USGS – USACE – CPRA Collaboration on Coastal Louisiana Airborne LiDAR Acquisition

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International LiDAR Mapping Forum, Denver USA, January 23 – 25, 2012

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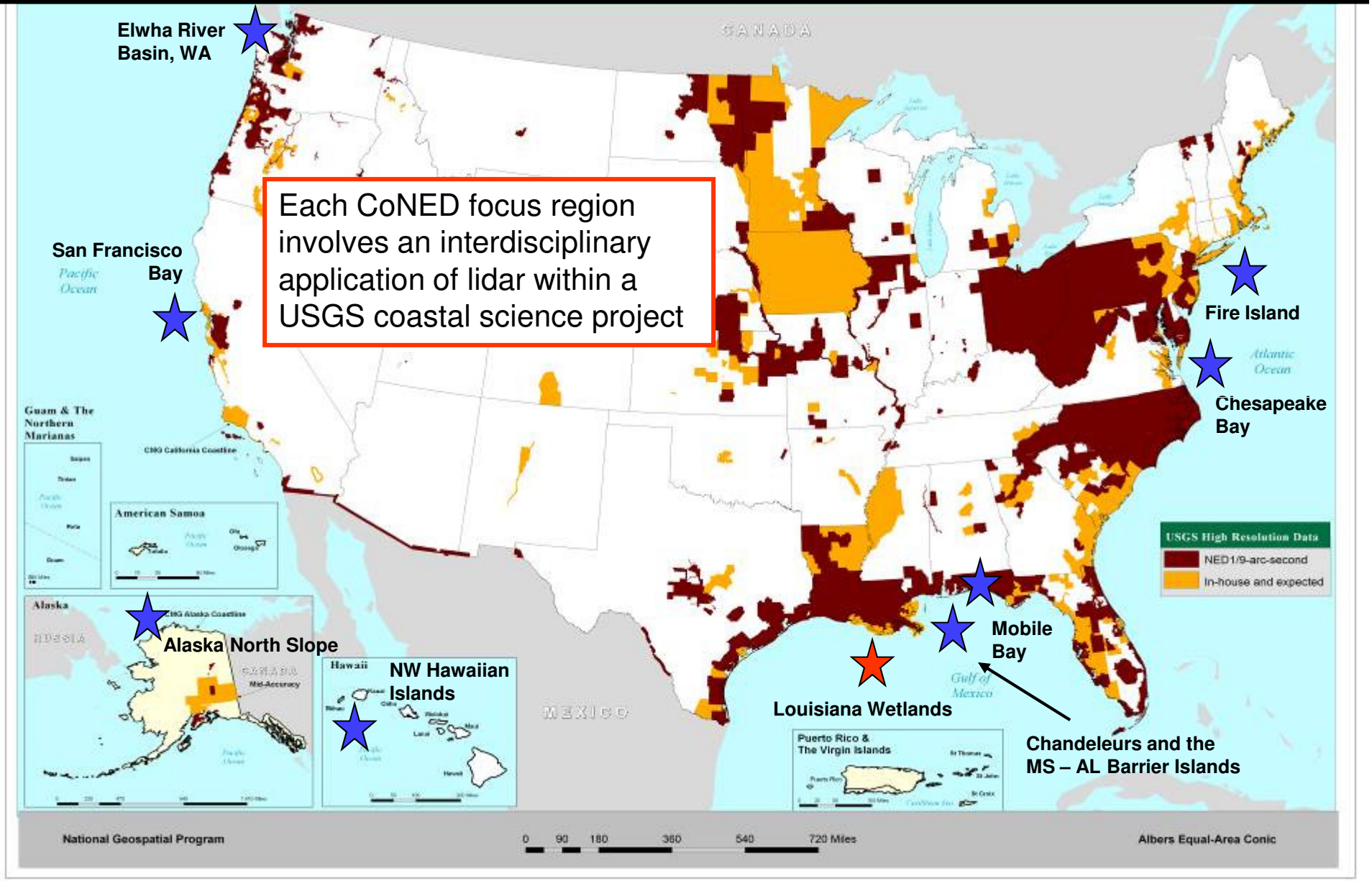
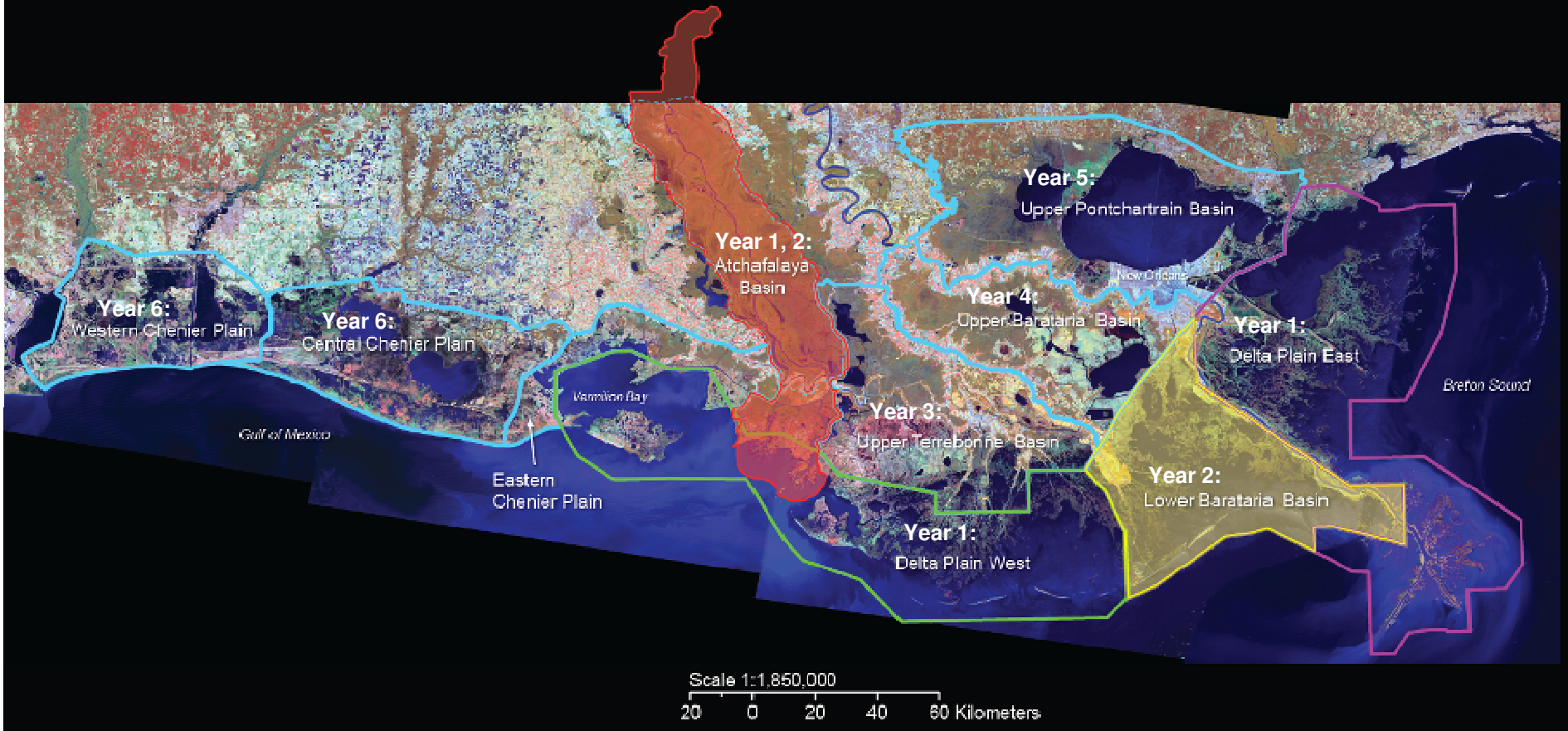
Topics

- Plan for a multi-year program of airborne lidar acquisition to cover all of coastal Louisiana
- Results from the Winter 2010 – 2011 airborne lidar survey of the Atchafalaya Basin
- Exploration of the viability of lidar-based mapping and monitoring of levees across the Mississippi River Delta Plain and the Atchafalaya Basin
- Mission: This project is intended to support both the prediction and modeling of wetland loss and the coastal protection and restoration community in Louisiana

Coastal National Elevation Dataset (CoNED) Focus Regions



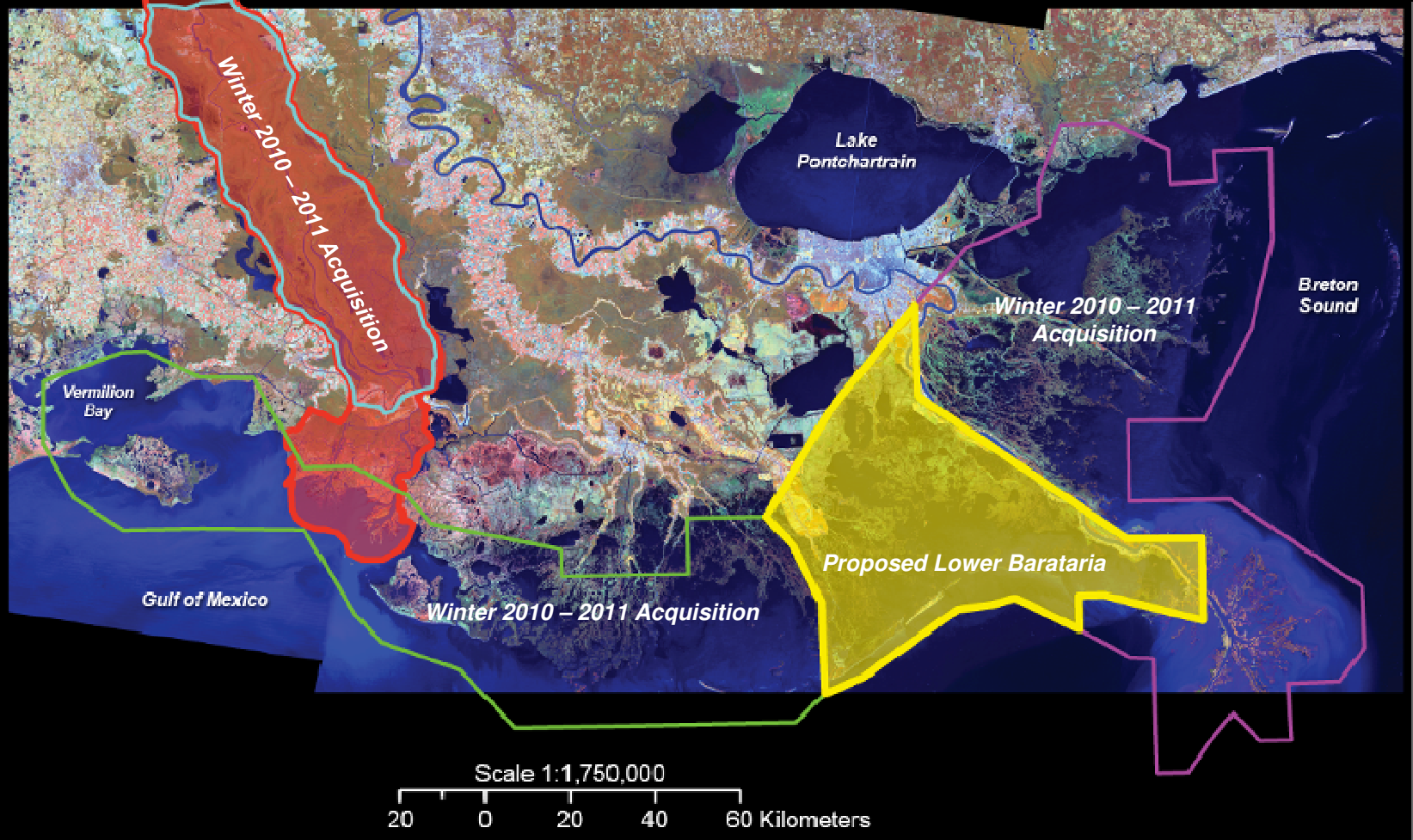
Plan for a ~6 Year Program of Airborne Lidar Acquisition to Cover All of South Louisiana



- Atchafalaya basin acquired december 2010, released in february 2010
- Mississippi river delta plain west region acquired spring 2011
- Mississippi river delta plain east region acquired spring 2011
- Proposed lower barataria basin acquisition december 2011
- Proposed atchafalaya basin post-flood acquisition december 2011
- Future coastal louisiana acquisitions post-2011

Due to seasonal water level fluctuations and the desire for “leaf-off” conditions, the intent is to mount these lidar collections during 6 consecutive Winter seasons

Winter 2010 – 2011 and Planned Winter 2011 – 2012 Lidar Acquisitions in South Louisiana



