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Pre-Delta-X: UAVSAR-derived Water Level Change Maps, Atchafalaya Basin, LA, USA, 2016

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Summary

This dataset contains five maps of cumulative changes in water levels at 30-minute intervals over a 150-minute period on 2016-10-16 in the Atchafalaya Basin in Southern Louisiana, USA, within the Mississippi River Delta (MRD) floodplain. Water surface elevations were measured on six flights at 30-minute intervals, with the Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), a polarimetric L-band synthetic aperture radar (SAR) flown on the NASA Gulfstream-III aircraft. The five georeferenced maps at 6 m resolution show the cumulative change of water levels (cm) every 30 minutes relative to the first sampling flight. These Level 3 maps were generated using the InSAR time series Small Baseline Subsets (SBAS) algorithm implemented in the GIANt toolbox and served to evaluate and compare hydrodynamic models.

Pre-Delta-X was a joint airborne and field campaign in the Mississippi River Delta during Spring 2015 and Fall 2016. The Pre-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 to support the upcoming Delta-X mission. The Delta-X algorithms are used to convert remote sensing observables to geophysical parameters, and the models are numerical hydrodynamic and ecological.

This dataset includes five files in geoTIFF (*.tiff) format.

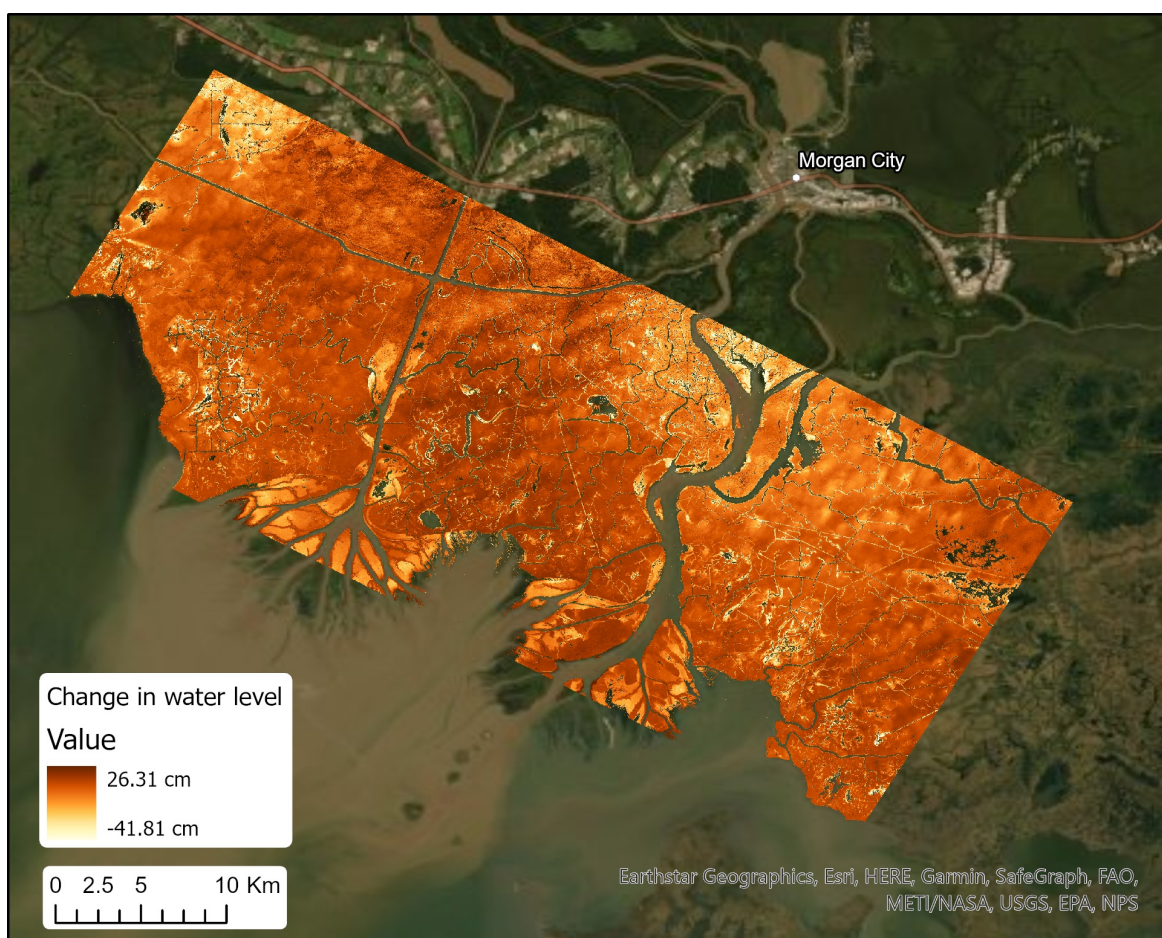


Figure 1. Map of water level changes based on water surface elevations measured by UAVSAR on October 16, 2016, at 14:08 and 16:37 UTC.

