Delta-X: Delft3D FM, Weighted Mean Hydroperiod, MRD, Louisiana, USA

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Documentation Revision Date: 2025-12-03

Dataset Version: 1

Summary

This dataset provides the weighted average hydroperiod derived from two Delft3D FM model simulations representing the low discharge (fall 2021) and high discharge (spring 2021) seasons. Each model was run for 31 days, excluding a 1-day warm-up period from the analysis. The weights for each model were derived from the long-term probability density function (PDF) of the Atchafalaya River discharge. Hydroperiod, which quantifies the frequency of inundation at each model grid cell, is computed by analyzing the water level time series and identifying periods when the water depth does not exceed the model-defined wet/dry threshold of 5 cm.

There is one data file in netCDF format in this dataset.

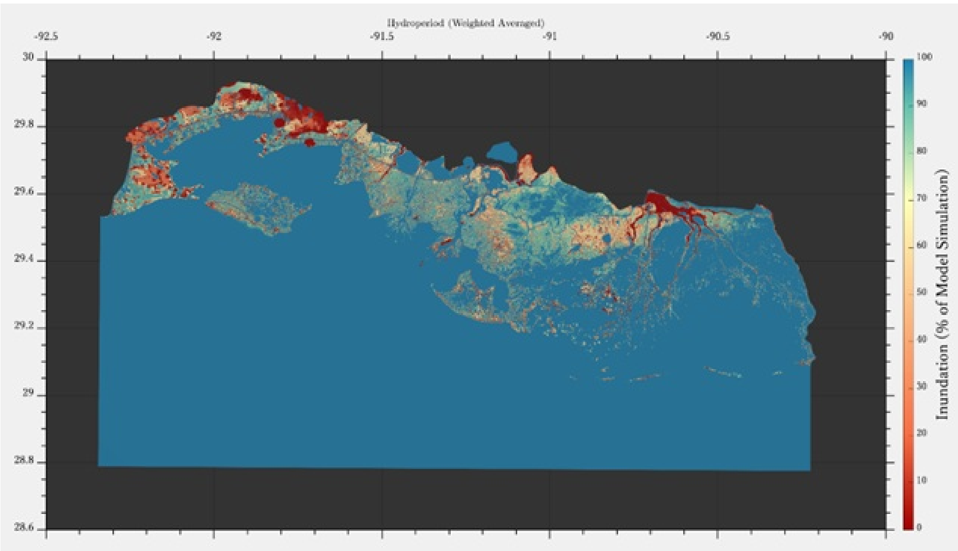

Figure 1. Weighted average hydroperiod derived from hydrodynamic model simulations for fall and spring 2021.

Citation

Payandeh, A.R., M. Simard, and C. Jones. 2025. Delta-X: Delft3D FM, Weighted Mean Hydroperiod, MRD, Louisiana, USA. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2421

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1. Dataset Overview

This dataset provides the weighted average hydroperiod derived from two Delft3D Flexible Mesh (FM) model simulations representing the low discharge and high discharge seasons. A weighted averaging approach was applied to combine the outputs of two hydrodynamic models representing different river discharge conditions (Payendah et al., 2025a; high discharge for fall 2021 and low discharge for spring 2021) (Figure 1). The weights for each model were determined using the probability density function (PDF) of the Atchafalaya River discharge. Specifically, the weight coefficients were derived by comparing the PDFs of the mean discharge during the fall and spring simulations. This method allows the model results to be weighted according to the relative contribution of river discharge during each simulation, providing a more representative combined outcome based on historical discharge variability.

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 datasets

Payandeh, A.R., M. Simard, and C. Jones. 2025. Delta-X: Delft3D FM, Extended Domain Hydrodynamic Model. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2464

- This dataset provides the river discharge conditions.

Payandeh, A.R., M. Simard, and C. Jones. 2025. Delta-X: Delft3D FM, Weighted Mean Salinity, MRD, Louisiana, USA. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2420

- This dataset uses the same methods and is for the same time period and study area

Acknowledgements

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2. Data Characteristics

Spatial Coverage: Atchafalaya River and Terrebonne Basins in southern Louisiana, USA

Spatial Resolution: 25 m

Temporal Coverage: 2021-03-20 to 2021-09-14

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Atchafalaya River and Terrebonne Basins	-92.3434	-90.2076	29.9336	28.7751

Data File Information

There is one file in netCDF format with this dataset: **Delft3DFM_Weighted_Averaged_Hydroperiod.nc4**

Table 1. Variables in the netCDF.

