

# Intermap's NEXTMap DTM

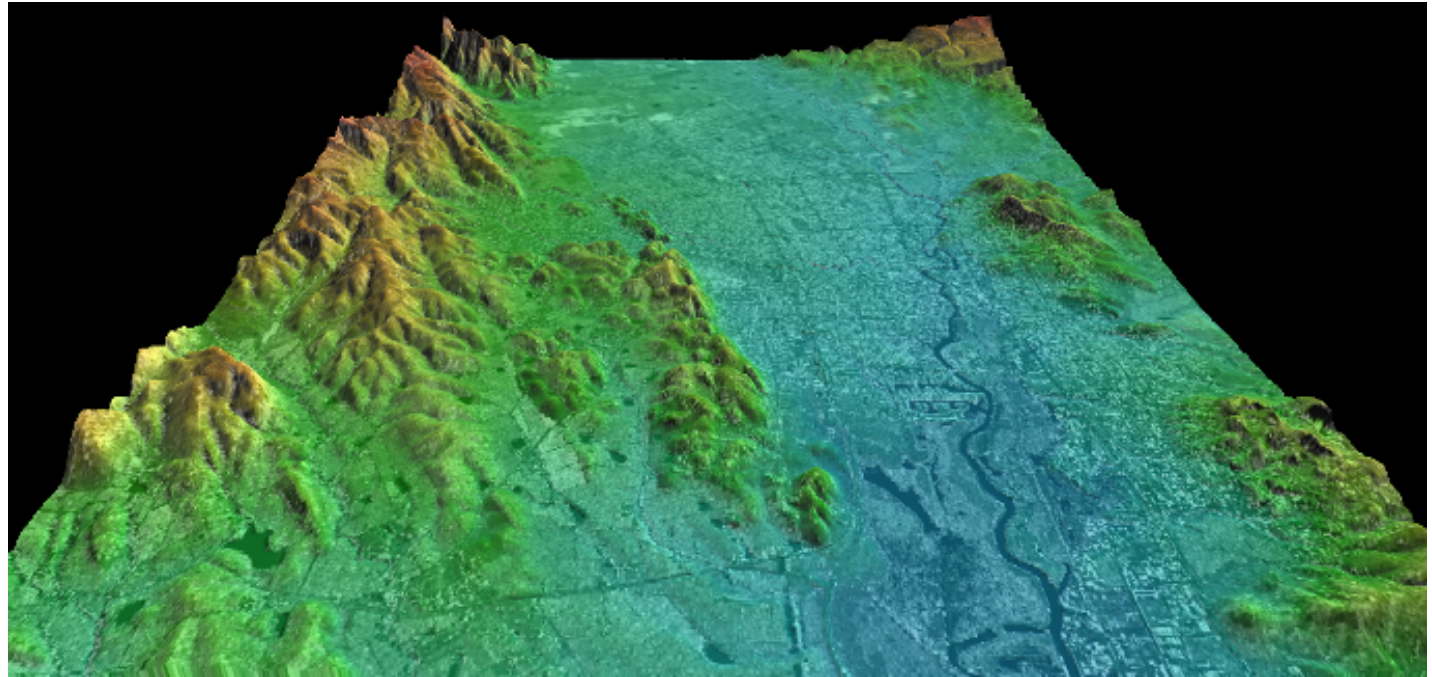
Legacy vs. Current

# NEXTMap USA DTM

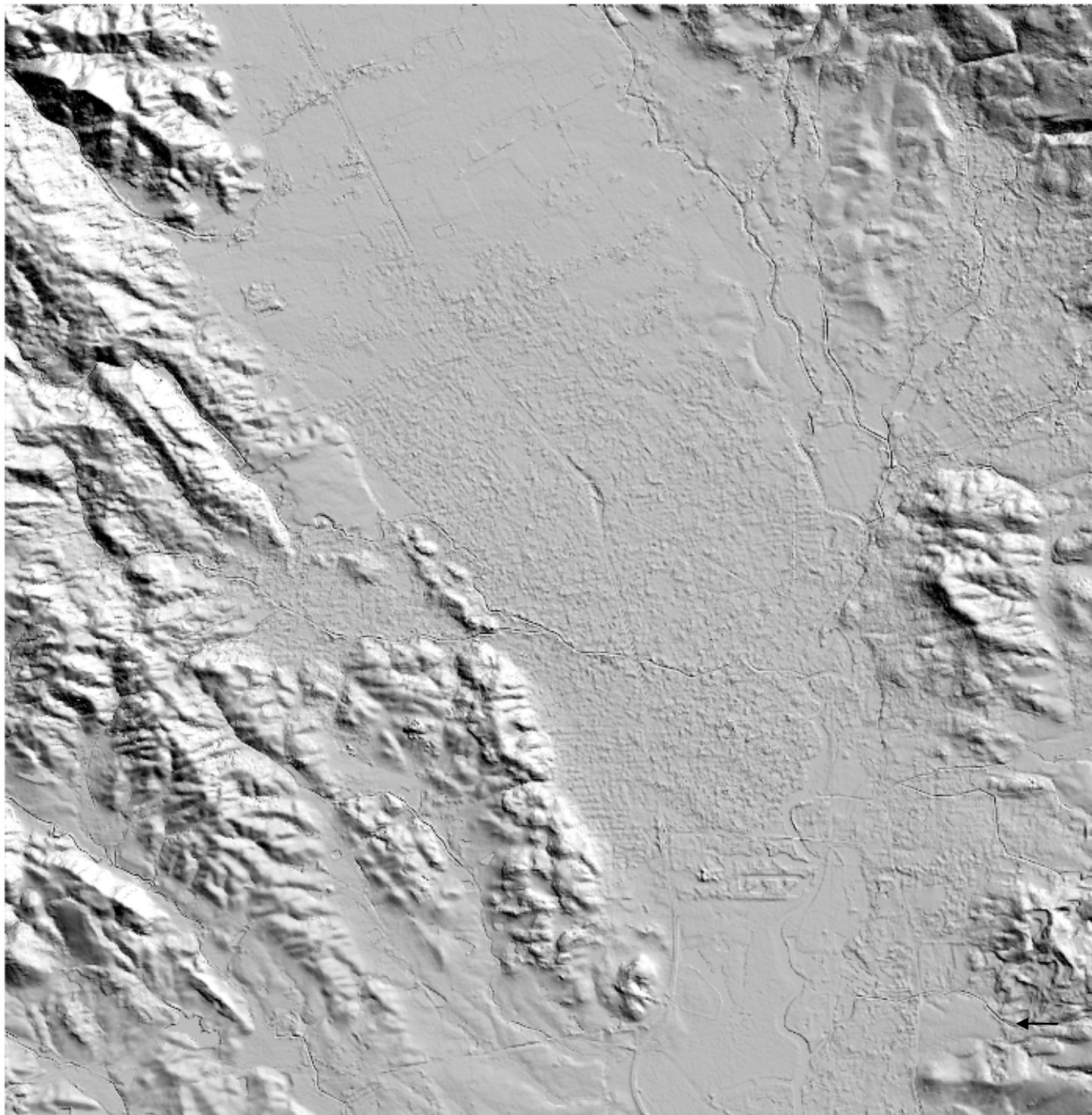
- The evolution of the NEXTMap Digital Terrain Model
  - The 80 / 20 rule
    - Drainage flow improvements
    - Ortho-rectification improvements
    - Obstructed area improvements
- The process
  - Client review and comment
  - Test, revise and test again
- Specification revisions
  - Changes to edit rules
  - Edit software (IES) Version 2.0
  - Edit process revision
  - Recurrent editor training
- Fully Integrated Terrain Solution (FITS) in obstructed areas
  - Application of ancillary data to enhance DTM

# Example Tile

- ▀ Representative tile: Forest, Urban, High Slope, Low Slope, Transportation, Hydrology etc.
- ▀ Moderate editing difficulty
- ▀ Availability of ancillary data for testing, full coverage:
  - LIDAR
  - CITIPIX
  - NED



