

NEXT GENERATION VOLUME CHANGE TOOLS

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COASTAL INLETS RESEARCH PROGRAM
FY24 IN PROGRESS REVIEW



U.S. ARMY



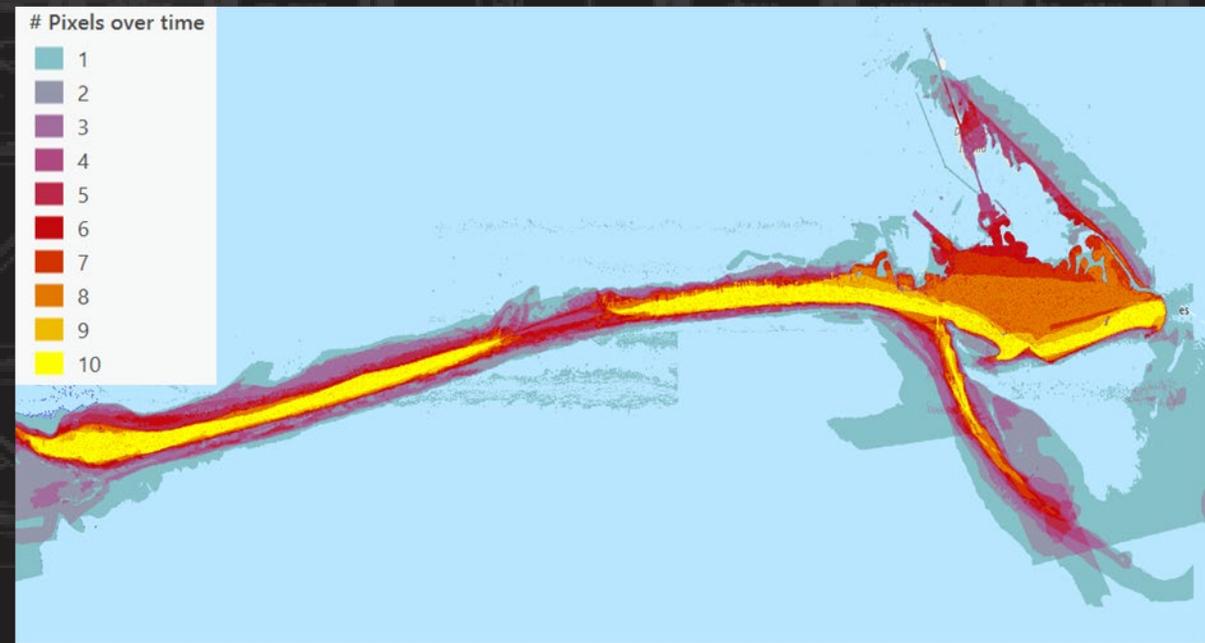
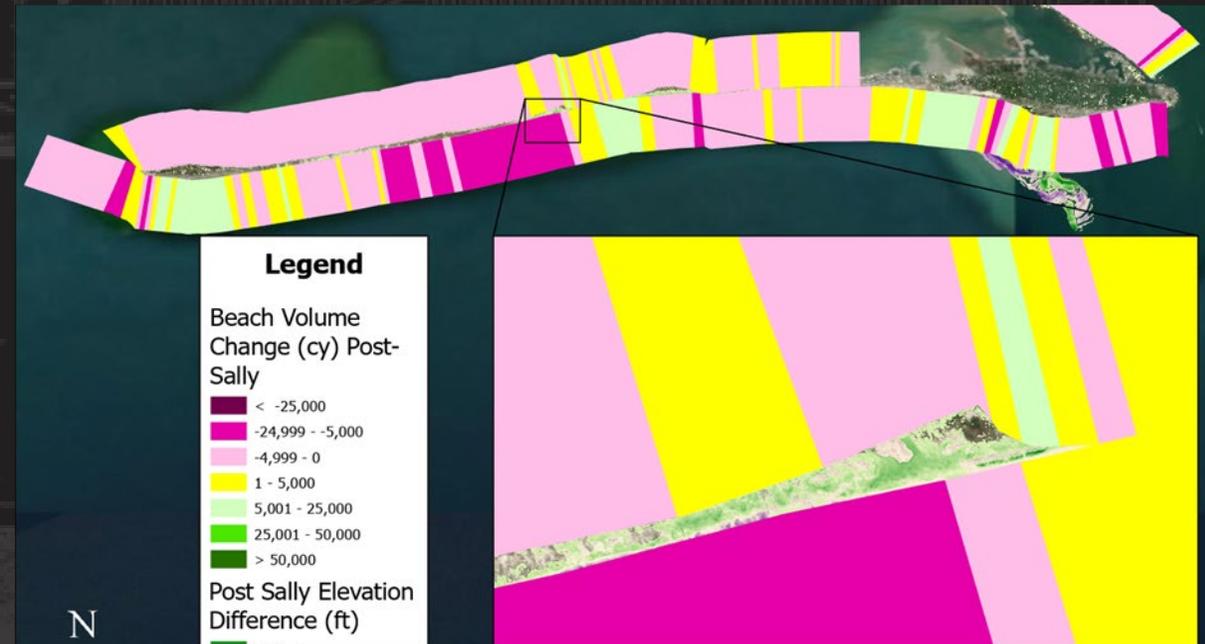
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ERDC



