Delta-X: UAVSAR L3 Gridded Open Water Channels, MRD, Louisiana, USA, 2021

Get Data

Documentation Revision Date: 2022-09-15

Dataset Version: 1

Summary

This dataset provides gridded estimates of water channels for the Atchafalaya and Terrebonne basins of the Mississippi River Delta in Louisiana, U.S.A. The data show channels with open water that are as narrow as 10 m. These channel estimates were generated from the Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) Level 1B interferometric products in radar coordinates acquired in the Spring and Fall Delta-X deployments of 2021, which have a spatial resolution of approximately 6 m. UAVSAR is a polarimetric L-band synthetic aperture radar (SAR) flown on the NASA Gulfstream-3 aircraft. There are two water channel products, one covering the Atchafalaya basin and the western edge of the Terrebonne basin, and another that primarily covers the Terrebonne basin with some overlap with the eastern edge of the Atchafalaya basin. The two files are provided in cloud-optimized GeoTIFF format. The channel estimates can be used to define open water paths in hydrodynamic models and to evaluate model performance.

There are two data files with this dataset in cloud-optimized GeoTIFF (.tif) format.

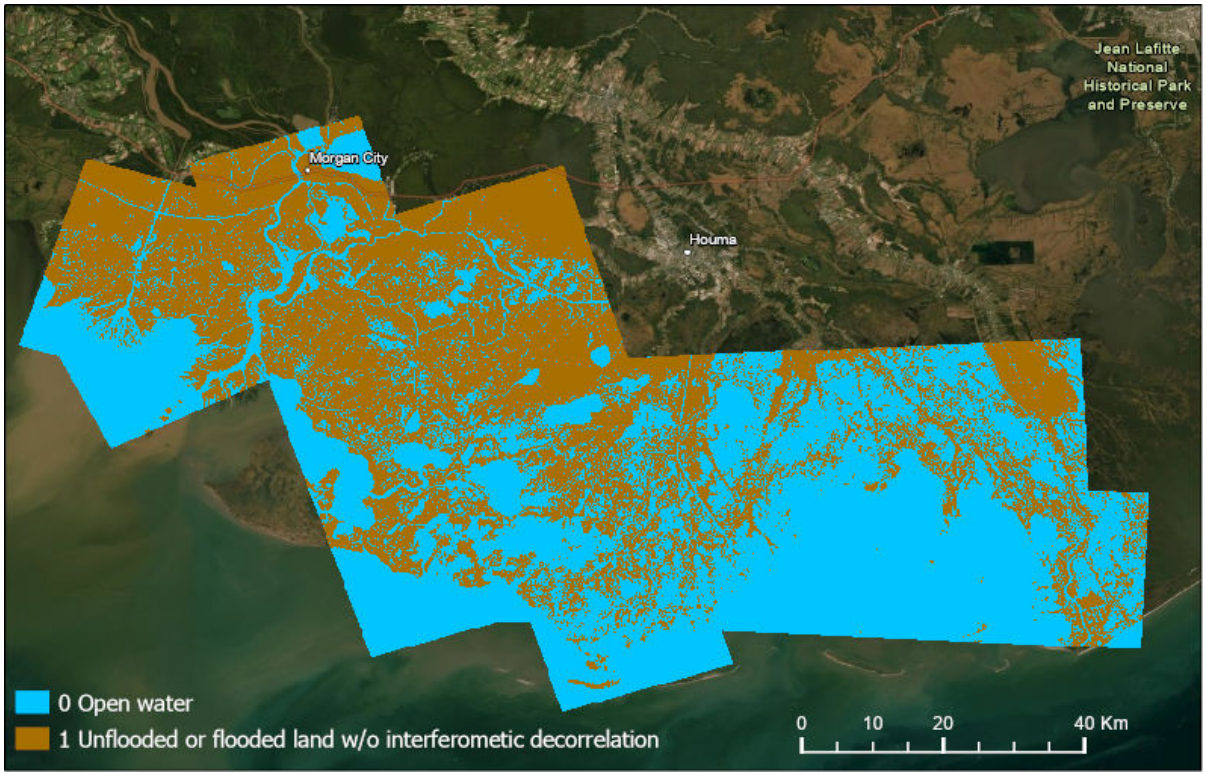

Figure 1. Water channels for Atchafalaya and Terrebonne basins of the Mississippi River Delta in coastal Louisiana. Open water (0) means that there was little or no vegetation above water surface. Unflooded land or flooded land without significant interferometric decorrelation (1) includes flooded land but with vegetation present above water surface.