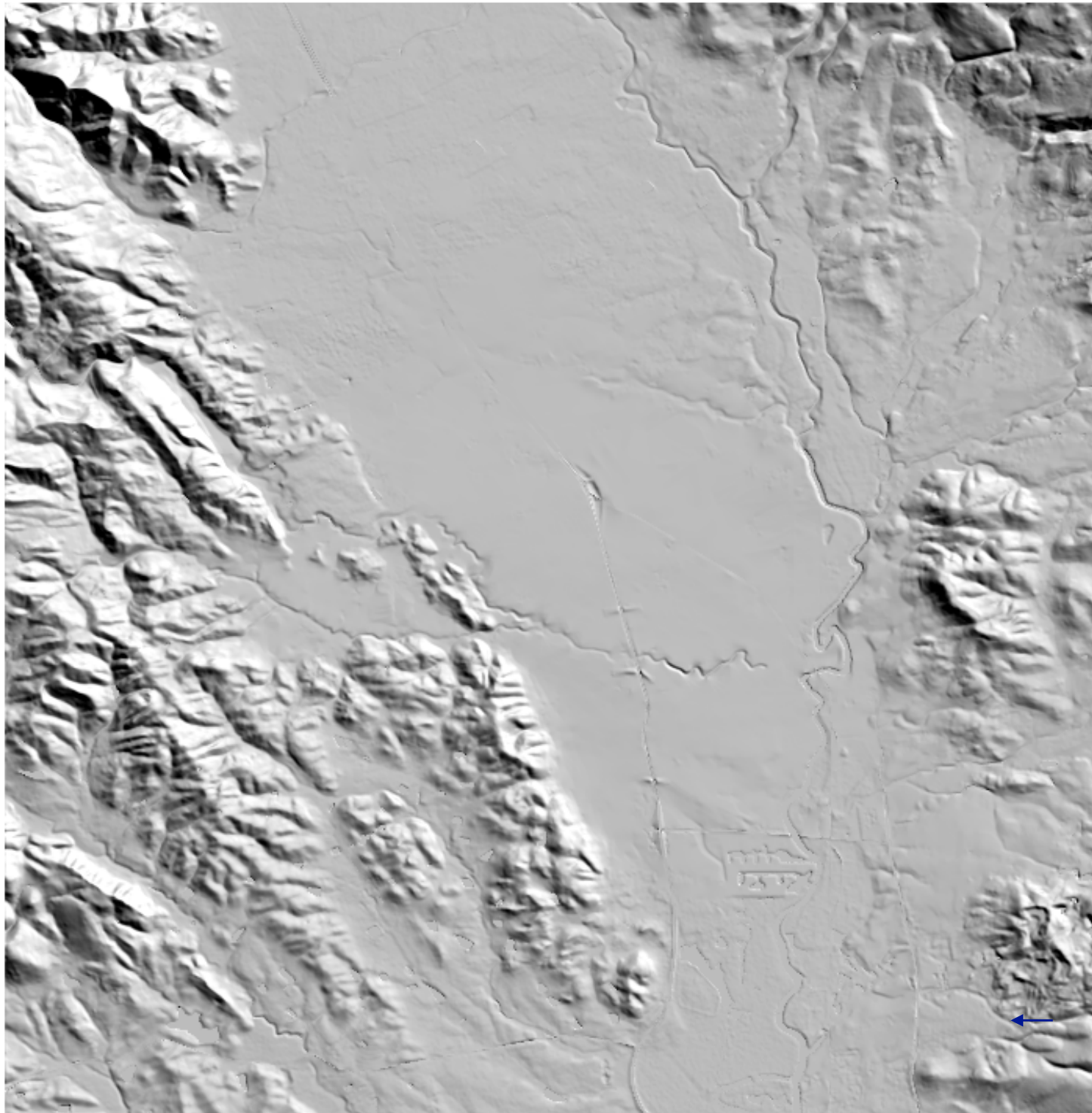
N38W122C3, Block 3405, Napa, Ca



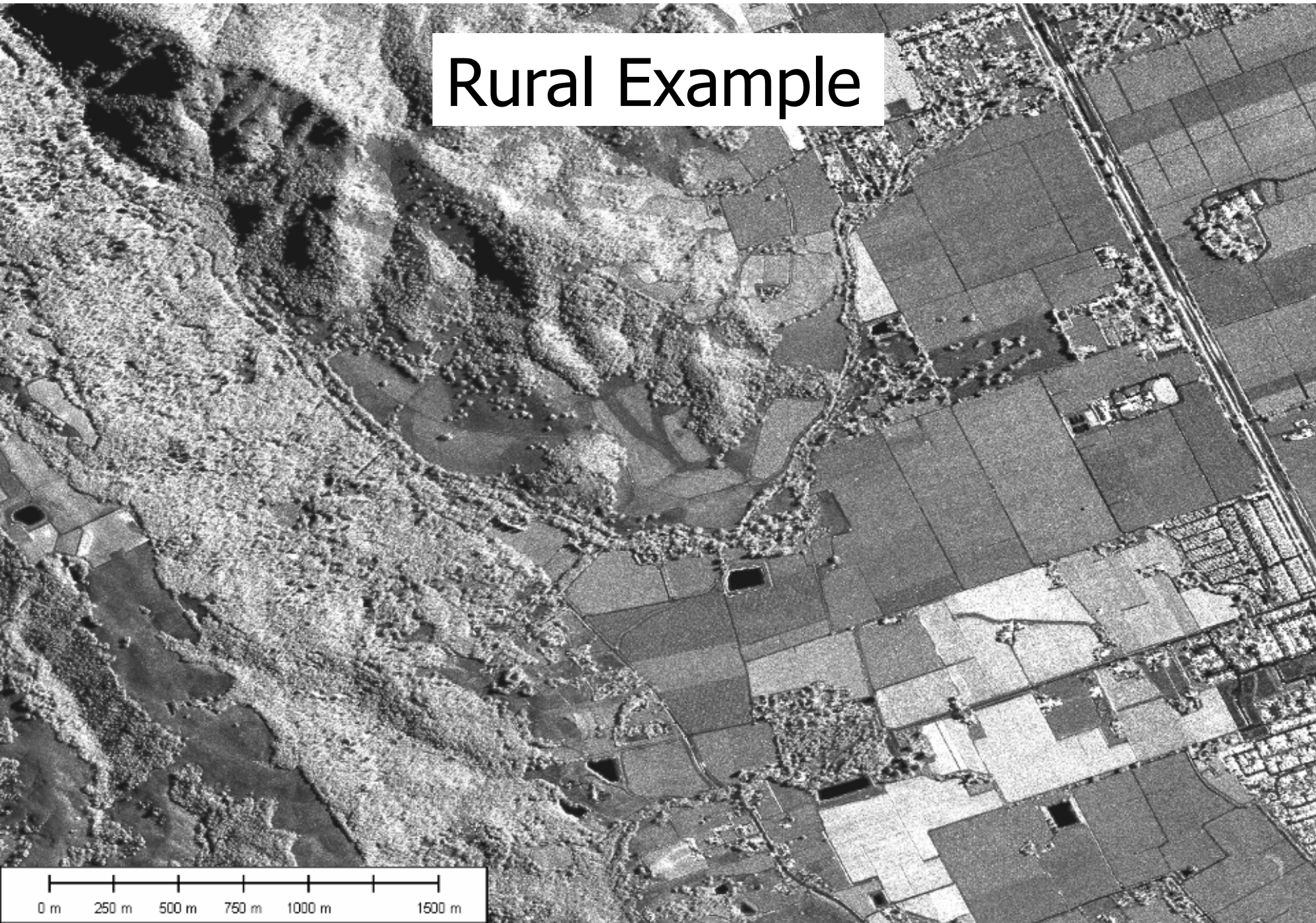
The Core  
Product  
DTM  
06/2006

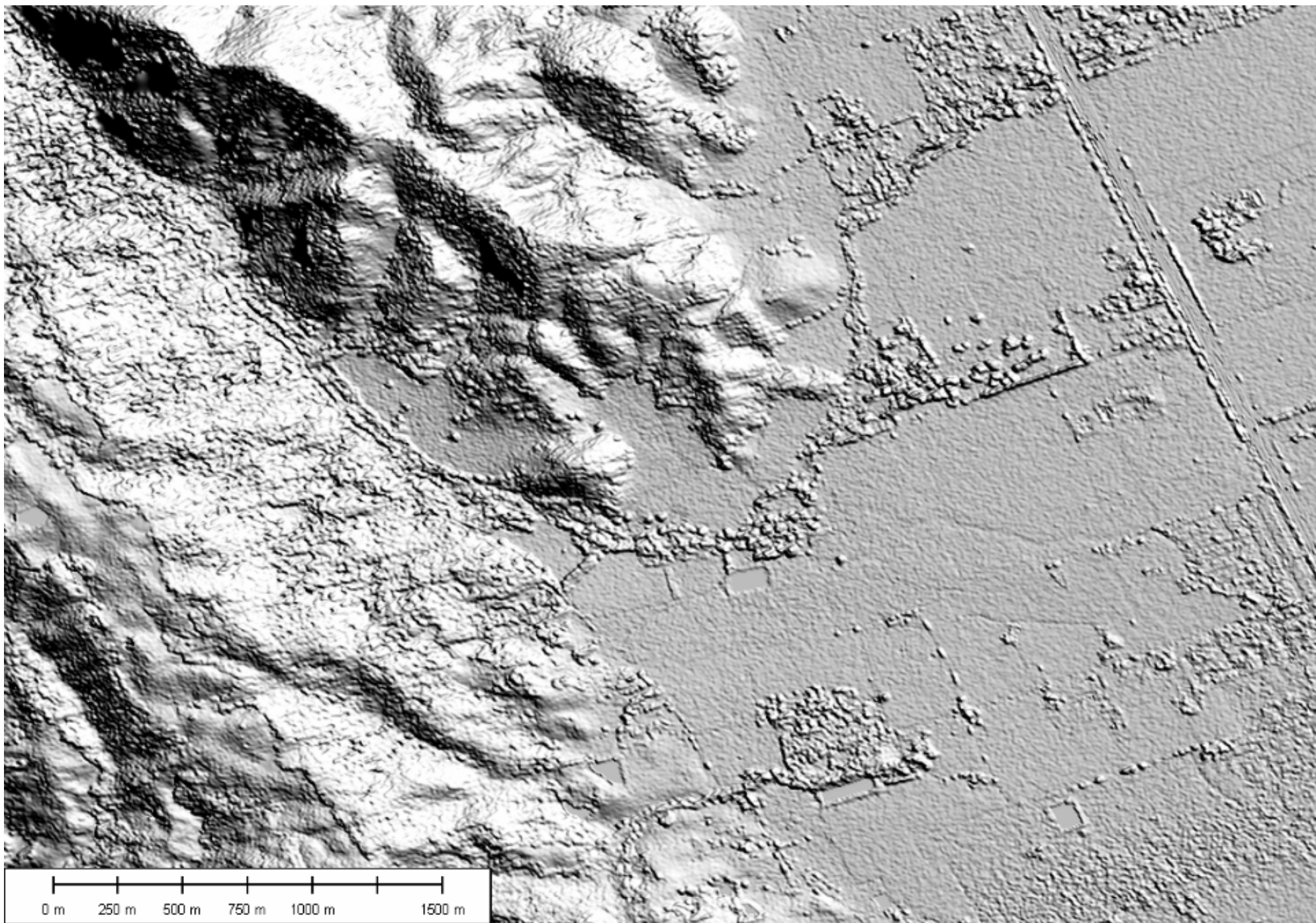


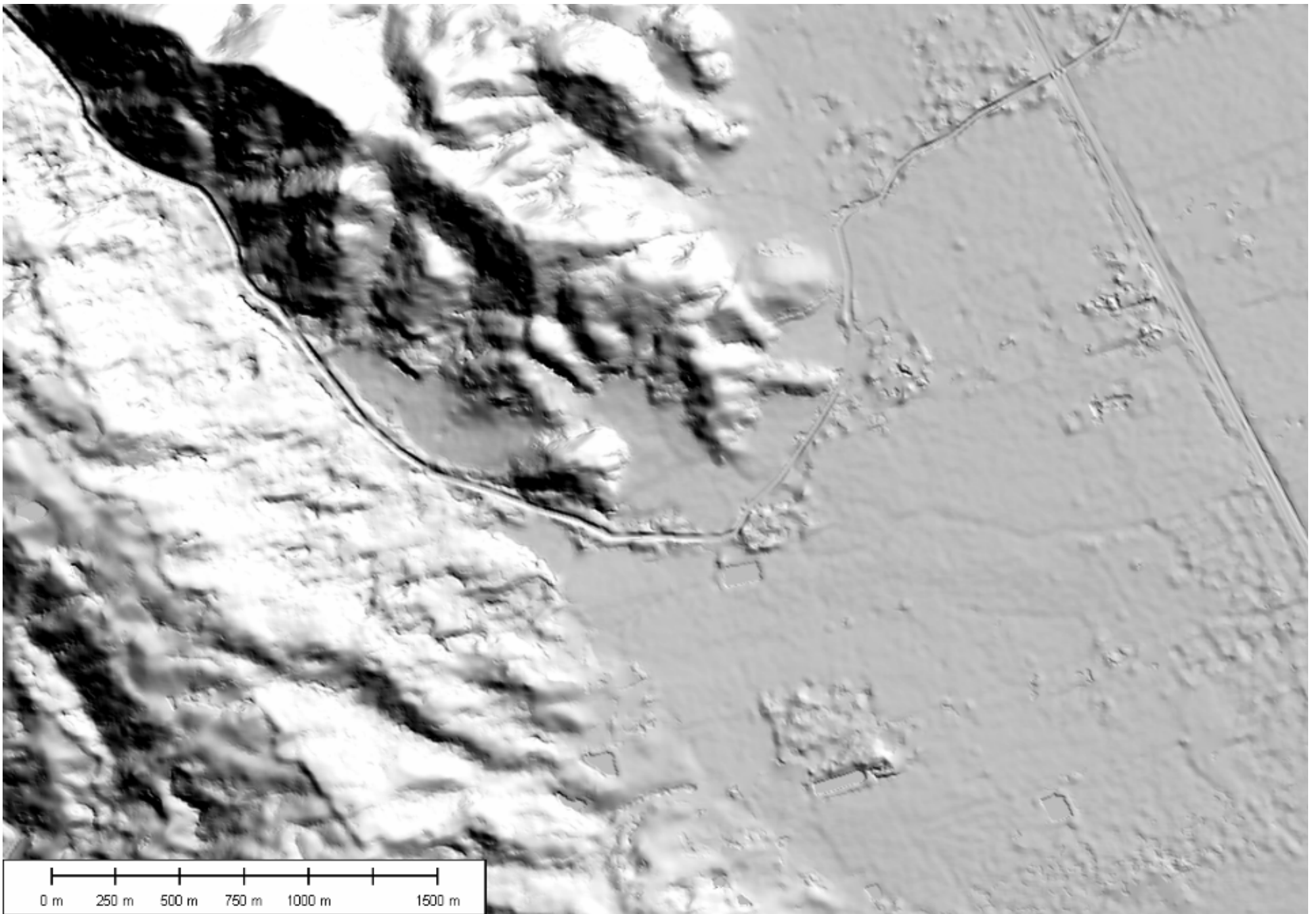
# The Core Product DTM Today



# Rural Example

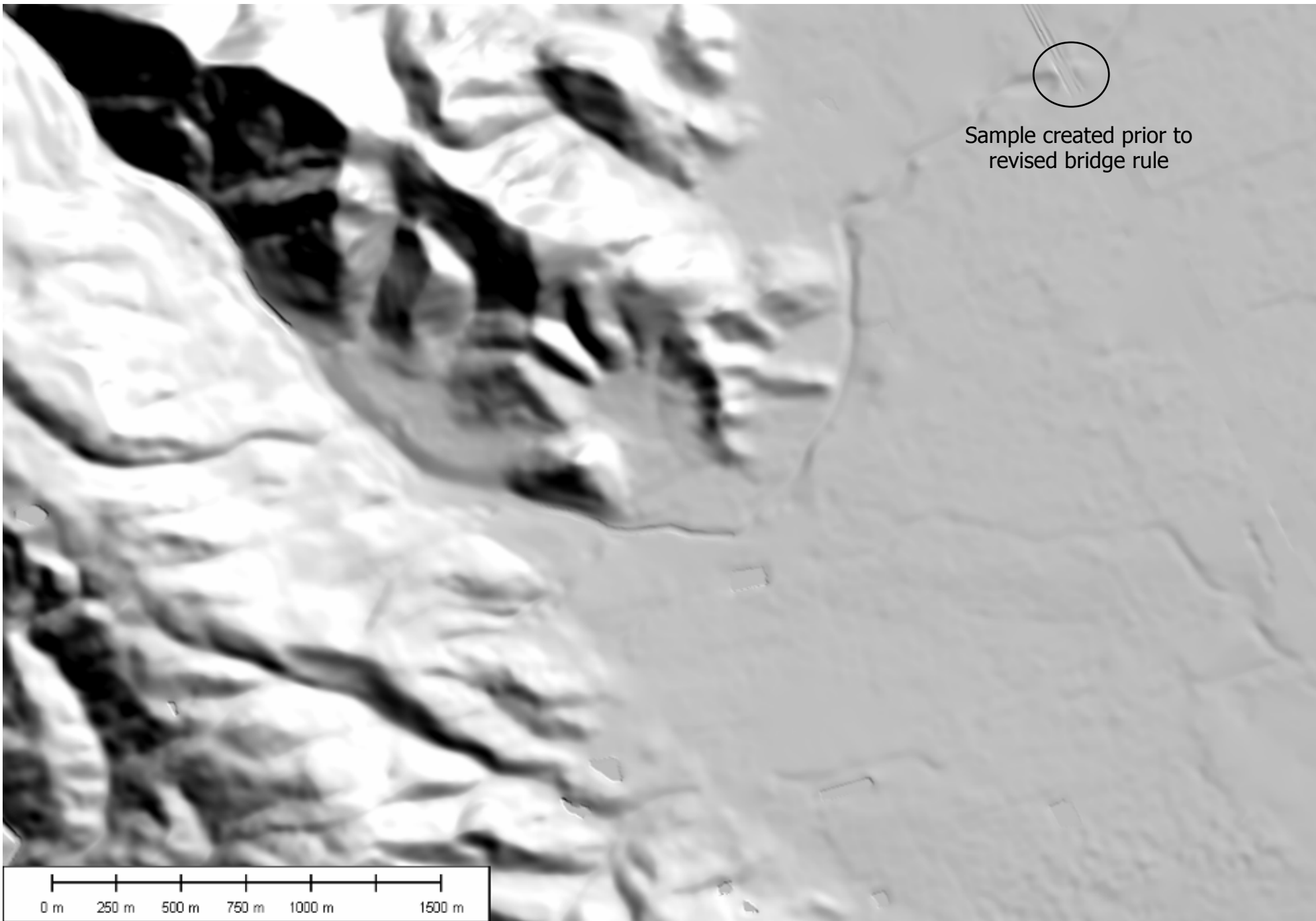




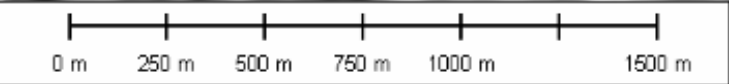


# Prior Digital Terrain Model



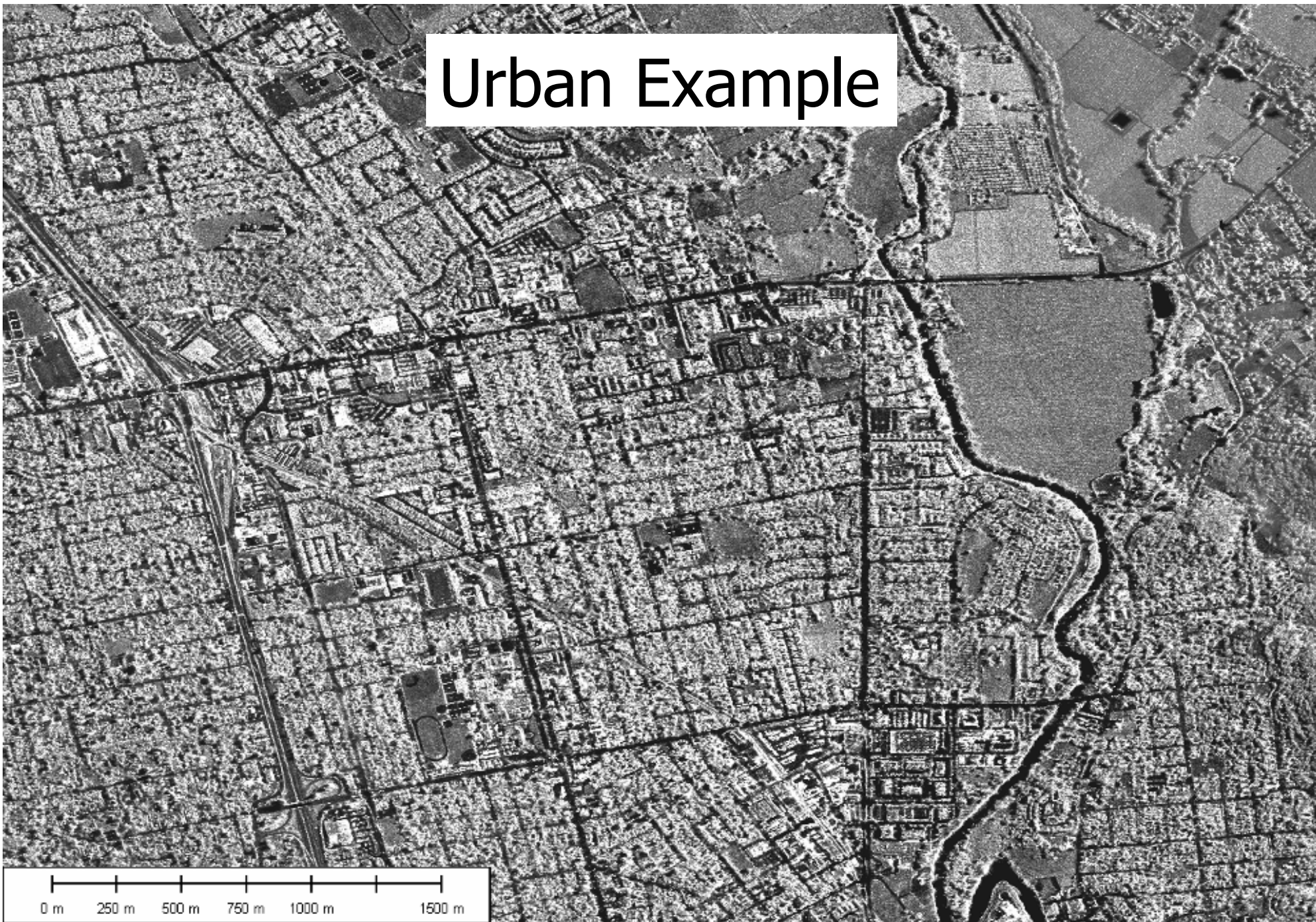


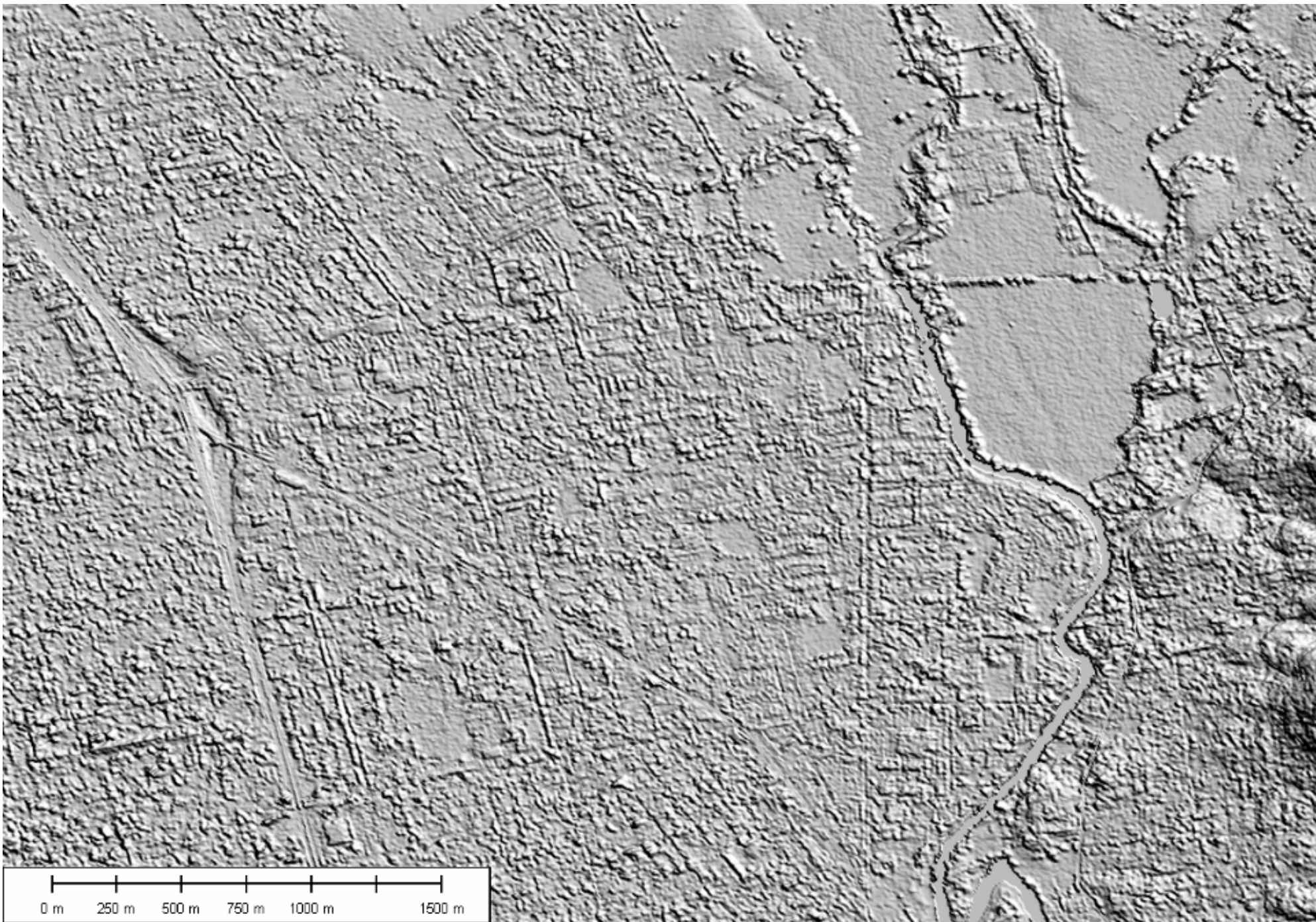
Sample created prior to revised bridge rule



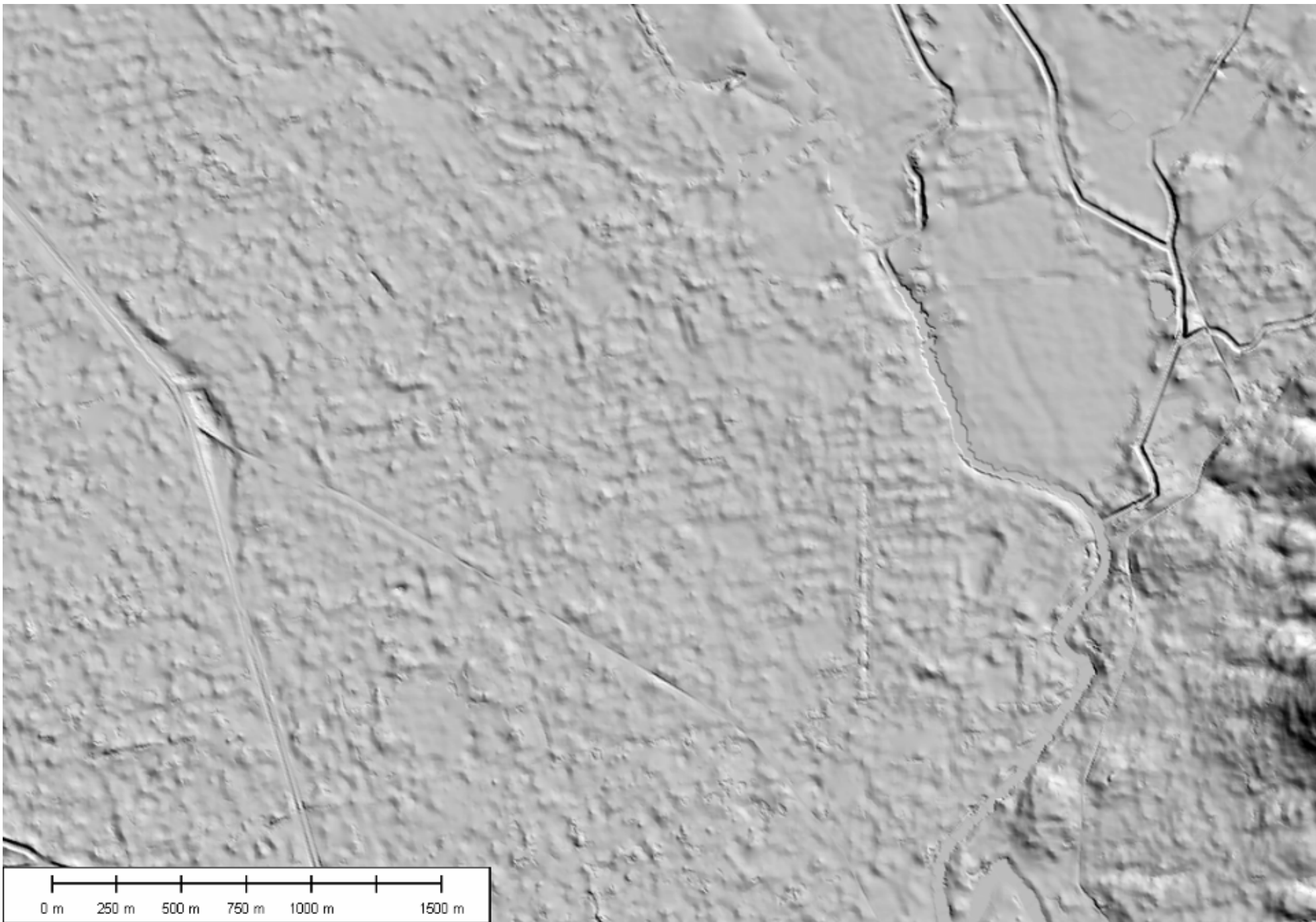
# Today's Core Product DTM

# Urban Example

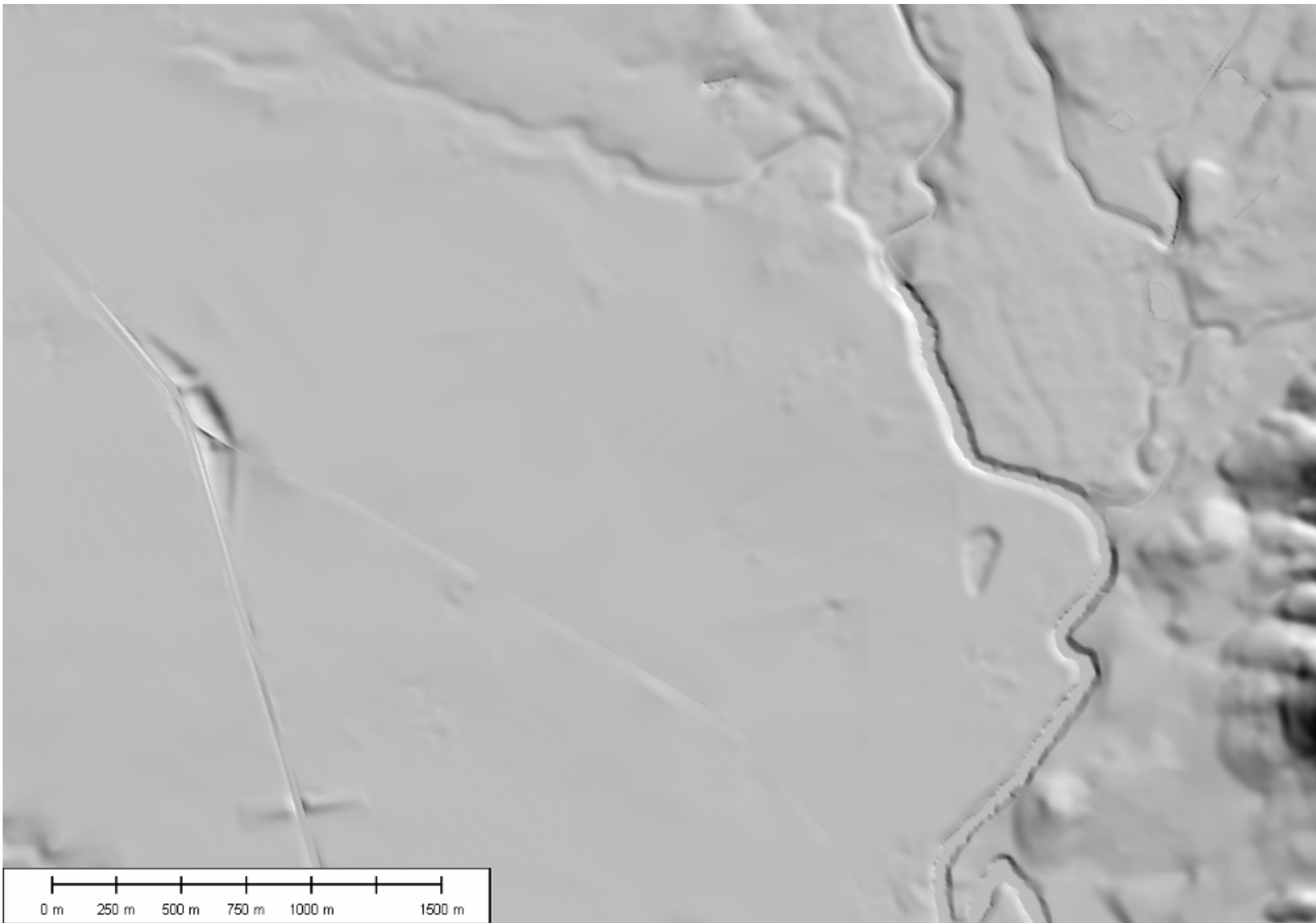




# Digital Surface Model



# Prior Digital Terrain Model



# Today's Core Product DTM

# Enhanced DTM Edit Rule Changes

- Single Line Drains (SLDs) – Saddles will be removed where the DTM is interrupted by elevations greater than 1 meter (saddle). [Previously 2m.](#)
- Bridges – Removed in the DTM. [Previously bridges were in in both DSM and DTM.](#)
  - Classification of bridge deck extents will allow optional addition of bridge deck elevation into the DTM or DSM if requested - **OR** -
  - Supply of an optional bridge elevation dataset
- Buildings – Removed in the DTM. [Previously isolated buildings were removed but remnants remained in dense, built up areas.](#)
- Trees and Forests – Removed in the DTM. [Previously tree stands greater than 100m remained in the DTM.](#)
- Crops that can be detected in radar data above surrounding bare ground are removed. [Previously as sensed.](#)
- Flood Defenses – Maintained in the DTM. Altered by no more than 1m from DSM in unobstructed areas. [Previously remained as sensed by the radar.](#)
- Roads and Railroads – As sensed by the radar in DSM and DTM. [Previously some classifications these features were flattened in both DSM and DTM.](#)

