



OPERA

Observational Products for End-Users from
Remote Sensing Analysis

Fifth OPERA Workshop

September 11, 2025

Accessing OPERA Data
Matthew Bonnema
NASA Jet Propulsion Laboratory

Accessing OPERA Data

Matthew Bonnema

*Jet Propulsion Laboratory
California Institute of technology*

©2025 All Rights Reserved

This workshop is open to US and non-US participants. The material presented has been cleared for unlimited release.

No ITAR information is to be presented.

National Aeronautics and
Space Administration





Many ways to access OPERA products:

- **Web portals:** Earthdata Search, NASA Worldview, ASF Vertex, ASF Displacement Portal
- **Programmatic:** Python
- **Cloud:** Google Earth Engine, Amazon Web Services
- **ArcGIS:** ArcGIS OPERA Toolbox (open source)

Which one to use?

- Whichever works best for you and your workflows
- Most access methods get data products from same data archive centers

OPERA Product Data Archives

National Aeronautics and
Space Administration



OPERA data hosted on major Distributed Active Archive Centers (DAACs)

→ Archive locations primarily by **application themes**

- ◆ Surface Water Extent (DSWx) on [PO.DAAC](https://podaac.jpl.nasa.gov)
(<https://podaac.jpl.nasa.gov>)
- ◆ Surface Disturbance (DIST) primarily on [LP DAAC](https://lpdaac.usgs.gov/)
(<https://lpdaac.usgs.gov/>)
- ◆ Surface Displacement (DISP) and intermediate radar products on
[ASF DAAC](https://asf.alaska.edu/) (<https://asf.alaska.edu/>)

→ Individual DAACs offer **additional search/access** methods

- ◆ Example: ASF DAAC offers specialized search portal for SAR data called **Vertex** <https://search.asf.alaska.edu/>