Citation

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1. Dataset Overview

This dataset contains five maps of cumulative changes in water levels at 30-minute intervals over a 150-minute period on 2016-10-16 in the Atchafalaya Basin in Southern Louisiana, USA, within the Mississippi River Delta (MRD) floodplain. Water surface elevations were measured on six flights at 30-minute intervals, with the Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), a polarimetric L-band synthetic aperture radar (SAR) flown on the NASA Gulfstream-III aircraft. The five georeferenced maps at 6 m resolution show the cumulative change of water levels (cm) every 30 minutes relative to the first sampling flight. These Level 3 maps were generated using the InSAR time series Small Baseline Subsets (SBAS) algorithm implemented in the GIANt toolbox and served to evaluate and compare hydrodynamic models.

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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 Publication

Jensen, D., K. C. Cavanaugh, M. Simard, G. S. Okin, E. Castañeda-Moya, A. McCall, and R. R. Twilley. 2019. Integrating imaging spectrometer and synthetic aperture radar data for estimating wetland vegetation aboveground biomass in coastal Louisiana. *Remote Sensing* 11(21):2533. <https://doi.org/10.3390/rs11212533>

Related Dataset

Simard, M., M.W. Denbina, D.J. Jensen, and R. Lane. 2020. Pre-Delta-X: Water Levels across Wax Lake Outlet, Atchafalaya Basin, LA, USA, 2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1801>

Acknowledgment

This work was supported by Jet Propulsion Laboratory Research and Technology Development (JPL-R&TD) FY17–19 (grants 01STCR / R.17.231.069).

2. Data Characteristics

Spatial Coverage: Atchafalaya Basin, Mississippi River Delta (MRD) floodplain, southern coast of Louisiana, USA

Spatial Resolution: 0.000063 degrees (approximately 6 m)

Temporal Coverage: 2016-10-16

Temporal Resolution: Five estimates at 30-minute intervals

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Atchafalaya Basin	-91.6220	-91.0576	29.7583	29.3562

Data File Information

There are five data files in geoTIFF (*.tif) format that provide the change in water levels relative to the initial measurement of water surface elevation. The files are named **PreDeltaX_wlc_gulfco_121011_1610161408_BBBBBBBBBB_01.tif** where

wlc = water level change,
 gulfco_121011 = UAVSAR line
 1610161408 = date and time of the initial sample in YYMMDDhhmm, and
 BBBBBBBBBB = date and time of the subsequent sample.

Table 1. File names and descriptions.

User Note: Change was computed as the difference in water-surface elevations (i.e., elevation_B – elevation_A).

File Name	Units	Description
PreDeltaX_wlc_gulfco_12011_1610161408_1610161438_01.tif	cm	Change after 30 min
PreDeltaX_wlc_gulfco_12011_1610161408_1610161508_01.tif	cm	Change after 60 min
PreDeltaX_wlc_gulfco_12011_1610161408_1610161538_01.tif	cm	Change after 90 min
PreDeltaX_wlc_gulfco_12011_1610161408_1610161607_01.tif	cm	Change after 120 min
PreDeltaX_wlc_gulfco_12011_1610161408_1610161637_01.tif	cm	Change after 150 min

Data File Details

- Spatial reference system: WGS 84 (EPSG:4326)
- Missing data value: -9999

3. Application and Derivation

Water surface elevation was measured using UAVSAR, a synthetic aperture radar instrument. The UAVSAR data were used to measure hydrological parameters, and the Level 3 water level change maps served to evaluate models of hydrodynamics in this river delta system.

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.

5. Data Acquisition, Materials, and Methods

Changes in water levels were mapped by taking the difference in water surface elevation between an initial sample and samples collected over the same area on the same day.



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

UAVSAR is a polarimetric L-band synthetic aperture radar operating with 80 MHz bandwidth from 1217.5–1297.5 GHz 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 (Fig. 2).

The UAVSAR instrument was operated in its standard acquisition configuration, flown 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 3. Map of the area sampled by UAVSAR on 2016-10-16.

On October 16, 2016, the UAVSAR line "gulfco_12011" was acquired 6 times in approximately 30-minute intervals (Fig. 3). This series of images was used to generate Level 3 water level change products. For the six acquisitions of this flight line, five water level change products were generated. The maps contain the cumulate water level change in centimeters between the first acquisition at time T_1 and the n^{th} acquisition at time T_n , where $n = 2-6$.

The unwrapped interferometric phase was generated using the open-source SNAPHU phase unwrapping code (Chen and Zebker, 2001), and georeferencing was done using code, provided by the UAVSAR processing team, that calls Geospatial Data Abstraction Library (GDAL) library functions (Warmerdam, 2008). The Level 3 water level change products were generated using the InSAR time series Small Baseline Subsets algorithm (Berardino et al., 2002) implemented in the GIANT toolbox (Agram et al., 2013).

6. Data Access

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

[Pre-Delta-X: UAVSAR-derived Water Level Change Maps, Atchafalaya Basin, LA, USA, 2016](#)

Contact for Data Center Access Information:

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

7. References

Agram, P. S., R. Jolivet, B. Riel, Y. N. Lin, M. Simons, E. Hetland, M. Doin, and C. Lasserre. 2013. New Radar Interferometric Time Series Analysis Toolbox Released. *Eos, Transactions American Geophysical Union* 94:69–70. <https://doi.org/10.1002/2013EO070001>

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