# Enhanced DTM Edit Process Changes

- ▀ Improved classification algorithms
  - DSM, ORI and COR inputs
- ▀ Fully Integrated Terrain Solution (FITS) in obstructed areas
  - Application of ancillary data to enhance DTM
- ▀ Terrain Builder
  - Breakline compilation using KDMS
- ▀ Improved handling of flattening and stepping of water surfaces

# Auto-Classifer

- ▀ Builds the edit mask from the DSM, ORI and COR
  - Defines where the data is obstructed and unobstructed
- ▀ Edit mask defines tool behavior
  - Example, the smoothing tool does not affect unobstructed posts
- ▀ Accurate edit mask key to producing desirable edit results
- ▀ Auto-Classifer results still require manual touch ups



# Fully Integrated Terrain Solution (FITS)

■ FITS utilizes the best available ancillary data to approximate the DTM in obstructed areas – input to the interactive edit process

- Ancillary sources

- MONA Pro for NEXTMap Europe
- USGS NED and Citipix and LiDAR where available for NEXTMap USA

- RADAR data is used to control the approximate surface

- Remove bias
- Warp ancillary data to FIT the RADAR data

■ Interactive edit process

- Editors validate FITS results in a stereo environment based on DSM elevations
- Where FITS results are questionable based on DSM elevations, editors can use vectors to adjust the elevations or revert back to DSM elevations and build the DTM manually without using FITS

# Fully Integrated Terrain Solution (FITS)

- ▲ Built into Intermap's Interactive Edit System (IES) tools
- ▲ IES classification/edit mask used to define fill areas
- ▲ Mask encompasses:
  - forest areas
  - void areas
  - obstructed single line drainage
  - urban areas
- ▲ FITS is not used in unobstructed areas with slopes less than  $10^{\circ}$

# FITS

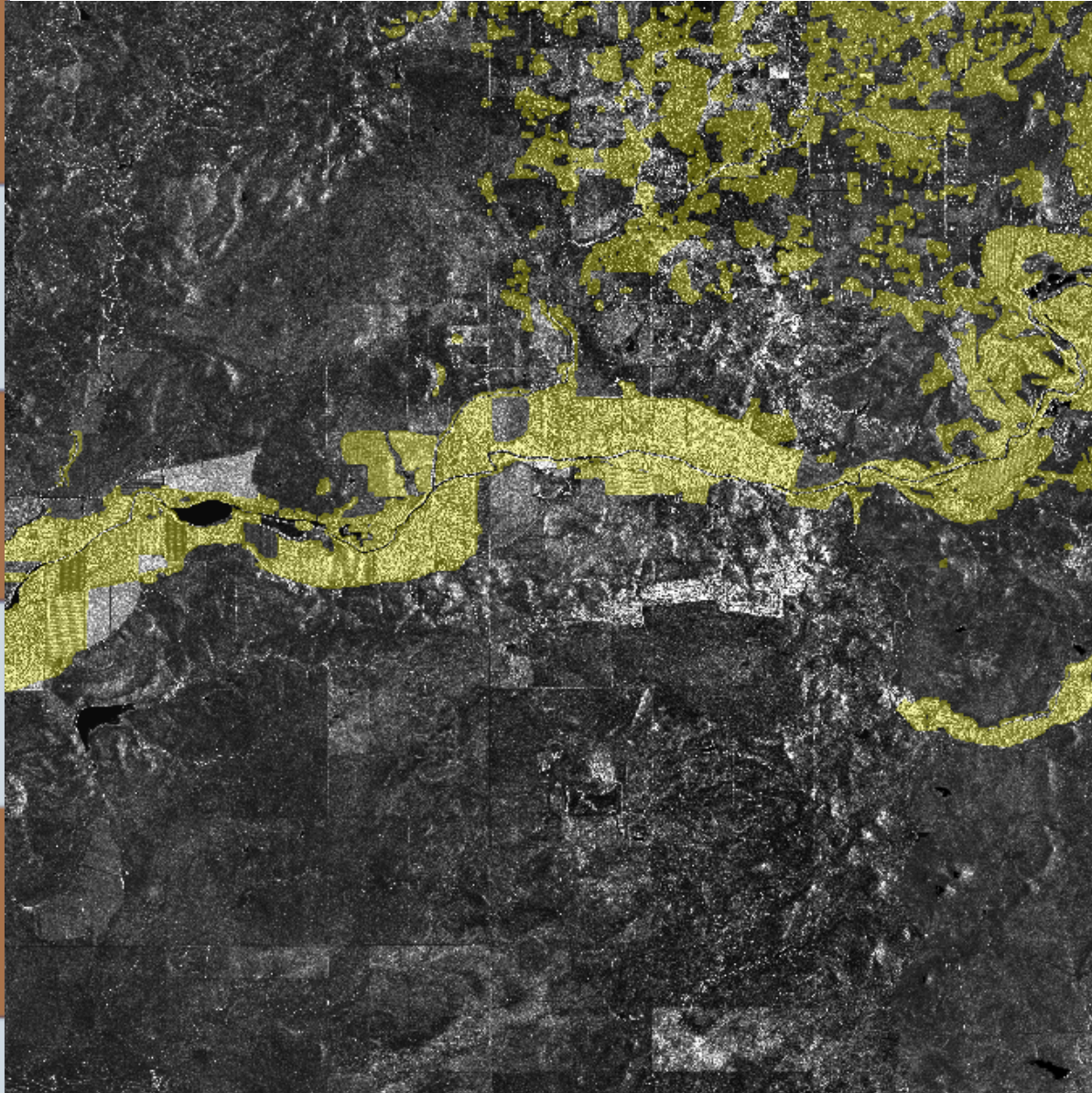
## ▲ Ancillary data is “warped” to best-fit Intermap data

- Ancillary elevations above DSM are excluded
- Removes ancillary data bias and reduces seam lines in transition areas
- Temporal differences are addressed interactively

## ▲ Occurs prior to the interactive DTM edit

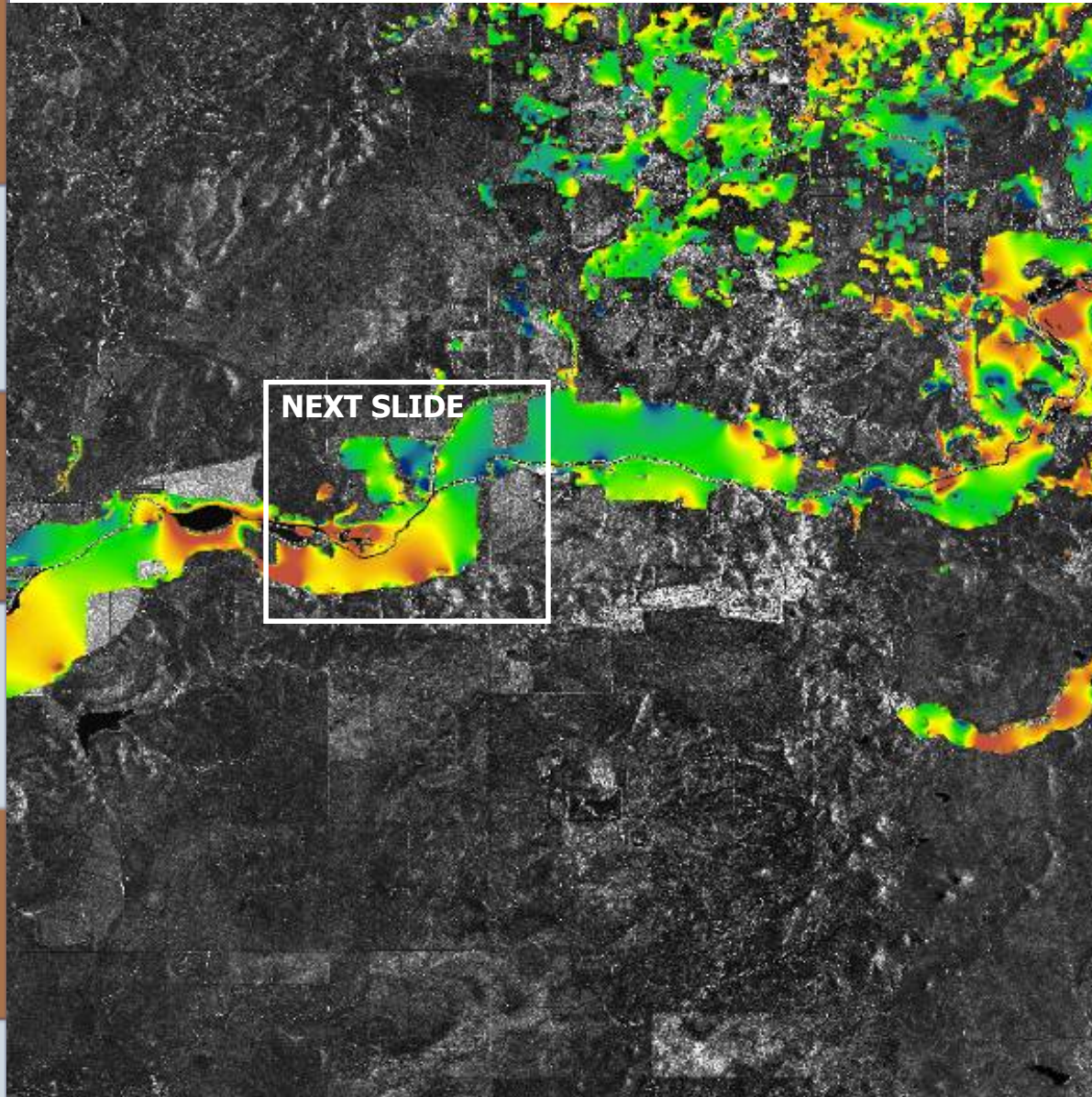
- DTM Grid Review - Editors ensure FITS areas match our data in a stereo environment that is based on DSM elevations

# FITS Mask – Example #1



- ▲ FITS areas (semi-transparent yellow)
- ▲ 14% of the tile

# NED minus DTM (in FITS areas)



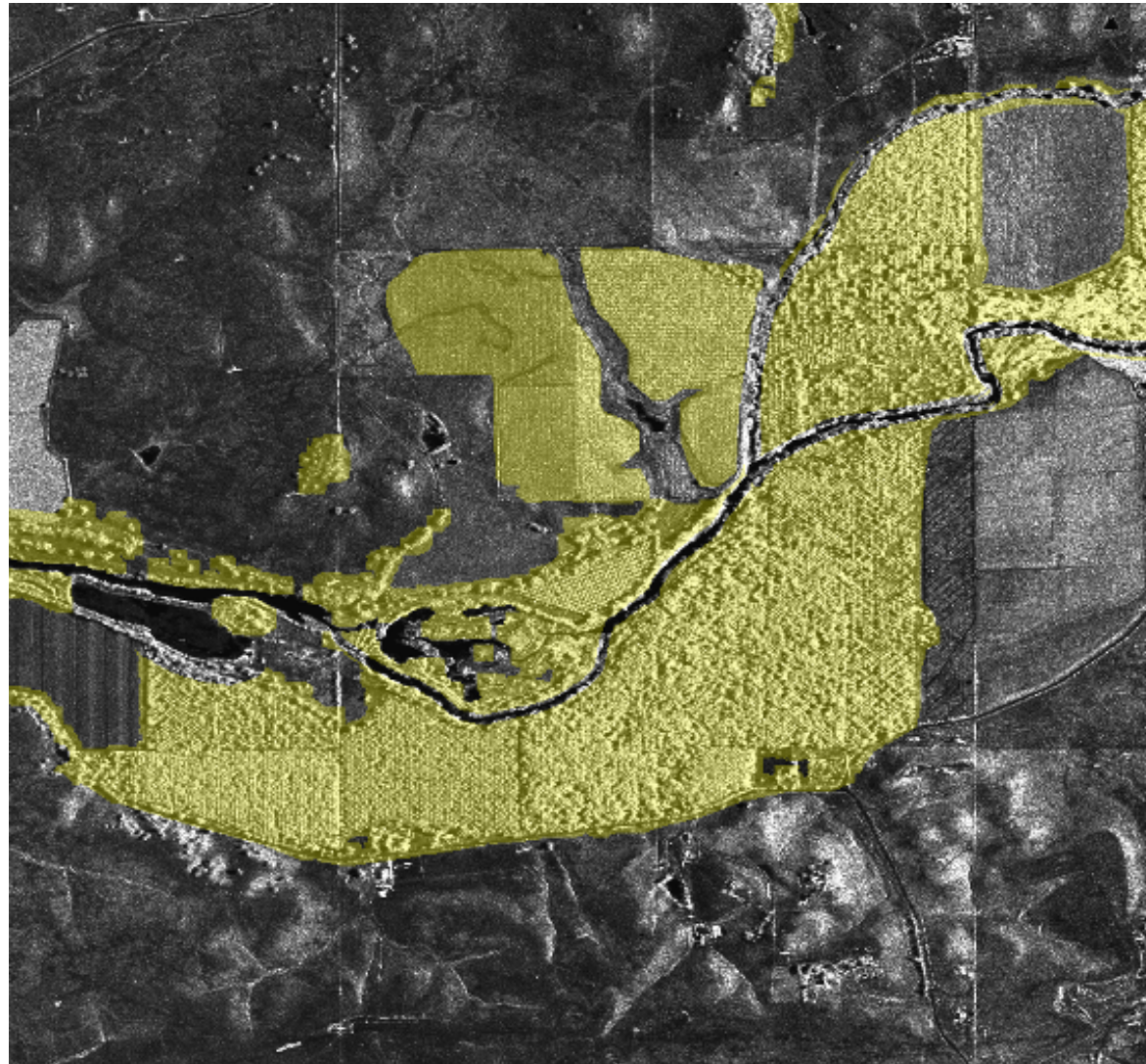
▀ DTM = NED in only 4 of 1,238,331 posts

▀ Stats:

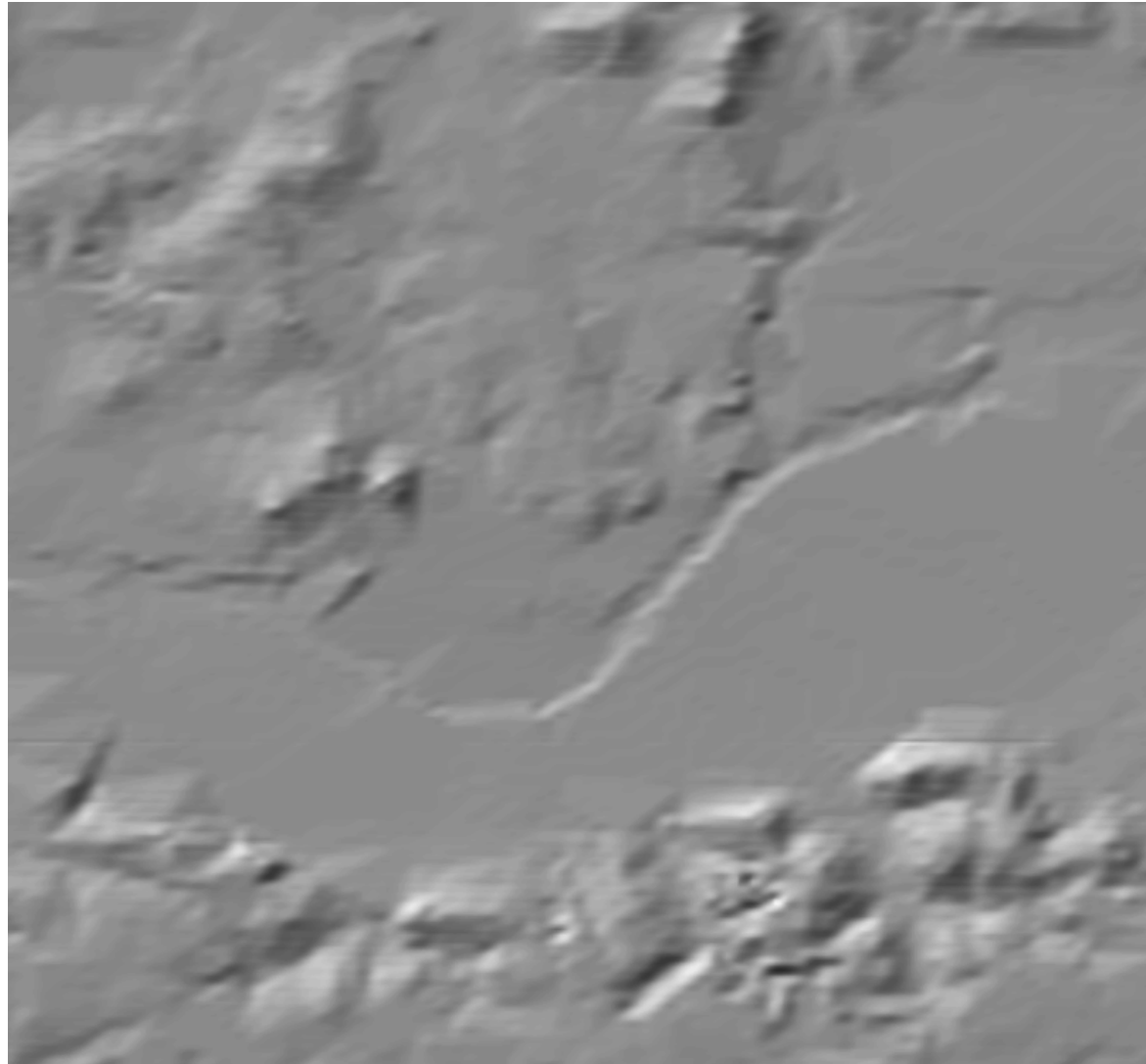
- Min. -10.00
- Max. 12.60
- Mean 0.13
- STDEV 1.42