CIRP





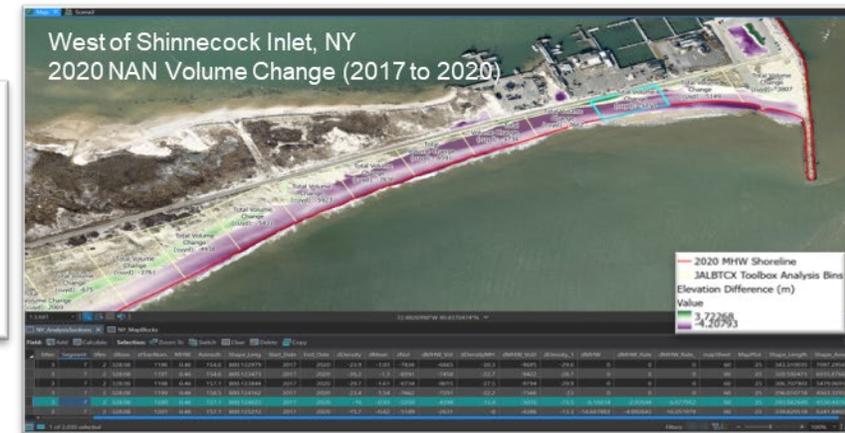
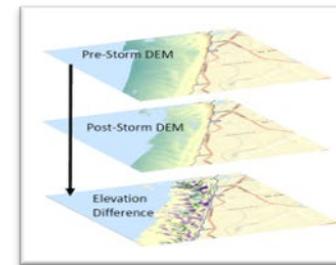
PROBLEM STATEMENT

PROBLEM: Current volume change analysis tools are limited in their ability to compare quantities between time periods as transect bins are fixed in space, restricting applicability whenever data coverages vary spatially.

SOLUTION: Advanced spatio-temporal sediment volume change analysis tools that have the potential to promote efficiencies in the sediment budget development process.

- SoN 2024-N-1968: New volume-change tools to improve sediment management
- SoN 2024-N-1969: Incorporating shoaling rates into sediment budget creation to improve sediment management
- FY24 was year 1 of 3
- Deliverables in FY24: 1) Kickoff PDT, 2) Feedback Form, 3) Literature Review, 4) CIRP Tech Discussion, 5) ORISE Fellowship Advertisement, and 6) Data Inventory