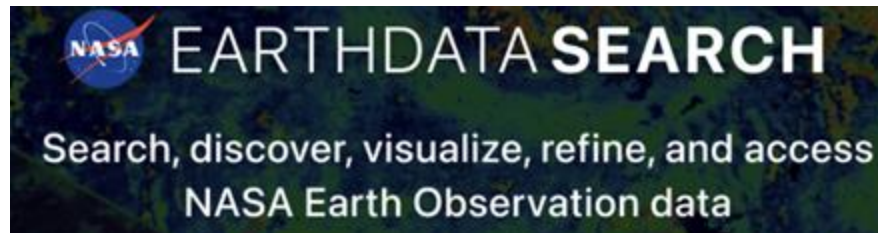


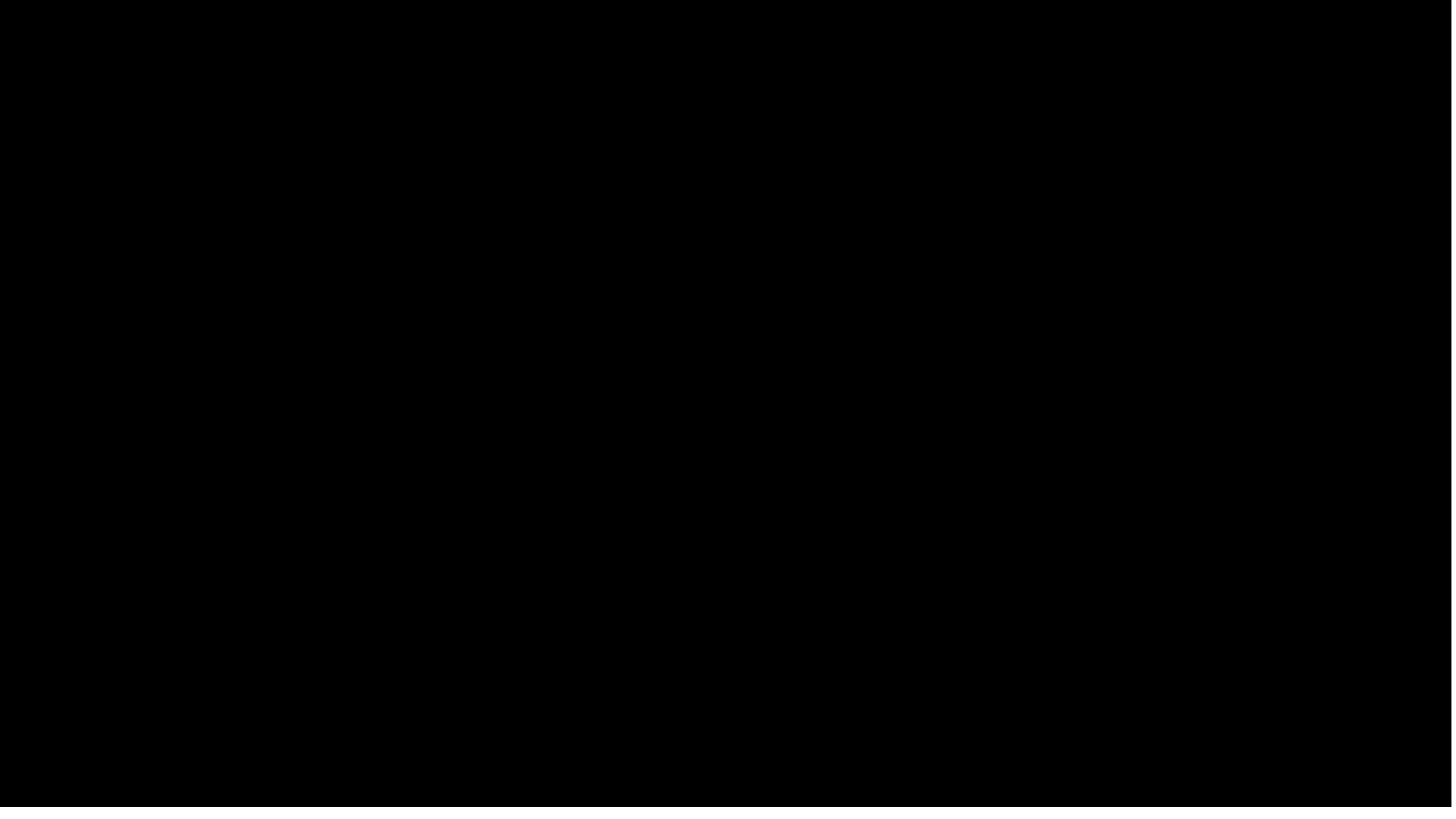


Earthdata Search as a **single unified interface** to search/download all OPERA products

<https://search.earthdata.nasa.gov/>

- Web portal for all NASA Earth data
- Search criteria:
 - By dataset name
 - By time
 - By spatial extent
- Dedicated **SNWG Specific Portal** also available for OPERA and other SNWG product collections
 - Search for “**OPERA**” keyword and wait for project info to show up, then select Project: **SNWG/OPERA**





