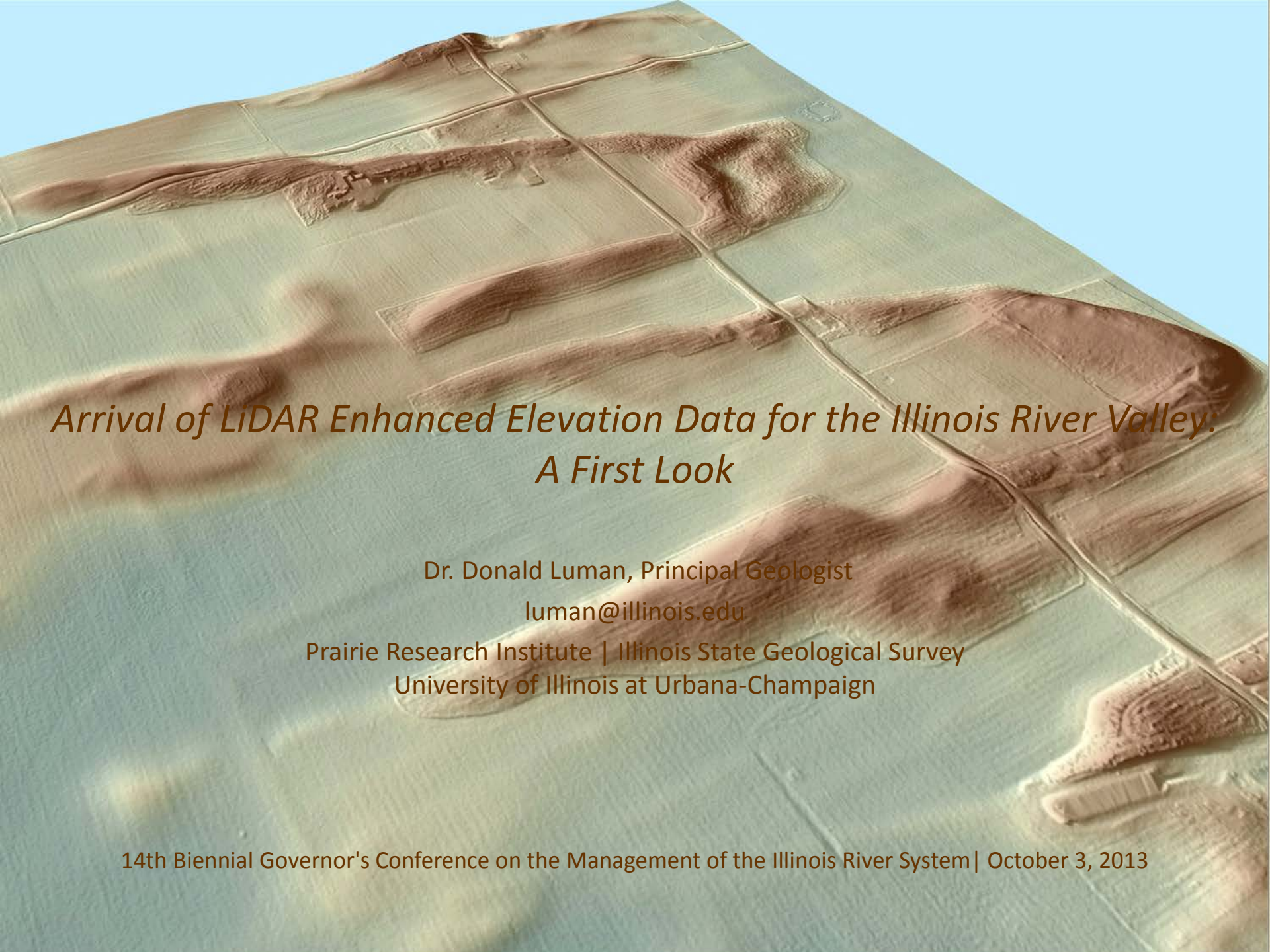


Arrival of LiDAR Enhanced Elevation Data for the Illinois River Valley: A First Look

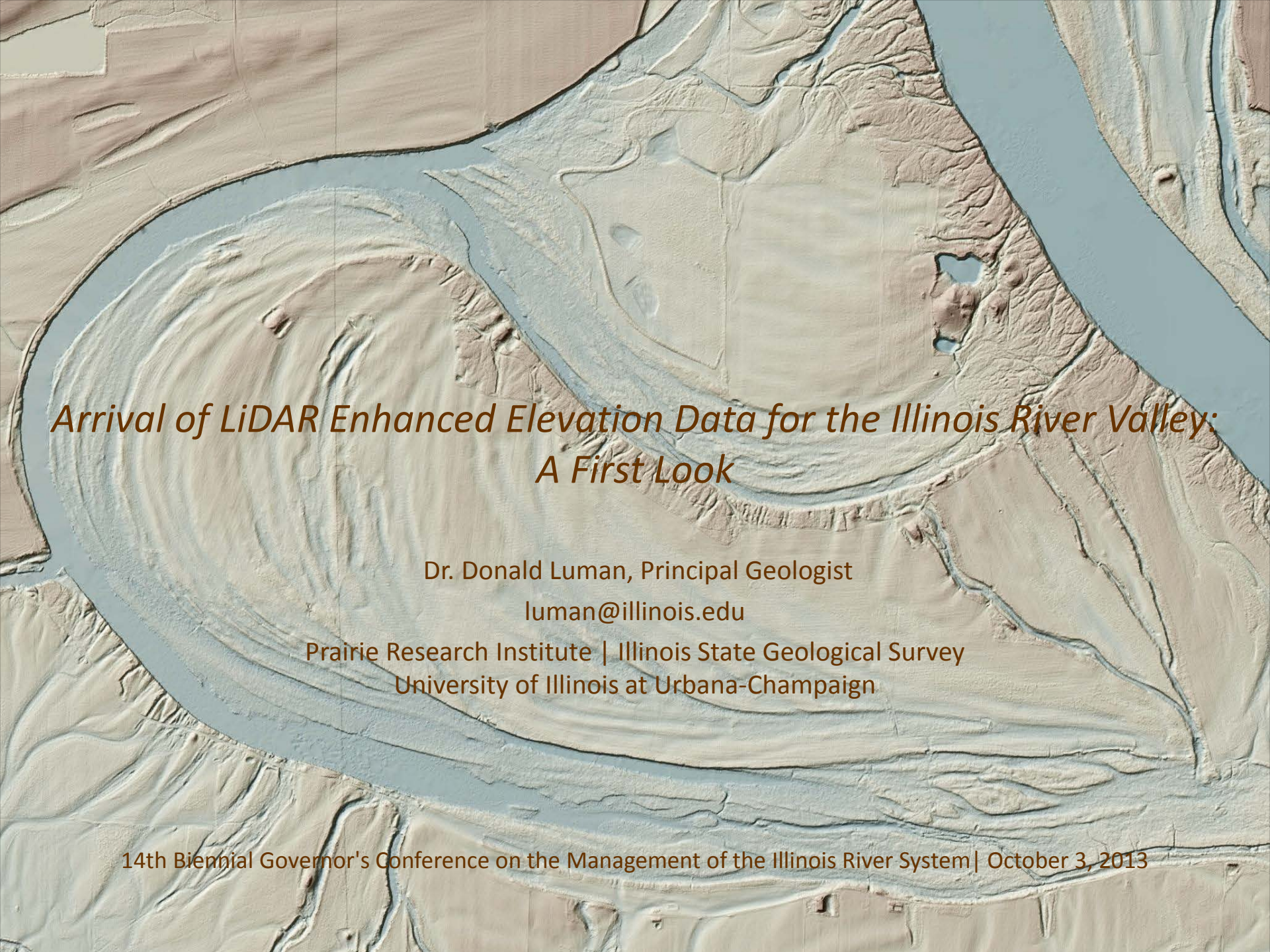
Dr. Donald Luman, Principal Geologist

luman@illinois.edu

Prairie Research Institute | Illinois State Geological Survey

University of Illinois at Urbana-Champaign

14th Biennial Governor's Conference on the Management of the Illinois River System| October 3, 2013



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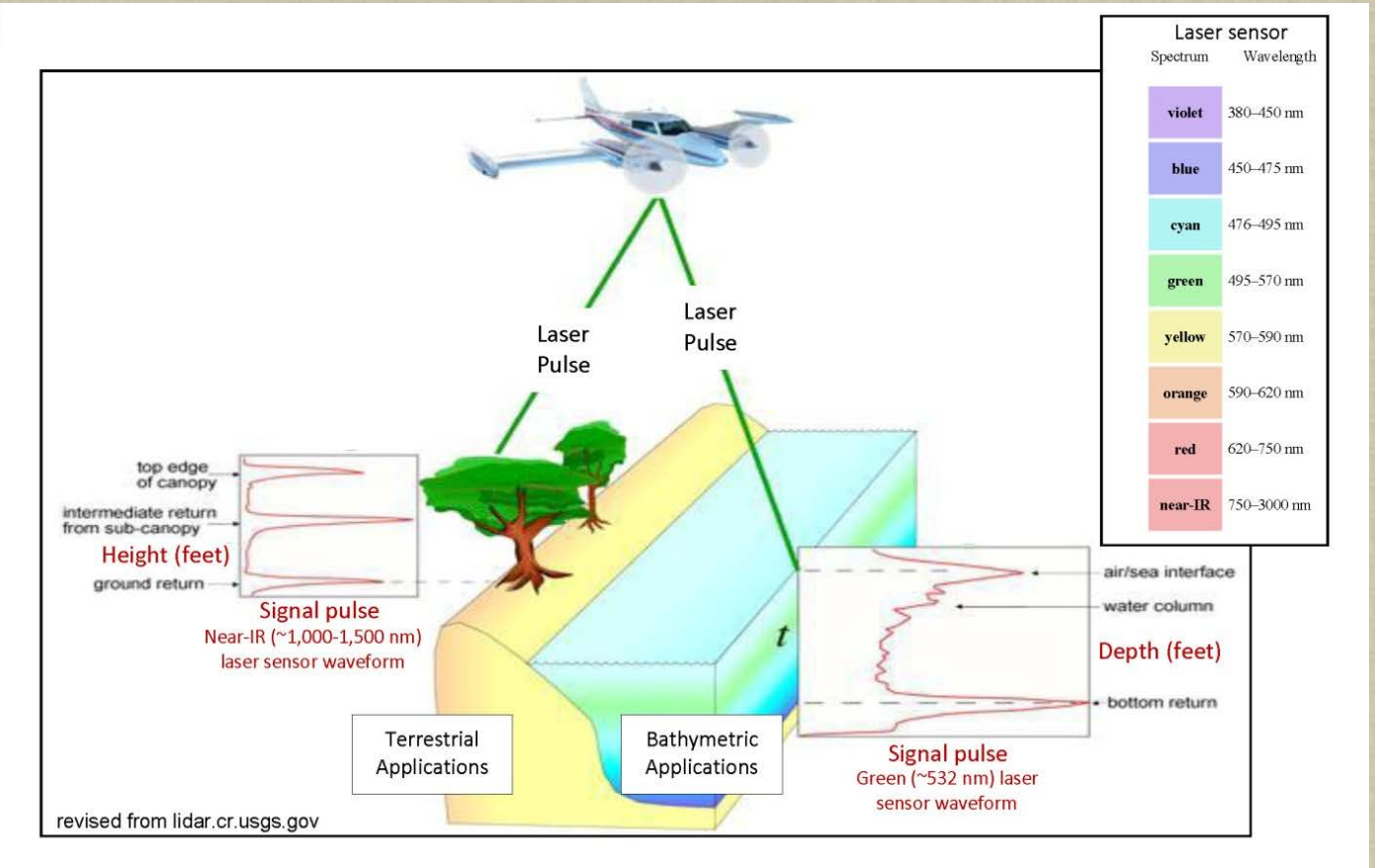
LiDAR Fundamentals

LiDAR, Light Detection And Ranging, is a remote sensing technique that uses a pulsating laser sensor to scan the surface. The reflected light pulses are detected by instruments that record the location of each return pulse in three dimensions. After processing, LiDAR point cloud data provide a detailed 3-D elevation model of the landscape.