High : 12.6014  
Low : -10.0024

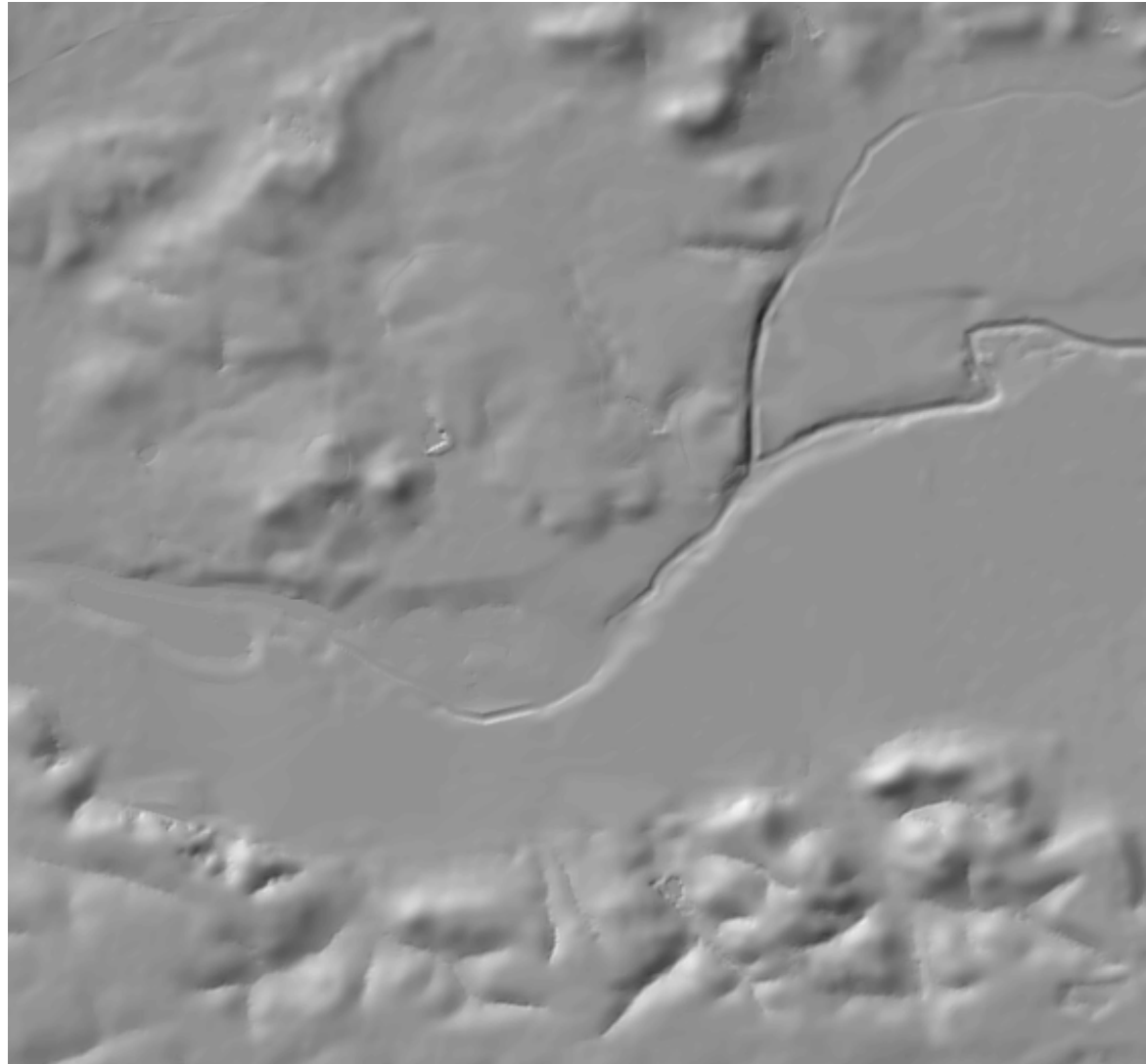
# ORI and FITS mask



# NED



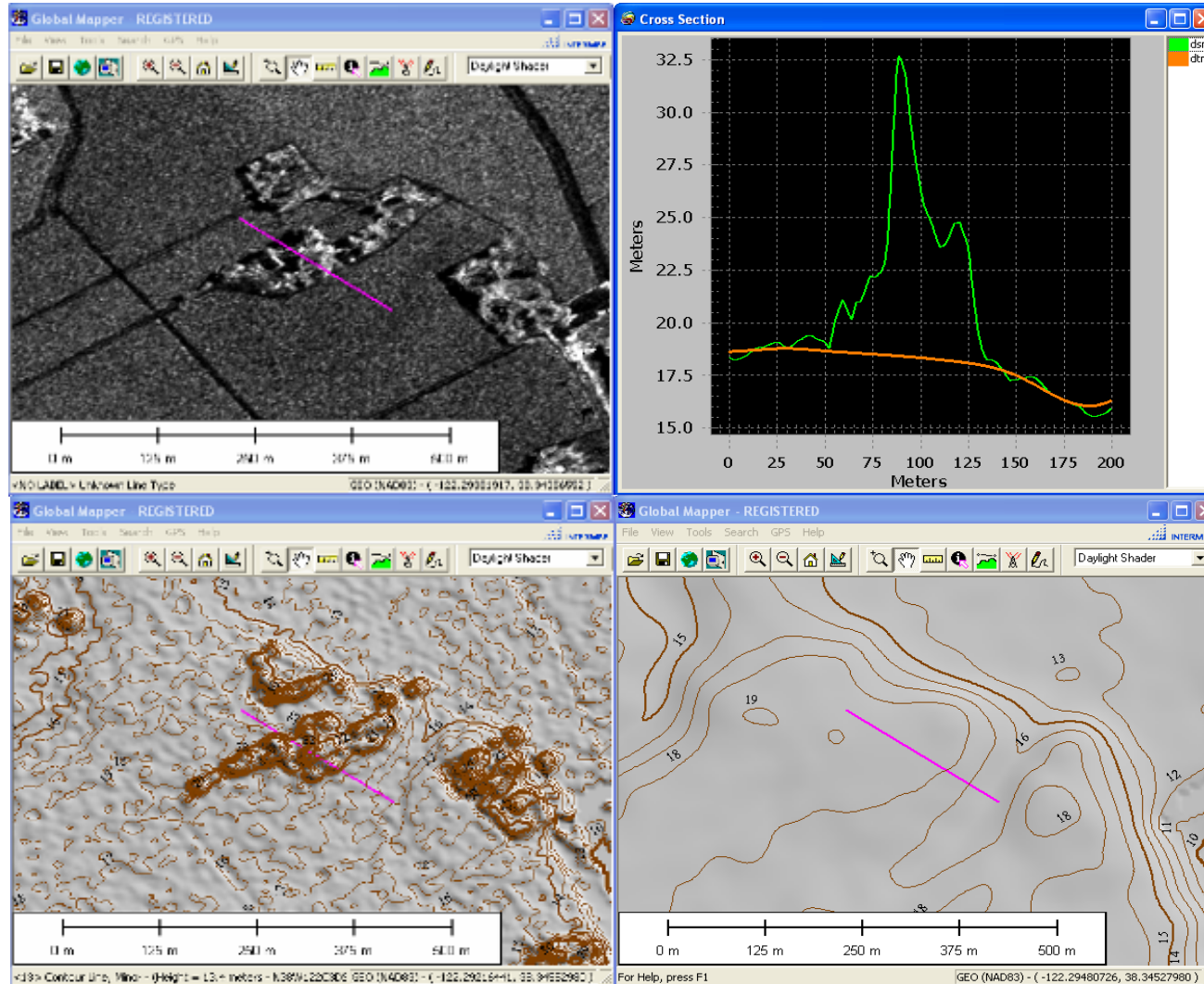
# DTM





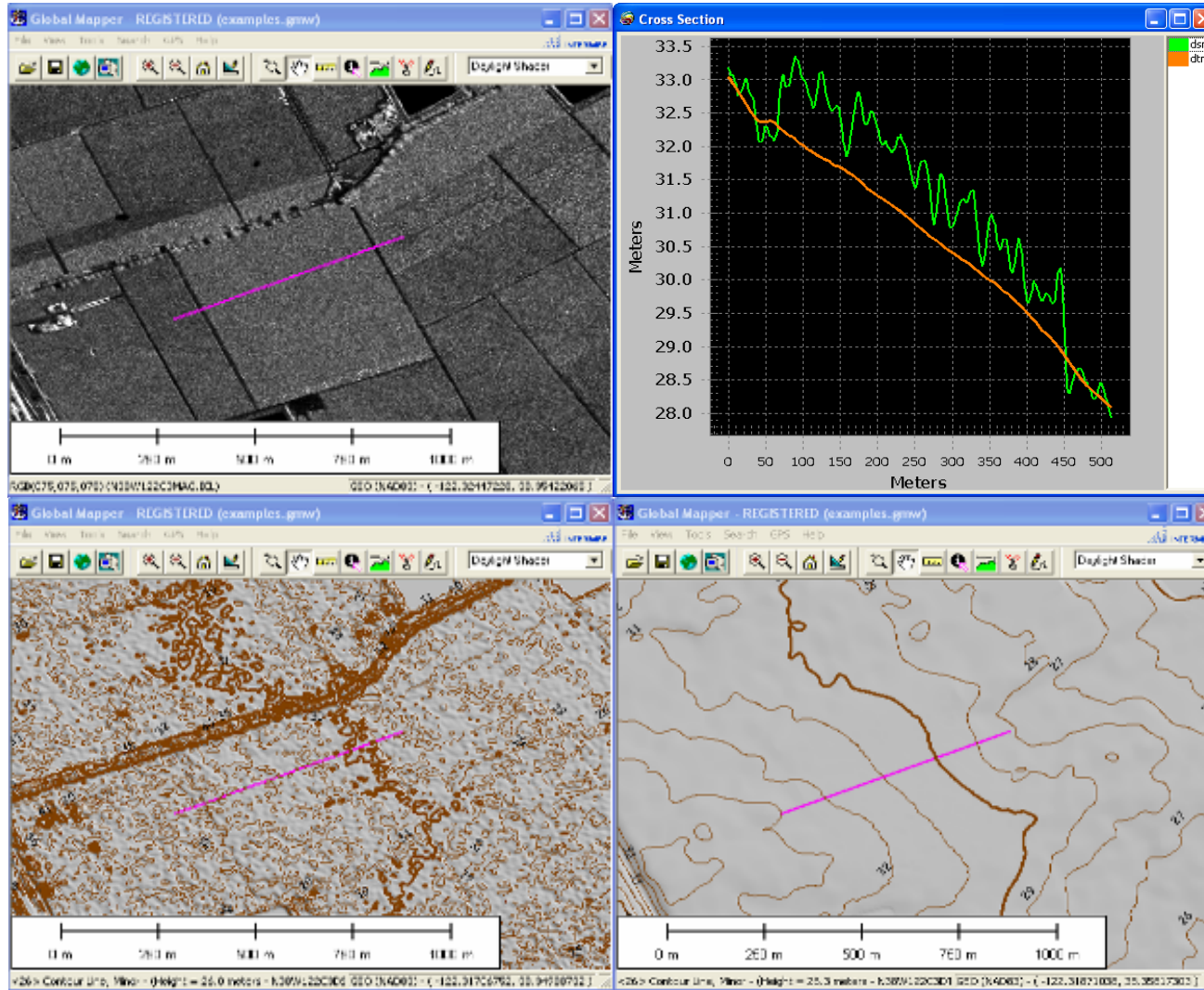
# Feature Examples

- Most obstructed features completely removed with virtually no remnants (95%)



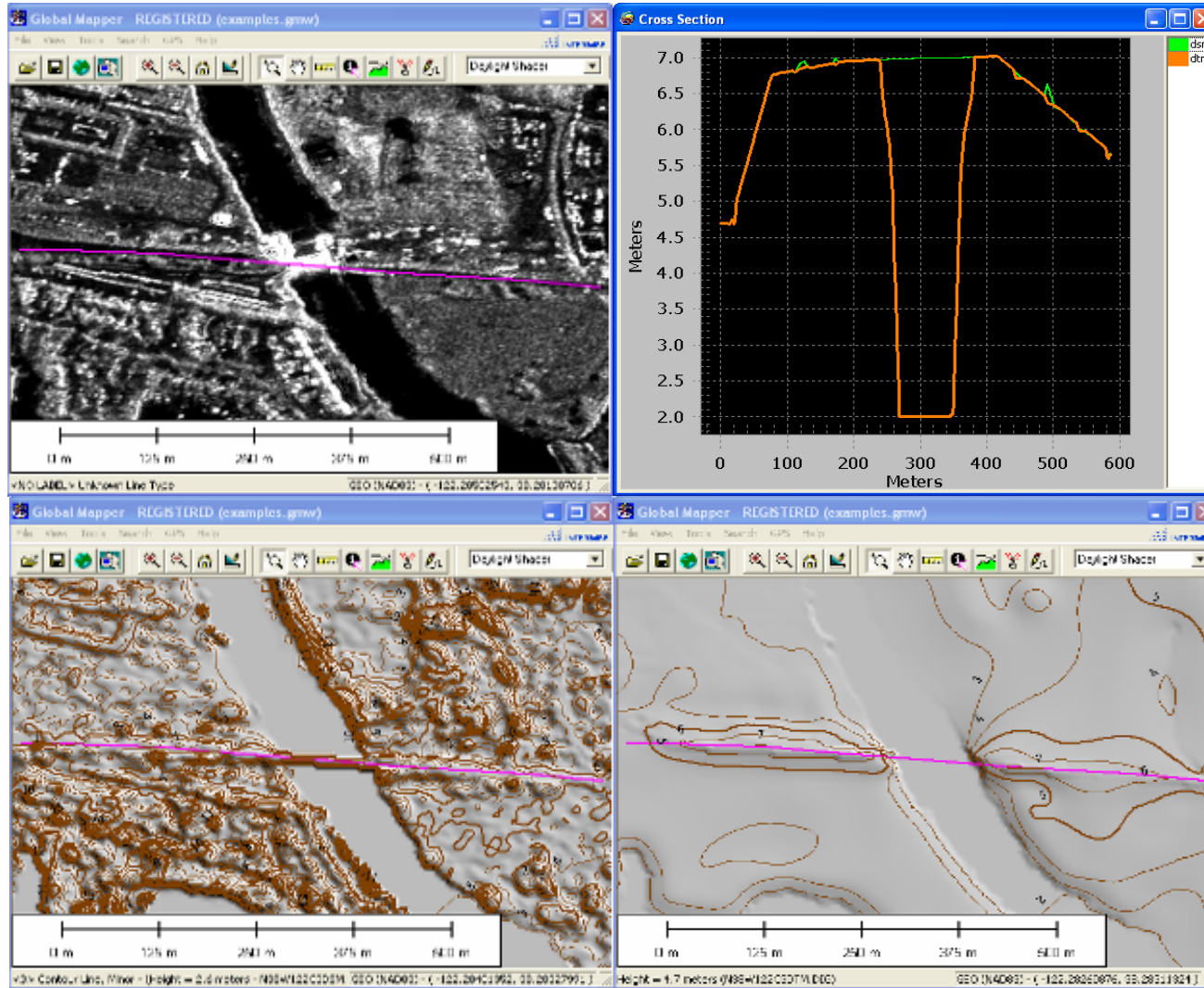
# Feature Examples

- ▀ Crops with detectable elevations are lowered to match surrounding bare ground



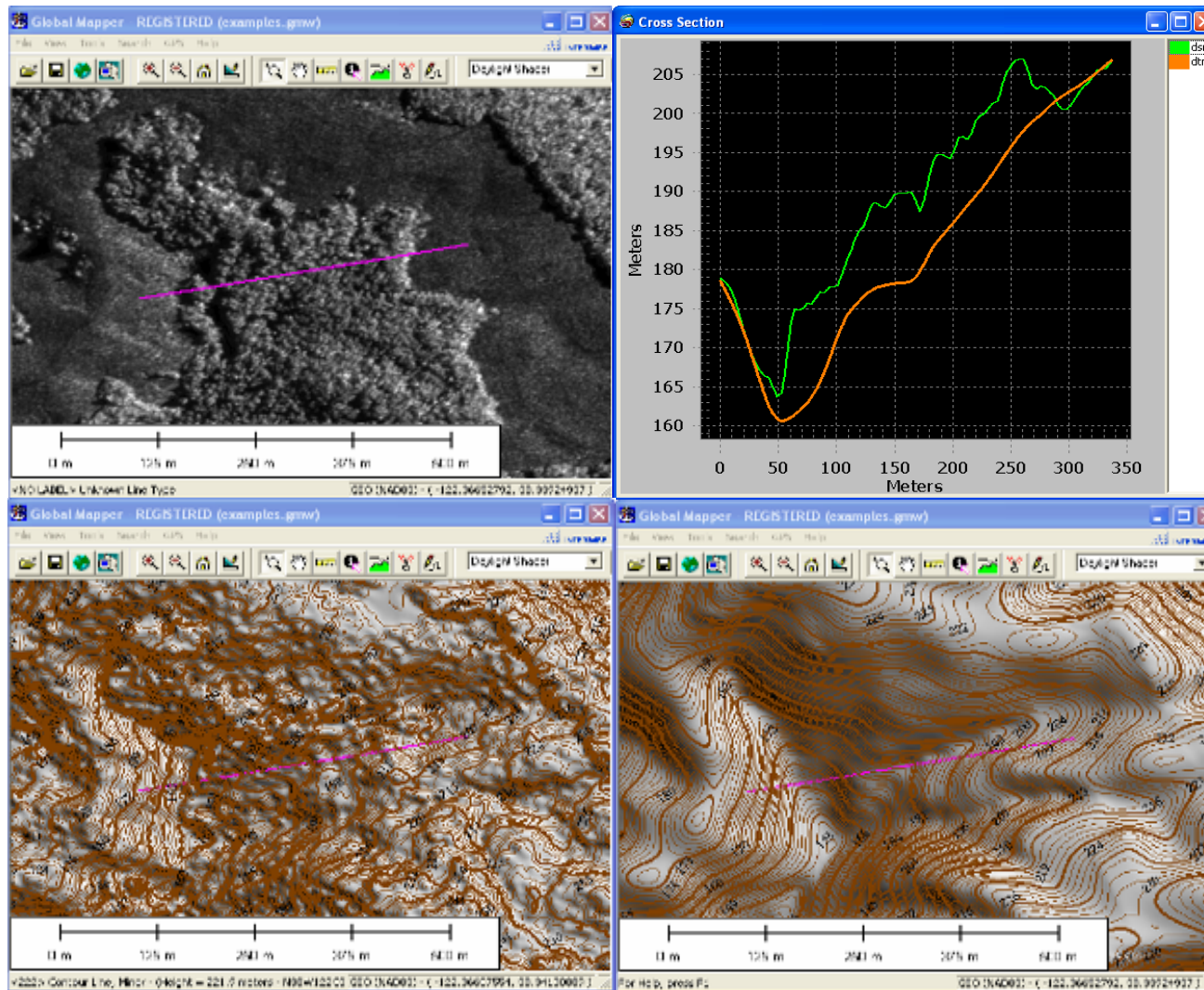
# Feature Examples

- ▄ Bridge deck elevations remain in DSM, removed from DTM



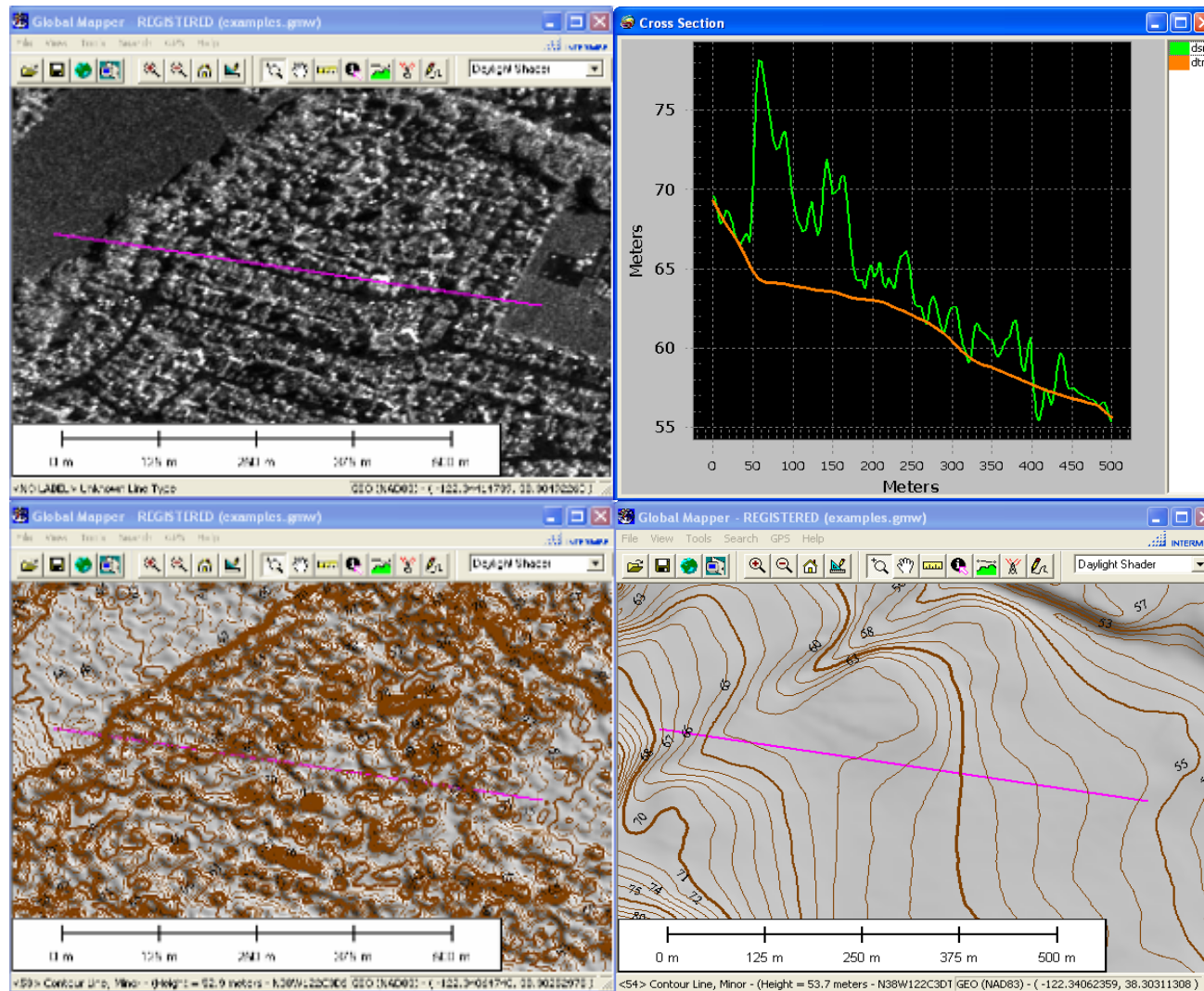
# Feature Examples

- Ancillary data is used to help define bare ground in obstructed areas (trees)