Explore and Visualize in Worldview

DSWx

DIST

National Aeronautics and
Space Administration

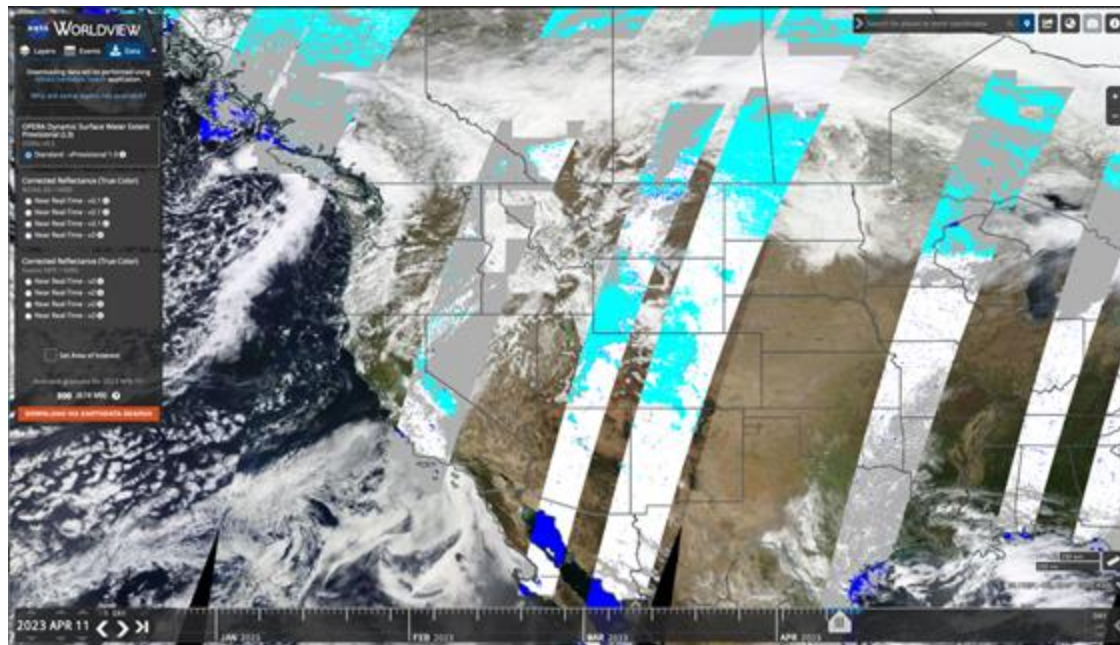


Explore & Access DSWx and DIST in NASA Worldview (RTC-S1 coming soon)

<https://worldview.earthdata.nasa.gov/>

Video tutorial:
<https://podaac.jpl.nasa.gov/OPERA?sections=data%2Bresources>

- Visual display, data preview/coverage in space & time
- Image layer comparison
- Overlay other NASA data layers:
- Adjust transparency, layers/ variables selection
- Download explored data selection via smart handoff to Earthdata Search



Search Tools: Vertex

DISP

RTC/CSLC

National Aeronautics and
Space Administration



- **Vertex** is ASF's web-based search tool similar to Earthdata Search, but specialized for SAR products (**OPERA RTC**, **CSLC**, and **DISP**)
- Search for and build **CSLC stacks** with SAR baseline information:
 - Identify pairs suitable for InSAR
 - Easily download an entire stack

<https://search.asf.alaska.edu/>

ASF Displacement Portal

DISP

National Aeronautics and
Space Administration



- Portal within Vertex:
 - Exploration of OPERA DISP product
 - Rapid visualization and download of displacement time series for user specified points
 - Visualizes short wavelength layer, which filters large regional scale displacements

<https://displacement.asf.alaska.edu>



ASF Displacement Portal Demo

DISP

National Aeronautics and
Space Administration



EARTHDATA

Other DAACs

ASF
Data Search
Vertex

Area Of Interest

Point

Draw

Flight Direction

Ascending



Radar Look Direction: 35°



Incidence Angle: 20° - 60°

Feedback



Search as AOP

Map Tools

Velocity 2014-2024

0.00 m/yr 0.03 m/yr

Rollout

Map Layers



Access OPERA Products by Python

ALL OPERA PRODUCTS

National Aeronautics and
Space Administration



Earthaccess

- Python library for searching and downloading earth data
- All OPERA products can be downloaded using a few simple code lines

Example Data Access for DSWx product from local computer:

https://podaac.github.io/tutorials/notebooks/datasets/OPERA_GIS_Notebook.html

NASA Earthdata Cloud Cookbook

How do I access Cloud Data from my Local Machine?

Downloading data

When you have found the data you want to use, you have two options. You can download the data to work locally, or access the data directly to work in the cloud. This second way of working is called "Direct Cloud Access" or simply, "Direct Access".

