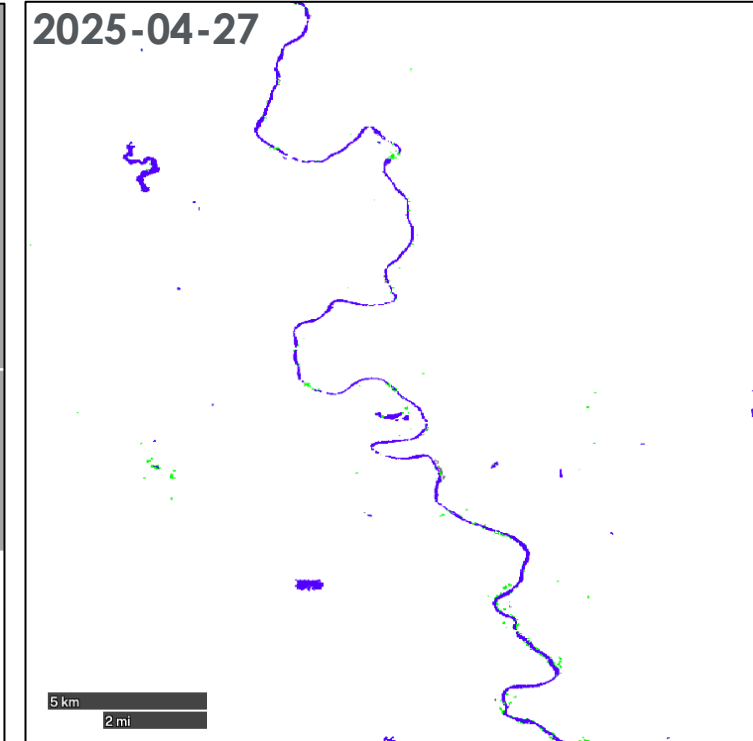
Optical: DSWx-HLS



Open Water

Cloud Mask

SAR: DSWx-S1



Open Water

Inundated Vegetation

Click on the Worldview [link](#) to see the complete scene.

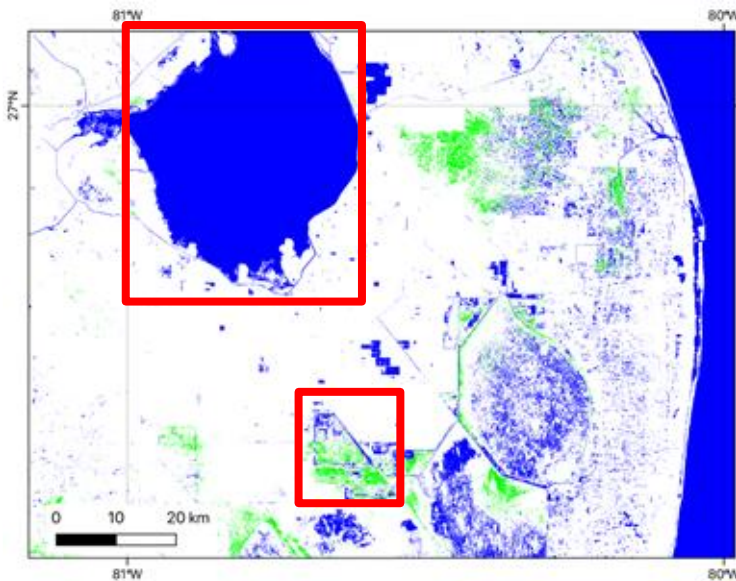
DSWx-S1 available on PO.DAAC Sep. 2024



DSWx-NI Enhances Mapping of Inundated Vegetation

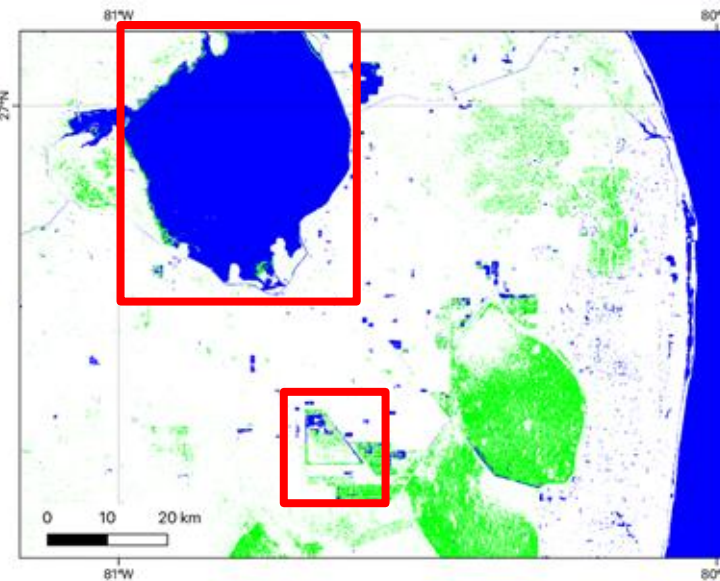
- DSWx-NI, DSWx-S1, and DSWx-HLS generally agree in mapping open-water extent.
- DSWx-S1 successfully maps herbaceous wetlands. DSWx-NI has better performance in denser vegetation. DSWx-HLS has limited capabilities in vegetated areas, mapping them as partial surface water.

DSWx-NI (07/20/2026)



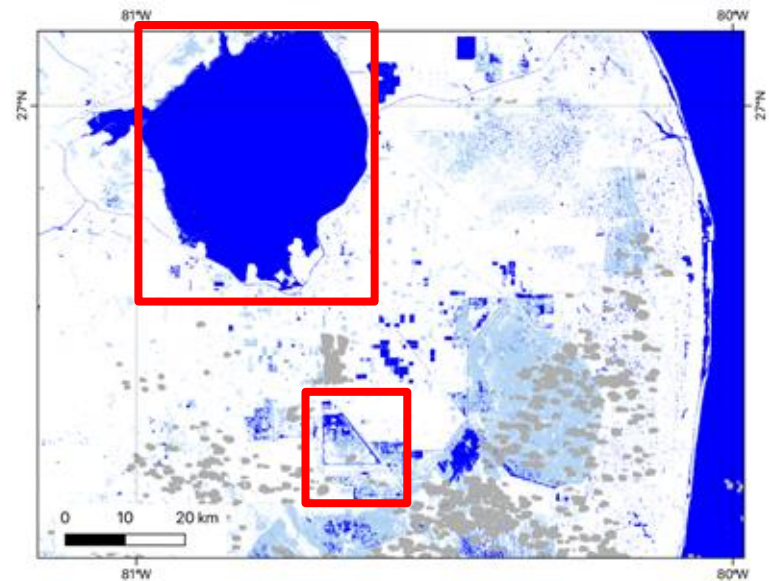
Blue : Open Water
Green : Inundated vegetation
Gray : Layover/shadow
White : Non-water

DSWx-S1 (05/14/2026)



Blue : Open Water
Green : Inundated vegetation
Gray : Layover/shadow
White : Non-water

DSWx-HLS (07/23/2026)

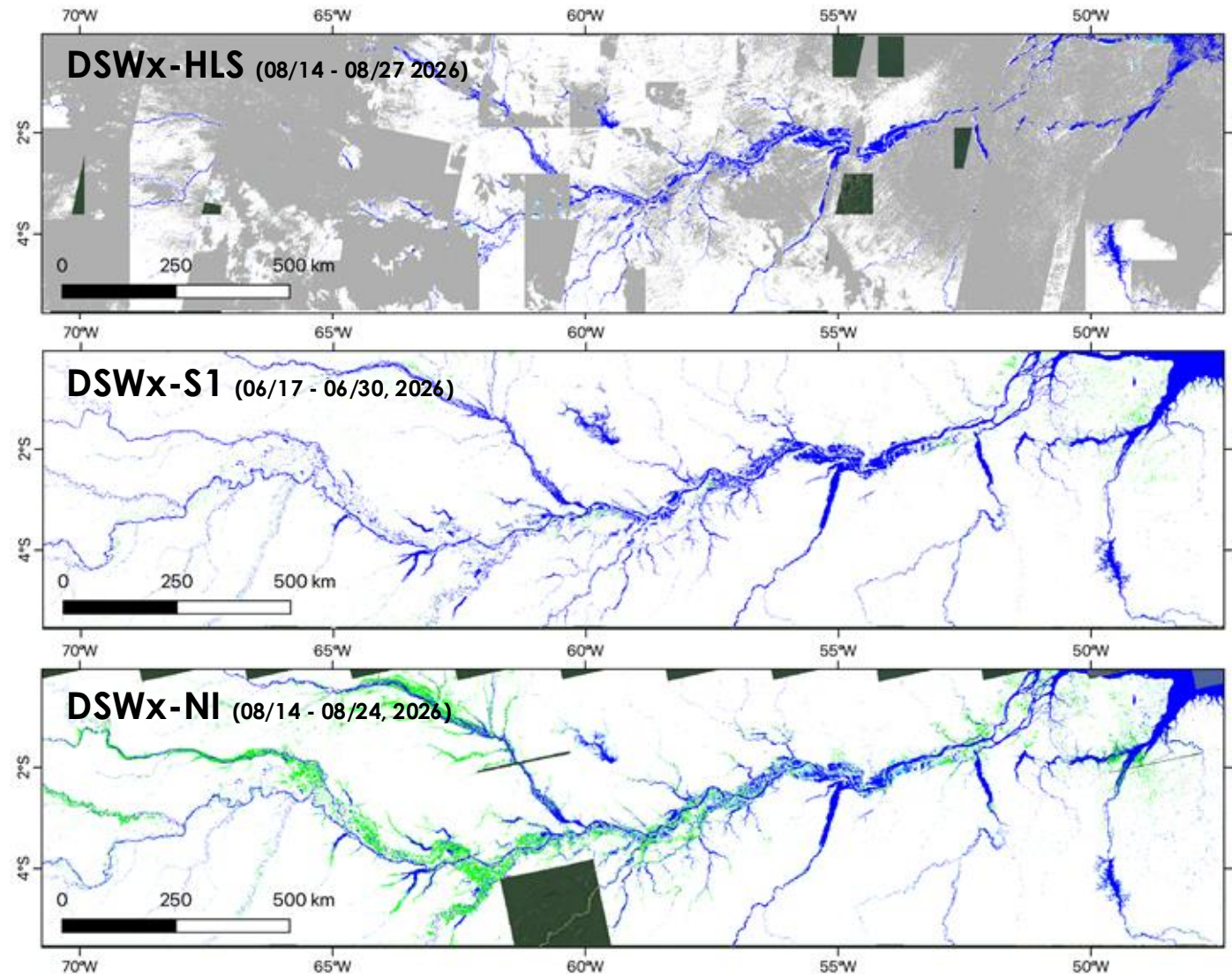


Blue : Open Water
Sky Blue : Partial Surface water
Cyan : HLS Snow/ice (high-confidence water)
Gray : HLS Cloud/Cloud Shadow
White : Non-water



DSWx-NI Enhances Mapping of Inundated Vegetation

- Optical imagery primarily detects exposed water, while forest canopies obscure most inundated vegetation.
- C-band reveals some flooding under the canopy.
- L-band shows substantially more inundated vegetation under densely forested areas.



Blue : Open Water
Sky Blue : Partial Surface water
Cyan : HLS Snow/ice
Gray : HLS Cloud/Cloud Shadow
White : Non-water

Blue : Open Water
Green : Inundated vegetation
Gray : Layover/shadow
White : Non-water

Blue : Open Water
Green : Inundated vegetation
Gray : Layover/shadow
White : Non-water



Which product is more appropriate for my application?

Currently two options (DSWx-HLS or DSWx-S1) with DSWx-NI coming soon. Which one should I use?

1. Data Availability

2. Data Quality Considerations:

– Cloud Cover:

- Persistent cloud cover favors radar platforms (Sentinel-1, NISAR)

– Landcover and Soil Type:

- Water detection in arid environments often favor optical data. Desert may appear as water in radar-derived DSWx-S1.
- Old lava flows can trick optical sensors. Radar may be more reliable.
- Sparse vegetation favors radar (Sentinel-1, NISAR).
- Dense vegetation favors NISAR.

– Feature Size and Sensitivity Requirements:

- DSWx-HLS is often more sensitive to water and has lower incidence of false detection.

– Duration of the Event:

- Long lasting or events with slow dynamics may enable temporal mosaicking for cloud removal.



Which product is more appropriate for my application?

Pervasive Cloud Cover with Immediate Response Needs: Hurricane Debby



Dynamic Surface Water Extent Sentinel-1

- Acquisition Dates: 4 and 6 August 2024
- This Image: Sentinel-1
- Inundation extent caused by Hurricane Debby (Landfall 5 August)
- Radar data shows water extents with no impediments from cloud cover.

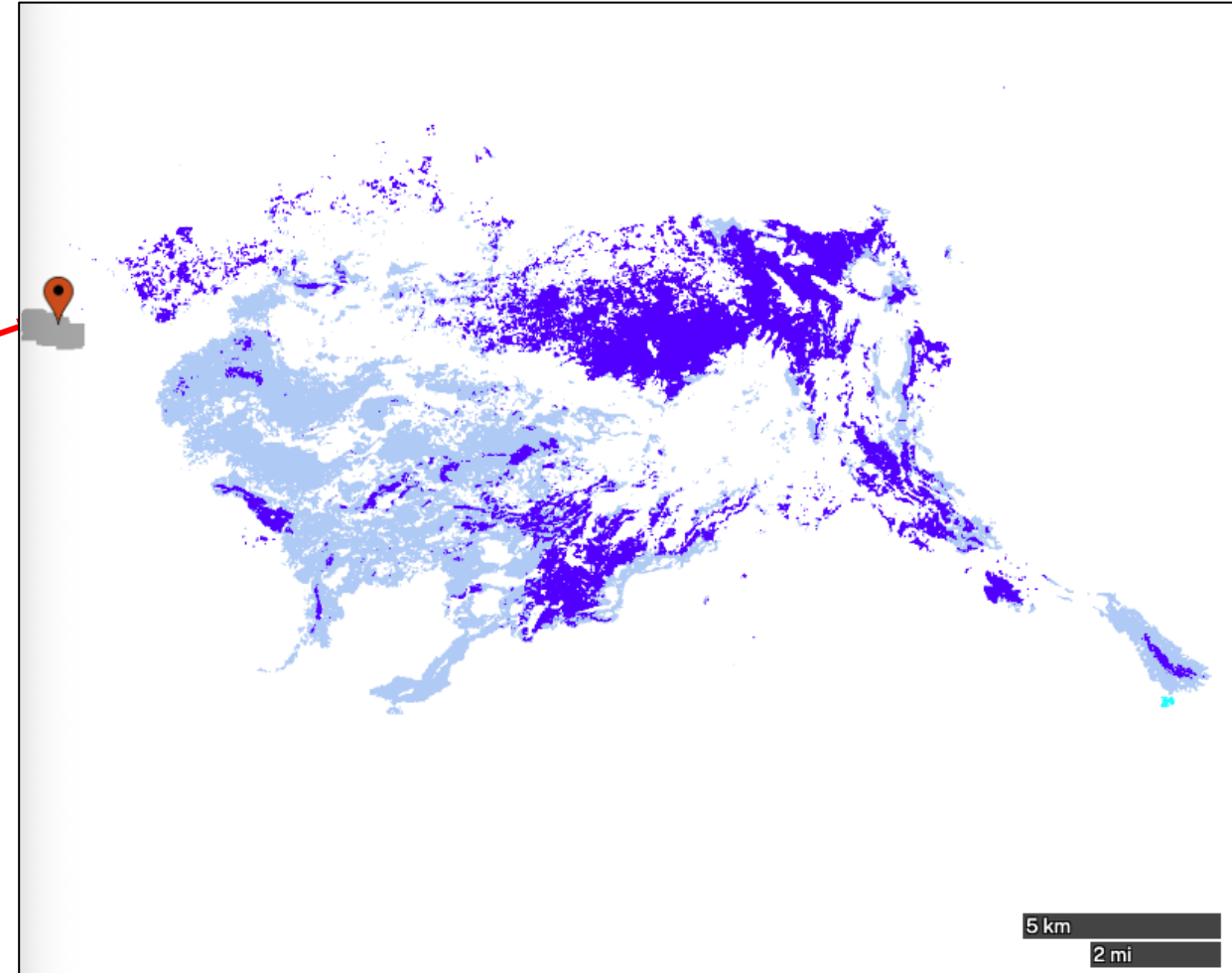
[Worldview link](#) showing cloud cover on 7 August 2024



Which product is more appropriate for my application?

Challenging Surface Types: Old Lava Flows

DSWx-HLS: 15 May 2026

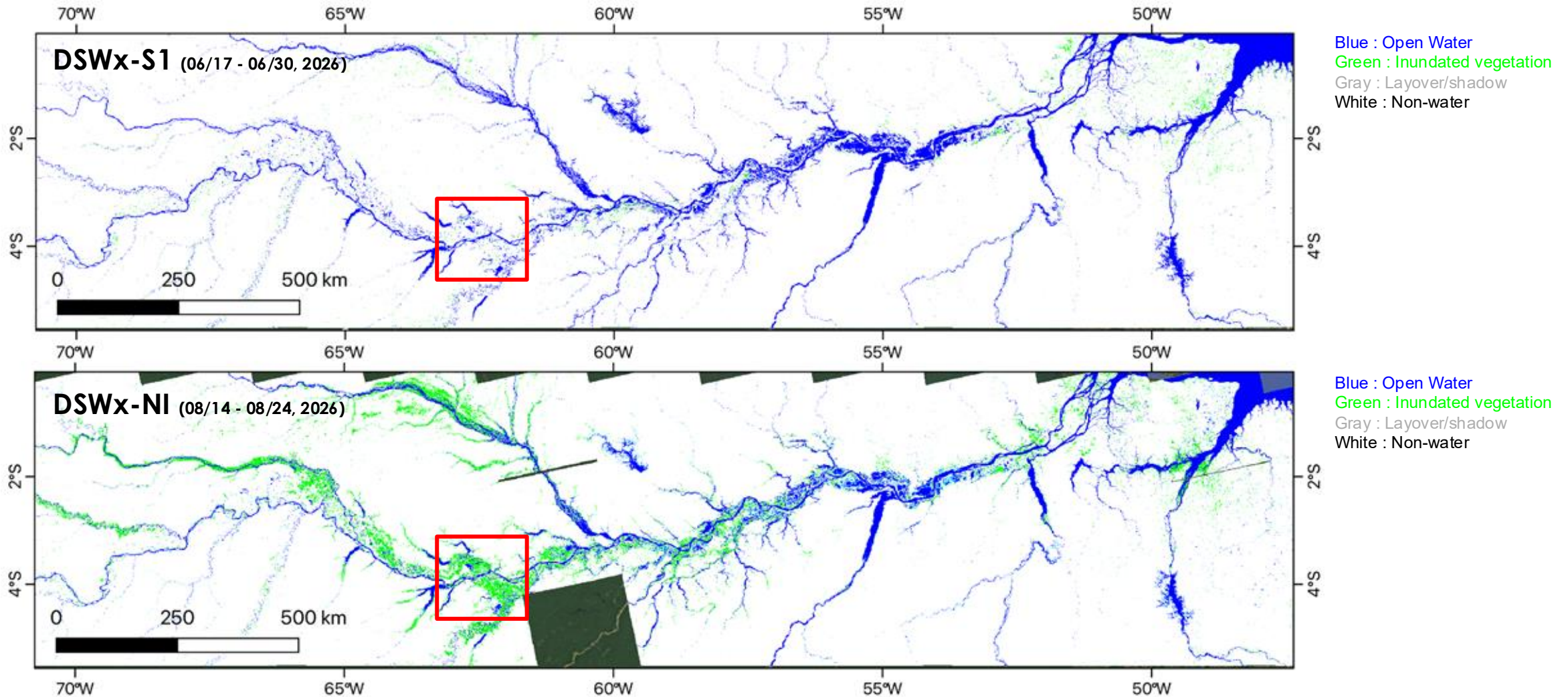


[Worldview Link](#)



Which product is more appropriate for my application?

