USGS –Seamless Pilot National Topography Model (NTM) for Southeast Texas

Jeffrey J. Danielson
USGS EROS
CoNED Applications Project Chief
Inland Bathymetry Research

Cynthia Miller-Corbett
USGS NGTOC
Hydrologist
Inland Bathymetry Research

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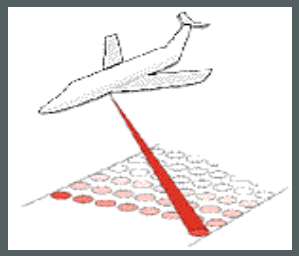
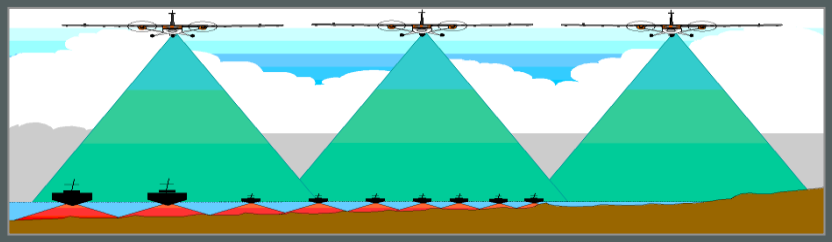
U.S. Department of the Interior
U.S. Geological Survey

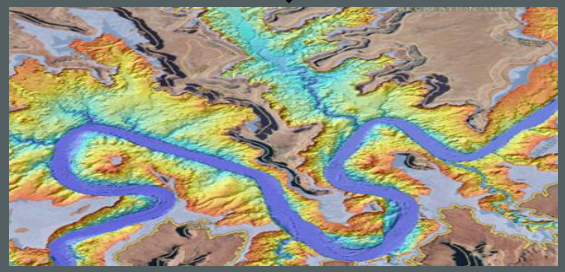
Topobathymetric Elevation Models (TBDEMs)

- Topobathymetric elevation models are a merged rendering of both topography (land elevation) and bathymetry (water depth) to provide an integrated seamless elevation product

- Elevation Data sources
  - Light Detection and Ranging (Lidar)
    - Airborne (NIR-1064nm)
    - Terrestrial Ground-Based (NIR-1064nm)
    - Topobathymetric (CZMIL: Green-532nm)
  - Structure-from-Motion (SfM)
  - Bathymetric Sonar (Acoustic)
    - Multi-Beam
    - Single-Beam
    - Swath
    - Hydrographic Surveys
  - Satellite-Derived Bathymetry







Bathymetry → Integrated Inland Elevation ← Terrestrial

USGS

Southeast Texas Pilot National Topography Model (NTM) – Requirements / Specifications and AOI

- **Spatial Resolution:** *1-Meter*
- **Projection: UTM Zone 15N**
- **Horizontal Datum:** *North American Datum of 1983 (NAD83 2011)*
- **Vertical Datum:** *North American Vertical Datum of 1988 (NAVD88)*
  - *Geoid – Geoid12B*
- **Lidar Quality Level Specifications / Point Density:**
  - *Topographic Lidar: Quality Level 2 (QL2) – 0.7 meter pulse spacing, 2 points per sq. meter, 10cm RMSEz*
  - *Bathymetric Lidar: Quality Level 2 (QL2B) – 0.7 meter pulse spacing, 2 points per sq. meter, 0.25, 0.0075 vertical accuracy coefficients (IHO S-44), 10cm RMSEz*
- **Gap–Filling:** *Smooth interpolate transition between land/water interfaces and moderate to high-resolution bathymetry data sources*
- **Land / Water Masking for Integration**
- **Interpolation:** *Terrain/TINs (Lidar) and Empirical Bayesian Kriging / Spline (Sonar)*
- **Nesting:** *Consistent Resampling, Cell Alignment (Pixel Edge), and Spatial Resolution*
- **Spatially Referenced and Compliant FGDC Metadata**

SETxNTM AOI

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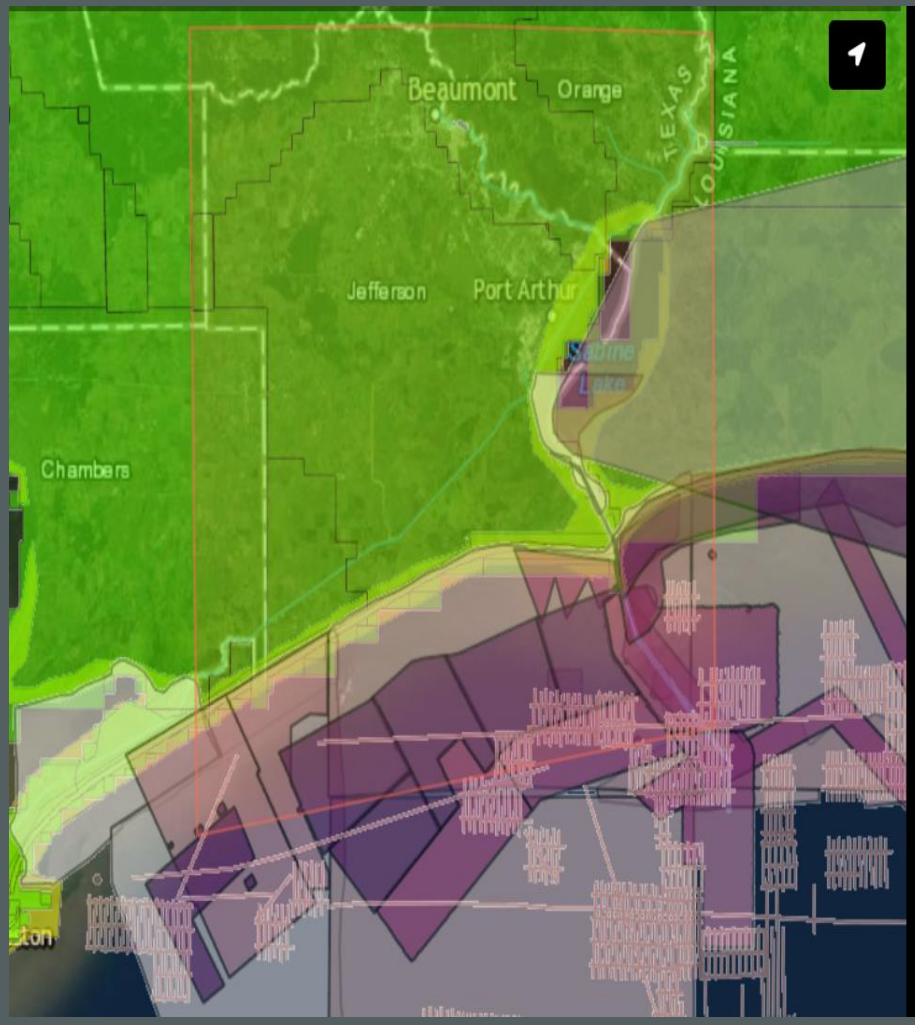
US Interagency Elevation Inventory (USIEI)

https://coast.noaa.gov/inventory/



FILTERS | SORT: COLLECTION YEAR 996 Datasets

USACE Hydrographic Surveys

CALCASIEU TO SABINE

COLLECTION DATE:	STATUS:	COLLECTION YEAR:
3/8/2022	Complete	2022

USACE Hydrographic Surveys

CALCASIEU TO SABINE

COLLECTION DATE:	STATUS:	COLLECTION YEAR:
3/8/2022	Complete	2022

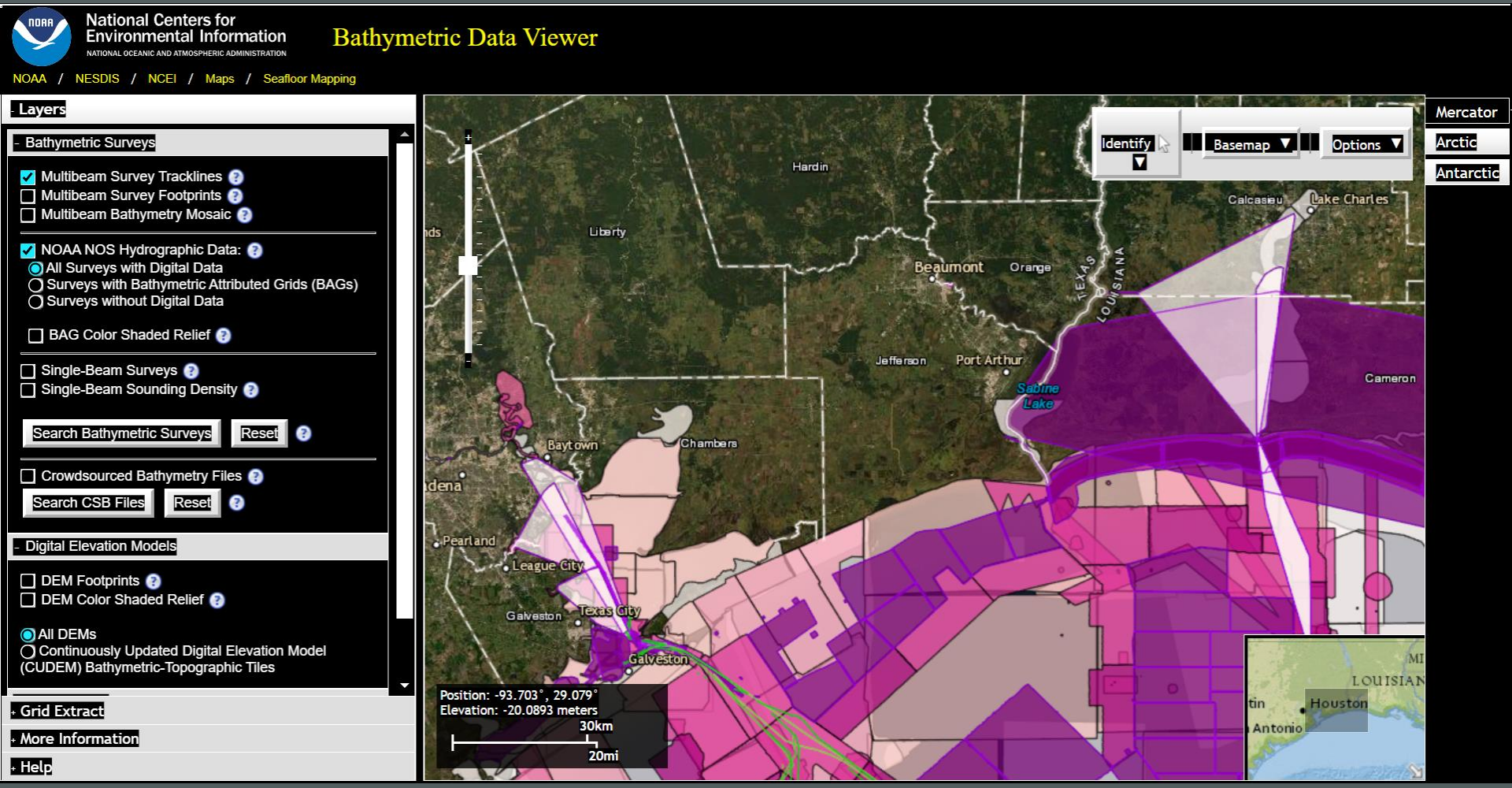
USACE Hydrographic Surveys

CALCASIEU TO SABINE

NOAA · USGS science for a changing world · FEMA · National Park Service · US Army Corps of Engineers · USDA

NOAA Bathymetric Data Viewer

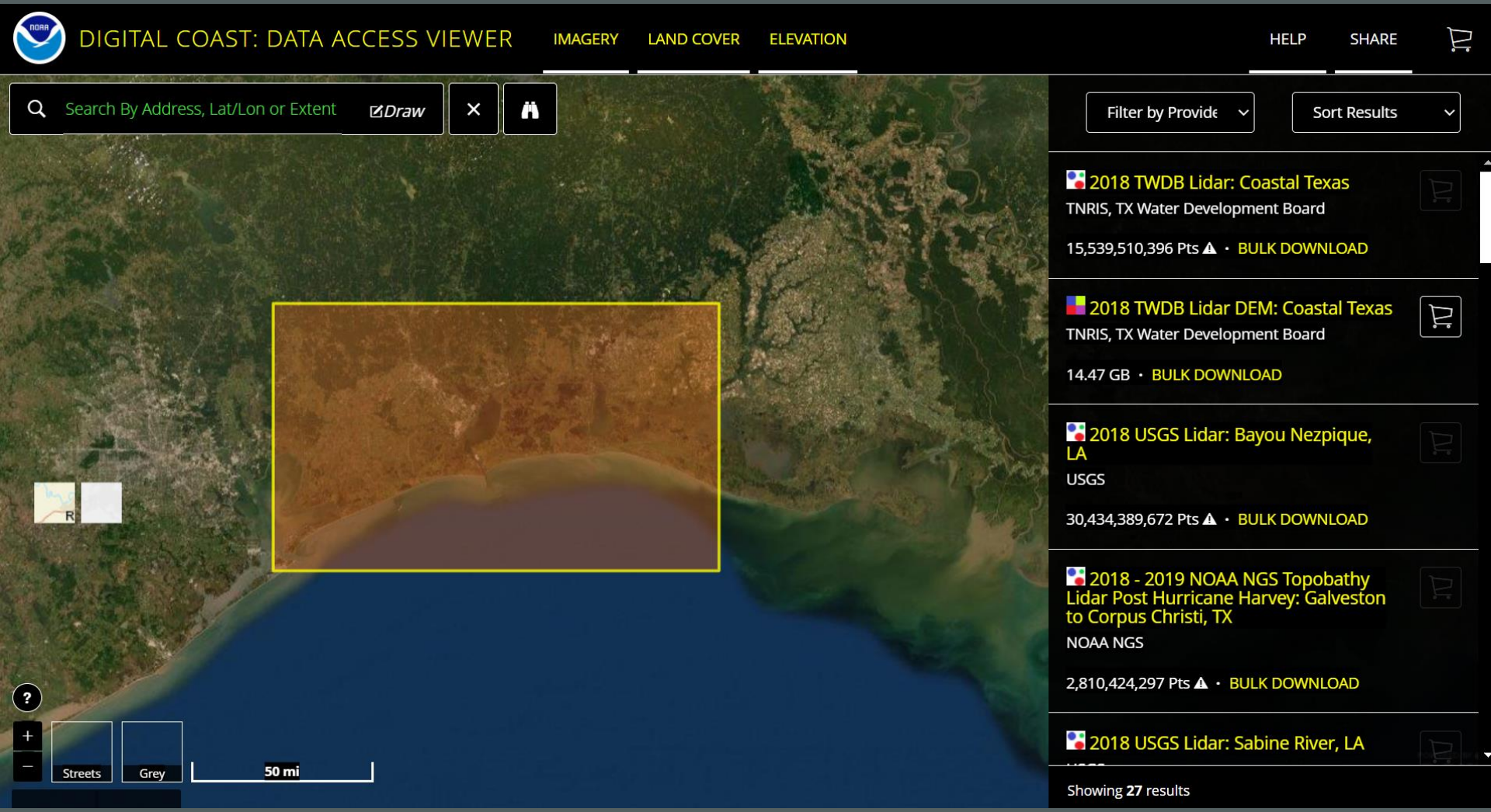
https://www.ncei.noaa.gov/maps/bathymetry/