Citation

Jones, C., T. Oliver-Cabrera, B. Varugu, M. Simard, and Y. Lou. 2022. Delta-X: UAVSAR L3 Gridded Open Water Channels, MRD, Louisiana, USA, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2109

Table of Contents

1. Dataset Overview

This dataset provides gridded estimates of water channels for the Atchafalaya and Terrebonne basins of the Mississippi River Delta in Louisiana, U.S.A. The data show channels with open water that are as narrow as 10 m. These channel estimates were generated from the Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) Level 1B interferometric products in radar coordinates acquired in the Spring and Fall Delta-X deployments of 2021, which have a spatial resolution of approximately 6 m. UAVSAR is a polarimetric L-band synthetic aperture radar (SAR) flown on the NASA Gulfstream-3 aircraft. There are two water channel products, one covering the Atchafalaya basin and the western edge of the Terrebonne basin, and another that primarily covers the Terrebonne basin with some overlap with the eastern edge of the Atchafalaya basin. The two files are provided in cloud-optimized GeoTIFF format. The channel estimates can be used to define open water paths in hydrodynamic models and to evaluate model performance.

Project: Delta-X

The Delta-X mission is a 5-year NASA Earth Venture Suborbital-3 mission to study the Mississippi River Delta in the United States, which is growing and sinking in different areas. River deltas and their wetlands are drowning as a result of sea level rise and reduced sediment inputs. The Delta-X mission will determine which parts will survive and continue to grow, and which parts will be lost. Delta-X begins with airborne and in situ data acquisition and carries through data analysis, model integration, and validation to predict the extent and spatial patterns of future deltaic land loss or gain.

Related Publications

Oliver-Cabrera, T., C.E. Jones, Z. Yunjun, and M. Simard. 2021. InSAR phase unwrapping error correction for rapid repeat measurements of water level change in wetlands. IEEE Transactions on Geoscience and Remote Sensing 60:1-15. https://doi.org/10.1109/TGRS.2021.3108751

Related Datasets

Jones, C., M. Simard, Y. Lou, and T. Oliver. 2021a. Delta-X: UAVSAR L1 Products, Single Look Complex (SLC) Stack, MRD, Louisiana, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1984

- The UAVSAR products used to generate the L1B, L2, and L3 products.

Jones, C., T. Oliver-Cabrera, M. Simard, and Y. Lou. 2021b. Delta-X: UAVSAR L1B Interferometric Products, MRD, Louisiana, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1979

- L1B products used to generate these L3 water channel products.

Acknowledgement:

This program was funded under the NASA Earth Venture Suborbital-3 Program, grant number NNH17ZDA001N-EVS3.

2. Data Characteristics

Spatial Coverage: Atchafalaya and Terrebone Basins, southern coast of Louisiana, USA

Spatial Resolution: 0.000056 degrees (approximately 6 m)

Temporal Coverage: 2021-03-27 to 2021-09-13

Temporal Resolution: one time estimates

Site Boundaries: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Atchafalaya and Terrebonne Basins	-91.5708	-90.1338	29.7800	29.0148

Data File Information

There are two data files with this dataset in cloud-optimized GeoTIFF (.tif) format:

Delta_Atchafalaya_channels_01.tif and **DeltaX_Terrebonne_channels_01.tif**

The L3 gridded channel products contain pixels with one of three discrete values:

- 0 = open water (no vegetation above water surface)
- 1 = unflooded land or flooded land without significant interferometric decorrelation (if flooded, there is vegetation present above water surface)
- -9999 = no data acquired

GeoTiFF characteristics:

- Projection: Latitude-Longitude, WGS-84 datum
- Cell size: 0.000056 x 0.000056 degrees (approximately 6 x 6 m)

3. Application and Derivation

UAVSAR was used to measure hydrological parameters, and these UAVSAR Level 3 gridded channel estimates serve to define the open water paths in hydrodynamic models and to evaluate model performance.

4. Quality Assessment

Data quality of the channel gridded estimates was assessed through comparison with optical imagery and with visual comparisons to Google Earth. In all products, pixels that lack data or for which the data fail quality tests have nodata value (-9999).

5. Data Acquisition, Materials, and Methods

UAVSAR is a polarimetric L-band synthetic aperture radar operating with 80 MHz bandwidth from 1217.5–1297.5 MHz designed for interferometry (InSAR) (Hensley et al., 2009). UAVSAR's swath width is 22 km, which illuminates an area from ~22°–67° incidence angle, with 3 m (cross-track average) by 1 m (along-track) single look ground resolution. The instrument is flown on a Gulfstream-III (C20) aircraft, with the radar electronics and antenna housed in a pod mounted below the fuselage (Figure 2).