Dense Vegetation: The Amazon River Floodplain

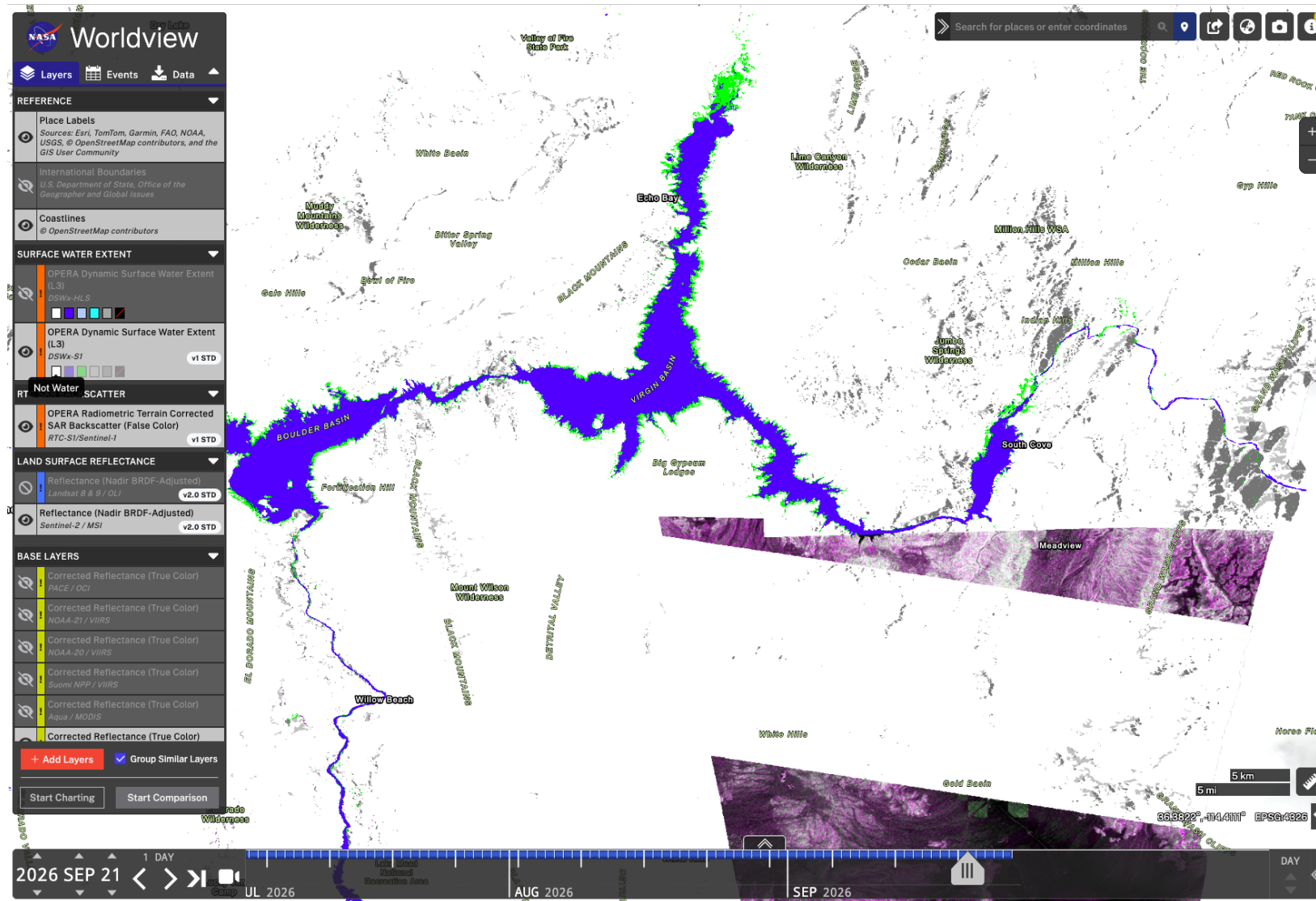


Worldview Live Demonstration

- How to add layers.
 - DSWx-HLS
 - DSWX-S1
 - HLS Surface Reflectance (Landsat and Sentinel-2)
 - RTC
- Redorder the layers.
- Make comparisons to show how clouds are transparent in the radar data.
- Compare DSWx-S1 and DSWx-HLS and contrast sensitivities.
- Enable/disable layers to inspect the underlying data.
 - Compare DSWx-HLS and surface reflectance.
 - Compare DSWx-S1 and RTC.
- Compare RTC and surface reflectance.



Worldview Live Demonstration



[Worldview Link](#)



Worldview Review

We learned:

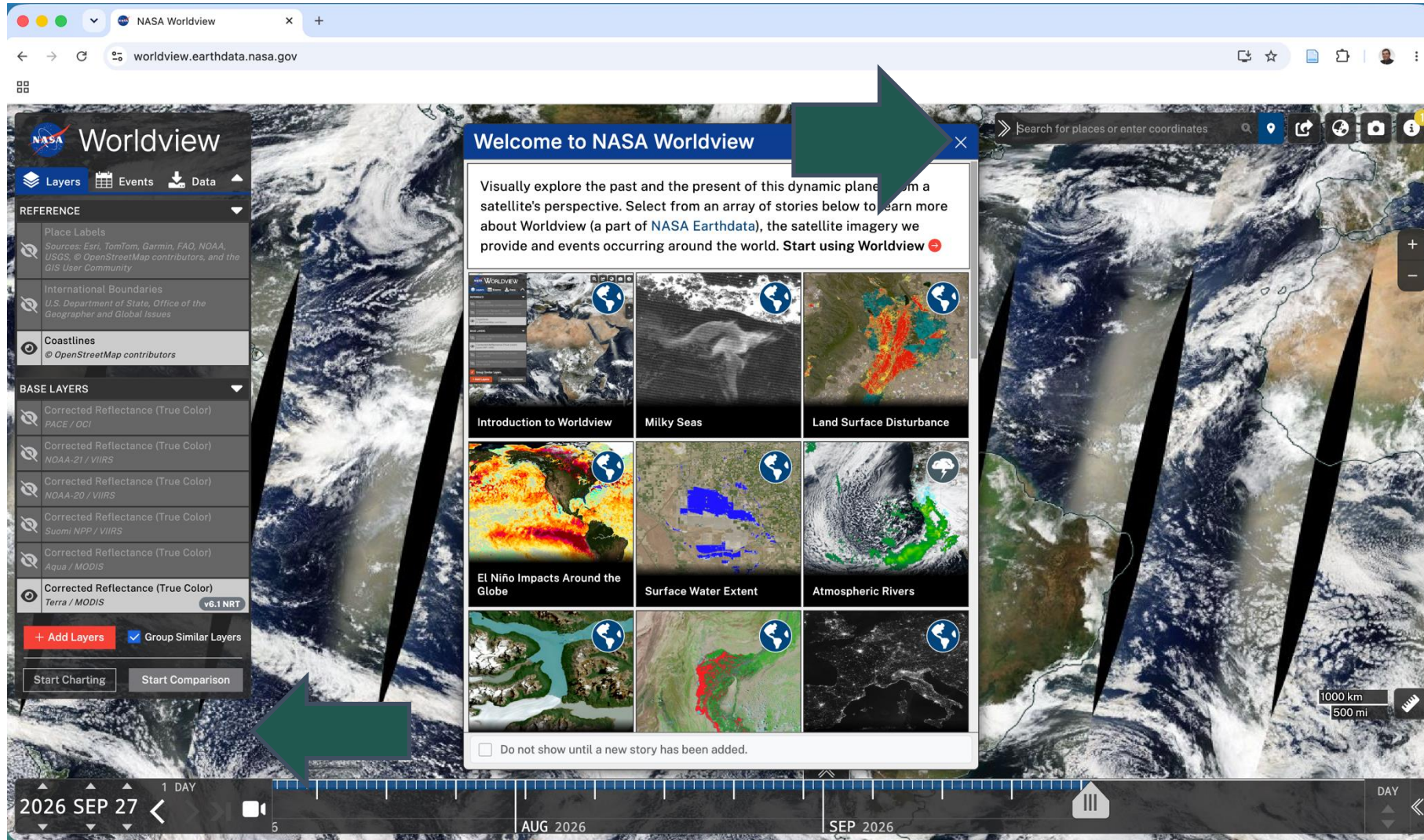
- How to display the appropriate layers.
 - DSWx-HLS, DSWx-S1
 - DSWx-HLS Source Data: Landsat 8 & 9 Reflectance, Sentinel-2 Reflectance
 - DSWx-S1 Source Data: OPERA Radiometric Terrain Corrected SAR Backscatter
- How to select the appropriate dates.
- How to perform visual comparisons between DSWx-HLS and DSWx-S1 as well as DSWx-HLS and Reflectance and DSWx-S1 and RTC.

Next, how Worldview can facilitate **data acquisition**.

The Context: Mapping surface water changes in Lake Mead in QGIS.



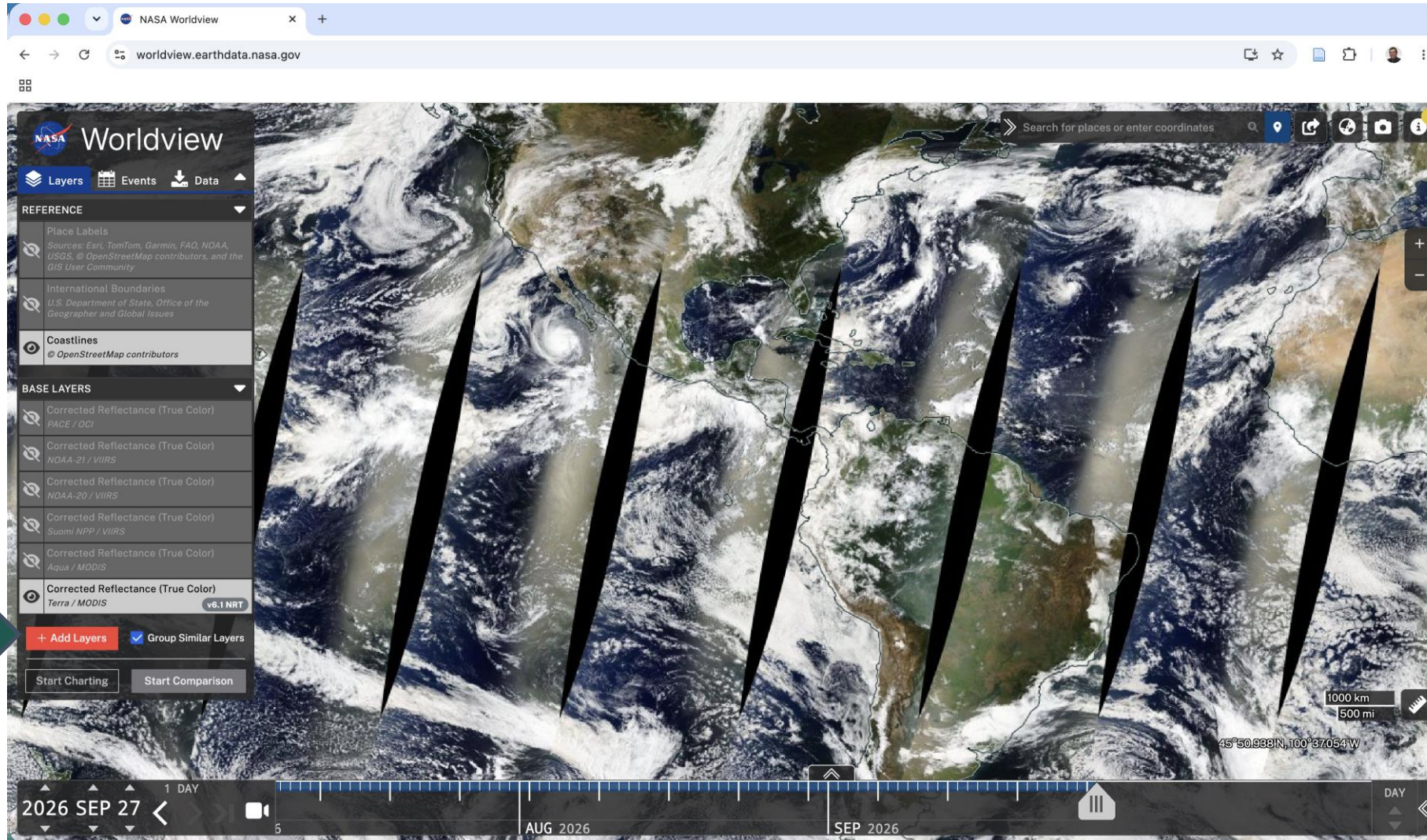
Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



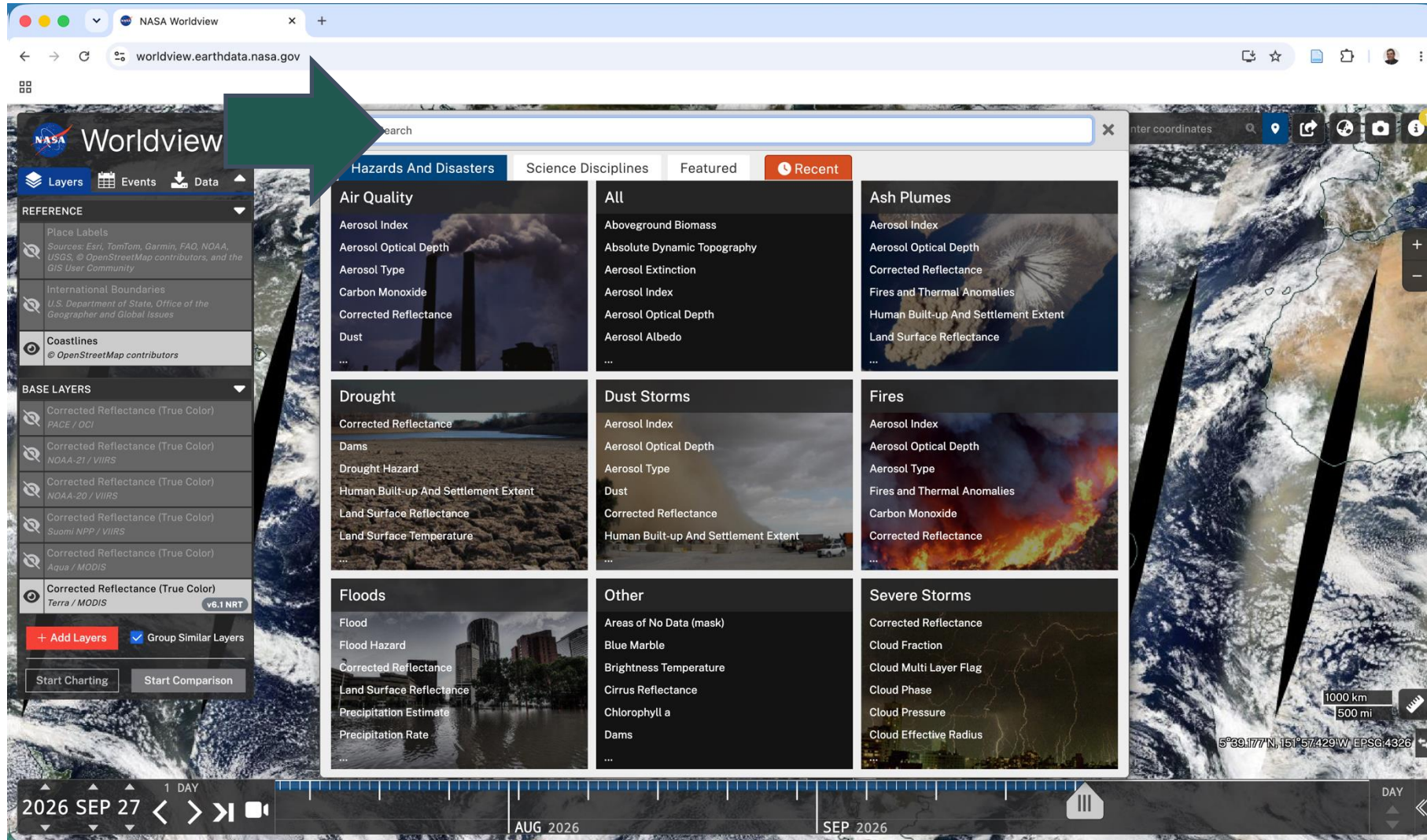
Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



Finding and Acquiring Data – Integration with Earthdata

The screenshot shows the NASA Worldview web application. The browser address bar displays 'worldview.earthdata.nasa.gov'. The interface includes a left sidebar with 'Layers', 'Events', and 'Data' tabs. The 'Layers' panel is active, showing a list of data layers categorized by 'REFERENCE', 'BASE LAYERS', and 'ANALYSIS'. A green arrow points to the 'DSWx' filter button at the top of the layer list. The main panel displays a search for 'DSWx' with two results: 'OPERA Dynamic Surface Water Extent (L3) DSWx-S1' and 'OPERA Dynamic Surface Water Extent (L3) DSWx-HLS'. A message states 'No layer selected. Select a layer to view details here!'. The bottom of the interface features a timeline for '1 DAY' starting from '2026 SEP 27' and ending at 'AUG 2026'.

[Worldview Link](#)



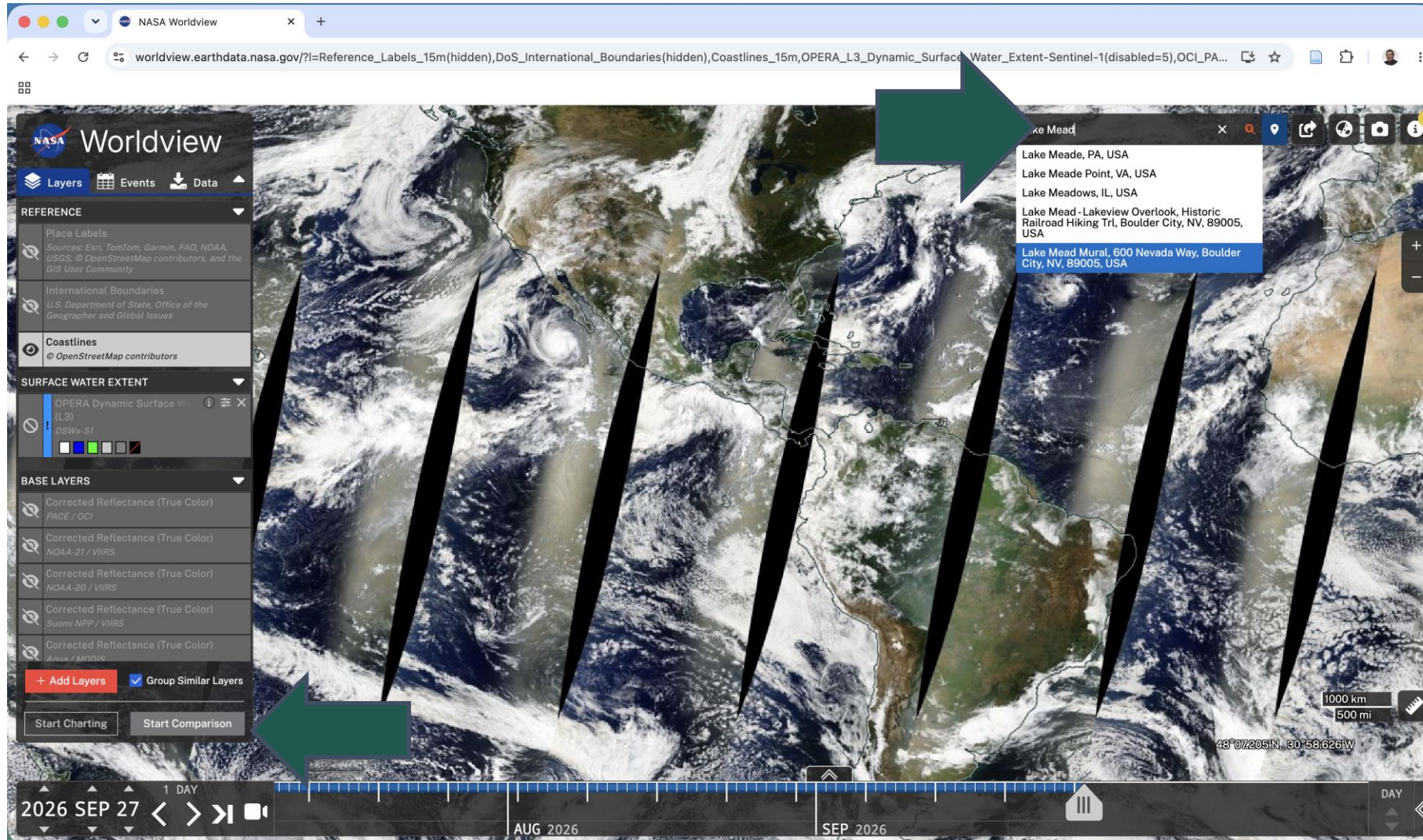
Finding and Acquiring Data – Integration with Earthdata

The screenshot displays the NASA Worldview web application. The interface includes a sidebar with various data layers categorized under 'REFERENCE', 'SURFACE WATER EXTENT', and 'BASE LAYERS'. The 'SURFACE WATER EXTENT' section is active, showing 'OPERA Dynamic Surface Water Extent (L3)' with a color scale. The main panel displays a list of layers with checkboxes, including 'OPERA Dynamic Surface Water Extent (L3) DSWx-S1' and 'OPERA Dynamic Surface Water Extent (L3) DSWx-HLS'. A large green arrow points from the 'OPERA Dynamic Surface Water Extent (L3) DSWx-S1' layer to a pop-up window that says 'No layer selected. Select a layer to view details here!'. The bottom of the interface features a timeline for the year 2026, with a date slider set to '2026 SEP 27' and a '1 DAY' duration. The map area shows a satellite image of a coastal region with a black arrow pointing to a specific location.