USGS

NOAA Data Access Viewer (DAV)

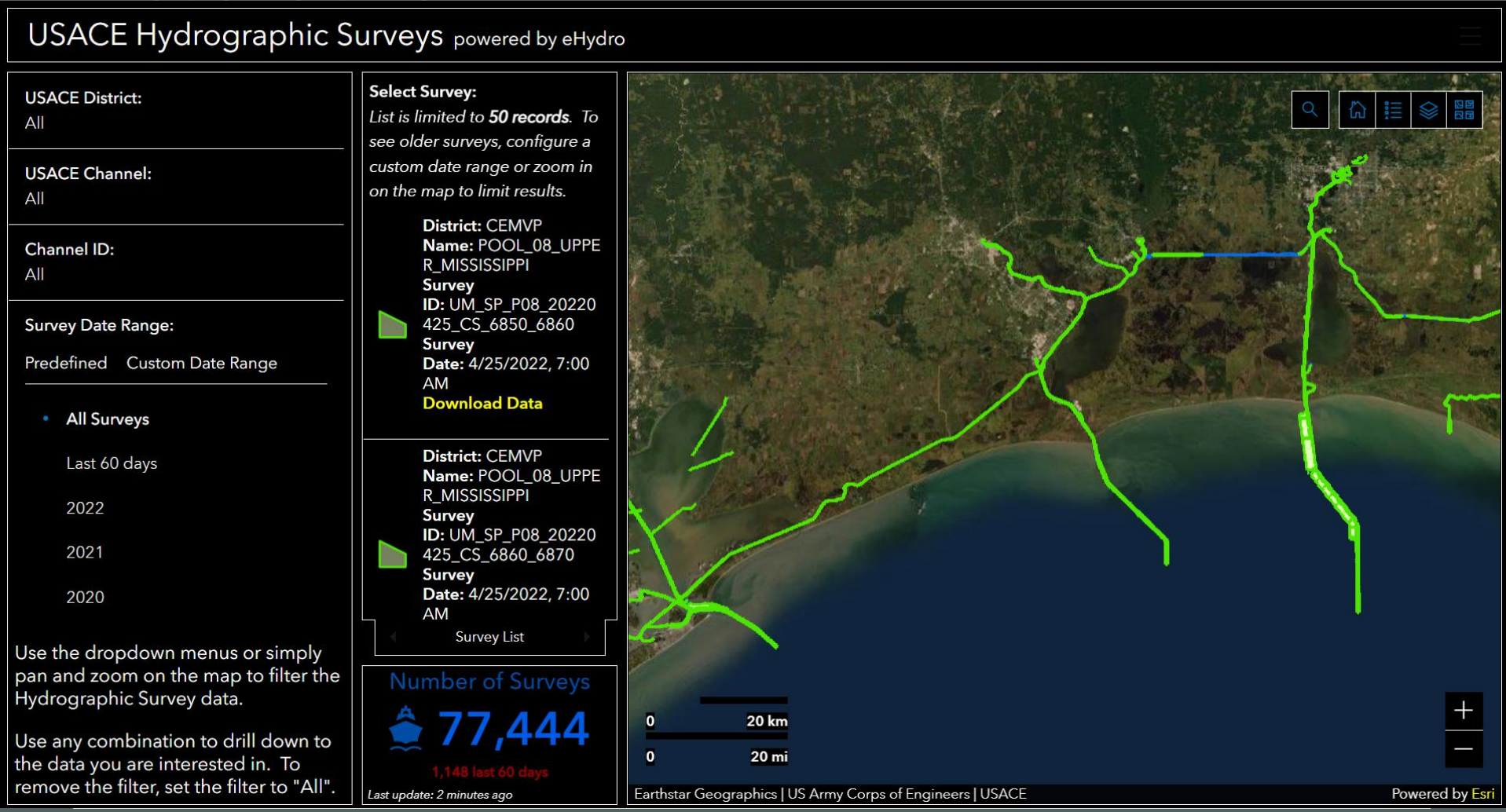
https://coast.noaa.gov/dataviewer/#/lidar/search/



USGS

USACE Hydrographic Surveys (eHydro)

https://www.arcgis.com/apps/dashboards/4b8f2ba307684cf59



USGS

Texas – SETx Integration Pilot

662 – Hydro Navigation Surveys

SURVEYJOBIDPK	SDSFEATURENAME	SURVEYTYPE	CHANNELAREAIDFK	usaceDistrictCode	SOURCEPROJECTION
NR_03_MBB_20160427_OT_40_MLLW	SABINE	OT	CESWG_NR_03_MBB	CESWG	Texas South Central
NR_03_MBB_20160218_OT_40_MLLW	SABINE	OT	CESWG_NR_03_MBB	CESWG	Texas South Central
PA_01_PAC_20170904_OT_40_MLLW	SABINE	OT	CESWG_PA_01_PAC	CESAM	Texas South Central
SR_03_HWY_20170904_OT_31_MLLW	SABINE	OT	CESWG_SR_03_HWY	CESWG	Texas South Central
SR_02_OTB_20170904_OT_31_MLLW	SABINE	OT	CESWG_SR_02_OTB	CESWG	Texas South Central
NR_01_SMC_20170902_OT_40_MLLW	SABINE	OT	CESWG_NR_01_SMC	CESWG	Texas South Central
GI_02_HIB_20170902_OT_13_0901_MLLW	GULF INTRACOASTAL WATERWAY	OT	CESWG_GI_02_HIB	CESWG	Texas South Central
SR_01_SOT_20170904_OT_31_0903_MLLW	SABINE	OT	CESWG_SR_01_SOT	CESWG	Texas South Central
SN_02_SRC_20170904_OT_40_MLLW	SABINE	OT	CESWG_SN_02_SRC	CESWG	Texas South Central
GI_01_PAH_20170904_OT_13_0902_MLLW	GULF INTRACOASTAL WATERWAY	OT	CESWG_GI_01_PAH	CESWG	Texas South Central
PA_02_JPA_20170831_OT_40_MLLW	SABINE	OT	CESWG_PA_02_JPA	CESWG	Texas South Central

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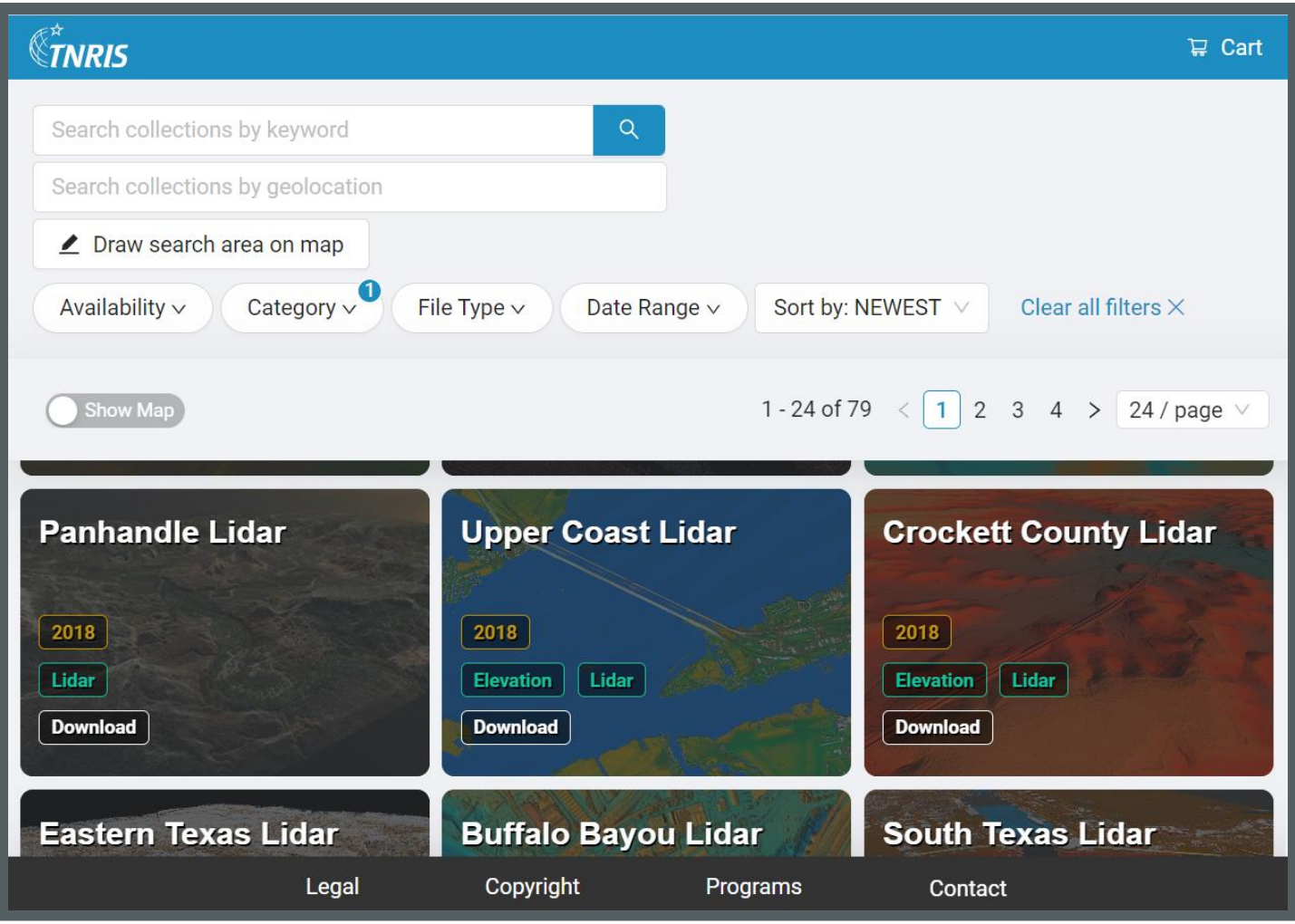
Texas Natural Resources Information System

https://data.tnris.org/



USGS

USGS – Inland Bathymetric and Topobathymetric Inventory

USGS science for a changing world

ScienceBase-Catalog Communities Help

ScienceBase Catalog → USGS Data Release Products → U.S. Geological Survey Inlan…

U.S. Geological Survey Inland Bathymetric and Topobathymetric Survey Inventory, version 3

View

USGS Inland to Coastal Zone Water Feature Bathymetric and Topobathymetric Surveys

Dates

Publication Date : 2023-09-29
Start : 2010
Last Update : 2023

Citation

Miller-Corbett, C.D. and Curtis, M.H., 2023, U.S. Geological Survey Inland to Coastal Zone Bathymetric and Topobathymetric Survey Inventory, version 3: U.S. Geological Survey data release, https://doi.org/10.5066/P9PDX9X3.

Summary

The U.S. Geological Survey (USGS) Inland Bathymetric and Topobathymetric Survey Inventory, v. 3 includes a survey records inventory and dataset footprints (when available) for inland bathymetric and topobathymetric surveys published by the USGS for the conterminous US and Puerto Rico. Survey records include water feature, state, publication title, data vintage, mission, online linkage to reports and datasets, collection methods, survey and survey product resolution, datums, geoid, and accuracy information if known. This database, identified as the USGS Inland Bathymetric and Topobathymetric Survey Inventory, v.3, has been approved for release by the U.S. Geological Survey (USGS). Although this database has been subjected to rigorous review and is substantially complete, the USGS reserves the right to revise the data pursuant to further analysis and review. Furthermore, the database is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use.

Map »

Spatial Services

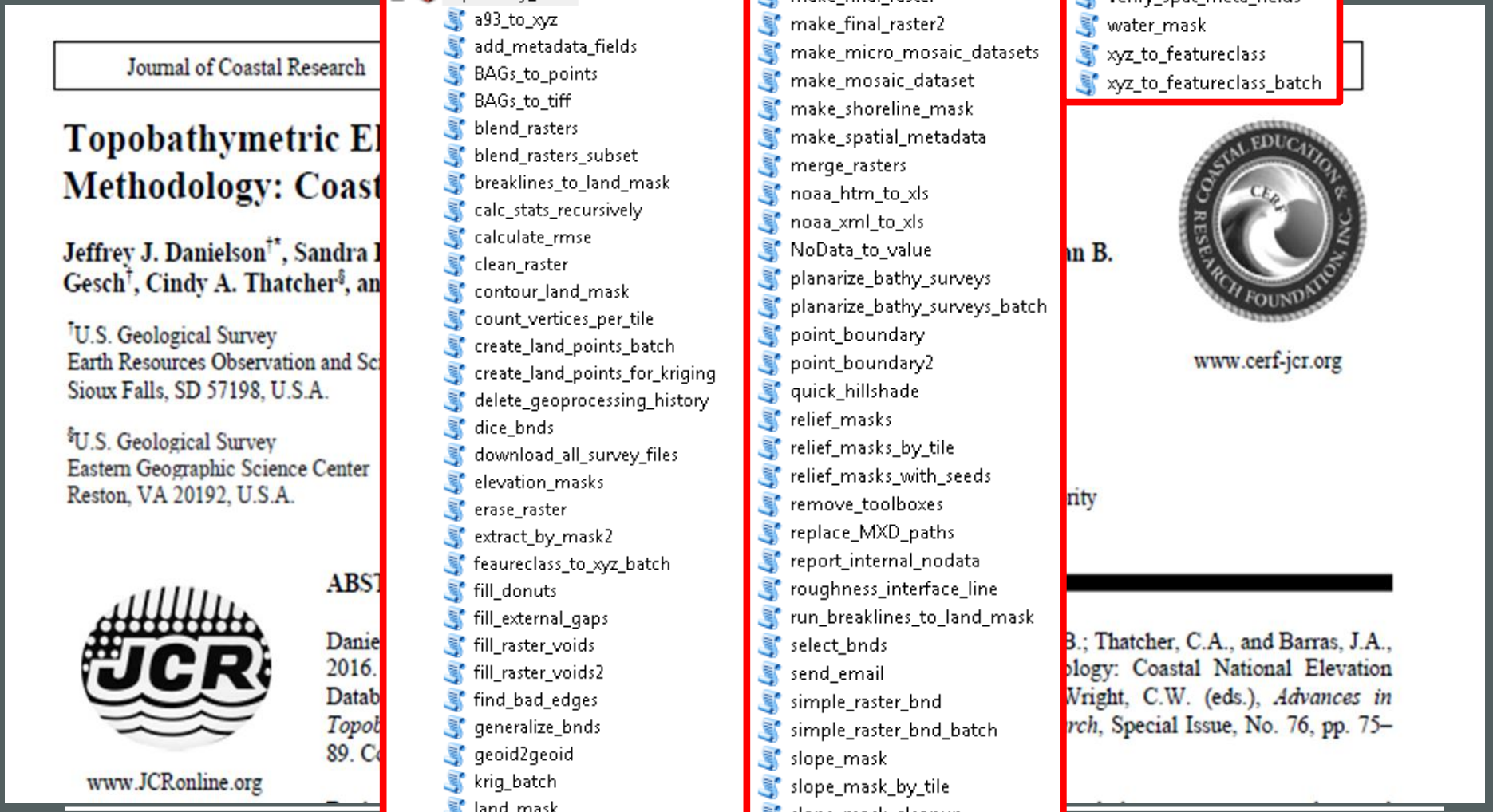
ArcGIS Mapping Service : https://gis.usgs.gov/sciencebase3/

ScienceBase WMS : https://www.sciencebase.gov/catal

https://www.sciencebase.gov/catalog/item/5fce600bd34e30b912396ad0

USGS

Coastal National Elevation Database (CoNED) Project Methods and Tools



Journal of Coastal Research

Topobathymetric El
Methodology: Coast

Jeffrey J. Danielson[†*], Sandra I
Gesch[†], Cindy A. Thatcher[§], an

[†]U.S. Geological Survey
Earth Resources Observation and Sc
Sioux Falls, SD 57198, U.S.A.