Scale 1:1,750,000

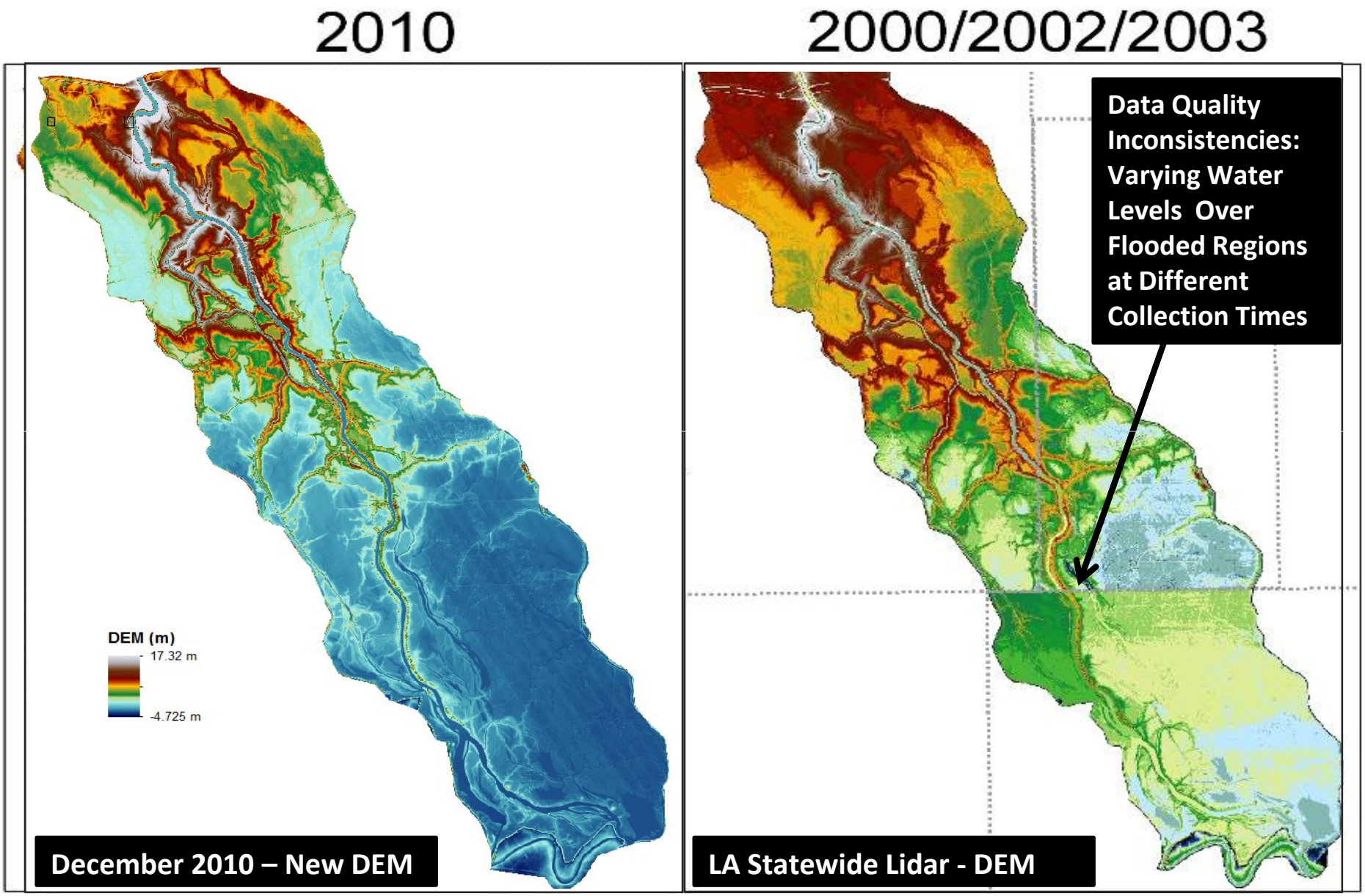
20 0 20 40 60 Kilometers

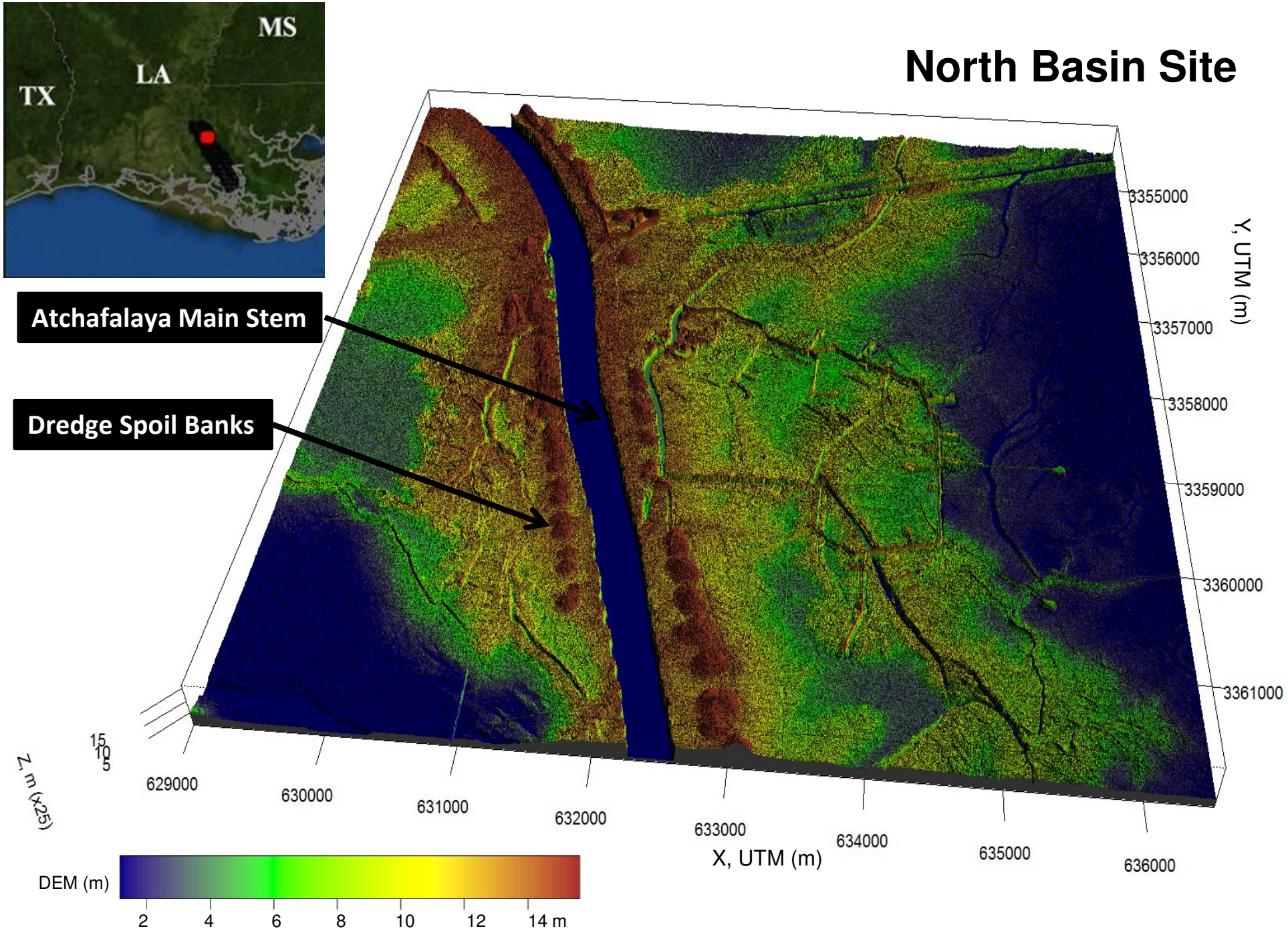
- Atchafalaya basin acquired december 2010
- Mississippi river delta plain west region
- Mississippi river delta plain east region
- Proposed lower barataria basin lidar acquisition
- Proposed atchafalaya basin post-flood lidar acquisition

Results from the December 2010 Lidar Survey of the Atchafalaya Basin Sponsored By USGS

The Challenge: Define elevations and thereby identify barriers to water flow in the Atchafalaya Basin under variable river stage conditions.

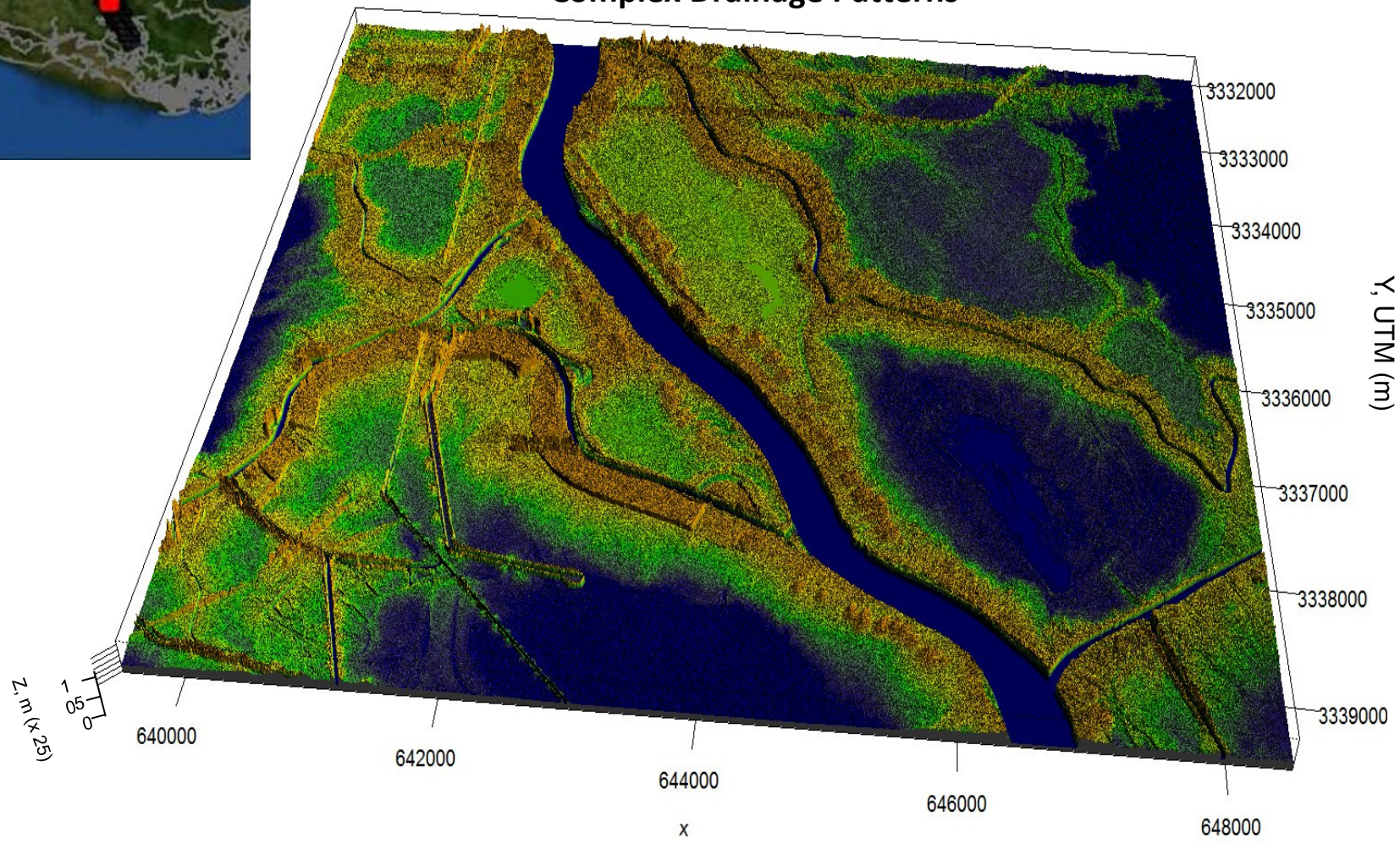
Atchafalaya Basin

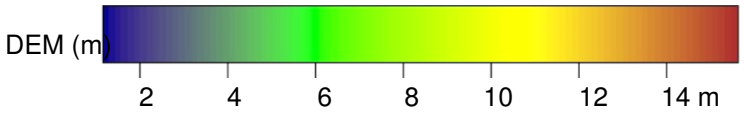


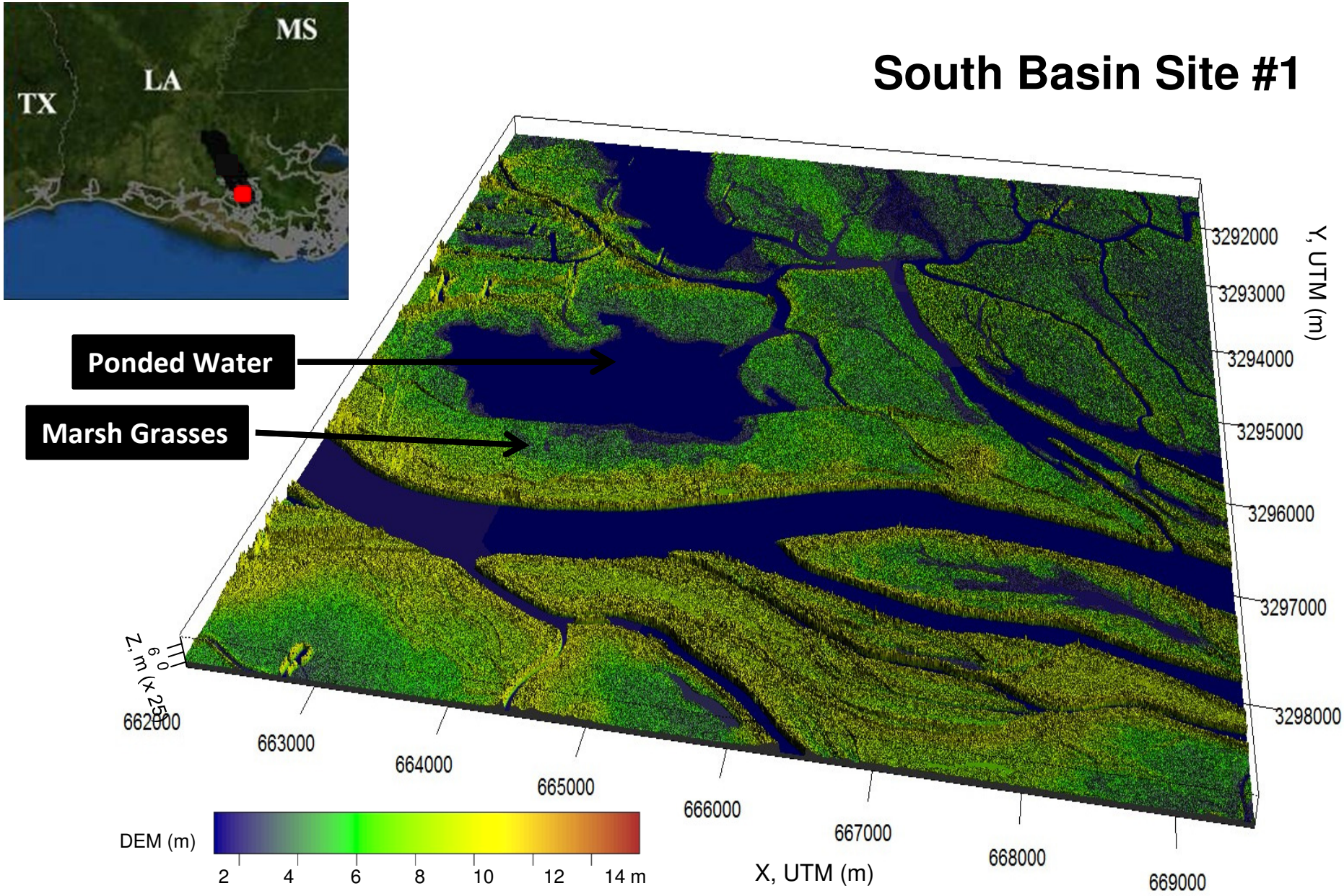

MS
LA
TX
North Basin Site
Atchafalaya Main Stem
Dredge Spoil Banks
Y, UTM (m)
3355000
3356000
3357000
3358000
3359000
3360000
3361000
Z, m (x25)
15
10
5
629000
630000
631000
632000
633000
634000
635000
636000
X, UTM (m)
DEM (m)
2
4
6
8
10
12
14 m