[Worldview Link](#)



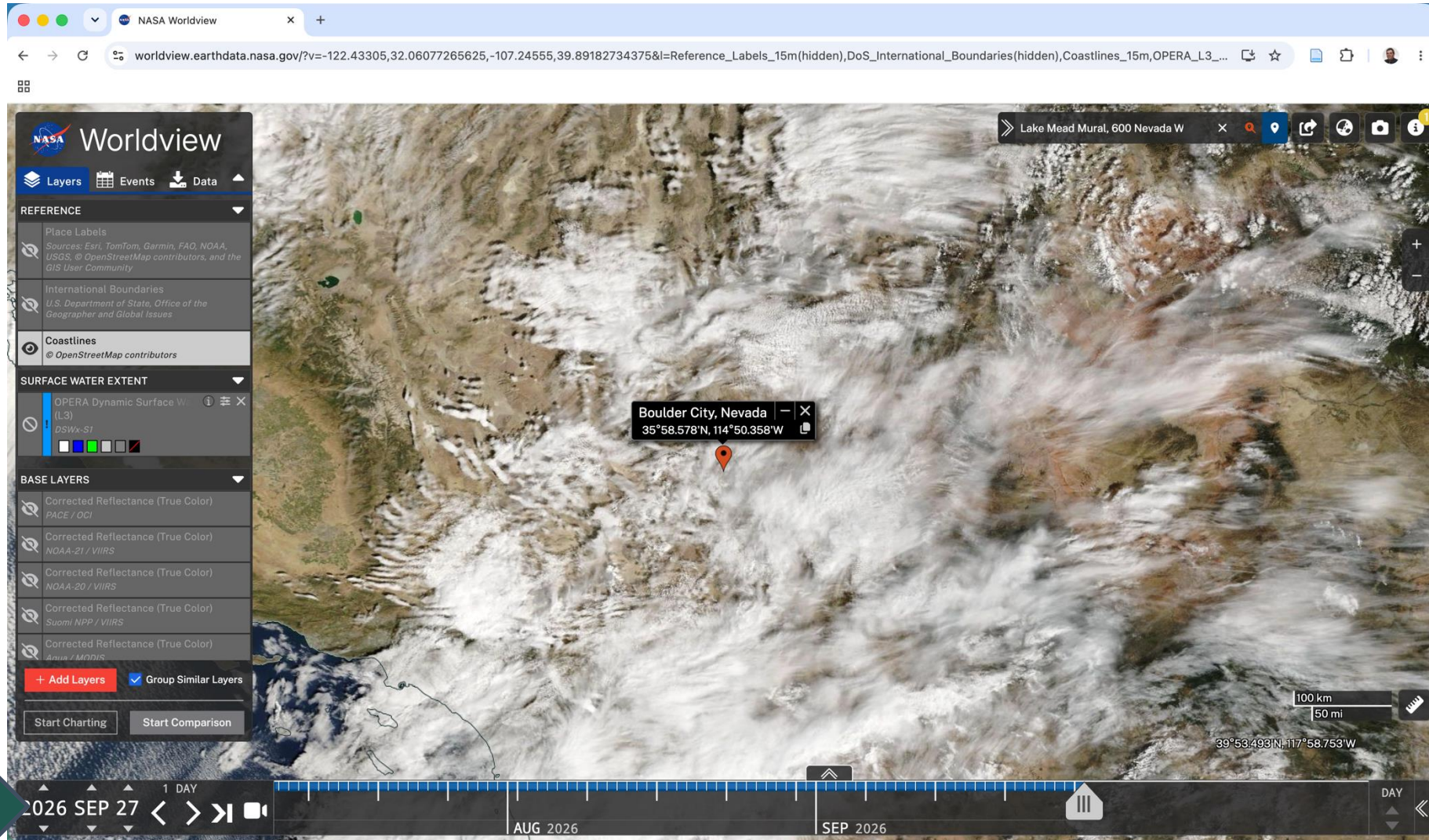
Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



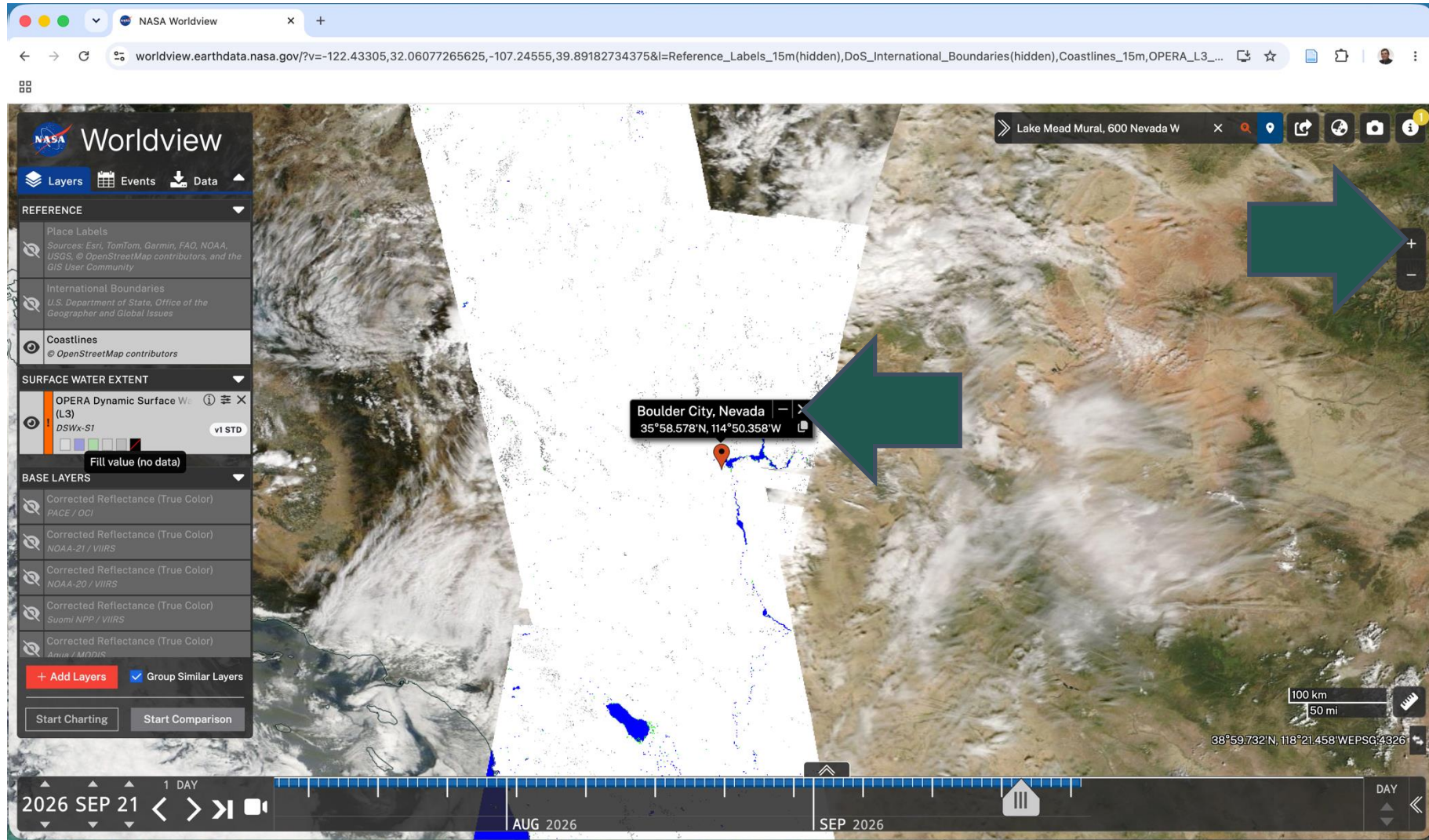
Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



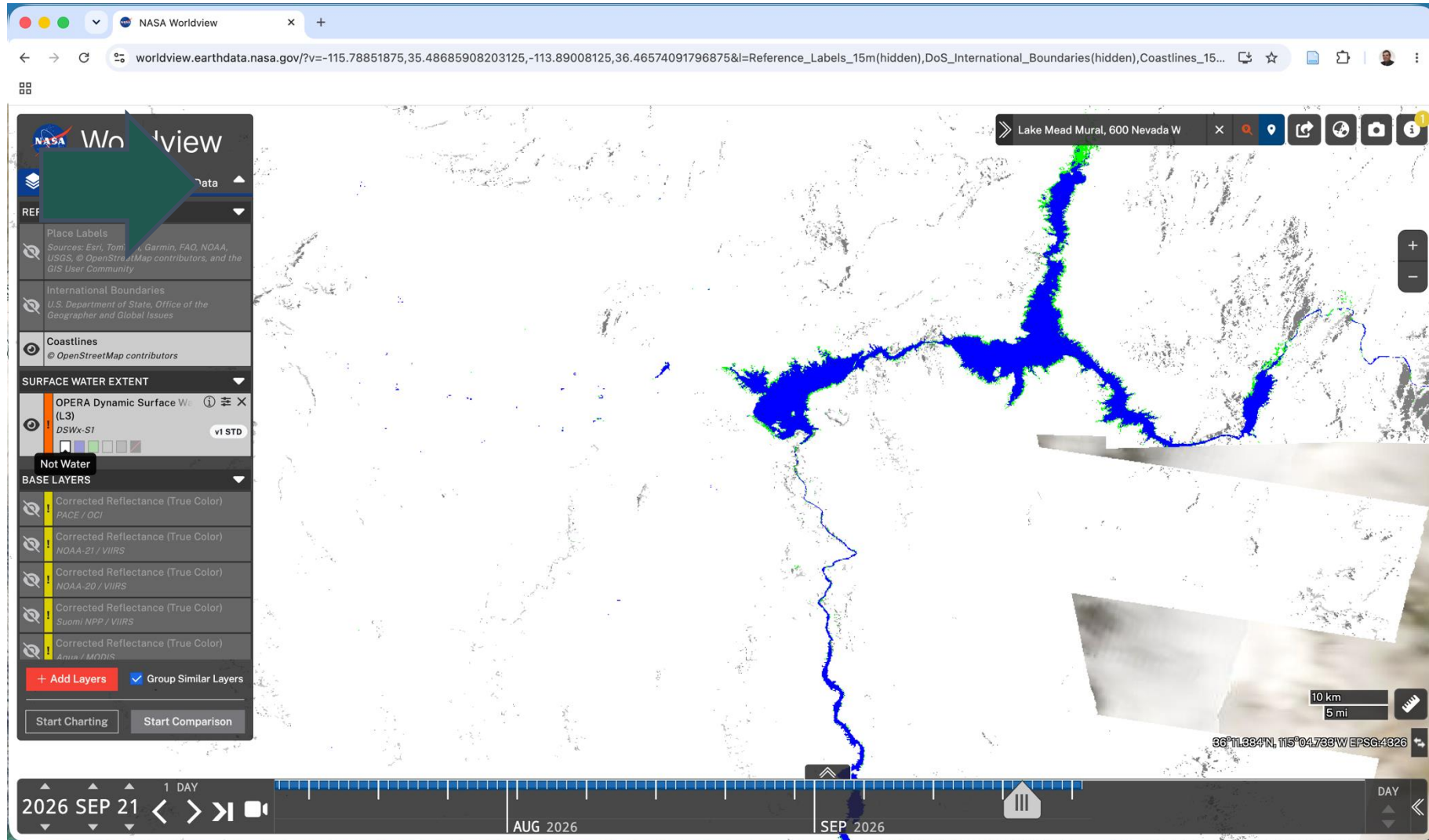
Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



Finding and Acquiring Data – Integration with Earthdata

The screenshot displays the NASA Worldview web application interface. The browser address bar shows the URL: `worldview.earthdata.nasa.gov/?v=-115.78851875,35.48685908203125,-113.89008125,36.46574091796875&I=Reference_Labels_15m(hidden),DoS_International_Boundaries(hidden),Coastlines_15...`. The sidebar on the left contains the following sections:

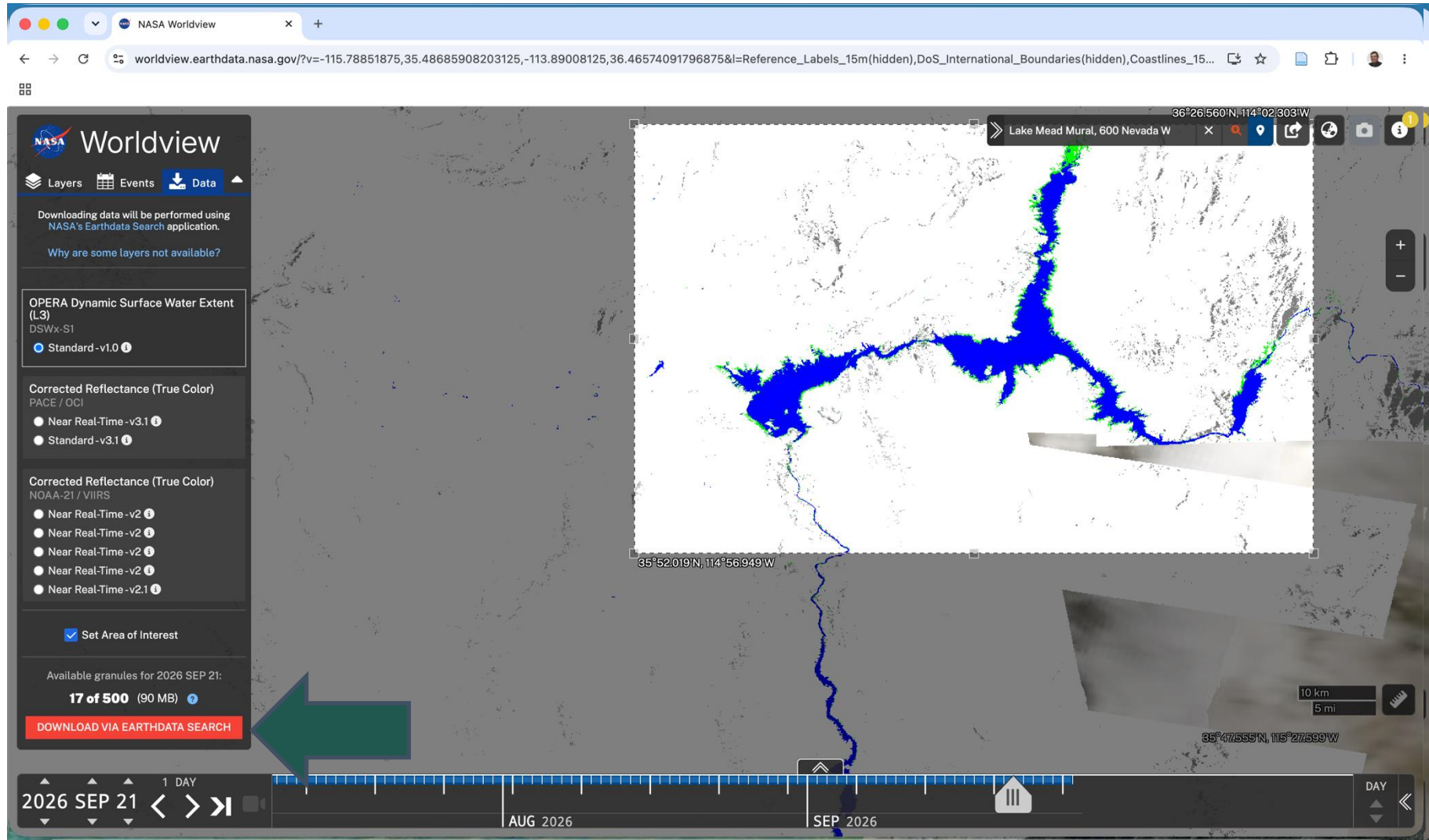
- Layers**: Includes a "Data" button and a "Hide sidebar" toggle.
- Downloading data will be performed using NASA's Earthdata Search application.**
- Why are some layers not available?**
- OPERA Dynamic Surface Water Extent (L3)**: Includes a selection for "Standard -v1.0".
- Corrected Reflectance (True Color) PACE / OCI**: Includes selections for "Near Real-Time -v3.1" and "Standard -v3.1".
- Corrected Reflectance (True Color) NOAA-21 / VIIRS**: Includes selections for "Near Real-Time -v2" and "Near Real-Time -v2.1".
- Set Area of Interest**: A button to define the area of interest.
- Available granules for 2026 SEP 21:** Shows "500 (3.14 GB)" and a "DOWNLOAD VIA EARTHDATA SEARCH" button.

The main map view shows a satellite image of Lake Mead, Nevada, with a blue line indicating the water extent. The timeline at the bottom shows the date "2026 SEP 21" and a "1 DAY" interval. The map includes a scale bar (10 km / 5 mi) and coordinates (36°20.168'N, 115°26.998'W).

[Worldview Link](#)



Finding and Acquiring Data – Integration with Earthdata



[Worldview Link](#)



Finding and Acquiring Data – Integration with Earthdata

The screenshot displays the NASA Earthdata Search web application. The search results for the query "C2949811996-POCLOUD" show 17 matching granules. The interface includes a sidebar with filters for spatial (Rectangle) and temporal (Start/Stop dates) data. A "Download Files" button is visible, and a "Visualization Layers" panel on the right shows the selected data layer. The map on the right shows the data extent over Africa, with a scale bar indicating 2000 km and 1000 mi.

Search Results (1 Collections)

Showing 17 of 17 matching granules

Sort: Start Date (Newest) View: List

Granule Search

Granule ID(s) Example: *_20240101_*, *_20240102_*

Temporal

Start: Type or click to select a date YYYY-MM-DD HH:mm:ss

End: Type or click to select a date YYYY-MM-DD HH:mm:ss

Download Files

Download All 17

Visualization Layers

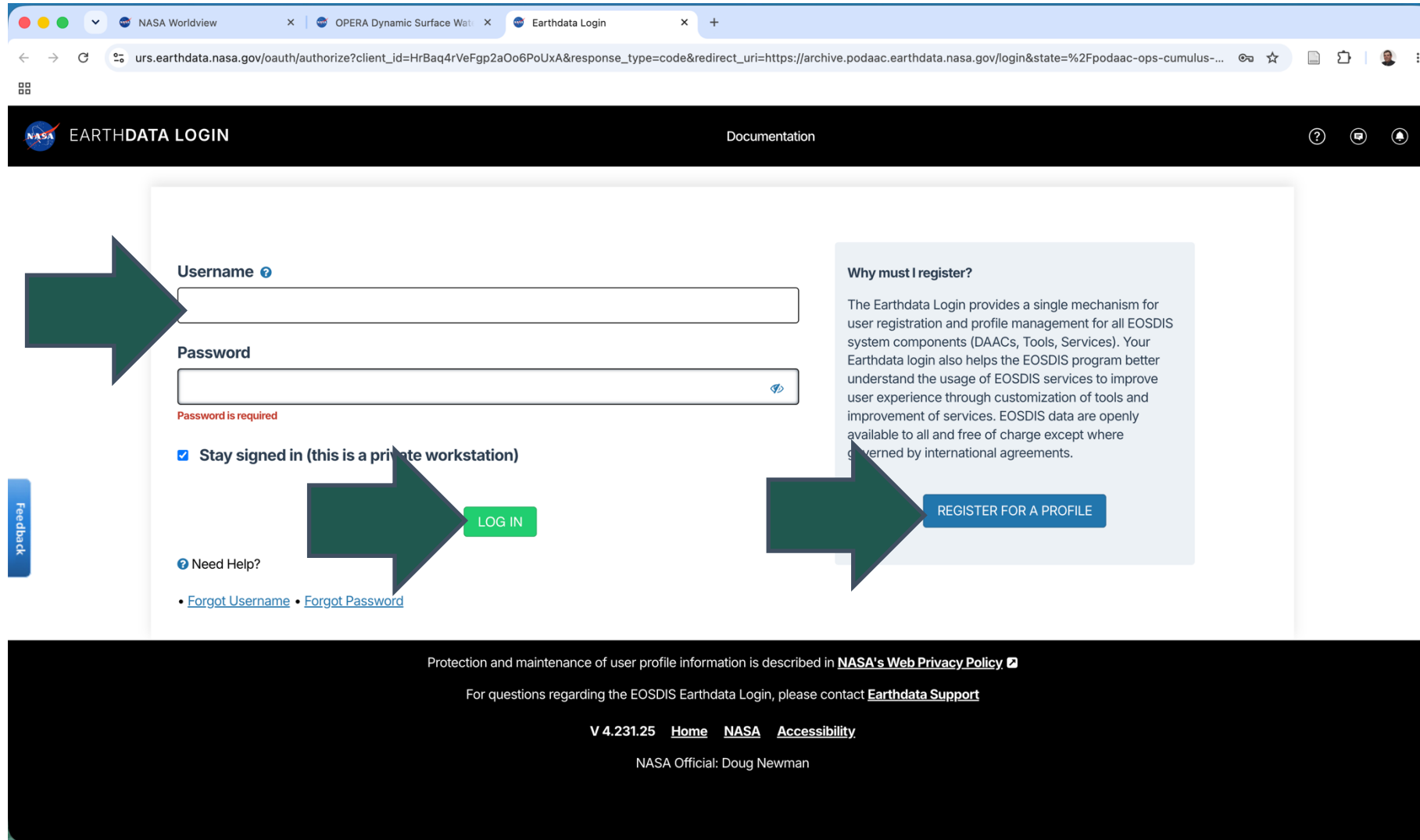
OPERA Dynamic Surface Water Extent (L3)

Hover for class names

[Worldview Link](#)



Finding and Acquiring Data – Integration with Earthdata



The screenshot shows the Earthdata Login page in a web browser. The browser's address bar displays the URL: `urs.earthdata.nasa.gov/oauth/authorize?client_id=HrBaq4rVeFgp2aOo6PoUxA&response_type=code&redirect_uri=https://archive.podaac.earthdata.nasa.gov/login&state=%2Fpodaac-ops-cumulus-...`. The page header includes the NASA logo, "EARTHDATA LOGIN", and a "Documentation" link. The main content area features a login form with fields for "Username" and "Password". A large green arrow points to the "Username" field. Below the password field, a red message states "Password is required". A checkbox labeled "Stay signed in (this is a private workstation)" is checked. A green "LOG IN" button is positioned below the form, with a green arrow pointing to it. To the right of the login form, a light blue box titled "Why must I register?" contains text explaining the benefits of registration. A blue "REGISTER FOR A PROFILE" button is located below this box, with a green arrow pointing to it. At the bottom of the page, a dark footer contains links for "NASA's Web Privacy Policy", "Earthdata Support", and "V 4.231.25 Home NASA Accessibility", along with the text "NASA Official: Doug Newman".

