OPERA

Observational Products for End-Users from Remote Sensing Analysis

2024 NASA Western Water Applications Office (WWAO) Annual Meeting

May 1, 2024

OPERA team

Jet Propulsion Laboratory, California Institute of Technology

Jet Propulsion Laboratory
California Institute of Technology

USGS · NASA Goddard Space Flight Center · University of Alaska Fairbanks · SMU · EarthScope Consortium · GLAD

www.jpl.nasa.gov/go/opera
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OPERA Team

National Aeronautics and Space Administration

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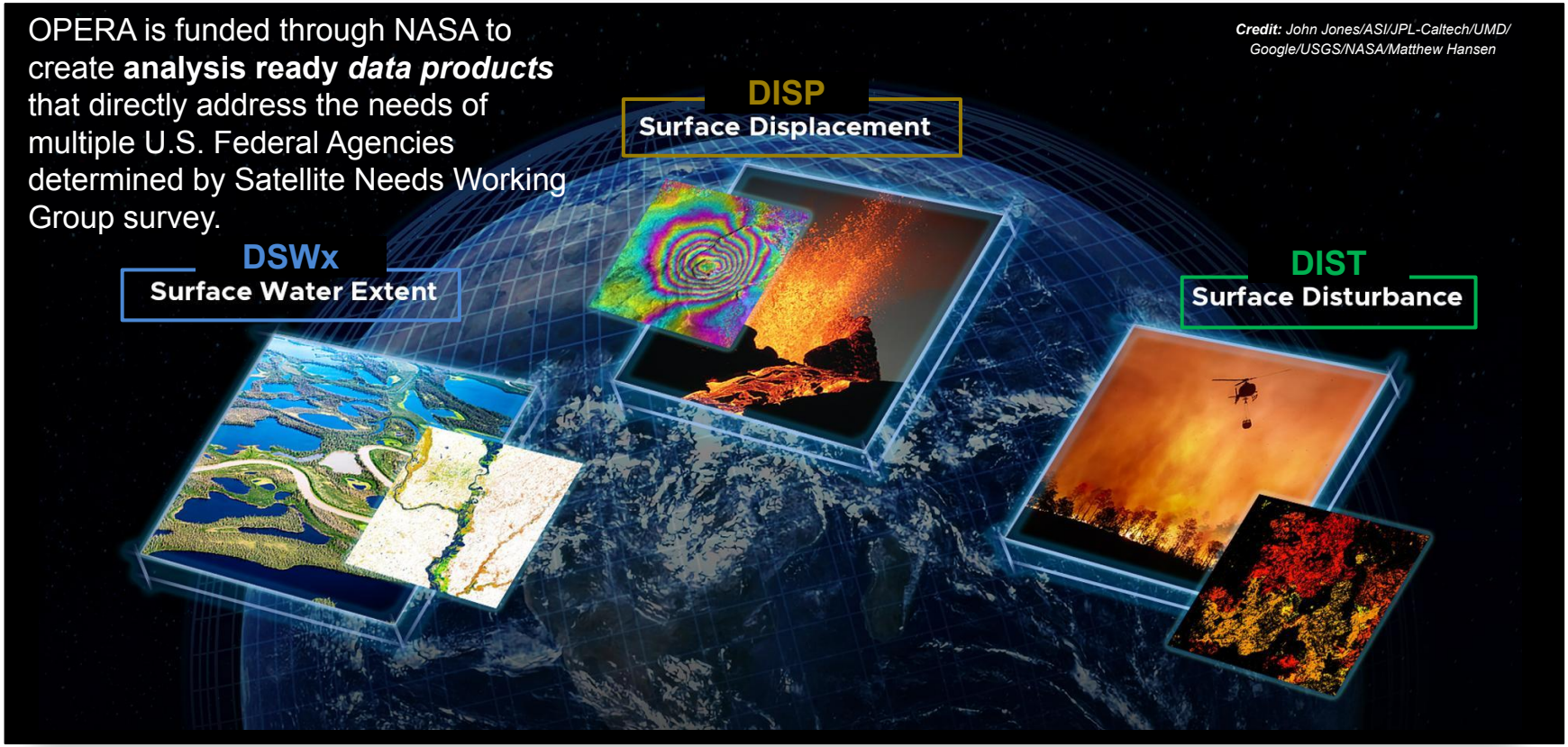
OPERA Background

National Aeronautics and Space Administration

OPERA is funded through NASA to create **analysis ready *data products*** that directly address the needs of multiple U.S. Federal Agencies determined by Satellite Needs Working Group survey.



Credit: *John Jones/ASI/JPL-Caltech/UMD/ Google/USGS/NASA/Matthew Hansen*

www.jpl.nasa.gov/go/opera
www.nasa.gov

Product Details

National Aeronautics and Space Administration

Level-3 products

- **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), Jul. 2024 (S1), May 2025 (NISAR)
- **Access**: PO.DAAC

Available now !

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- **Production Begins:** Feb. 2023 (HLS)
- **Product Record Begins:** Feb. 2023 (HLS)
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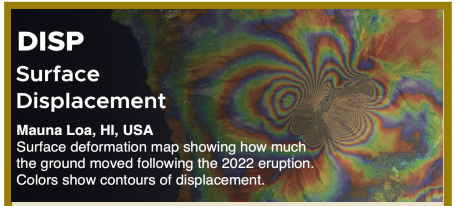
Available now!

***NEW product*:** SAR disturbance from S1



- **Description:** Maps surface displacements using SAR in LOS (S1 and NISAR)
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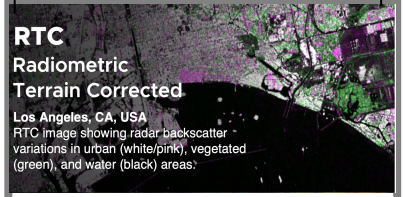
- **Access**: ASF DAAC

Notional product: vertical + horiz. DISP products from S1 A/B

Level-2 products



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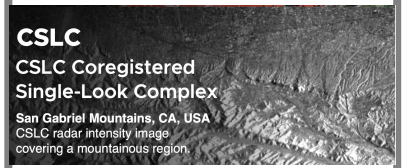

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National Aeronautics and Space Administration

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Available now !

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W product*: SAR disturbance
S1

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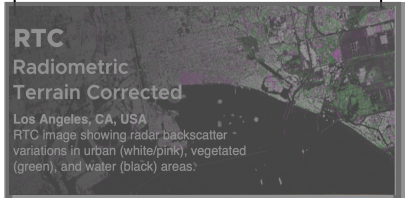
Level-2 products



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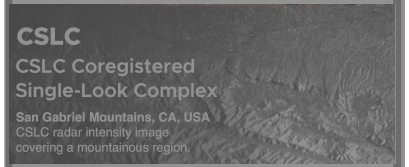