[§]U.S. Geological Survey
Eastern Geographic Science Center
Reston, VA 20192, U.S.A.

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- a93_to_xyz
- add_metadata_fields
- BAGs_to_points
- BAGs_to_tiff
- blend_rasters
- blend_rasters_subset
- breaklines_to_land_mask
- calc_stats_recursively
- calculate_rmse
- clean_raster
- contour_land_mask
- count_vertices_per_tile
- create_land_points_batch
- create_land_points_for_kriging
- delete_geoprocessing_history
- dice_bnds
- download_all_survey_files
- elevation_masks
- erase_raster
- extract_by_mask2
- feaureclass_to_xyz_batch
- fill_donuts
- fill_external_gaps
- fill_raster_voids
- fill_raster_voids2
- find_bad_edges
- generalize_bnds
- geoid2geoid
- krig_batch
- land_mask
- land_mask_with_seeds
- list_MXD_layers
- list_neighbors
- list_raster_properties_recursively
- make_final_raster
- make_final_raster2
- make_micro_mosaic_datasets
- make_mosaic_dataset
- make_shoreline_mask
- make_spatial_metadata
- merge_rasters
- noaa_htm_to_xls
- noaa_xml_to_xls
- NoData_to_value
- planarize_bathy_surveys
- planarize_bathy_surveys_batch
- point_boundary
- point_boundary2
- quick_hillshade
- relief_masks
- relief_masks_by_tile
- relief_masks_with_seeds
- remove_toolboxes
- replace_MXD_paths
- report_internal_nodata
- roughness_interface_line
- run_breaklines_to_land_mask
- select_bnds
- send_email
- simple_raster_bnd
- simple_raster_bnd_batch
- slope_mask
- slope_mask_by_tile
- slope_mask_cleanup
- values_to_NoData
- vdatum_raster
- vdatum_raster_batch
- verify_raster_paths
- verify_spat_meta_fields
- water_mask
- xyz_to_featureclass
- xyz_to_featureclass_batch

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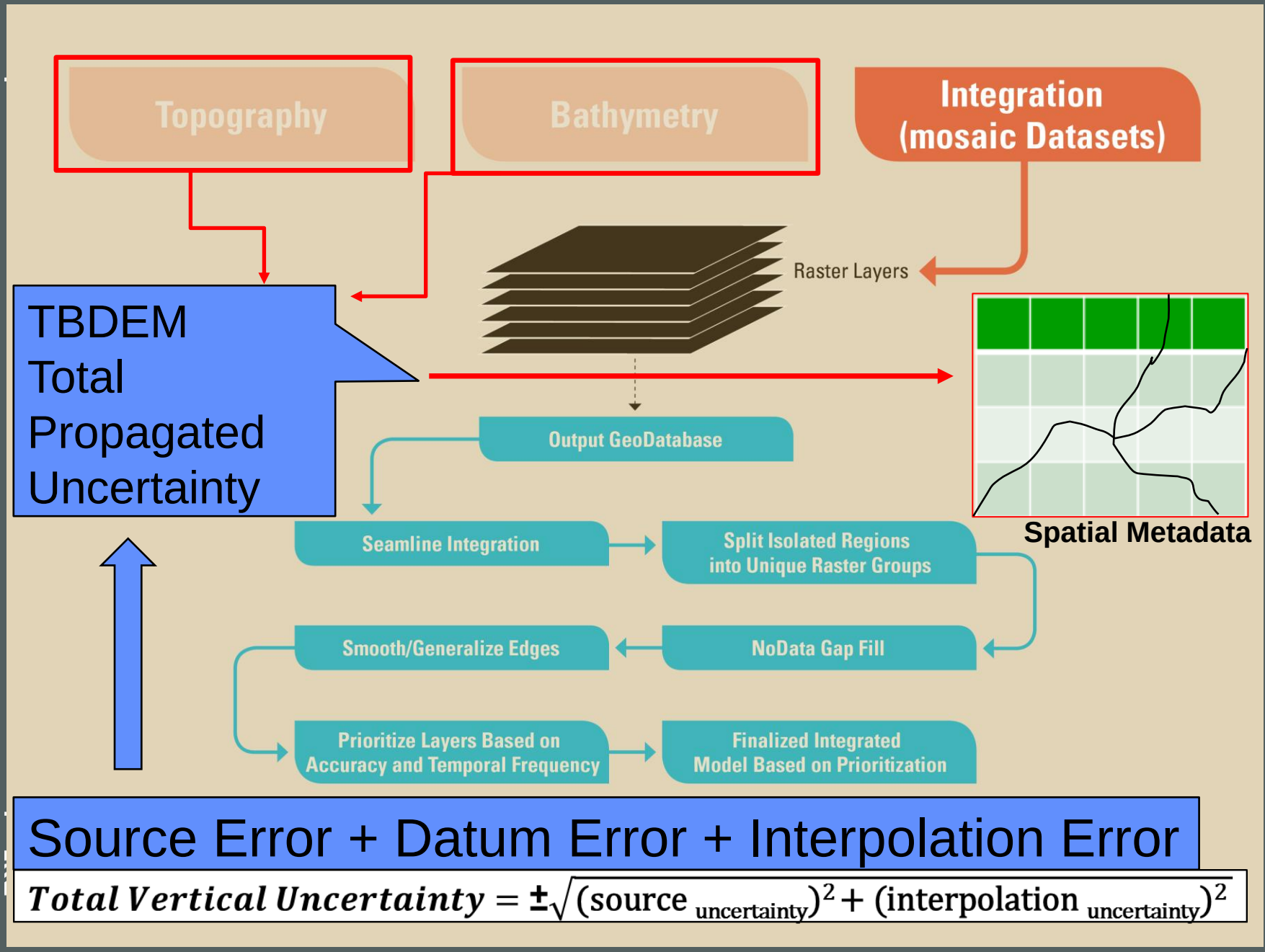
Wright, C.W. (eds.), *Advances in*
rch, Special Issue, No. 76, pp. 75–

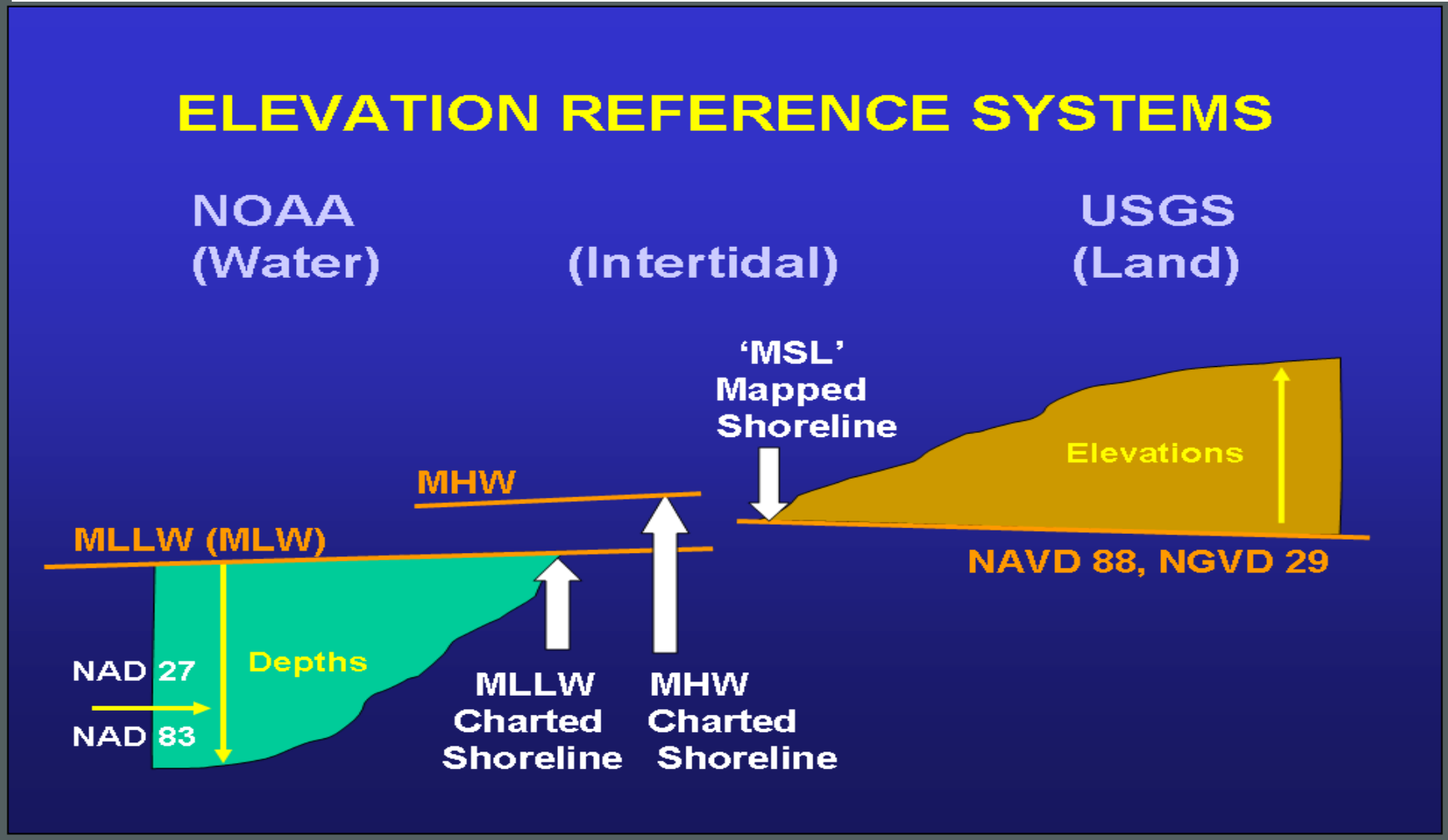
www.cerf-jcr.org

USGS

Topobathymetric – Integration Workflow

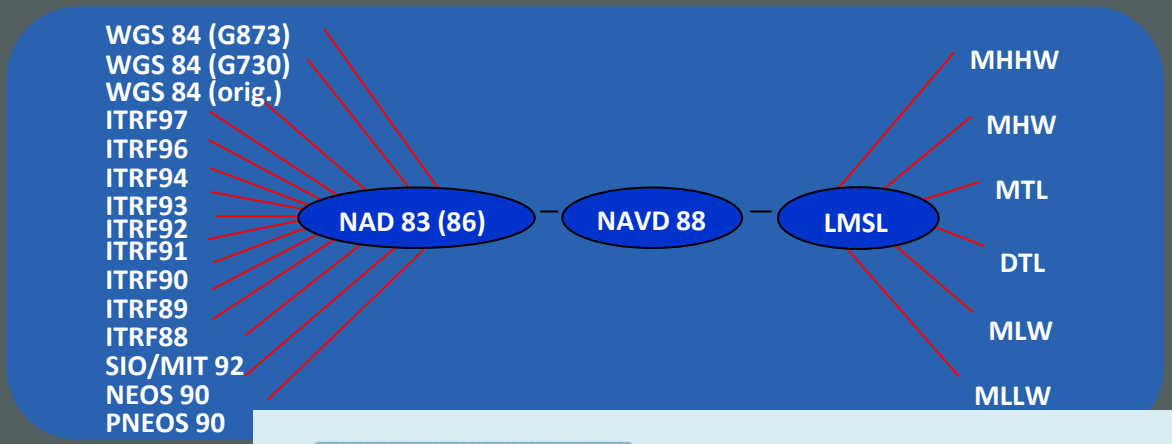


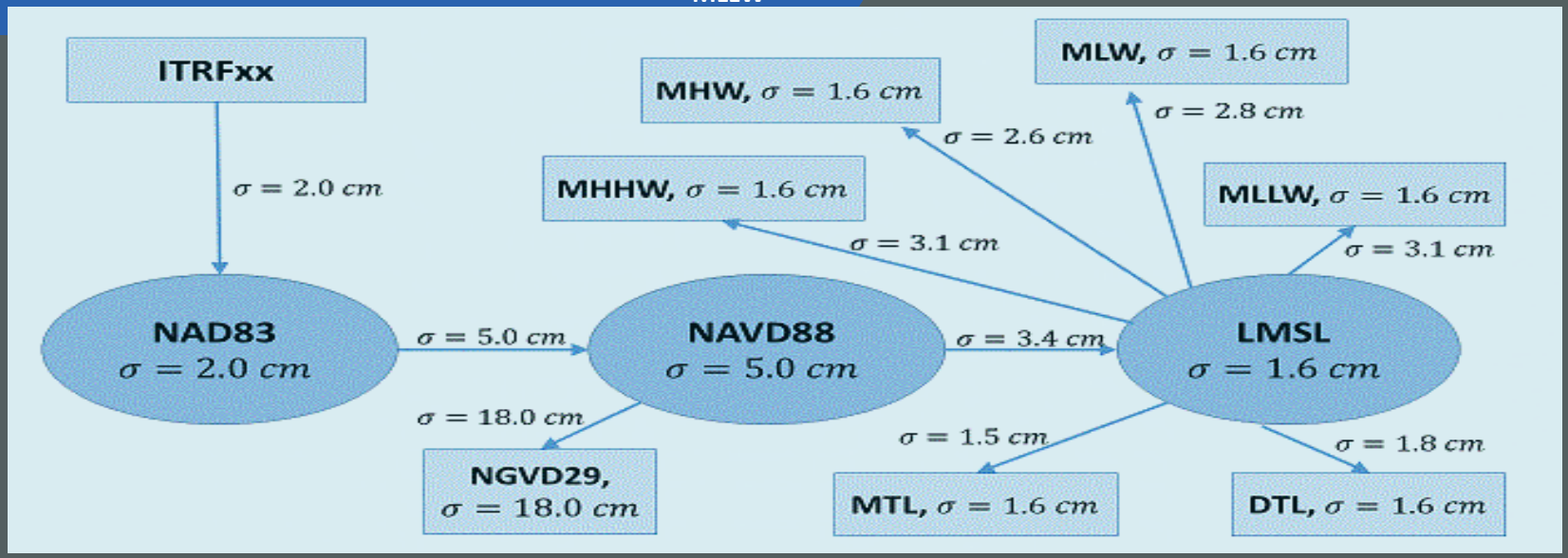
Elevation Reference Systems



USGS

Datum Transformation and Uncertainty





USGS

SETx Pre-Processing Steps for Topographic Lidar:

TBDEM Requirements:

Spatial Resolution: 1-Meter
Projection: UTM Zone 15N
Horizontal Datum: North American Datum of 1983 (NAD83 2011)
Vertical Datum: North American Vertical Datum of 1988 (NAVD88)
Geoid – Geoid12B (Geoid18-Addl Copy Transformed Following Project Completion)
Raster Data Format: GeoTIFF