Central Basin Site

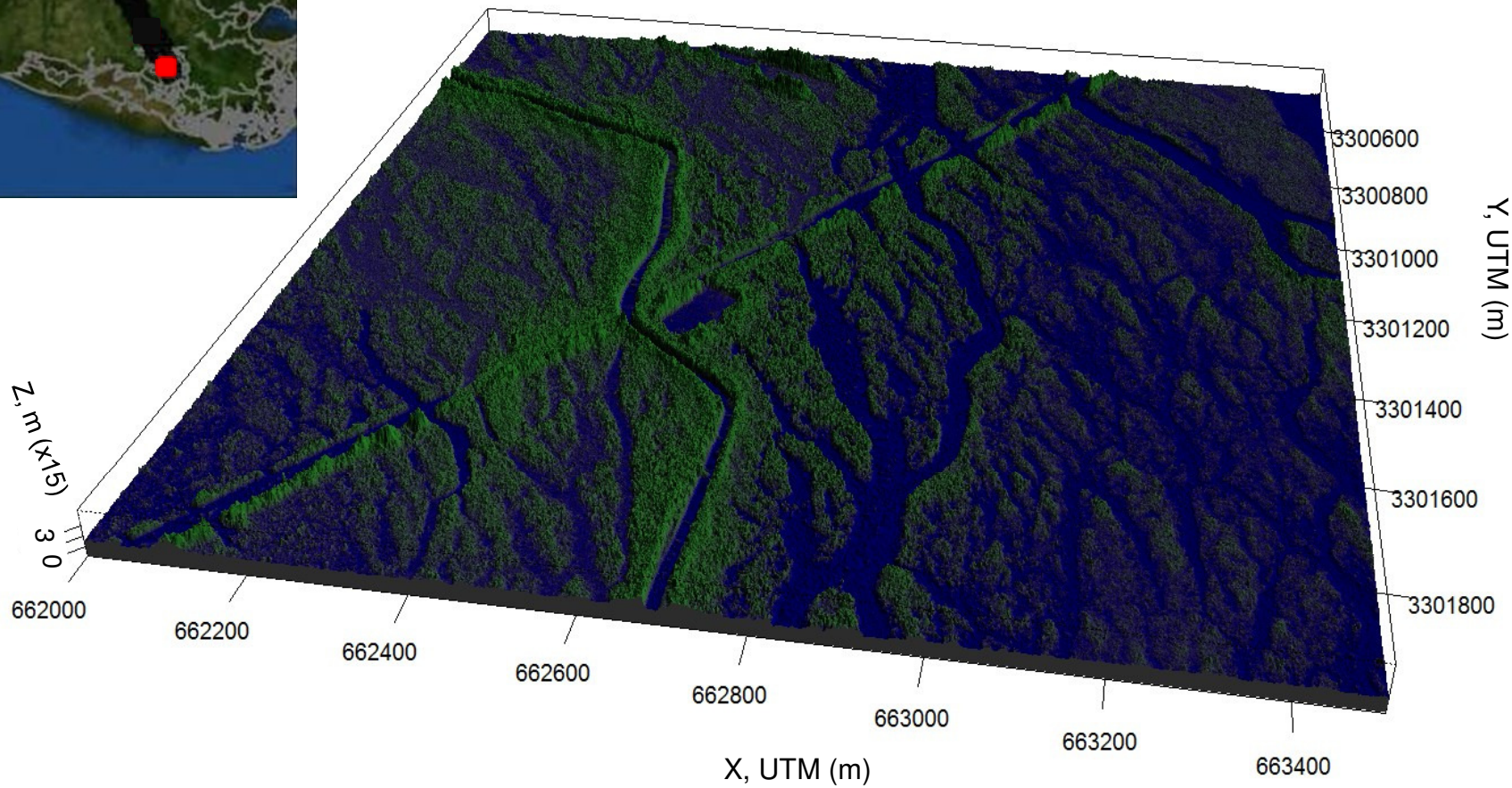
Complex Drainage Patterns

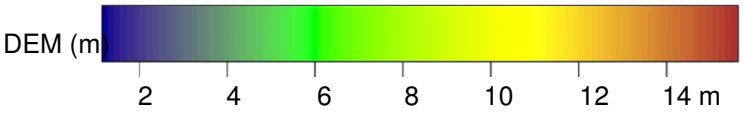





MS
LA
TX
South Basin Site #1
Ponded Water
Marsh Grasses
Z, m (x 25)
662000
663000
664000
665000
666000
667000
668000
669000
X, UTM (m)
3292000
3293000
3294000
3295000
3296000
3297000
3298000
Y, UTM (m)
DEM (m)
2
4
6
8
10
12
14 m

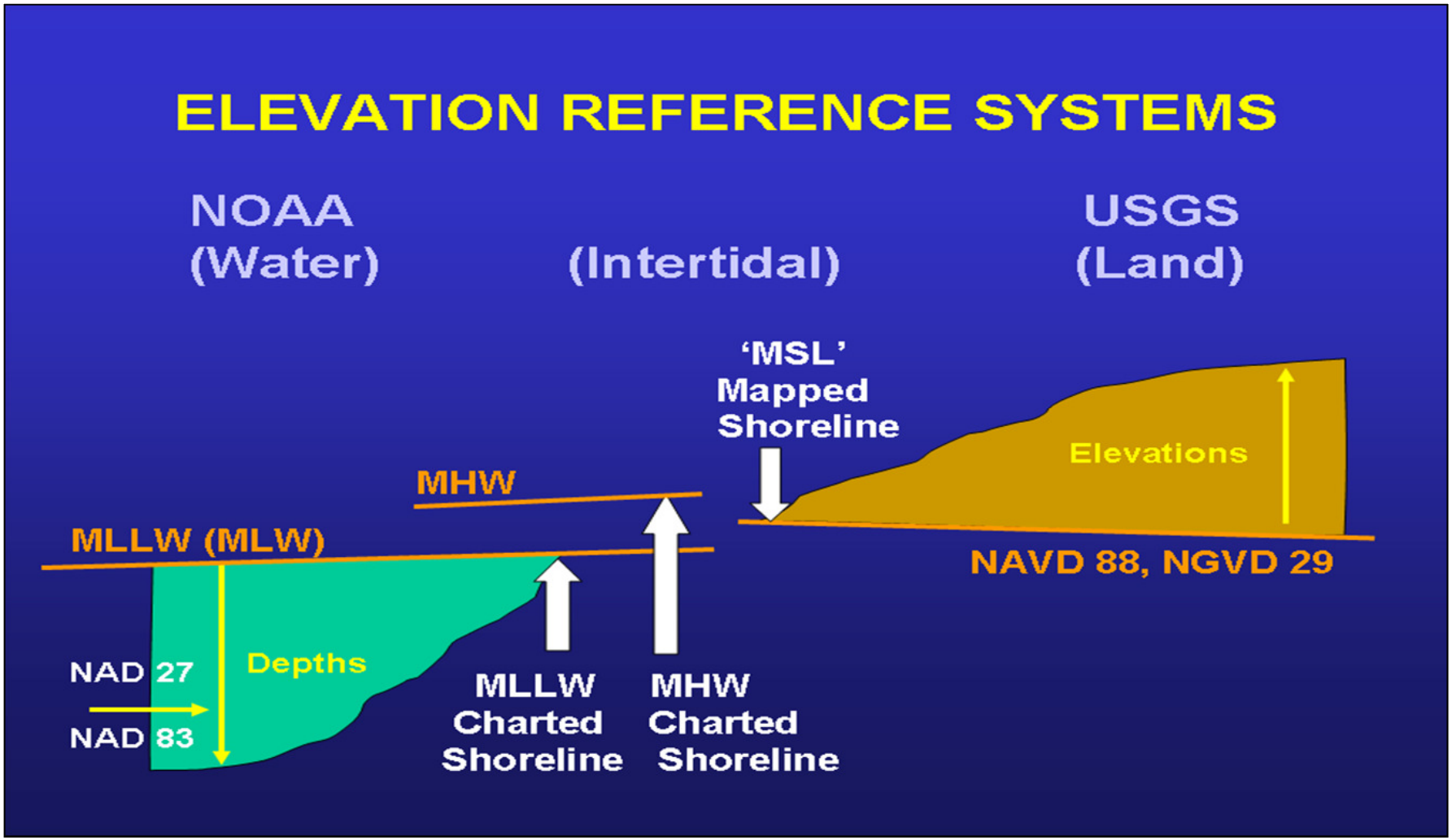
South Basin Site #2



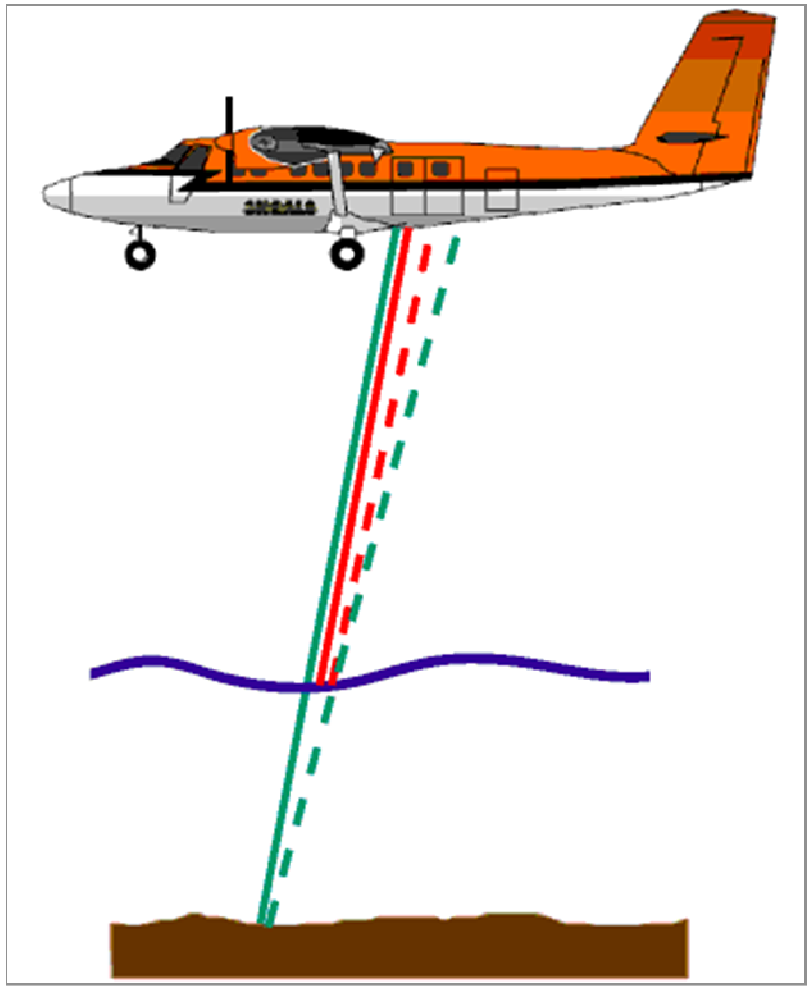


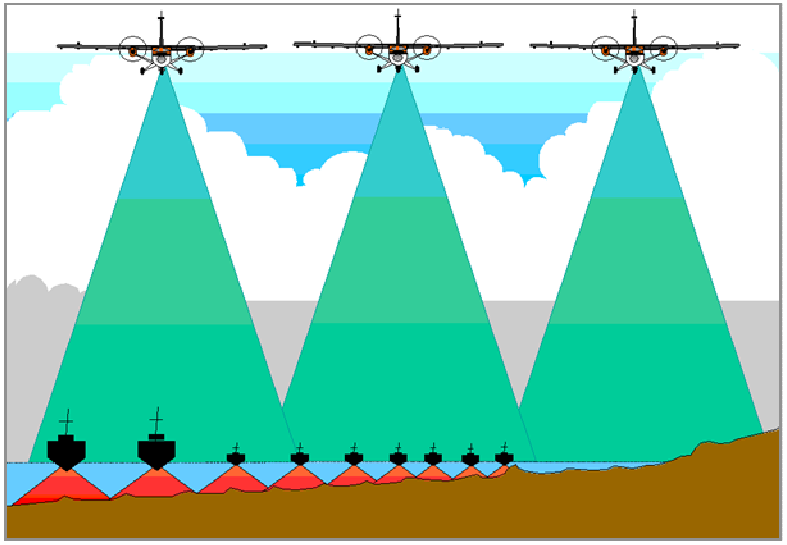
Terrain is so flat that subtle flightline to flightline biases that are within the target vertical accuracy specification can start to become apparent

CoNED – Elevation Reference Systems



CoNED – Mapping the Coastal Land / Water Interface: Topo/Bathy Lidar Technology





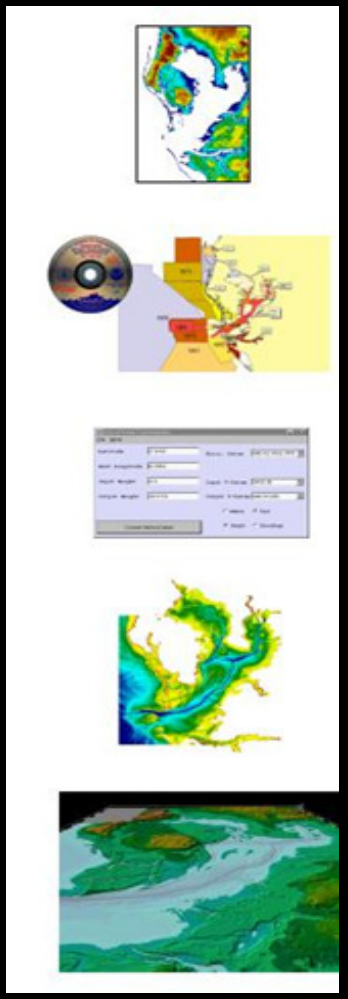
Bathymetric / topographic lidar data along the land/water interface provides up-to-date, high-resolution data in the critical inter-tidal zone.

Topo/bathy lidar data becomes the integrated buffer between the bathymetry and land surface topography

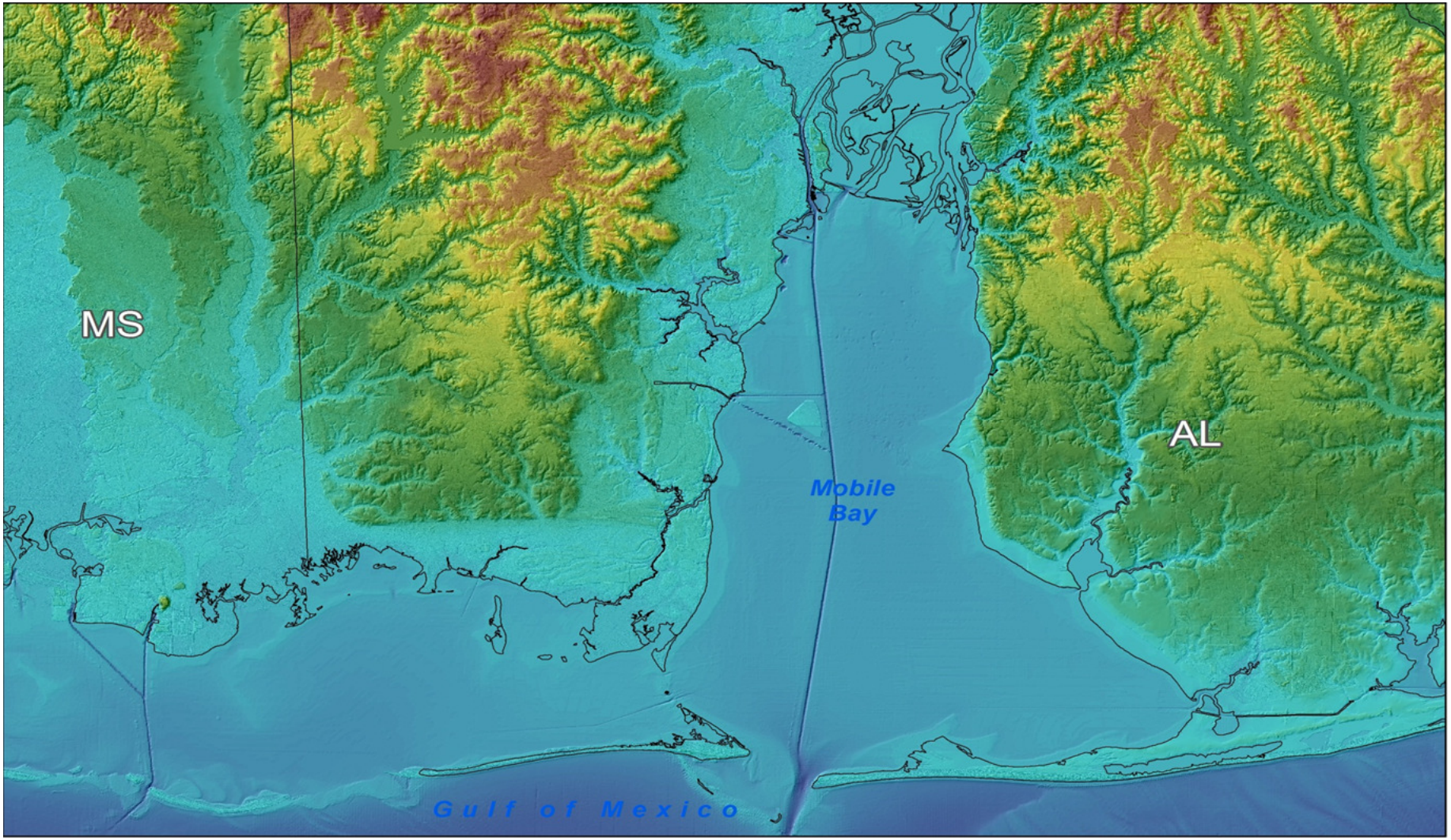
CoNED – Topo/Bathy Technical Overview

- **Topography – Lidar Point Cloud & DEM**
  - Topographic Lidar (Ground Classification)
- **Bathymetric Data Sources**
  - Bathymetric Lidar
  - Multibeam Acoustic
  - Single Beam Acoustic
  - Sidescan Sonar
  - Hydrographic Soundings
- **Bathymetric Pre-Processing**
  - If required, transform soundings from tidally referenced observations into orthometric heights using VDatum
  - Remove overlapping bathymetry surveys
  - Prioritize surveys based on spatial distribution, point density, and accuracy
- **Develop integrated shoreline from available bathymetry and topography data**
  - High-resolution coastline (NAVD88)
  - Topo/bathy lidar datasets
  - Logical masking of topo/bathy input data
  - Interpolation-Gap Fill (Nearshore coastal zone)