Existing Framework: DEMs of Difference & Transect Bins





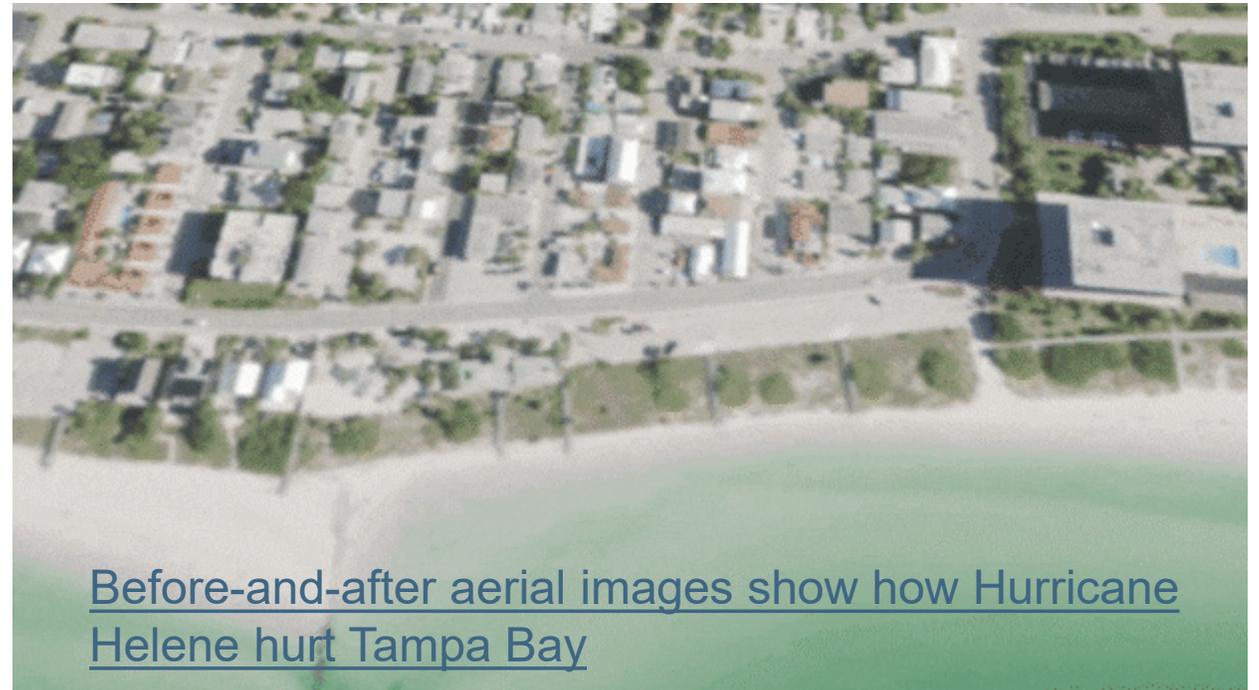
CAPABILITY AND STRATEGIC IMPACT



Fulfill requirements for a flexible volume change framework leveraging current geomorphic feature extraction and classification R&D together with multi-dimensional space-time and conformal mapping approaches. Aims to improve both the characterization and quantification of volumes for coastal projects in support of sediment budget development, operations and maintenance, and project monitoring.

Source: Tampa Bay Times and National Ocean Service

Accurate beach volume information is a critical need for planning, operation, and maintenance of USACE Flood Risk Management (FRM) and Coastal Storm Risk Management (CSR) projects to ensure the effective management of sediments in support of a USACE goal to increase beneficial use of dredge material (BUDM) to 70% by 2030.





PROJECT ROADMAP



FY24



Lit Review



ORISE Fellow



Data Compilation

- ERDC Special Report
- Data inventory geodatabase

Tech Transfer



FY25



Volume Partitioning

Hotspot Analysis



Bias Assessments

- Workflow for space-time cubes
- TPI-based products and vegetation metrics

Tech Transfer



FY26



Methods Refinements

Additional Pilot Sites



Product Development

- Enhanced land cover and planform mapping products
- Next-generation volume products