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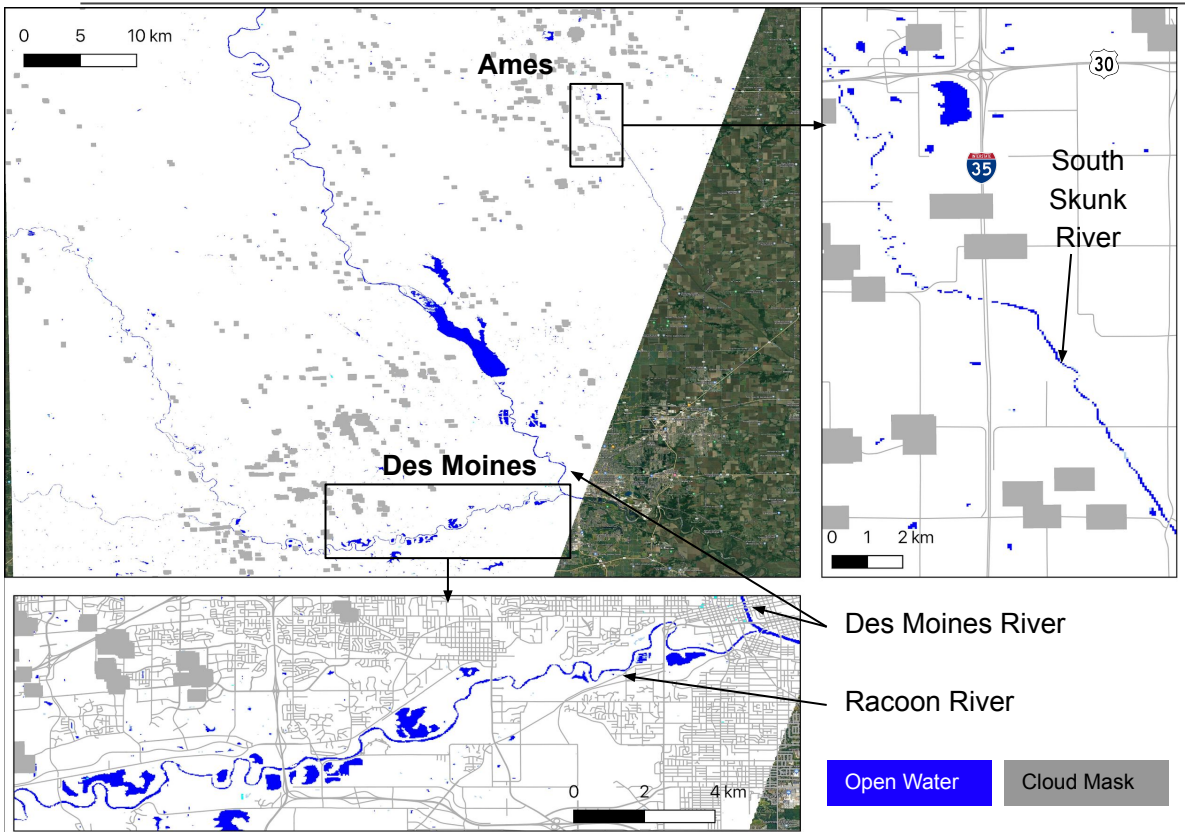
Dynamic Surface Water Extent (DSWx)

National Aeronautics and Space Administration



Dynamic Surface Water Extent Harmonized Landsat Sentinel

- Acquisition date: 13 April 2024
- This image: Sentinel 2A
- South Skunk River: near the limit of detection
- Des Moines and Racoon Rivers are well observed
- Ada Hayden Heritage Park Lake near Ames, Saylorville Lake near Des Moines and several lakes and reservoirs around the Racoon River are visible

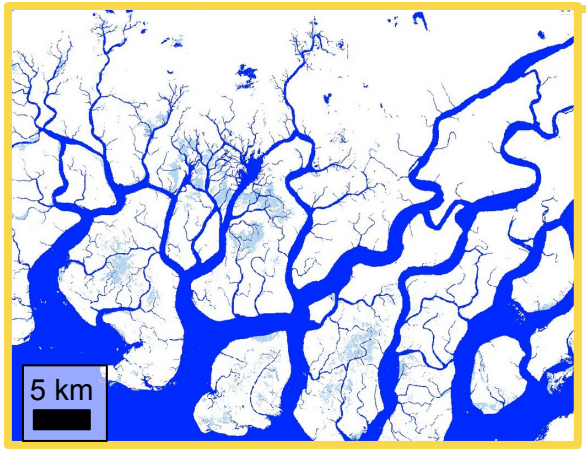
Dynamic Surface Water Extent (DSWx-HLS)

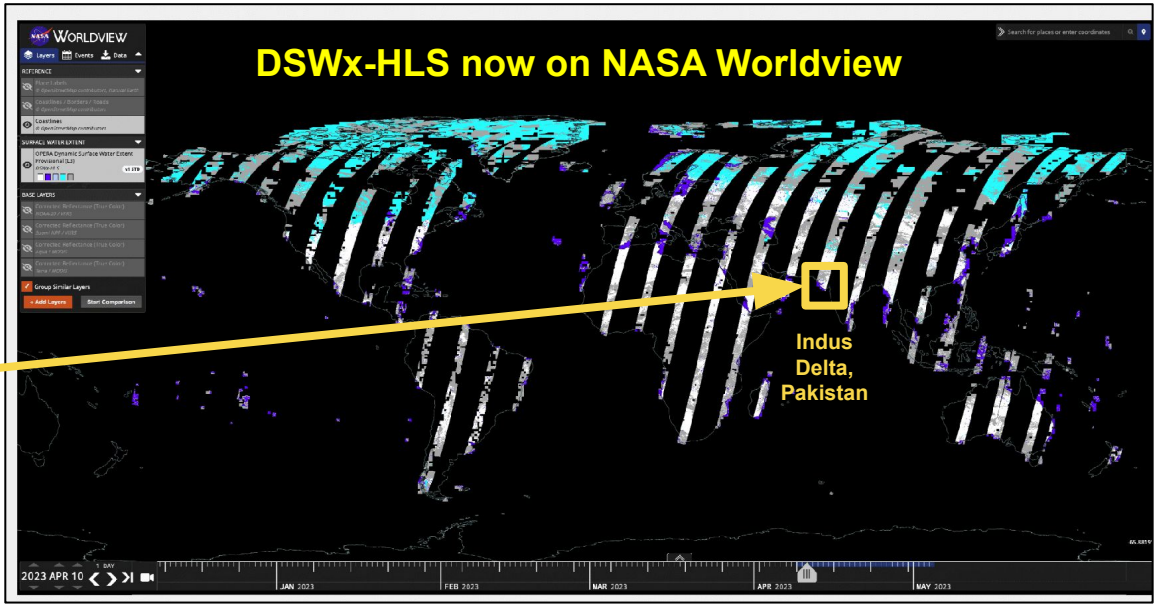
National Aeronautics and Space Administration

Worldview QR

DSWx-HLS

- Partial Surface Water
- Open Surface Water
- Not Water





DSWx-HLS available on PO.DAAC since Apr 2023

PO.DAAC QR

www.jpl.nasa.gov/go/opera
www.nasa.gov

Dynamic Surface Water Extent (DSWx)

National Aeronautics and Space Administration

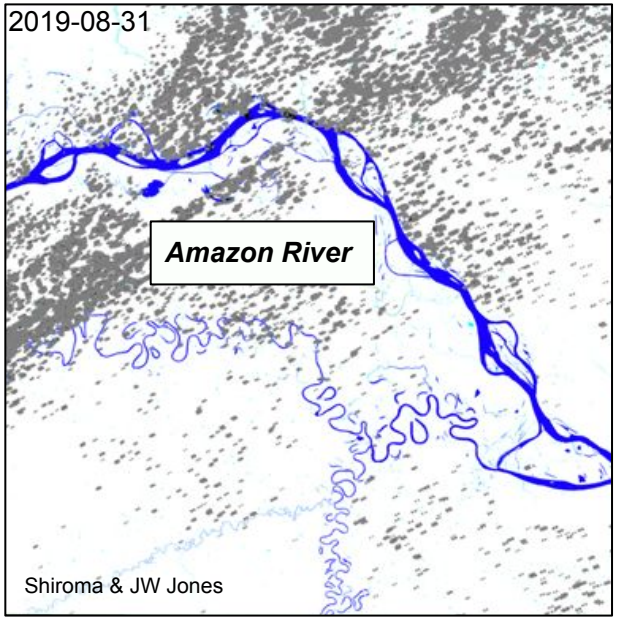
SAR provides a complementary view to optical:

