Delta-X: UAVSAR L2 Interferometric Products, MRD, Louisiana, 2021

Get Data

Documentation Revision Date: 2022-08-29

Dataset Version: 1.1

Summary

This dataset contains georeferenced UAVSAR Level 2 (L2) interferometric products for Delta-X flight lines acquired during the spring (2021-03-27 to 2021-04-18) and fall (2021-09-03 to 2021-09-13) deployments. This dataset provides water-level change observations throughout wetlands of the Atchafalaya and Terrebonne Basins, in Southern Louisiana, USA, within the Mississippi River Delta (MRD), and it may be used to generate time series analysis. The data were collected by Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), a polarimetric L-band synthetic aperture radar flown on the NASA Gulfstream-III (C20) aircraft as part of the Delta-X campaign. Water surface elevations were measured on multiple flights at 30-minute intervals. Data quality was assessed by comparing water elevation estimates with data from in situ water level gauges throughout the study area. The data include interferogram phase, interferogram amplitude, unwrapped interferogram phase, and coherence products in ENVI format.

A set of nearest-neighbor (NN), NN+1, and NN+2 co-registered VV-polarization interferograms were generated from the quad-polarization SLC stack product using a combination of the InSAR Scientific Computing Environment (ISCE; Rosen et al., 2012), the statistical-cost, network-flow algorithm for phase unwrapping (SNAPHU; Chen et al., 2001), and previously developed python code. Unwrapped phase products were corrected using the phase unwrapping correction algorithm described in Oliver-Cabrera et al. (2021).

Delta-X was a joint airborne and field campaign in the Mississippi River Delta that took place during Spring and Fall 2021. The Delta-X campaign conducted airborne (remote sensing) and field (in situ) measurements to observe hydrology, water quality (e.g., total suspended solids (TSS)), and vegetation structure. This data serves for the continued development of algorithms and models. The Delta-X algorithms are used to convert remote sensing observables to geophysical parameters, and to develop numerical, hydrodynamic and ecological models.

This dataset includes a total of 1924 files in ENVI format.

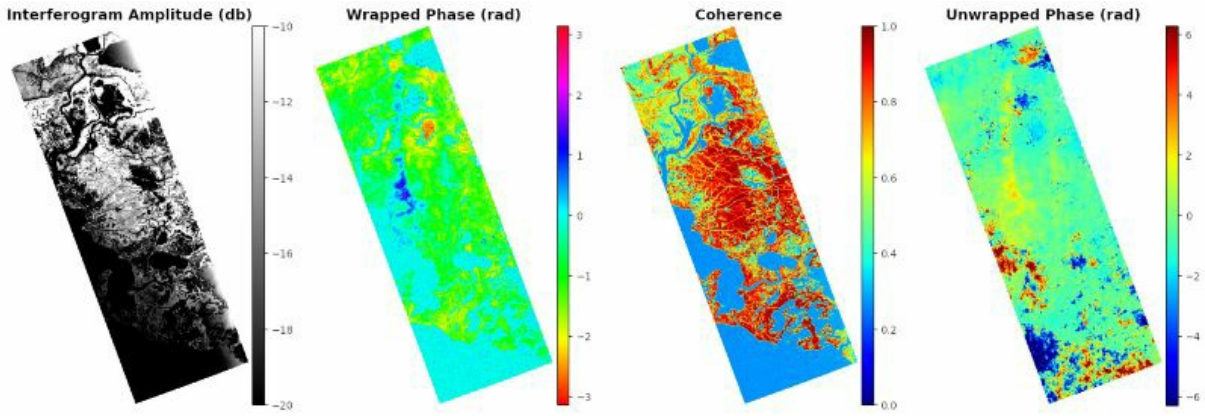

Figure 1. UAVSAR interferometric product example. From left to right: Interferometric amplitude (displayed in decibel scale), wrapped interferometric phase, interferometric coherence and unwrapped interferometric phase, generated using acquisitions from flight-line wterre_34202 on 2021-04-06 at 20:32 and 21:02 (UTC) times.

Citation

Jones, C., T. Oliver-Cabrera, M. Simard, and Y. Lou. 2022. Delta-X: UAVSAR L2 Interferometric Products, MRD, Louisiana, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2057

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1. Dataset Overview

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Project: Delta-X

The Delta-X mission is a 5-year NASA's 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-Cabrera. 2022. 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

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

Jones, C., T. Oliver-Cabrera, M. Simard, and Y. Lou. 2022. 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 the L2 and L3 products.

Jones, C., T. Oliver-Cabrera, M. Simard, and Y. Lou. 2022. Delta-X: UAVSAR L3 Water Level Changes, MRD, Louisiana,, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2058

- L3 water-level change products generated from this L2 dataset.

Acknowledgments

This work was supported by NASA Earth Venture Suborbital-3 (EVS-3) program (grant NNH17ZDA001N-EVS3).

2. Data Characteristics

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

Spatial Resolution: 0.000056 degrees (approximately 5 m)

Temporal Coverage: 2021-03-27 to 2021-04-18

Temporal Resolution: Repeated samples at 30-minute intervals

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Atchafalaya and Terrebonne Basins	-91.5894	-90.1386	29.7800	29.0136

Data File Information

This dataset includes 1924 files in ENVI format. Each ENVI consist of a binary data file (*.dat) plus a metadata header file (*.hdr); the data file and its associated header are provided in a zip archive (*.zip).