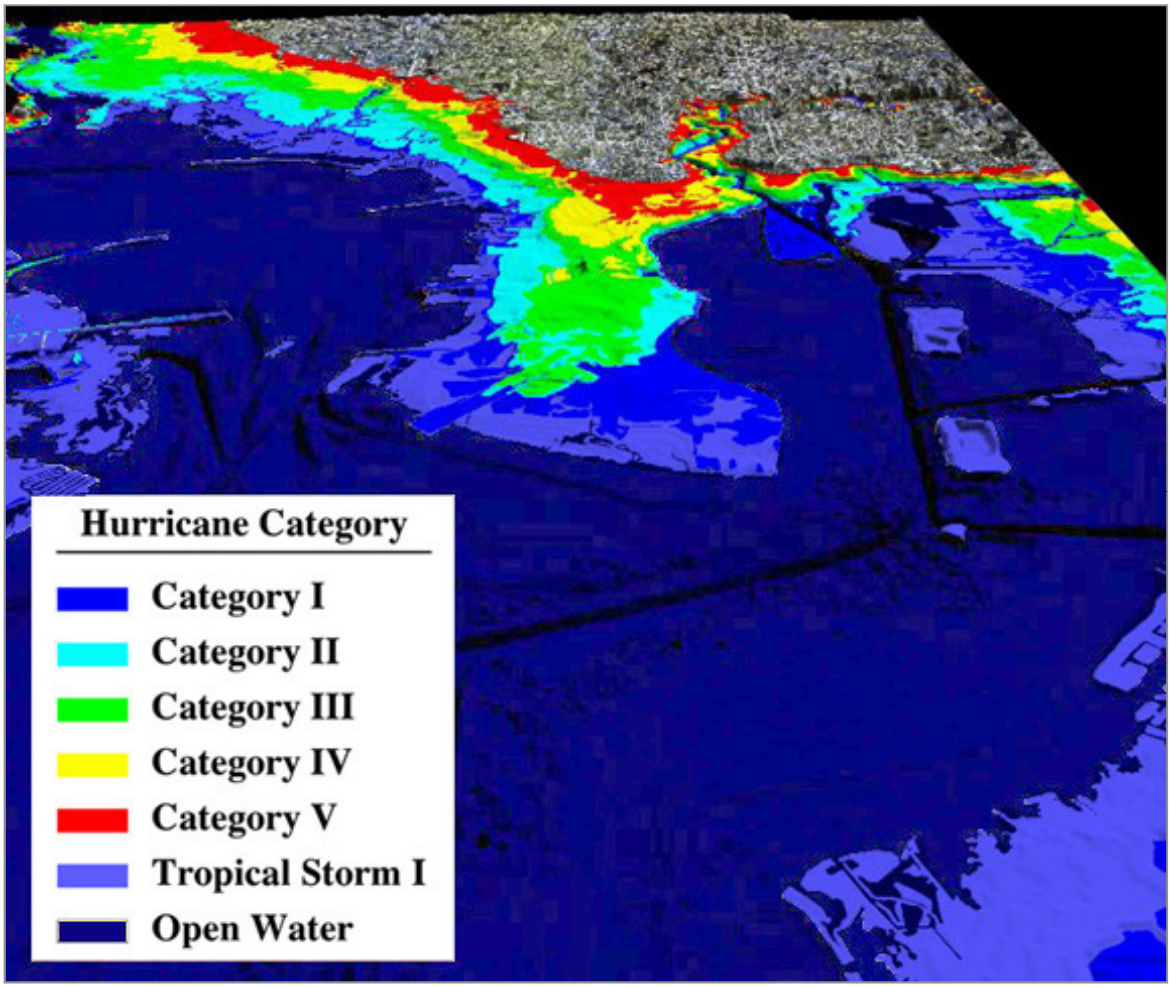
- **Lidar (Topography) Geodatabase Ingest**
- **Lidar Terrain Creation:**
  - Construct terrain data structures from the lidar and integrated shoreline point collections
  - Convert terrain data structures into raster surface models
- **Bathymetric Gridding**
  - Thin-plate spline / TIN approach
  - For gridded bathymetry, employ a smoothing operation to minimize noise effects.
- **Merge the lidar (topography), integrated shoreline, and bathymetry raster models into a single merged raster model**



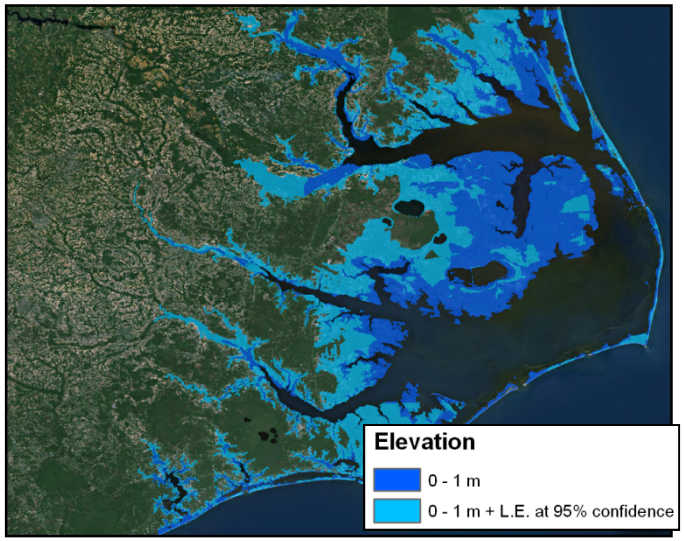
Example CoNED Focus Region – Mobile Bay, Alabama
1/9th Arc-Second Topobathymetric Elevation Model - Final



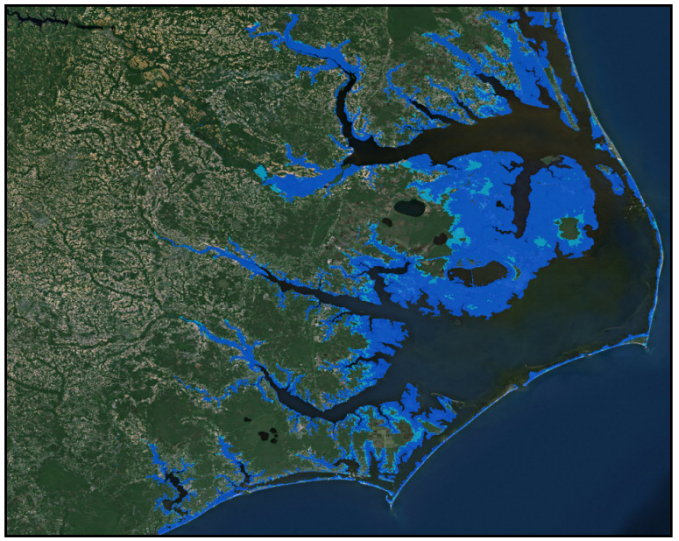
Topo/Bathy Application: Coastal Storm Surge Modeling



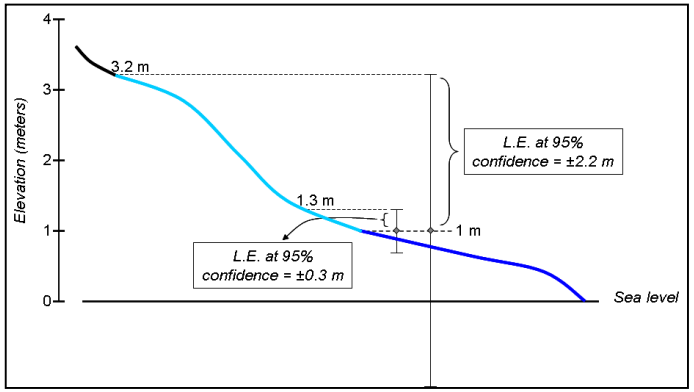
Topo/Bathy Application: Sea Level Rise (SLR) Modeling



Elevation source for SLR modeling: NED from 30-m DEM



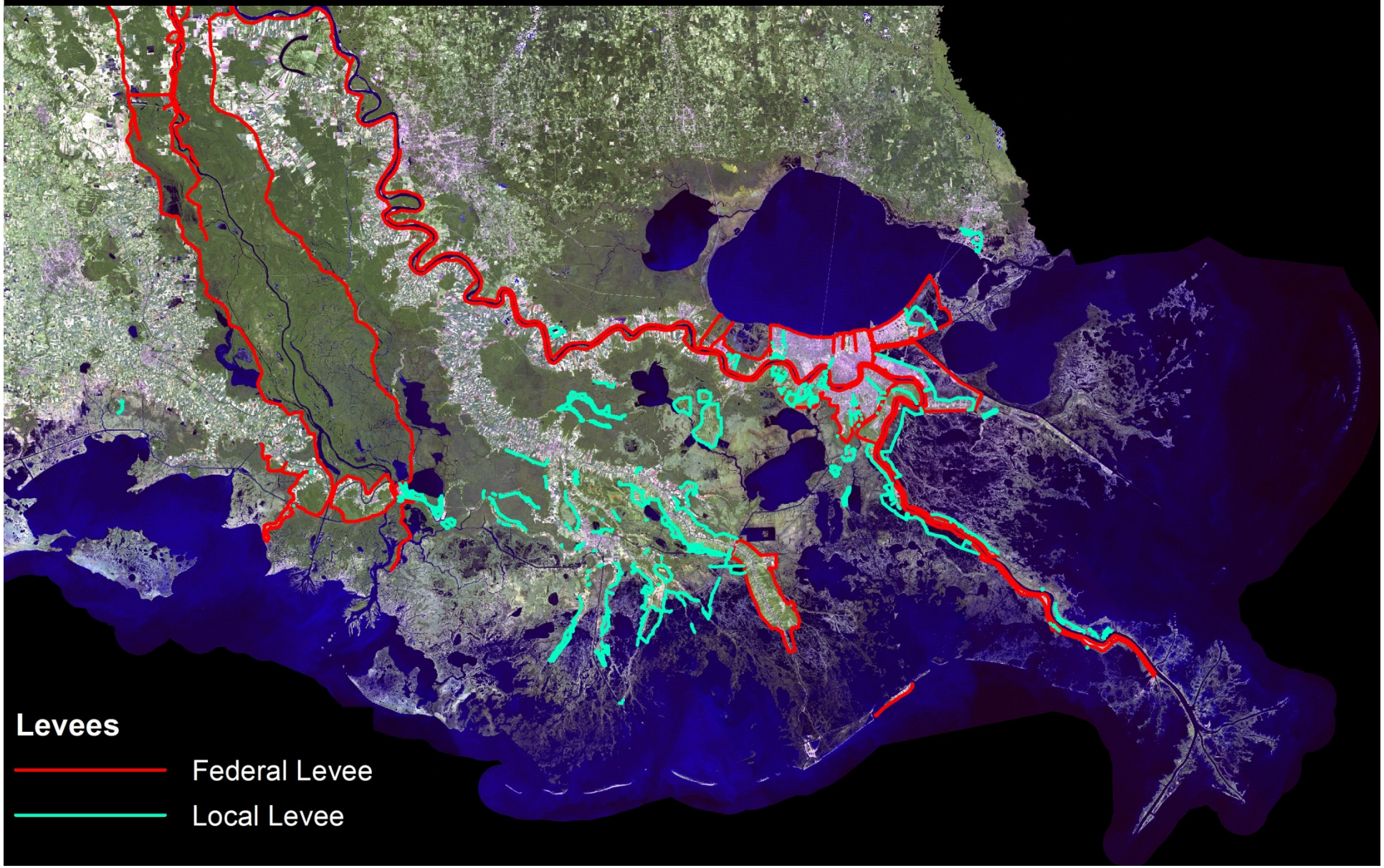
Elevation source for SLR modeling: NED from 3-m lidar data



***Dark blue*: Land ≤ 1 meter in elevation**

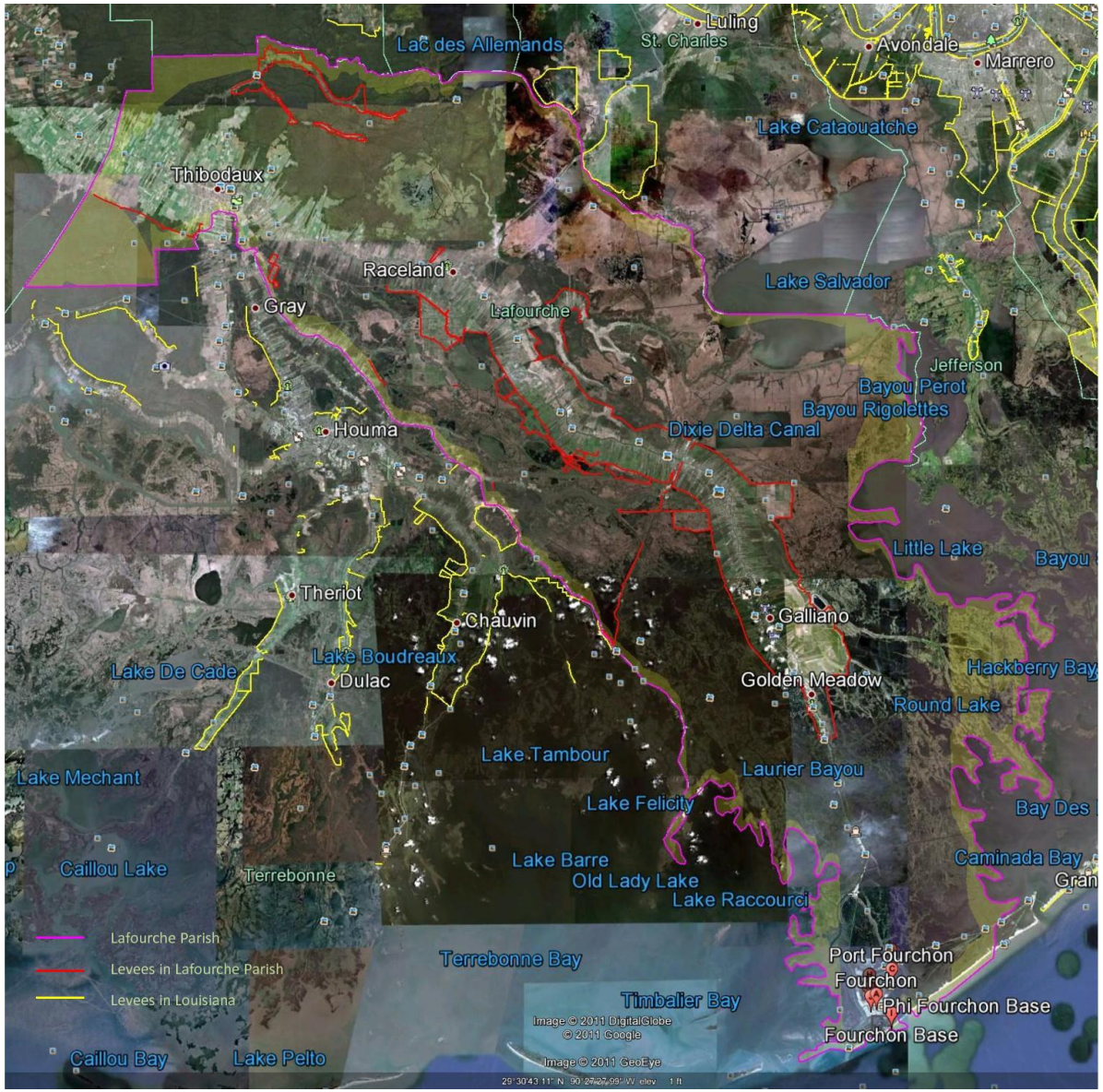
***Light blue*: Area of uncertainty associated with 1 meter elevation**