- **Spatial Pre-Processing Steps (Topographic Lidar):**
  - **Mosaic Rasters or Grid Point Cloud Data**
  - **QA/QC Processed Raster**
  - **Compute Basis Statistics**
  - **Check Projection – Define / Reproject to Final Spatial Reference**
  - **Generate Simple Raster Boundary**
  - **Check for Small Raster Voids, Fill Raster Voids if they exist**
  - **Breakline Processing – If no vendor breaklines exist, generate from point cloud using ConVex Hull Algorithm and manually adjust.**
  - **Check Vertical Datum, Convert to Final Spatial Reference if necessary**
  - **Clip Final Raster to SETx Project Area of Interest**

USGS

Southeast Texas – 3D NTM Pilot Model

Credit: Jeff Danielson and Cynthia Miller-Corbett, USGS

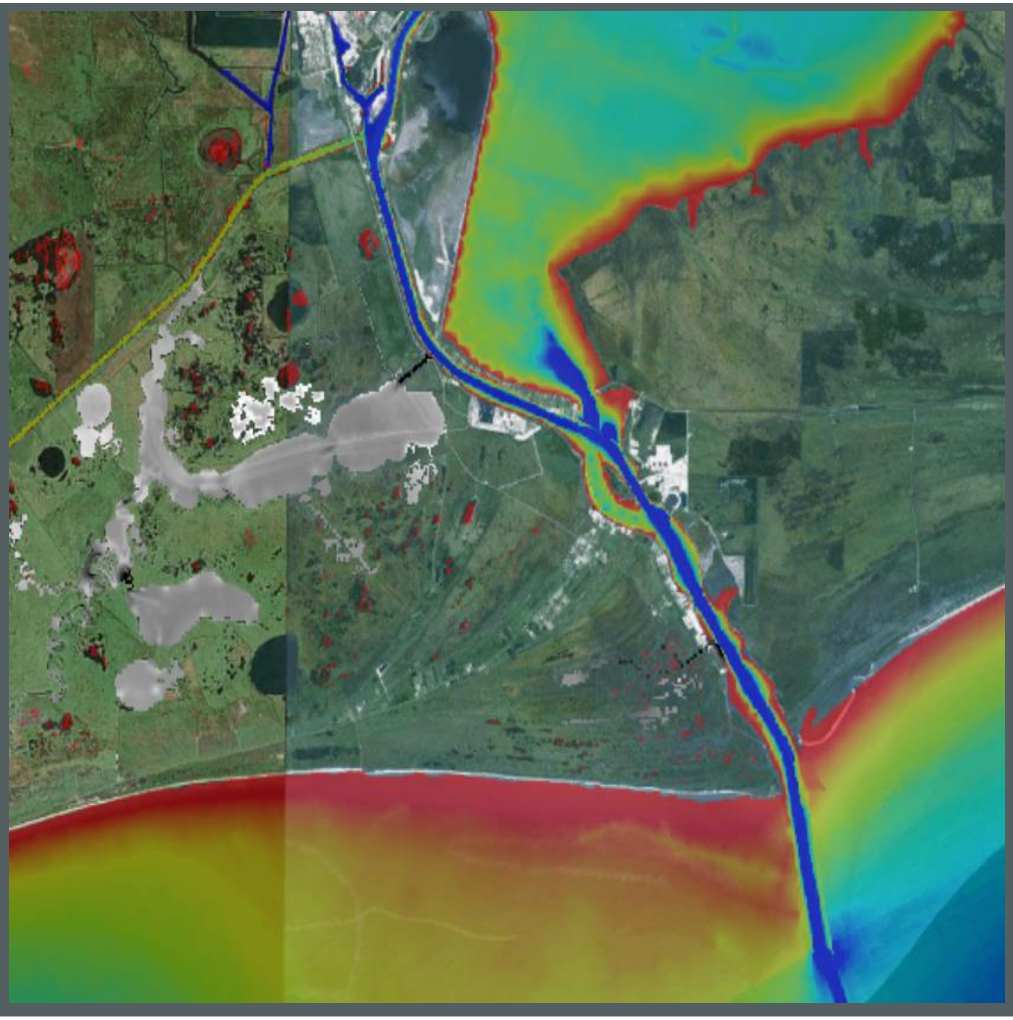
TBDEM Highlights:

- Raster Format: Cloud Optimized GeoTIIFF (COG)
- Raster Size: 67.33 GB
- Minimum Elevation = -34.43 Meters
- Maximum Elevation = 100.04 Meters
- Absolute Vertical Accuracy = 0.27m compared to 82 NOAA NGS GPS on Benchmarks

Danielson, J.J., Miller-Corbett, C.D., and Thatcher, C.A., 2023, Southeast Texas Pilot National Topography Model (NTM), 1933 to 2021: U.S. Geological Survey data release, https://doi.org/10.5066/P9N4WLC8.

USGS

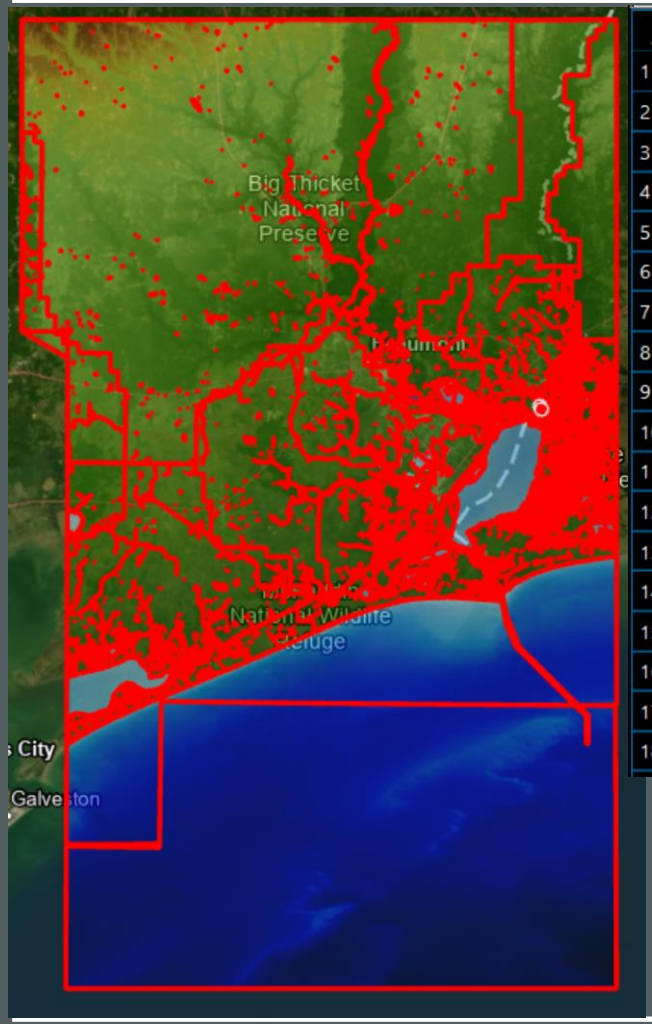
Southeast Texas – 3D NTM Pilot Model



SETX NTM Bathymetry Coverage

USGS

Southeast Texas – 3D NTM Pilot Model Spatially Referenced Metadata (Sources)



	Title	Source_Organization	Date_Acquired
1	USACE Hydrographic Bathymetry 2021	U.S. Army Corps of Engineers	2021
2	USACE Hydrographic Bathymetry 2007	U.S. Army Corps of Engineers	2007
3	Upper_Coast_TNRIS_Topo_Lidar_2018_Hydroflattened_Values_O...	Texas Natural Resources Information System	2018
4	Upper_Coast_TNRIS_Topo_Lidar_2018	Texas Natural Resources Information System	2018
5	SETX_NTM_Void_Filled_Areas_2023	U.S. Geological Survey	N/A
6	NOAA_NCEI _CUDEM_1/9th_Arc_Second_Topobathymetry	NOAA	1933 - 2017
7	NOAA_NCEI _CUDEM_1/3rd_Arc_Second_Bathymetry	NOAA	1897 - 2009
8	LA_Sabine_River_Topo_Lidar_2018	U.S. Geological Survey	2018
9	LA_Chenier_Plain_Topo_Lidar_2017_Hydroflattened_Values_Only	U.S. Geological Survey	2017
10	LA_Chenier_Plain_Topo_Lidar_2017	U.S. Geological Survey	2017
11	Keith_Lakes_Salt_Bayou_Topobathy_2023_Transition_Patch	U.S. Geological Survey	2007; 1933 - 201
12	Keith_Lakes_Salt_Bayou_Intercoastal_Waterway_Topobathy_202...	U.S. Geological Survey	N/A
13	Keith_Lakes_Salt_Bayou_Bathymetry_2007	Texas Water Development Board	2007
14	Jefferson_Liberty,_Chambers_TNRIS Topo_Lidar_2017	Texas Natural Rersources Information System	2017
15	Jefferson, Liberty, Chambers TNRIS_Topo_Lidar_2017_Hydroflatt...	Texas Natural Rersources Information System	2017
16	FEMA_Region_6_Neches_Basin_Topo_Lidar_2016_Hydroflatted_...	U.S. Geological Survey	2016; 2017
17	FEMA_Region_6_Neches_Basin Topo_Lidar_2016	U.S. Geological Survey	2016; 2017
18	Eastern_Texas_3DEP_NRCS_ Topo_Lidar_2018	U.S. Geological Survey and National Resource...	2018

SETxNTM By the Numbers:

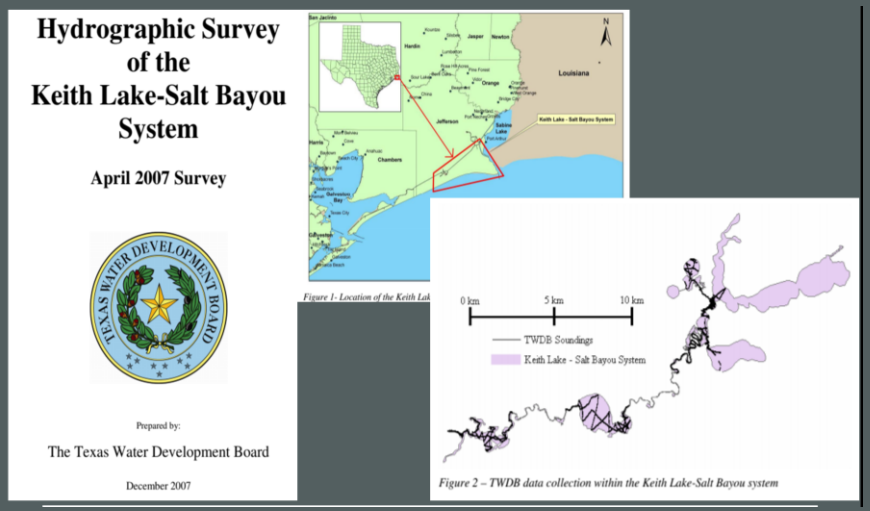
- 18 Layers Make-up the Spatial Metadata
- 11 Unique Topography/Bathymetry Sources
- 6 Federal and State Source Organizations
- Topography: 2016 to 2018
- Bathymetry: 1933 to 2021

USGS

Southeast Texas – 3D NTM Pilot Model

Texas Water Development Board: Keith Lake-Salt Bayou

TWDB: Keith Lake-Salt Bayou (2007)

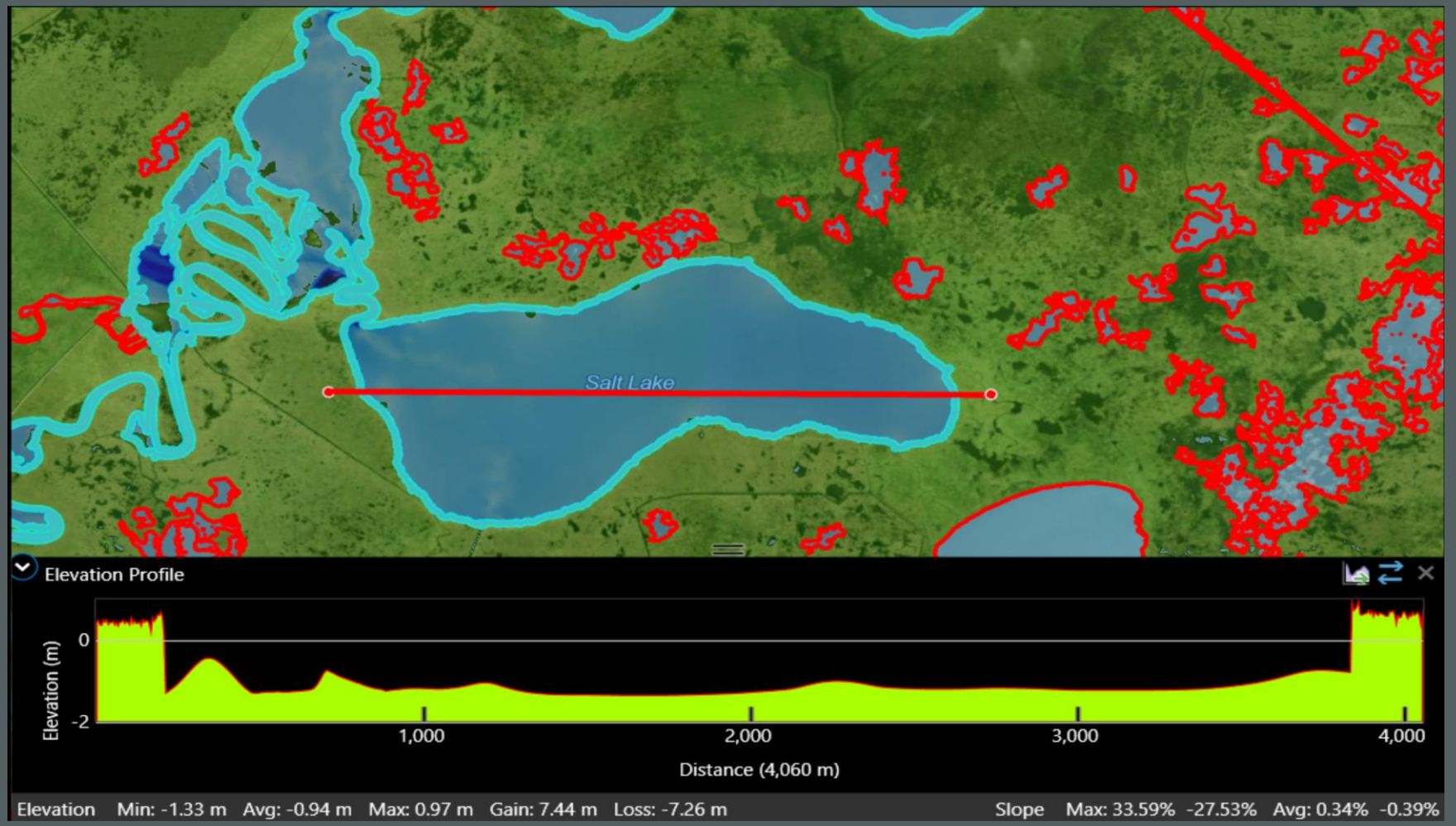


TWDB Bathymetry:

- Source Vertical Datum: NAVD88 (2007)
- Source Vertical Units: Feet (2007)
- Single-Bream Sonar: Tracklines