LiDAR Collection Platforms

Fixed Wing

Rotary

Terrestrial

Mobile

http://www.youtube.com/watch?feature=player_embedded&v=Z_24s5pzBQA

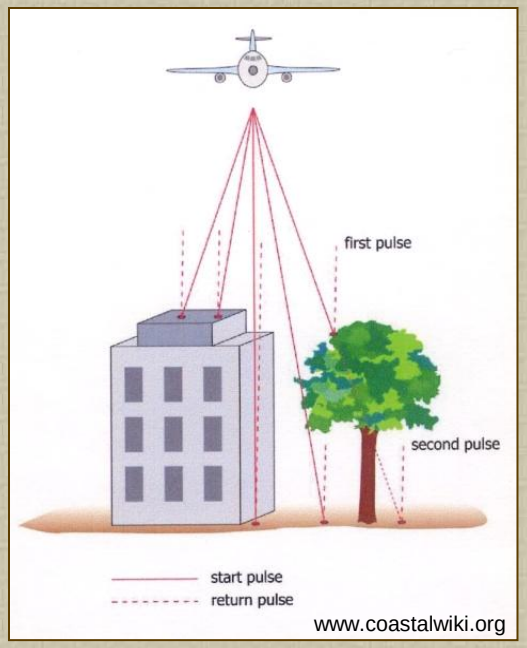
rms

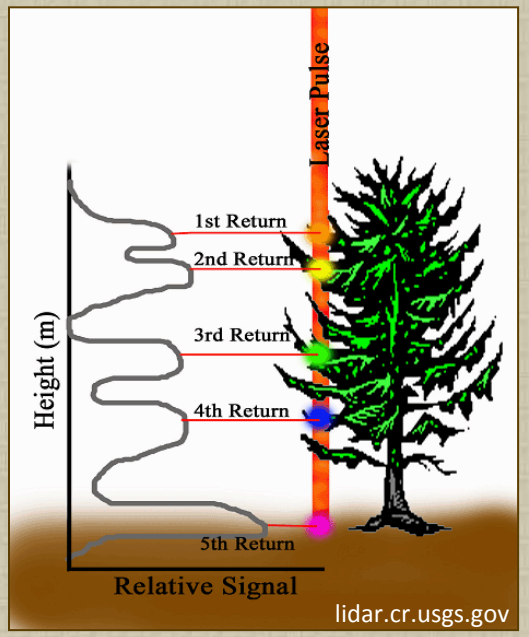
Rotary

Terrestrial

http://www.youtube.com/watch?feature=player_embedded&v=Z_24s5pzBQA

LiDAR Fundamentals





- The “first return” recorded by an airborne LiDAR sensor is the first object contacted by a laser pulse, which may be a building rooftop, a tree, or the ground surface.
- When a laser pulse encounters a soft target such as a tree, a portion of the laser beam continues downward and reflects from the underlying branches and trunk providing a “second return” back to the laser sensor.
- If conditions are ideal, the last returns represent the ground surface. To maximize the probability of acquiring sufficient ground returns in vegetated terrain, LiDAR is collected in the Midwest during the leaf-off portion of the year when deciduous tree canopies are barren, crops are absent, and other vegetation types are dormant. However, wherever filtered daylight can pass through vegetated canopy, a portion of the laser pulses will likely reach the surface and produce ground returns (see photos below).

LiDAR Fundamentals

- When the individual returns are viewed as a 3-D model, the result is an all returns LiDAR point cloud.
- The individual returns of a LiDAR point cloud appear to float at various levels, from the highest elevations (shown here in red) successively down to the lowest elevations, which are typically ground returns (shown here in blue).
- The point cloud data are interpreted by an analyst using specialized algorithms and classified into standardized categories according to the ASPRS LAS Data Exchange Format Standard established in 2003, *e.g.* Class 2=Ground.
- "A majority of LiDAR point cloud data describe vegetation and structures, not the ground surface ."The Oregon Geological Surveys' analysis of ~20 billion pulses show that only 14% of the pulses produced returns from the ground surface.

LiDAR Fundamentals

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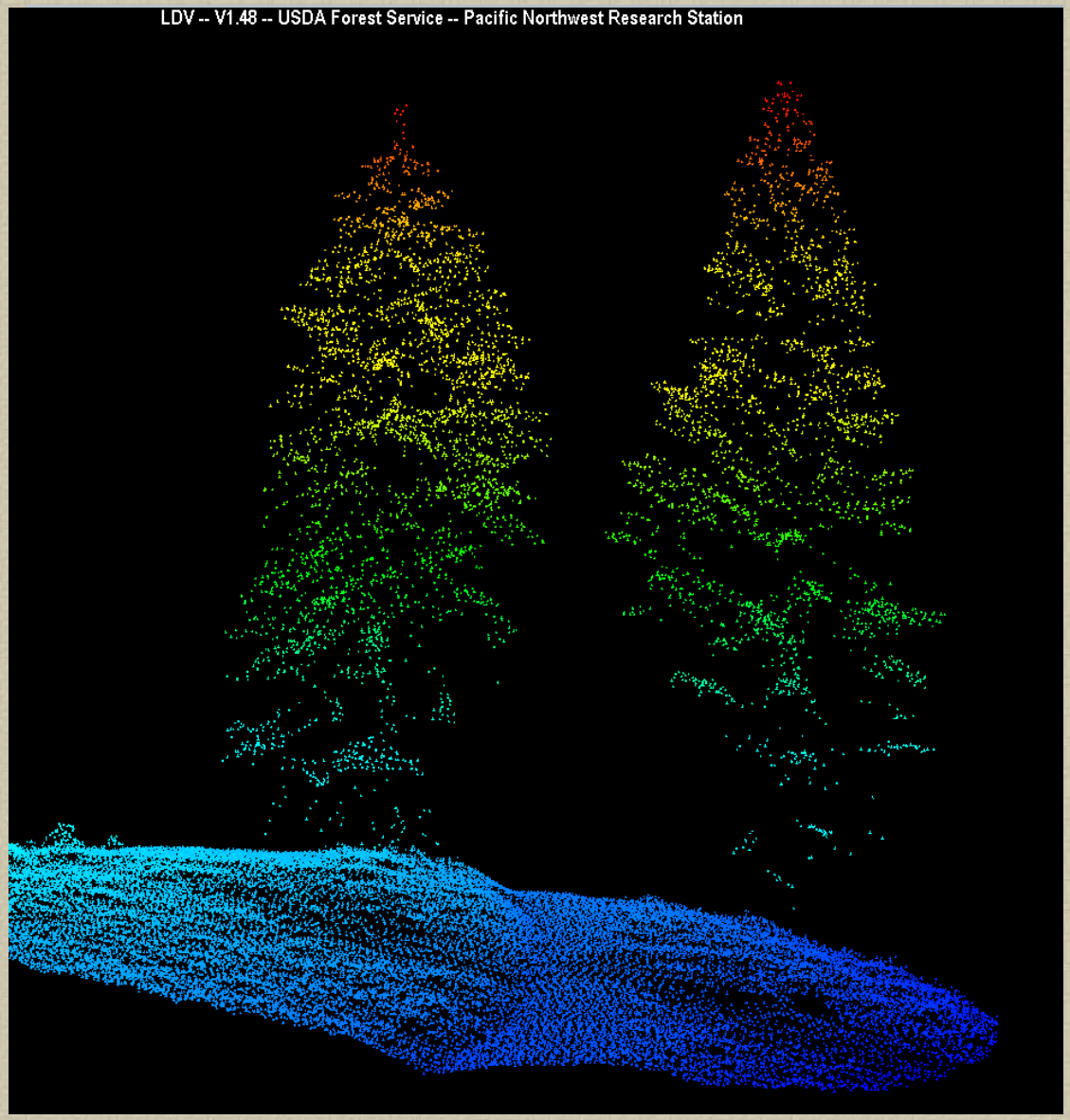


Project Deliverables

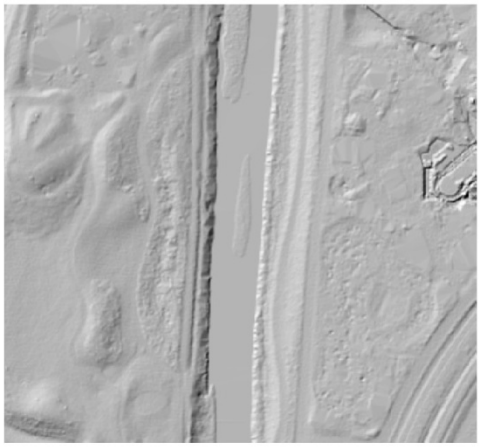
- Raw, boresighted LiDAR (organized by flight line)
- Classified, georeferenced, tiled LiDAR (LAS) data
- Digital Elevation Model - DEM
- Linear / polygonal breaklines (hydro-enforcement)
- Digital Terrain Model – DTM
- Elevation contours (topography)
- Tile Scheme
- Control Report
- Project Metadata (FGDC-compliant)
- Project Summary Report

- The LAS file format is an open, public file format for the interchange of 3D point cloud data between users (as defined by ASPRS)
- Developed by ASPRS in conjunction with LiDAR vendors and industry members of the ASPRS Standards Committee