During the Delta-X campaign, the UAVSAR instrument was operated in its standard acquisition configuration, operating at an altitude of 12.5 km in quad-polarization mode, transmitting horizontally and vertically polarized radiation on alternate pulses and receiving both co-polarized (HH or VV) and cross-polarized (HV or VH) returns for each pulse.

Figure 2. (A) UAVSAR is flown on a G-3 aircraft, mounted in a pod hung below the fuselage. The antenna is left-side looking. The pod contains (B) the antenna (left-side looking) and (C) the digital and RF electronics. The recording media are housed within the fuselage.

The radar instrument is designed to minimize the number of interfaces with the aircraft for improved portability. The aircraft provides 28 V DC power to the radar via the Power Distribution Unit (PDU), which is also responsible for maintaining the thermal environment in the pod. The instrument uses both an embedded GPS inertial navigation unit (EGI) and a differential GPS (DGPS) unit to derive the antenna position, attitude and velocity in real-time. Waypoints for the desired flight paths are generated prior to flight by the Flight Planning Subsystem and loaded into the platform's Precision Autopilot system and the radar's Automatic Radar Controller (ARC) along with radar command information for each waypoint. The ARC is designed to operate in a fully autonomous mode or to accept commands from the Radar Operator Workstation (ROW) through an ethernet connection. The active array antenna consists of 24 L-band Transmit/Receive modules that feed 48 radiating elements within the 0.5 m by 1.5 m array. Robust differential interferometric measurement imposes two observational constraints on the UAVSAR radar and platform, namely, flight track repeatability and antenna steering capability. The UAVSAR G-III aircraft contains a Platform Precision Autopilot (PPA) system (Lin, 2008) to control the aircraft position through the aircraft's instrument landing system based upon high precision real-time position information provided by a DGPS unit that is part of the radar instrument. The aircraft normally flies within 5 meters of the planned flight track. The antenna is electronically steered to compensate for variations in the yaw and pitch angles of the aircraft, which arise from varying and different wind conditions aloft both within a single acquisition and on repeated tracks. The steering adjustments are designed to maintain a constant look direction and the adjustments are based on real-time attitude angle measurements derived from the EGI.

A minimum of two operators fly onboard the aircraft, one the radar operator and the other the PPA operator. The system contains automated on-board track monitoring software that evaluates flight performance during science data collection based on predefined track quality criteria and notifies the operators when the aircraft deviates from the planned track outside the bounds of accepted tolerances. The operator can then request that the flight line be aborted and reacquired. The decision to re-fly lines is made with consideration to line priority, aircraft fuel levels, and crew day limitations. During Delta-X flights, the UAVSAR flight crew included a mission scientist from the Delta-X team to make decisions about line priority and reacquiring lines in cases where a flight line was aborted.

Water Channel Gridded Estimates

Two geocoded L3 gridded channel estimates were generated covering the combined area imaged by UAVSAR and starting from UAVSAR Level 1B Interferometric products (Jones et al., 2021) from both spring and fall campaigns. The two spatial areas cover primarily the Atchafalaya basin and the Terrebonne basin (Figures 1 and 2).

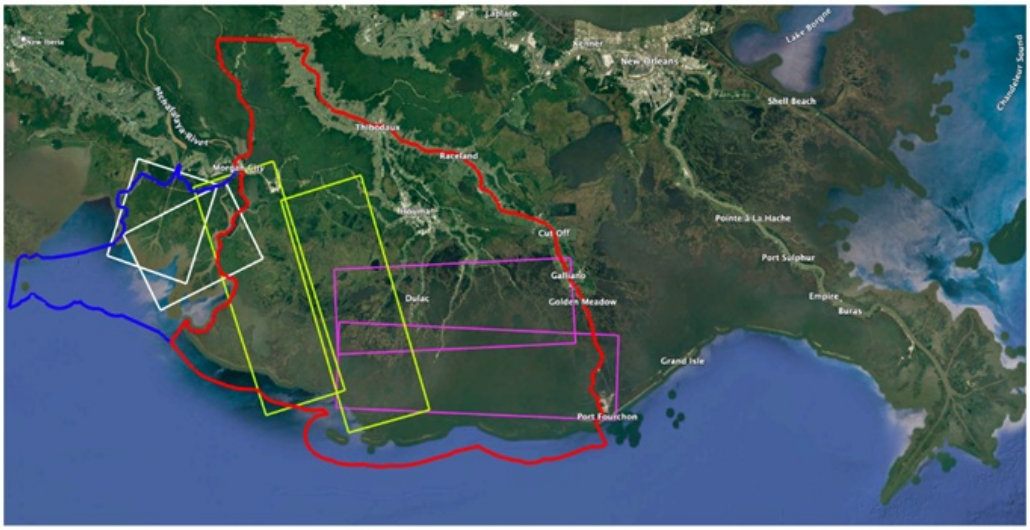

Figure 3: The Atchafalaya (blue) and Terrebonne (red) basin outlines and the coverage of the UAVSAR flights lines used to generate the channel estimates. Repeated acquisitions of two lines were made on each flight, one plan covering the Atchafalaya area (white), the second covering West Terrebonne (green), and the third covering East Terrebonne (purple).