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

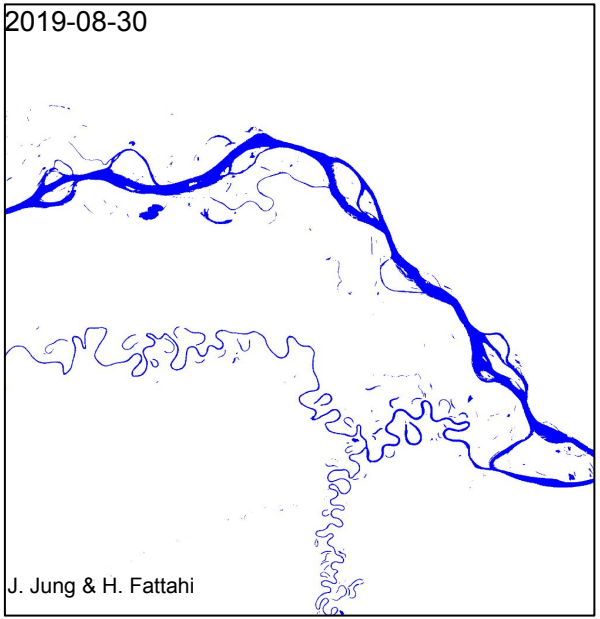
A note on inundated vegetation:

- 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



SAR: DSWx-S1



Open Water | Cloud Mask

DSWx-S1 available on PO.DAAC Jul. 2024

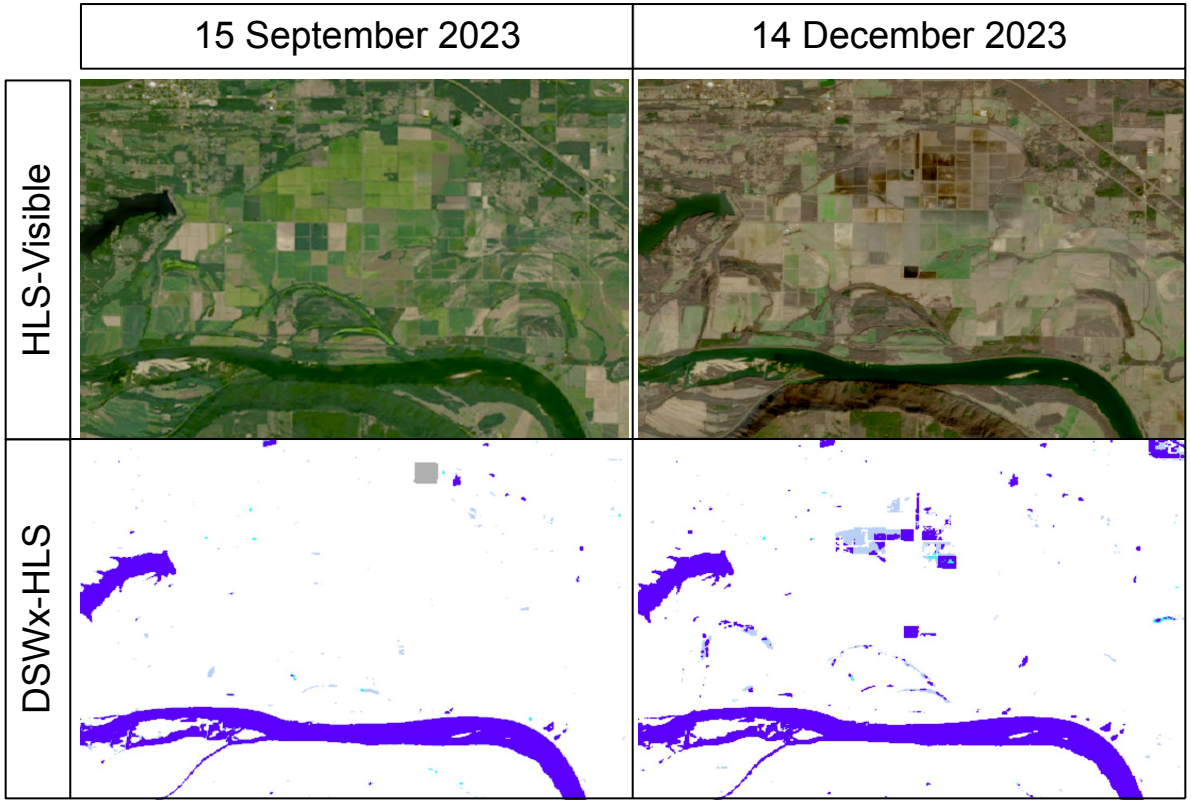
Dynamic Surface Water Extent (DSWx)

National Aeronautics and Space Administration

Example of past use cases

Monitoring Rice Paddies with DSWx - Arkansas

National Aeronautics and Space Administration



DSWx product shows the inundation of the fields

- Open Surface Water
- Partial Surface Water
- Frozen/high sediment
- Clouds/cloud shadows

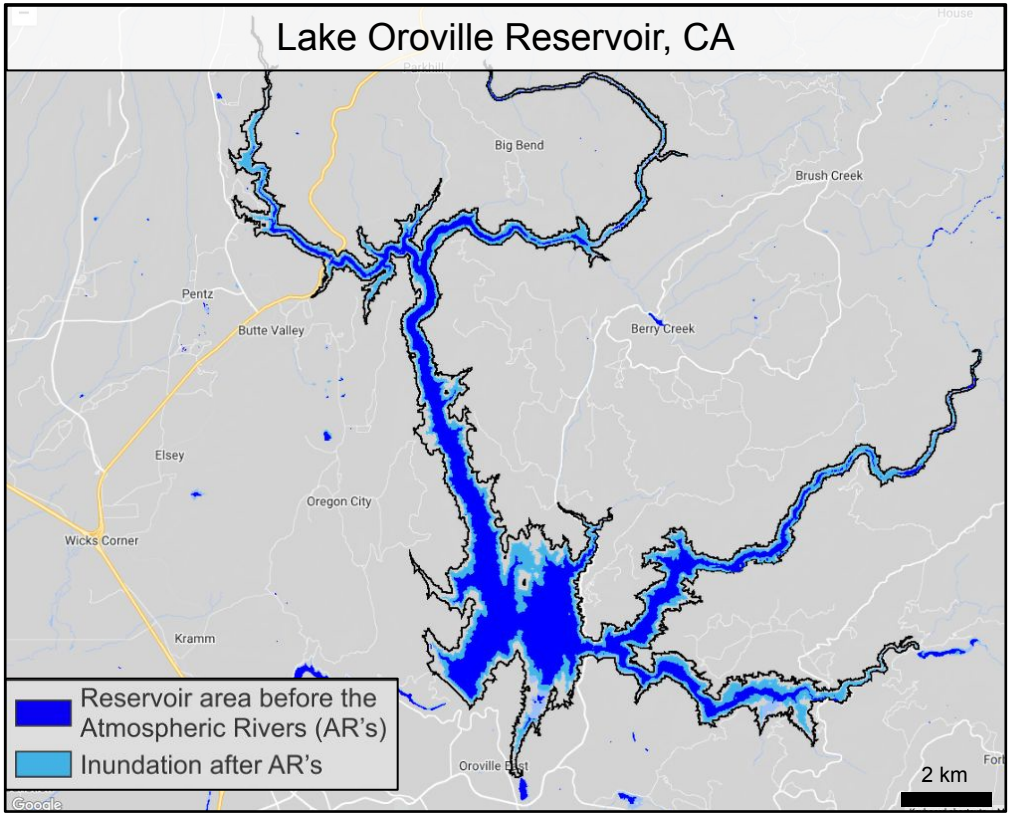
Scan this QR code to see the data in worldview

www.jpl.nasa.gov/go/opera
www.nasa.gov

Application: DSWx for Reservoir infilling

National Aeronautics and Space Administration

Rapid reservoir infilling due to series of Atmospheric Rivers in California during late 2022 and early 2023



Surface disturbance – Use Cases

National Aeronautics and Space Administration

Level-2 products

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- **Access**: PO.DAAC
- **Available now !**
  DSWx-SWOT
  (delayed until further notice)