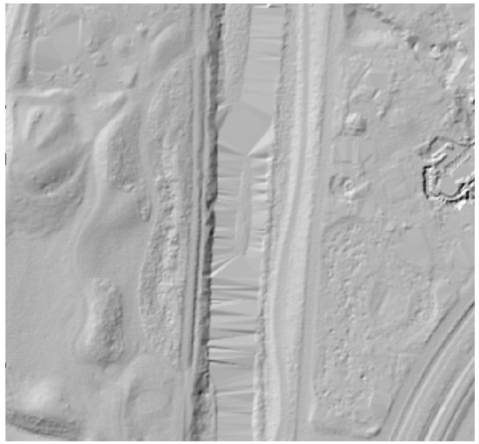
Derivative Surface Models

DSM

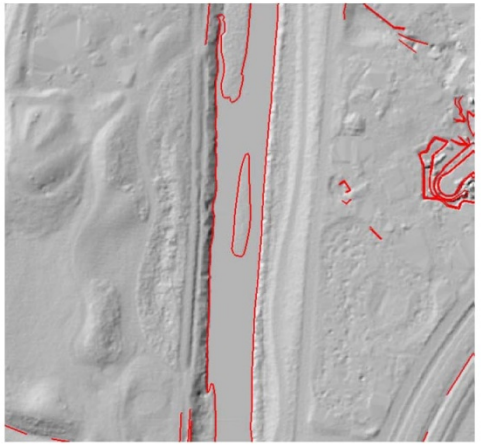
DTM



DEM

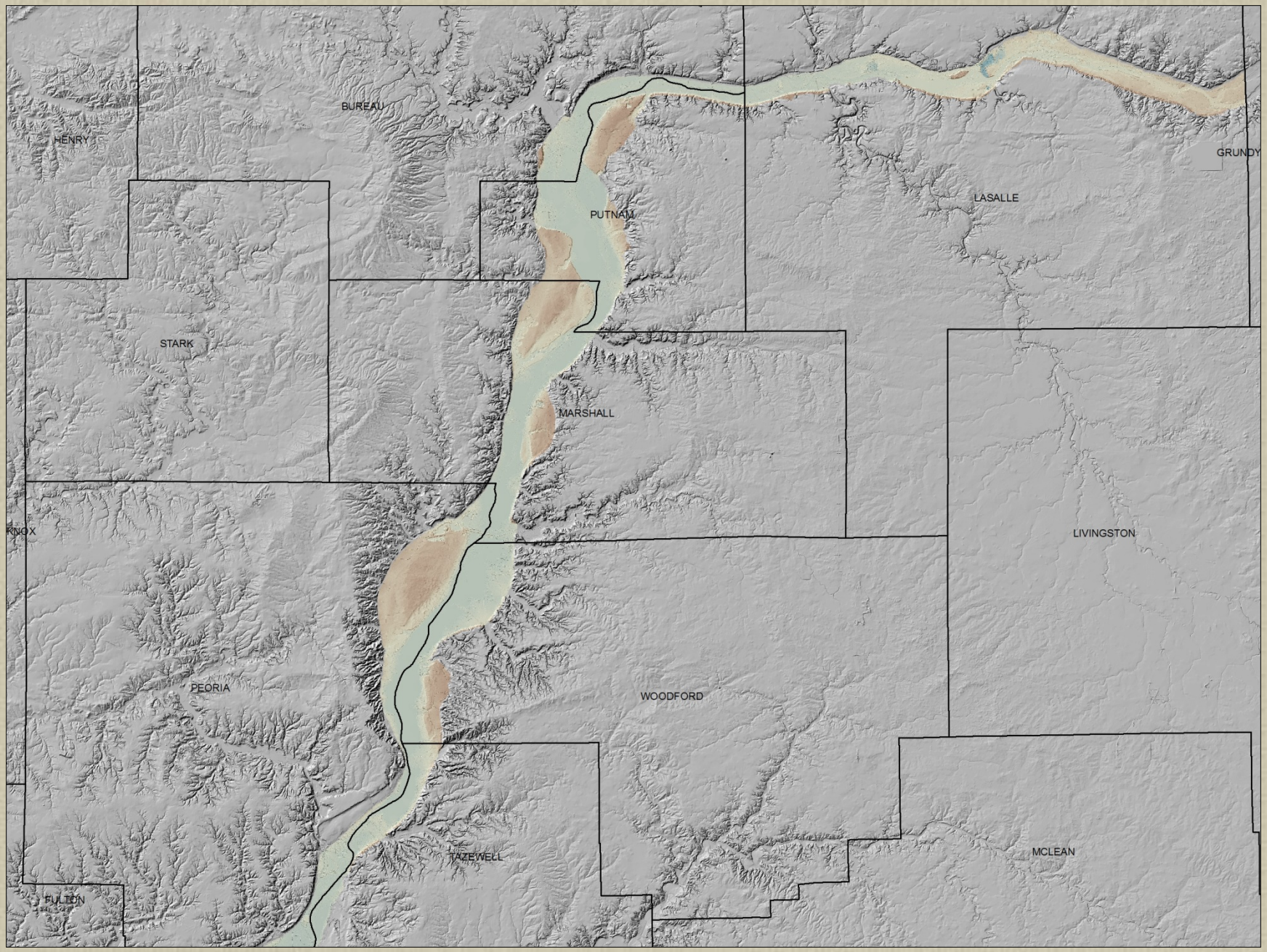


DTM, showing breaklines



ASPRS LiDAR Data Classifications*

Classification Code	Class
0	Created, never classified
1	Unclassified
2	Ground
3	Low Vegetation
4	Medium Vegetation
5	High Vegetation
6	Building
7	Low Point (Noise)
8	Model Keypoints
9	Water
10	Reserved for ASPRS Definition
11	Reserved for ASPRS Definition
12	Overlap Points
13 - 31	Reserved for ASPRS Definition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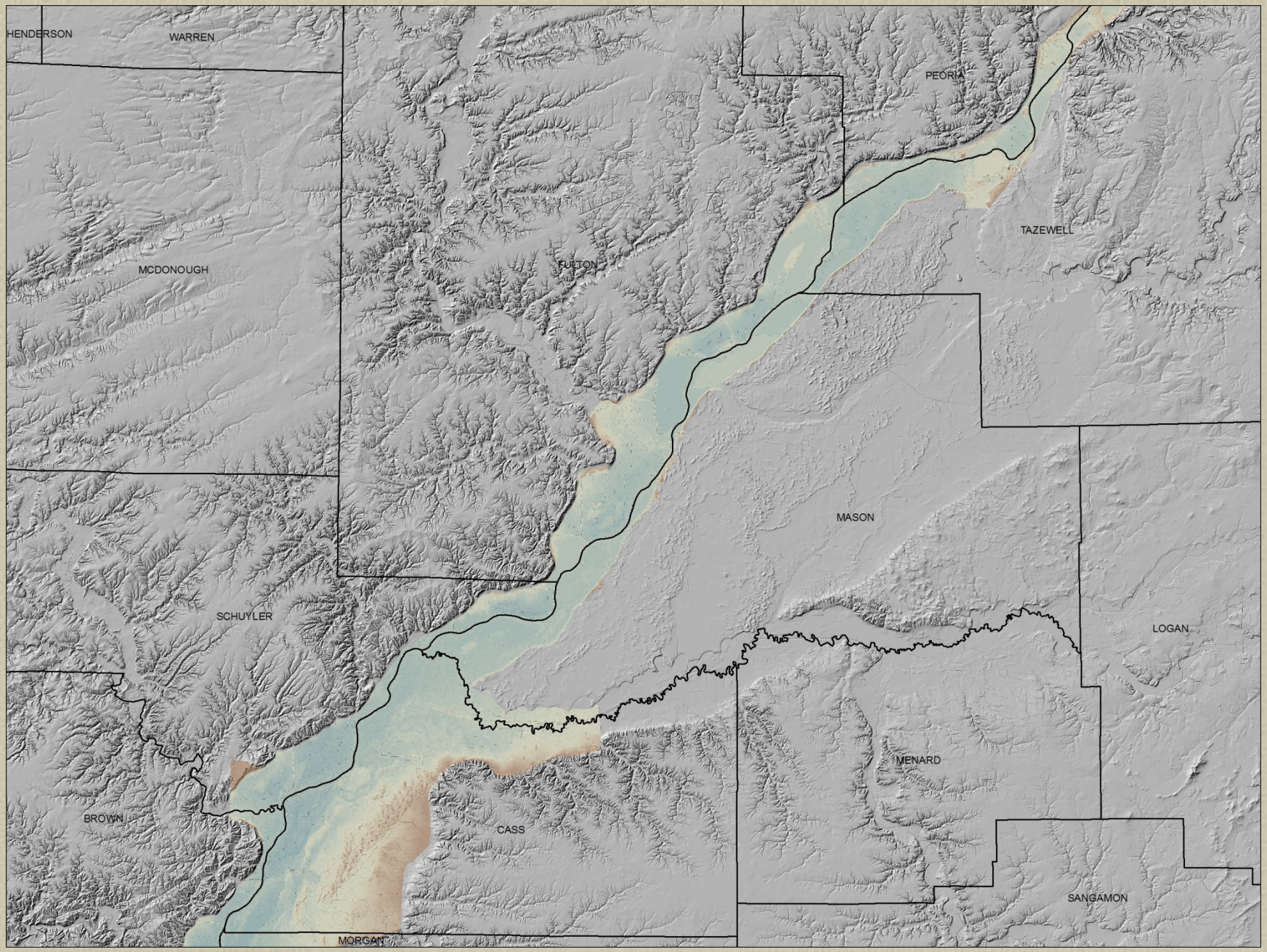
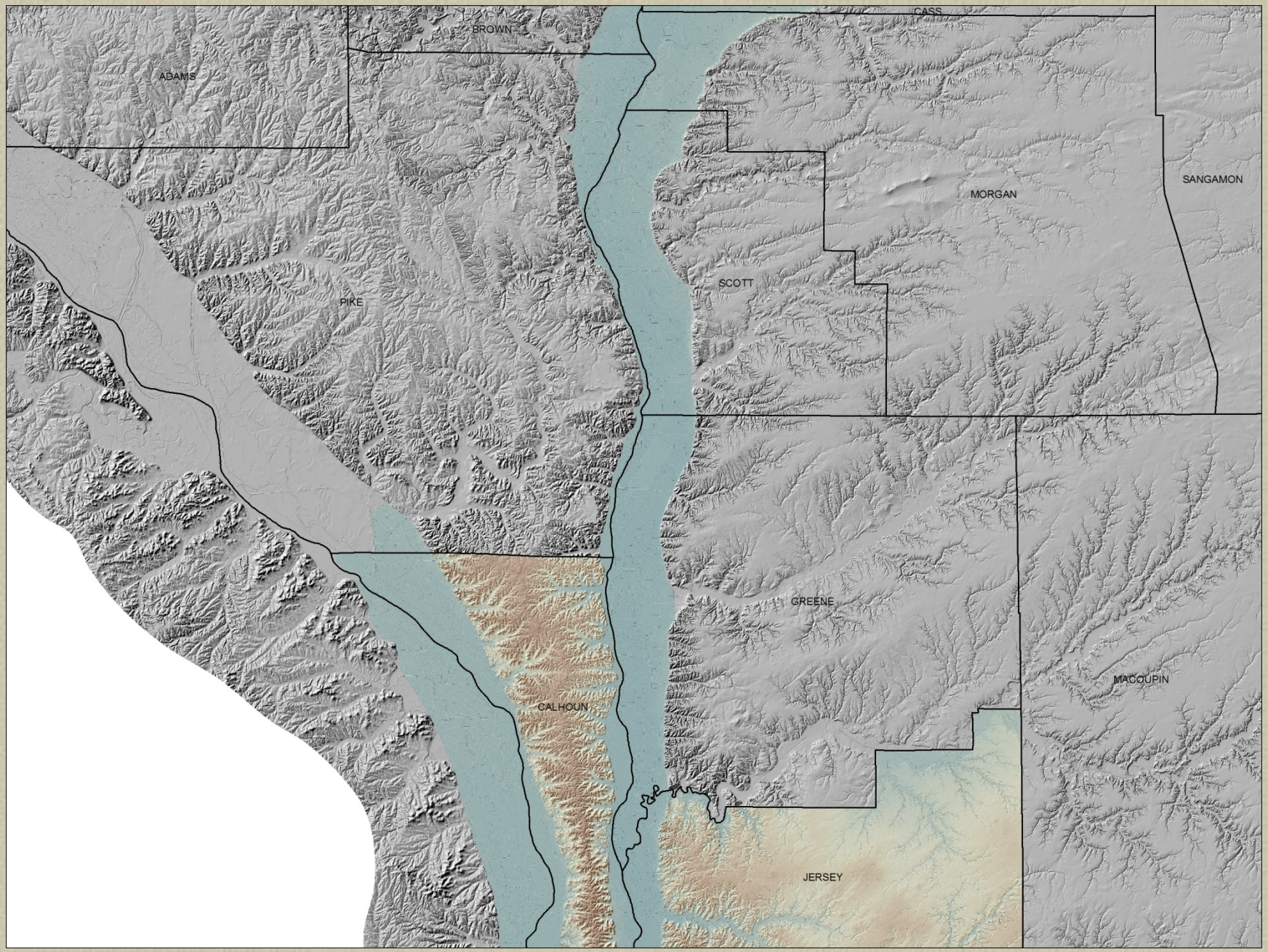
HENRY
GRUNDY
PUTNAM
LASALLE
STARK
MARSHALL
KNOX
LIVINGSTON
PEORIA
WOODFORD
TAZEWELL
MCLEAN
FULTON