Lidar-Based Mapping and Monitoring of Levees Across the Mississippi River Delta Plain and Atchafalaya Basin

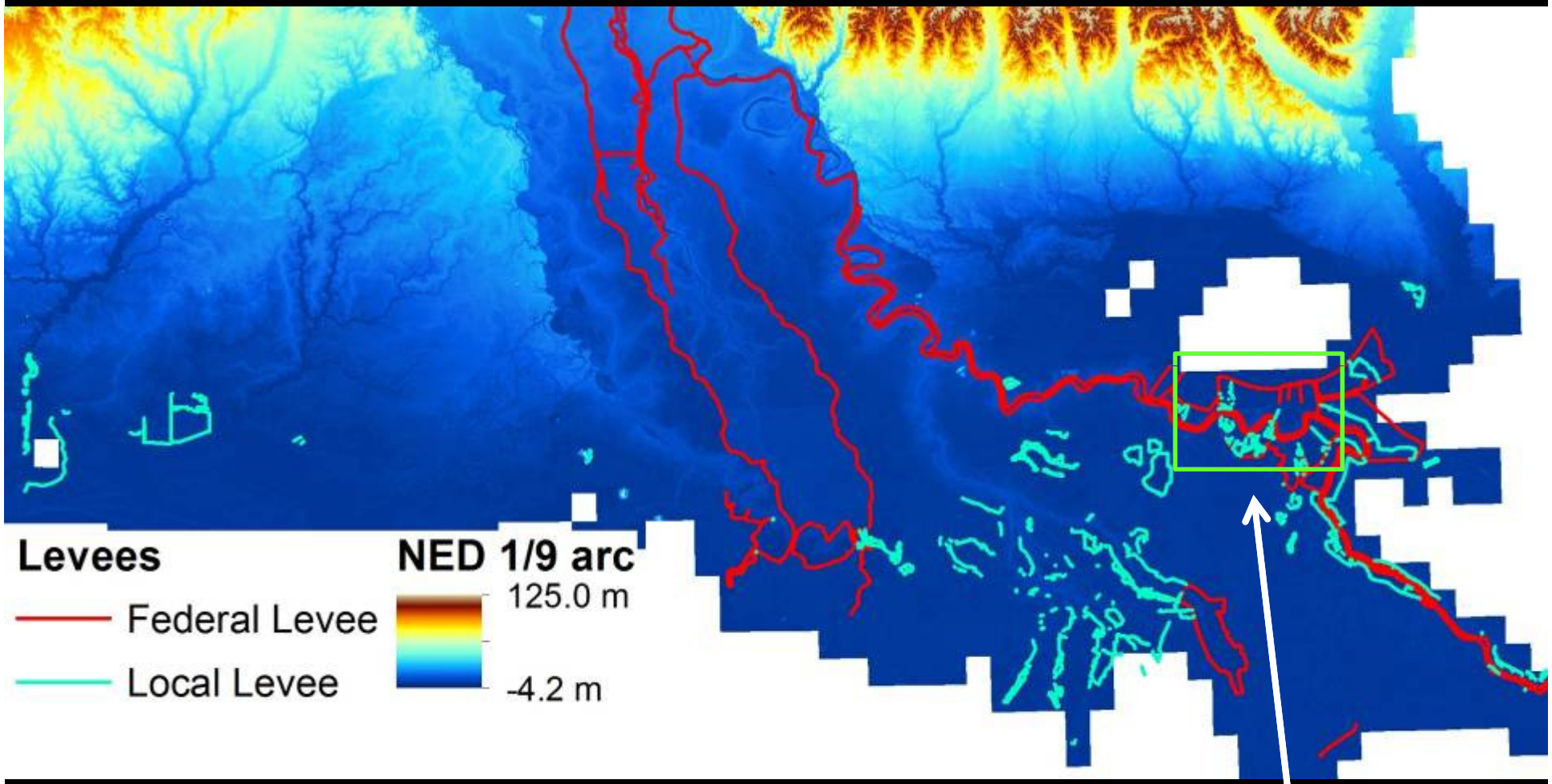


Lidar-Based Mapping and Monitoring of Levees Across the Mississippi River Delta Plain – Lafourche Parish

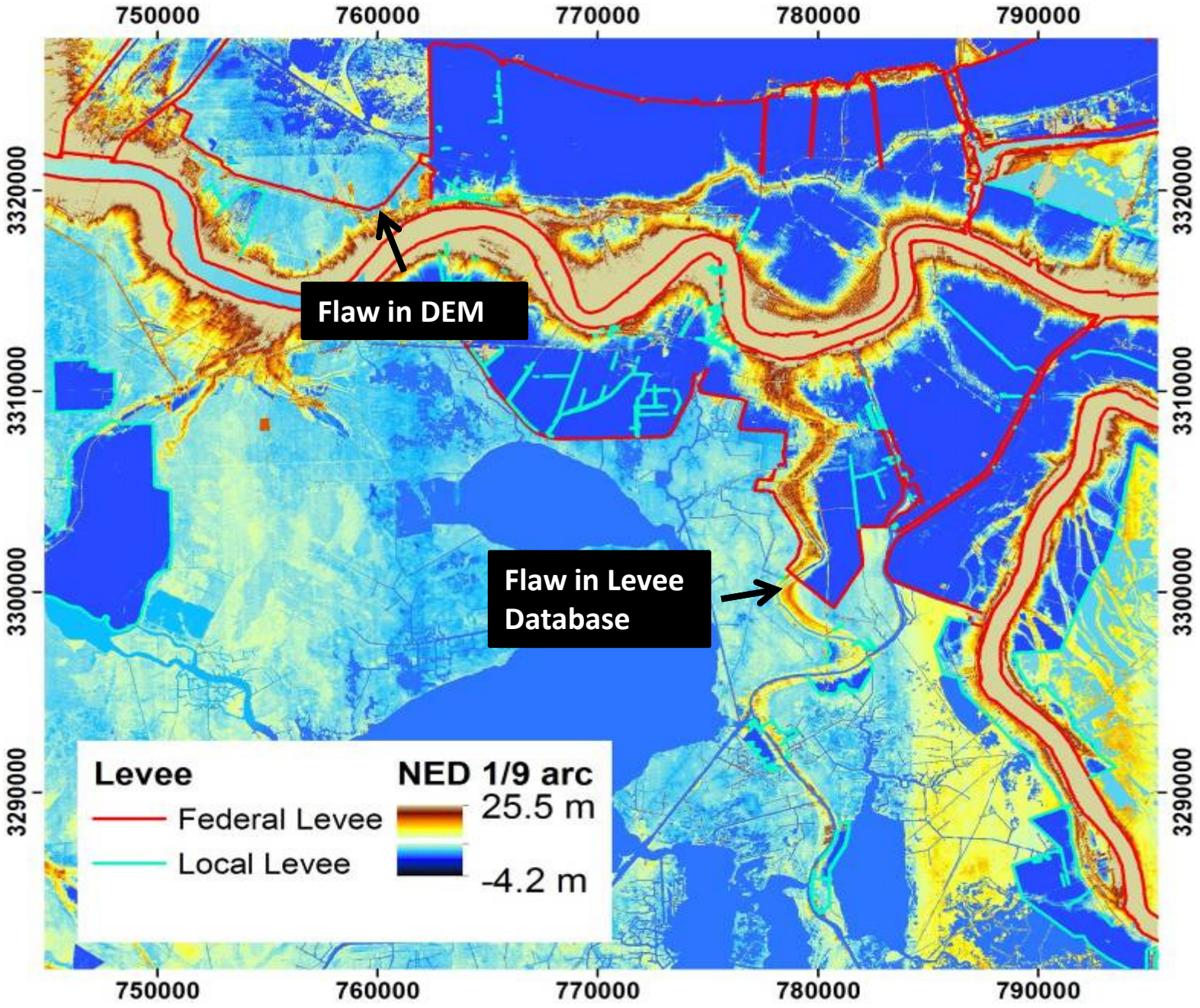
Lafourche Parish

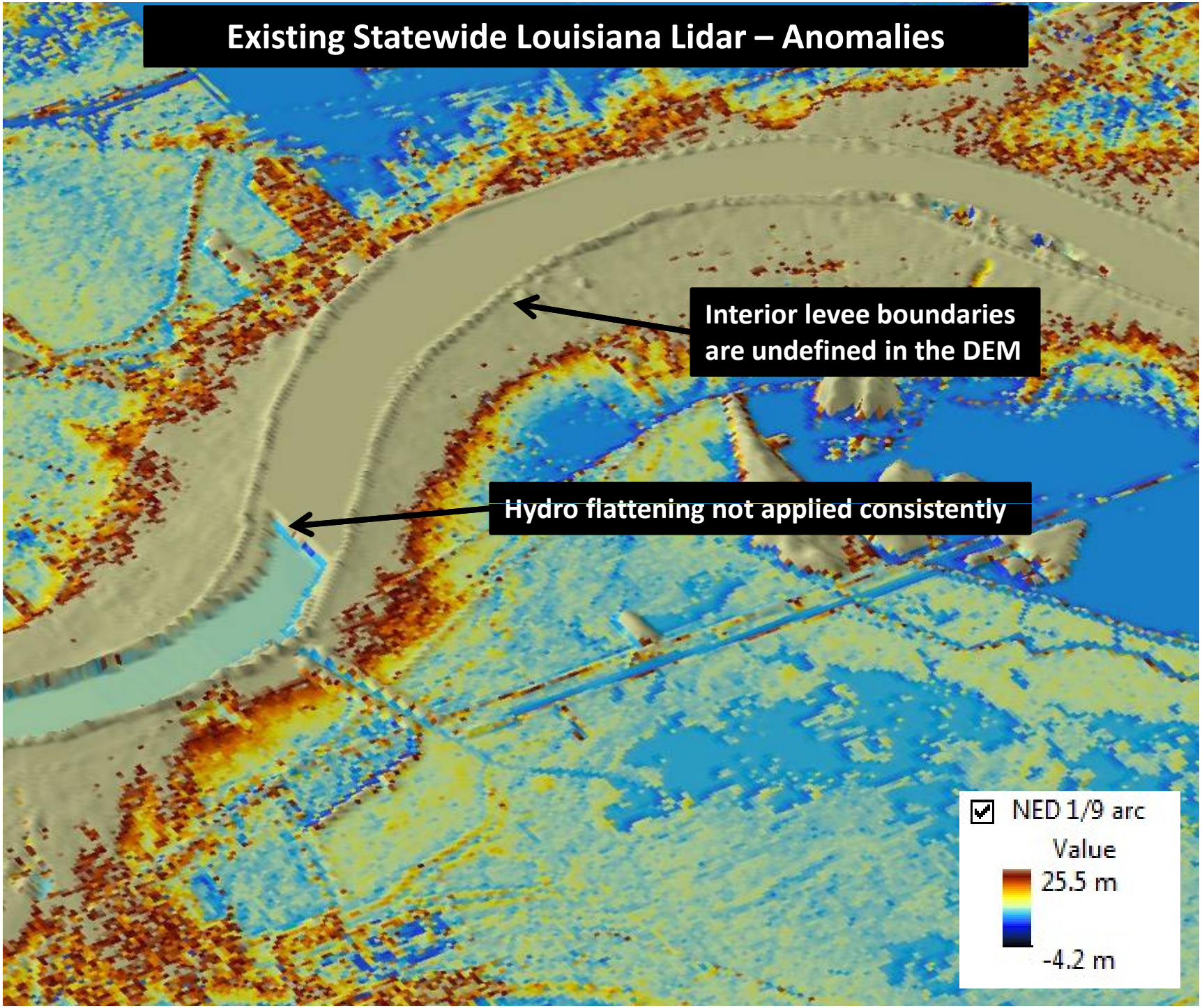


Can Louisiana Levees Be Mapped Using the Existing Louisiana Lidar Topography Dataset Acquired in 2002 - 2003?