Tech Transfer





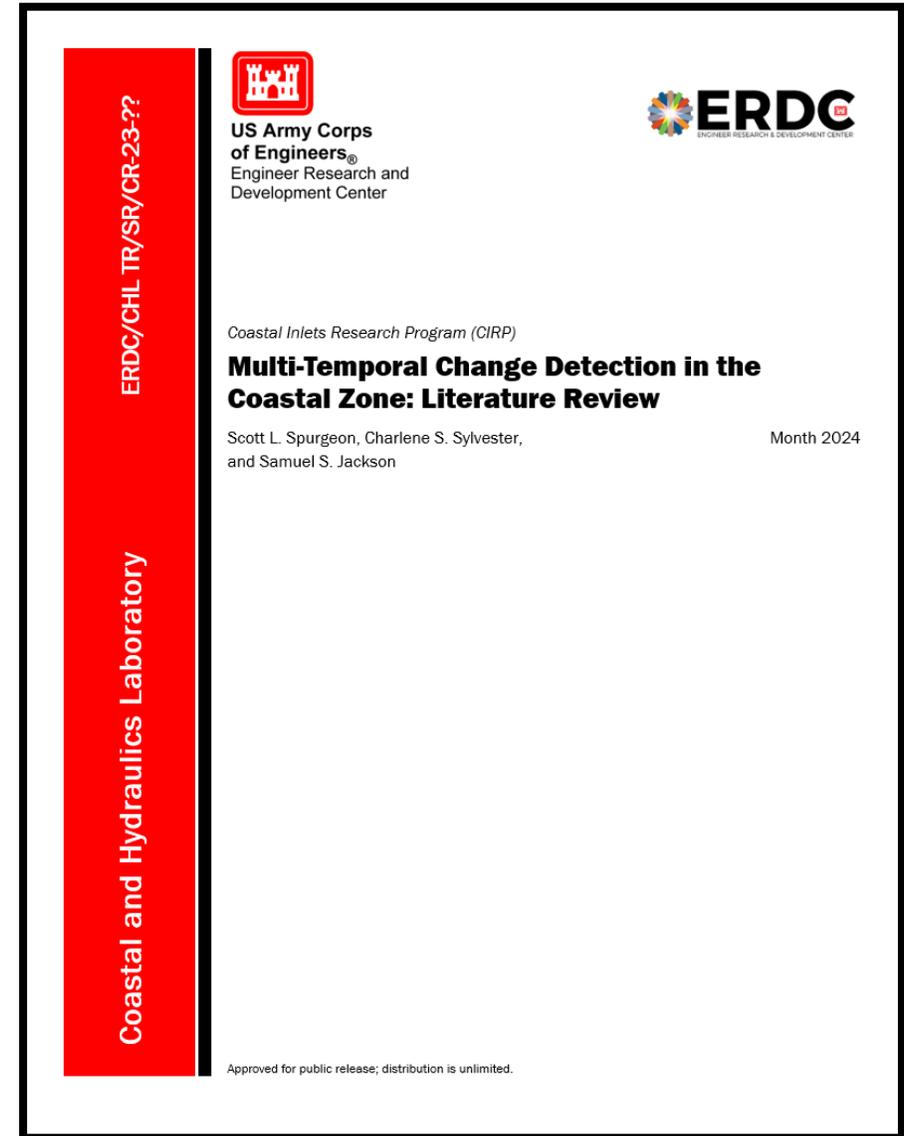
LITERATURE REVIEW



- BLUF: To determine the current state-of-art related to multi-temporal change detection, identify temporal data requirements for robust change analysis, and identify existing tools for performing change detection analysis.
- 80+ Refereed Pieces of Literature Sourced from 1993-2024

Topics Include:

- Geomorphology Change Detection Background
- 1-D Change Detection: Shoreline Position
- 1-D Change Detection: Beach Profiles
- 2.5-D Change Detection: DEM of Difference
- Space-Time Cube Analysis
- Errors and Uncertainties