HENDERSON
WARREN
PEORIA
TAZEWELL
MCDONOUGH
FULTON
MASON
SCHUYLER
LOGAN
MENARD
BROWN
CASS
SANGAMON
MORGAN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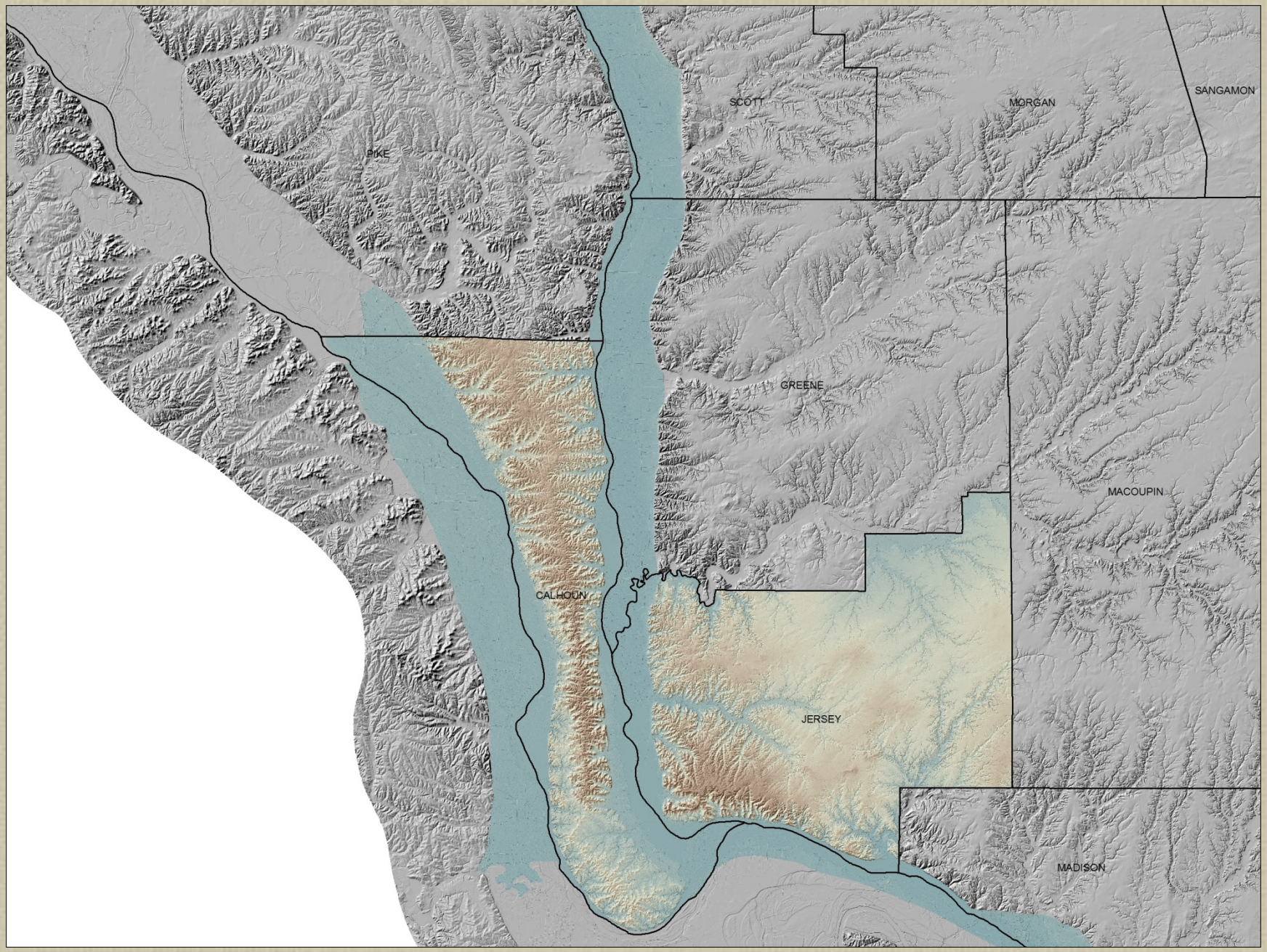
BROWN
ADAMS
SANGAMON
MORGAN
SCOTT
PIKE
GREENE
MACOUPIN
CALHOUN
JERSEY