This page covers two situations of downloading data from Earthdata Cloud to your local machine:

- Downloading data using the **earthaccess** library
- Downloading data from an OPeNDAP server

earthaccess

Python R Matlab Command Line

We can use the **earthaccess** python library to grab the file URLs and then access them with the **xarray** library.

```
#Import packages
import earthaccess
import xarray as xr

#Authentication with Earthdata Login
auth = earthaccess.login(strategy="netrc")
```

Find How-To's and examples in the **PODAAC Cookbook OPERA Chapter**

https://podaac.github.io/tutorials/quarto_text/OPERA.html

Python earthaccess Example

ALL OPERA PRODUCTS

National Aeronautics and
Space Administration



```
import earthaccess
```

```
auth = earthaccess.login()
```

```
results = earthaccess.search_data(short_name="OPERA_L3_DIST-ALERT-HLS_V1",  
                                   temporal = ("2024-04-01", "2024-04-30"),  
                                   bounding_box = (32.02, -118.61, 33.96, -115.91))
```

Product Name
Time info
AOI info

```
files = earthaccess.download(results, "./local_folder")
```

Product	Product short name
DSWx-HLS	OPERA_L3_DSWX-HLS_V1
DIST-ALERT-HLS	OPERA_L3_DIST-ALERT-HLS_V1
DIST-Annual	OPERA_L3_DIST-ANN-HLS_V1
RTC-S1	OPERA_L2_RTC-S1_V1
CSLC-S1	OPERA_L2_CSLC-S1_V1

Product	Product short name
DSWx-S1	OPERA_L3_DSWX-S1_V1
DISP-S1	OPERA_L3_DISP-S1_V1

OPERA DIST in Google Earth Engine

DIST

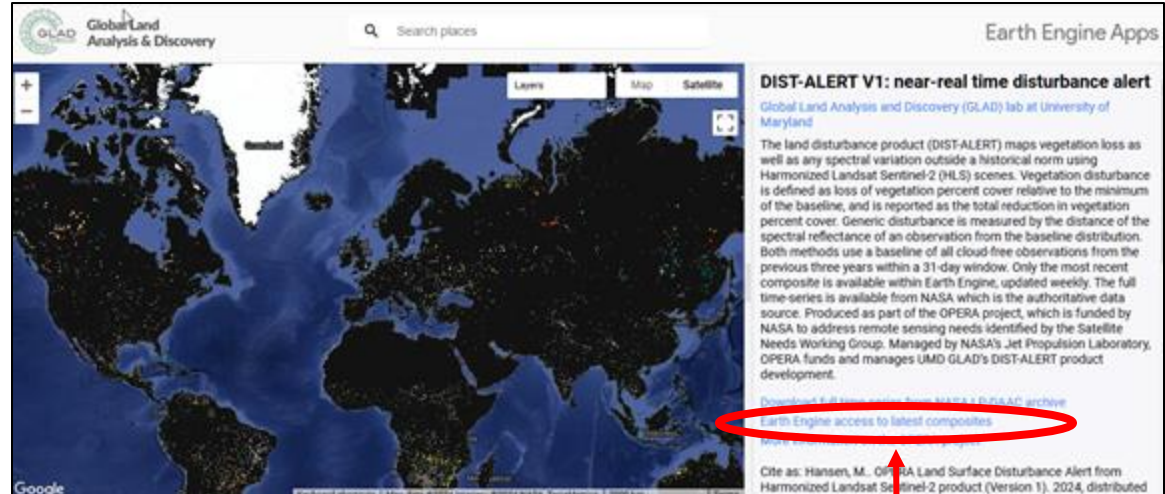
National Aeronautics and
Space Administration



DIST-ALERT weekly global composites are available in GEE

- GEE based **web app** for visualizing latest DIST-ALERT data
- Made by mosaicing one week of DIST-ALERT products into a global map
- Can import latest weekly composite into your own GEE environment and perform your own analysis