Data from both spring and fall were used because the spring campaign had many inundated areas that obscured the channel network and because in both spring and fall some of the lines had low coherence over parts of the scene, probably from heavy cloud cover. To get the best channel extent without a lot of seasonally flooded areas included in the map, in general the higher tide Fall campaign data was used to make the map, although in some cases channels in parts of the scene were taken from data acquired in other flights for the reasons mentioned above. One Spring data set was used to get better channel definition in the interior of the west Terrebonne basin. Tables 1 lists the flight lines used for generating these maps and the number of acquisitions of each. Figure 4 shows the coverage of each flight line. Figure 5 shows the tidal conditions for all spring and fall flight dates.

The final channel gridded estimates was constructed from individual channel images made for each flight date and flight line. The individual channel images were made using the interferometric coherence (L1B coh.dat files, Jones et al., 2022a) or all acquisitions during the flight. For example, on 2021-09-05, the atchaf_06309 line was acquired 9 times with ~25-30 minute intervals between acquisitions. The water pixels were selected based on the average interferometric coherence of the nearest neighbor (NN) interferometric pairs applying a maximum average coherence threshold of 0.40. This threshold was selected to identify areas with open water during the entire flight, not flooded emergent vegetation, although some pixels with low coherence could represent disturbance from other sources (e.g., human activity at the Delta-X ground sites).

After merging the individual images, the final gridded estimates were geocoded using the lat/lon/height (.llh) files from the single look complex (SLC) data set (Jones et al., 2022a) and produced in GeoTIFF format using gdal-based code.

Table 1: Summary of flight lines, dates, and number of acquisitions for the data used to make the channel maps.

UAVSAR flight line	Date	Number of acquisitions
atchaf_06309	2021-09-05	9
	2021-09-13	2
atchaf_19809	2021-09-05	9
	2021-09-13	4
eterre_08705	2021-09-07	8
eterre_27309	2021-09-07	7
wterre_16300	2021-04-07	7
	2021-09-12	7
wterre_34202	2021-04-07	8
	2021-09-12	8

Figure 4. Spatial coverage of each UAVSAR flight line acquired during the 2021 Delta-X campaign. Shown are the Atchafalaya and Terrebonne Basins along the southern coast of Louisiana, USA.

Table 2. Level 1 (L1) co-registered single look complex (SLC) stack products (Jones et al, 2022b) used to generate these L3 products.

UAVSAR flight line	Baseline L1 SLC Product
atchaf_06309	atchaf_06309_02
	atchaf_06309_03
atchaf_19809	atchaf_19809_02
	atchaf_19809_03
wterre_16300	wterre_16300_02
	wterre_16300_03
wterre_34202	wterre_34202_02
	wterre_34202_03
eterre_08705	eterre_08705_02
	eterre_08705_03
eterre_27309	eterre_27309_01
	eterre_27309_02