- **Description:** Maps vegetation disturbance using optical (HLS)
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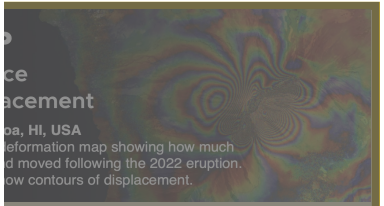
***NEW product*:**
SAR disturbance from S1



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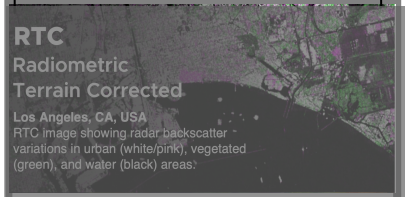

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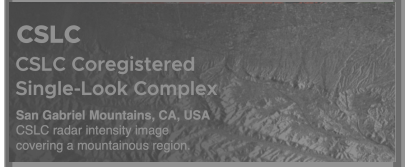

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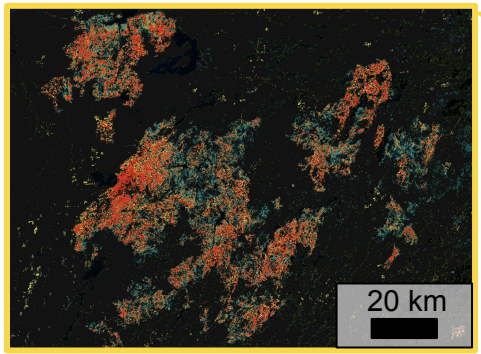
Surface Disturbance (DIST-HLS)

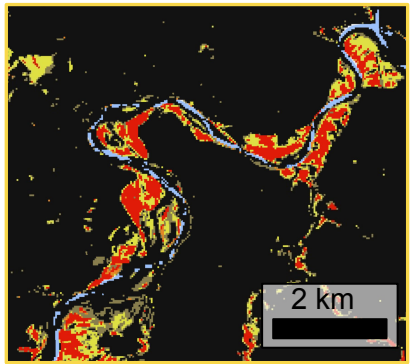
National Aeronautics and Space Administration

NASA

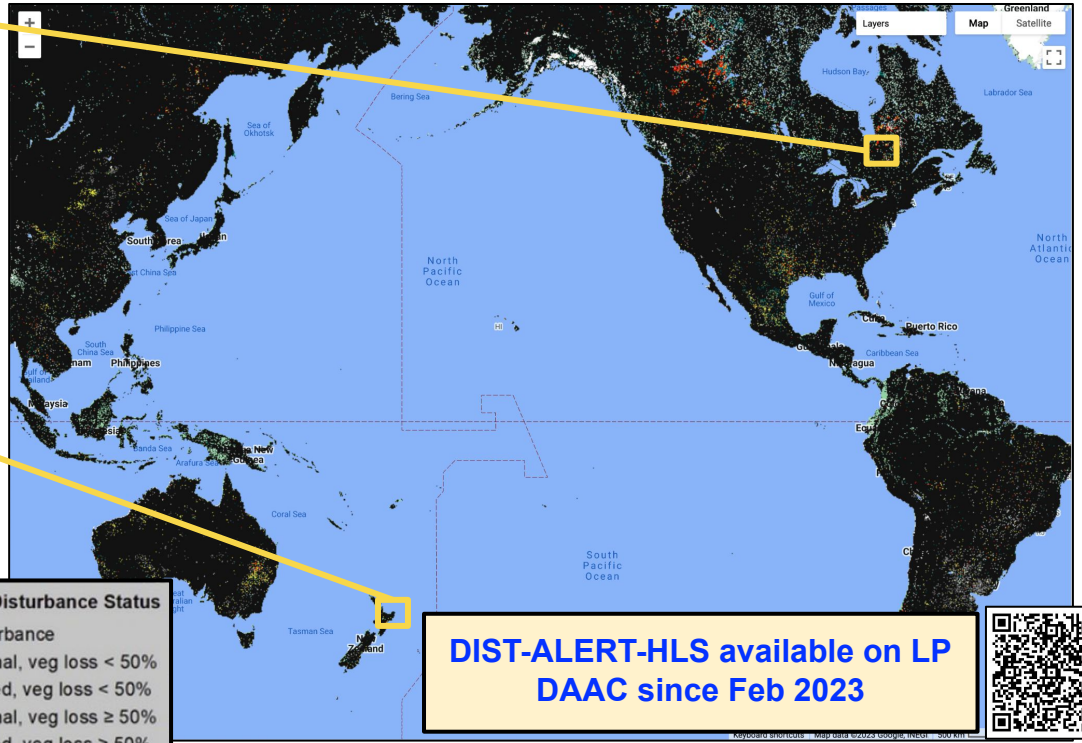
2023 Forest fires in Quebec



2023 Erosion from floods in NZ



DIST-ALERT-HLS



DIST-ALERT-HLS available on LP DAAC since Feb 2023

www.jpl.nasa.gov/go/opera
www.nasa.gov

Surface Displacement – Use Cases

National Aeronautics and Space Administration

Level-3 products

DSWx
Surface Water Extent


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

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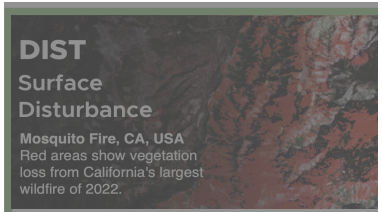
- **Access**: PO.DAAC

Available now !

DSWx-SWOT
(delayed until further notice)

DIST
Surface Disturbance


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

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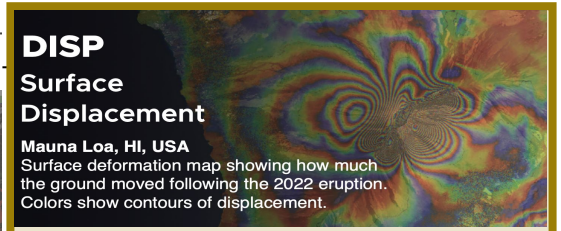
Available now!

NEW product: SAR disturba from S1

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.

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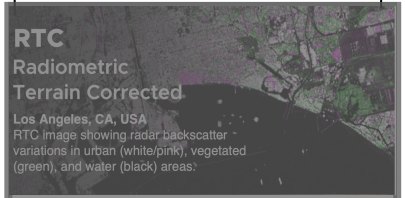
Level-2 products

RTC
Radiometric Terrain Corrected


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

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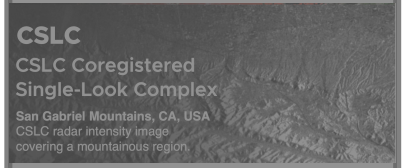
CSLC
CSLC Coregistered Single-Look Complex