SCOTT
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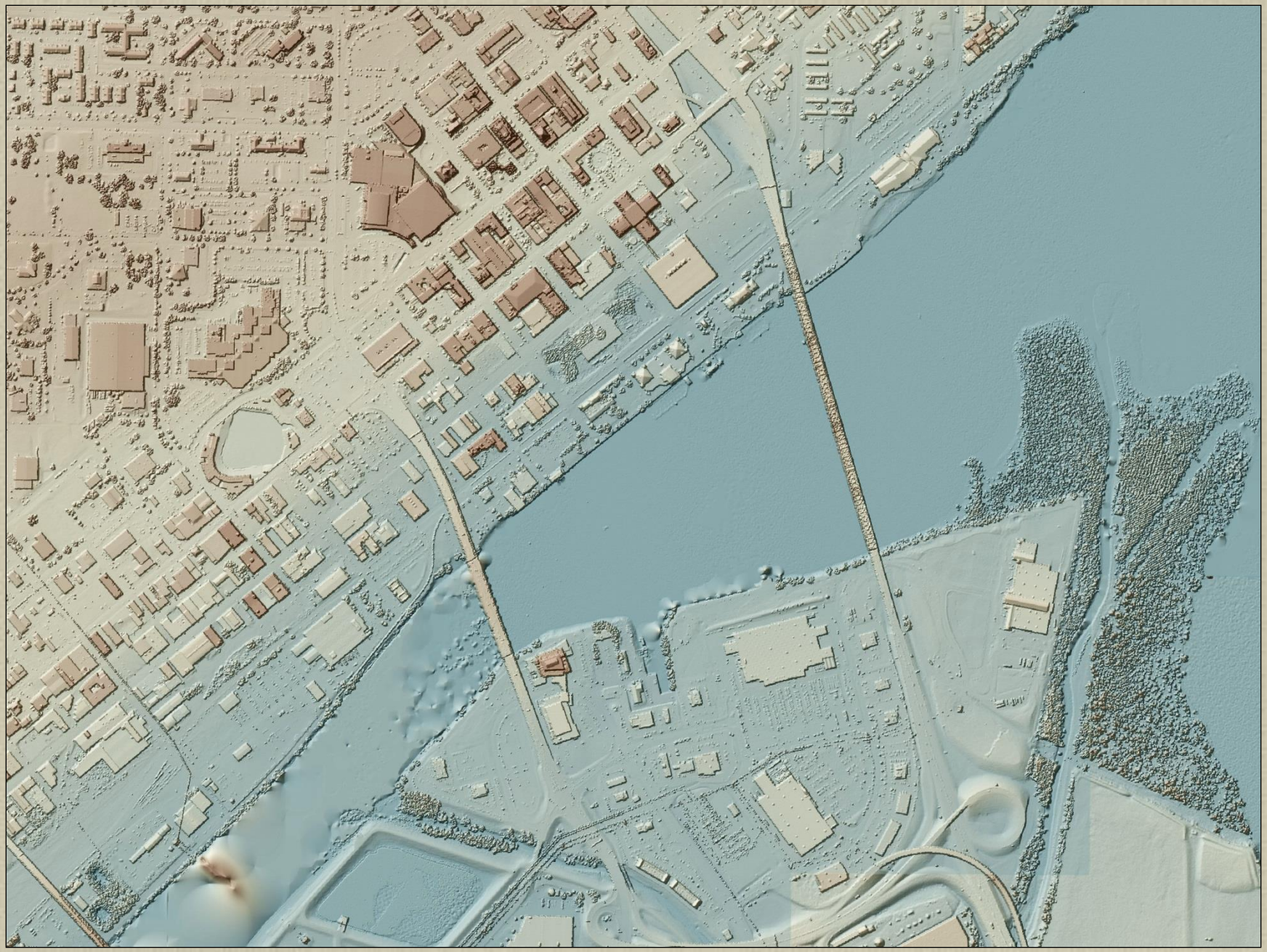
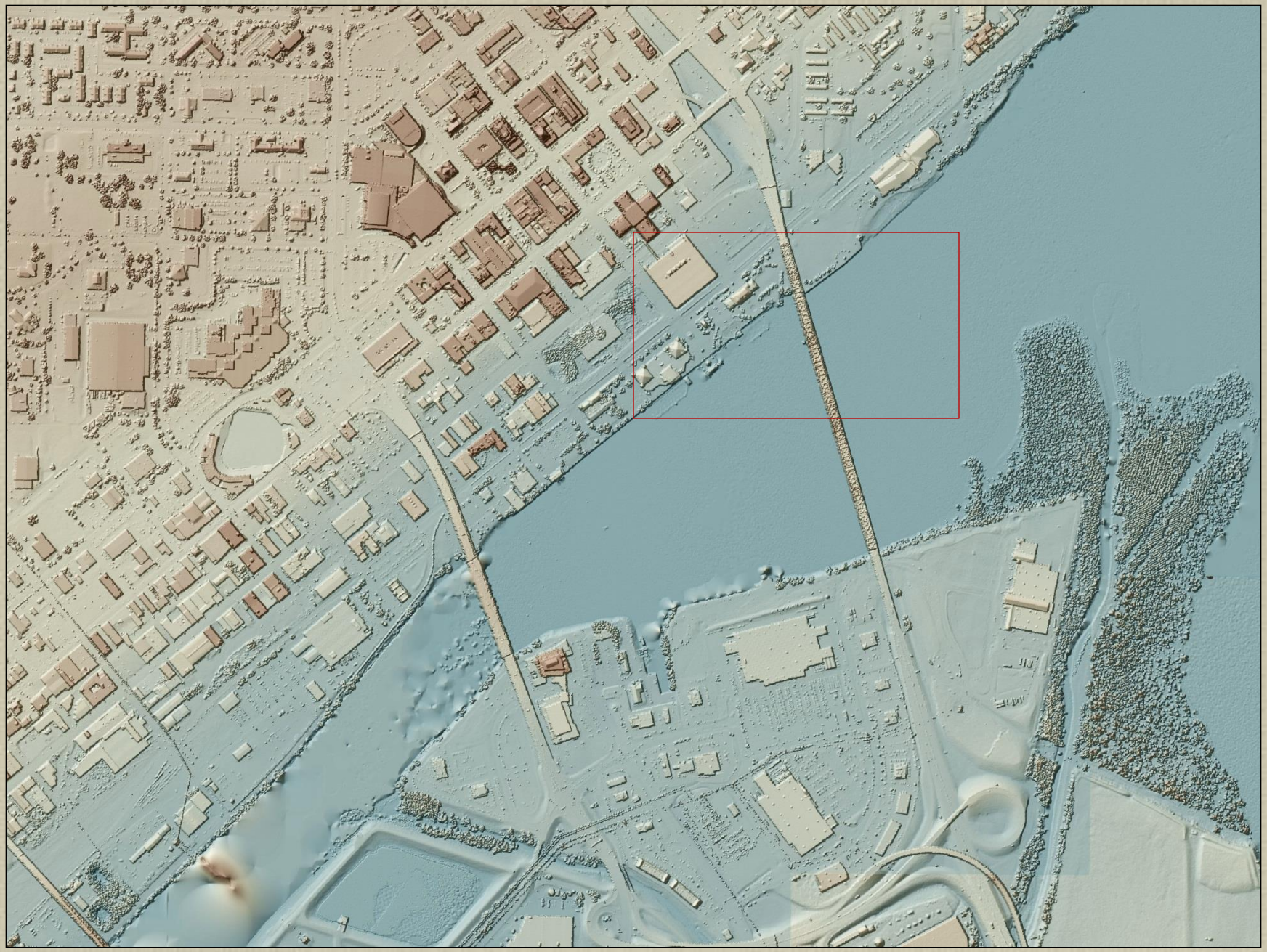
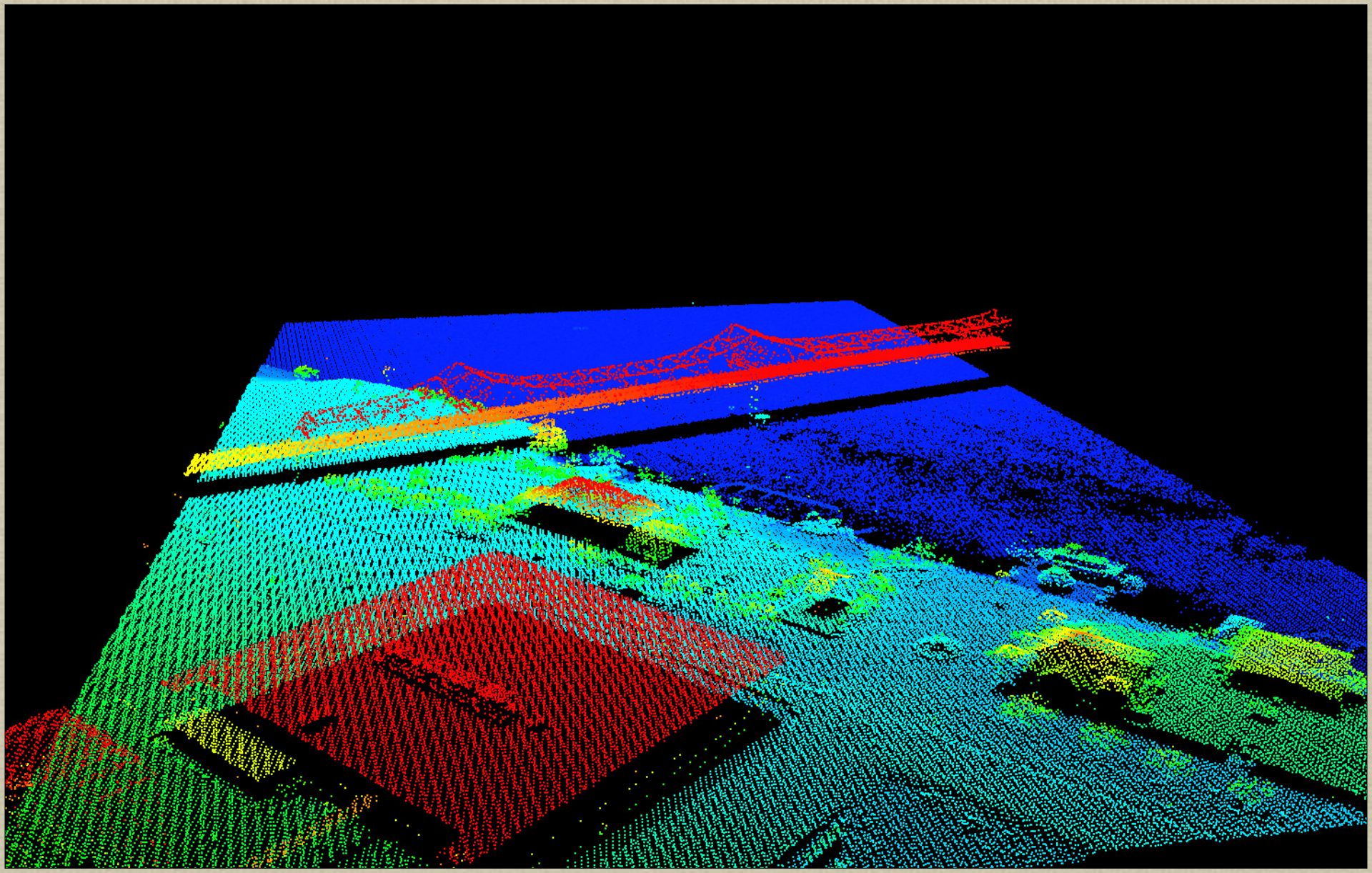
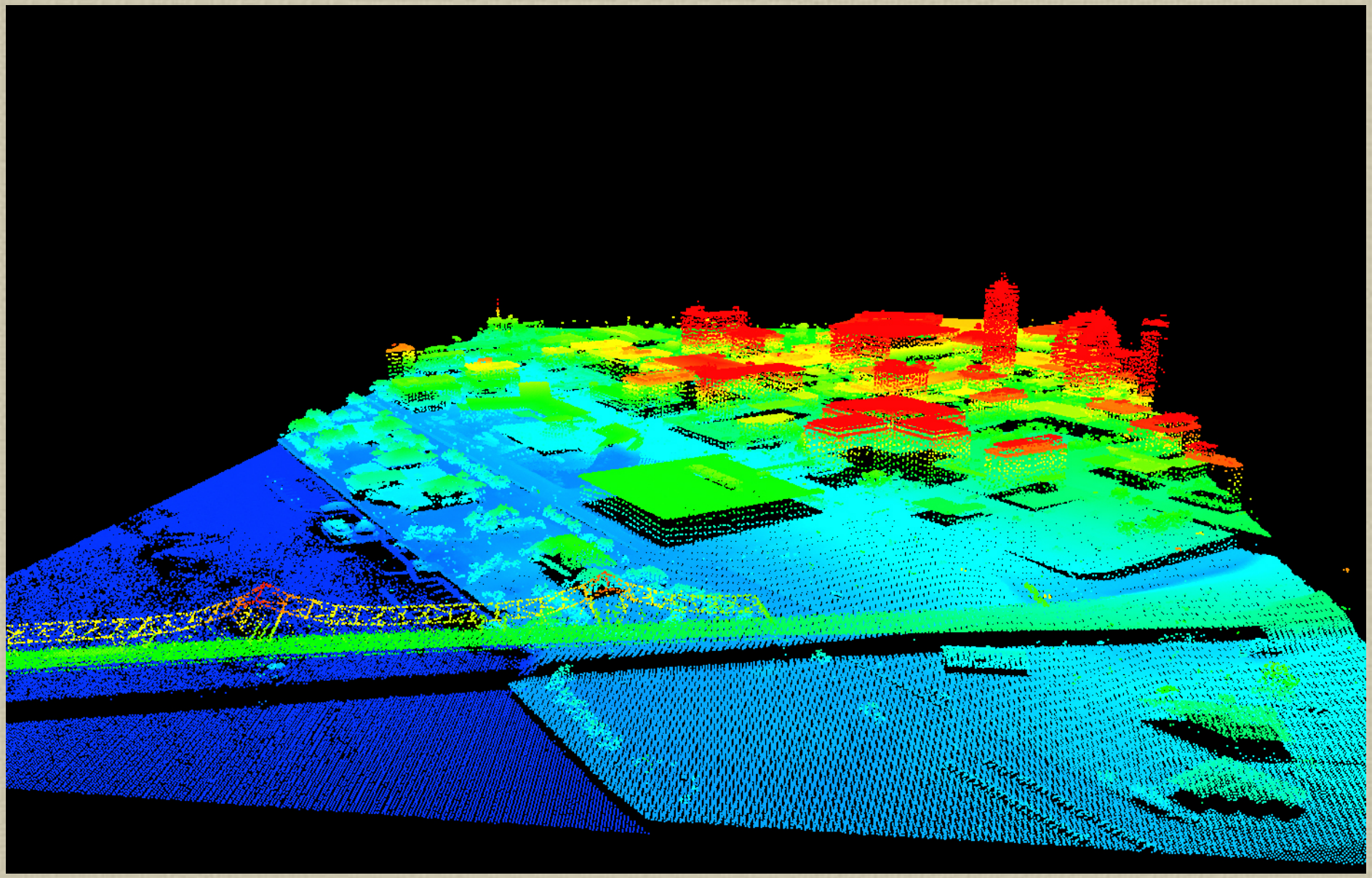
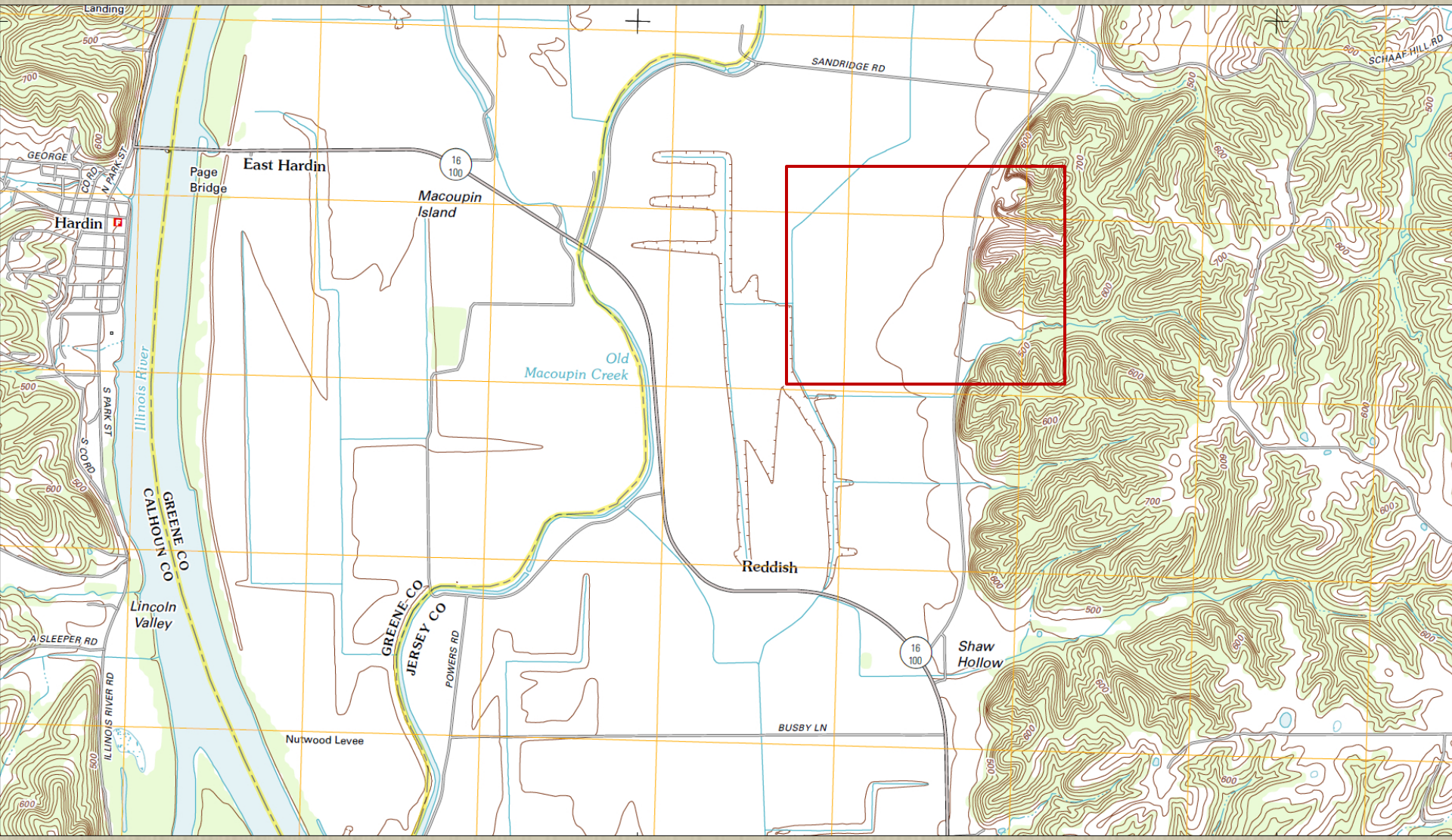
PIKE
GREENE
MACOUPIN
CALHOUN
JERSEY
MADISON