Username ?

Password

Password is required

☒ Stay signed in (this is a private workstation)

LOG IN

Need Help?

[Forgot Username](#) • [Forgot Password](#)

Why must I register?

The Earthdata Login provides a single mechanism for user registration and profile management for all EOSDIS system components (DAACs, Tools, Services). Your Earthdata login also helps the EOSDIS program better understand the usage of EOSDIS services to improve user experience through customization of tools and improvement of services. EOSDIS data are openly available to all and free of charge except where governed by international agreements.

REGISTER FOR A PROFILE

Protection and maintenance of user profile information is described in [NASA's Web Privacy Policy](#)

For questions regarding the EOSDIS Earthdata Login, please contact [Earthdata Support](#)

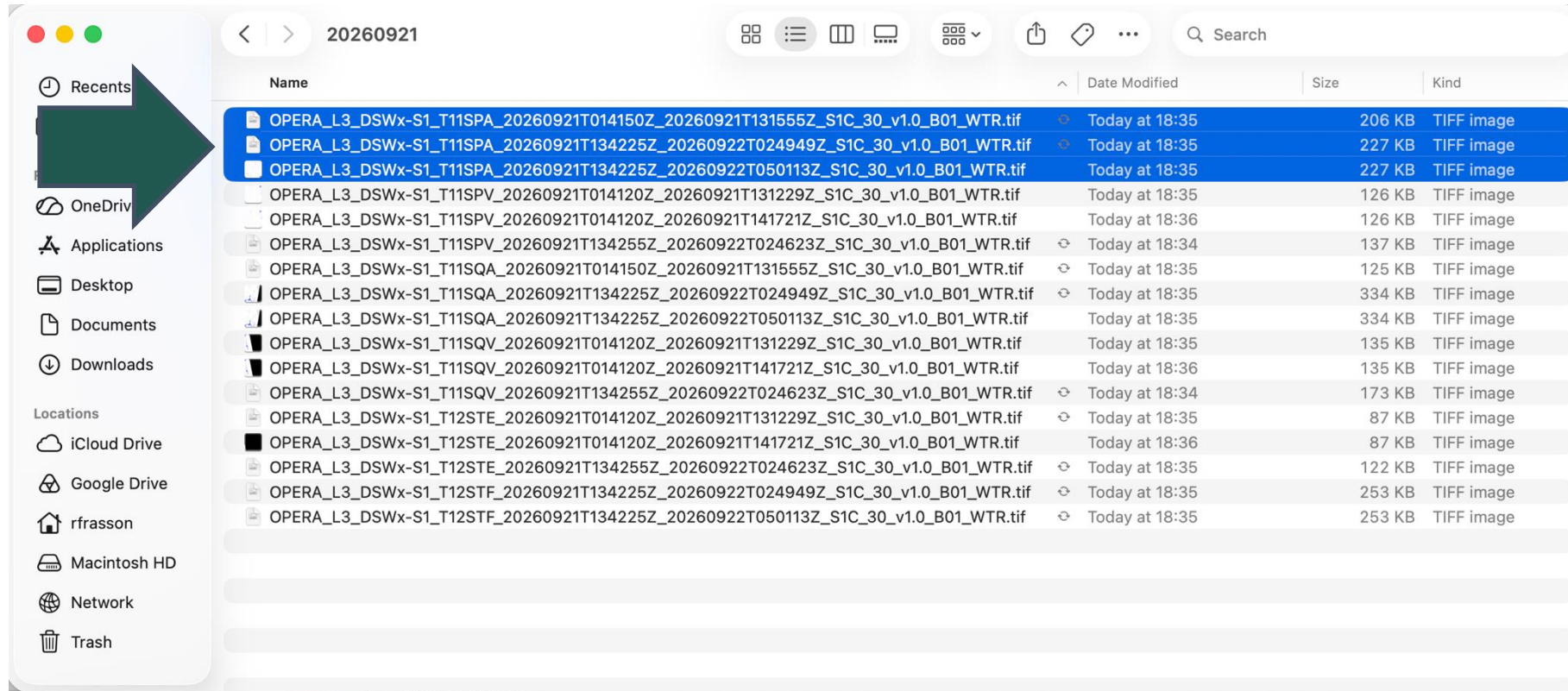
V 4.231.25 [Home](#) [NASA](#) [Accessibility](#)

NASA Official: Doug Newman

[Worldview Link](#)



Acquiring Data – Integration with Earthdata



Data Retrieval through Worldview – Earthdata Review

We learned how to:

- Find the target area.
 - Search for Lake Mead
- Add the appropriate layer.
 - DSWx-S1
- Set an area of interest.
- Integrate between Worldview and the Earthdata portal.
- Download the WTR layer.

This download method was not automated and not practical for more than a few granules. Earthdata portal offers an app that facilitates download or helps create a download script. Alternatively, programmatic data discovery and download is available through the Python Earthdata library.

Next, how to visualize data in a GIS platform.



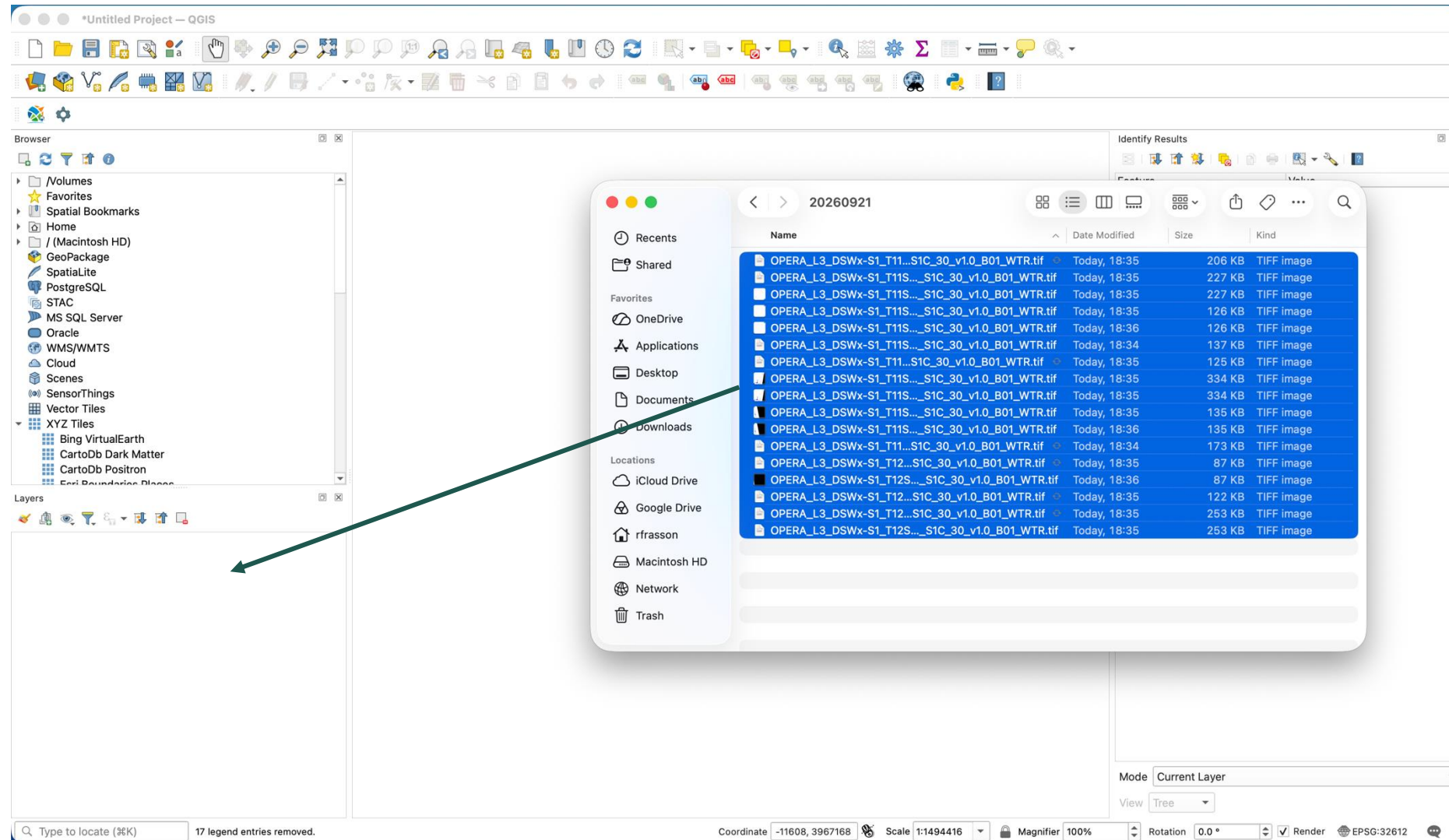
Bringing the Data into GIS and Visualizing the Change in Surface Area

Context:

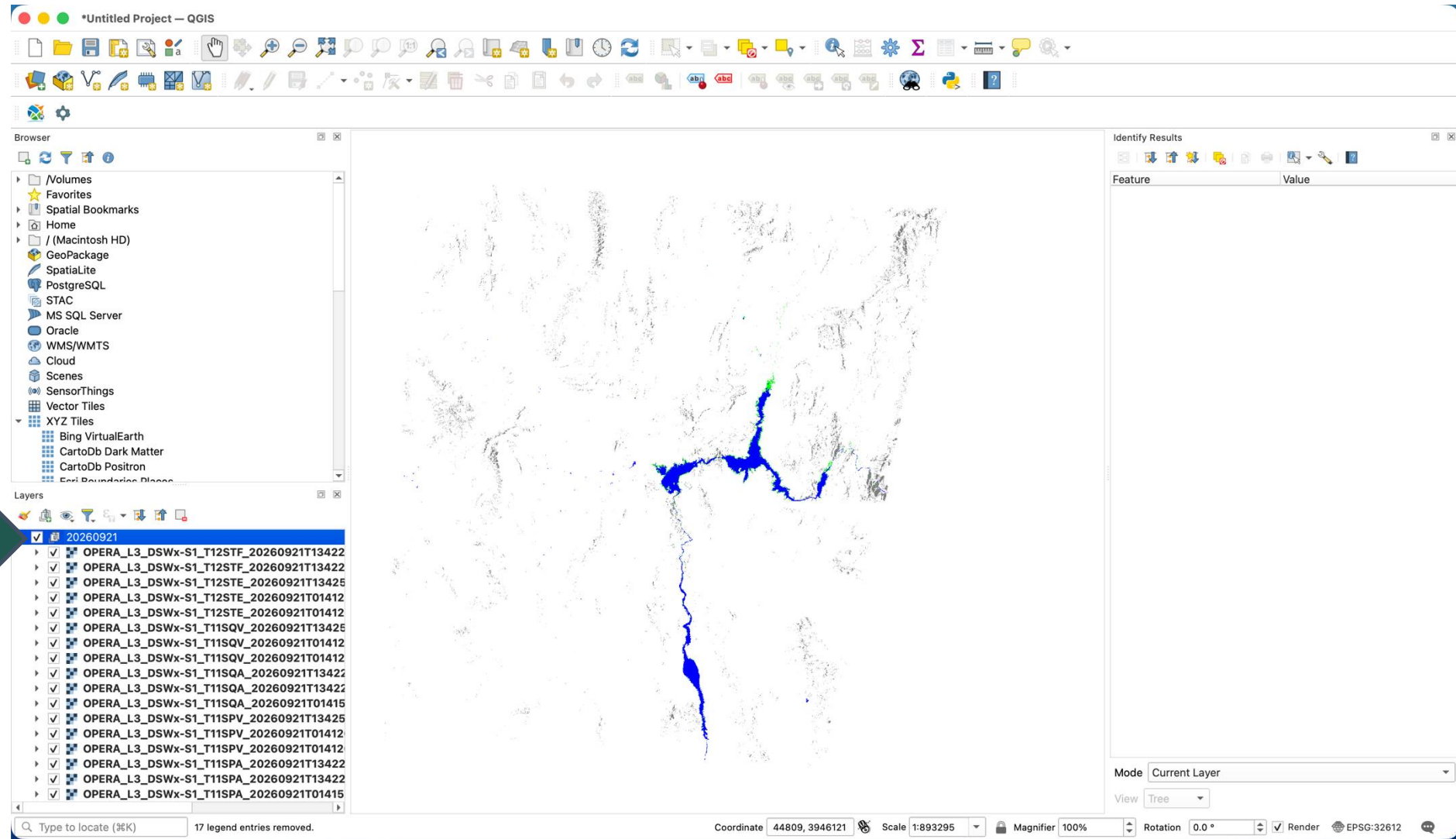
- Water levels were higher in September 2024 than currently.
 - We want to visualize the change.
- Add the lower water level data.
 - Add the DSWx-S1 captured in September 2026 and place it into a group.
- Add the higher water level data.
 - Add the DSWx-S1 captured in September 2024 into a second group.
- Order the groups so that the lower water level date is up.
- For the **low** water mask day only, make all non-water classes transparent.
- For the **high** water mask day only, change the water classes colors.



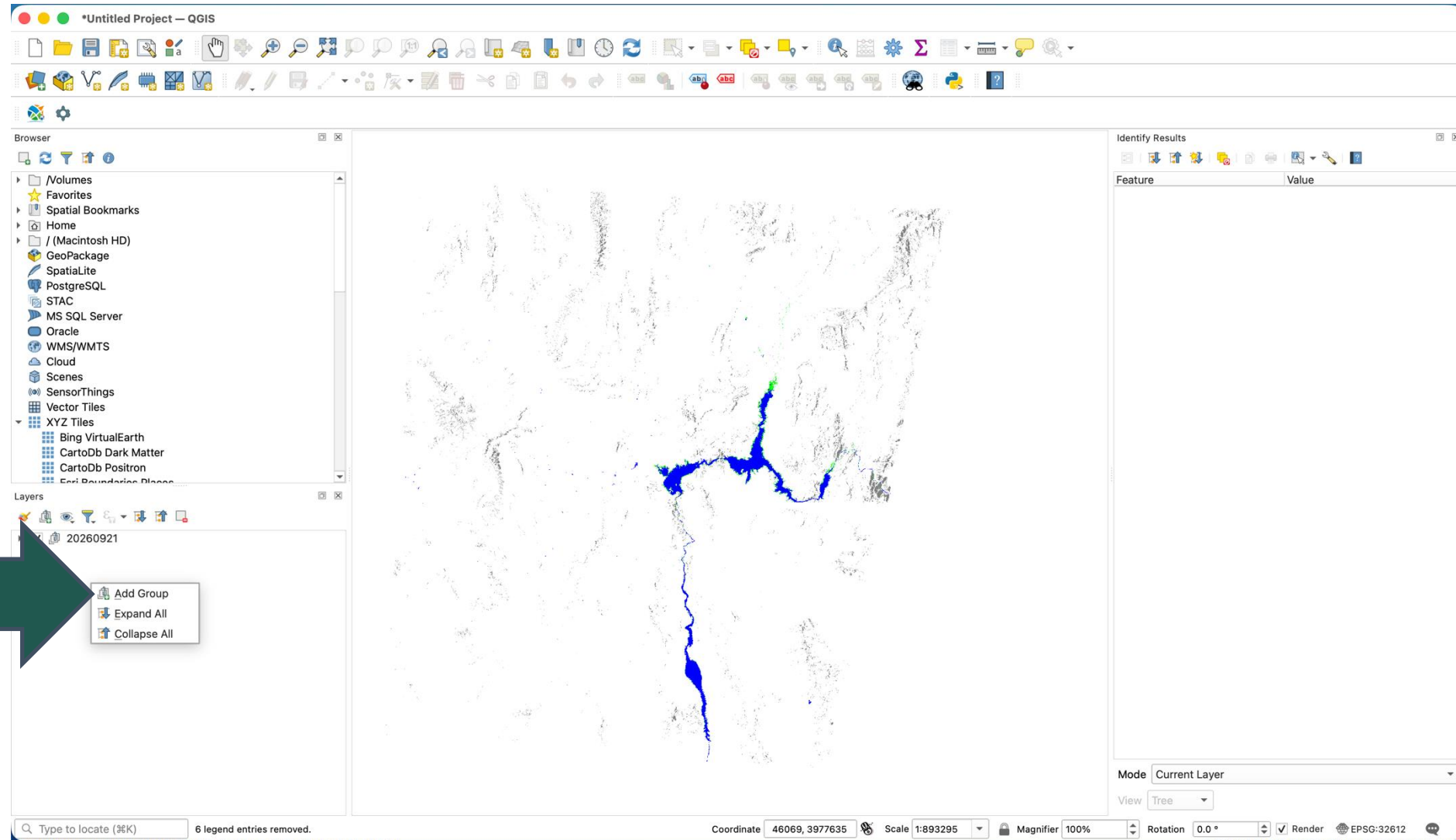
Basic GIS Operations with DSWx Data: Add Raster Layer



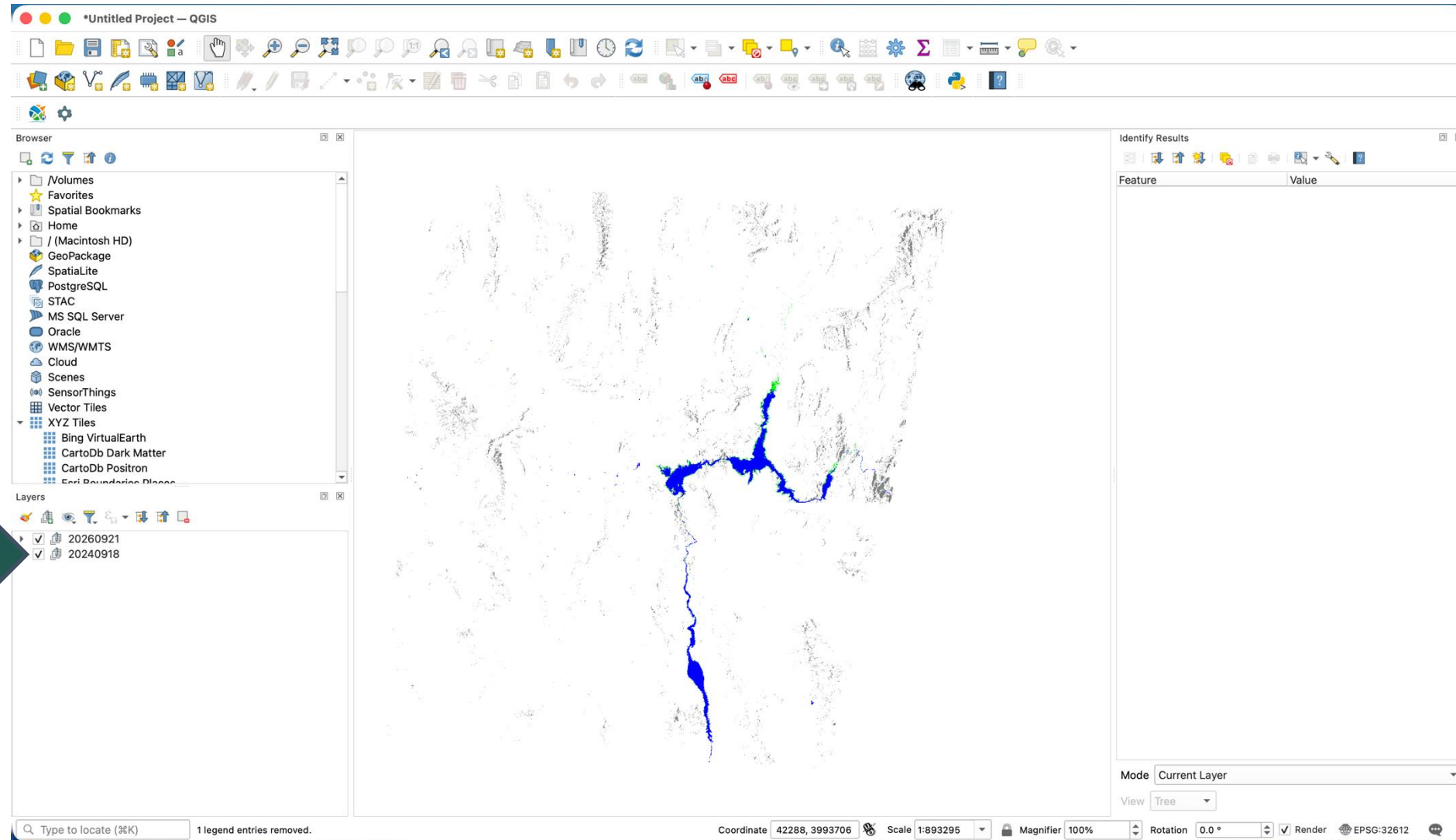
Basic GIS Operations with DSWx Data: Add Raster Layer