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

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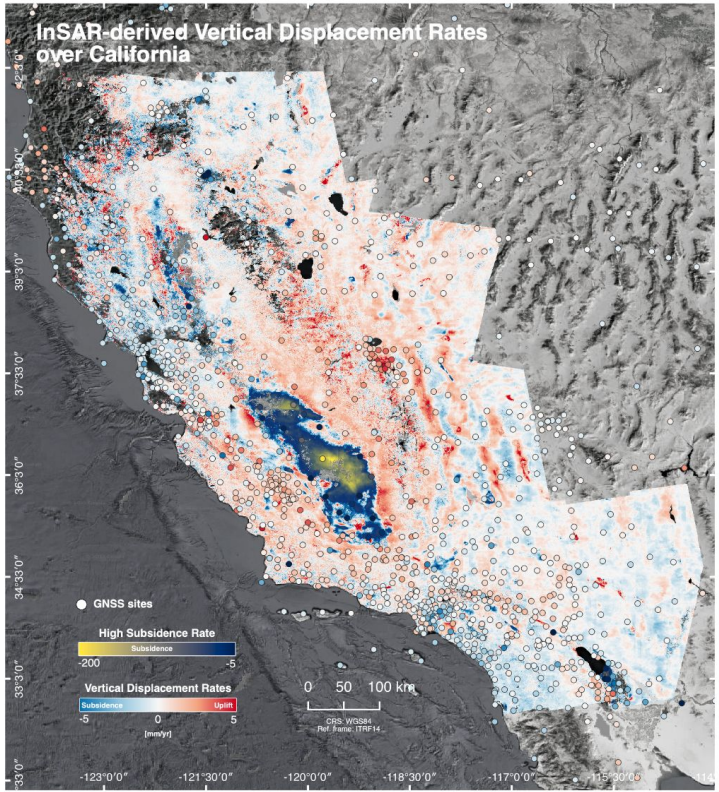
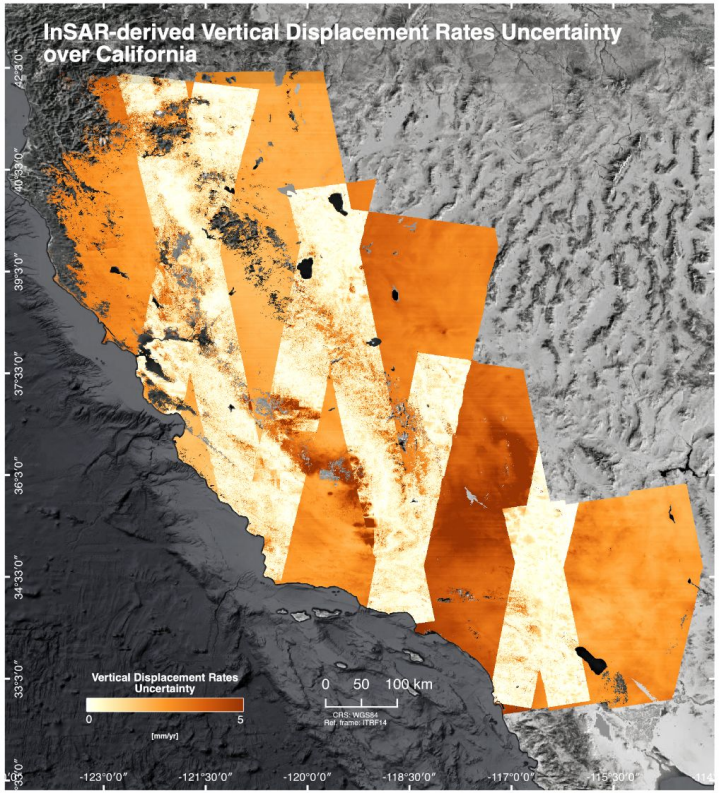
Vertical Land Motion from S1 (Notional Product)

National Aeronautics and Space Administration





State-wide VLM maps

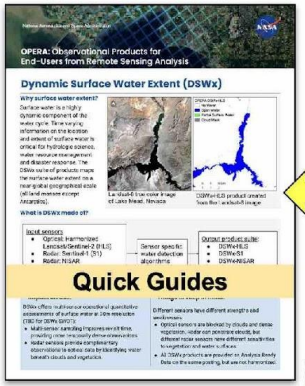
Inputs: InSAR L2 products from ARIA, GNSS rates from JPL measures

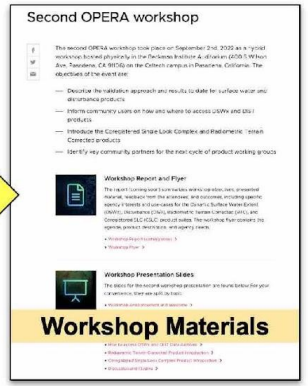
[Marin Govorcin, David Bekaert and Simran Sangha, JPL]

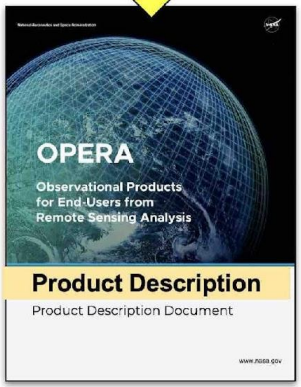
OPERA's Stakeholder Engagement Program

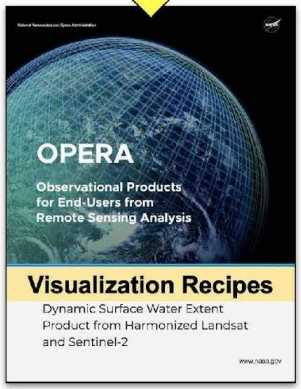
National Aeronautics and Space Administration

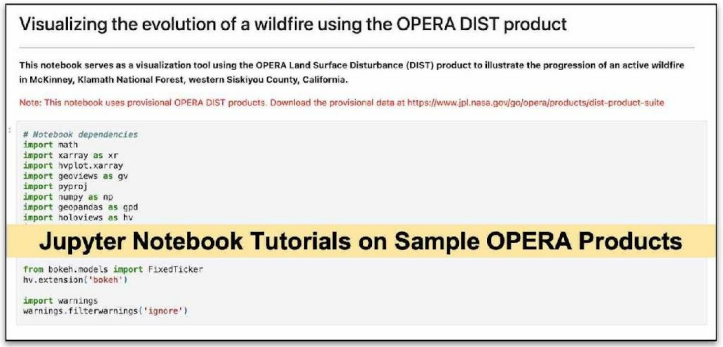
We maintain a regularly updated website and manage an active **Stakeholder Engagement Program** (SEP) to engage with science, application and federal stakeholders. We support the broader SNWG SEP.











Conclusions

National Aeronautics and Space Administration

- ➔ OPERA is on track for product development
  Staggered release, ~2 years development-to-production
- ➔ **Current products with broad applications:**
  - ◆ DSWx-HLS, DIST-HLS, RTC-S1, CSLC-S1
- ➔ **Next product releases:**
  - ◆ DSWx-S1, DISP-S1, DSWx-NI, CSLC-NI, DISP-NI, DIST-S1
- ➔ ***Product Sustainability requires user buy-in and testimonials. Federal users are critical for SNWG-funding beyond FY25***

Stay Informed
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or visit our website

https://tinyurl.com/emailOPERA

OPERA @
SNWG EarthData Portal

https://search.earthdata.nasa.gov/search?portal=snwg&q=%22OPERA%22

Fourth OPERA Stakeholder Engagement Workshop

July 19, 2024
San Diego, CA and online!

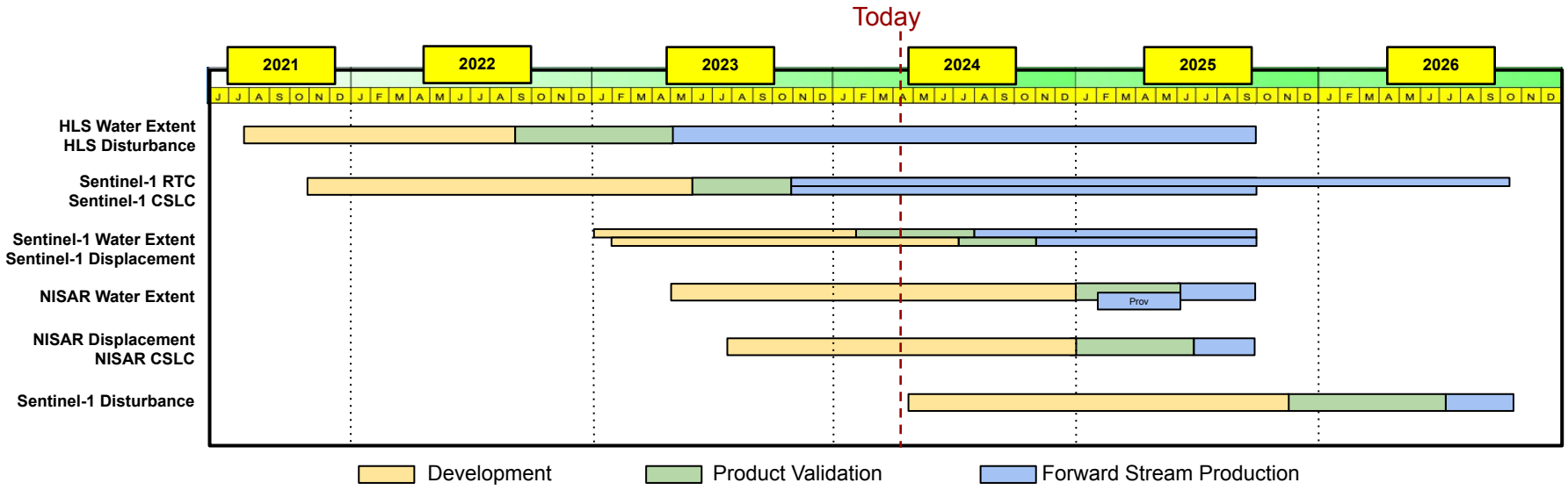
Register for our workshop Today!

