Pre-Delta-X: L3 AirSWOT-derived Water Level Profiles, Wax Lake Outlet, LA, USA, 2015

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Summary

This dataset contains water level profiles generated from the AirSWOT data collected in the Atchafalaya Basin in Southern Louisiana, USA, within the Mississippi River Delta (MRD) floodplain. Part of the Pre-Delta-X Campaign, AirSWOT used near-nadir wide-swath Ka-band radar interferometry to measure water-surface elevation and uncertainty in May 2015. This Level 3 (L3) AirSWOT dataset is in the form of numerous profiles of water level along the Wax Lake Outlet.

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 three files in comma-separated value (*.csv) format, one for each date of sampling.

Figure 1. Extent of AirSWOT Level 3 water level profiles along the Wax Lake Channel in the Atchafalaya Basin. The red line shows the general path of the channel draining to the Gulf of Mexico. Source: 2015 AirSWOT data collection

Citation

Denbina, M.W., M. Simard, E. Rodriguez, X. Wu, and C. Michailovsky. 2021. Pre-Delta-X: L3 AirSWOT-derived Water Level Profiles, Wax Lake Outlet, LA, USA, 2015. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1819

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1. Dataset Overview

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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

Denbina, M., M. Simard, E. Rodriguez, X. Wu, A. Chen, and T. Pavelsky. 2019. Mapping water surface elevation and slope in the Mississippi River Delta Using the AirSWOT Ka-band interferometric synthetic aperture radar. Remote Sensing 11:2739. https://doi.org/10.3390/rs11232739

Related Datasets

Denbina, M.W., M. Simard, E. Rodriguez, X. Wu, and C. Michailovsky. 2020. Pre-Delta-X: L2 AirSWOT Water Surface Elevations, Atchafalaya Basin, LA, USA, 2016. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1818

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

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2. Data Characteristics

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

Spatial Resolution: Points at 50 m intervals

Temporal Coverage: 2015-05-08 to 2015-05-11

Temporal Resolution: Three daily estimates

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Atchafalaya Basin	-91.4565	-91.3630	29.7276	29.4624

Data File Information

There are three data files in comma-separated value (*.csv) format, one for each date of sampling. The files provide estimates of water surface elevation at points along the sampled Wax Lake Outlet. The files are named **PreDeltaX_WaterLevel_YYYYMMDD_Atcha_AirSWOT.csv** where YYYYMMDD is the sampling date.

Table 1. Variables names and descriptions.

Variable	Units	Description
channel_id	none	String identifying the river channel of this profile (e.g., "WLO" for Wax Lake Outlet)
date	YYYY-MM-DD	Acquisition date
time	hh:mm:ss	Acquisition time (UTC)
utc_time	Seconds of day	Acquisition time in number of seconds since the start of the acquisition day (UTC)
along_channel_distance	meters	Distance along the river channel

CoordX	meters	UTM X coordinate, in WGS 84 / UTM Zone 15N projected coordinate reference system (EPSG:32615)
CoordY	meters	UTM Y coordinate, in WGS 84 / UTM Zone 15N projected coordinate reference system (EPSG:32615)
longitude	decimal degrees	Longitude coordinate in WGS 84 coordinate reference system (EPSG:4326)
latitude	decimal degrees	Latitude coordinate in WGS 84 coordinate reference system (EPSG:4326)
water_surface_elevation_NAVD88	meters	Water surface elevation in meters, with respect to the North American Vertical Datum 1988 (NAVD 88) geoid
water_surface_elevation_WGS84	meters	Water surface elevation in meters, with respect to the World Geodetic System 1984 (WGS 84) ellipsoidal surface
water_surface_elevation_uncertainty	meters	Estimated 1-sigma standard deviation of the water surface elevation

3. Application and Derivation

AirSWOT uses airborne radar interferometry to measure open water surface elevation. It was developed in collaboration with the NASA's Surface Water and Ocean Topography (SWOT) project and has supported multiple ocean and hydrology campaigns including Tanana River, Yukon Flats Basin, and Willamette River. AirSWOT elevation measurements can be used to calibrate and validate hydrodynamic models and to estimate river discharge.

4. Quality Assessment

Data quality was assessed by comparing elevation estimates with data from in-situ water level gauges throughout the study area. The analysis estimated phase drift rate to make global calibration adjustments based on cross-over. Estimated phase drift rate was assessed using the in-situ measurements of water surface elevation and slope. When there were large differences between estimates and in-situ measurements, the phase drift rate for each track was adjusted and a global adjustment applied to derive a new data product. The phase drift rate becomes more stable the longer the radar is turned on. Therefore, for this campaign, the data collected in the first hour of each flight was processed using a first-order (linear) phase drift rate, while data collected after the first hour was processed using a zero-order (constant) phase drift. For more details on the uncertainty analysis and phase calibration see Denbina et al. (2019).

AirSWOT produced continuous gridded elevation data. On a pixel basis, elevation error is dominated by random noise, and contiguous pixels along a river channel were averaged to reduce measurement noise. Assuming a total averaging area of 1 km^2, the height noise was less than 10 cm. Other factors such as atmospheric delays, GPS errors, and instrument drift produced slowly varying errors that were corrected using in-situ data (leveled pressure transducers) and cross-over calibration from overlapping flight lines. The combined measurement system yielded errors smaller than 1 cm/km over 10 km reaches.

5. Data Acquisition, Materials, and Methods

AirSWOT used near-nadir wide-swath radar interferometry (Rodriguez et al., 2017; Altenau et al., 2017) to measure water-surface elevation. The instrument operated at Ka-band (35.75 GHz) and includes six antennas that formed multiple baseline pairs for along-track and across-track interferometry. These antenna combinations provided contiguous coverage from about 500 m to 4 km from nadir, which removed water-motion-induced geolocation and height errors. The instrument was coupled with a high-precision Applanix GPS/IMU system. AirSWOT produced Level 2 continuous gridded elevation data used to derive water level profiles (Denbina et al., 2020).

This Level 3 dataset is in the form of elevation profiles of water levels along various river channels within the study area. The water level profiles were calculated along predefined river centerlines from the gridded elevation data. The AirSWOT data was masked using a water mask to remove land pixels. The data were then projected into a channel-centric coordinate system defined by an along-channel and cross-channel axis. Points with cross-channel coordinate values above a certain threshold were discarded. The profile was generated from the remaining points using a moving average in the along-channel direction, followed by a Savitzky-Golay filter to provide additional smoothing. Each row in the CSV files represents a different profile sample along a given river channel.

6. Data Access

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

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Contact for Data Center Access Information:

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

7. References

Altenau, E. H., T. M. Pavelsky, D. Moller, C. Lion, L. H. Pitcher, G. H. Allen, P. D. Bates, S. Calmant, M. Durand, and L. C. Smith. 2017. AirSWOT measurements of river water surface elevation and slope: Tanana River, AK. Geophysical Research Letters 44(1):181–189. https://doi.org/10.1002/2016GL071577

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