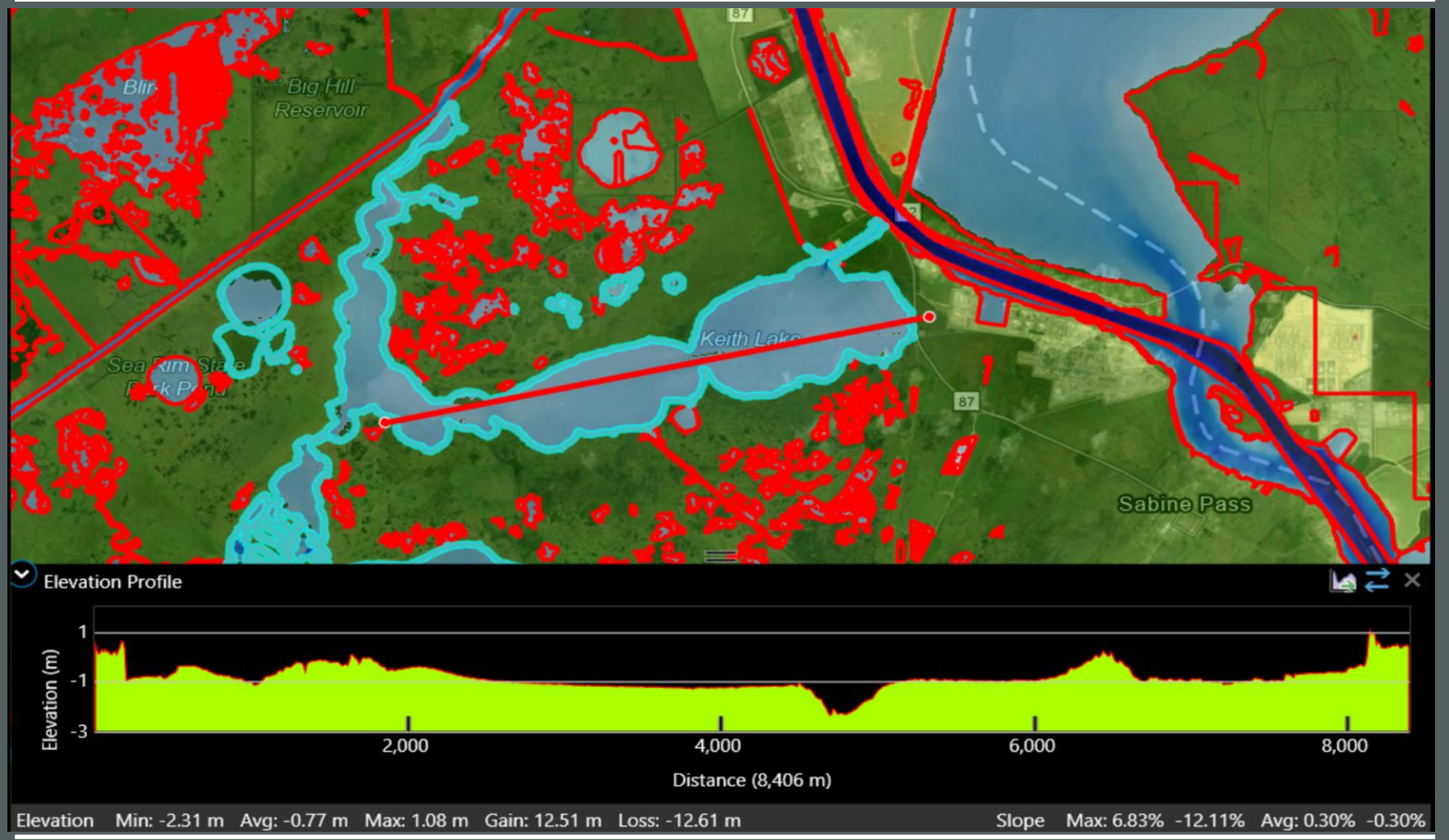
USGS

Southeast Texas – 3D NTM Pilot Model
TWDB: Keith Lake-Salt Bayou



USGS

Southeast Texas – 3D NTM Pilot Model
TWDB: Keith Lake-Salt Bayou



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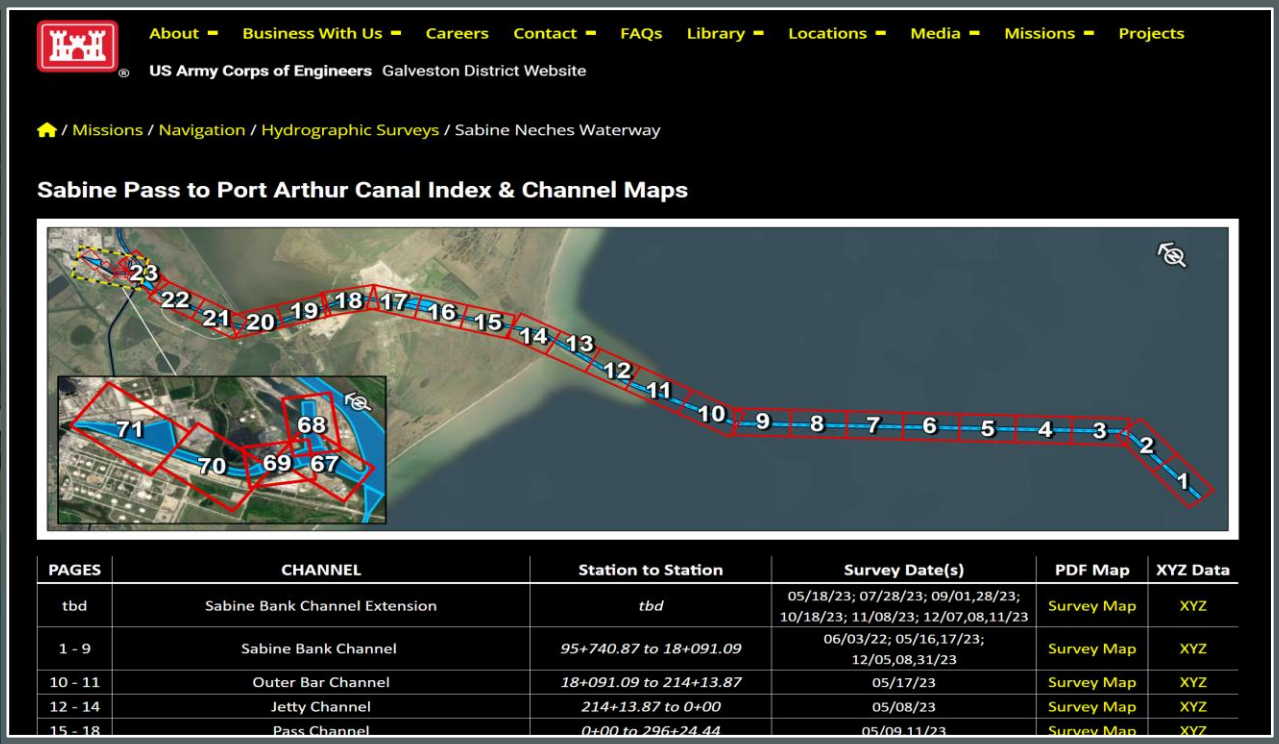
Southeast Texas – 3D NTM Pilot Model

USACE Galveston District: Neches/Sabine Waterway

USACE Neches and Sabine Bathymetry (2021/2007)



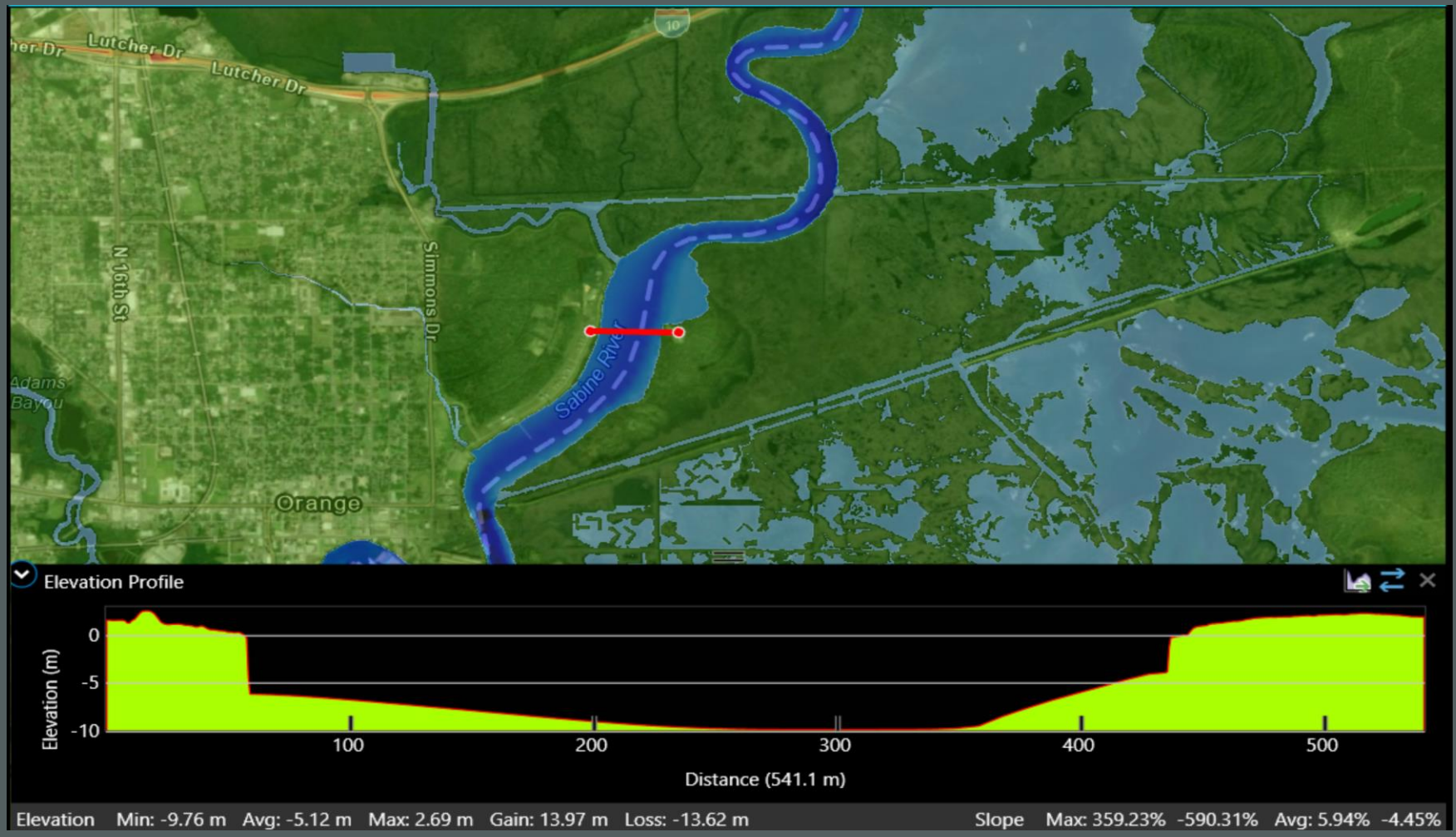
PAGES	CHANNEL	Station to Station	Survey Date(s)	PDF Map	XYZ Data
tbd	Sabine Bank Channel Extension	*tbd*	05/18/23; 07/28/23; 09/01,28/23; 10/18/23; 11/08/23; 12/07,08,11/23	Survey Map	XYZ
1 - 9	Sabine Bank Channel	*95+740.87 to 18+091.09*	06/03/22; 05/16,17/23; 12/05,08,31/23	Survey Map	XYZ
10 - 11	Outer Bar Channel	*18+091.09 to 214+13.87*	05/17/23	Survey Map	XYZ
12 - 14	Jetty Channel	*214+13.87 to 0+00*	05/08/23	Survey Map	XYZ
15 - 18	Pass Channel	*0+00 to 296+24.44*	05/09,11/23	Survey Map	XYZ

USACE Bathymetry:

- Source Vertical Datum: MLLW (2021), MTL (2007)
- Source Vertical Units: Feet (2021), Meters (2007)
- Single-Bream Sonar: Cross-Sections (50 to 100 ft. approx. spacing)