https://www.jpl.nasa.gov/go/opera/opera-workshops/fourth-workshop

Backup slides

Schedule

National Aeronautics and Space Administration



A ***notional*** **Vertical Land Motion (VLM)** product proposed under SNWG 2022 cycle

Staggered release to get products to users ASAP.
Four products in production today

Live and growing OPERA product archives at the DAACs

National Aeronautics and Space Administration

OPERA has produced more than 5 million granules

Products in production:

- Optical Surface Water Extent
- Optical Surface Disturbance
- SAR Radiometric Terrain Corrected
- SAR Coregistered Single Look Complex

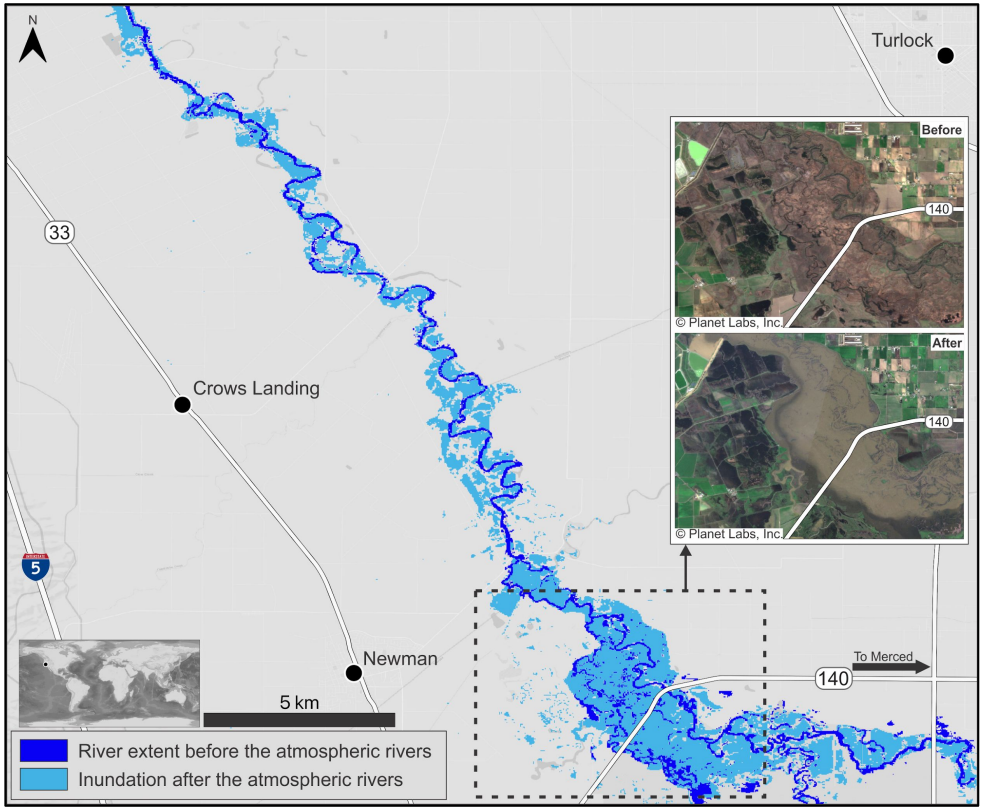
OPERA @ SNWG EarthData Portal

https://search.earthdata.nasa.gov/search?portal=snwg&q=%22OPERA%22

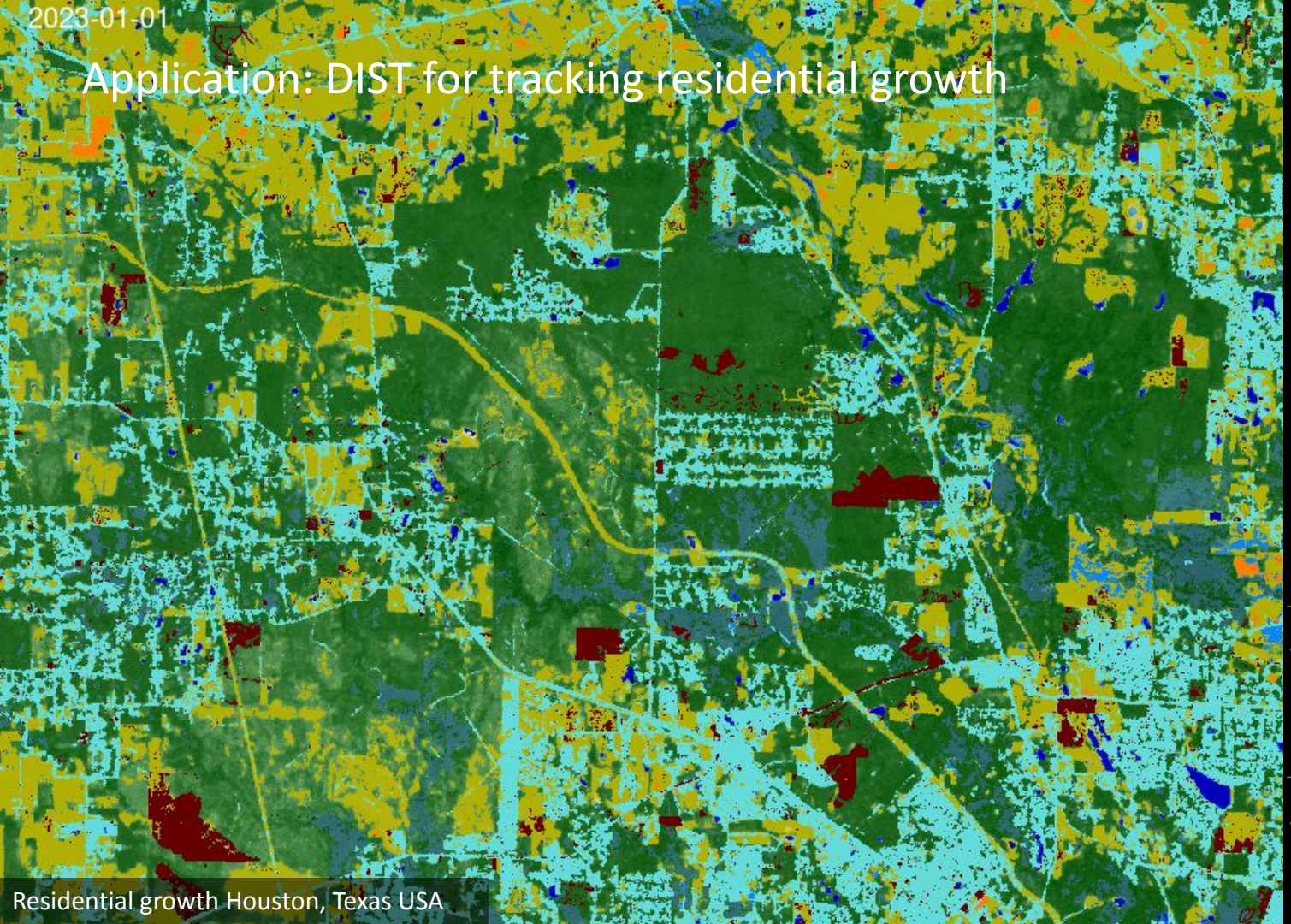
★ No urgent response requirement, but we aim to distribute products as fast as possible (<24 hours)