Landing
SANDRIDGE RD
SCHAAF HILL RD
GEORGE
CO RD
N PARK ST
Page
Bridge
East Hardin
16
100
Macoupin
Island
Hardin
Old
Macoupin Creek
Illinois River
S PARK ST
S CO RD
GREENE CO
CALHOUN CO
Lincoln
Valley
GREENE CO
JERSEY CO
POWERS RD
Reddish
16
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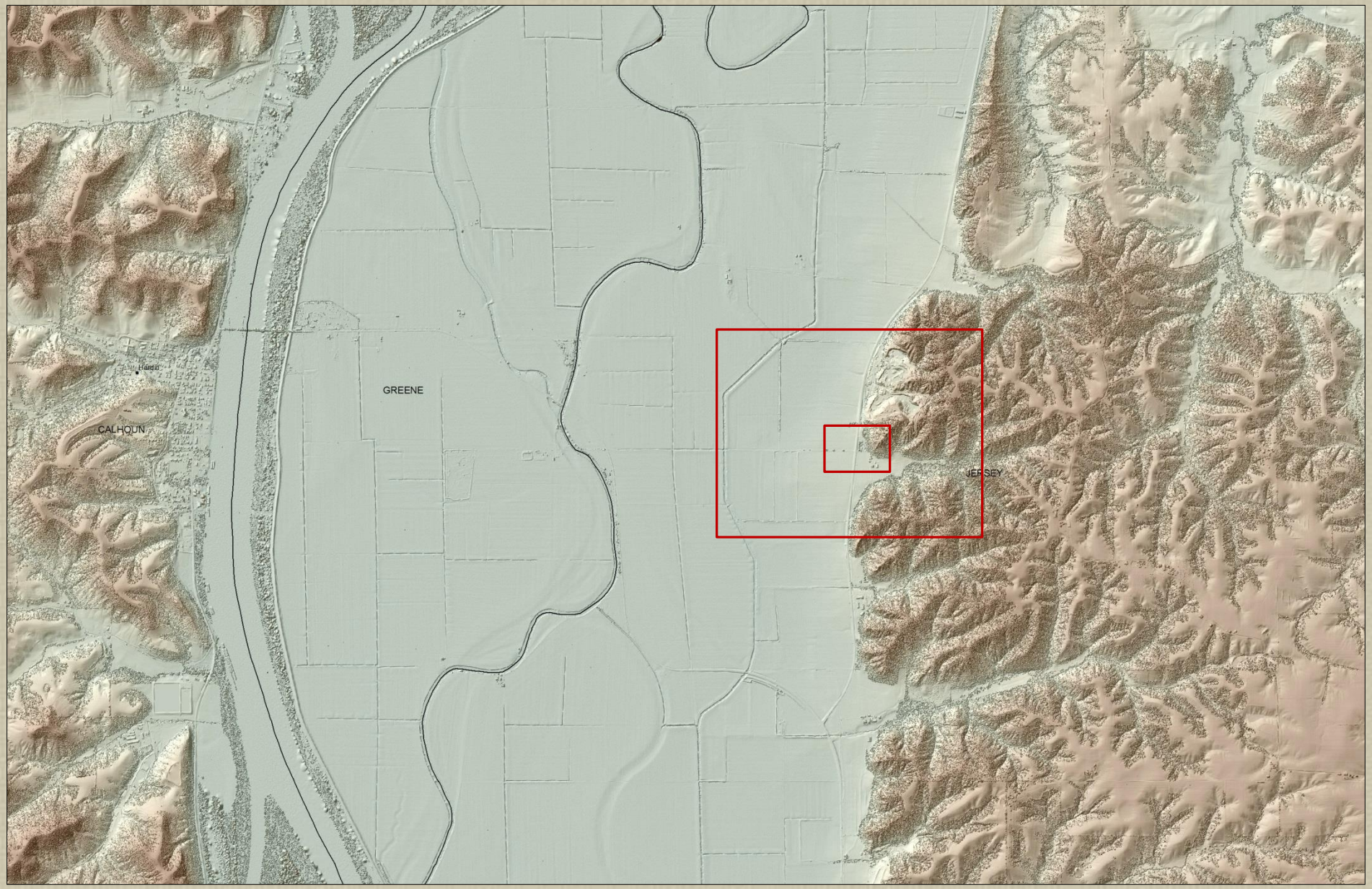
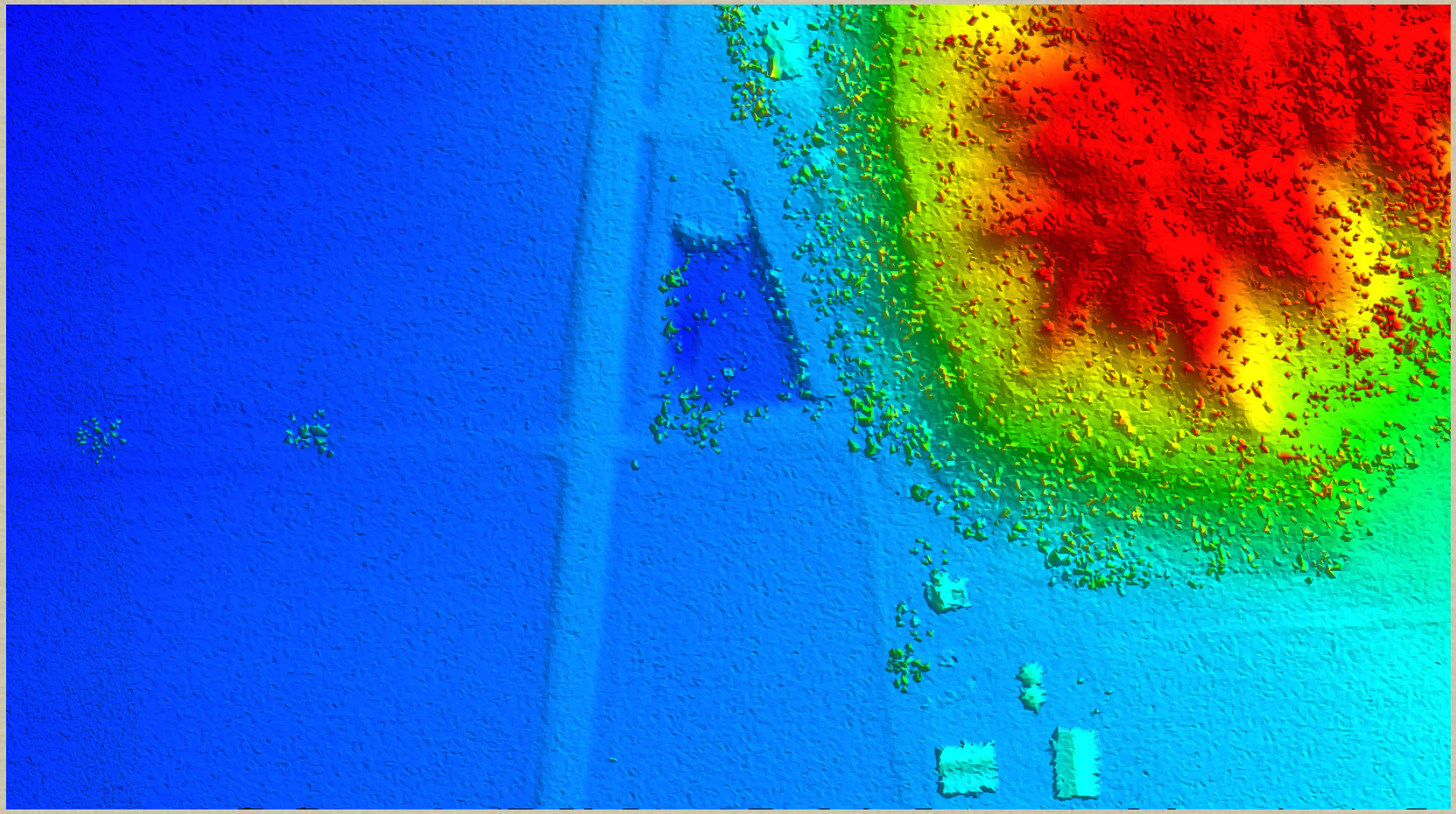
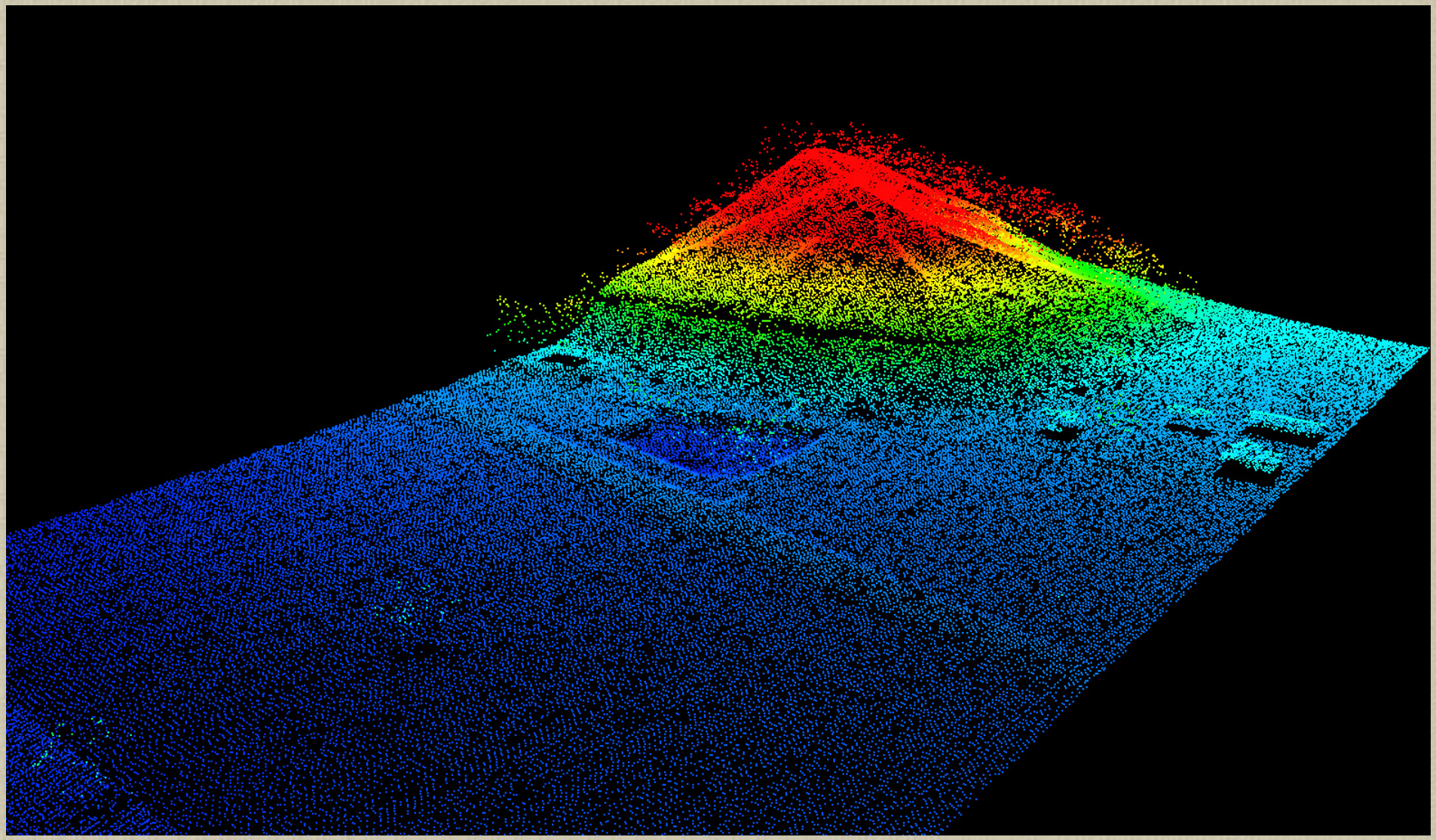
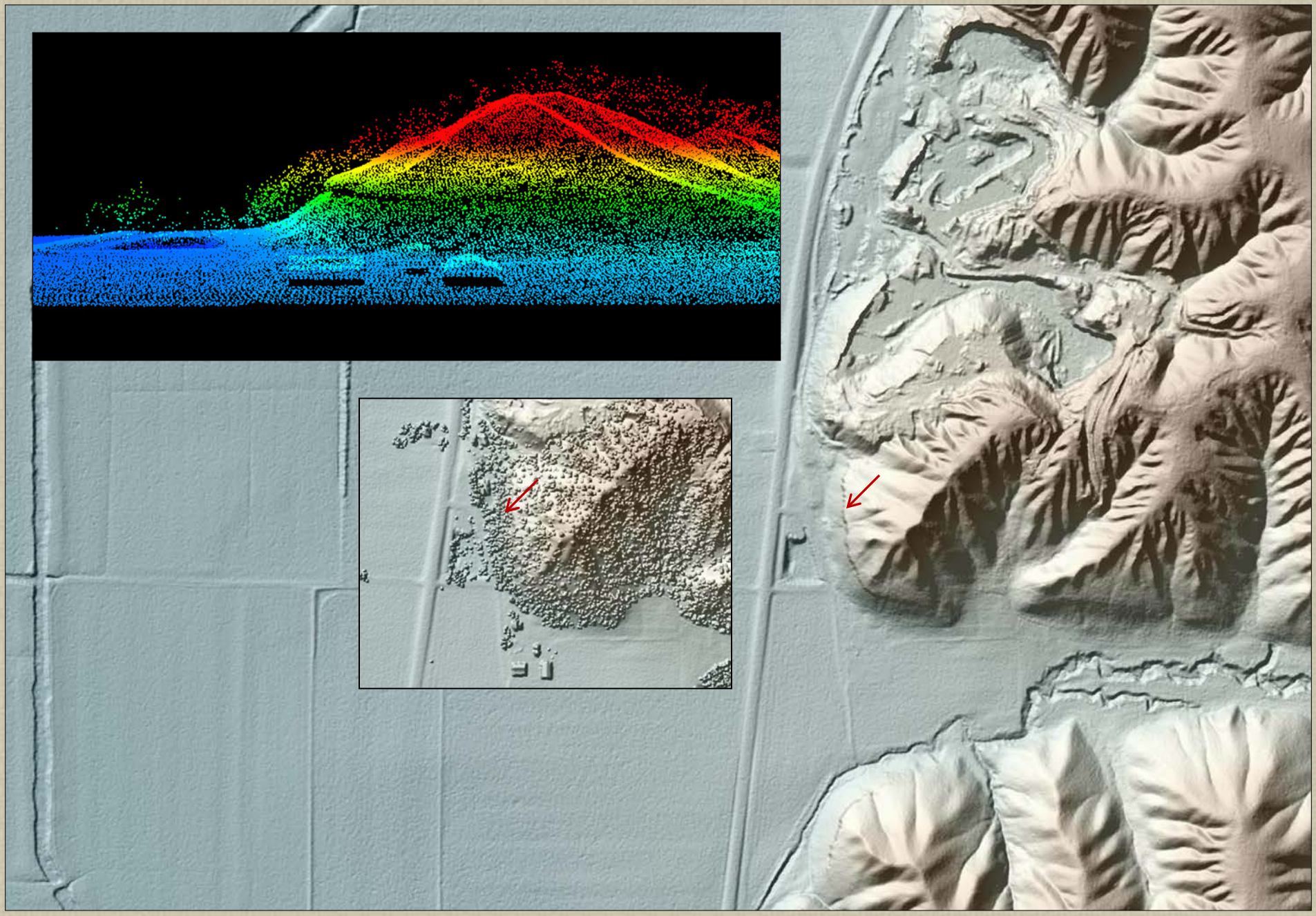
Shaw
Hollow
A SLEEPER RD
ILLINOIS RIVER RD
Nutwood Levee
BUSBY LN