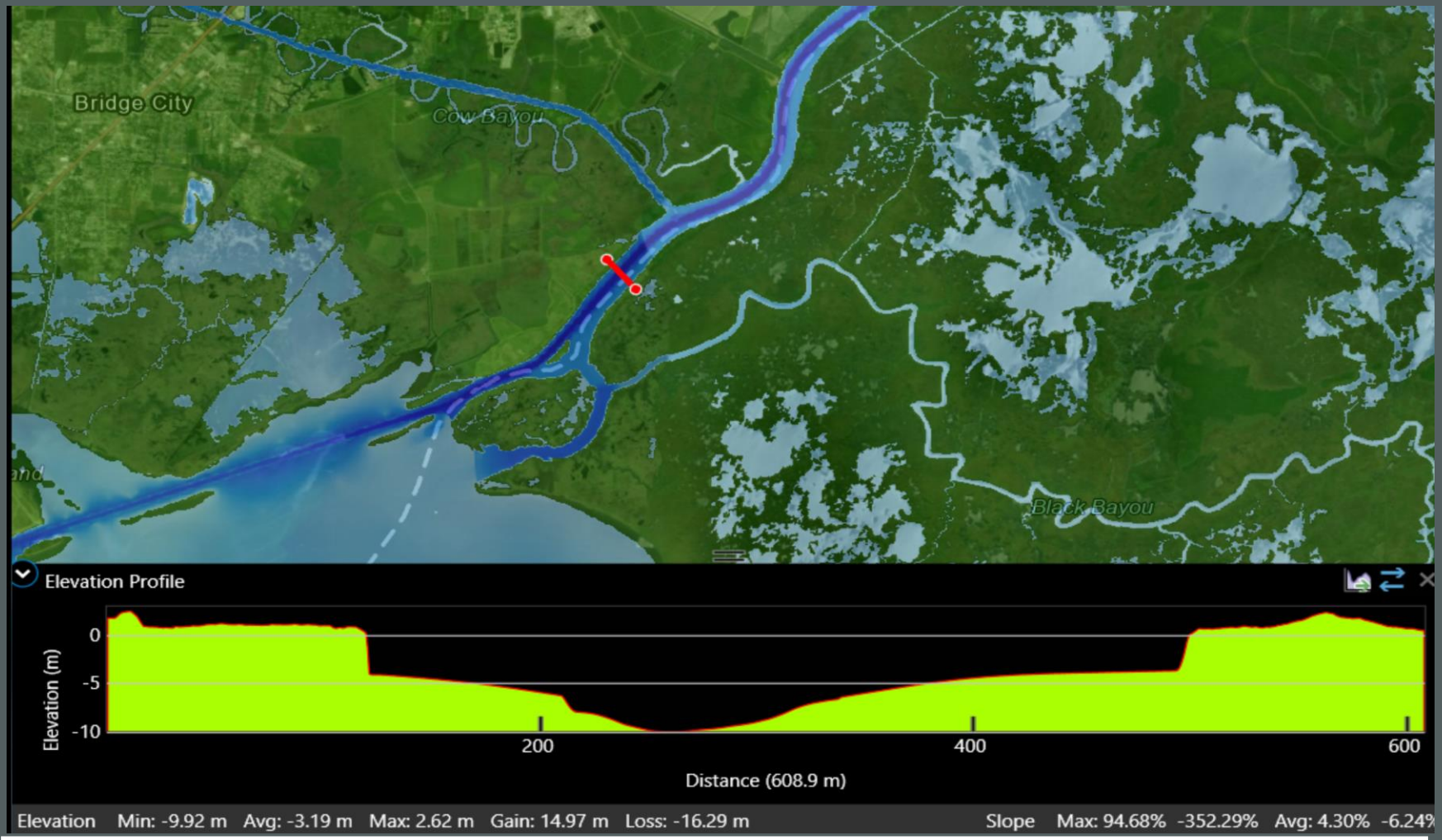
USGS

Southeast Texas – 3D NTM Pilot Model
Sabine River Elevation Profile



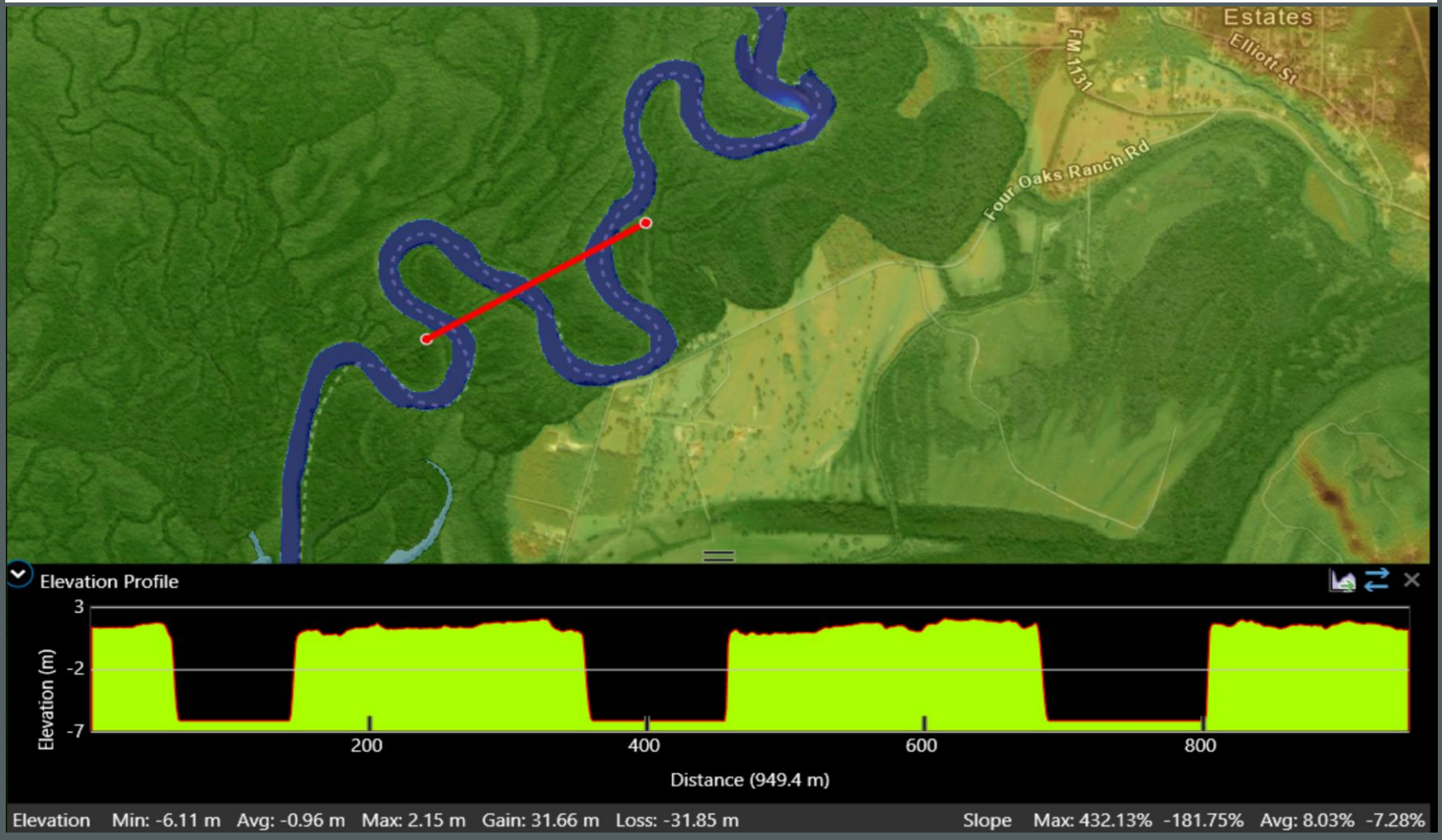
USGS

Southeast Texas – 3D NTM Pilot Model
Sabine River Elevation Profile



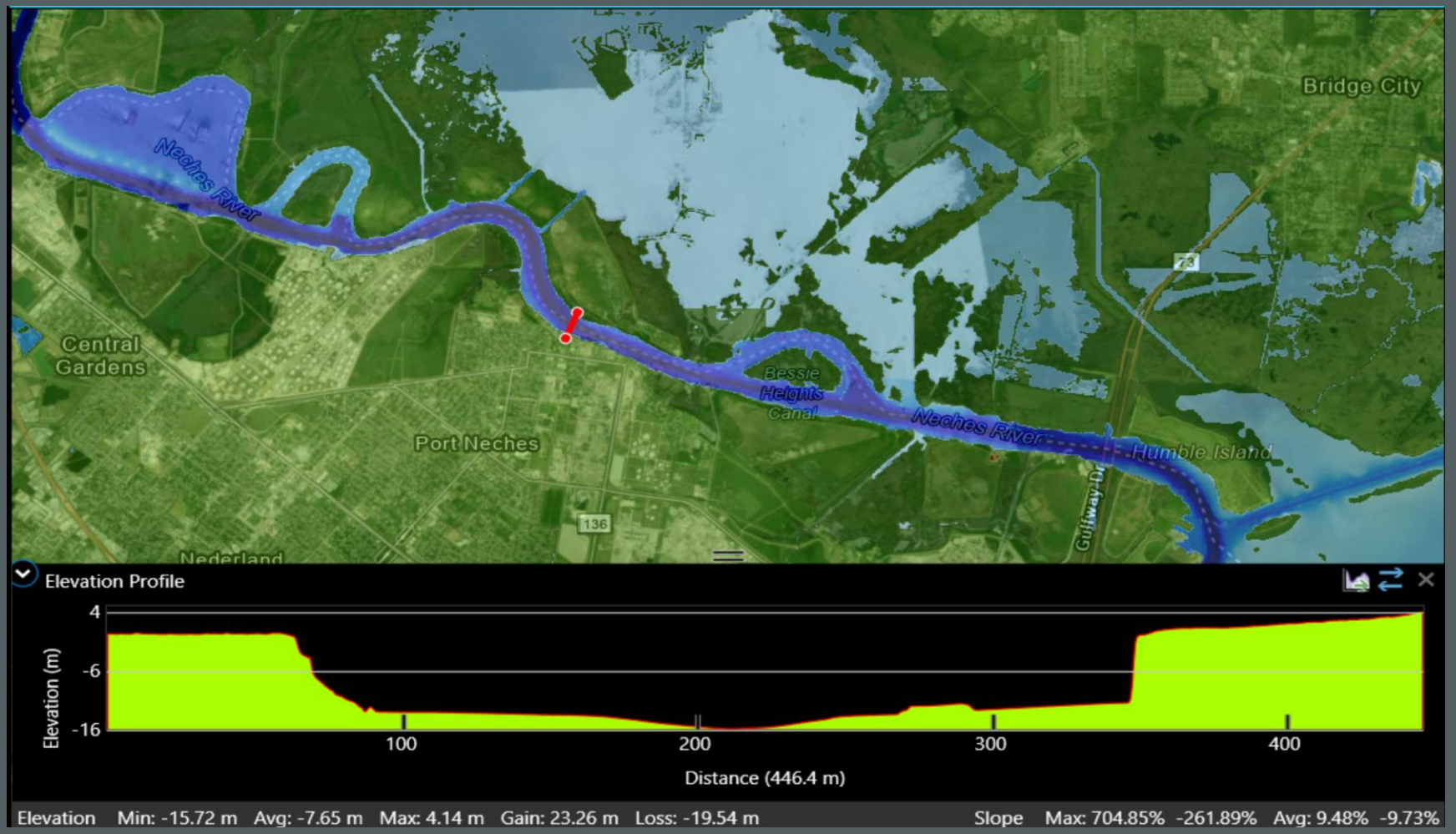
USGS

Southeast Texas – 3D NTM Pilot Model
Neches River Elevation Profile



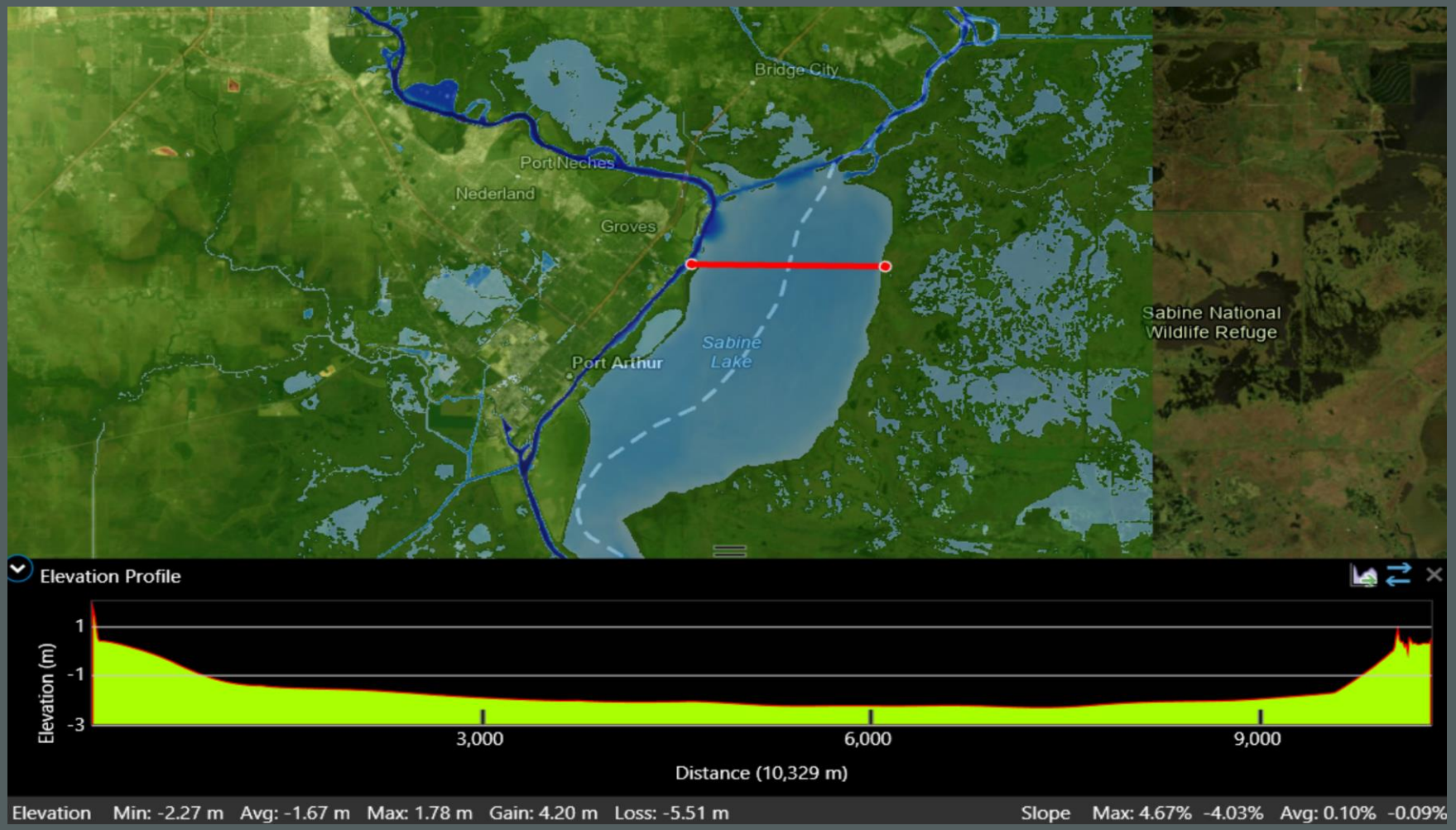
USGS

Southeast Texas – 3D NTM Pilot Model
Neches River Elevation Profile



USGS

Southeast Texas – 3D NTM Pilot Model
Sabine Lake Elevation Profile



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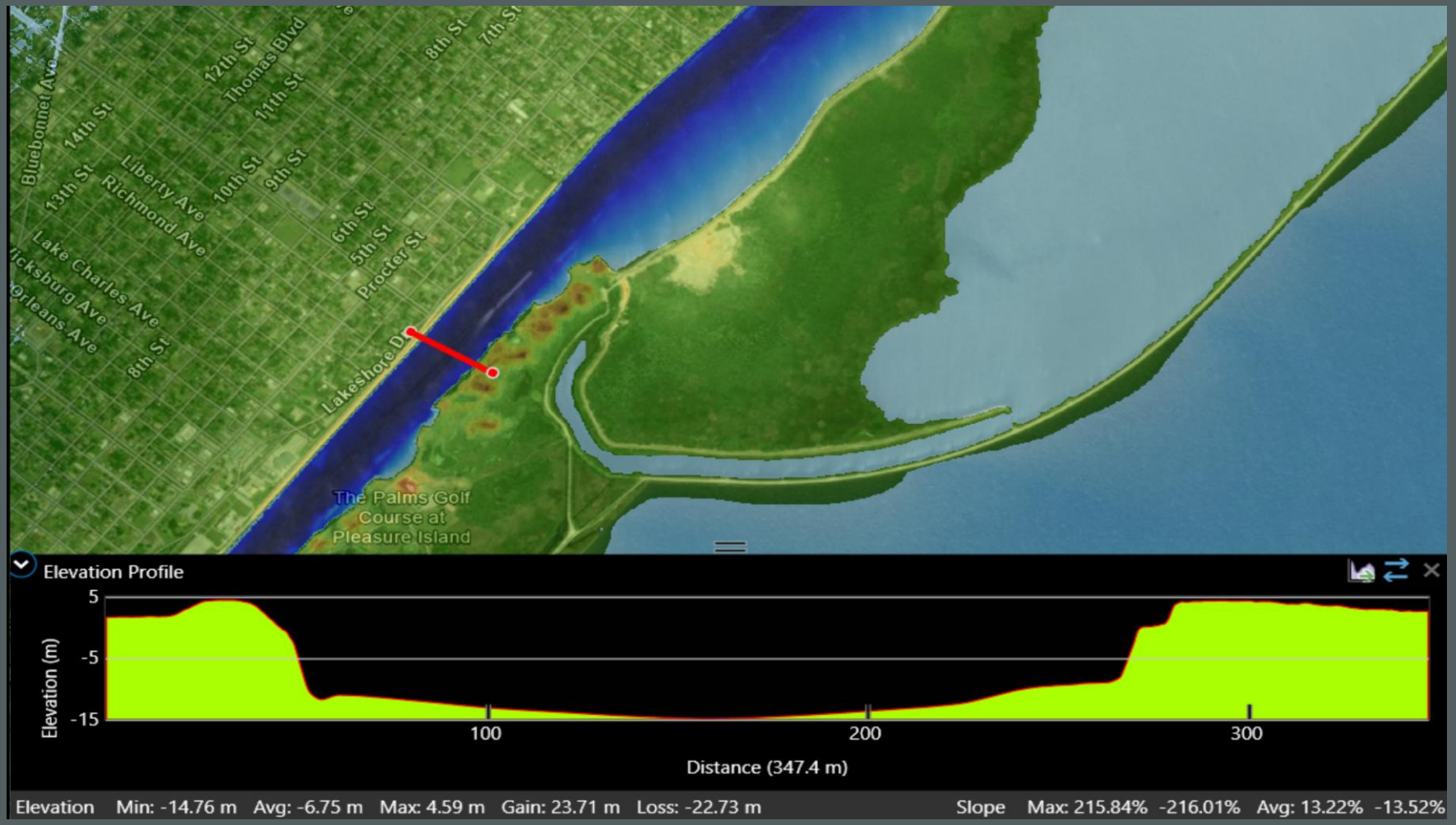
Southeast Texas – 3D NTM Pilot Model
Sabine Pass Elevation Profile