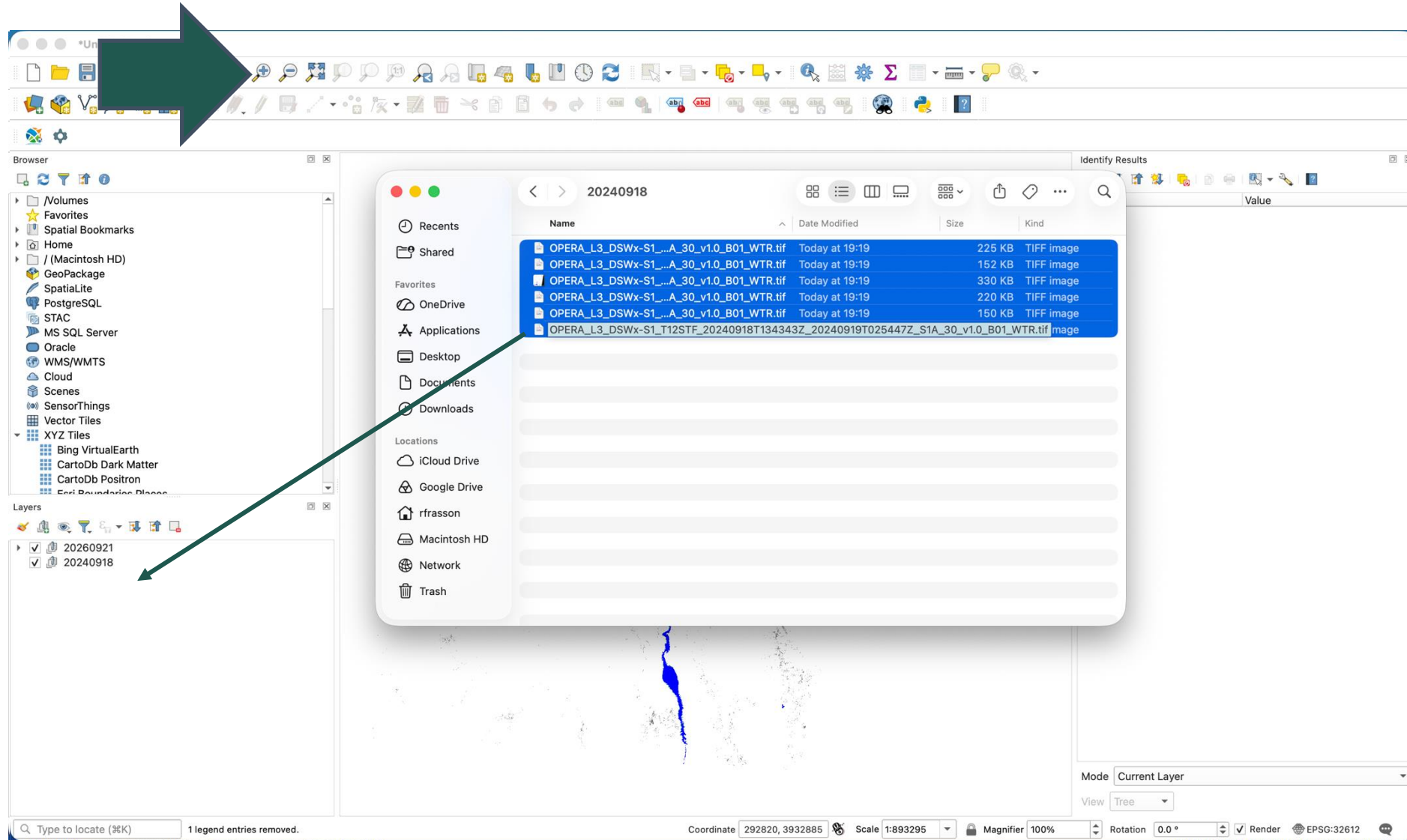
Basic GIS Operations with DSWx Data: Add Raster Layer



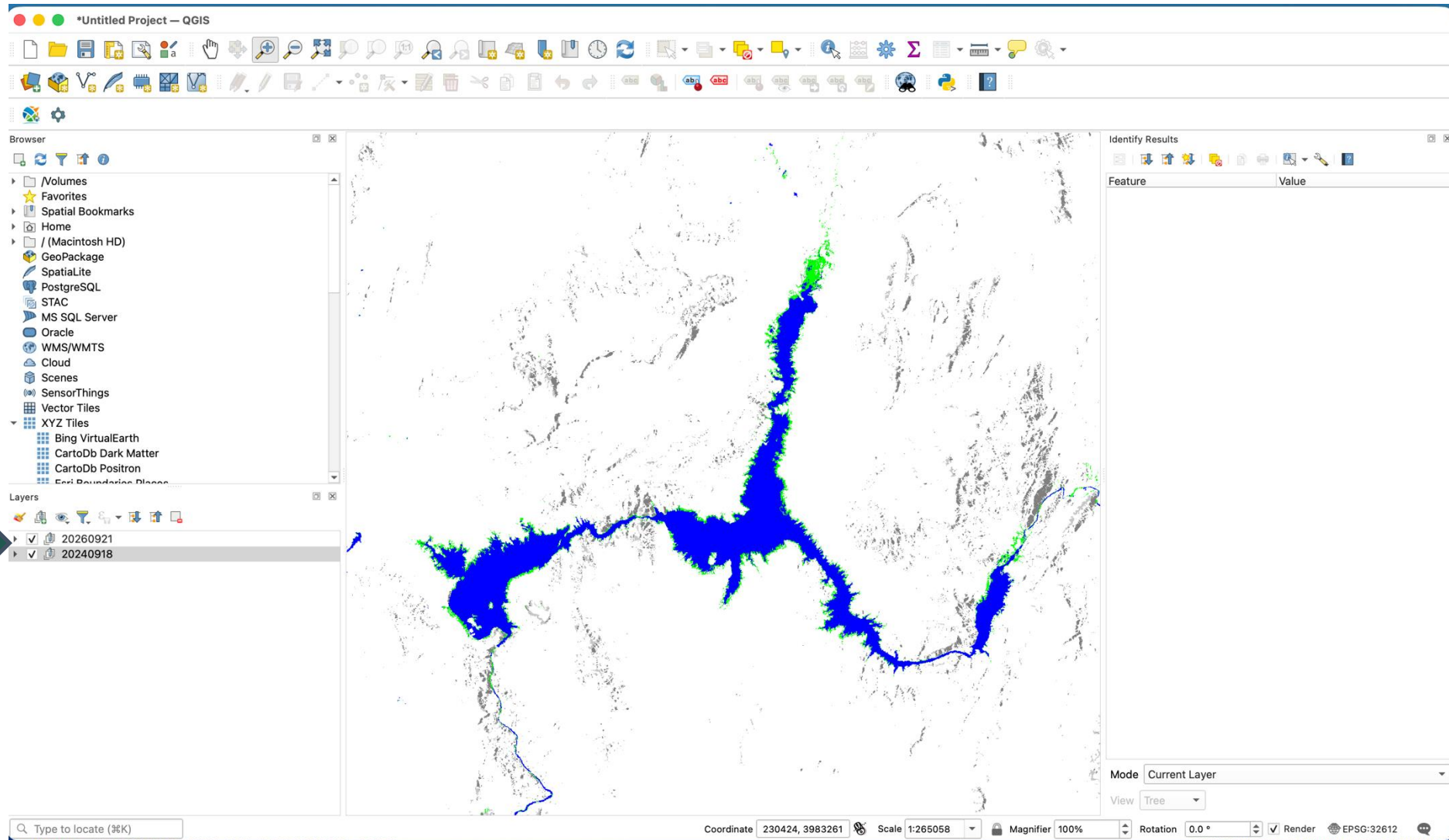
Basic GIS Operations with DSWx Data: Add Raster Layer



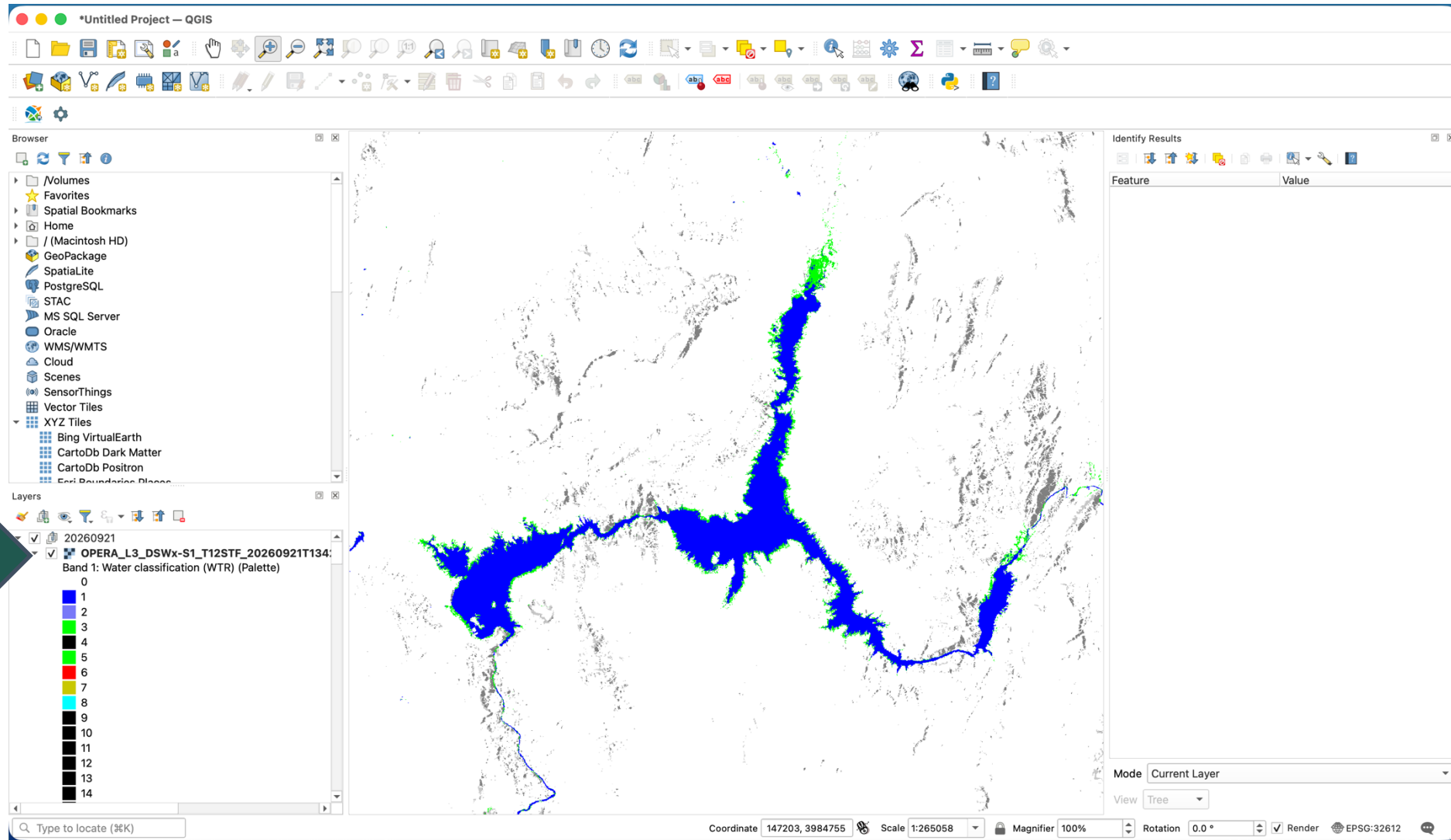
Basic GIS Operations with DSWx Data: Add Raster Layer



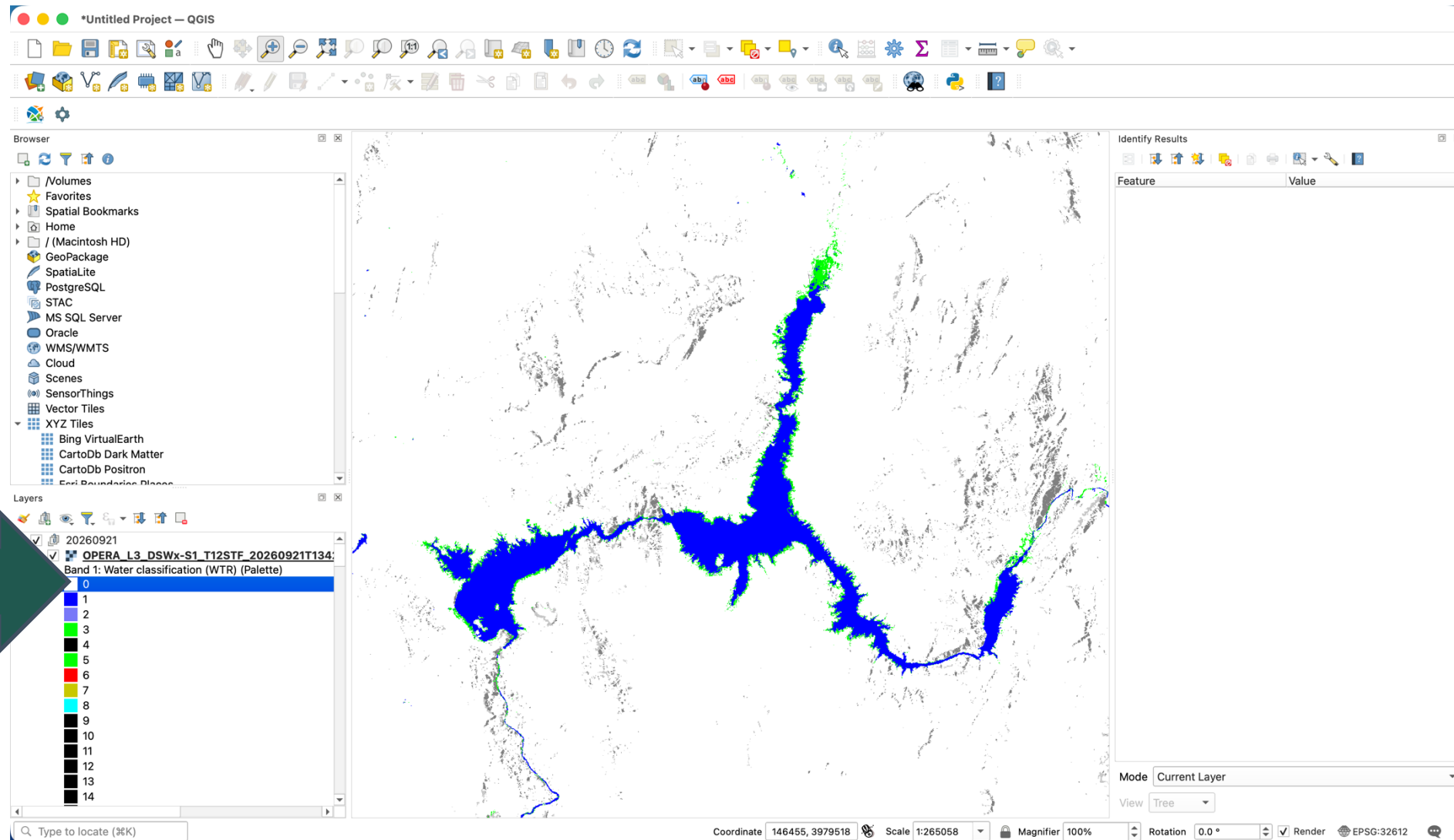
Ordering the Layers and Setting Transparencies



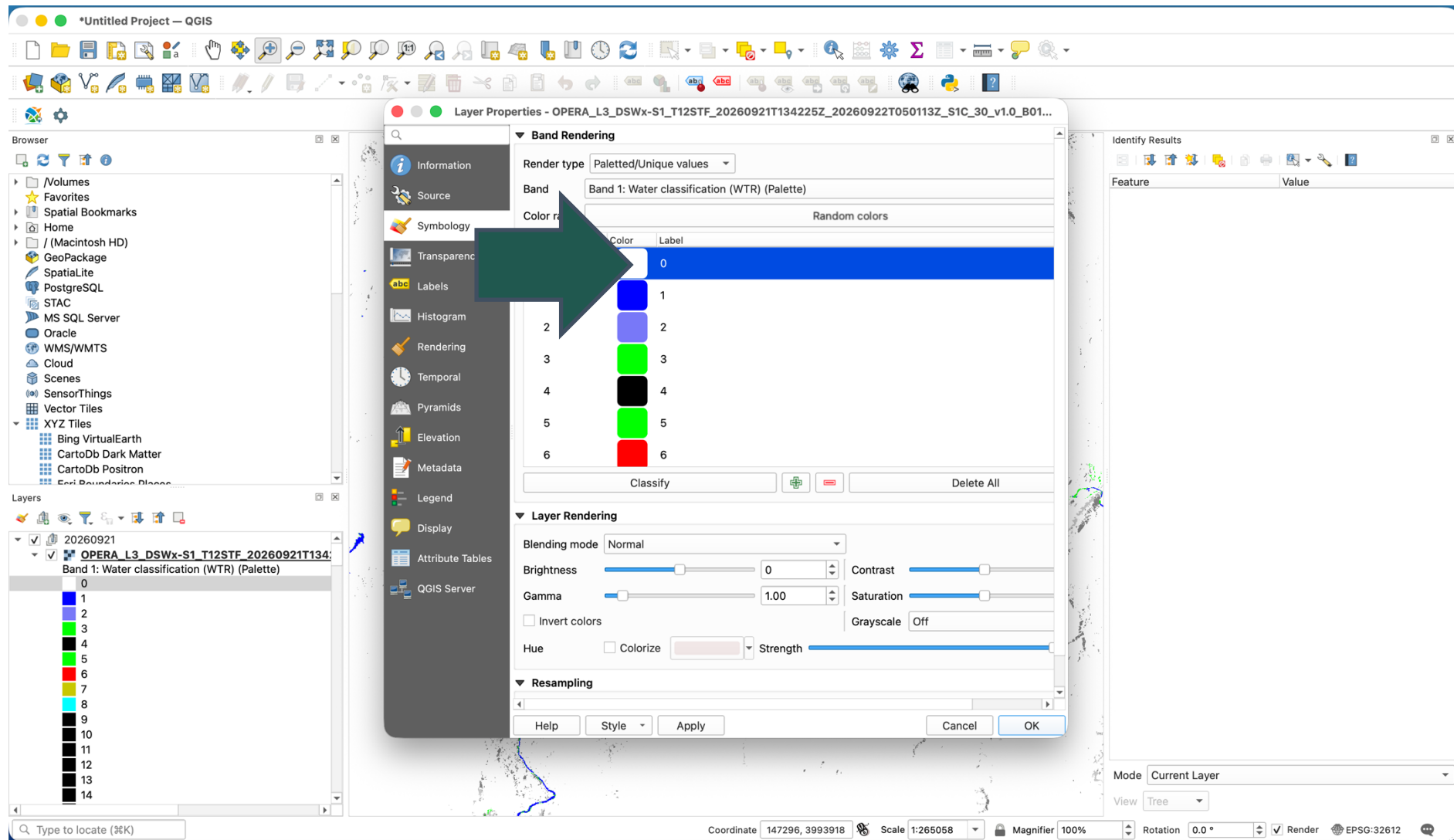
Ordering the Layers and Setting Transparencies