Application: DSWx for Inundation Mapping

National Aeronautics and Space Administration



Flooding in San Joaquin Valley caused by Atmospheric Rivers hitting California Central Valley in January 2023



Very high confidence

Vegetation loss in 2023

Low confidence

Vegetation loss from 2022

Terra firma

Percent short vegetation: 100% / 0

Tree height for stable tree cover: >25m / 3

Annual percent water: 100% / 0

Wetland

Percent short vegetation: 100% / 0

Tree height for stable tree cover: >25m / 3

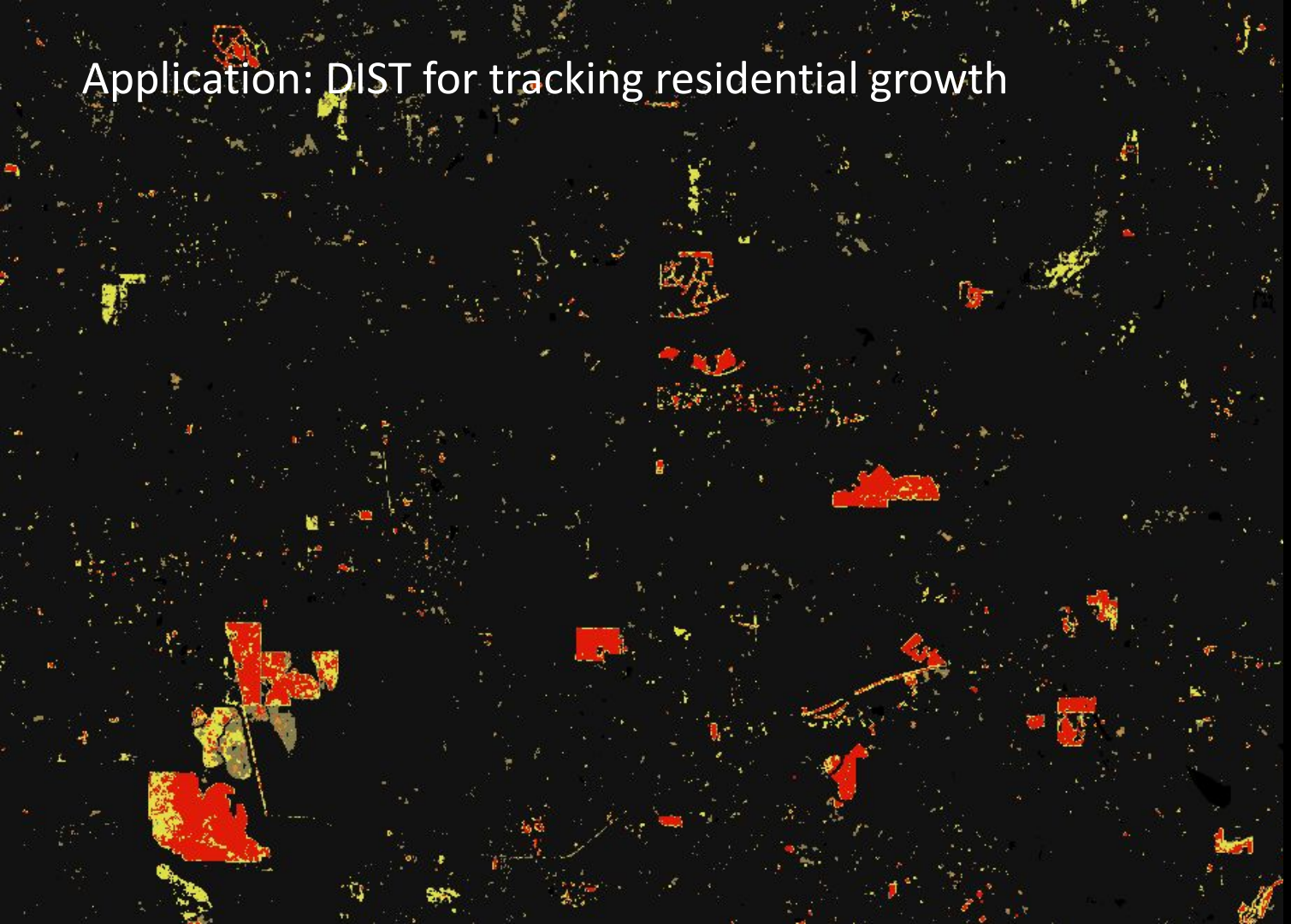
Permanent snow/ice

Land use

Stable cropland

Stable built-up

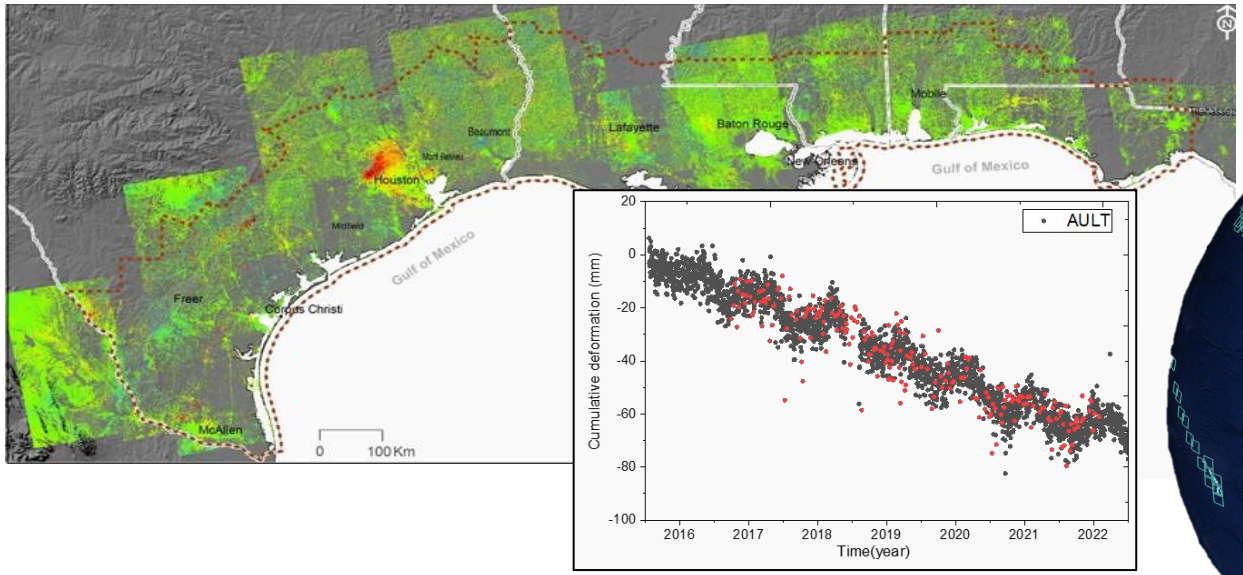
Application: DIST for tracking residential growth