USGS

Southeast Texas – 3D NTM Pilot Model
Sabine Pass Elevation Profile

USGS

Southeast Texas – 3D NTM Pilot Model Intercoastal Waterway Elevation Profile

USGS

Southeast Texas – 3D NTM Pilot Model Intercoastal Waterway Elevation Profile

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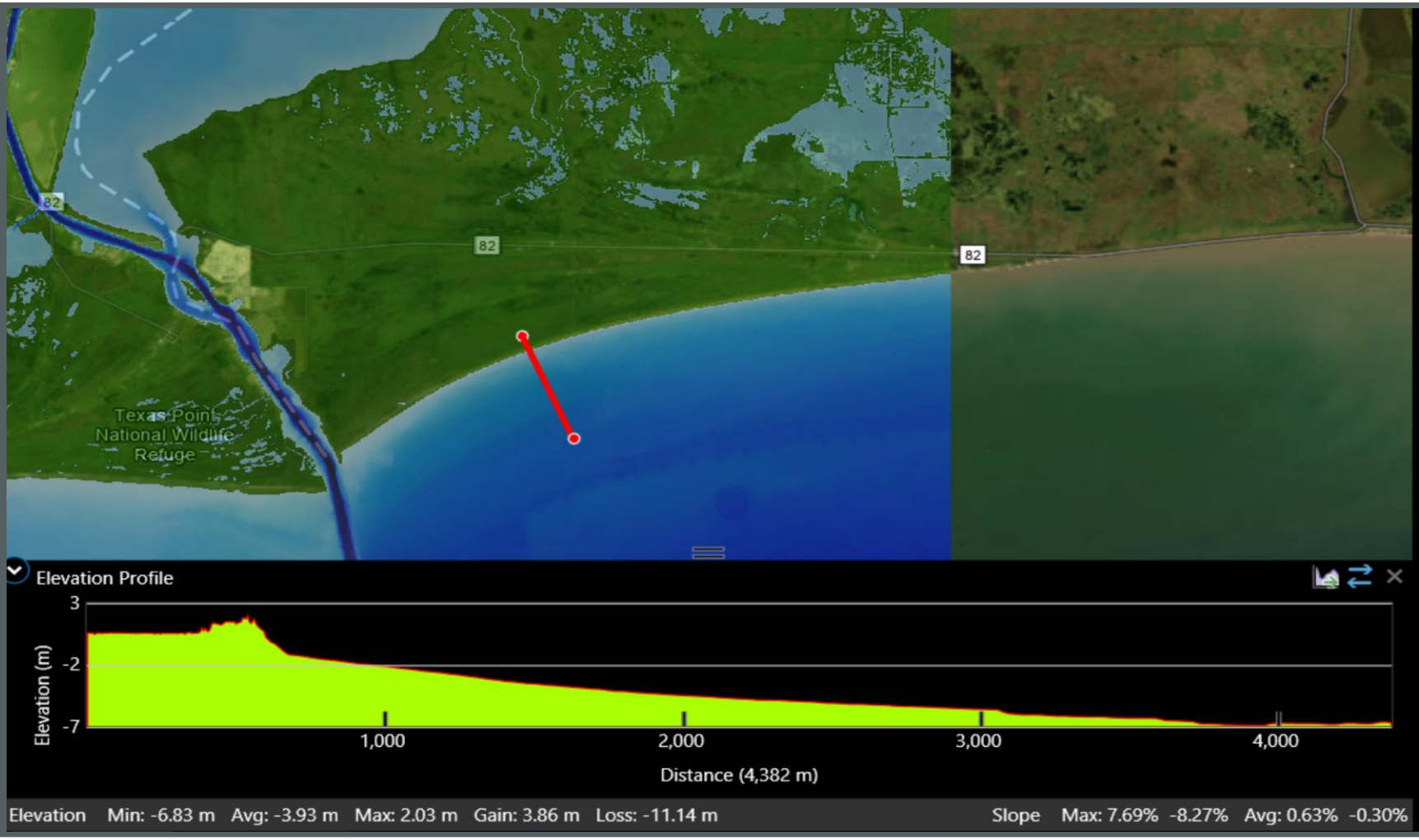
Southeast Texas – 3D NTM Pilot Model Offshore Elevation Profile



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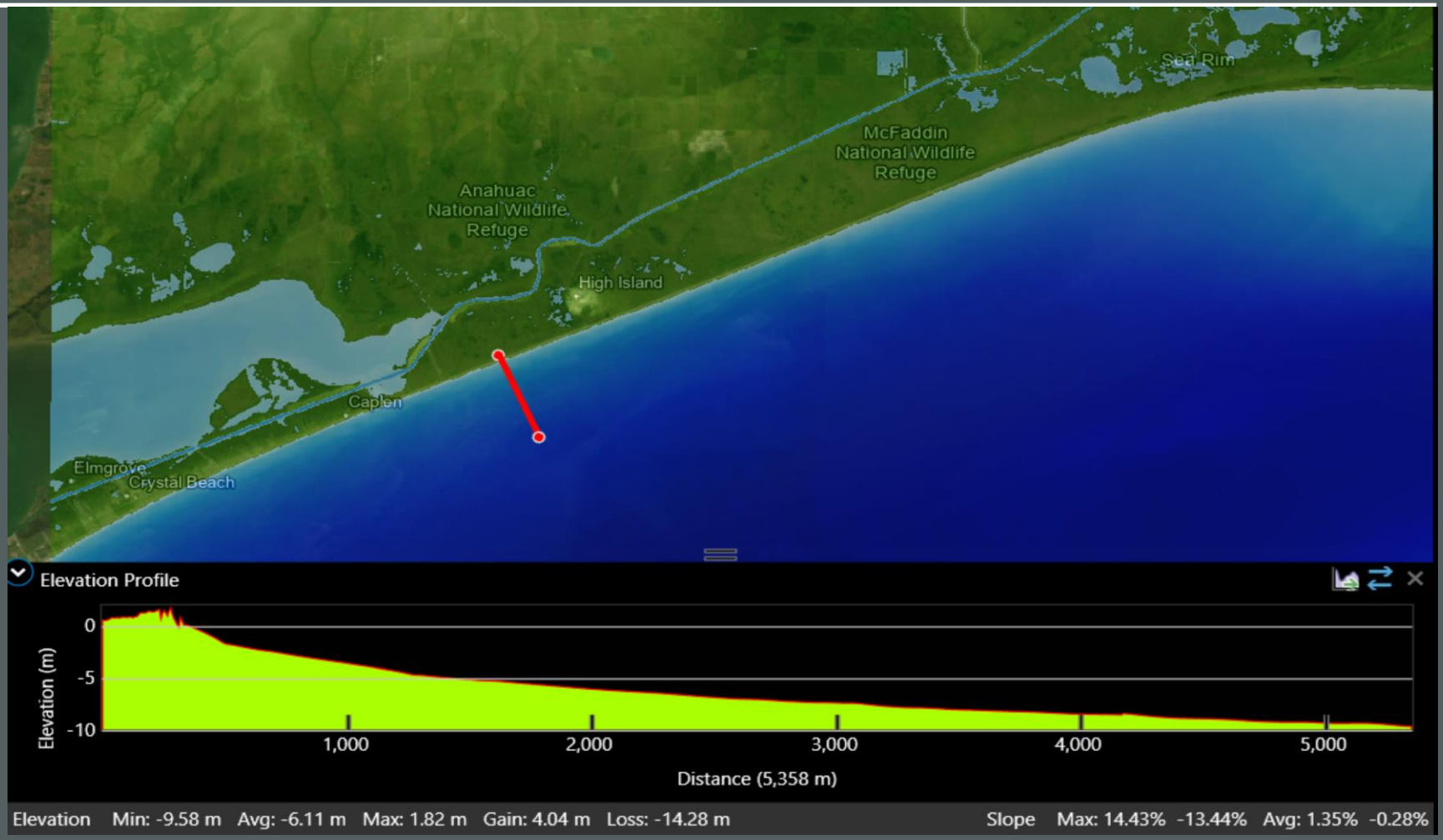
Southeast Texas – 3D NTM Pilot Model Offshore Elevation Profile



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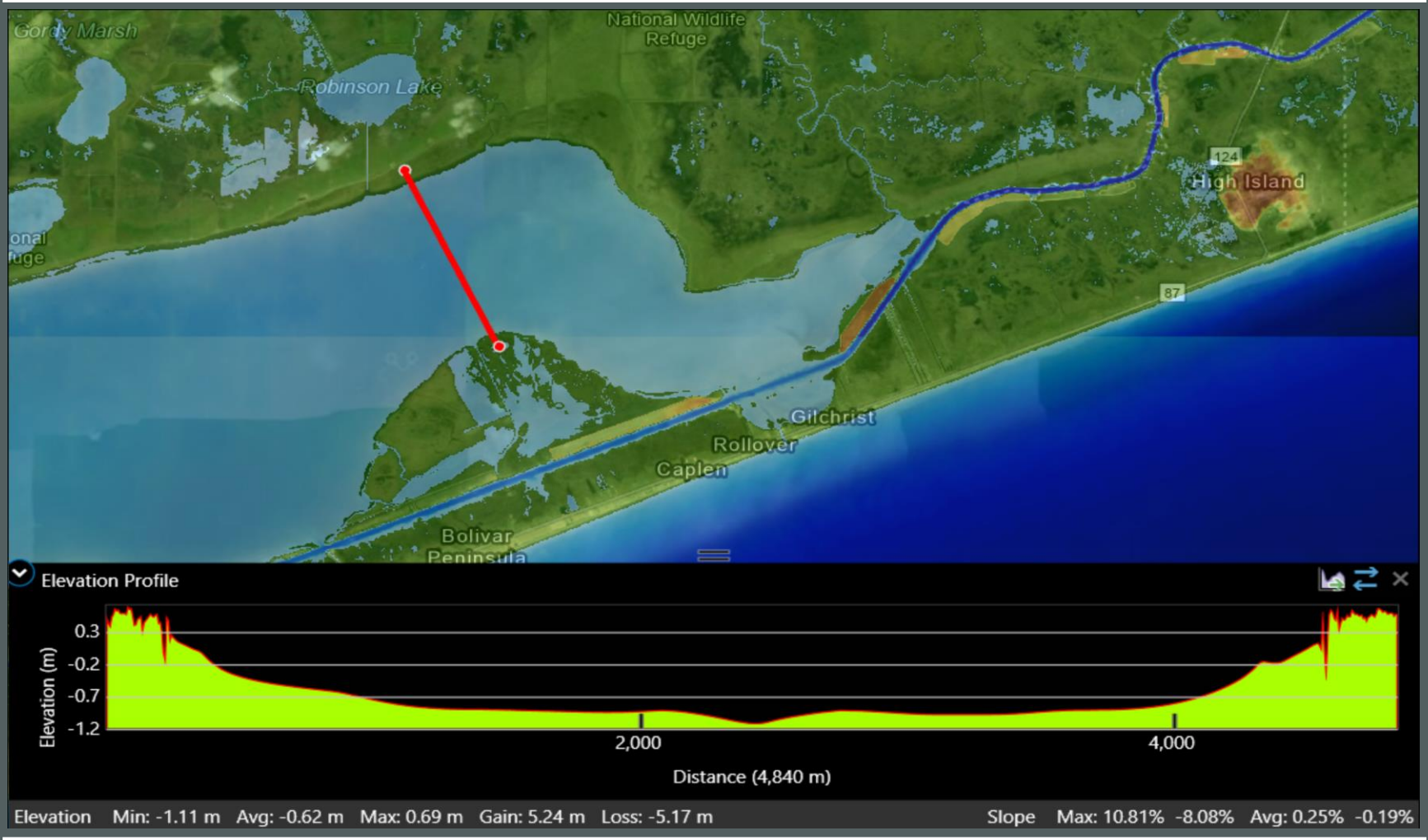
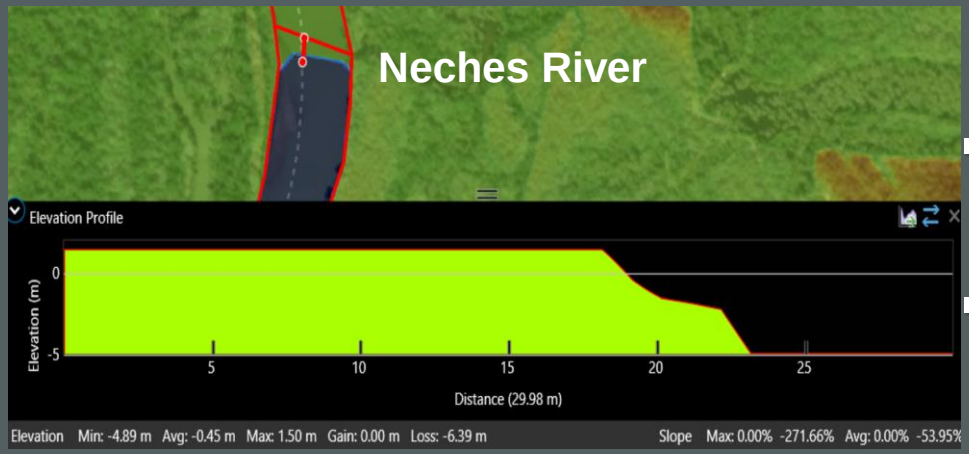
Southeast Texas – 3D NTM Pilot Model
East Bay Elevation Profile



USGS

Southeast Texas – 3D NTM Pilot Model Hydro-Flattened TBDEM Areas (More Bathymetry)