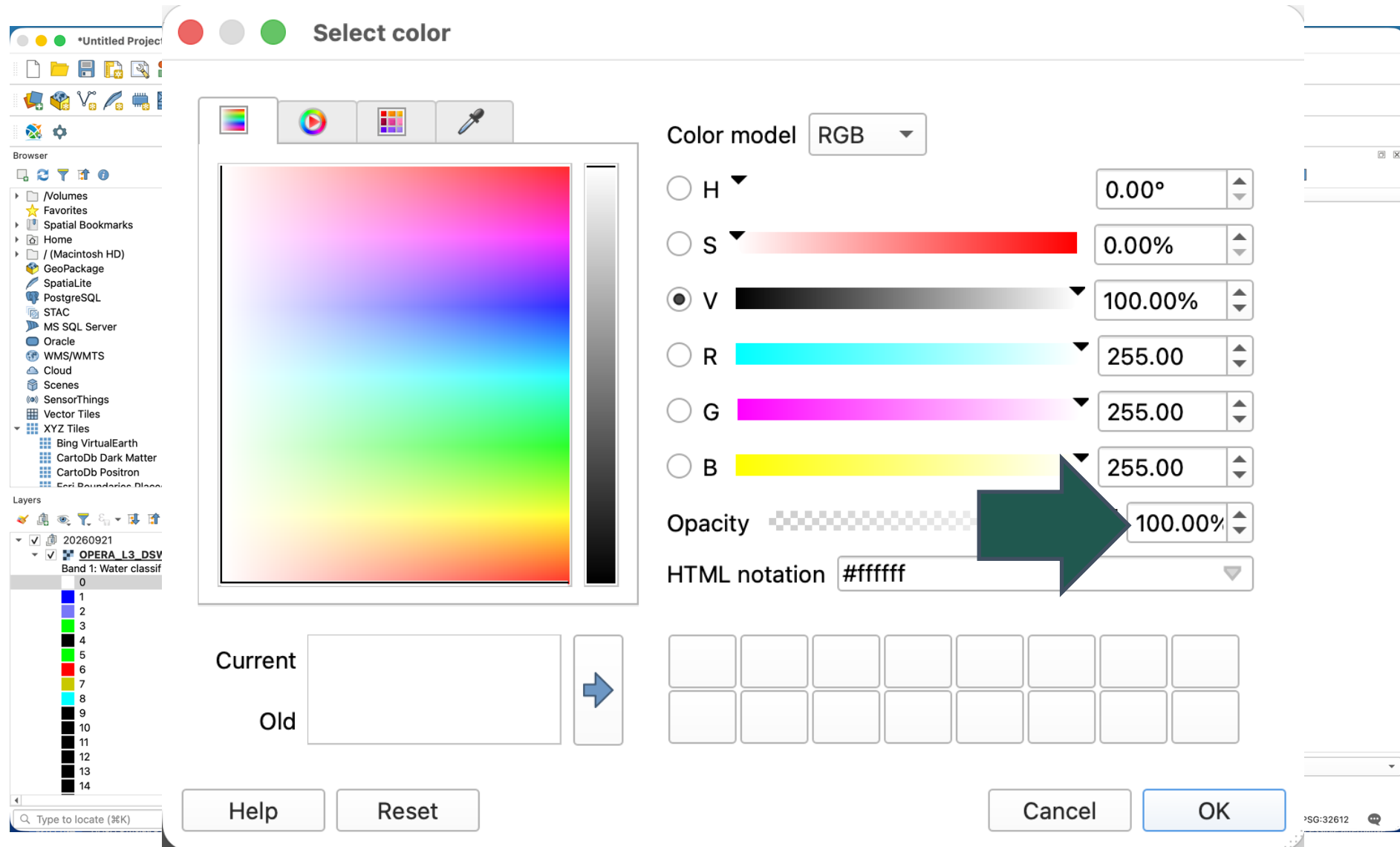
Ordering the Layers and Setting Transparencies



Ordering the Layers and Setting Transparencies



Ordering the Layers and Setting Transparencies



Ordering the Layers and Setting Transparencies

Layer Properties - OPERA_L3_DSx-S1_T12STF_20260921T134225Z_20260922T050113Z_S1C_30_v1.0_B01...

Render type: Paletted/Unique values

Band: Band 1: Water classification (WTR) (Palette)

Color ramp: Random colors

Value	Color	Label
250	[Light Blue]	250
251	[Light Blue]	251
252	[Dark Blue]	252
253	[Dark Blue]	253
254	[Dark Blue]	254

Change Color...
Change Opacity...
Change Label...

Classify [Add] [Remove] Delete All

Layer Rendering

Blending mode: Normal

Brightness: 0 Contrast: [Slider]

Gamma: 1.00 Saturation: [Slider]

☐ Invert colors Grayscale: Off

Hue: ☐ Colorize [Slider] Strength: [Slider]

Resampling

Zoomed in: Nearest Neighbour out: Nearest Neighbour Oversampling: 2.00

Help Style Apply Cancel OK



Ordering the Layers and Setting Transparencies

Layer Properties - OPERA_L3_DSx-S1_T12STF_20260921T134225Z_20260922T050113Z_S1C_30_v1.0_B01...

Render type: Paletted/Unique values

Band: Band 1: Water classification (WTR) (Palette)

Color ramp: Random colors

Value	Color	Label
250		250
251		251
252		252
253		253
254		254
255		255

Opacity dialog: Change color opacity [%] 100

Layer Rendering:

- Blending mode: Normal
- Brightness: 0
- Gamma: 1.00
- Contrast: 0
- Saturation: 0
- Grayscale: Off
- Hue: Colorize (Strength: 0)

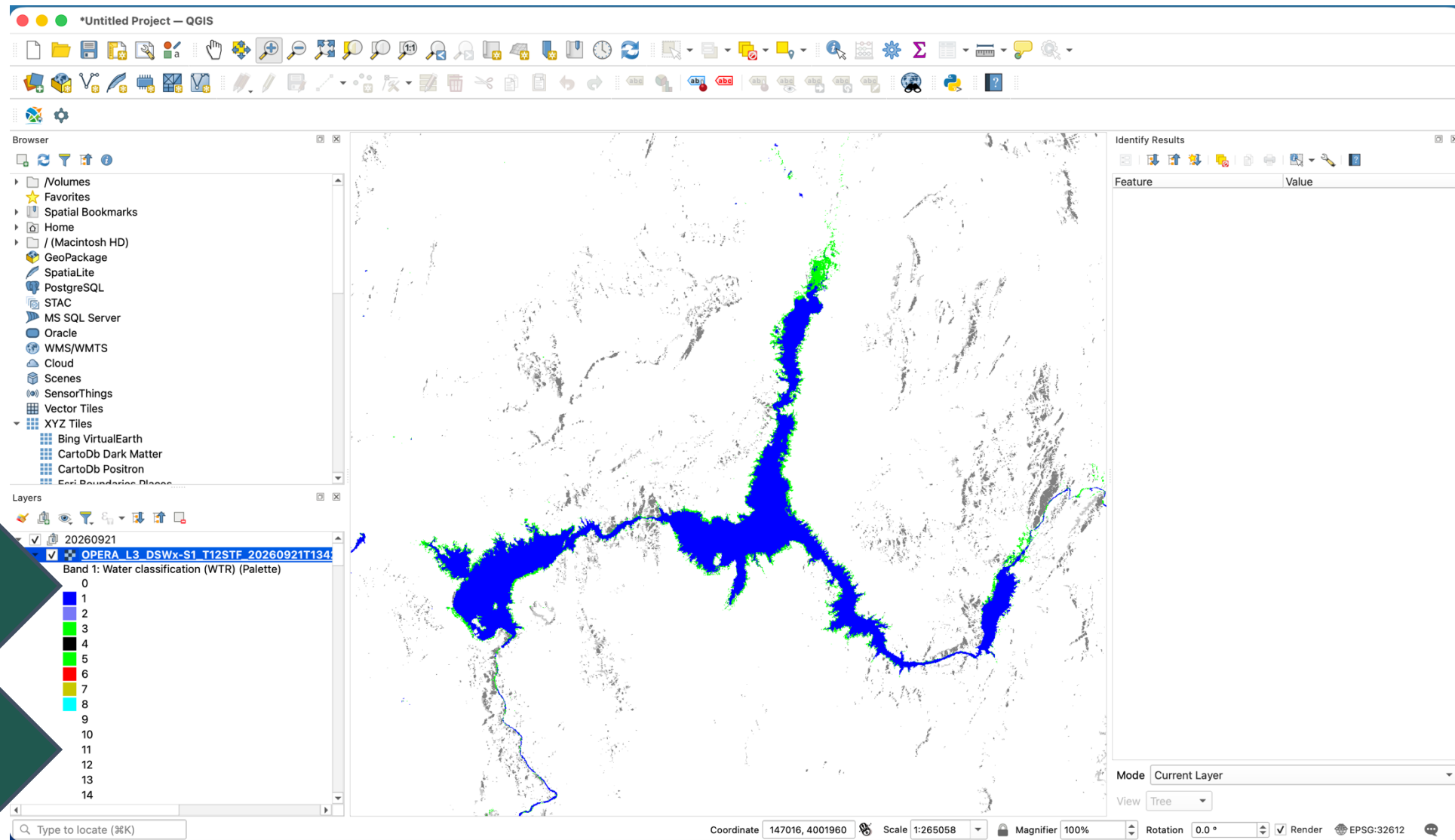
Resampling:

- Zoomed: in Nearest Neighbour out Nearest Neighbour
- Oversampling: 2.00

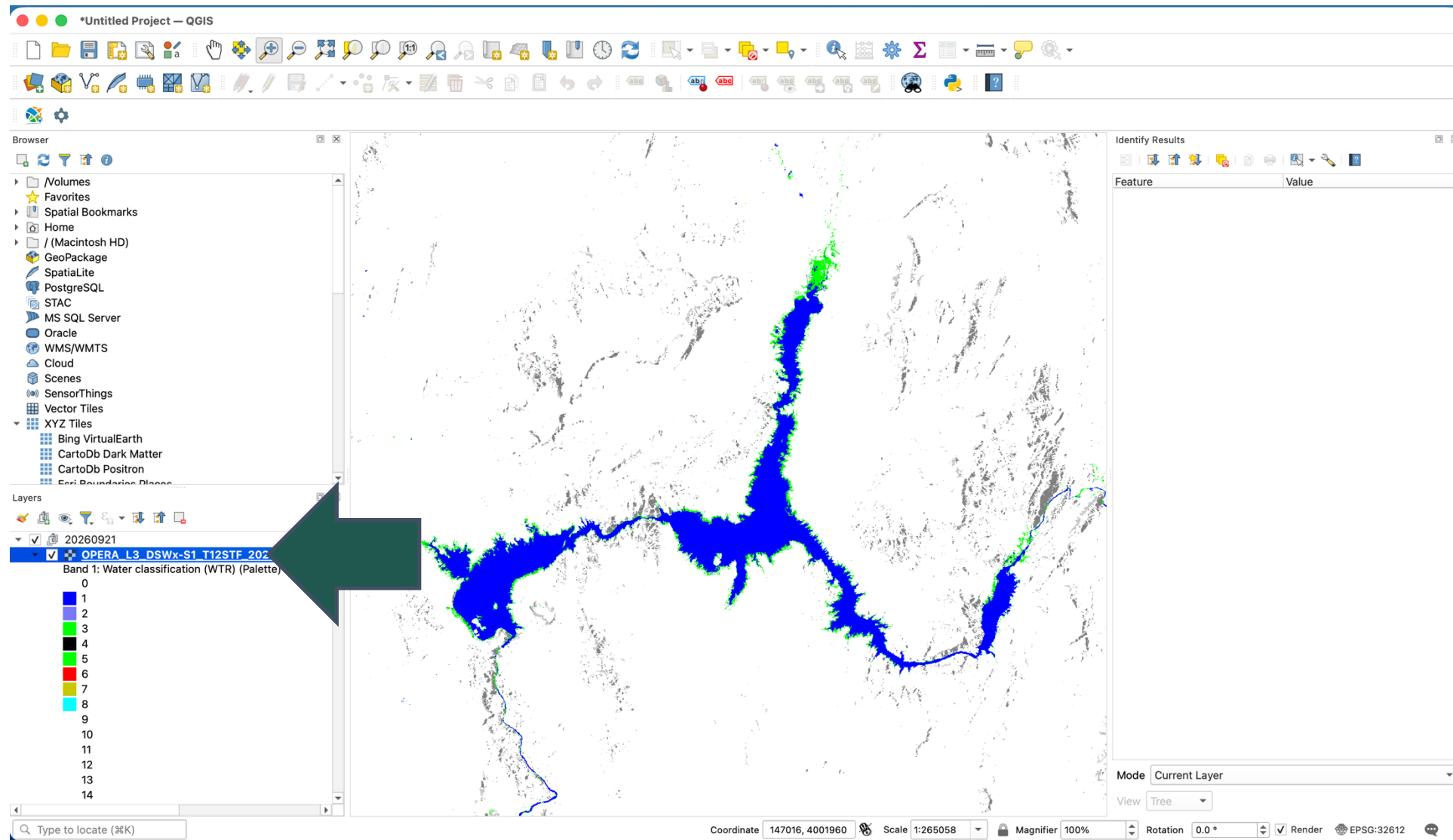
Buttons: Help, Style, Apply, Cancel, OK



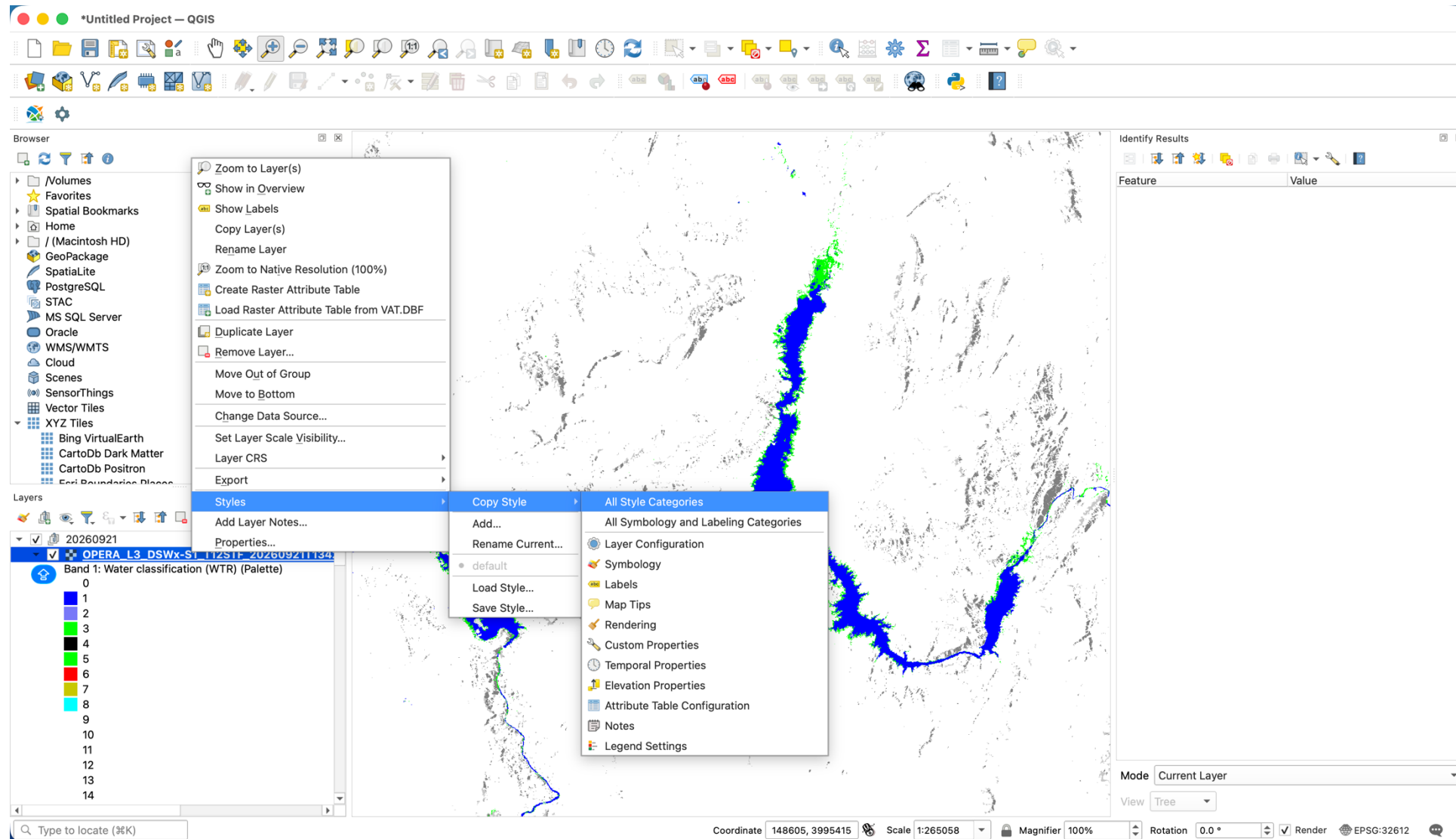
Copying the Transparencies from One Layer, Applying to the Group



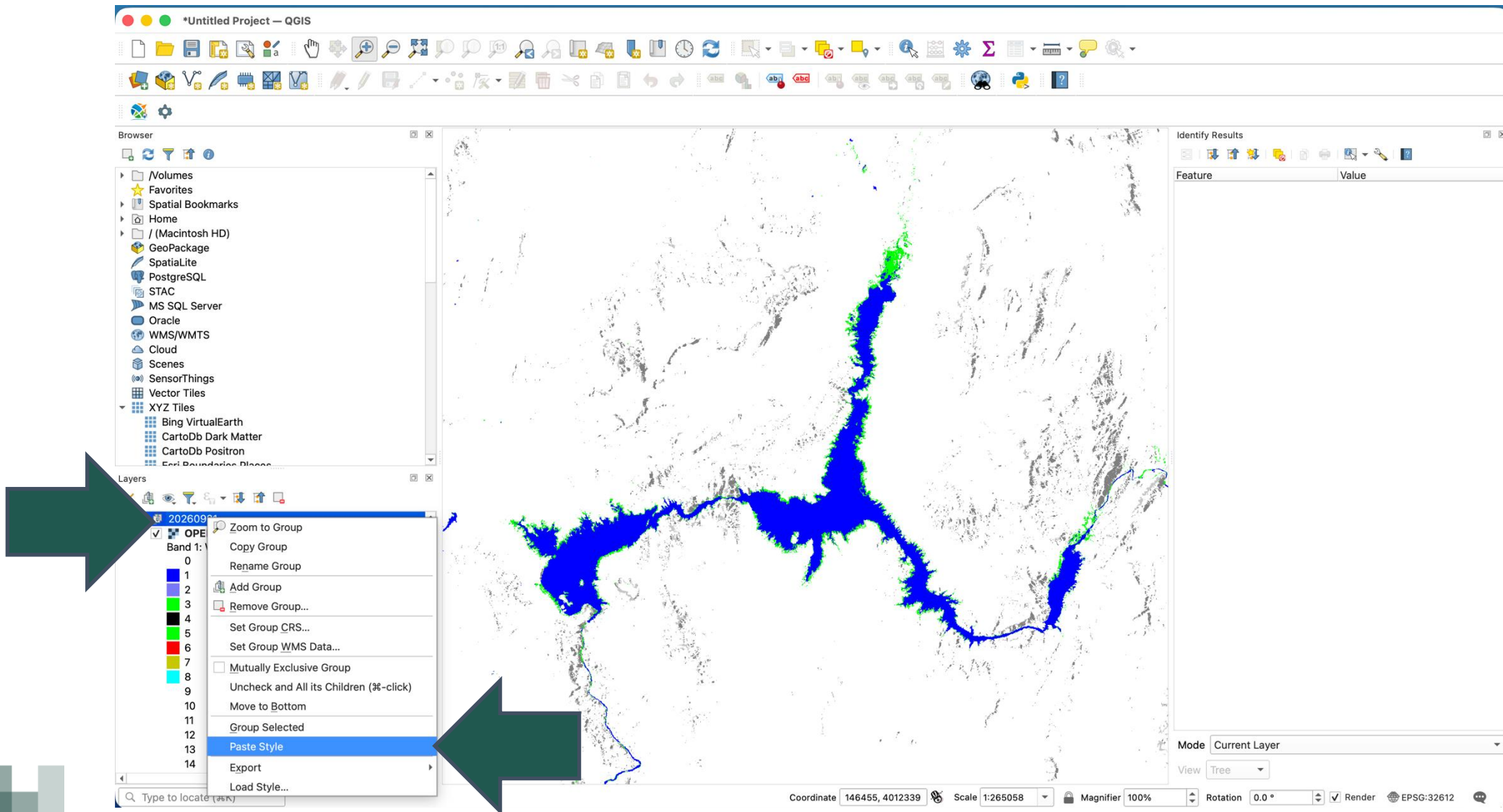
Copying the Transparencies from One Layer, Applying to the Group