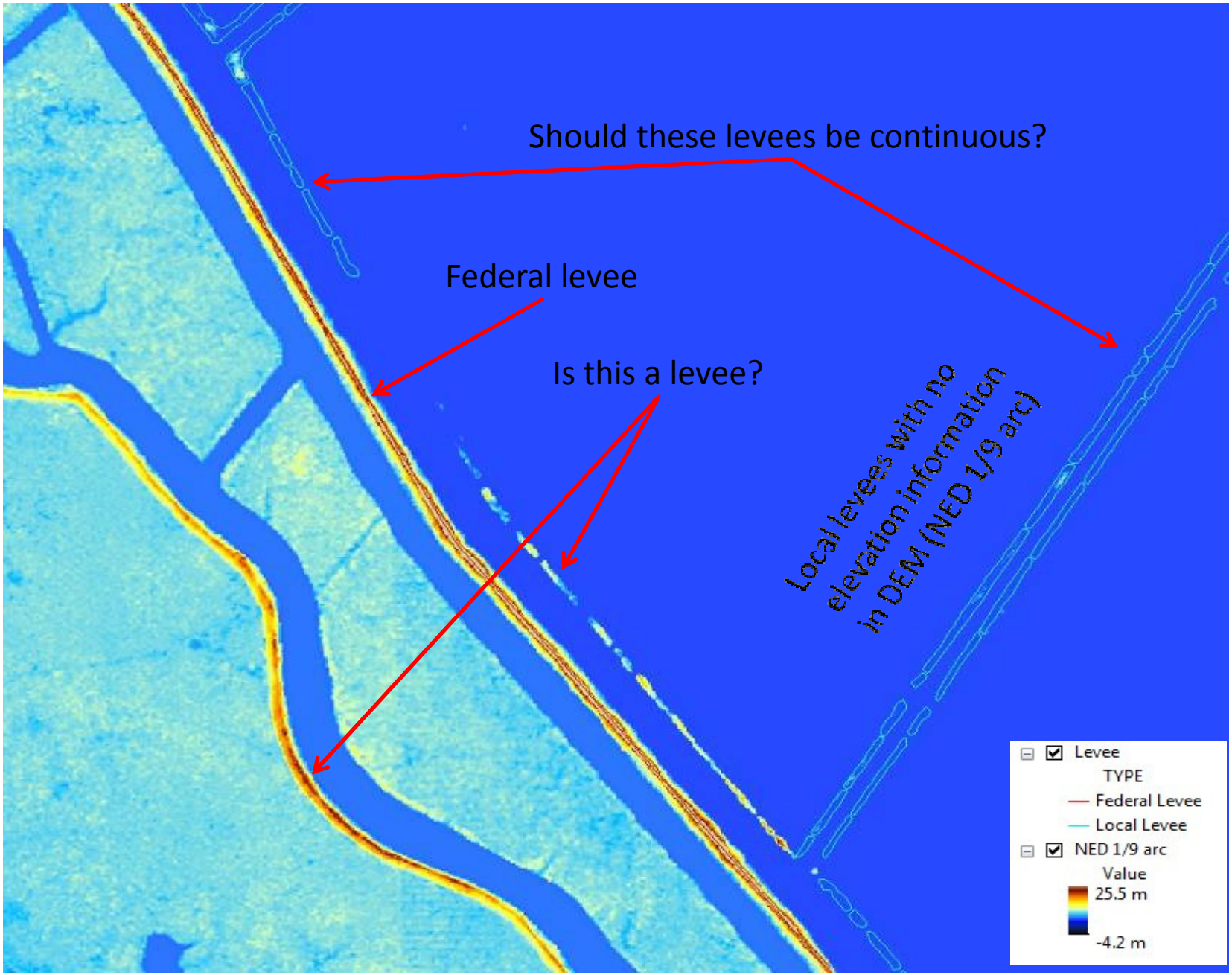


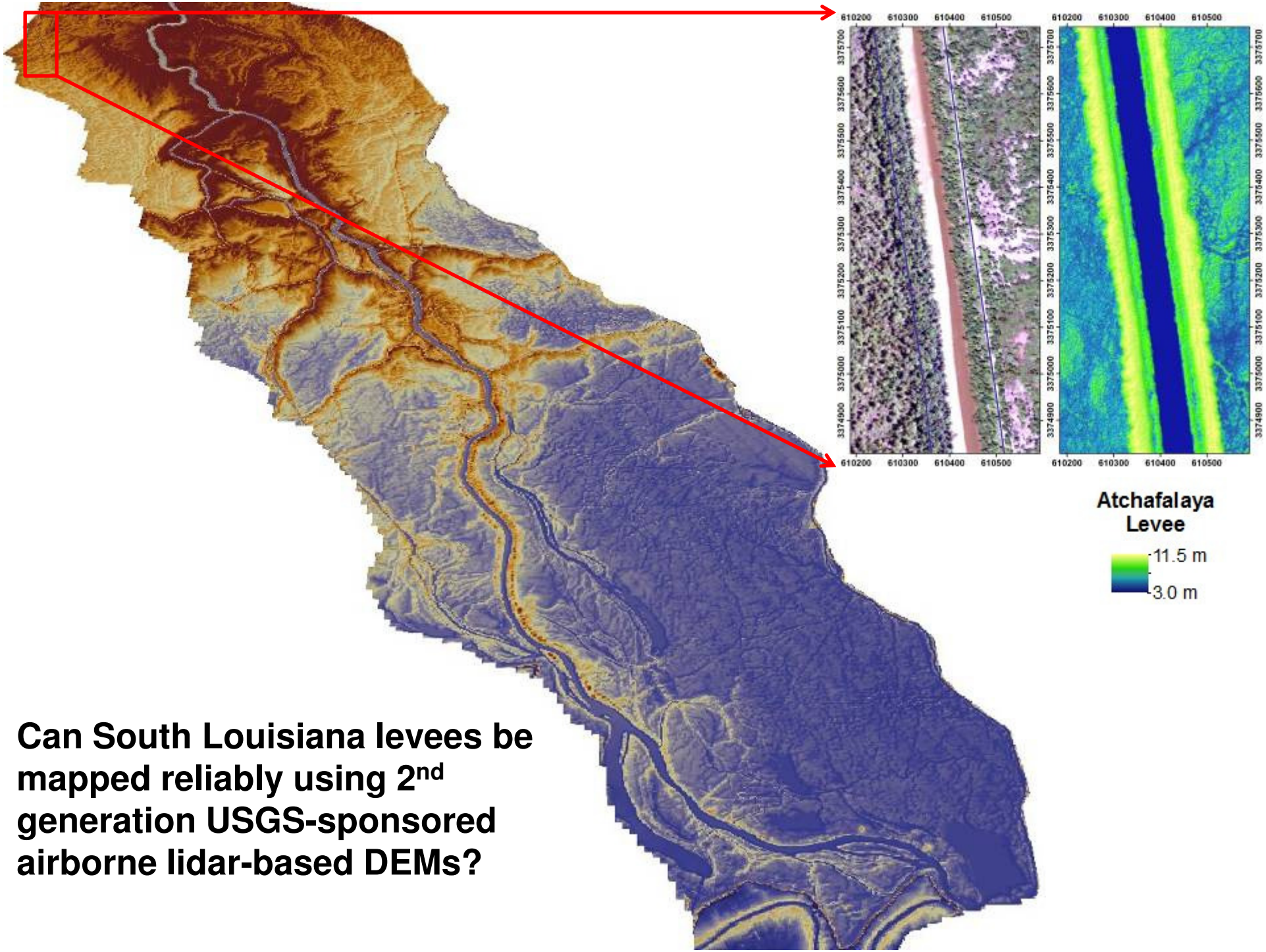
Existing Statewide Louisiana Lidar – Anomalies



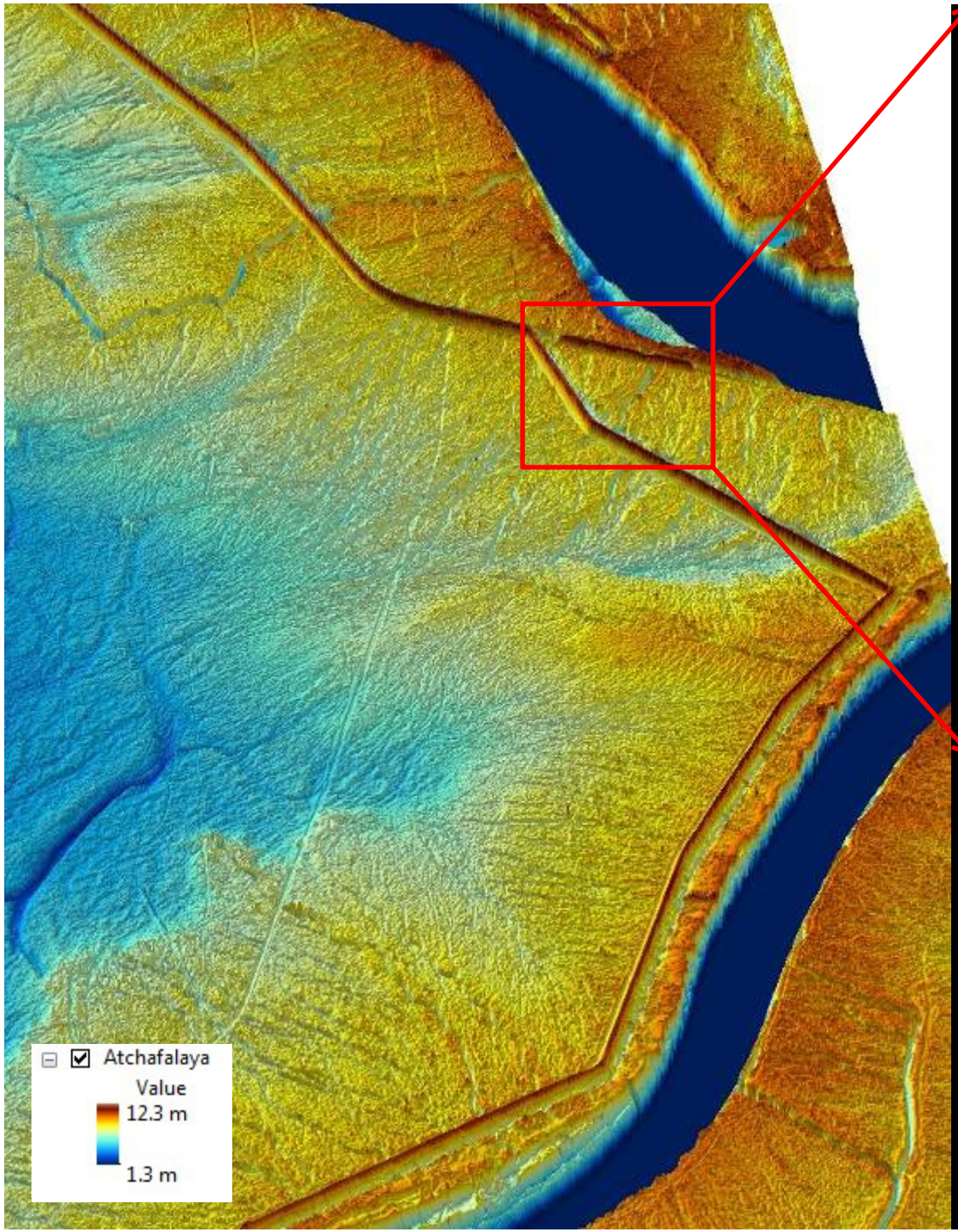

Existing Statewide Louisiana Lidar – Anomalies
Interior levee boundaries are undefined in the DEM
Hydro flattening not applied consistently
NED 1/9 arc
Value
25.5 m
-4.2 m

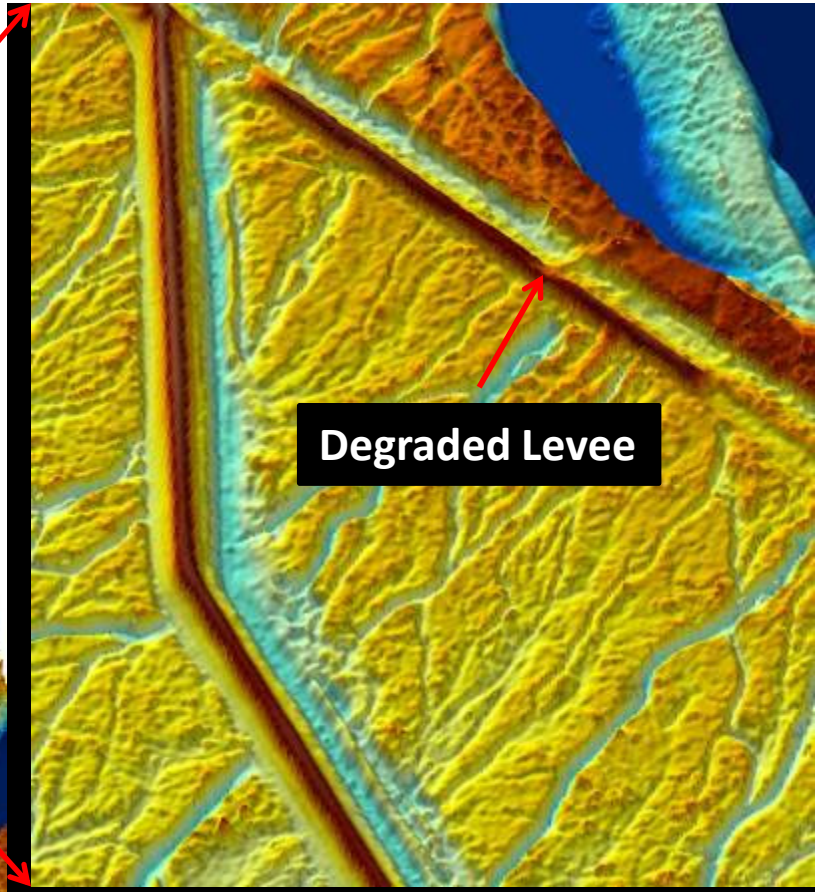
Existing Statewide Louisiana Lidar – Missing Levees





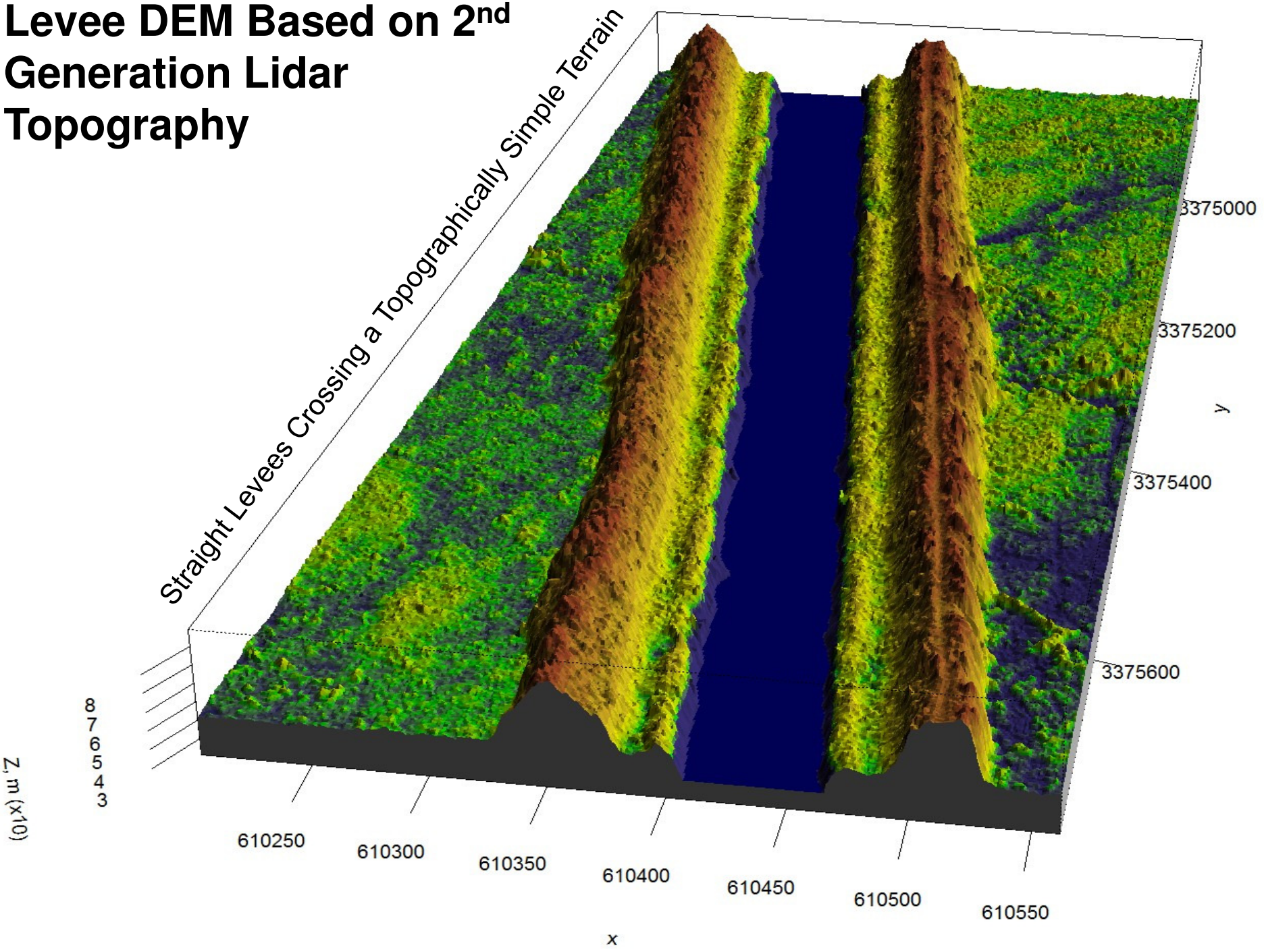
Can South Louisiana levees be mapped reliably using 2nd generation USGS-sponsored airborne lidar-based DEMs?