<https://glad.earthengine.app/view/dist-alert>



Click here to access latest composite in your own GEE scripts

OPERA DSWx in Google Earth Engine

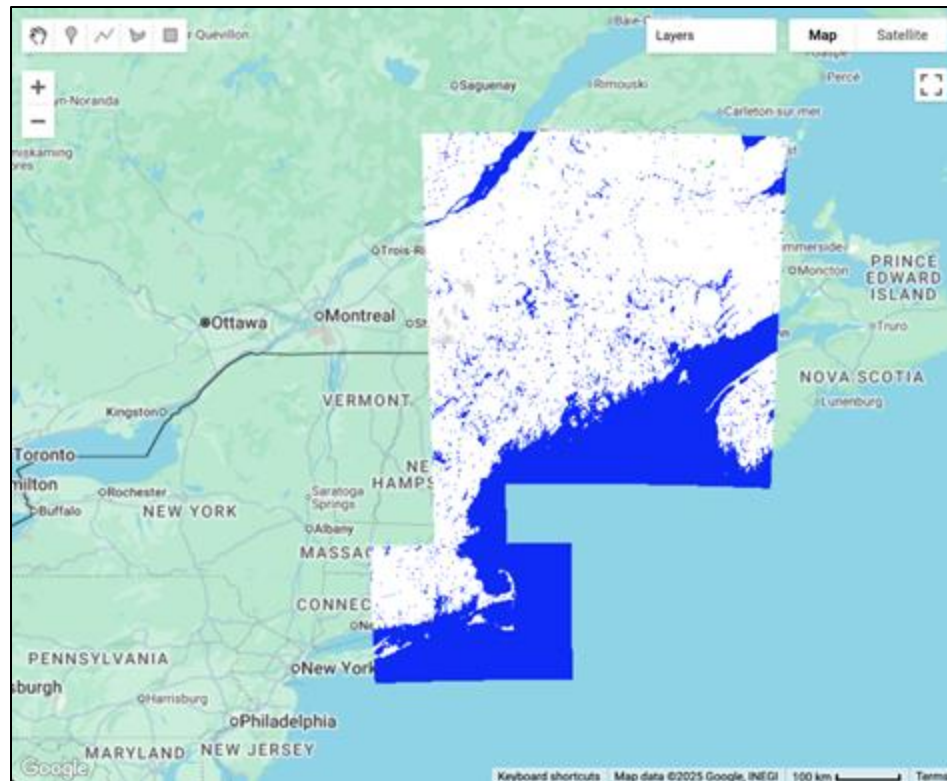
DSWx

National Aeronautics and
Space Administration



DSWx-HLS and DSWx-S1 product collection
are coming to GEE

- Entire collection of individual DSWx granules will be available in GEE
- Access and analyze DSWx-HLS and DSWx-S1 alongside other geospatial datasets
- Collections are currently ingesting and not yet discoverable via GEE search





ArcGIS Toolbox designed to work specifically with OPERA products

- Currently compatible with DSWx, DIST, and RTC products
- Functionality:
 - **Search, download, and open** OPERA products
 - **Filter** products (e.g. filter DSWx-HLS by cloud cover)
 - **Mosaic** products across spatial domains
 - **Zonal statistic** calculations with pre-set options for OPERA Products
- Open Source: <https://github.com/OPERA-Cal-Val/OPERA-ArcGIS-Toolbox>

OPERA-ArcGIS-Toolbox

License: Apache 2.0

Overview

The toolbox contains three geoprocessing tools.

- (a) OPERA Granule Download
- (b) OPERA Granule Filter
- (c) OPERA Granule Mosaic
- (d) OPERA Zonal Statistics





Many ways to access OPERA products:

- **Web portals:** Earth Data Search, Worldview, Vertex, Displacement Portal
- **Programmatic:** Python
- **Cloud: Google Earth Engine** (DIST weekly mosaics provided by UMD),
- **ArcGIS:** ArcGIS OPERA Toolbox (open source)

Which one to use?

- Whichever works best for you and your workflows
- All access methods get data products from same data archive centers