DATA INVENTORY

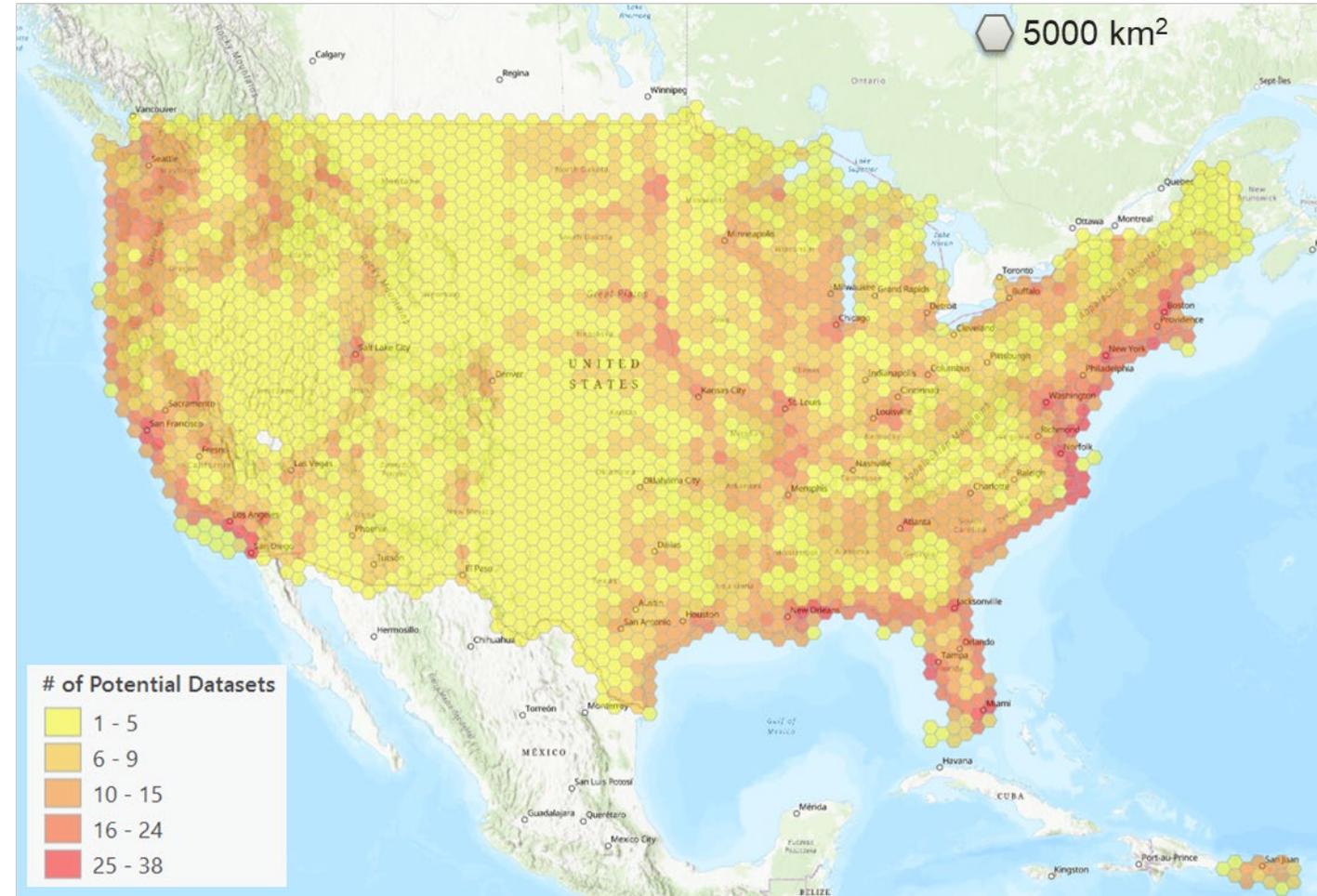


Purpose

- Identify coastal areas with data coverage that has sufficient spatial and temporal resolution to meet the objectives of this R&D.

Data Requirements:

- Spatial resolution supports 3-m DEM
- Datasets are available for at least 10 temporally-unique time periods
- Adequate geospatial metadata to support datum transformations



Source: Spatial join of tessellation grid and US Interagency Elevation Inventory Polygons





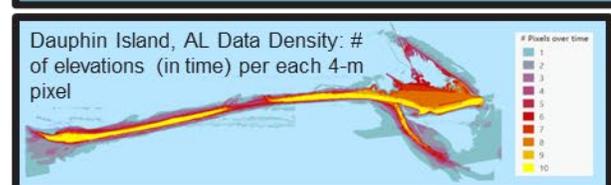
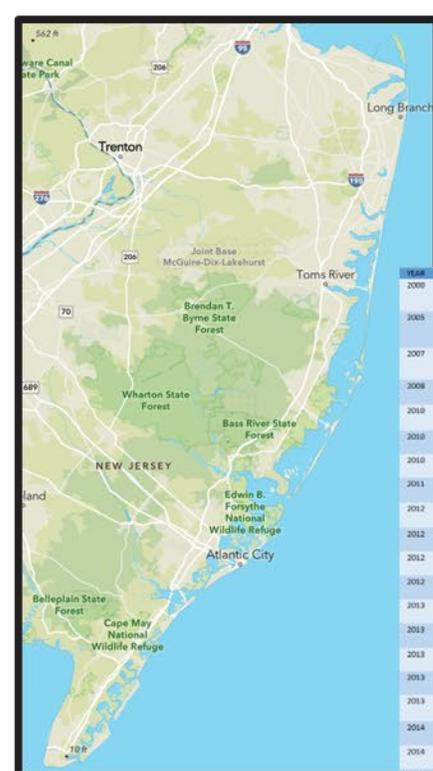
PILOT AREAS & DATA INVENTORIES



- Pilot Areas Identified in FY24 include:
 - MS/AL Barrier Islands (15 data sets)
 - Duck, North Carolina (29 data sets)
 - New Jersey Coastline (28 data sets)