The files are named ***ssssss_aaaaa_YYLLDDHHMM_yylldd hhmm_vv_product.****grd.dat.zip* (e.g., wterre_34202_2104071352_2104071422_01_intphase.grd.dat.zip), where

- **ssssss** = "atchaf", "eterre" or "wterre"; 6-character alphanumeric site name assigned to the UAVSAR flight line .
- **aaaaa** = 5-character flight line ID assigned to the UAVSAR flight line (Table 1, Fig 3). The first 3 characters are the aircraft heading in degrees from North, and the last 2 characters are an alphanumeric counter chosen to ensure uniqueness of the ID.
- **YYLLDDHHMM** = starting time of first acquisition, encoded as YY = the last two digits of the year, LL = month, DD = day of month, HH = hour, and MM = minute, in UTC.
- **yylldd hhmm**= start time of second acquisition, encoded as yy = the last two digits of the year, ll = month, dd = day of month, hh = hour, and mm =

minute, in UTC.
- **vv** = version number of file.
- **product** = "intphase" (interferogram phase), "unwphase" (unwrapped interferogram phase), "intamp" (interferogram amplitude) or "coh" (coherence).

These L2 interferometric products are provided as real Float32 datatypes. The ENVI header files contain the names of the products from which the product was derived (Table 2), the data format, along with the number of samples and lines in the raster and pixel spacing information. The no data value is NaN.

3. Application and Derivation

The UAVSAR interferometric products serve as maps of surface change throughout the wetland regions. This data is used to produce water level change time series measurements that are used to evaluate and compare hydrodynamic model performance.

4. Quality Assessment

Data quality was assessed by comparing water elevation estimates with data from in situ water level gauges throughout the study area. Residual errors were assessed through a scene-wide comparison of elevation estimates for sites above the high-water level. Pixels that lack data or which failed quality tests were marked with a “no data” value (NaN).

5. Data Acquisition, Materials, and Methods

The Uninhabited Aerial Vehicle Synthetic Aperture Radar (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 was flown on a Gulfstream-III (C20) aircraft with the radar electronics and antenna housed in a pod mounted below the fuselage (Figure 2). Table 1 summarizes the acquisitions used to generate the interferometric products, and the spatial coverage of all flight lines is shown in Figure 3.

Figure 2. UAVSAR is flown on a Gulfstream-III aircraft, mounted in a pod hung below the fuselage.

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.

A set of nearest-neighbor (NN), NN+1, and NN+2 co-registered VV-polarization interferograms were generated from the quad-polarization SLC stack product (Jones et al., 2022a) using a combination of the InSAR Scientific Computing Environment (ISCE; Rosen et al., 2012), the statistical-cost, network-flow algorithm for phase unwrapping (SNAPHU; Chen et al., 2001), and previously developed python code. Unwrapped phase products were corrected using the phase unwrapping correction algorithm described in Oliver-Cabrera et al. (2021).

The Level 1 (L1) UAVSAR single look complex (SLC) VV-polarization co-registered stack products (Jones et al., 2022a) were the underlying data for L1B products (Jones et al., 2022b) and these L2 products, which were then used to generate L3 water-level change products (Jones et al., 2022c).

Table 1. Summary of all UAVSAR flight lines, number of acquisitions and interferograms produced from the data collected during the Delta-X's 2021 deployments. Detailed information about these flights is available from https://uavsar.jpl.nasa.gov/ by searching on the flight line name.

UAVSAR flight line	Date	Number of acquisitions	Interferograms produced
atchaf_06309	2021-03-27	8	18
	2021-04-01	7	15
	2021-04-02	9	21
	2021-09-05	9	21
	2021-09-13	2	1
atchaf_19809	2021-03-23	9	21
	2021-04-01	9	21
	2021-04-02	9	21
	2021-09-05	9	21

	2021-09-13	4	6
eterre_08705	2021-04-12	8	18
	2021-04-16	6	12
	2021-04-18	7	15
	2021-09-04	8	18
	2021-09-07	8	18
eterre_27309	2021-04-12	7	15
	2021-04-16	7	15
	2021-04-18	7	15
	2021-09-04	8	18
	2021-09-07	7	15
wterre_16300	2021-04-05	8	18
	2021-04-06	7	15
	2021-04-07	7	15
	2021-09-03	6	12
	2021-09-12	7	15
wterre_34202	2021-04-05	8	18
	2021-04-06	6	12
	2021-04-07	8	18
	2021-09-03	7	15
	2021-09-12	8	18

Figure 3. Spatial coverage of each UAVSAR flight line acquired during the 2021 Delta-X campaign. Map shows 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 used to generate these L2 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

6. Data Access

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

Delta-X: UAVSAR L2 Interferometric Products, MRD, Louisiana, 2021

Contact for Data Center Access Information:

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

7. References

Chen, C.W., and H.A. Zebker. 2001. Network approaches to two-dimensional phase unwrapping: intractability and two new algorithms: erratum. Journal of the Optical Society of America A 18:1192. https://doi.org/10.1364/josaa.18.001192

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., M. Simard, Y. Lou, and T. Oliver. 2022a. Delta-X: UAVSAR Single Look Complex (SLC) Stack L1 Product, LA, USA, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1984

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

Jones, C., T. Oliver-Cabrera, M. Simard, and Y. Lou. 2022c. Delta-X: UAVSAR L3 Water Level Changes, Atchafalaya and Terrebonne Basins, 2021. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2058

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8. Dataset Revisions

Version	Release Date	Revision Notes
1.1	2022-08-29	Fall 2021 data were added to the dataset. Dataset title and user guide were updated.
1.0		Initial release with Spring 2021 data only. (Preprint)