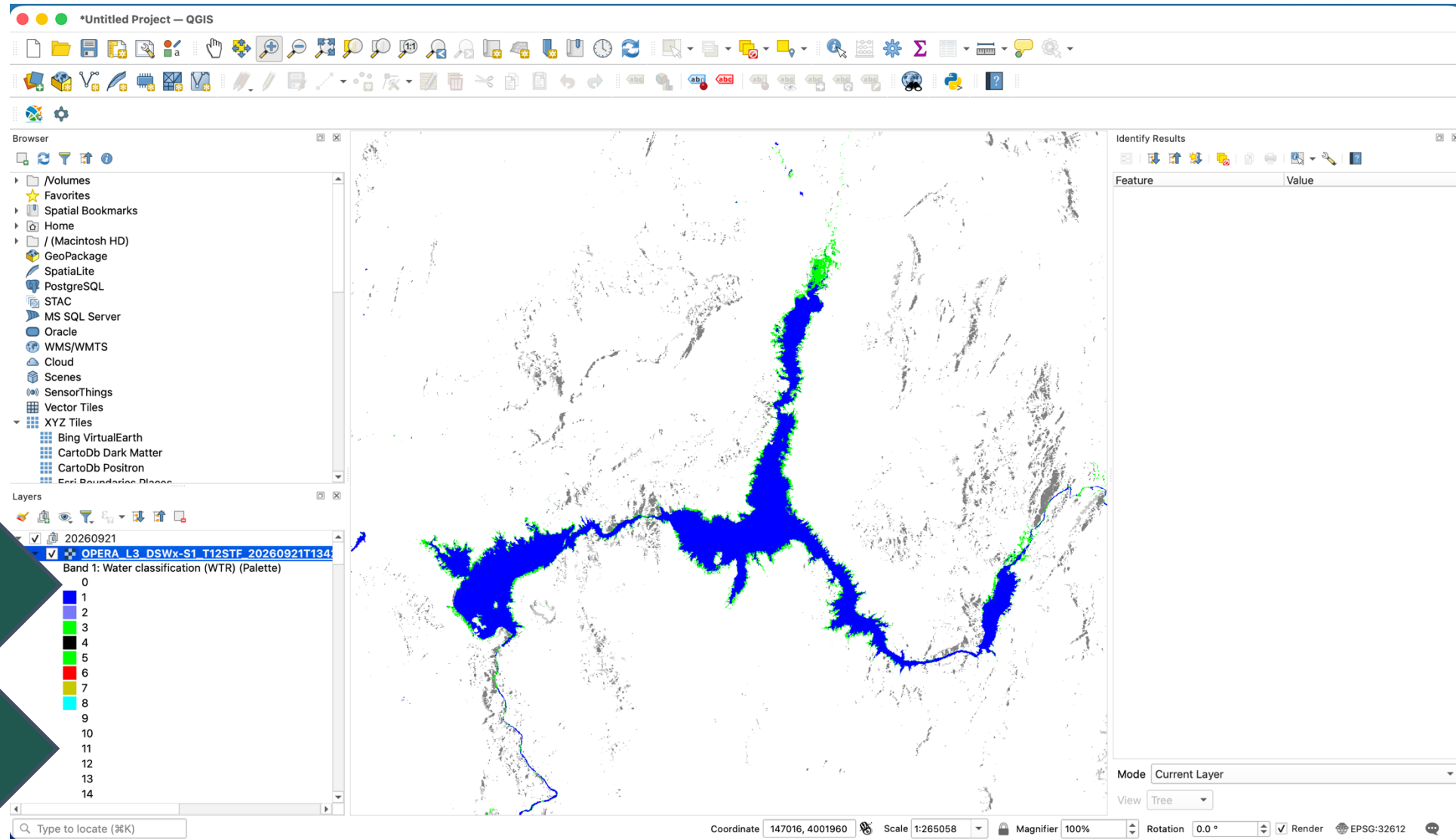
Copying the Transparencies from One Layer, Applying to the Group



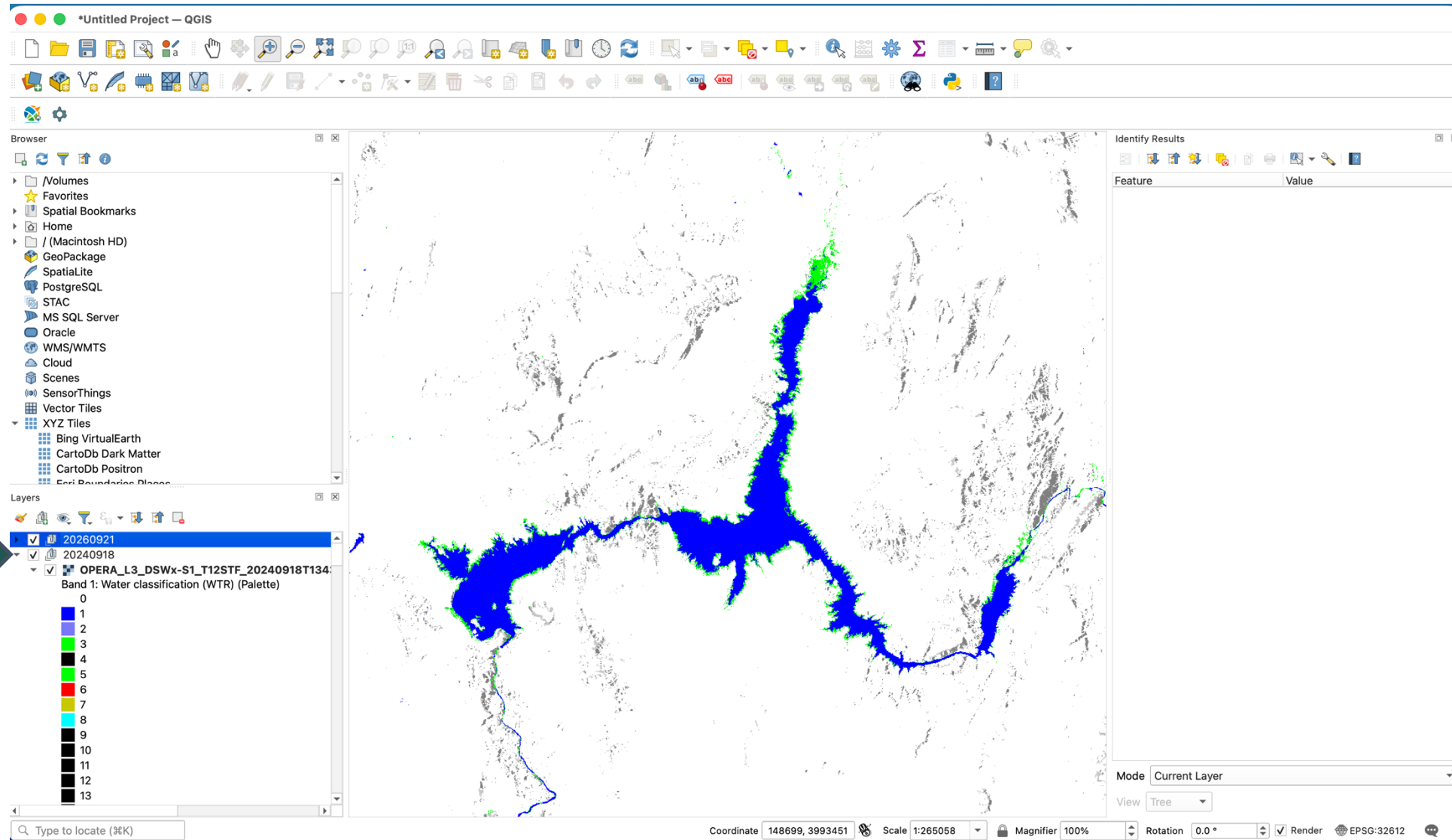
Copying the Transparencies from One Layer, Applying to the Group



Copying the Transparencies from One Layer, Applying to the Group



Setting the Water Colors in the High Water Day, Copying to the Other Layers



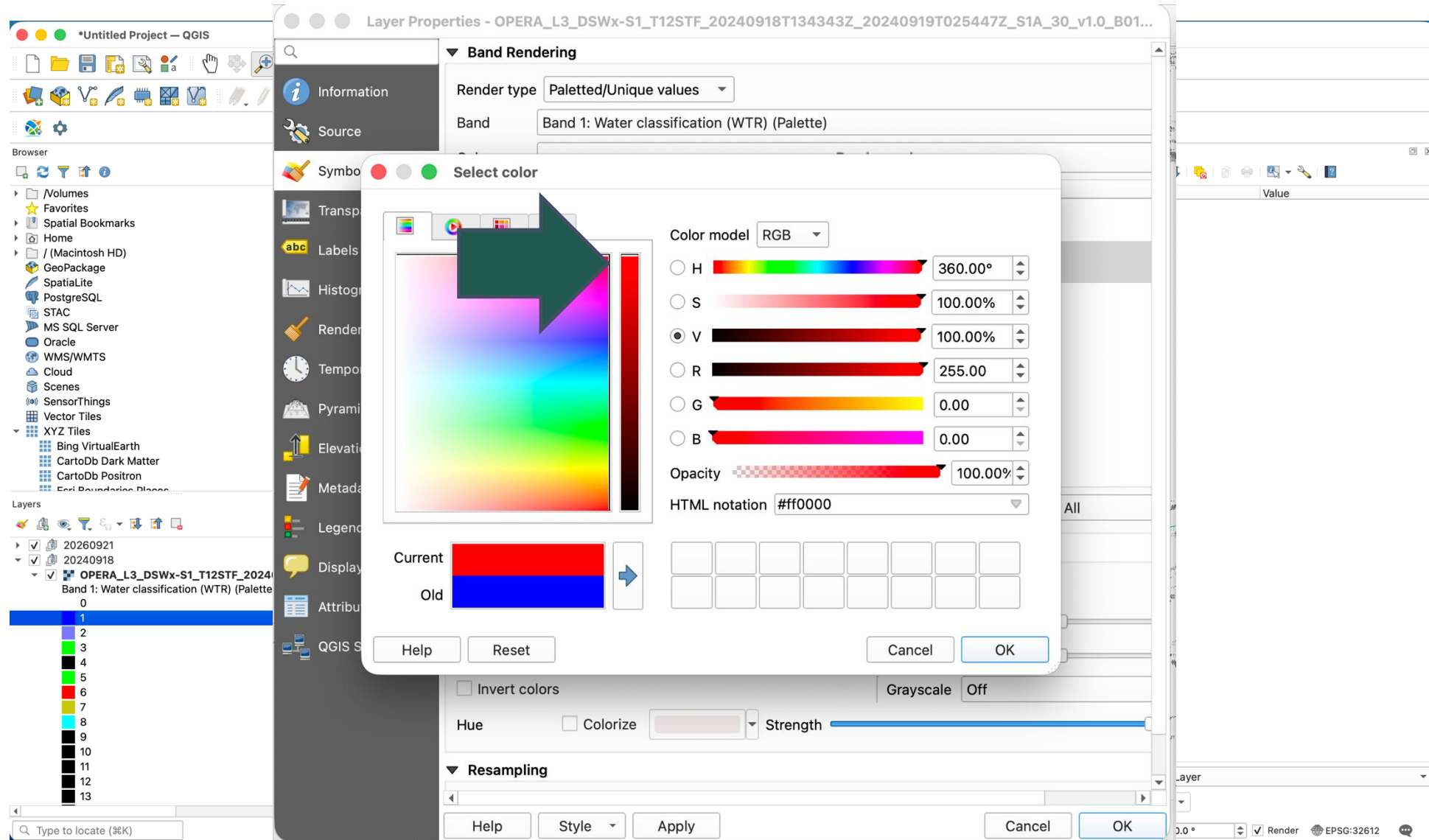
Setting the Water Colors in the High Water Day, Copying to the Other Layers

The screenshot shows the QGIS interface with the Layer Properties dialog open for the layer 'OPERA_L3_DSWx-S1_T12STF_20240918T134343Z_20240919T025447Z_S1A_30_v1.0_B01...'. The dialog is set to 'Band Rendering' with 'Render type' as 'Paletted/Unique values'. The 'Band' is 'Band 1: Water classification (WTR) (Palette)'. The 'Color ramp' is 'Random colors'. A table shows the color mapping for values 0 through 6. A large green arrow points from the 'Value' column to the 'Color' column, indicating the mapping process. The 'Layer Rendering' section shows 'Blending mode' as 'Normal', 'Brightness' at 0, 'Gamma' at 1.00, 'Contrast' at 0, 'Saturation' at 0, 'Grayscale' as 'Off', and 'Hue' as 'Colorize'. The 'Resampling' section is also visible. The 'Layers' panel on the left shows the layer 'OPERA_L3_DSWx-S1_T12STF_20240918T134343Z_20240919T025447Z_S1A_30_v1.0_B01...' selected, with a large green arrow pointing to it.

Value	Color	Label
0		0
1	Blue	1
2	Purple	2
3	Green	3
4	Black	4
5	Green	5
6	Red	6



Setting the Water Colors in the High Water Day, Copying to the Other Layers



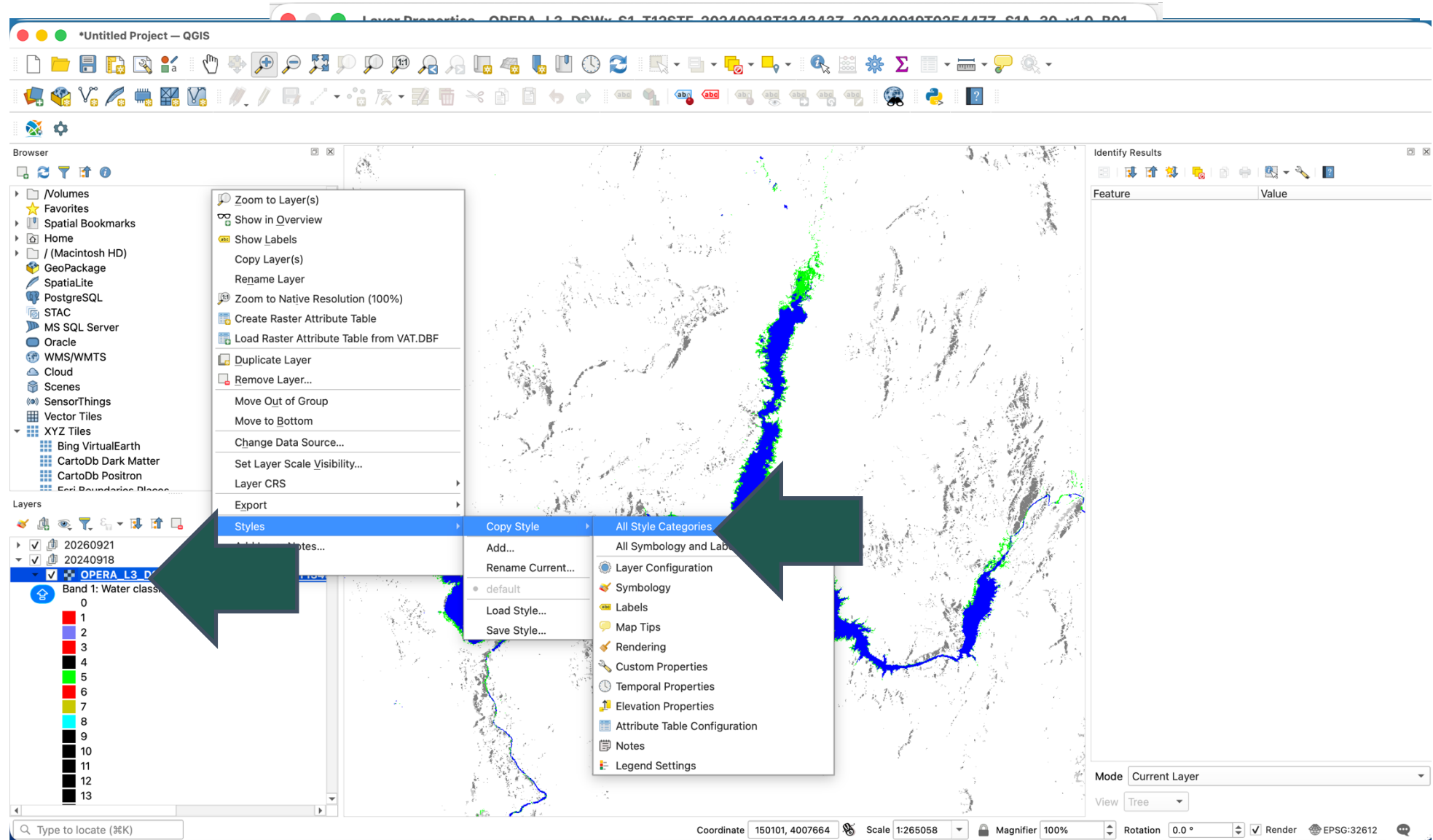
Setting the Water Colors in the High Water Day, Copying to the Other Layers

The screenshot shows the QGIS interface with the Layer Properties dialog open for the layer 'OPERA_L3_DSWx-S1_T12STF_20240918T134343Z_20240919T025447Z_S1A_30_v1.0_B01...'. The dialog is set to 'Band Rendering' with 'Render type' as 'Paletted/Unique values'. The 'Band' is 'Band 1: Water classification (WTR) (Palette)'. The 'Color ramp' is 'Random colors'. A table shows the color mapping for values 0 through 6. A large green arrow points to the row for value 3, which is highlighted in blue. The 'Layer Rendering' section shows 'Blending mode' as 'Normal', 'Brightness' at 0, 'Gamma' at 1.00, 'Contrast' at 0, 'Saturation' at 0, 'Invert colors' unchecked, 'Hue' unchecked, and 'Strength' at 0. The 'Resampling' section is empty. The 'Layers' panel on the left shows the layer 'OPERA_L3_DSWx-S1_T12STF_20240918T134343Z_20240919T025447Z_S1A_30_v1.0_B01...' selected.

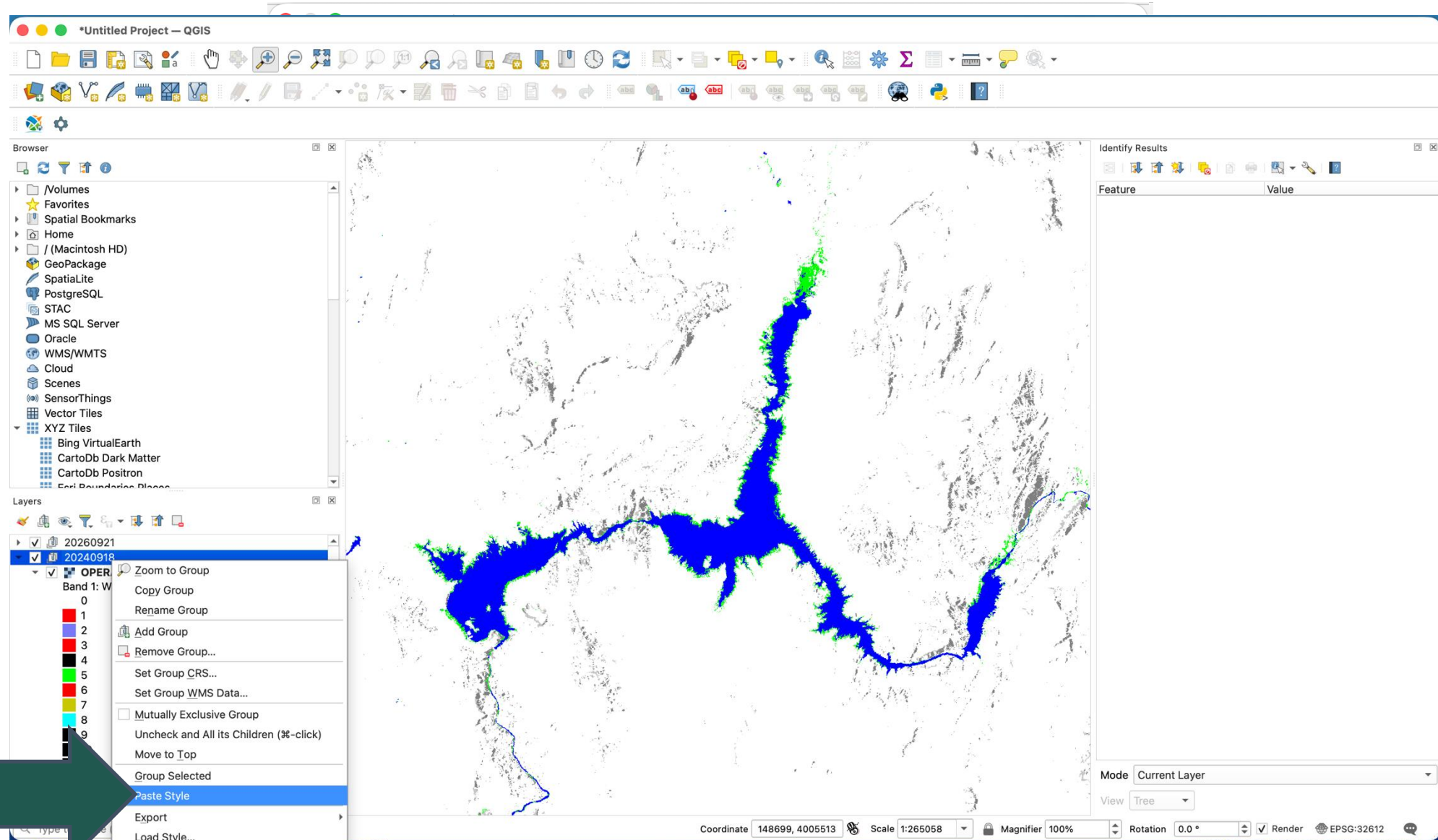
Value	Color	Label
0		0
1	Red	1
2	Purple	2
3	Blue	3
4	Black	4
5	Green	5
6	Red	6