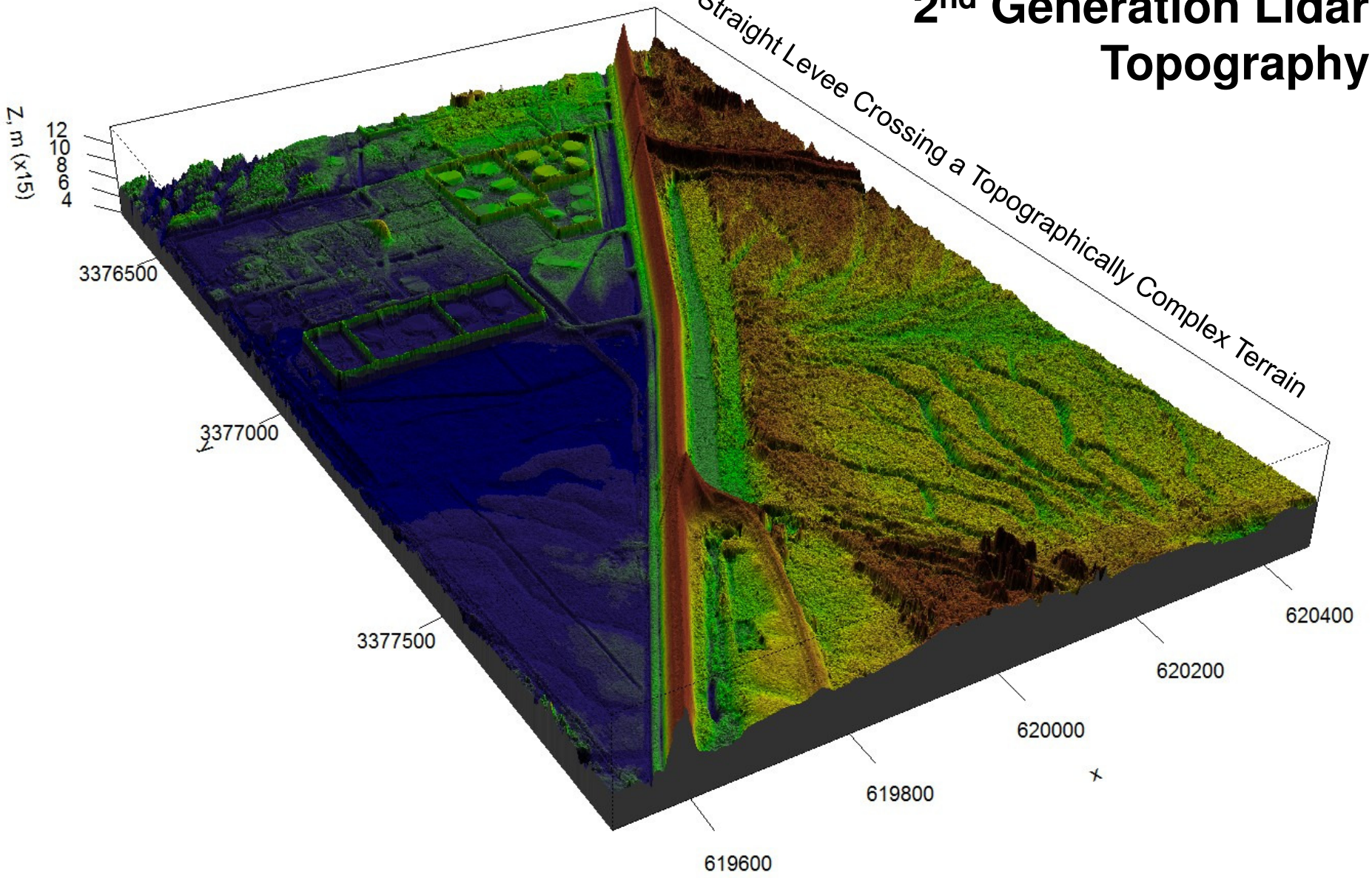


Levees were captured with high fidelity by the Winter 2010 – 2011 airborne lidar survey of the Atchafalaya Basin

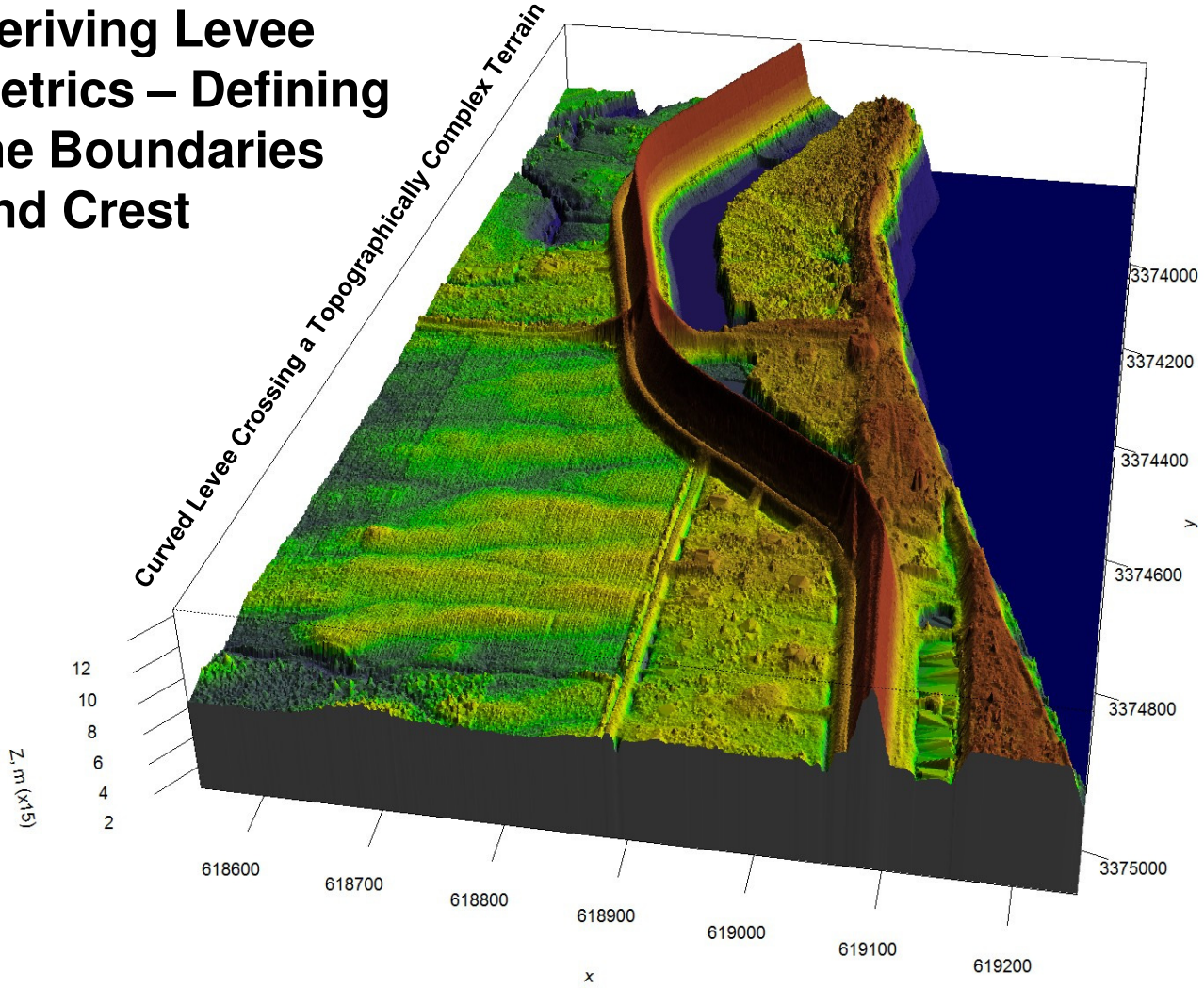
Levee DEM Based on 2nd Generation Lidar Topography