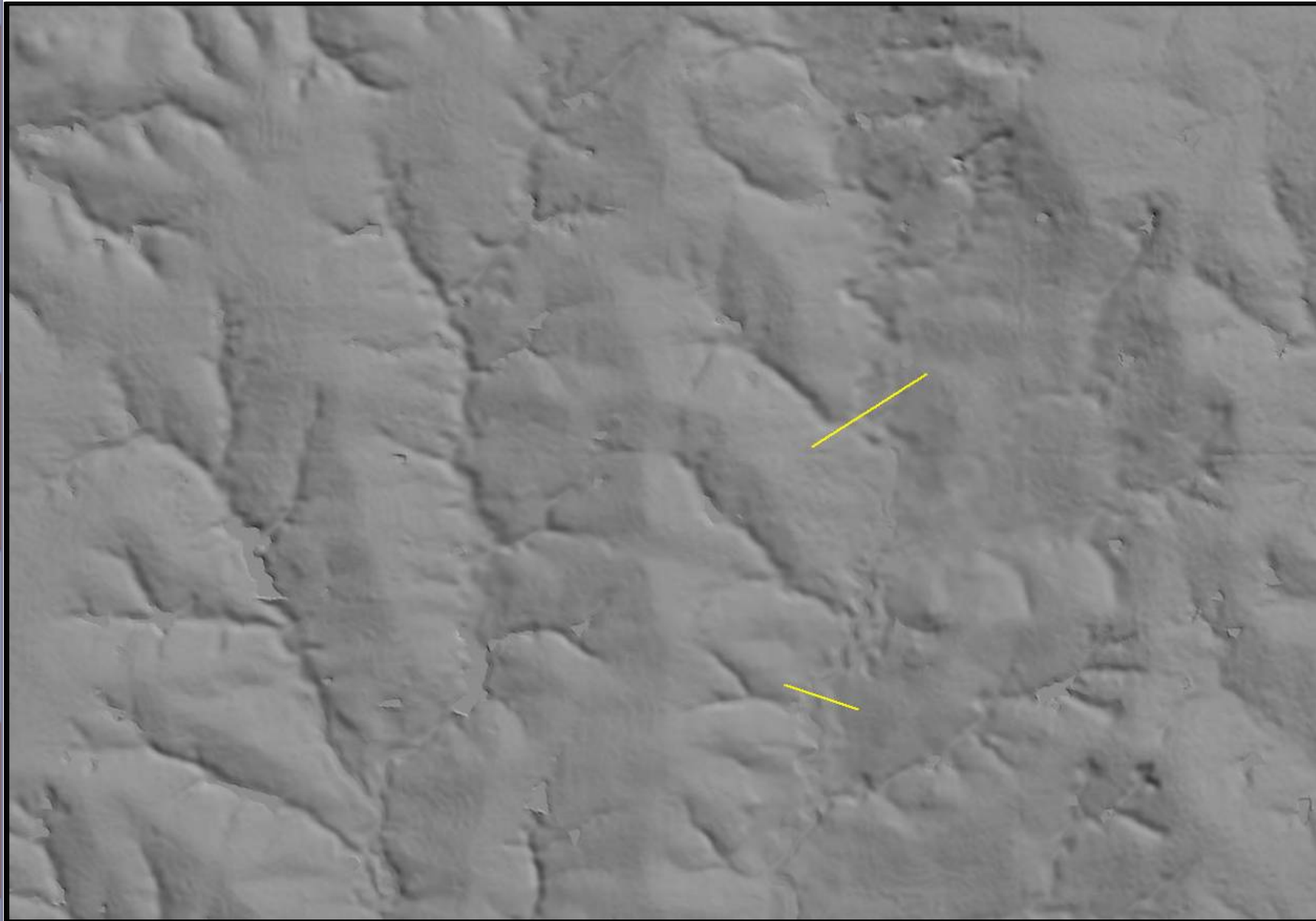


# Feature Examples

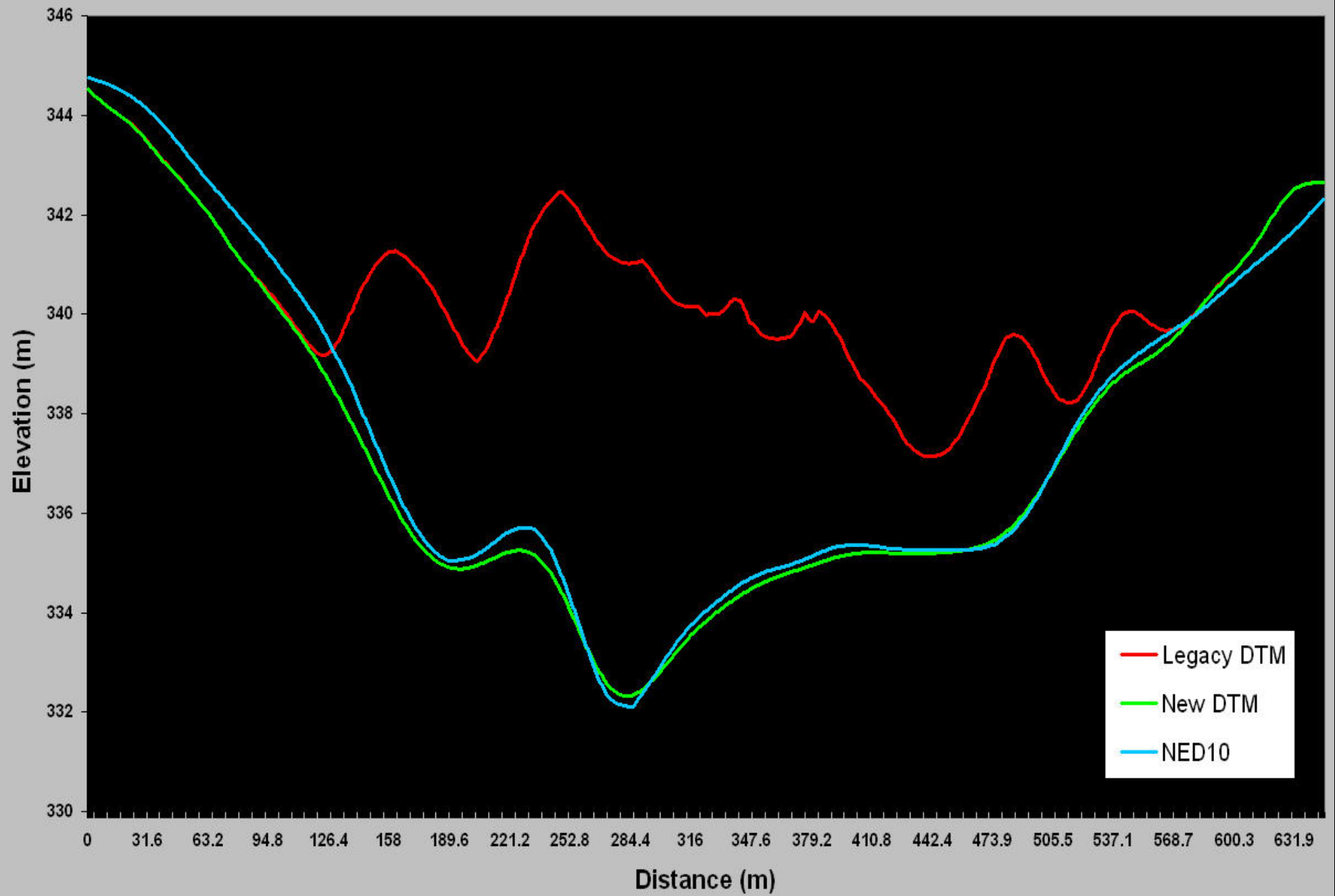
- Ancillary data is used to help define bare ground in obstructed areas (urban)



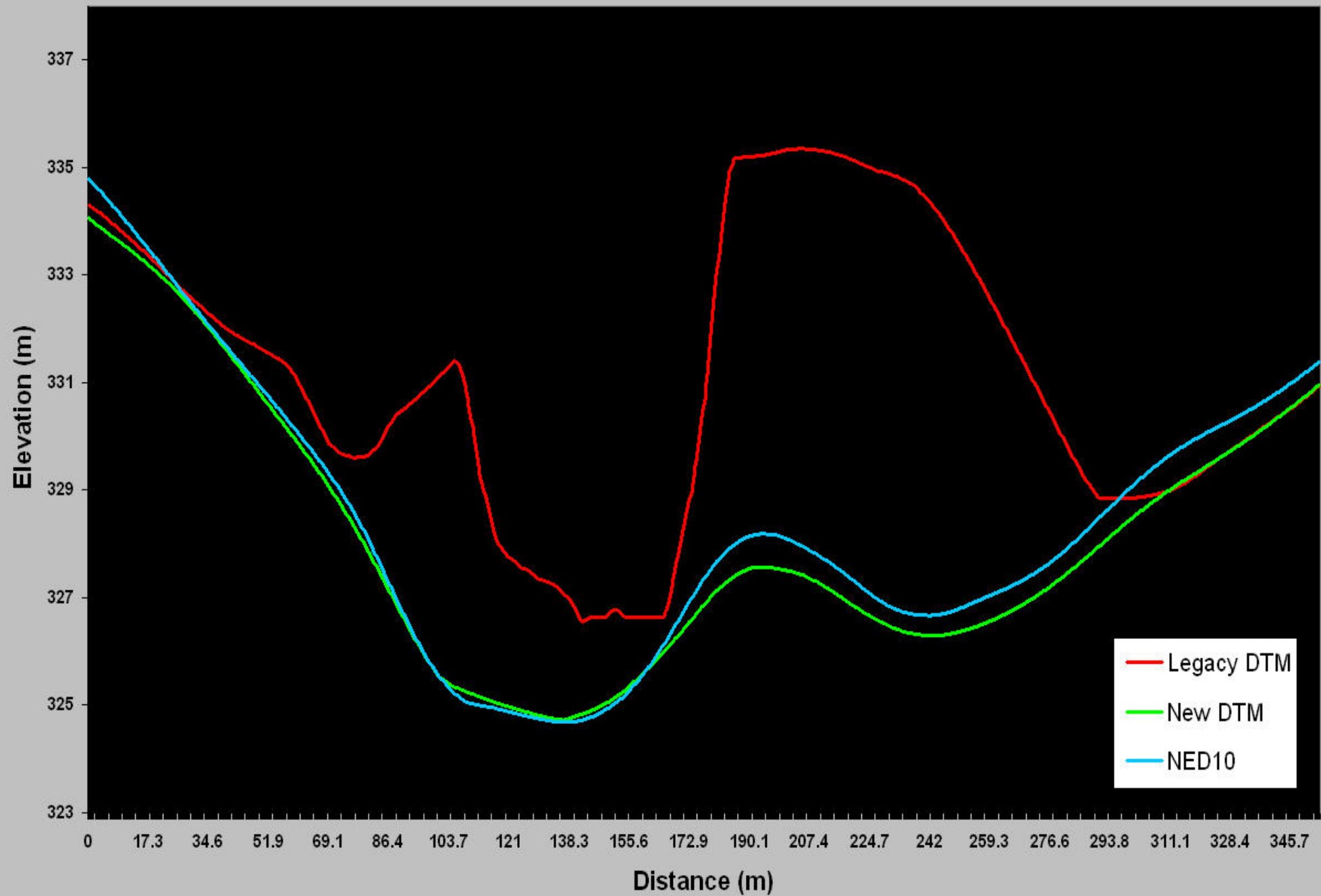
# Legacy vs Enhanced DTM



# Profile A

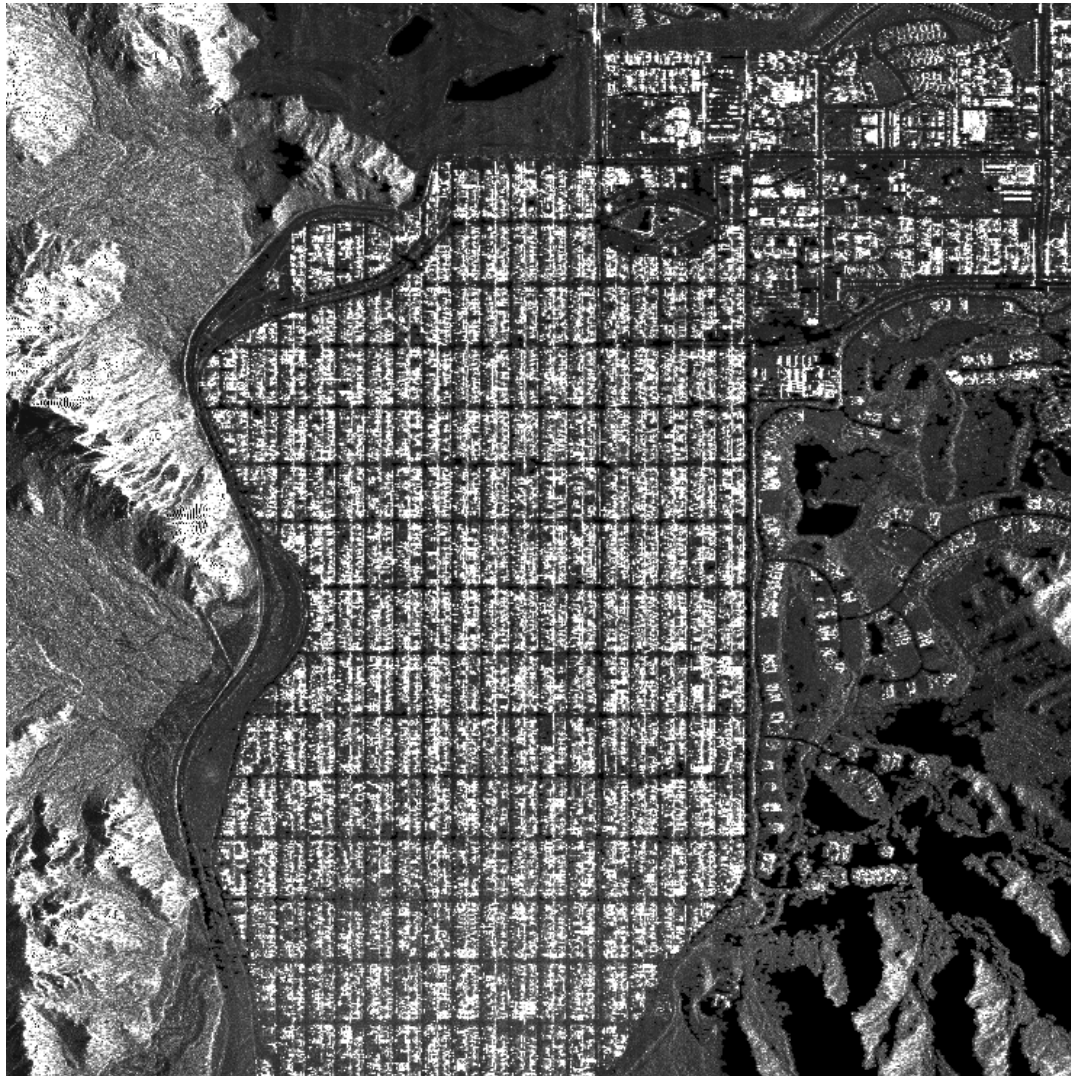


# Profile B

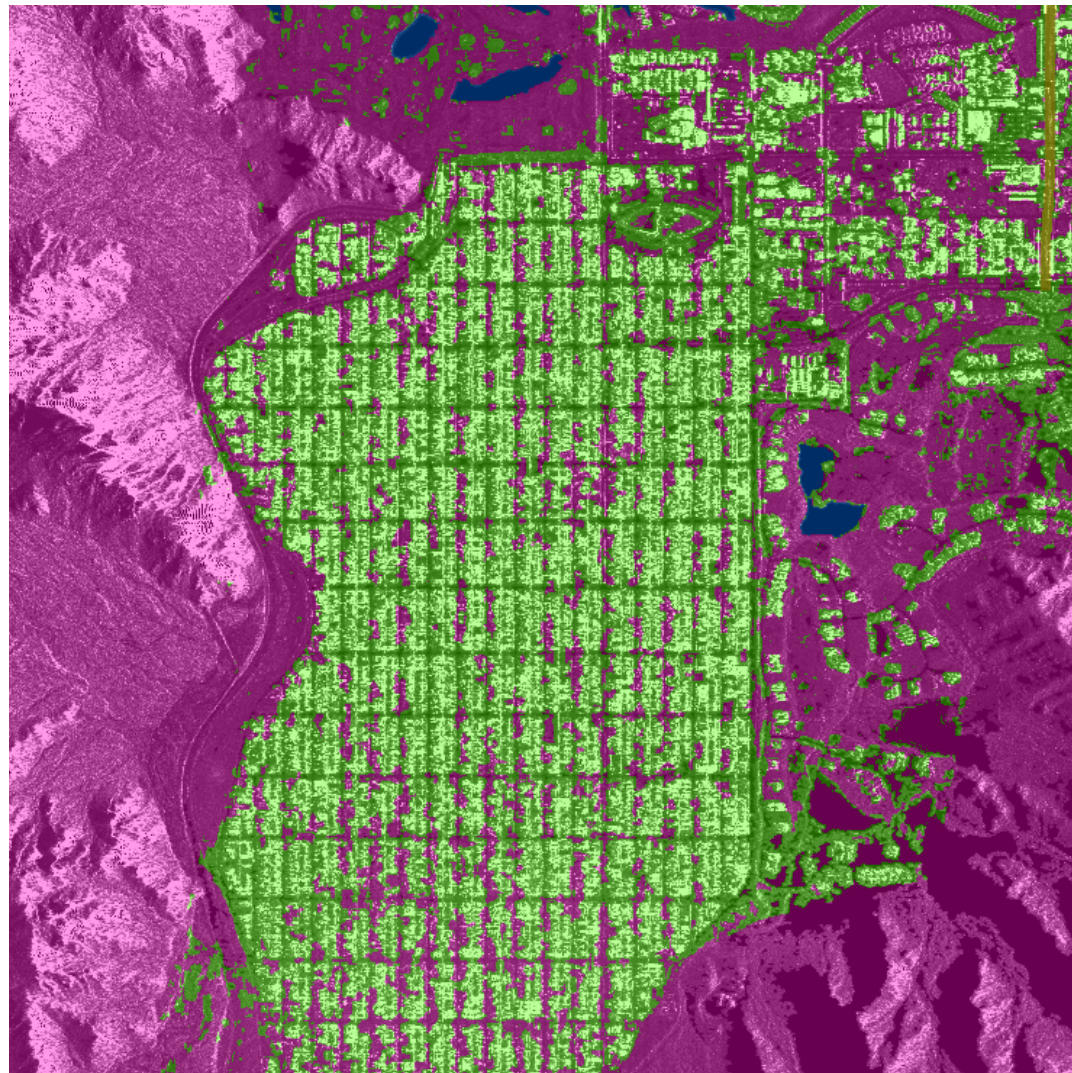




# ORI

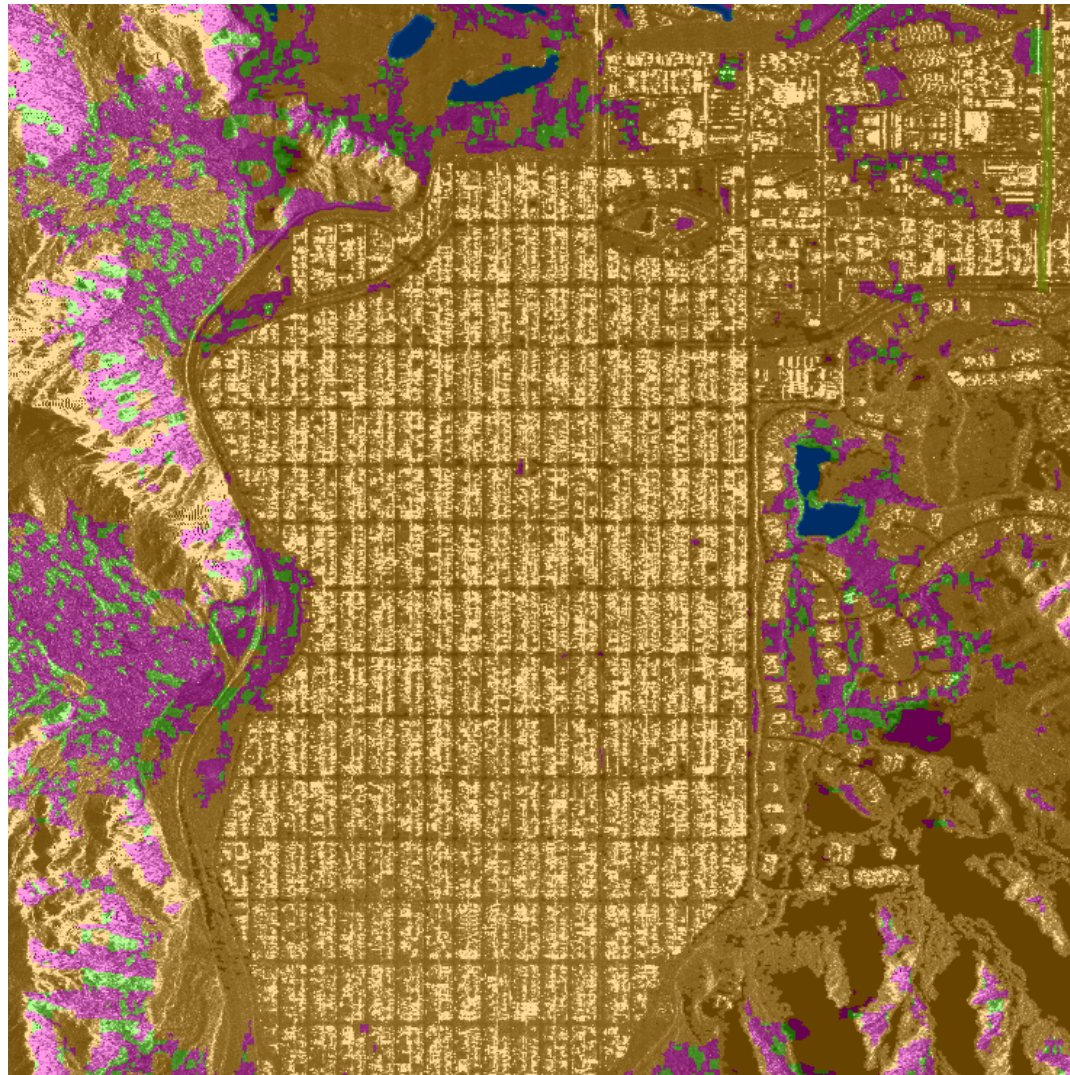


# Legacy Auto-Classifier



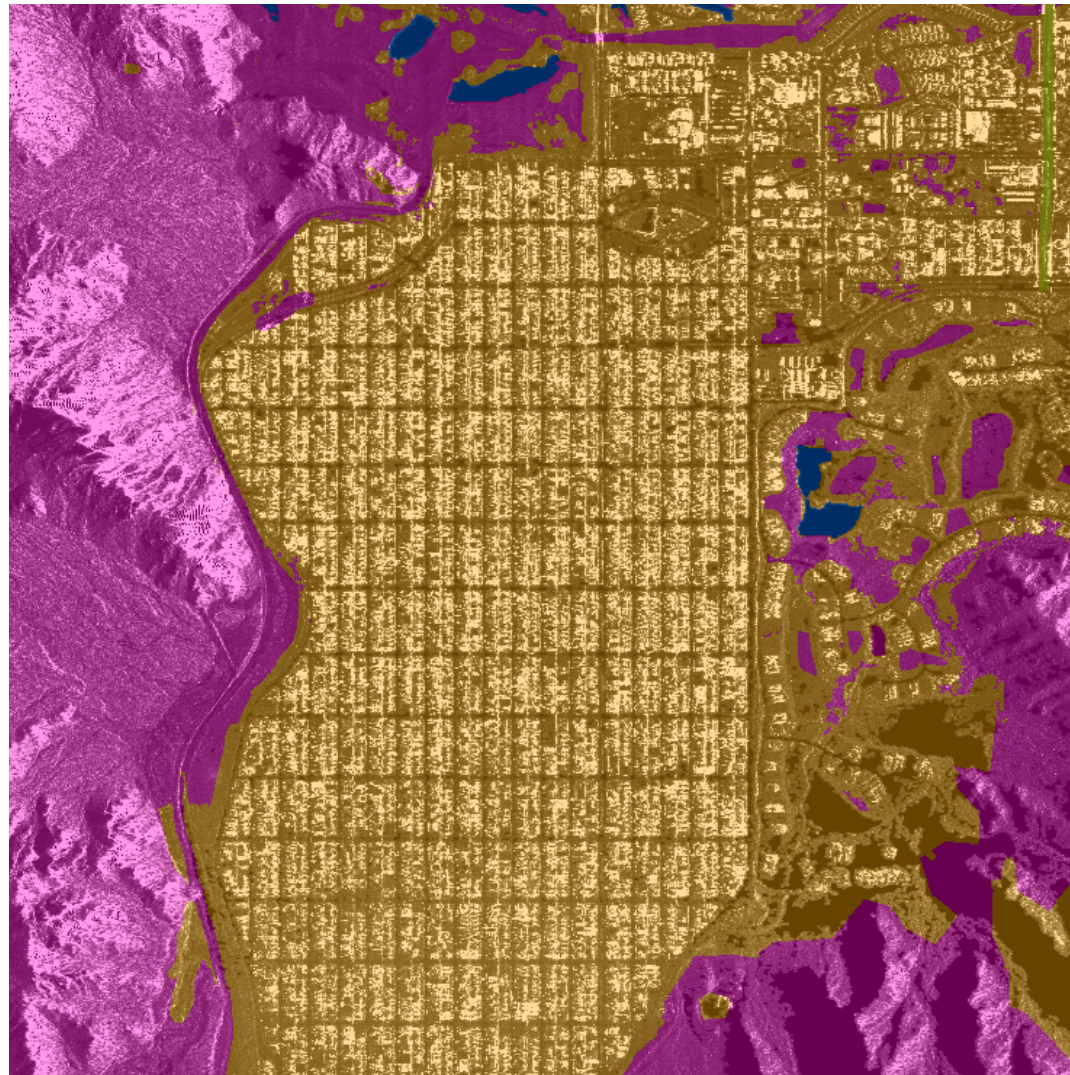
No FITS classification at all  
(would require lots of manual touch up)