Variable Name	Units	Description
wgs84	-	WGS 84 coordinate system metadata
mesh2d	-	Topology data of 2D mesh
mesh2d_node_x	degrees east	x-coordinate (longitude) of mesh nodes
mesh2d_node_y	degrees north	y-coordinate (latitude) of mesh nodes
mesh2d_node_z	m	z-coordinate (altitude) of mesh nodes
mesh2d_edge_x	degrees east	Characteristic x-coordinate of the mesh edge (e.g., midpoint)
mesh2d_edge_y	degrees north	Characteristic y-coordinate of the mesh edge (e.g., midpoint)
mesh2d_edge_nodes	-	Start and end nodes of mesh edges
mesh2d_face_nodes	-	Vertex nodes of mesh faces (counterclockwise)
mesh2d_edge_faces	-	Neighboring faces of mesh edges
mesh2d_face_x	degrees east	Characteristic x-coordinate of mesh face
mesh2d_face_y	degrees north	Characteristic y-coordinate of mesh face
mesh2d_face_x_bnd	degrees east	x-coordinate bounds of mesh faces (corner coordinates)
mesh2d_face_y_bnd	degrees north	y-coordinate bounds of mesh faces (corner coordinates)
mesh2d_face_z	m	z-coordinate of mesh faces
mesh2d_Hydroperiod	percent	Frequency of inundation: weighted mean hydroperiod of the fall and spring simulations

3. Application and Derivation

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. Hydrodynamic models such as the Delft3d FM (Deltares, 2025) are important to these processes in simulating river discharge conditions.

4. Quality Assessment

Not provided.

5. Data Acquisition, Materials, and Methods

Weighted Average of Model Results Based on River Discharge

To combine the outputs of two hydrodynamic models representing different river discharge conditions (Payendah et al., 2025a; high discharge for fall 2021 and low discharge for spring 2021), a weighted averaging approach was applied. The weights for each model were derived from the long-term probability density function (PDF) of the Atchafalaya River discharge (Figure 2). The PDF was calculated using hourly discharge data from 1996 to 2024, obtained from the USGS station at Morgan City (ID: 07381600). Specifically, the weight coefficients were derived by comparing the PDFs of the mean discharge during the fall and spring simulations. The density values were then evaluated at the mean discharge of the fall simulation ($pdf_{meanFall}$) and at the mean discharge of the spring simulation ($pdf_{meanSpring}$). The density values obtained were used to form the weights as follows:

$$W_{Fall} = pdf_{meanFall}/(pdf_{meanFall} + pdf_{meanSpring})$$

$$W_{Spring} = pdf_{meanSpring}/(pdf_{meanFall} + pdf_{meanSpring})$$

Where W_{Fall} and W_{Spring} are the weight coefficients used for averaging and $pdf_{meanFall}$

and $pdf_{meanSpring}$ represent the PDFs of the mean discharge for the fall and spring simulations, respectively.

This method allows the model results to be weighted according to the relative contribution of river discharge during each simulation, providing a more representative combined outcome based on historical discharge variability. Based on this method, the calculated weights for the fall and spring simulations were 0.74 and 0.26, respectively.

Refer to Payendah et al. (2025a) for additional model details.

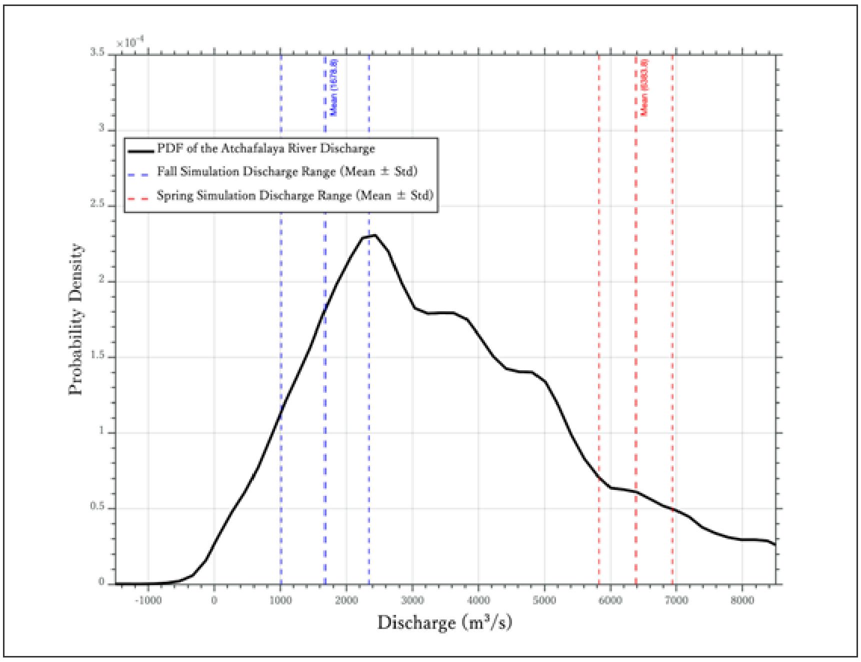

Figure 2. Probability density function (PDF) of Atchafalaya River discharge. Blue vertical lines represent the mean discharge ± standard deviation for the fall simulation, while red vertical lines indicate the mean discharge ± standard deviation for the spring simulation.

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

Deltares. 2025. Delft3d FM user manual. Deltares; Delft, The Netherlands. https://content.oss.deltares.nl/delft3d/D-Flow_FM_User_Manual.pdf

Payandeh, A.R., M. Simard, and C. Jones. 2025a. Delta-X: Delft3D FM, Extended Domain Hydrodynamic Model. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2464

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