YEAR	DATASET	BEG_DATE	END_DATE	SOURCE	COVERAGE
1996	1996 Fall East Coast NOAA/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	10/9/1996	10/16/1996	NASA/NOAA	Topography
1997	1997 Fall East Coast NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	9/15/1997	10/2/1997	NASA/NOAA/USGS	Topography
1998	1998 Fall East Coast NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	9/7/1998	9/7/1998	NASA/NOAA/USGS	Topography
1999	Fall 1999 East Coast NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	10/6/1999	11/4/1999	NASA/NOAA/USGS	Topography
1999	1999 Post-Hurricane Floyd NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	9/18/1999	10/7/1999	NASA/NOAA/USGS	Topography
1999	1999 Post-Hurricane Dennis NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	9/3/1999	n/a (9/3/1999 - based on Floyd's arrival)	NASA/NOAA/USGS	Topography
2000	2000 Spring North Carolina NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	2/22/2000	3/19/2000	NASA/NOAA/USGS	Topography
2001	2001 NCMP Lidar: Phase 1A (Nause, Pigeonfish, Tar-Palmica, White Oak River Basins)	1/3/2001	3/23/2001	USGS	Topography
2004	2004 US Army Corps of Engineers (USACE) Topobathy Lidar: Alabama, Florida, Mississippi and North Carolina	4/1/2004	9/25/2004	USACE	Topography
2005	2005 US Army Corps of Engineers (USACE) National Coastal Mapping Program Topobathy Lidar: Delaware, Maryland, New Jersey, New York, North Carolina and Virginia	8/24/2005	11/26/2005	USACE	Topography and Bathymetry
2008	2008 NOAA Integrated Ocean and Coastal Mapping (IOCMP) Lidar: North Carolina and Virginia	1/17/2008	3/27/2008	NOAA	Topography
2008	2008 US Army Corps of Engineers (USACE) Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) Topobathy Lidar: North Carolina	9/14/2008		USACE	Topography
2009	2009 USACE NCMP Topobathy Lidar: Atlantic Coast (NC, VA)	8/10/2009	8/24/2009	USACE	Topography
2009	2009 USGS/NPS Experimental Advanced Airborne Research Lidar (EAARL): Cape Hatteras National Seashore - Post-Hurricane Ida	11/27/2009	12/7/2009	USGS/NPS	Topography and Bathymetry
2010	2010 USACE NCMP Topobathy Lidar DEM: Atlantic Coast (NC - VA)	7/27/2010	7/28/2010	USACE	Topography and Bathymetry
2012	2012 U.S. Geological Survey Topographic Lidar: Northeast Atlantic Coast Post-Hurricane Sandy	11/5/2012	11/29/2012	USGS	Topography



YEAR	DATASET	BEG_DATE	END_DATE	SOURCE	COVERAGE
2000	2000 Fall East Coast NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion Project for the US Coastline	9/20/2000	11/2/2000	NOAA/USGS/NASA	Topography
2005	2005 USACE NCMP Topobathy Lidar: Delaware, Maryland, New Jersey, New York, North Carolina, and Virginia	8/24/2005	11/26/2005	USACE	Topography and Bathymetry
2007	2007 USGS/NASA Experimental Advanced Airborne Research Lidar (EAARL): Fire Island National Seashore, NY and Sandy Hook, NJ	4/26/2007	5/16/2007	USGS/NASA	Topography and Bathymetry
2008	2008 USGS South New Jersey County Project Lidar: Cape May County	4/1/2008		USGS/DEMA/NDP	Topography
2010	FEMA RIAMAP Atlantic, Ocean, and Monmouth NJ Area of Interest	2/15/2011		FEMA	Topography
2010	2010 USACE NCMP Topobathy Lidar: Atlantic Coast (NJ - VA)	8/1/2010	8/7/2010	USACE USGS	Topography and Bathymetry
2010	2010 USACE NCMP Topobathy Lidar	8/28/2010	9/11/2010	USACE	Topography and Bathymetry
2011	2011 NOAA National Geodetic Survey (NGS) Lidar: Fire Island, NY and Cape May to Absecon Island, NJ	7/16/2011	11/9/2011	NOAA	Topography
2012	EAARL-8 Coastal Topography - Eastern New Jersey, Hurricane Sandy, 2012: First Surface, Pre-Sandy	10/26/2012	11/9/2012	USGS/NASA	Topography
2012	2012 USGS EAARL-8 Coastal Topography: Post-Sandy, First Surface (NS)	10/26/2012	11/9/2012	USGS/NASA	Topography
2012	2012-2013 Post-Hurricane Sandy EAARL-8 Submerged Topography - Barnegat Bay, New Jersey	11/1/2012	1/10/2013	USGS/NASA	Topography
2012	2012 USACE Topobathy Lidar: Post Sandy (NJ & NY)	11/16/2012		USACE	Topography and Bathymetry
2013	2013 NOAA NGS Topobathy Lidar: Great Egg (NJ)	9/25/2013	9/29/2013	NOAA	Topography and Bathymetry
2013	2013 NOAA NGS Topobathy Lidar: Little Egg (NJ)	9/19/2013	9/20/2013	NOAA	Topography and Bathymetry
2013	2013 NOAA NGS Lidar of New Jersey Barnegat Light	9/23/2013	9/24/2013	NOAA	Topography and Bathymetry
2013	2013 USACE NCMP Topobathy Lidar: New Jersey	6/23/2013	6/24/2013	USACE	Topography and Bathymetry
2013	2013 USACE NCMP Topobathy Lidar: Barnegat Bay and Seaside Heights (NJ)	9/3/2013	10/2/2013	USACE	Topography and Bathymetry
2014	2014 USGS CMSP Lidar: Post Sandy (New Jersey)	3/21/2014	4/21/2014	USGS	Topography
2014	2014 NOAA Post-Hurricane Sandy Topobathymetric Lidar: Annapolis for Shoreline Mapping	1/8/2014	7/27/2014	NOAA	Topography and Bathymetry
2014	2014 USACE NCMP Topobathy Lidar: Avalon, NJ	3/6/2014		USACE	Topography and Bathymetry
2014	2014 USACE NCMP Topobathy Lidar: Little Egg Harbor, NJ	3/9/2014		USACE	Topography and Bathymetry
2014	2014 NOAA OCS Topobathy Lidar: New Jersey	4/1/2014	4/3/2014	NOAA	Topography and Bathymetry
2015	2015 USACE NCMP Topobathy Lidar: Avalon (NJ)	6/9/2015		USACE	Topography and Bathymetry
2017	2017 USACE NCMP Topobathy Lidar: East Coast (NY, NJ, DE, MD, VA, NC, SC, GA)	8/19/2017	9/15/2017	USACE	Topography and Bathymetry
2019	2019 USGS Lidar: South New Jersey	8/8/2019	4/28/2019	USGS	Topography