# Current Auto-Classifier



FITS classification added automatically (require less manual touch up)

# Final Edit Mask

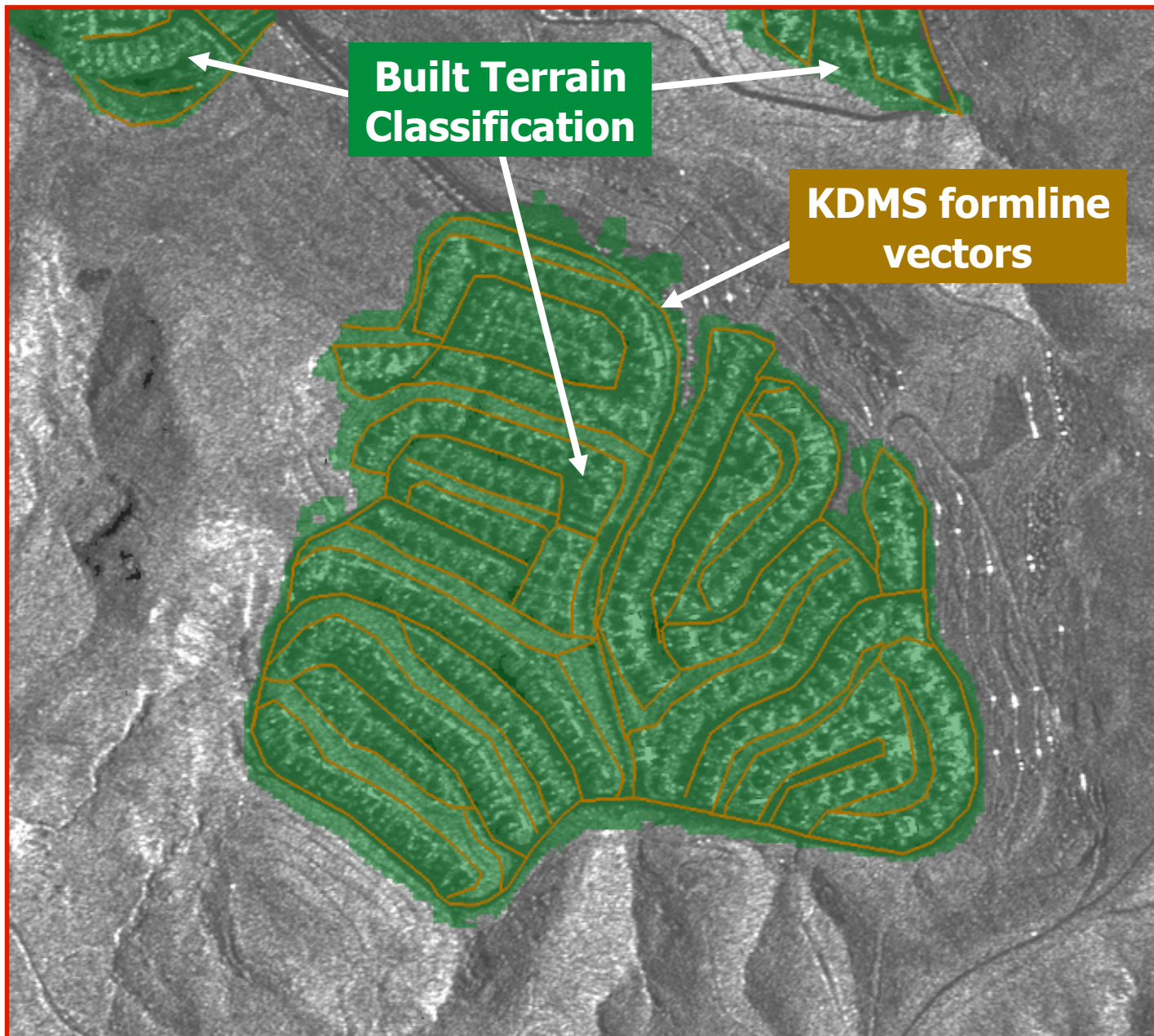


After manual touch-ups

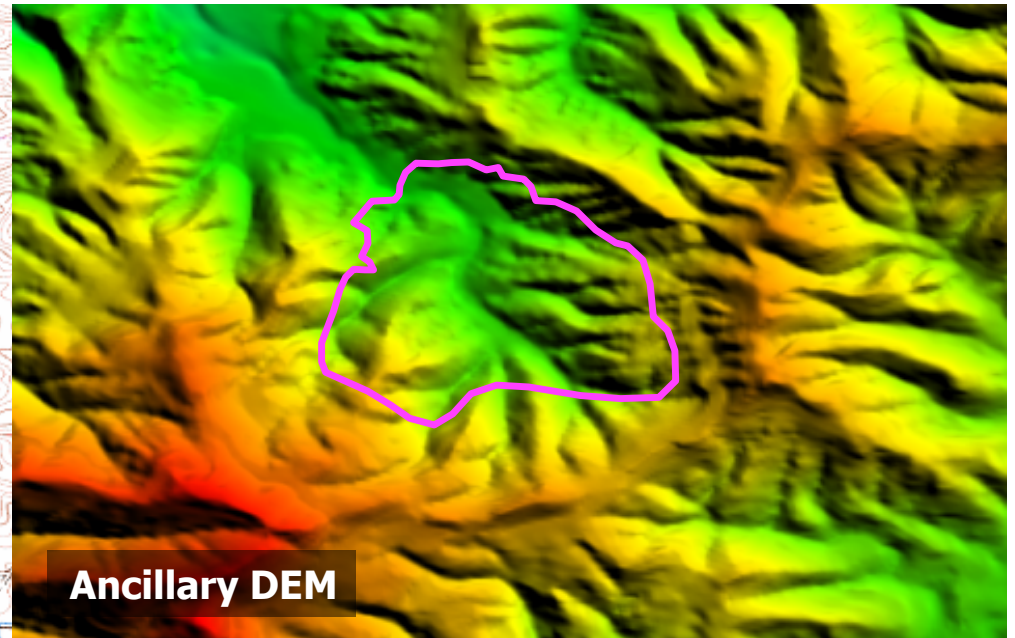
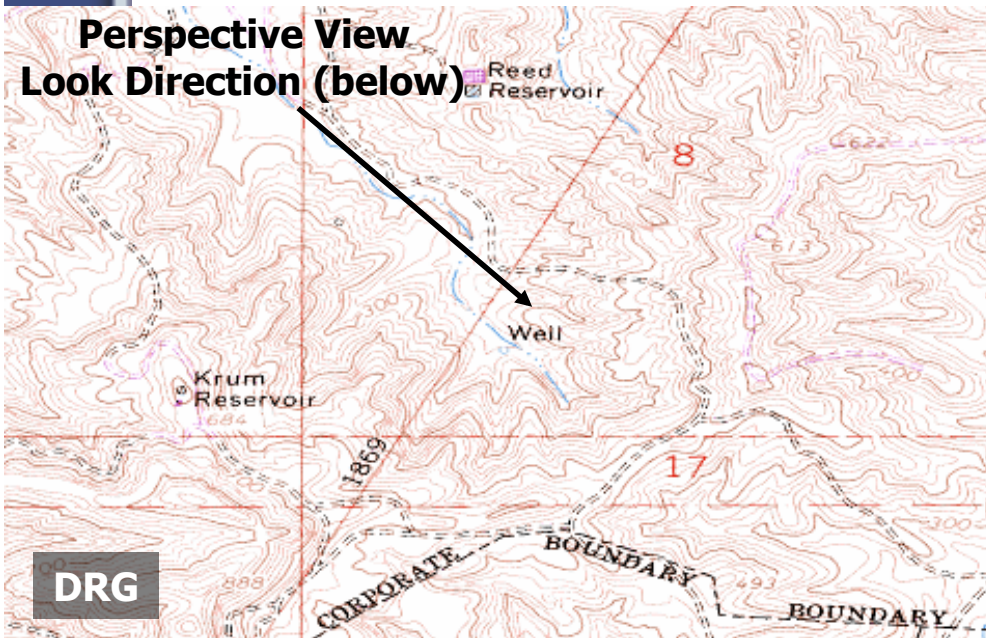
# Terrain Builder Tool

- ▀ Better and faster tool for “brute force” editing
- ▀ Build or shape terrain using KDMS vectors and interpolation in areas of:
  - Temporal change
  - Poor or questionable ancillary data

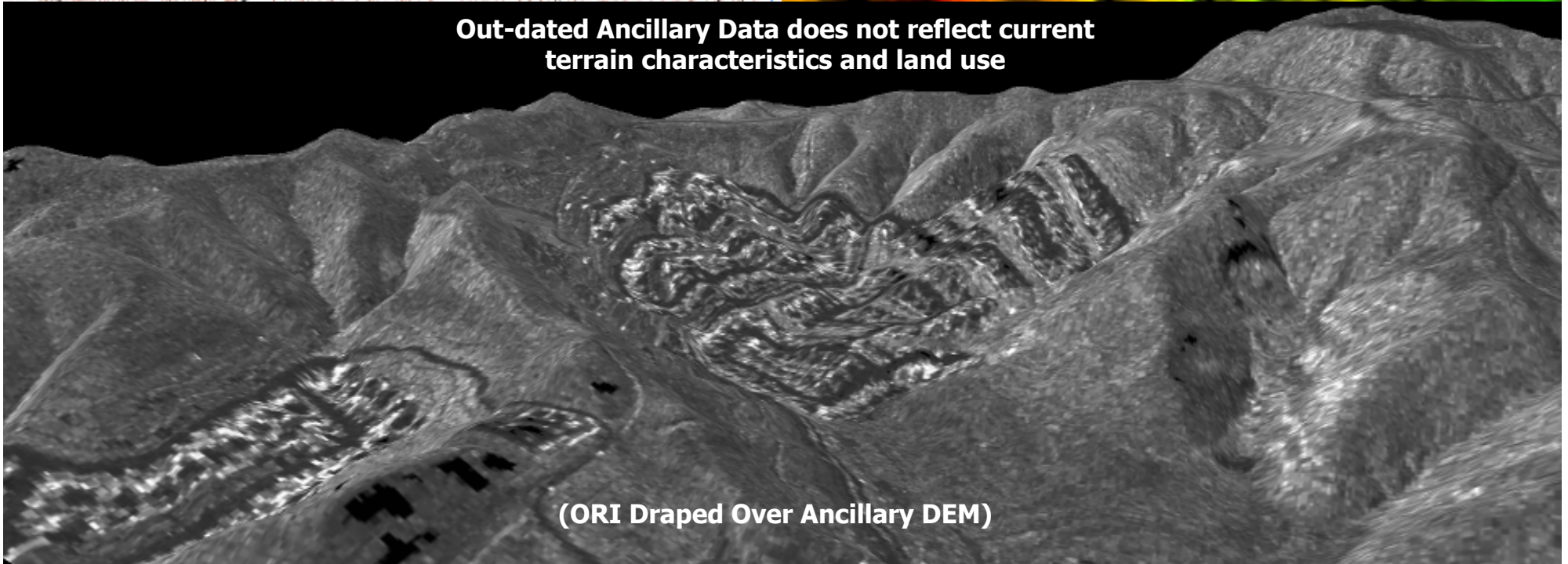
# Terrain Builder Tool Example: Temporal Change



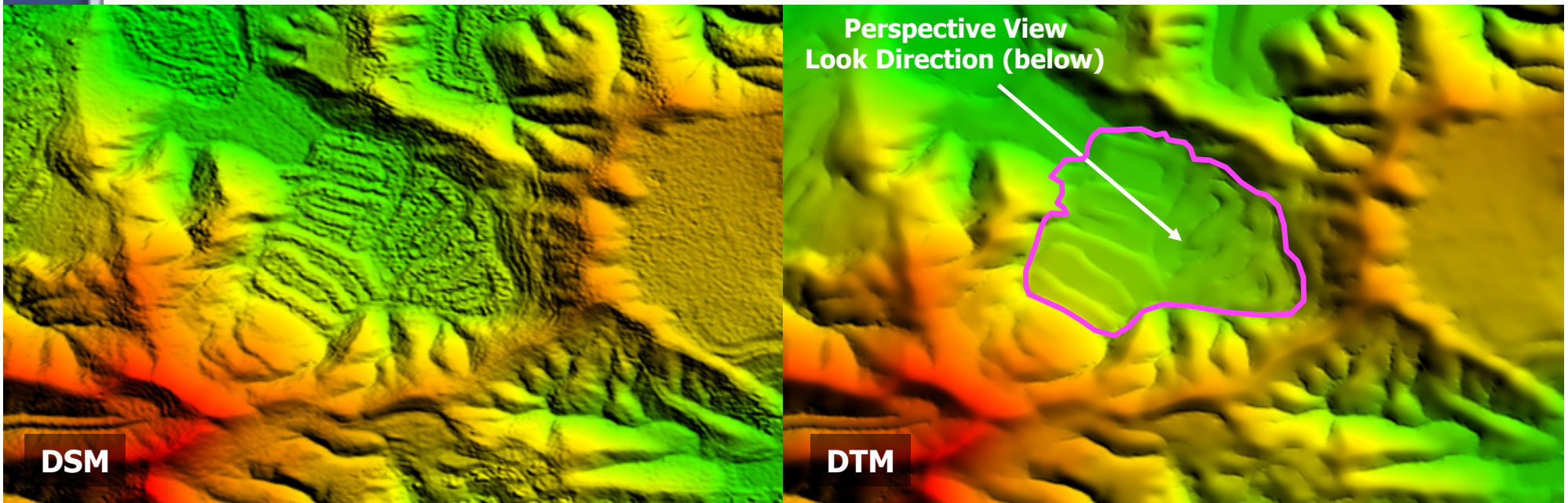
# Poor Ancillary Data...can't use FITS



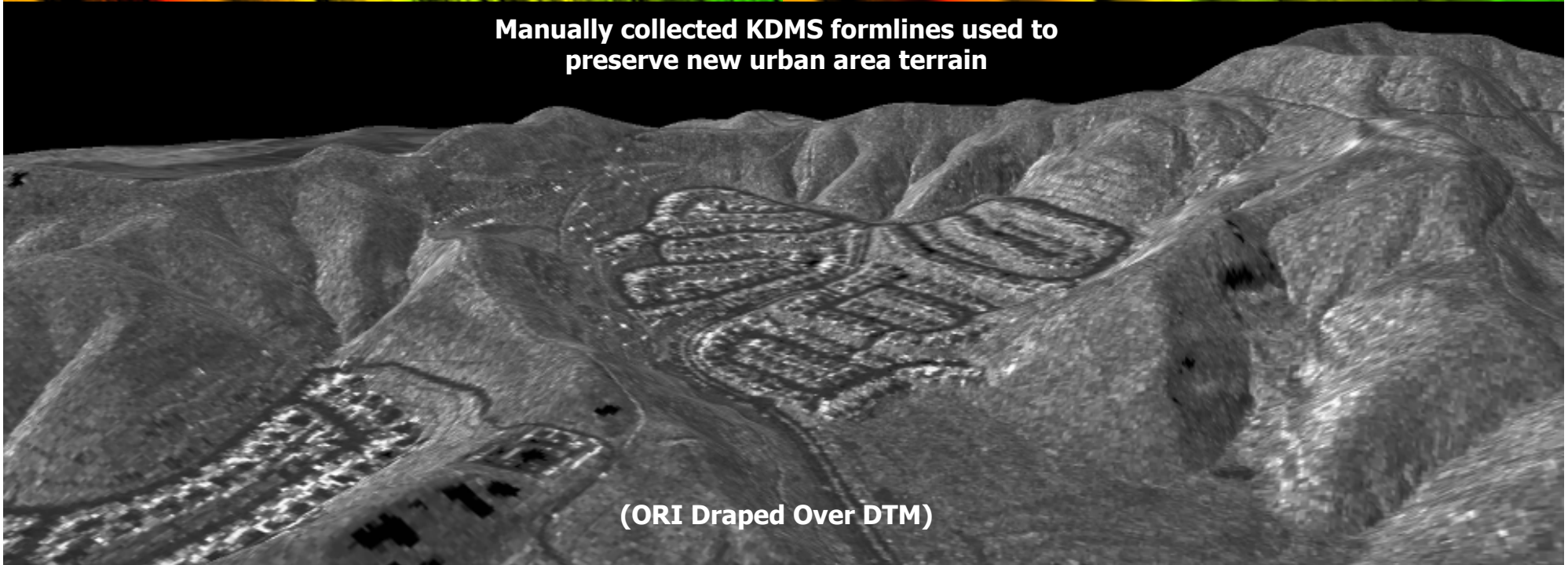
**Out-dated Ancillary Data does not reflect current terrain characteristics and land use**