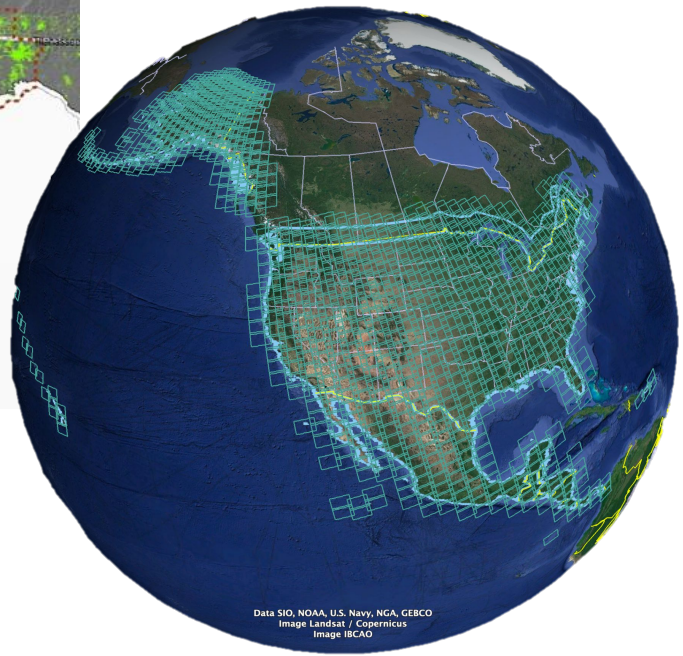


DISP-S1

National Aeronautics and Space Administration

Combination of Persistent and Distributed Scatterer time-series





North America DISP-S1 data are expected in Fall 2024

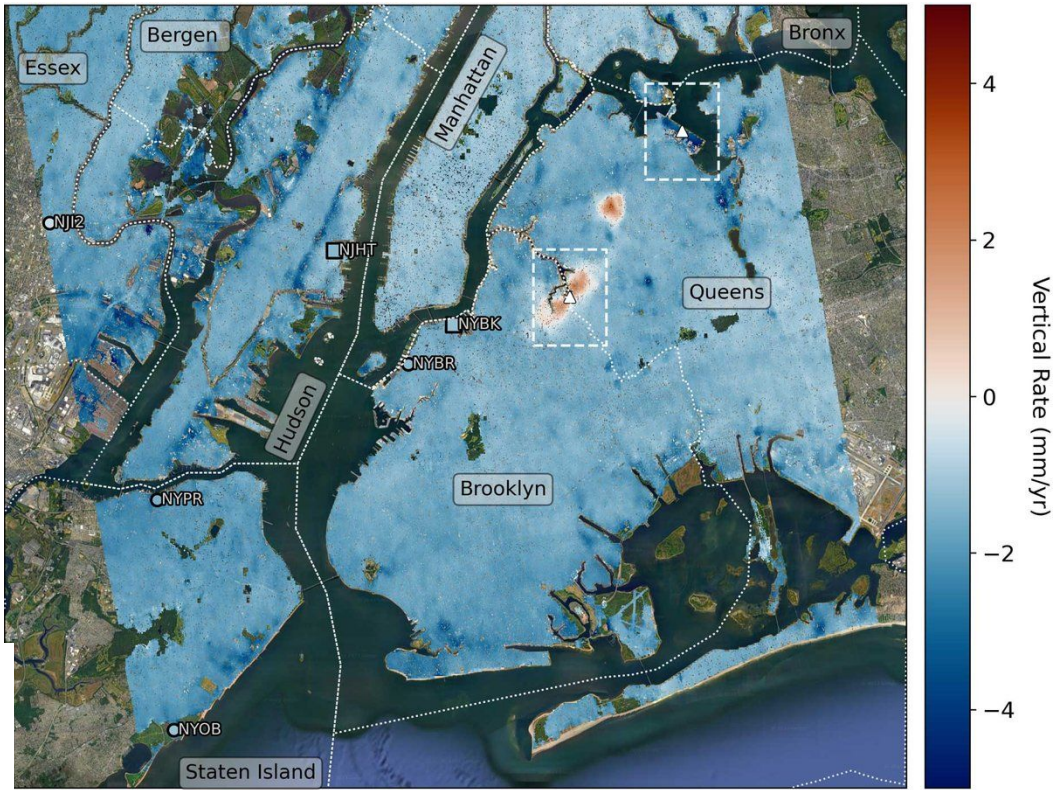
Products will be distributed through ASF DAAC

Left credit: Zhong Lu et al, Southern Methodist University

Vertical Land Motion from S1 (Notional Product)

National Aeronautics and Space Administration

- New York City, NY
- Vertical Displacement Rates derived from InSAR time-series datasets (Buzzanga et al. 2023).



The Washington Post
Democracy Dies in Darkness

HIDDEN PLANET

New York City is sinking. These spots are sinking fastest.

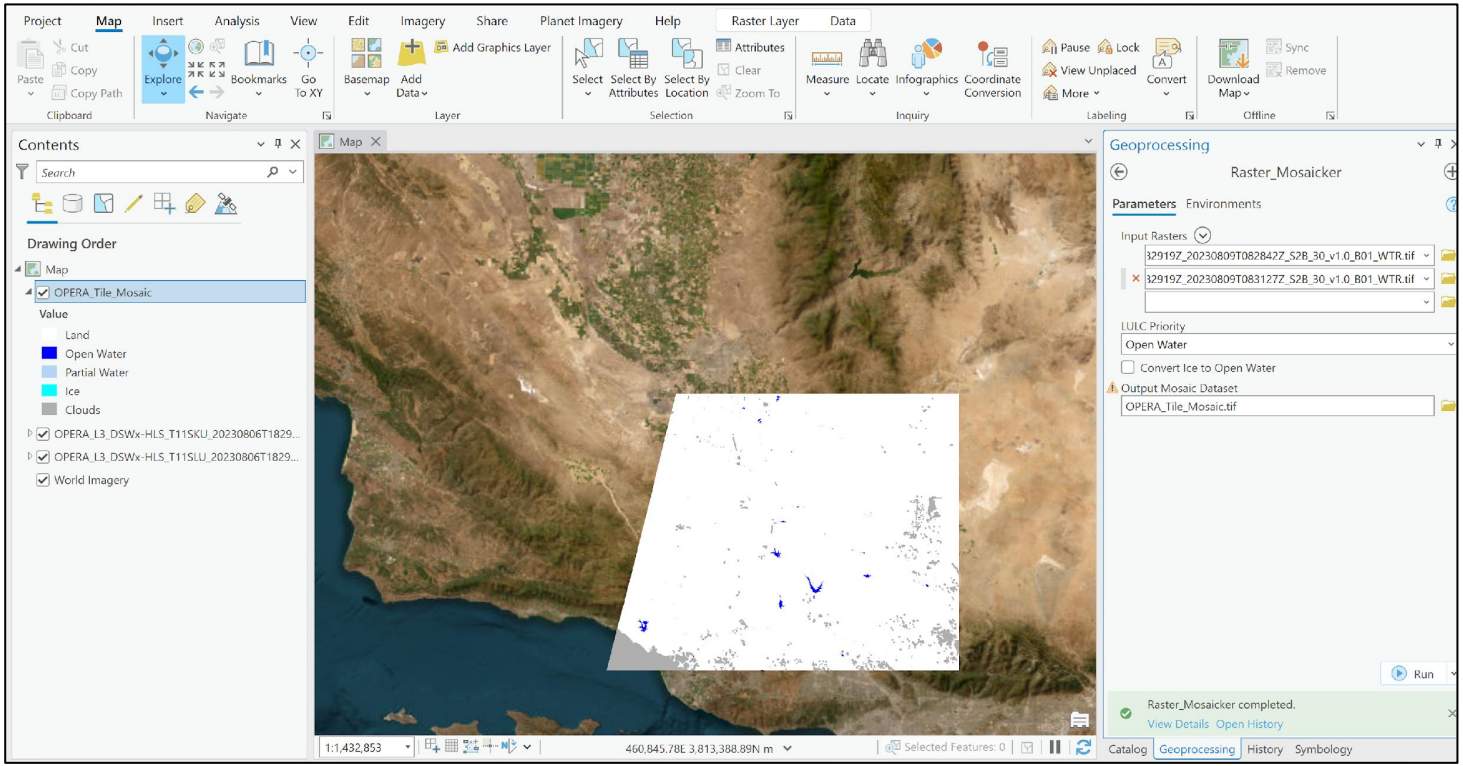
OPERA ArcGIS Pro Toolbox (future release)

National Aeronautics and Space Administration

Toolbox for OPERA DSWx-HLS Developed at JPL:

1) download and data access,
2) filter data
3) performs temporal compositing,
*all with correct labels/attributes

- Note that OPERA is working with the DAACs to get the OPERA data into ArcGIS.



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