YEAR	DATASET	BEG_DATE	END_DATE	SOURCE	COVERAGE
1998	1998 Fall Gulf Coast NOAA/USGS/NASA Airborne LIDAR Assessment of Coastal Erosion (ALACE) Project for the US Coastline	10/29/1998	11/9/1998	NOAA/USGS/NASA	Topography
2001	2001 USGS/NASA Airborne Topographic Mapper (ATM) Lidar: Coastal Alabama, Florida, Louisiana, Mississippi, Texas	9/9/2001	10/13/2001	USGS/NASA	Topography
2004	2004 US Army Corps of Engineers (USACE) Topobathy Lidar: Alabama, Florida, Louisiana, Mississippi and North Carolina	4/1/2004	9/25/2004	USACE	Topography and Bathymetry
2005	2005 US Army Corps of Engineers (USACE) Post-Hurricane Katrina Topo/Bathy Project for the Alabama, Florida, Louisiana and Mississippi	10/12/2005	12/11/2005	USACE	Topography and Bathymetry
2007	2007 USGS/NPS/NASA Experimental Advanced Airborne Research Lidar (EAARL): Northern Gulf of Mexico Barrier Islands	6/27/2007	6/30/2007	USGS/NPS/NASA	Topography
2010	2010 USACE NCMP Topobathy Lidar: Alabama	5/27/2010	5/29/2010	USACE	Topography and Bathymetry
2011	2011 USACE NCMP Topobathy Lidar: Gulf Coast (AL, LA, MS)	5/31/2011	6/4/2011	USACE	Topography and Bathymetry
2014	2014 Mobile County, AL Lidar	1/12/2014	1/22/2014	City of Mobile, AL	Topography
2016	2016 USACE NCMP Topobathy Lidar: Gulf Coast (AL, FL, MS, TX)	7/23/2016	10/10/2016	USACE	Topography and Bathymetry
2018	2018 USGS Topobathy Lidar: Gulf Coast Islands (AL, FL, LA)	10/27/2018	11/3/2018	USGS	Topography and Bathymetry
2018	2018 USACE NCMP Topobathy Lidar: Gulf Coast (AL, MS)	11/16/2018	11/18/2018	USACE	Topography and Bathymetry
2019	2019 USACE NCMP Topobathy Lidar: Gulf Coast (MS)	11/9/2019	11/10/2019	USACE	Topography and Bathymetry
2020	2020 USACE NCMP Post Sally Topobathy Lidar: Gulf Coast (AL, FL, MS)	10/1/2020	10/13/2020	USACE	Topography and Bathymetry
2022					
2023	2023 USGS Lidar: Southwest Central Alabama	1/9/2023	3/5/2023	USGS	Topography
2025					



DATA INVENTORY ASSESSMENT



- Evaluate fitness-for-use (coverage, quality, applicability)
- Determine data processing requirements
- Verify projections, datums, units, etc.