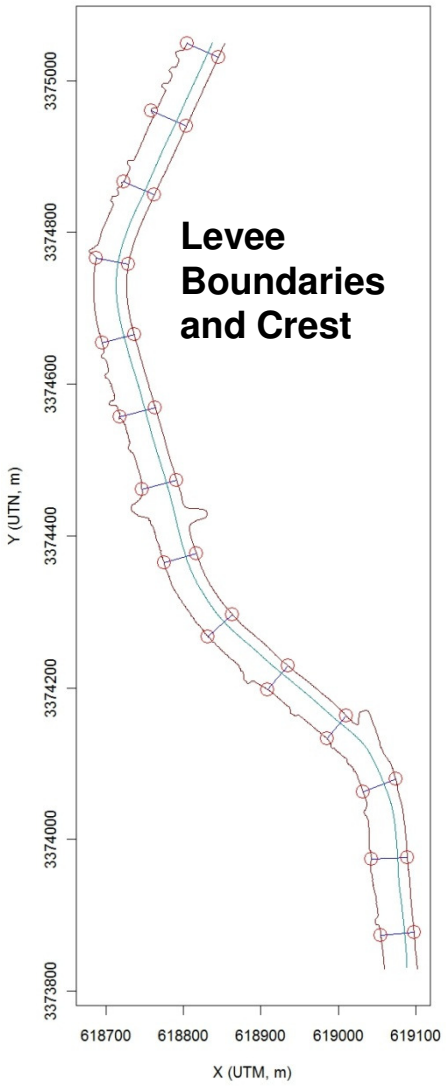


Levee DEM Based on 2nd Generation Lidar Topography

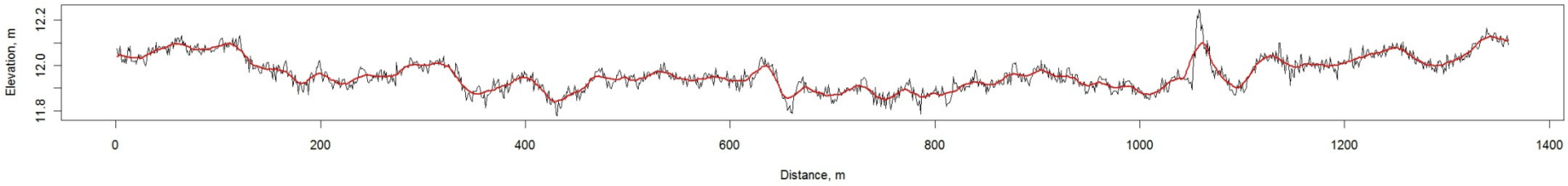


Deriving Levee Metrics – Defining the Boundaries and Crest

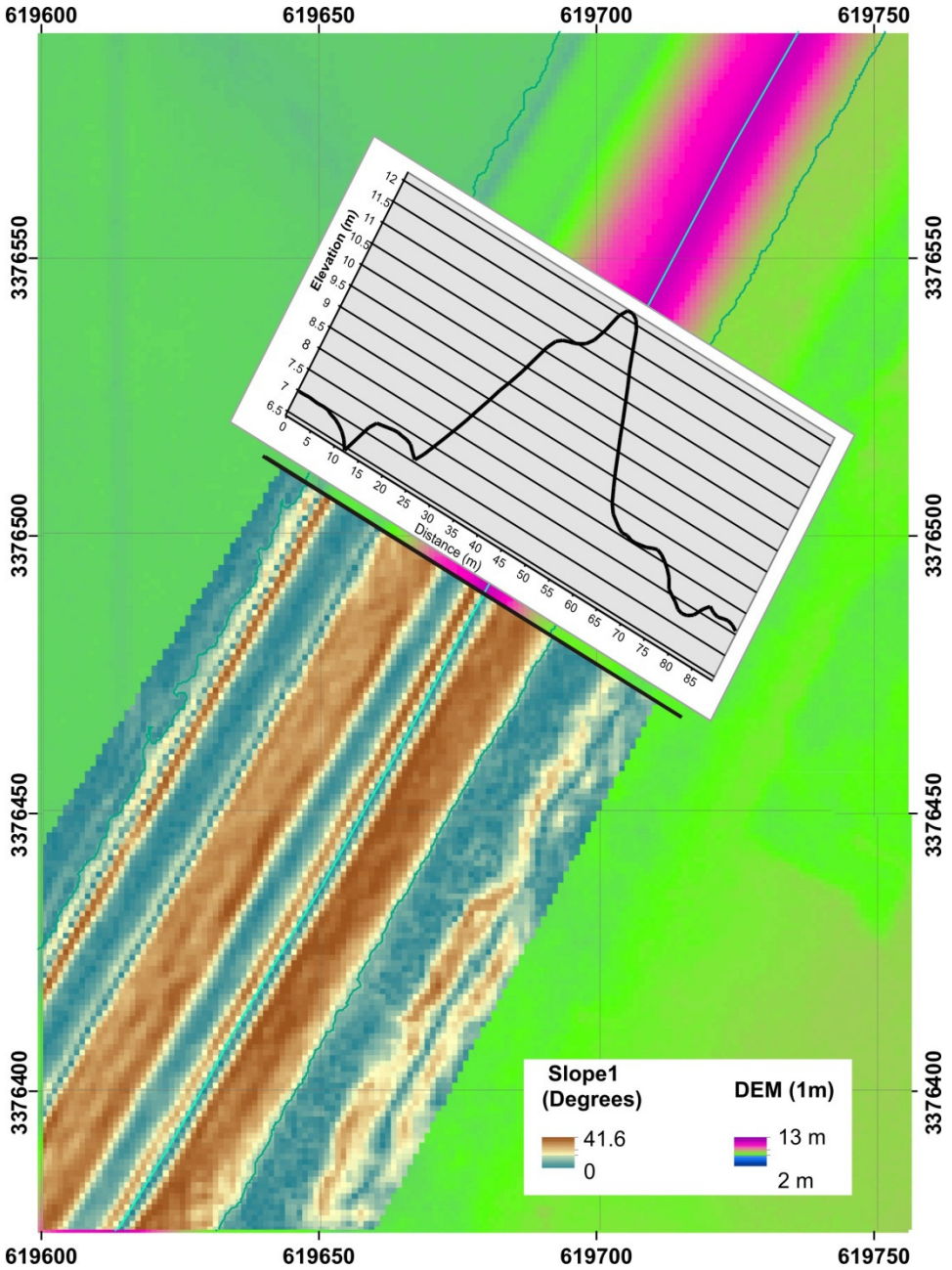


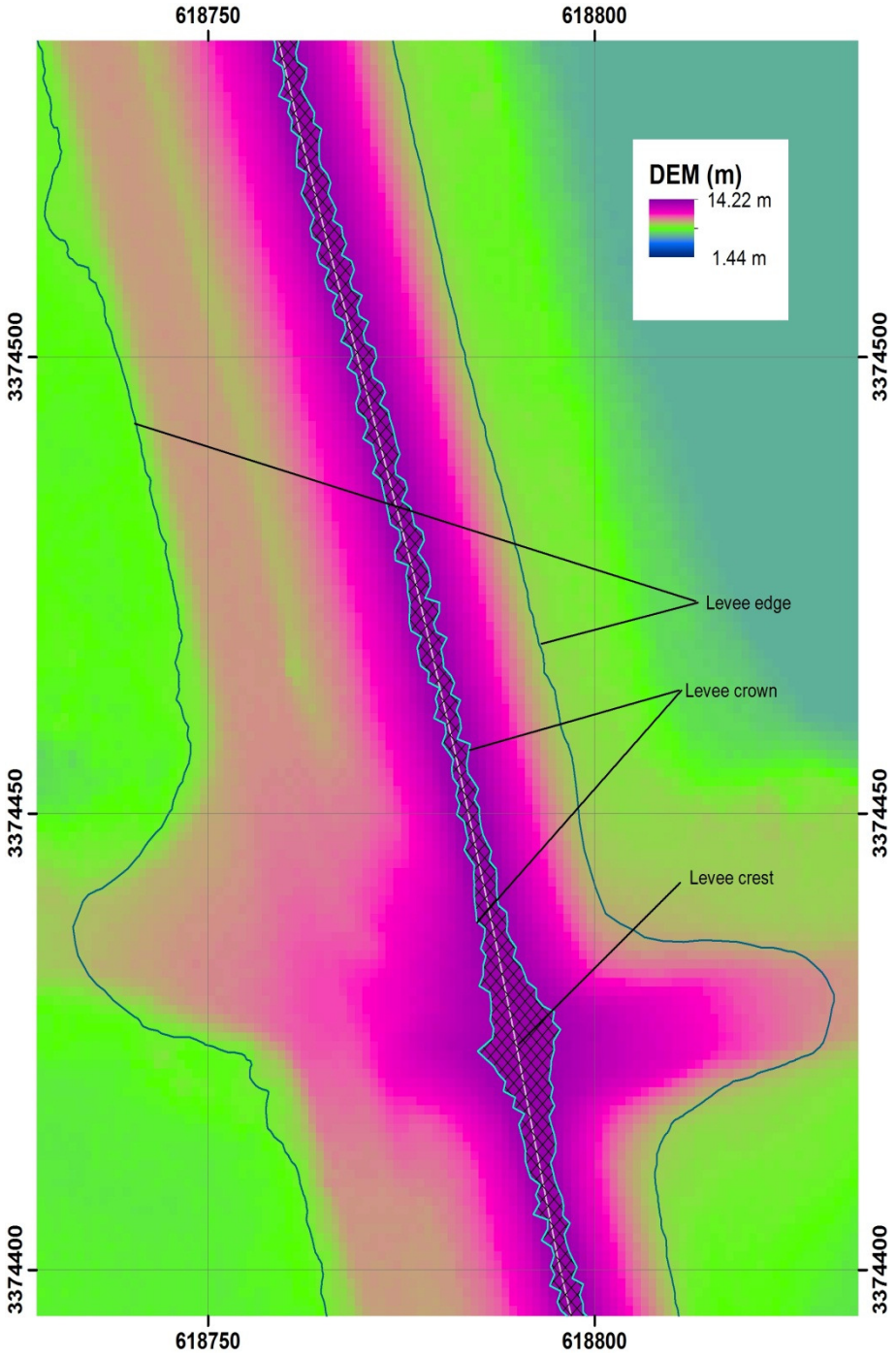


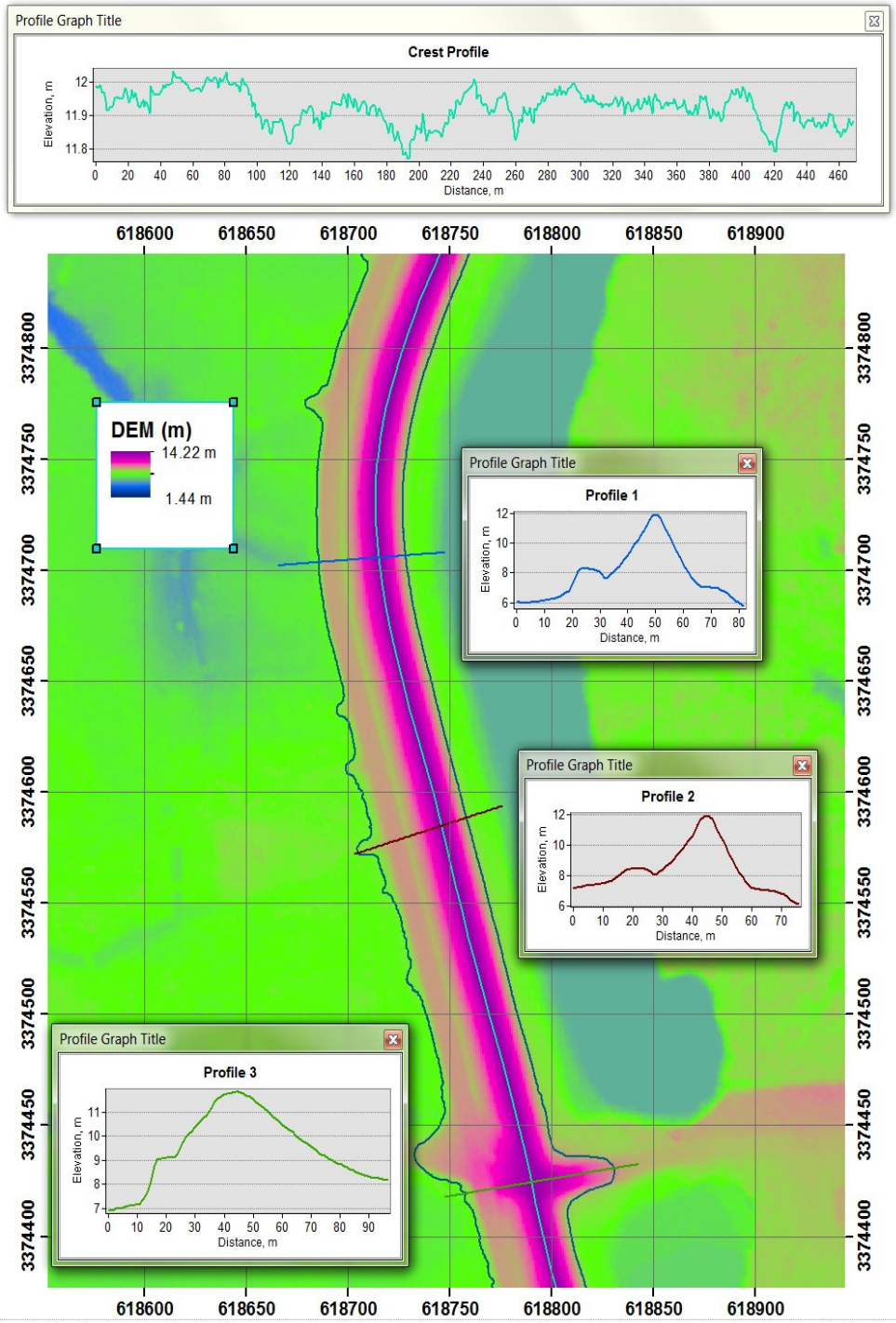
Levee Crest Profile



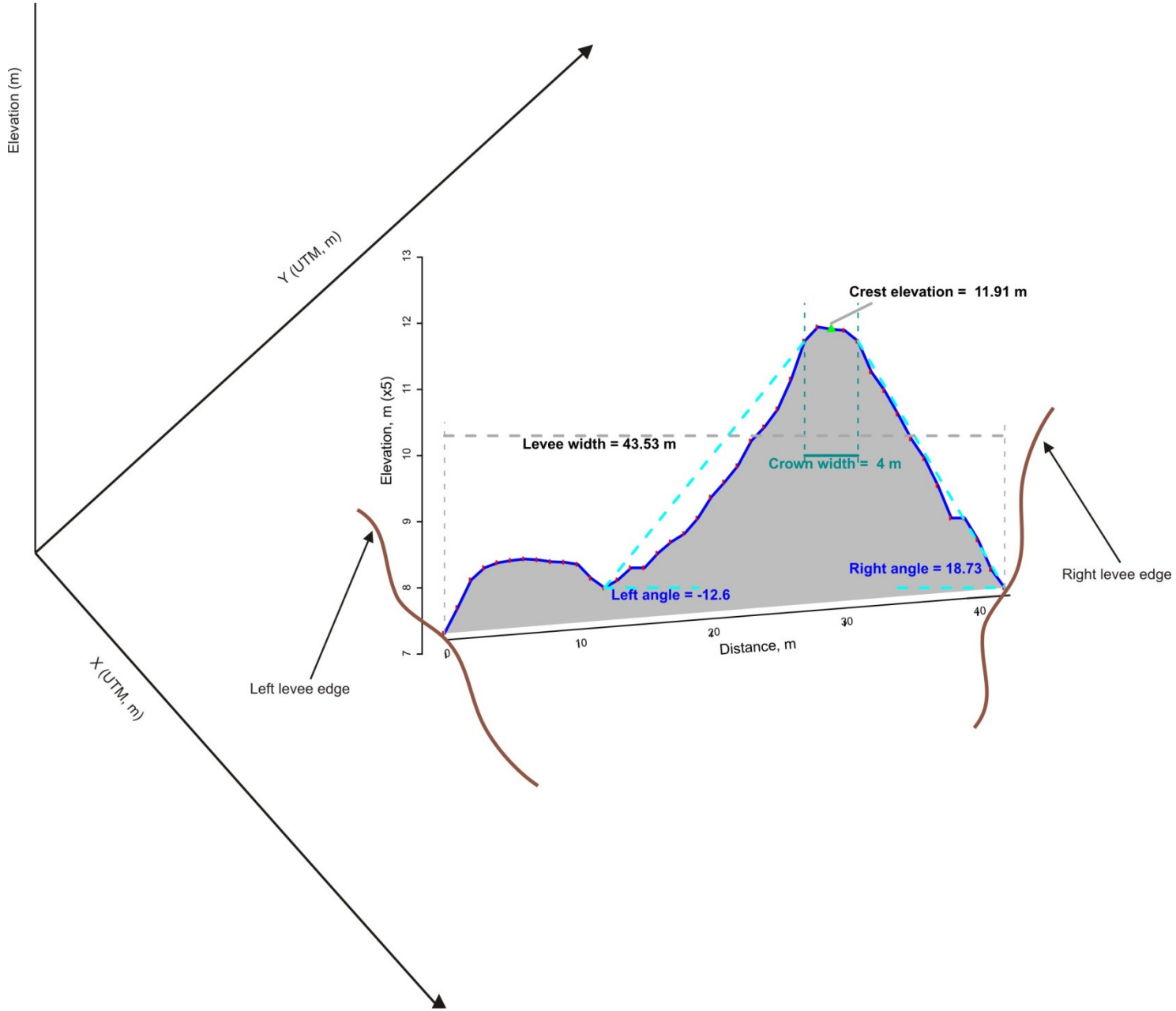
Deriving Levee Metrics – Slope Profiles



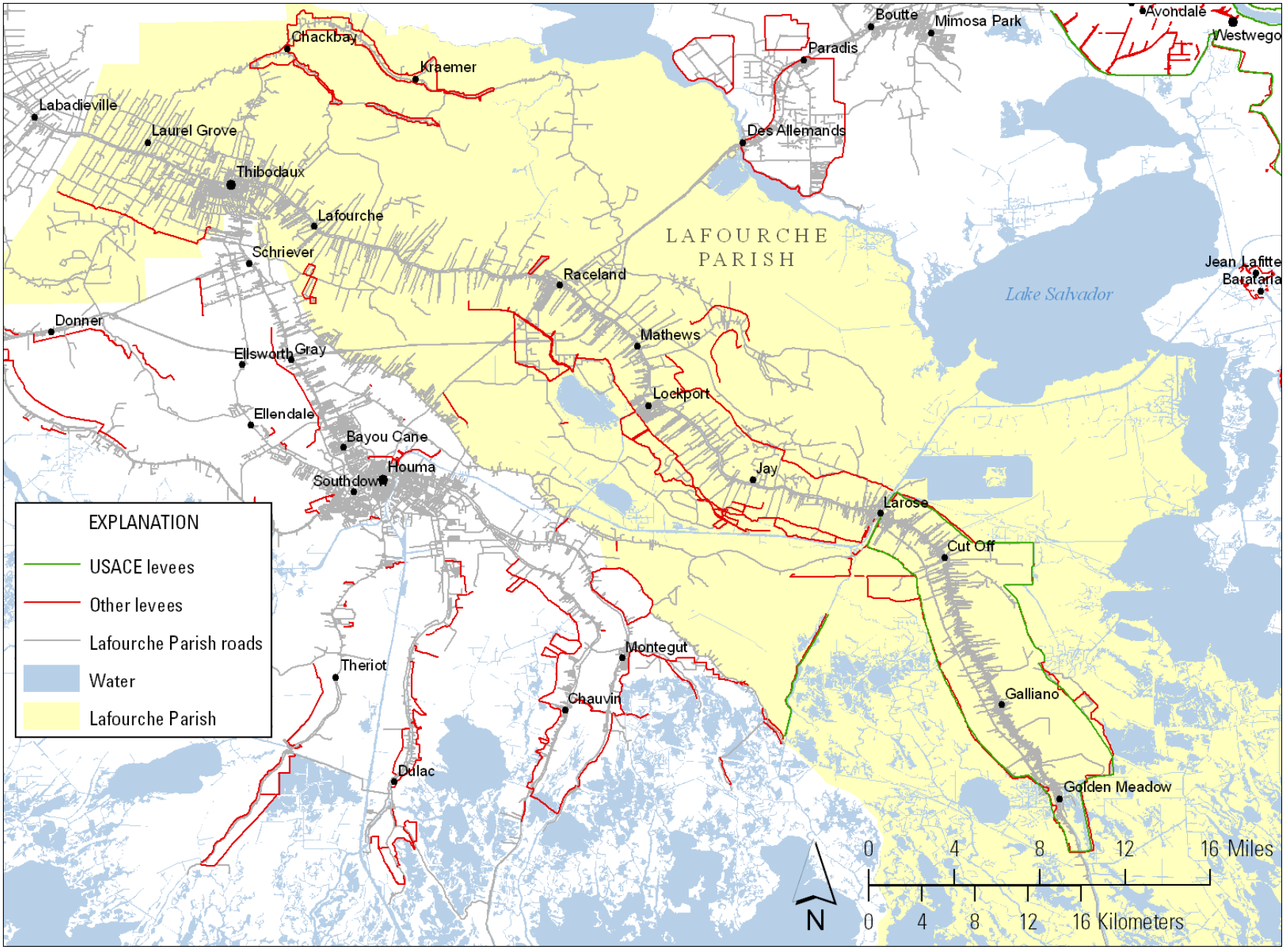

618750
618800
3374500
3374450
3374400
DEM (m)
14.22 m
1.44 m
Levee edge
Levee crown
Levee crest


Profile Graph Title
Crest Profile
Elevation, m
Distance, m
618600
618650
618700
618750
618800
618850
618900
3374800
3374750
3374700
3374650
3374600
3374550
3374500
3374450
3374400
DEM (m)
14.22 m
1.44 m
Profile Graph Title
Profile 1
Elevation, m
Distance, m
Profile Graph Title
Profile 2
Elevation, m
Distance, m
Profile Graph Title
Profile 3
Elevation, m
Distance, m

Deriving Levee Metrics Based on the Analysis of Orthogonal Profiles



Regional “Scaling Up”Levee Metrics Analysis Using a “Levee – Following” Airborne Lidar Survey in LaFourche Parish



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Summary

- A USGS – sponsored partnership to create a multi-year program of airborne lidar acquisitions to cover all of coastal Louisiana has been established
- The successful pre-Summer 2011 flood Winter 2010 – 2011 airborne lidar survey of the Atchafalaya Basin will be repeated with expanded coverage in Winter 2011 - 2012
- Pilot analysis of 2nd generation lidar surveys during Winter 2010 – 2011 has led to an initiative to map and monitor of levees across the Mississippi River Delta Plain and Atchafalaya Basin using targeted "levee – following" airborne lidar collections

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Acknowledgements

USGS Coastal and Marine Geology Program, Reston, VA

USGS National Geospatial Program, Reston, VA

USGS National Wetlands Research Center, Lafayette, LA

Louisiana Coastal Protection and Restoration Authority, Baton Rouge, LA

US Army Corps of Engineers, New Orleans District, New Orleans, LA