# Terrain Builder Tool Results



Manually collected KDMS formlines used to preserve new urban area terrain

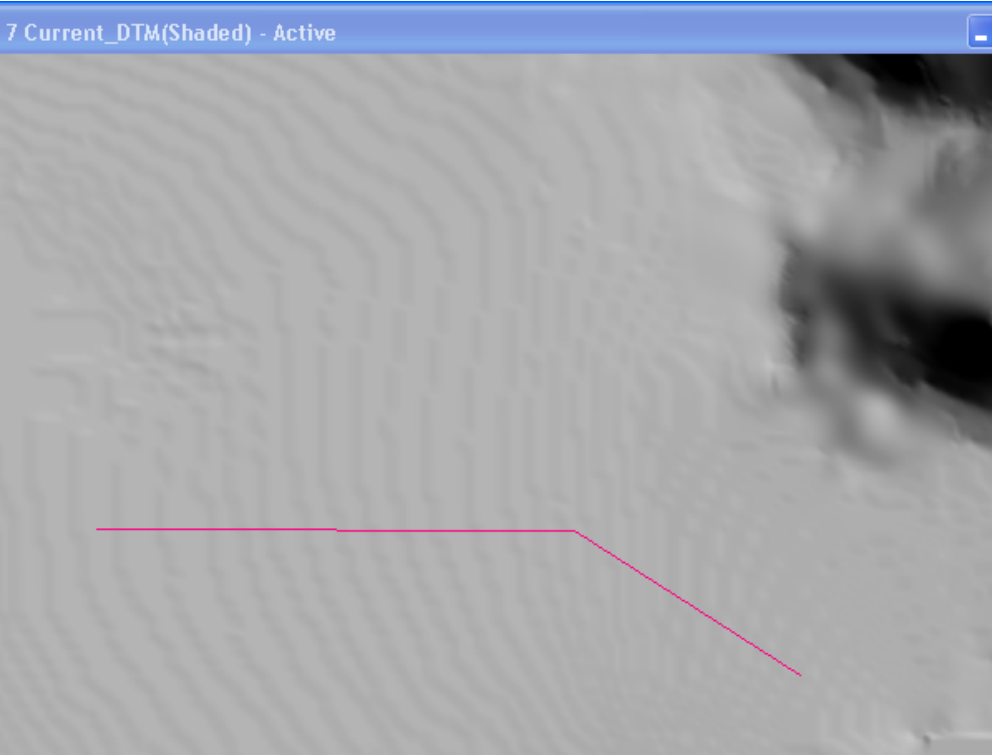
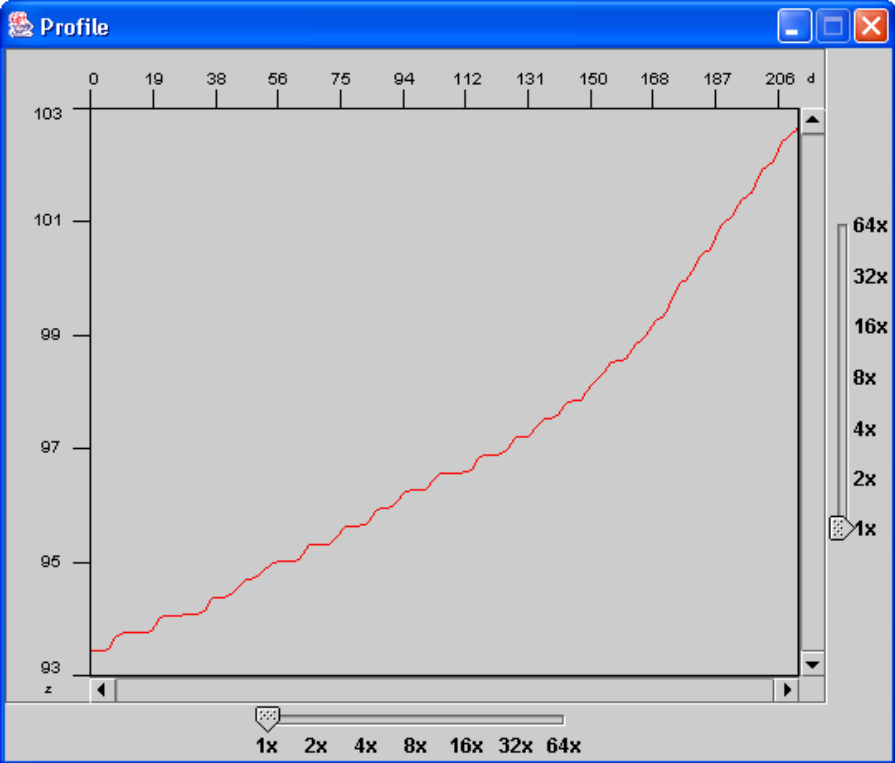




# Smoothing Tool

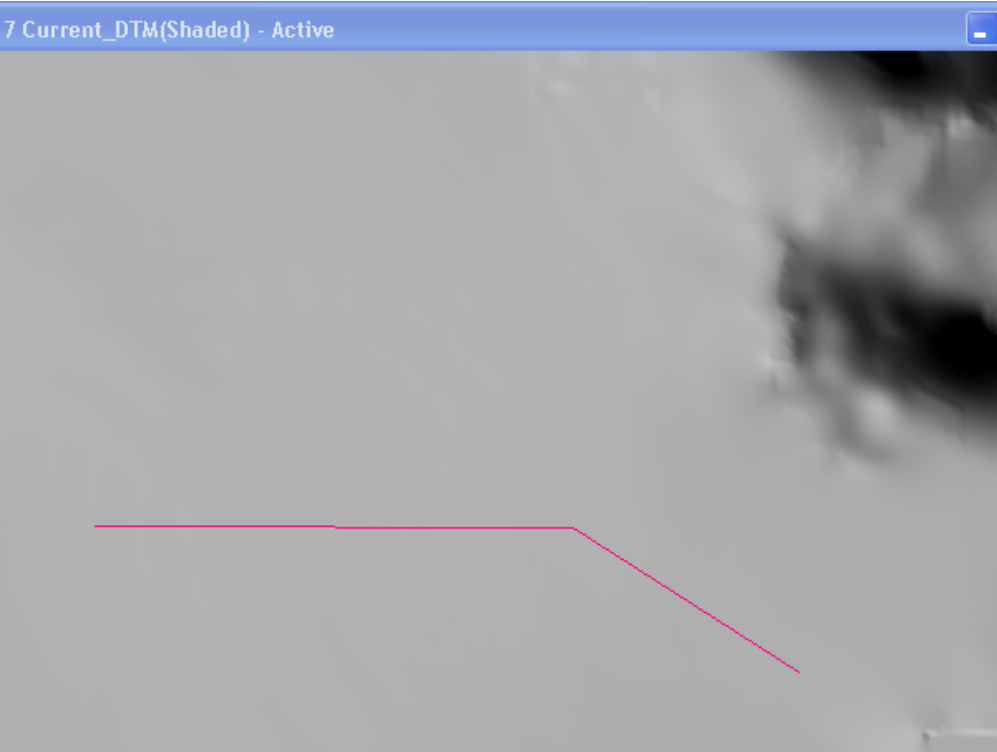
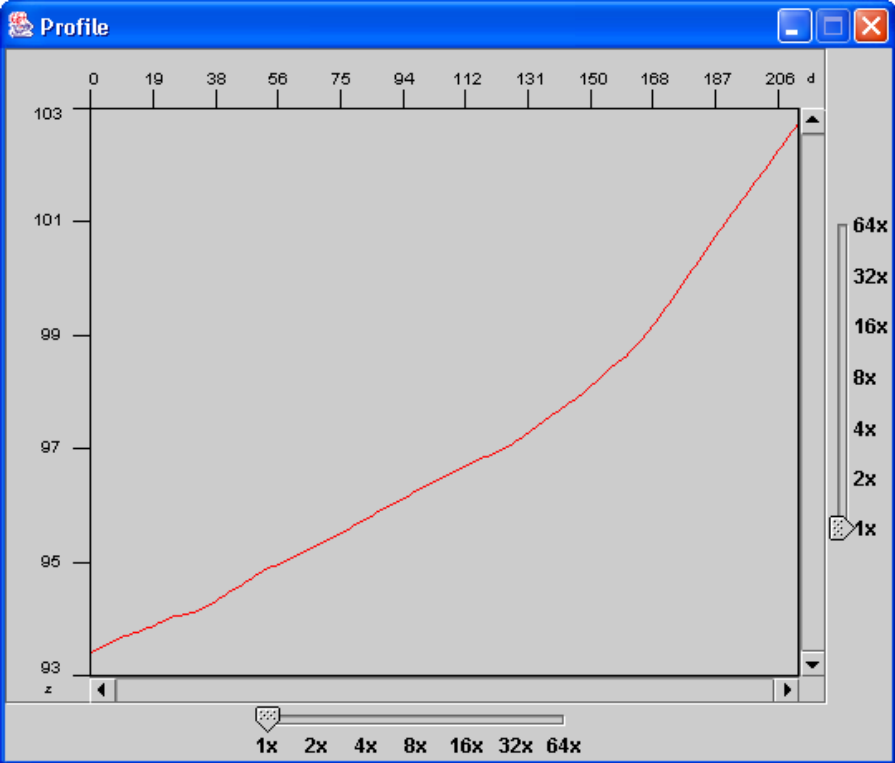
- ▀ Solution to over-smoothing in unobstructed areas
- ▀ Obstructed terrain only
  - Will not affect unobstructed data
- ▀ Addresses ancillary data artifacts
  - NED stepping
  - Resampling artifacts (screen door)
- ▀ Blends transition between obstructed and unobstructed
- ▀ Honors breaklines