GREENE
CALHOUN
JERSEY







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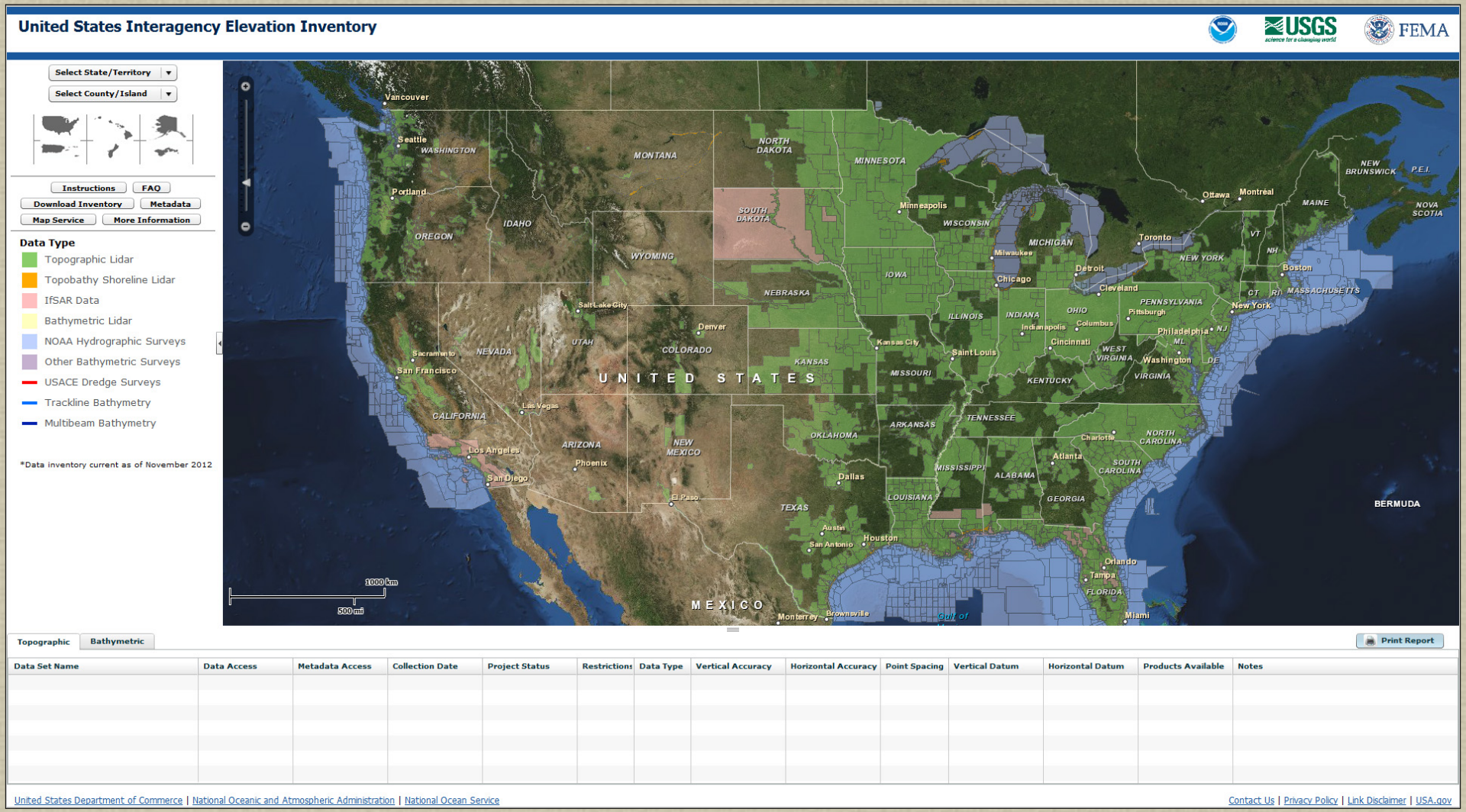
LiDAR Status

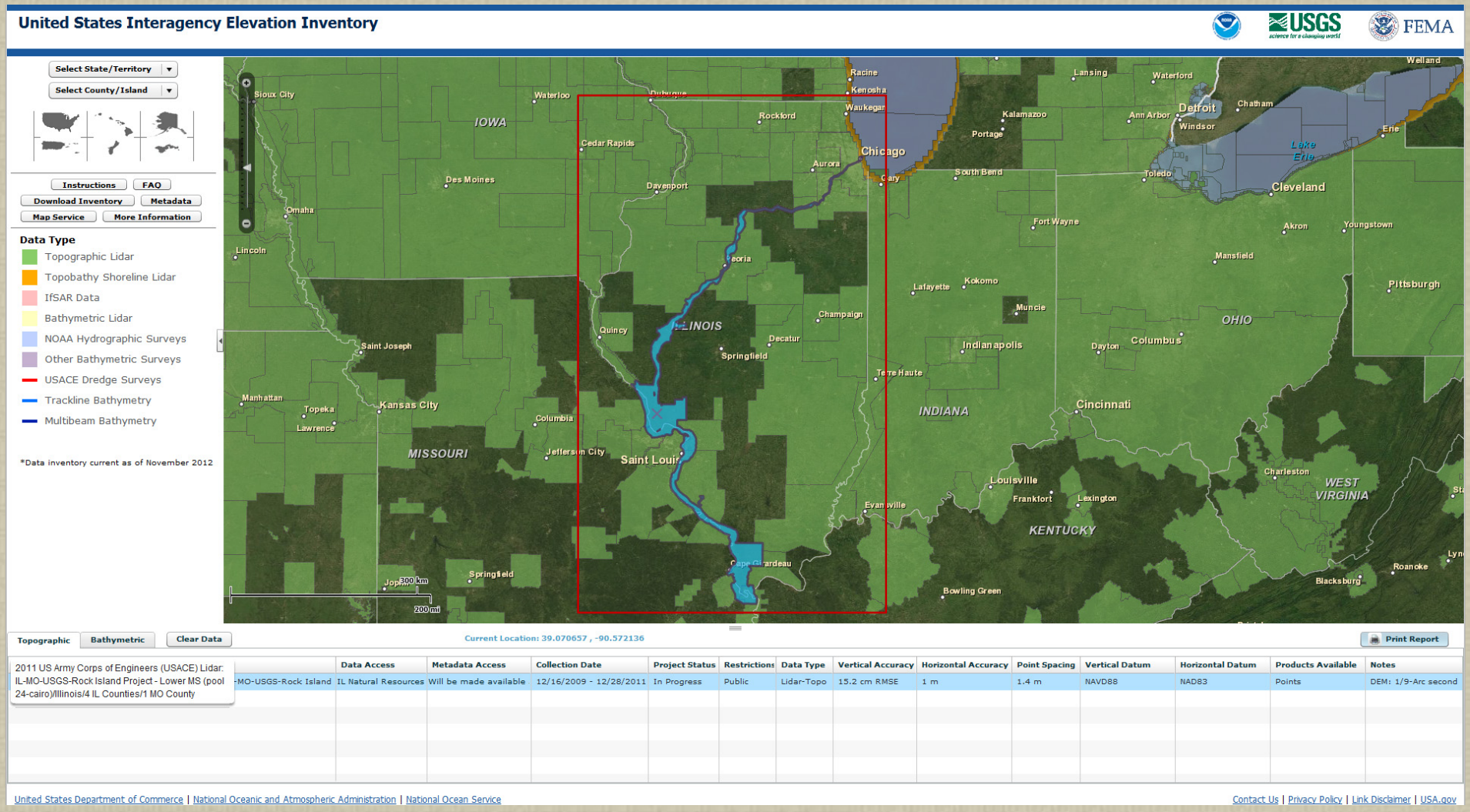
The U.S. Interagency Elevation Inventory is an online comprehensive, nationwide listing of known high-accuracy topographic data, including topographic and bathymetric LiDAR, as well as IfSAR. The USIEI is a collaborative effort between NOAA and the U.S. Geological Survey, with contributions from the Federal Emergency Management Agency…it is updated annually.



http://www.csc.noaa.gov/inventory/

LiDAR Status

The U.S. Interagency Elevation Inventory - ILLINOIS

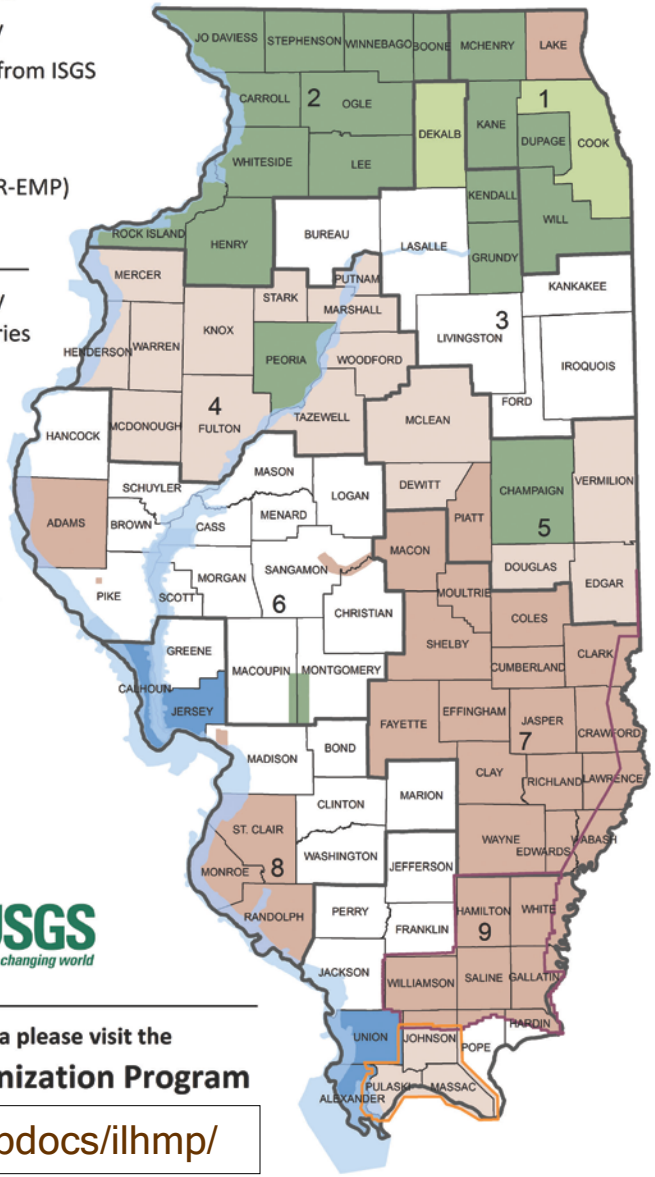


LiDAR Status for Illinois

March 2013

- Data Available thru Clearinghouse
- Data Available thru County
- Data Available by request from ISGS
- In Progress - IDOT
- In Progress - USGS & IDOT
- In Progress - USACE (UMRR-EMP)
- Acquisition Not Planned