Raster Information	
Columns	9018
Rows	9903
Number of Bands	1
Cell Size X	1
Cell Size Y	1
Uncompressed Size	340.67 MB
Format	TIFF
Source Type	Generic
Pixel Type	floating point
Pixel Depth	32 Bit
NoData Value	-9999
Colormap	absent

2019 USACE NCMP Topobathy Lidar of MS Gulf Coast

Raster Information	
Columns	6452
Rows	2386
Number of Bands	1
Cell Size X	4
Cell Size Y	4
Uncompressed Size	58.73 MB
Format	TIFF
Source Type	Generic
Pixel Type	floating point
Pixel Depth	32 Bit
NoData Value	-9999
Colormap	absent

2010 USACE NCMP Topobathy Lidar: Dauphin Island, AL

Projection & Datum Options:

Projection: UTM Zone: Zone 16 Range 090W-084W

Horizontal Datum: NAD83 Horizontal Units: Meters

Vertical Datum: NAVD88 Vertical Units: Meters

Output Options:

Output Product: Raster Output Format: Grid - GeoTiff 32-bit

Grid Method: TIN Grid Units: Meters

Fill Small Gaps Grid Size: 1

Data Options:

Use Advanced Options

Data Classes: All

Add Intensity Images

Reset

DIGITAL COAST
Dive in to Get the Data, Tools, and Training That Communities Need to Address Coastal Issues

Previous Next



ANTICIPATED MILESTONES AND PRODUCTS



FY24

- **Special Report: Multitemporal Change Detection in the Coastal Zone: Literature Review**
- Pilot Site Data Inventory & Geodatabase

FY25

- Volume Partitioning
 - Relative Relief, Geomorphons, and Vegetation Metrics for Pilot Sites
 - Segmented DEMs and Volumes for Pilot Sites
 - **TN: DEM Segmentation Using Regional Datasets**
- Hot Spot Analysis
 - ArcGIS Pro Workflow and Space-Time Cube Products for Pilot Sites
 - **TN: Workflows for Creating Space Time Cubes from DEM Datasets**
- Investigate Methods to Address Uncertainty
 - Calculation of Bias Metrics and Anomaly Surfaces for Pilot Sites

FY26

- Refinement of Volume Partitioning
 - Enhanced Landcover Derivative Products for Pilot Sites
 - Proof-of-Concept Demonstration of Using Enhanced Landcover Derivative Products in SBAS
 - **TN: Use of Segmented Volumes in SBAS: A Case Study**
- Refinement of Hot Spot Analysis
 - **TN/JA: Parameter evaluation for Hot Spot Analysis using ArcGIS Pro**
 - Planform Mapping Products for Pilot Sites
- Refinement of Methods to Address Uncertainty
 - **ERDC Publication or Journal Article on Developing Uncertainty Estimates for Volumes**



SUMMARY

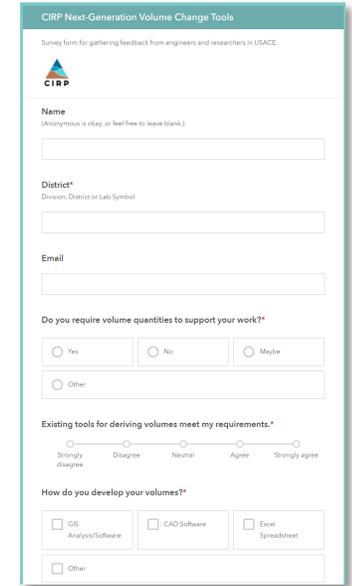


FY24 Major Advancements in Capability

- Leveraging of CSAT-supported Jupyter-based workflow to support data discovery and inventorying

FY24 Major Products & Collaborations

- PDT Kick-off (21 Jun 2024)
- Literature Review
- Dataset Inventory
- CIRP Tech Discussion (12 Sept 2024)
- ORISE Advertisement with CIRP Inlet Haz. Shoals
 - <https://www.zintellect.com/Opportunity/Details/ERDC-CHL-2024-0010>
- Feedback form
 - <https://arcg.is/Tr5v50>



FY25 Products & Advancements

- Volume Partitioning
 - Relative Relief, Geomorphons, and Vegetation Metrics for Pilot Sites
 - Segmented DEMs and Volumes for Pilot Sites
 - **TN: DEM Segmentation Using Regional Datasets**
- Hot Spot Analysis
 - ArcGIS Pro Workflow and Space-Time Cube Products for Pilot Sites
 - **TN: Workflows for Creating Space Time Cubes from DEM Datasets**
- Investigate Methods to Address Uncertainty
 - Development of a Bias Metrics for Pilot Sites
- Growth of team with ORISE Fellow, CHL & EL team members