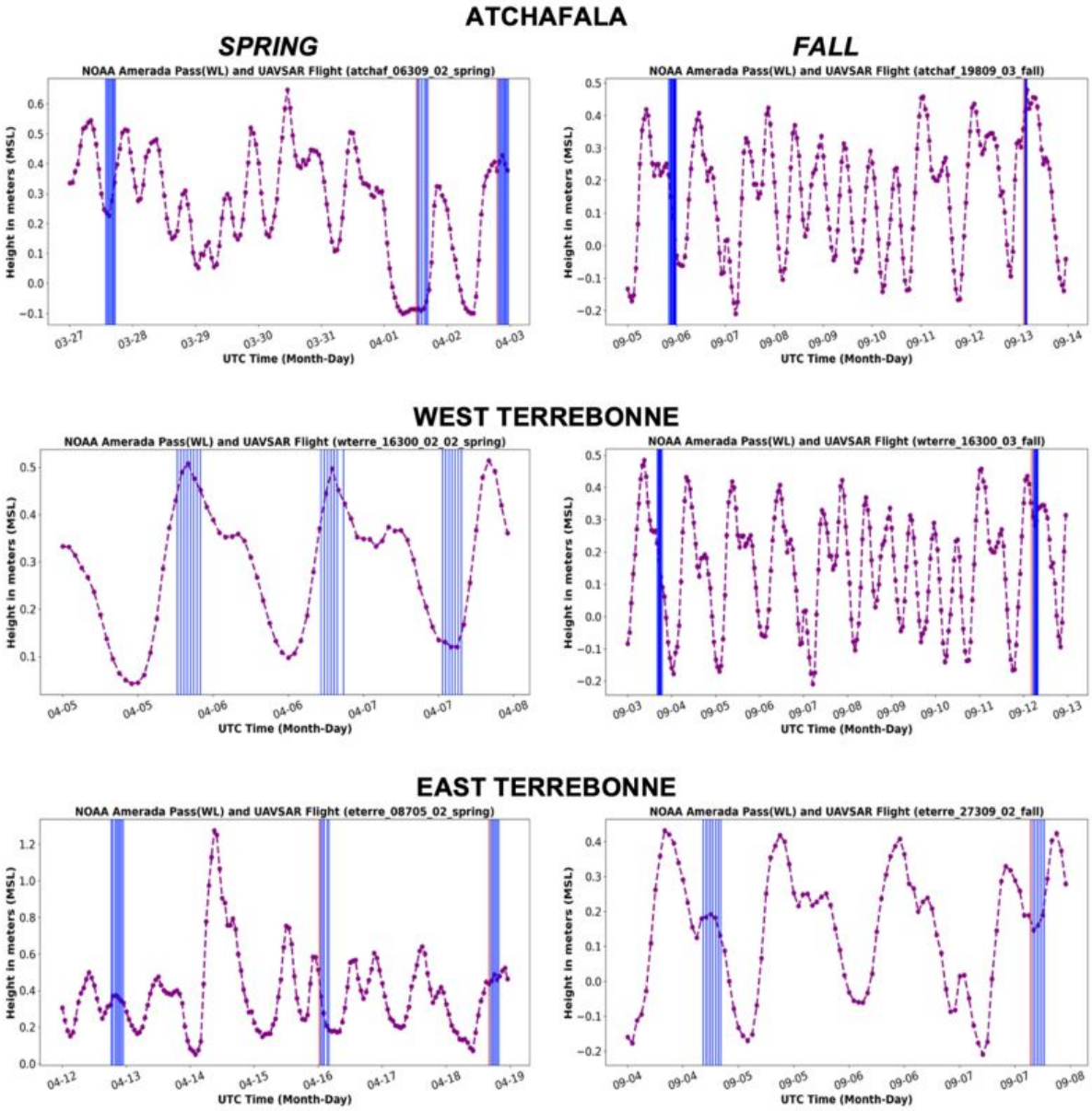

Figure 5. Water levels measured at the NOAA Amerada Pass gauge in the Atchafalaya Delta during each flight of the spring (left) and fall (right) Delta-X field seasons. Flight dates are shown by blue vertical lines.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

Delta-X: UAVSAR L3 Gridded Open Water Channels, MRD, Louisiana, USA, 2021

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

Hensley, S., H. Zebker, C. Jones, T. Michel, R. Muellerschoen, and B. Chapman. 2009. First deformation results using the NASA/JPL UAVSAR instrument. 2009 2nd Asian-Pacific Conference on Synthetic Aperture Radar. https://doi.org/10.1109/APSAR.2009.5374246

Jones, C., T. Oliver-Cabrera, M. Simard, and Y. Lou. 2022a. Delta-X: UAVSAR L1B Interferometric Products, MRD, Louisiana, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1979

Jones, C., M. Simard, Y. Lou, and T. Oliver-Cabrera. 2022b. Delta-X: UAVSAR L1 Single Look Complex (SLC) Stack Products, MRD, Louisiana, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1984

Oliver-Cabrera, T., C.E. Jones, Z. Yunjun, and M. Simard. 2021. InSAR phase unwrapping error correction for rapid repeat measurements of water level change in wetlands. IEEE Transactions on Geoscience and Remote Sensing 60:1-15. https://doi.org/10.1109/TGRS.2021.3108751





Home

About Us
- Mission
- Data Use and Citation Policy
- User Working Group
- Partners

Get Data
- Science Themes
- NASA Projects
- All Datasets

Submit Data
- Submit Data Form
- Data Scope and Acceptance
- Data Authorship Policy
- Data Publication Timeline
- Detailed Submission Guidelines

Tools
- MODIS
- THREDDS
- SDAT
- Daymet
- Airborne Data Visualizer
- Soil Moisture Visualizer
- Land - Water Checker

Resources
- Learning
- Data Management
- News
- Earthdata Forum

Contact Us