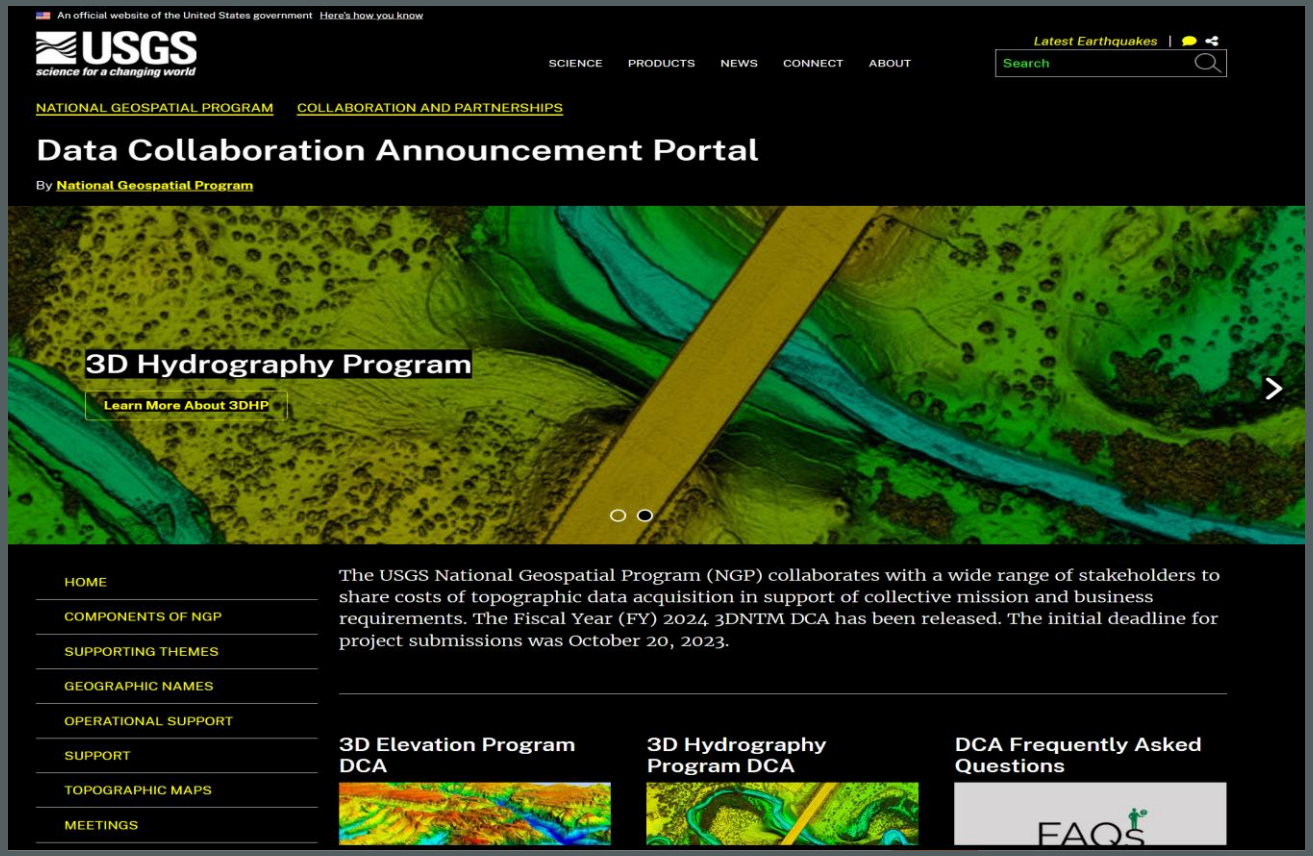
SETx NTM Hydro-Flattened TBDEM Areas



- **Key Comments:**
  - Located spatially in areas with no current or known bathymetry coverage
  - Over 1,358 single-part features in the spatial metadata with areas greater than 15,000 meters
  - Example features include lakes, canals, waterways, and rivers
  - Water clarity is a limiting factor so acoustic technologies will have to be emphasized along with targeted bathymetric lidar acquisitions
  - **There is a significant need for more comprehensive inland bathymetry mapping in Southeast Texas**
  - **<u>More coordination and partnering</u>!**

USGS

3DEP Data Collaboration Announcement (DCA)



www.usgs.gov/3DNTM/DCA

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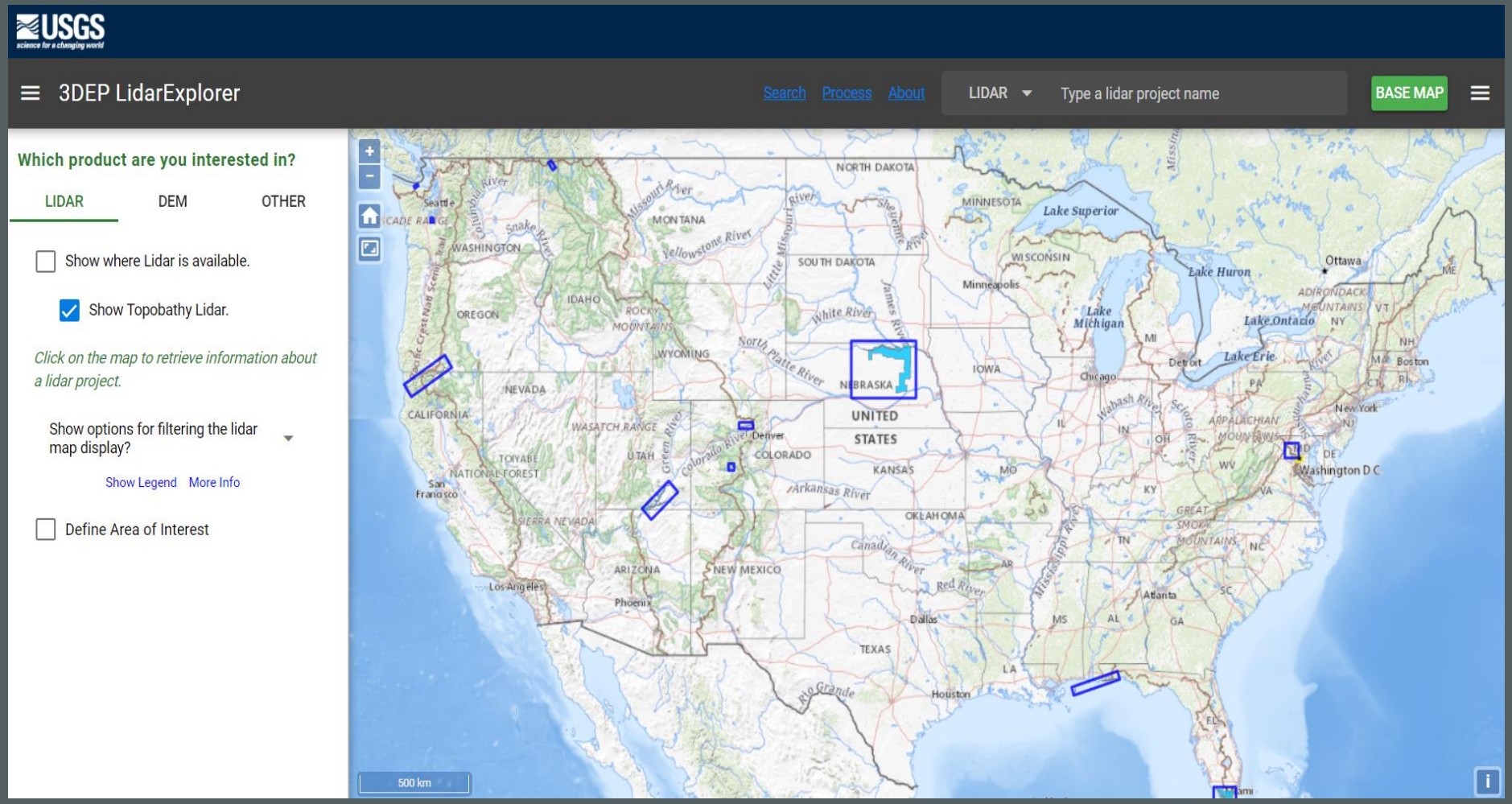
Inland Bathymetry Research
3DEP Lidar Explorer – Topobathy Lidar Publications



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Southeast Texas – 3D NTM Pilot Model
USGS ScienceBase

ScienceBase Catalog → Earth Resources Observatio… → Southeast Texas Pilot Nation…

Southeast Texas Pilot National Topography Model (NTM), 1933 to 2021

View

Dates

Publication Date : 2023-11-03
Start Date : 1933
End Date : 2021

Citation

Danielson, J.J., Miller-Corbett, C.D., and Thatcher, C.A., 2023, Southeast Texas Pilot National Topography Model (NTM), 1933 to 2021: U.S. Geological Survey data release, https://doi.org/10.5066/P9N4WLC8.

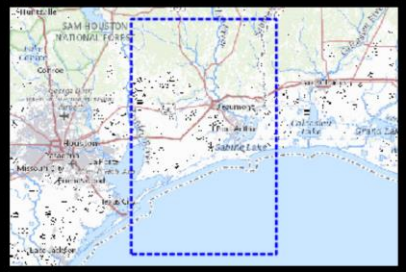
Summary

The U.S. Geological Survey (USGS) 3D Elevation Program (3DEP) has initiated the development of a second pilot 3D National Topography Model (3DNTM) to generate 3-dimensional surface elevation models that integrate topographic bare-earth elevation surfaces with river channel bed and coastal bathymetry and topobathymetry. Detailed knowledge of integrated river system topography, bathymetry, and topobathymetry is essential for fisheries habitat restoration, hydrologic modeling, and other key science applications such as flood mapping and identification of fluvial geomorphic features. An integrated 1-meter topobathymetric digital elevation model (TBDEM) for Hardin, Orange, and Jefferson counties in Southeast Texas has been developed for this second pilot study. This pilot 3DNTM product supports the Southeast Texas Flood Coordination Study where flood planning and modeling are essential for resource management to minimize impacts from rainstorm and hurricane events. Within the pilot project area of interest, the following hydrographic features are included: reaches of the Neches and Sabine Rivers, Sabine-Neches Water Way (Sabine Channel), Lake Sabine, the Keith Lake-Salt Bayou, and the Intercoastal Waterway. The Southeast Texas TBDEM comprises the spatial integration of 12 different geospatial elevation sources, including topographic lidar data from USGS 3DEP and Texas Strategic Mapping (StratMap), single-beam acoustic data from Texas Water Development Board for the Keith-Lakes-Salt Bayou System, multiple single-beam acoustic surveys from the U.S. Army Corps of Engineers, and nearshore to offshore bathymetry from the National Oceanic and Atmospheric Administration (NOAA),

… show more …

Contacts

Map »



Communities

- Earth Resources Observation and Science Center (EROS)
- USGS Data Release Products

Tags

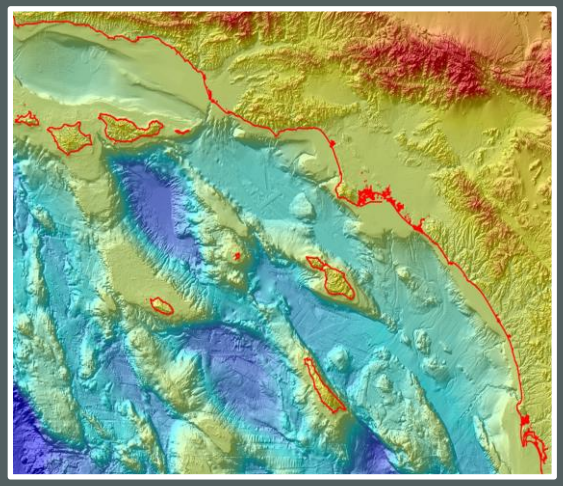
Harvest Set : USGS Science Data Catalog (SDC)
Theme : elevation, geoscientificInformation, inlandWaters, oceans
Place : 3D Elevation Program (3DEP), 3D National Topography Model (3D NTM), Beaumont, East Pass, Gulf of Mexico, Hardin County, Jefferson County, Keith Lake-Salt Bayou System, National Geospatial Program (NGP), Neches River, Orange County, Port Arthur, Port Neches, Sabine Lake, Sabine River, Sabine-Neches Waterway,

https://doi.org/10.5066/P9N4WLC8

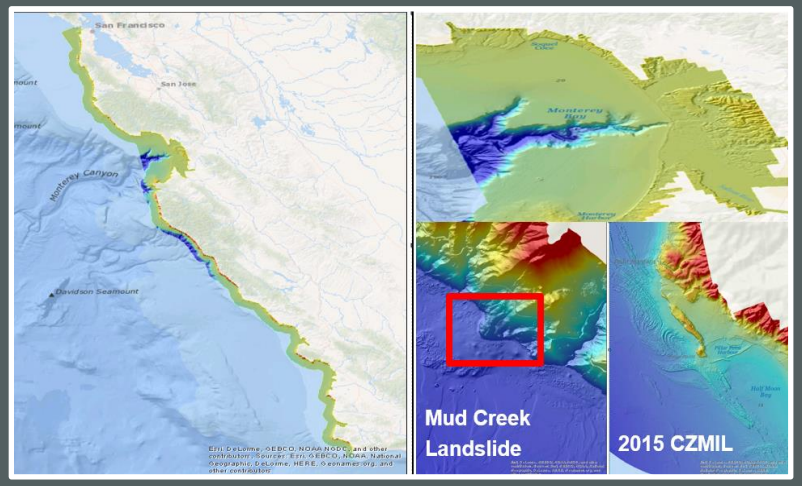
USGS

Questions (Jeffrey Danielson, daniels@usgs.gov, Cynthia Miller-Corbett, cmcorbet@usgs.gov)

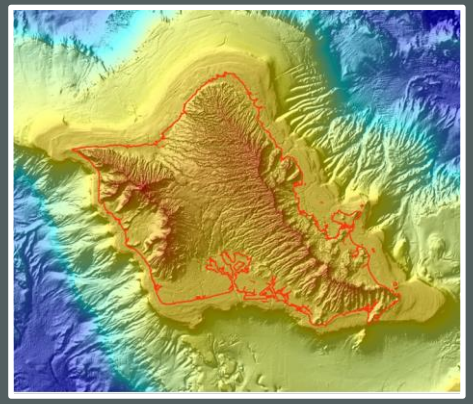
San Francisco Bay



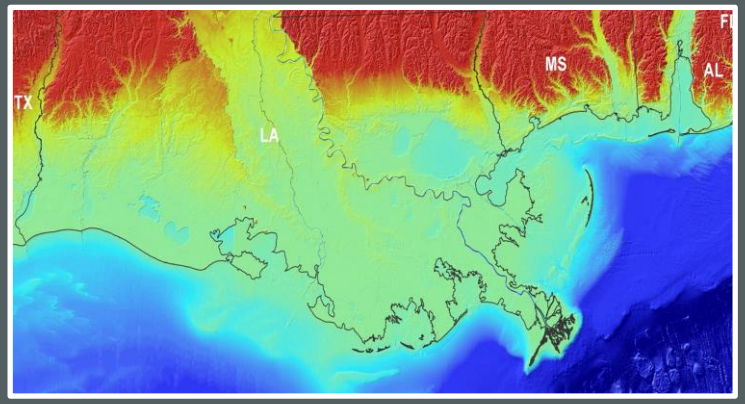
Southern California



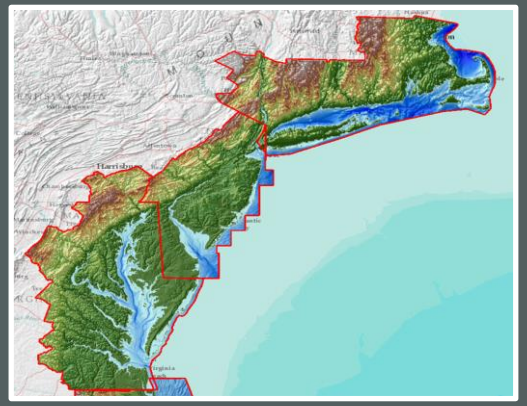
Central California



Hawaii - Oahu



Northern Gulf of Mexico (NGOM)



Hurricane Sandy Region

USGS

Interagency Working Group On Ocean And Coastal Mapping