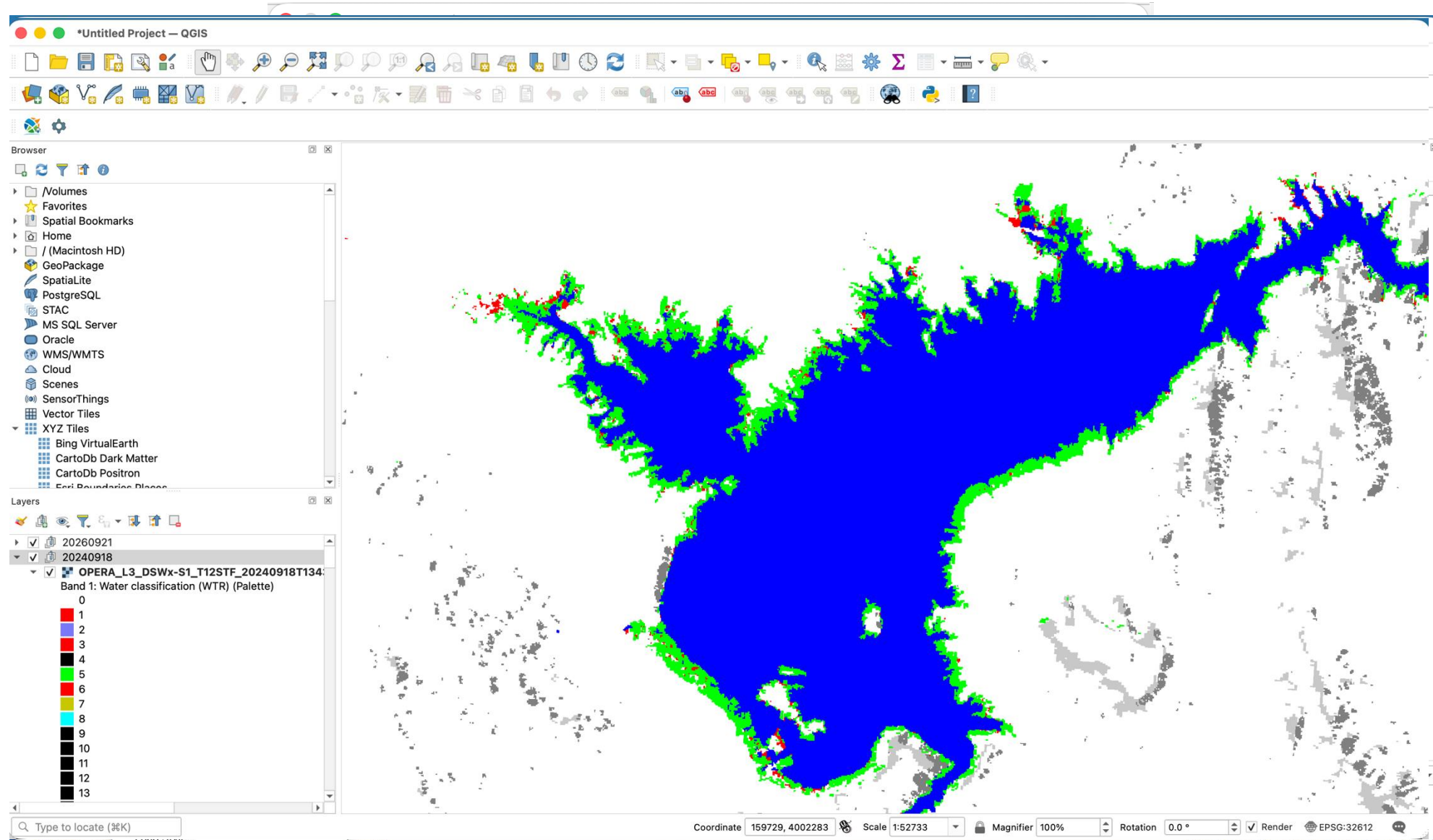
Setting the Water Colors in the High Water Day, Copying to the Other Layers



Setting the Water Colors in the High Water Day, Copying to the Other Layers

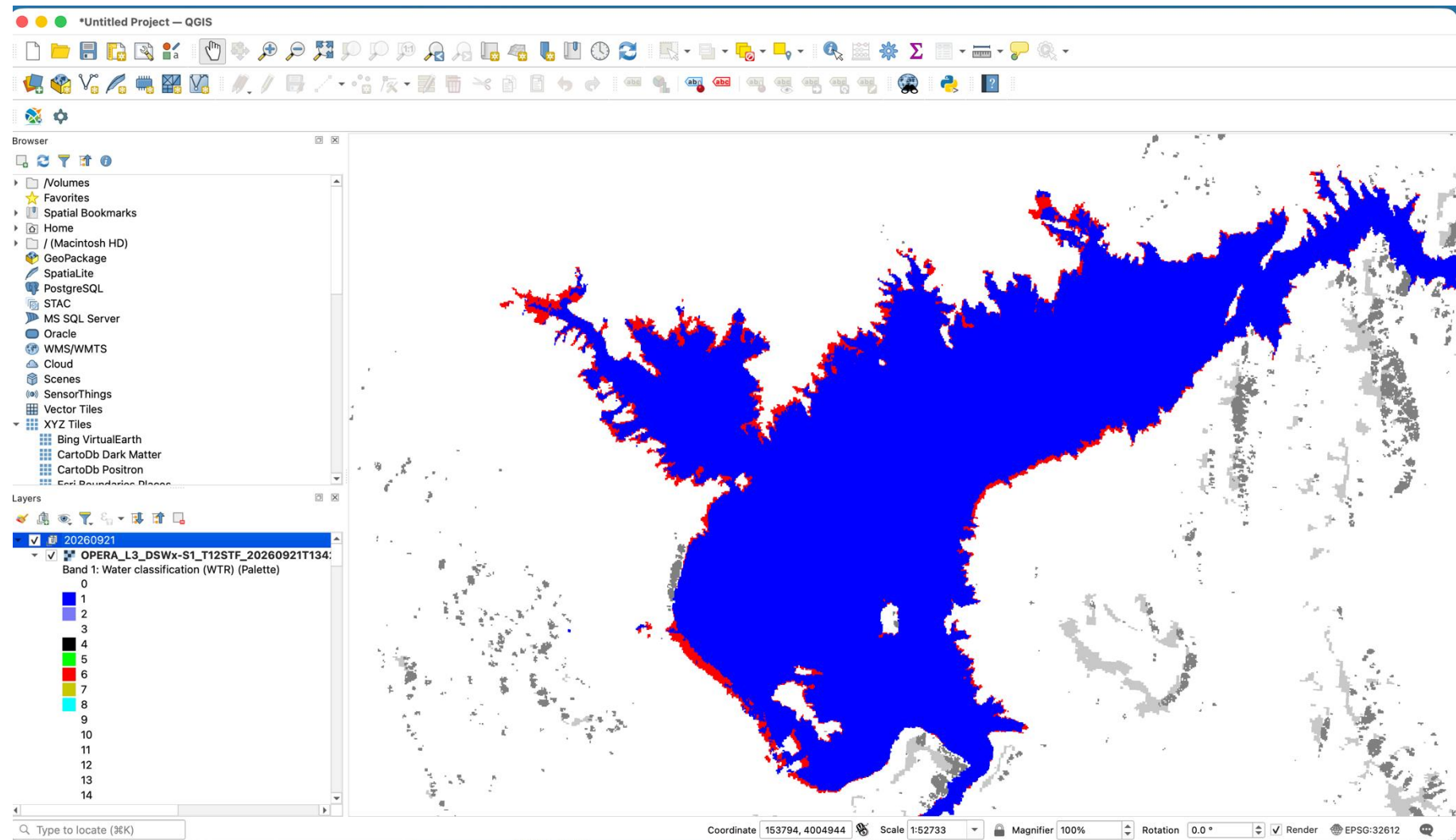


Setting the Water Colors in the High Water Day, Copying to the Other Layers



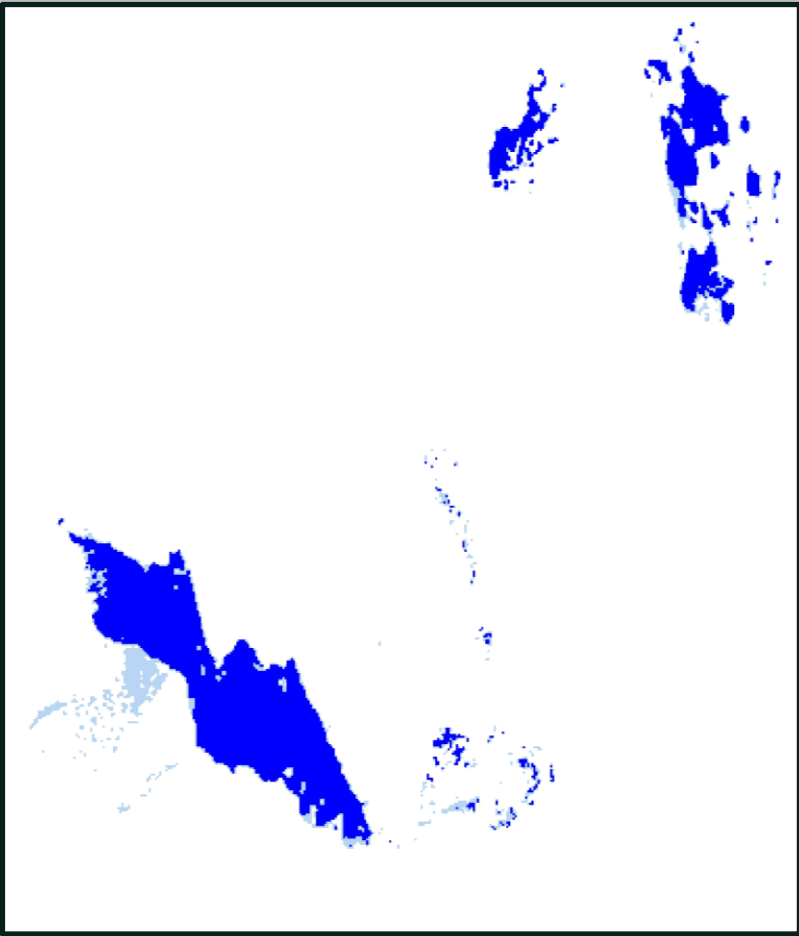
Examining Change in Open Water Only

1. Hide class 3 in both groups.
 - Change in surface area is more dramatic.
2. Why disregarding class 3 is appropriate here:
 - Little vegetation cover bordering Lake Mead.
3. Calculating water areas for these days and others gives important quantitative information.



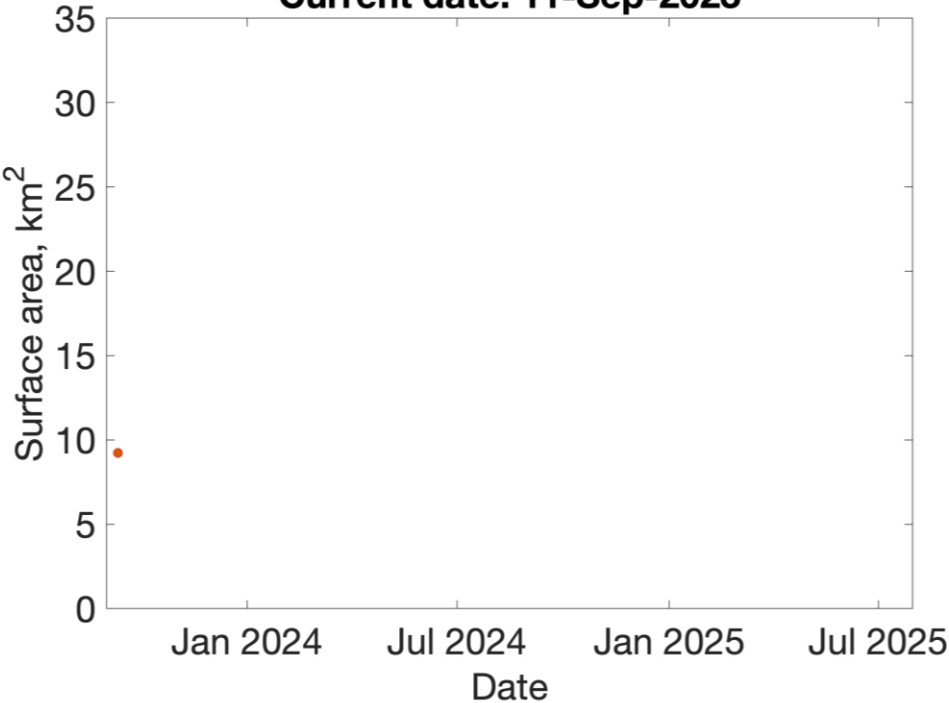
Monitoring Surface Water with DSWx

Al Asfar lake



0 3 km

Current date: 11-Sep-2023



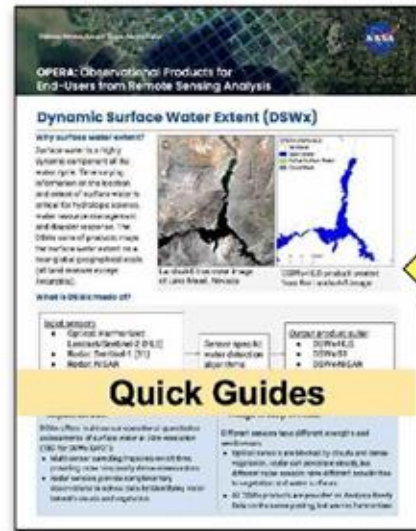
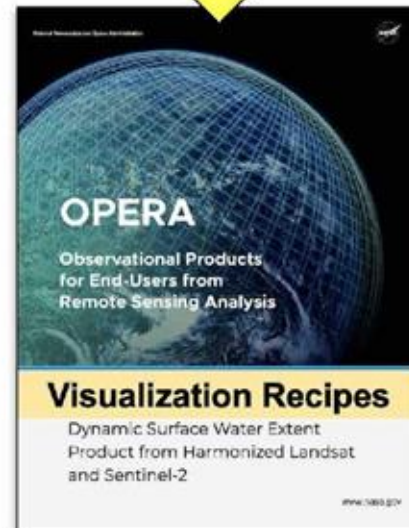
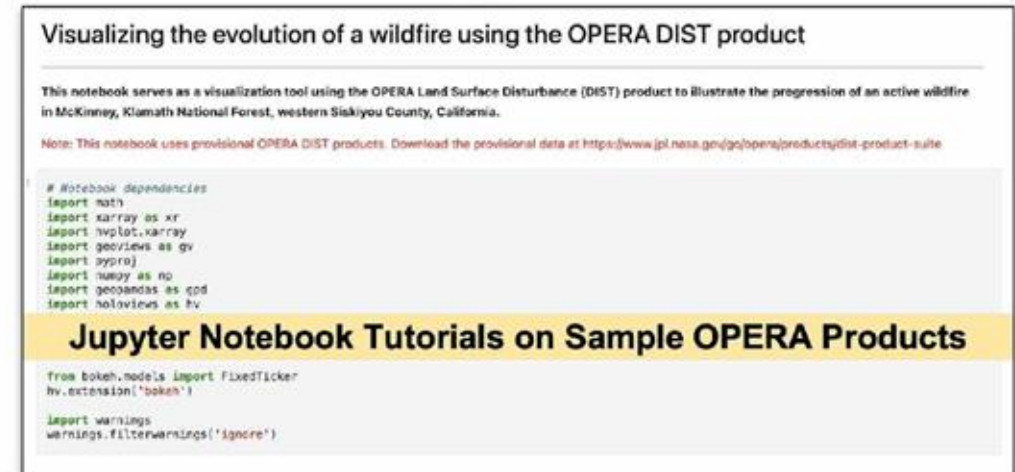
Dynamic Surface Water Extent Colors

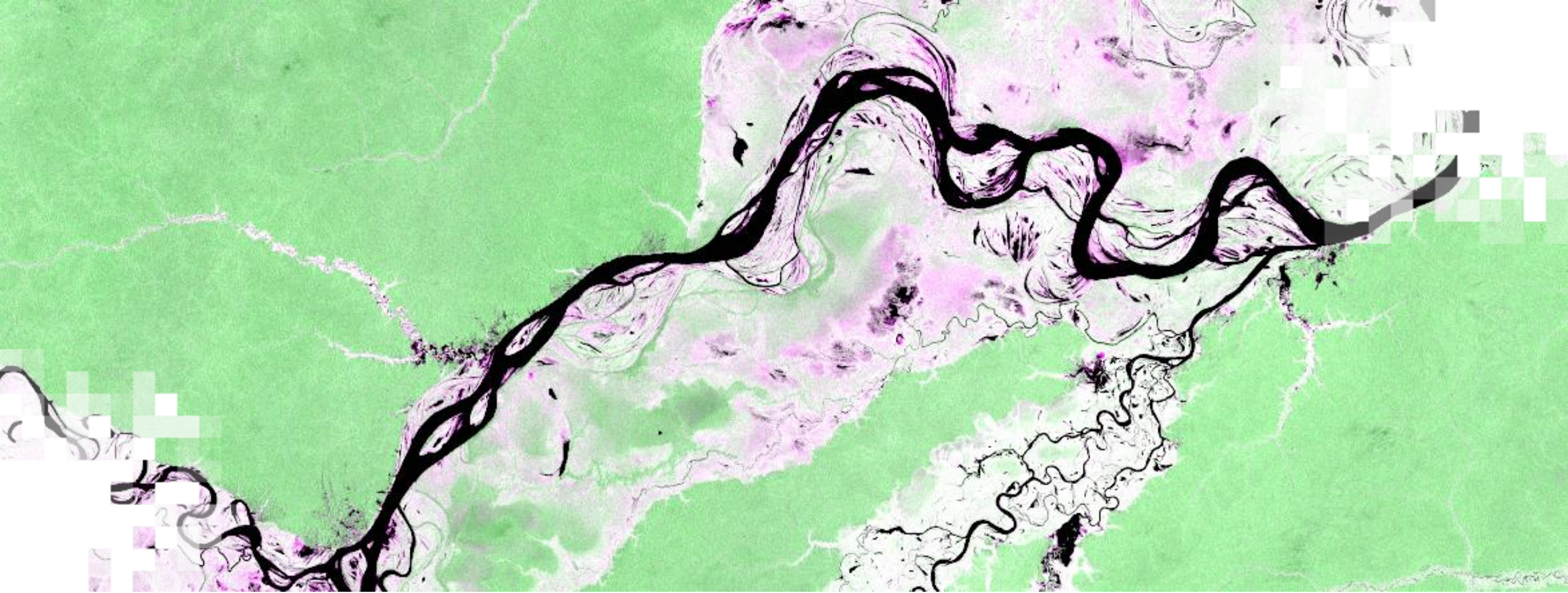
- Open Surface Water
- Partial Surface Water
- Clouds/Cloud Shadows



Additional OPERA Tools and Tutorials

We maintain a regularly updated website and manage an active [Stakeholder Engagement Program \(SEP\)](#) to engage with science, application and federal stakeholders. We support the broader SNWG SEP.





Summary

Summary

- OPERA Surface Water Extent products are analysis-ready datasets that reduce the need for users to process raw satellite imagery.
- DSWx products provide standardized classifications of surface water, enabling consistent monitoring across different regions and time periods.
- Surface water monitoring requires understanding product limitations, including challenges related to cloud cover, vegetation, terrain, and classification uncertainty.
- Time series analysis of DSWx products enables users to track flooding events, seasonal water dynamics, and long-term changes in surface water extent.
- Open-source tools such as NASA Worldview and QGIS allow users to visualize, analyze, and integrate OPERA DSWx products into their own workflows.
- NISAR's L-band observations provide new opportunities for monitoring inundation in vegetated environments where traditional optical and shorter-wavelength SAR observations may be limited.
- OPERA DSWx products support applications ranging from emergency response after flooding events to long-term water resource management.



Homework and Certificates

- **Homework:**
 - One homework assignment
 - Opens on 10/27/2026
 - Access from the [training webpage](#)
 - Answers must be submitted via Google Forms
 - **Due by Nov. 17, 2026**
- **Certificate of Completion:**
 - Attend both live sessions (attendance is recorded automatically)
 - Complete the homework assignment by the deadline
 - You will receive a certificate via email approximately two months after completion of the course.



Contact Information

Instructors:

- Renato Frasson
 - renato.prata.de.moraes.frasson@jpl.nasa.gov
- Erika Podest
 - erika.podest@jpl.nasa.gov

- [ARSET Website](#)
- [ARSET YouTube](#)

For questions, comments, or to share how you have applied our trainings to your work or studies, email nasa.arset@gmail.com.

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Thank You!