- IDOT Acquisition Boundary
- FEMA Acquisition Boundaries
- 9 IDOT District Boundaries



Additional information:

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217-244-9306
sbeavers@illinois.edu

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Illinois Department of Transportation

USGS
science for a changing world

For access to LiDAR data please visit the

Illinois Height Modernization Program

http://crystal.isgs.uiuc.edu/nsdihome/webdocs/ilhmp/

Online LiDAR Data Derivatives

Illinois Geospatial Data CLEARINGHOUSE

site index • license agreement • contact us

Illinois Height Modernization: LiDAR Derivatives

Data Products

Datasets in ArcGrid format are available for selected Illinois counties. The original, classified LiDAR data point cloud has been processed to create a digital terrain model (DTM) and a digital surface model (DSM) for each county. Additionally, each county .zip file contains an associated shaded relief model, or 'hillshade', an ArcGIS v.10.1 .mxd file, and also ArcGrid pyramid files and statistics to facilitate display and analysis. Visit the Illinois LiDAR Data page to access originally contracted data deliverables (bare earth, contours, DAT, DGN, LAS, and TIN).

Product Definitions

DSM: all returns

Processing all returns in the classified point cloud that represent both the ground surface and aboveground features (buildings, roadways and overpasses, vegetation, etc.) produces a DSM. A DSM is commonly referred to as the 'First Returns' reflective surface model.

DTM: ground returns with hydrologic breaklines

When only the ground returns in a classified point cloud are used, the resulting hydro-flattened grid of bare-earth elevations is a DTM. Also, lake surfaces are smoothed and stream courses are conditioned for downhill flow using breakline data. This subset of the processed returns from the airborne laser sensor represent the ground surface and is commonly referred to as the 'Bare Earth' point cloud.

DEM: ground returns without hydrologic breaklines

When hydro-flattening is not imposed during processing of the ground returns, either because of missing or insufficient breakline data, the resulting Bare Earth elevation grid is classified as a DEM.

Download Data

Note: ZIP files are large in size; some may take several hours to download. Make certain your Internet provider does not have a 2GB cap or time limit on file downloads. Submit a Help Request Form to receive any county by mail.

2009 - Adams	ZIP 23.8 GB	2011 - Hardin	by request	xxxx - Morgan	not acquired
2009-2011 - Alexander	by request	2012 - Henderson	by request	2011 - Moultrie	ZIP 5.7 GB
xxxx - Bond	not acquired	2009 - Henry	ZIP(-s) 5.6 GB	2009 - Ogle	ZIP(-s) 6.3 GB
2007 - Boone	ZIP 4.2 GB	xxxx - Iroquois	not acquired	2008 - Peoria 2012 - Peoria	ZIP 7.5 GB by request
xxxx - Brown	not acquired	xxxx - Jackson	not acquired	xxxx - Perry	not acquired
xxxx - Bureau	not acquired	2011 - Jasper	ZIP 10.6 GB	2011 - Piatt	ZIP 32.3 GB
2009-2011 - Calhoun	by request	xxxx - Jefferson	not acquired	xxxx - Pike	not acquired
2009 - Carroll	ZIP(-s) 2.9 GB	2009-2011 - Jersey	by request	2011 - Pope	by request
2011 - Cass	by request	2009 - JoDaviess	ZIP(-s) 4.1 GB	2011 - Pulaski	expected
2008 - Champaign	ZIP(-s) 7.1 GB	2011 - Johnson	by request	2012 - Putnam	by request
xxxx - Christian	not acquired	2008 - Kane	ZIP(-s) 3.5 GB	2012 - Randolph	ZIP 16.7 GB
2011 - Clark	ZIP 10.9 GB	xxxx - Kankakee	not acquired	2011 - Richland	ZIP 12.4 GB
2011 - Clay	ZIP 15.5 GB	2010 - Kendall	ZIP 6.1 GB	2009 - Rock Island	ZIP(-s) 3.1 GB
xxxx - Clinton	not acquired	2012 - Knox	ZIP 24.4 GB	2012 - St. Clair	ZIP 20.4 GB
2011 - Coles	ZIP 8.6 GB	2007 - Lake	ZIP 13.1 GB	2011 - Saline	ZIP 5.4 GB
2008 - Cook	contact county	xxxx - LaSalle	not acquired	xxxx - Sangamon	not acquired
2011 - Crawford	ZIP 10.1 GB	2011 - Lawrence	ZIP 8.5 GB	xxxx - Schuyler	not acquired
2011 - Cumberland	ZIP 7.6 GB	2009 - Lee	ZIP(-s) 6.5 GB	xxxx - Scott	not acquired
2009 - DeKalb	contact county	xxxx - Livingston	not acquired	2011 - Shelby	ZIP 15.9 GB
2012 - DeWitt	expected	xxxx - Logan	not acquired	2012 - Stark	ZIP 8.11 GB
2012 - Douglas	expected	2011 - Macon	ZIP 9.0 GB	2009 - Stephenson	ZIP(-s) 3.6 GB
2006 - DuPage	ZIP(-s) 3.0 GB	xxxx - Macoupin	not acquired	2012 - Tazewell	by request
2012 - Edgar	expected	xxxx - Madison	not acquired	2009-2011 - Union	by request
2011 - Edwards	ZIP 5.4 GB	xxxx - Marion	not acquired	2012 - Vermilion	ZIP 34.1 GB
2011 - Effingham	ZIP 10.3 GB	2012 - Marshall	ZIP 9.8 GB	2011 - Wabash	ZIP 5.7 GB
2011 - Fayette	ZIP 16.8 GB	xxxx - Mason	not acquired	2012 - Warren	by request
xxxx - Ford	not acquired	2011 - Massac	expected	xxxx - Washington	not acquired
xxxx - Franklin	not acquired	2012 - McDonough	by request	2011 - Wayne	ZIP 16.3 GB
2012 - Fulton	by request	2008 - McHenry	ZIP(-s) 3.8 GB	2012 - White	by request
2012 - Gallatin	by request	2012 - McLean	expected	2009 - Whiteside	ZIP(-s) 5.5 GB
xxxx - Greene	not acquired	xxxx - Menard	not acquired	2004 - Will	ZIP 6.8 GB
2008 - Grundy	ZIP(-s) 2.4 GB	2012 - Mercer	by request	2011 - Williamson	ZIP 6.3 GB
2012 - Hamilton	ZIP 5.9 GB	2012 - Monroe	ZIP 12.0 GB	2007 - Winnebago	ZIP 8.1 GB
xxxx - Hancock	not acquired	xxxx - Montgomery	not acquired	2012 - Woodford	by request

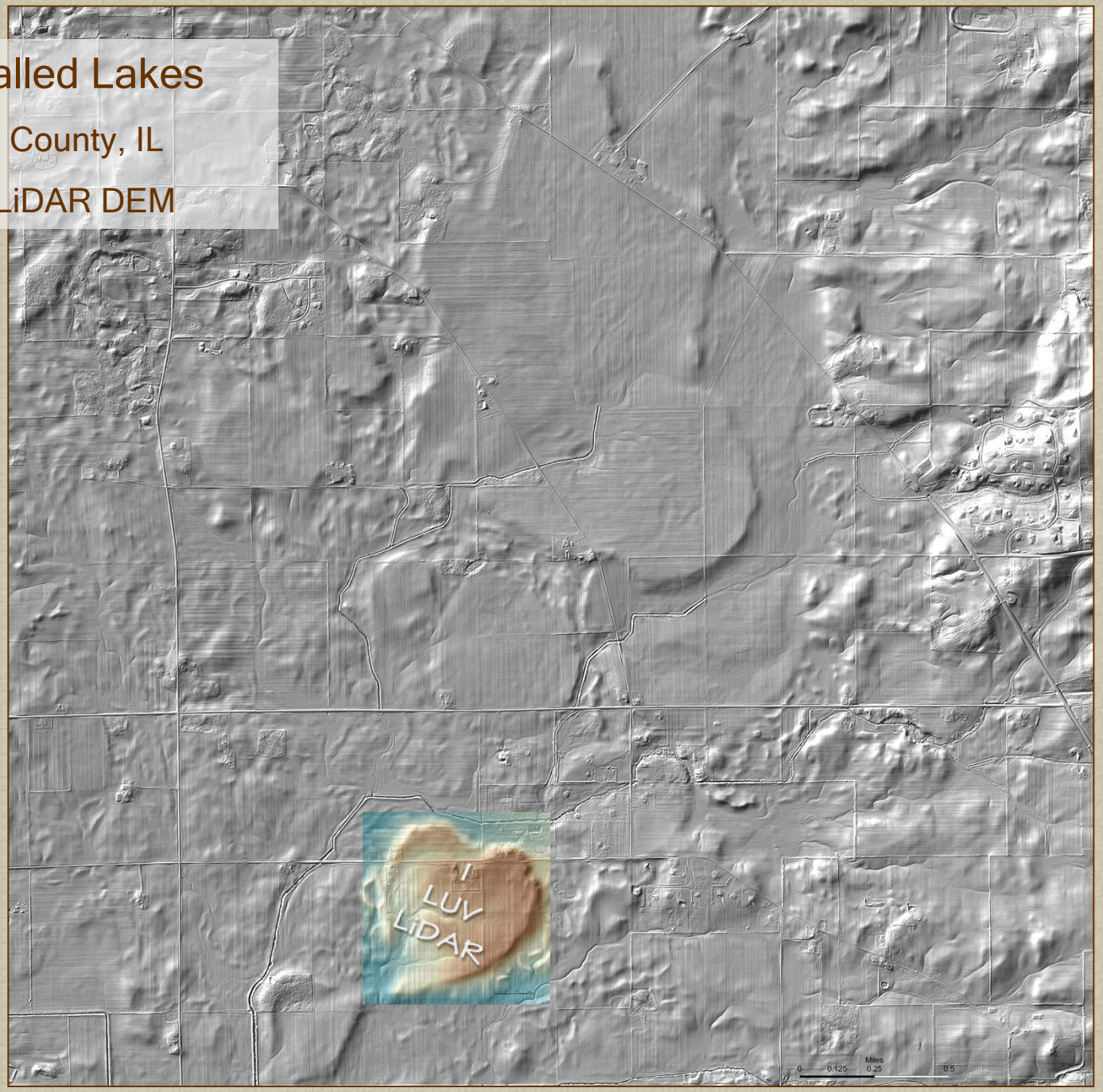
expected = LiDAR has been acquired but not yet delivered; derivative data products will be produced.
by request = derivative data available upon request. Please submit Help Request Form.
not acquired = LiDAR not acquired or planned
contact county = distribution is available only through county; contact information available from ISGS.
(-s) = digital surface model not yet available.

Metadata

Generalized metadata has been produced for each county DTM/DEM and DSM derivative data product, which can be accessed by clicking on a selected grid file using ArcCatalog. Be certain you have first selected on the ArcCatalog toolbar the 'FGDC CSDGM Metadata' option under Customize > ArcCatalog Options > Metadata. Please refer to the Readme file within each county ZIP download file for additional distribution information.

http://crystal.isgs.uiuc.edu/nsdihome/webdocs/ilhmp/county/dsm-dtm.html

Ice Walled Lakes

Kane County, IL

2008 LiDAR DEM