# NED Stepping



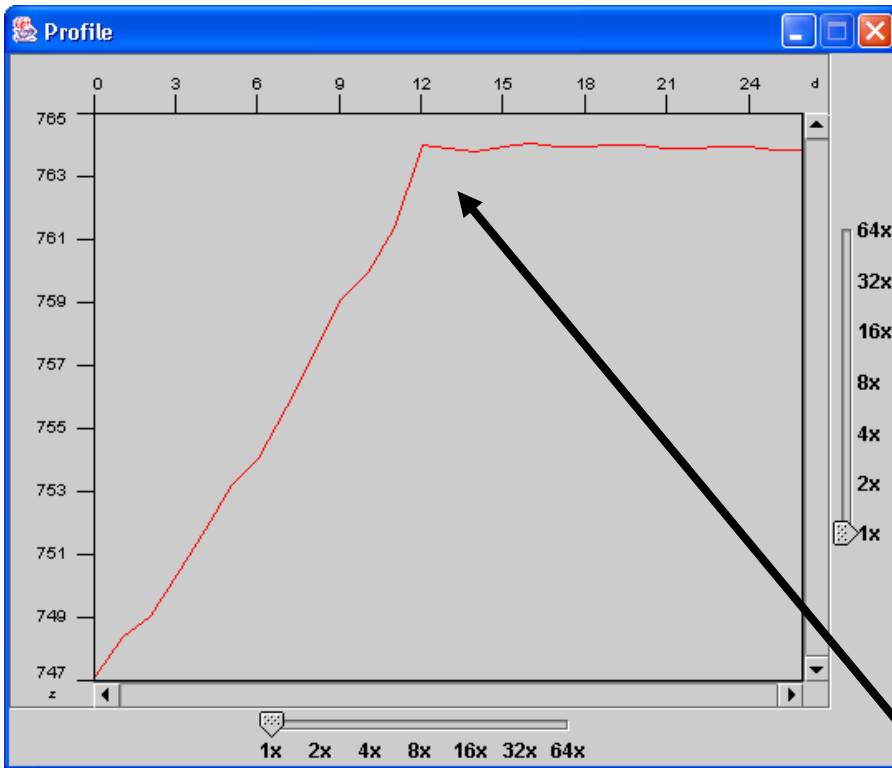
BEFORE

# NED Stepping



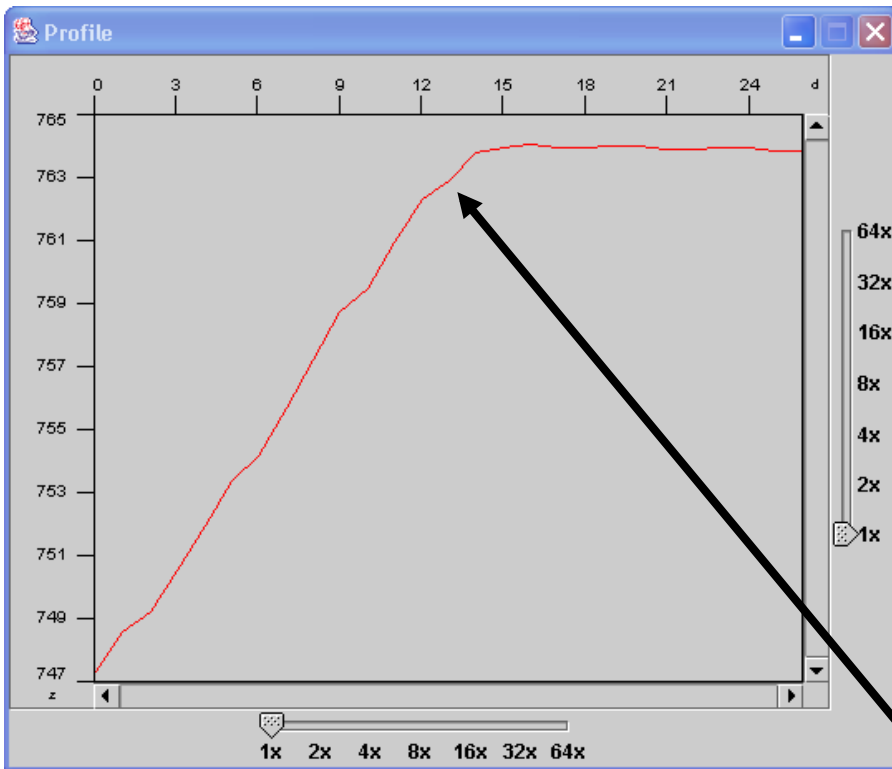
AFTER

# Blends Transitions



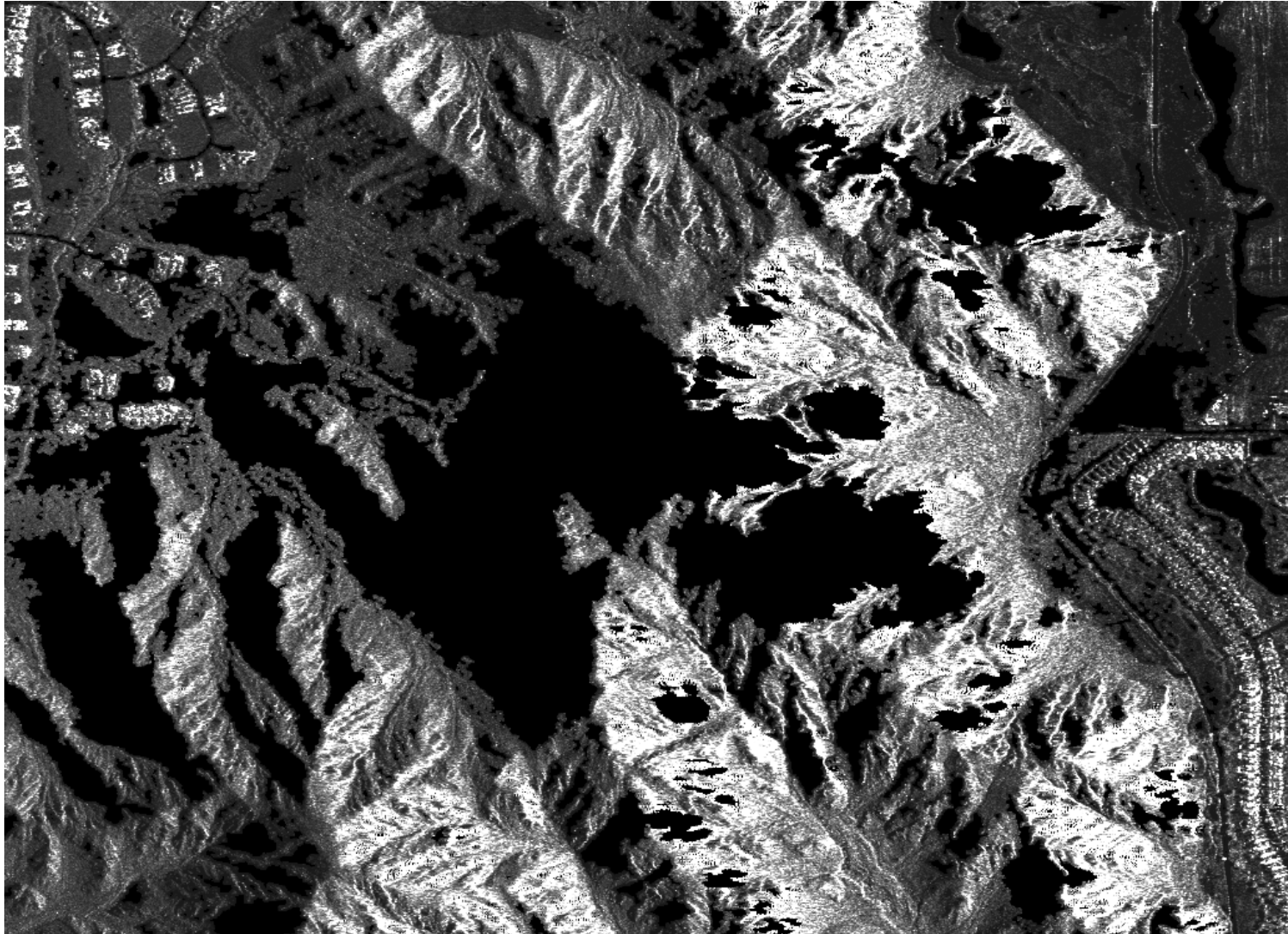
BEFORE

# Blends Transitions



AFTER

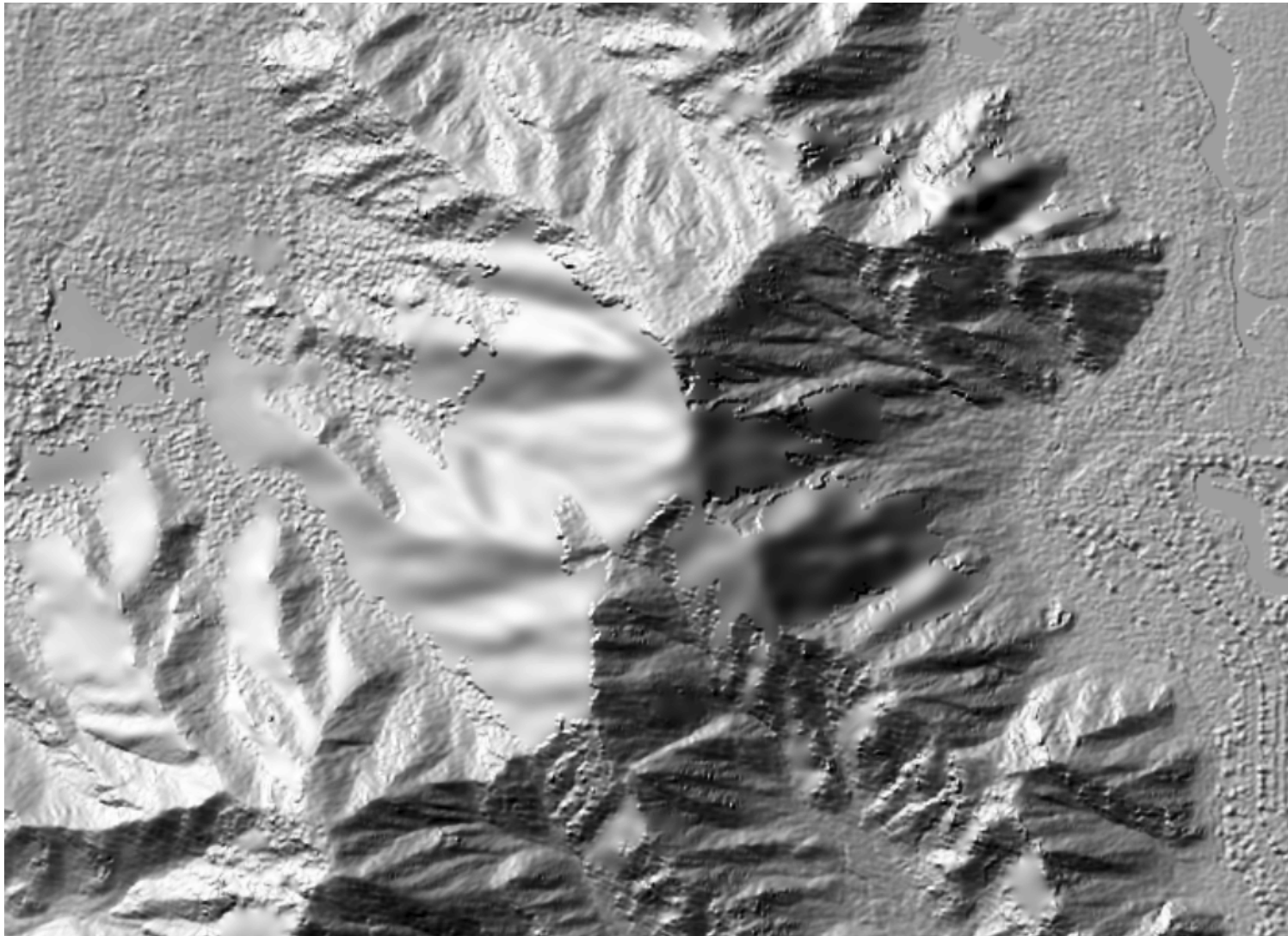
# ORI



# Previous DSM



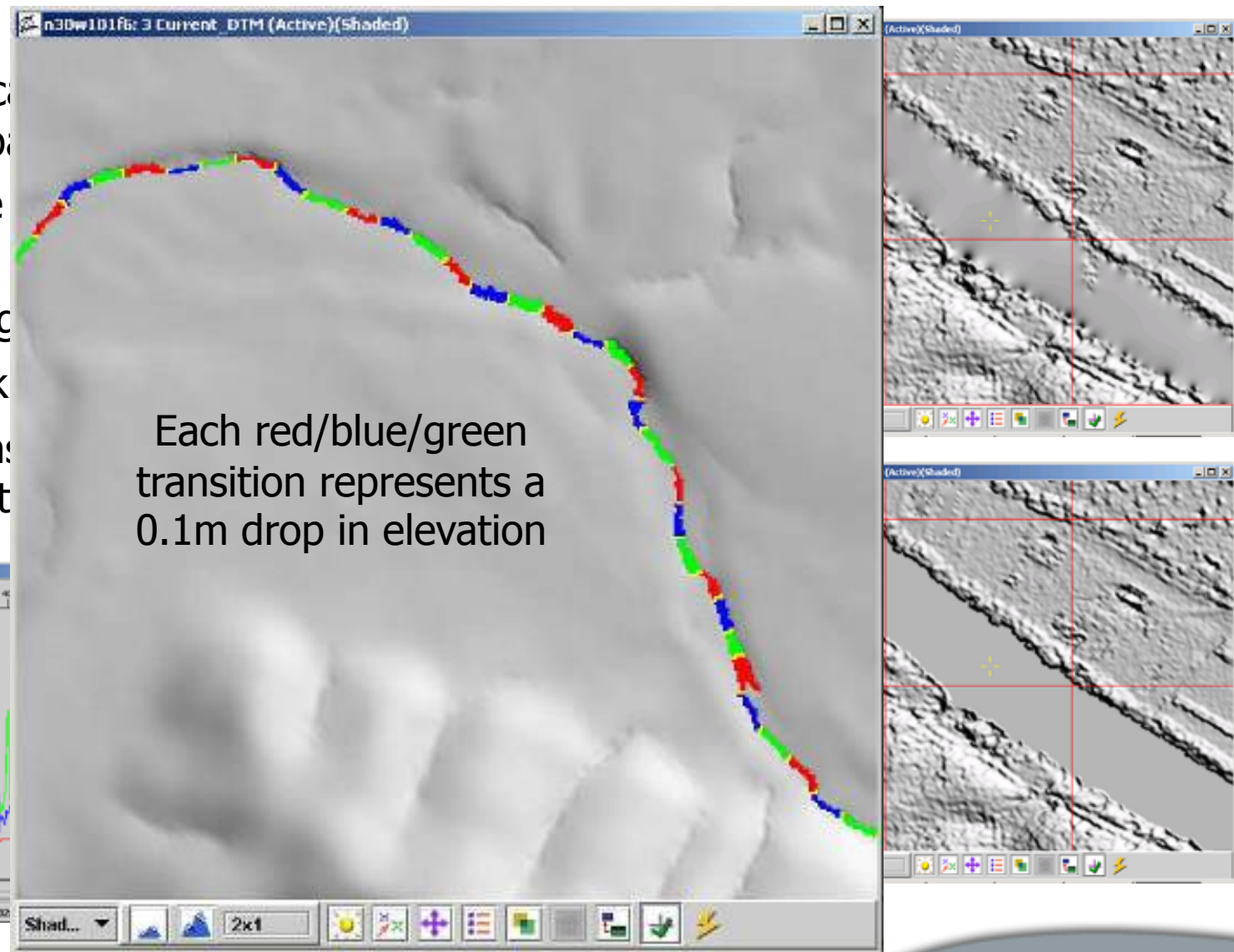
# Enhanced DSM



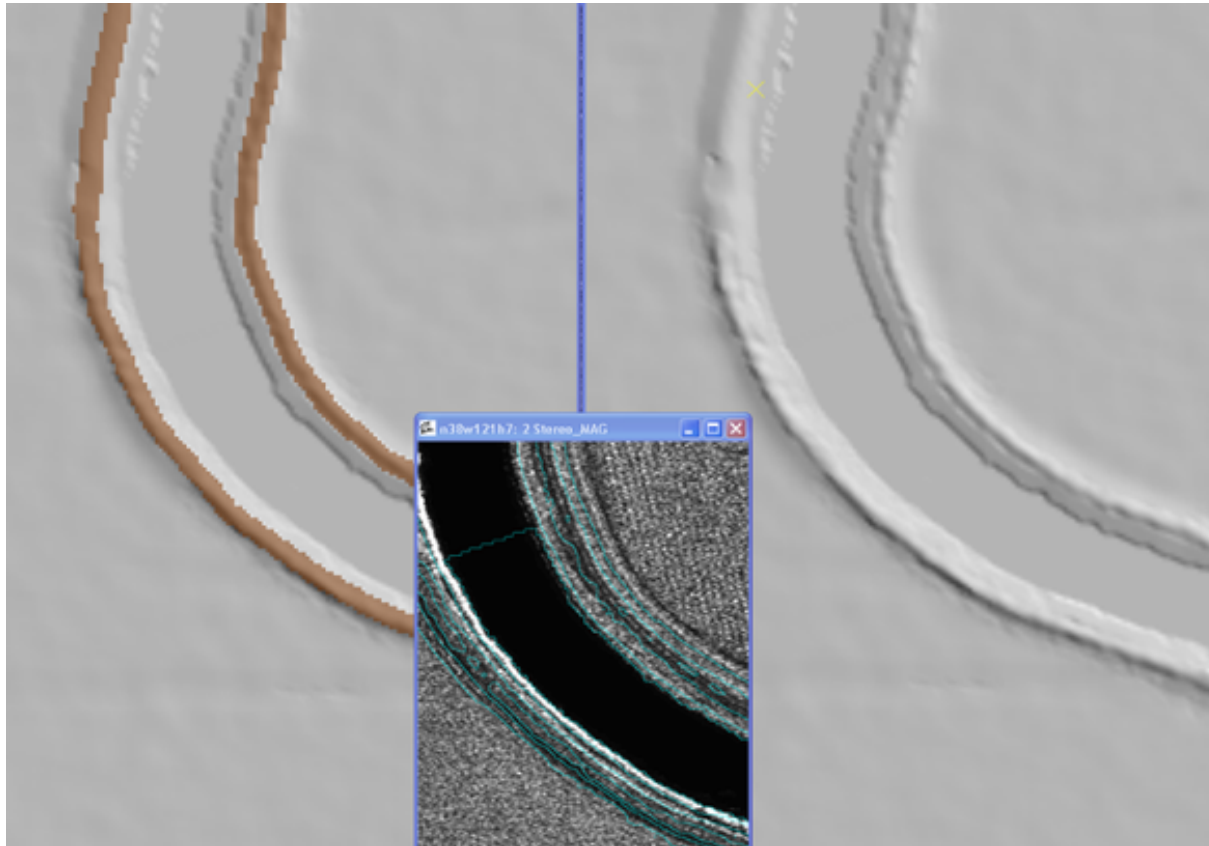


# River Editing

- ▶ A profile can be created for a network path
- ▶ Select the network path
- ▶ Click along the path
- ▶ Right click to end the path
- ▶ Visually inspect the path for appropriateness



# Embankments



- ▀ Embankment classification preserves elevations that may have been smoothed and lowered by Bald Earth Algorithm
- ▀ When Bald Earth is run is uses a different smoothing kernal on this classification to ensure DTM elevations are within 1m of DSM elevations

# Previous Road / Railway Edits

## ▀ NEXTMap USA

- Only TIGER roads A1, A2 and A3 were edited

## ▀ NEXTMap Deutschland

- Primary and secondary roads were edited (identified as yellow and orange roads on the ancillary raster map)

# Why did we edit those roads in our previous Core Products?

## ▀ Ortho Rectification

- To ensure that major roads rectify without local distortions caused by any first surface features
- Using the DTM

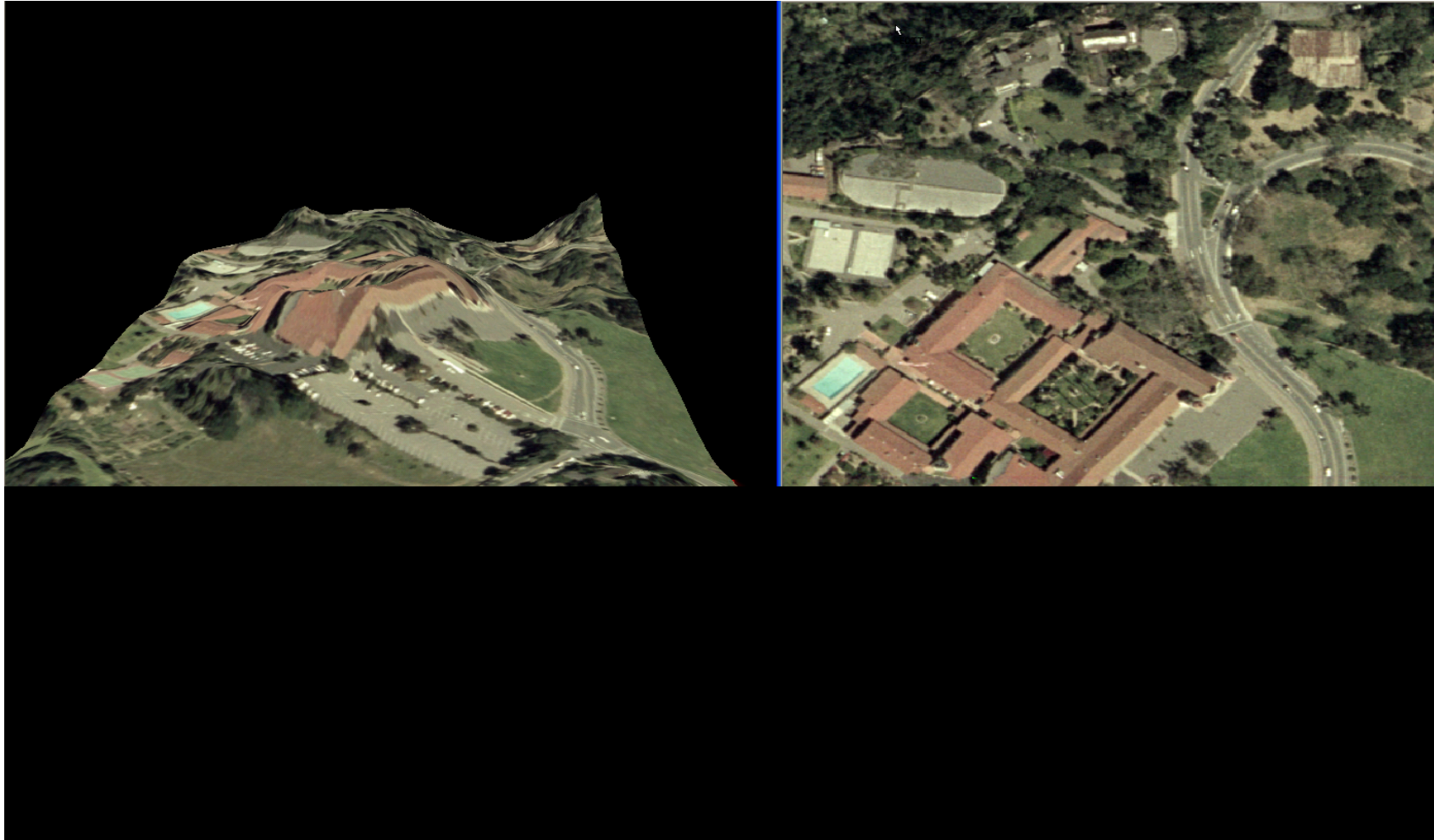
## ▀ Visualization

- To ensure major roads look “correct” or more realistic when creating fly-through scenes, image drapes etc.
- Using DSM or DTM

# Are those edits still required?

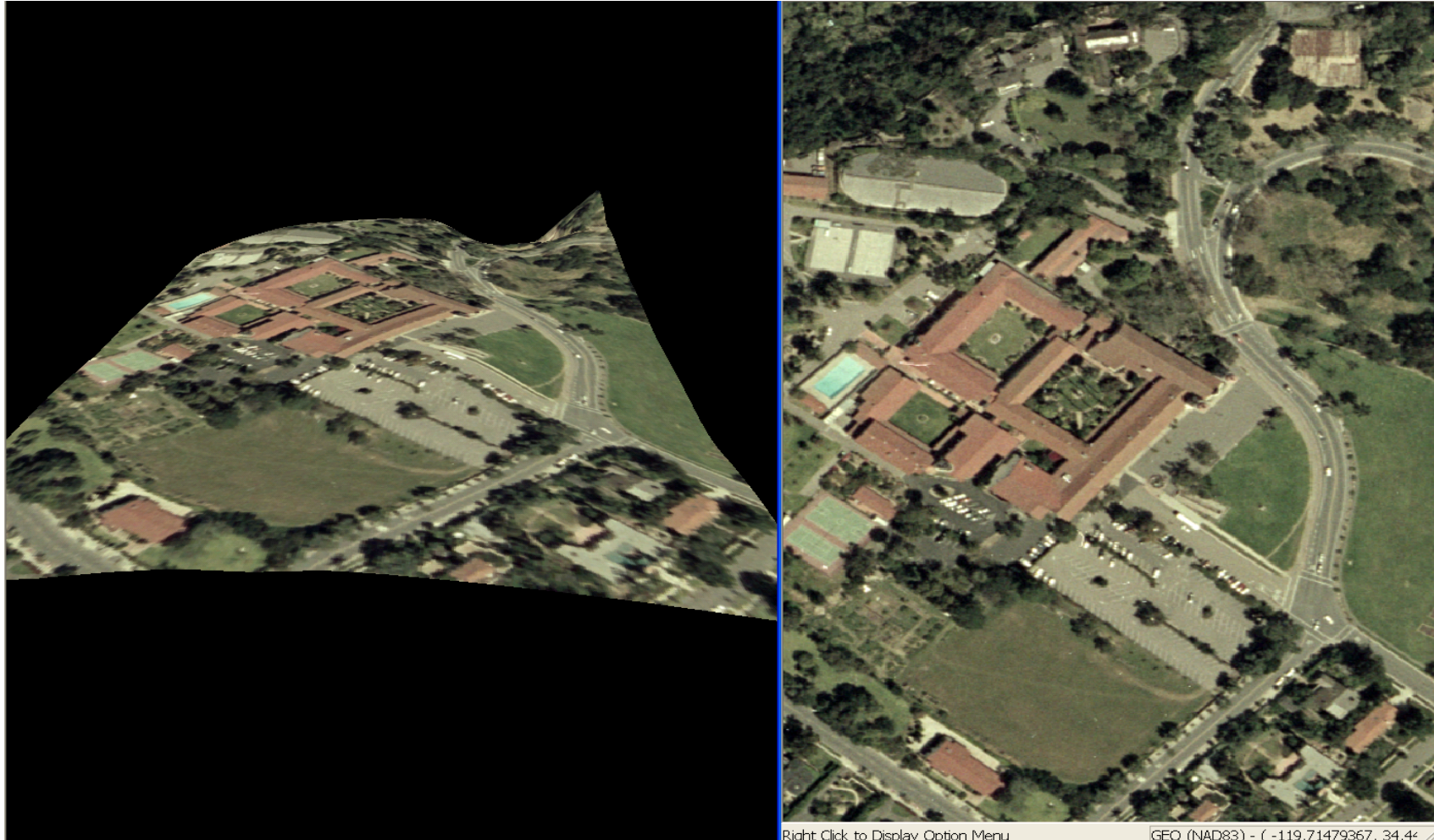
- ▀ New DTM no longer contains remnants of first surface features that used to create problems with ortho rectification
- ▀ Removing major road edits does not significantly degrade DSM visualization
- ▀ Road vectors can no longer be extracted from our Core Product DSM and DTM

# Ortho Rectification Example



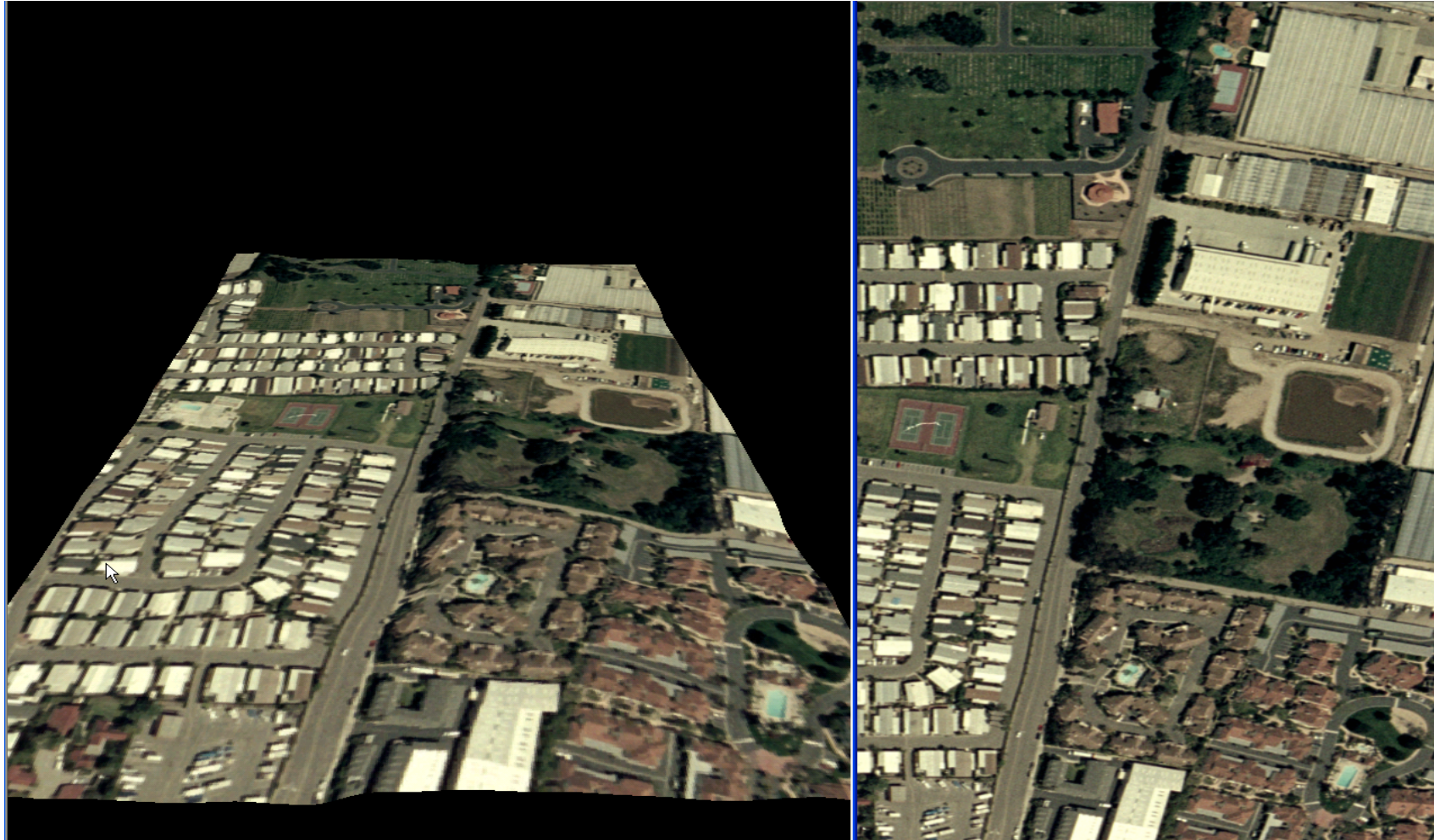
Legacy DTM – first surface distortion

# Ortho Rectification Example



▲ New DTM – no first surface distortion

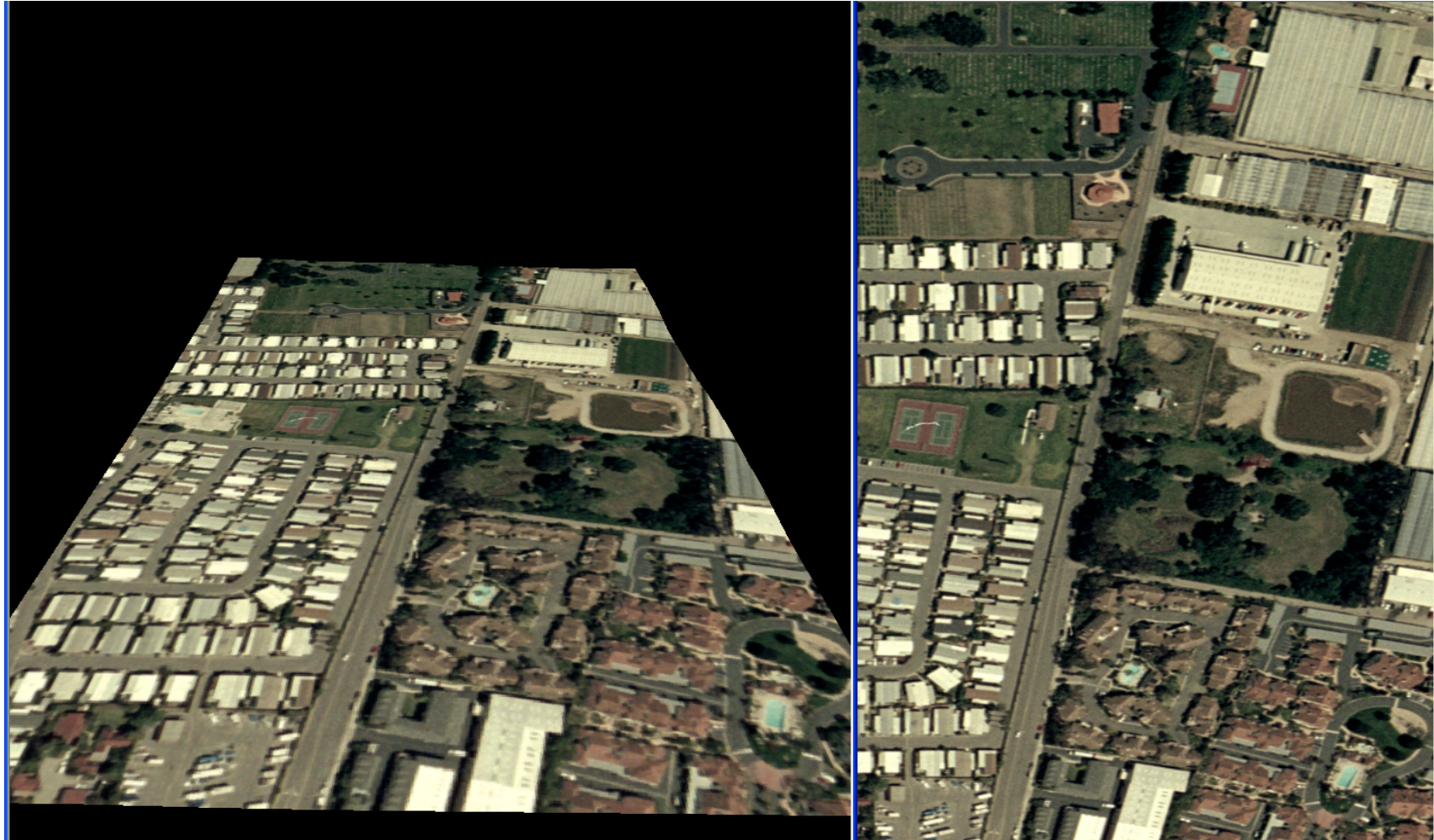
# Ortho Rectification Example



Legacy DTM – first surface distortion

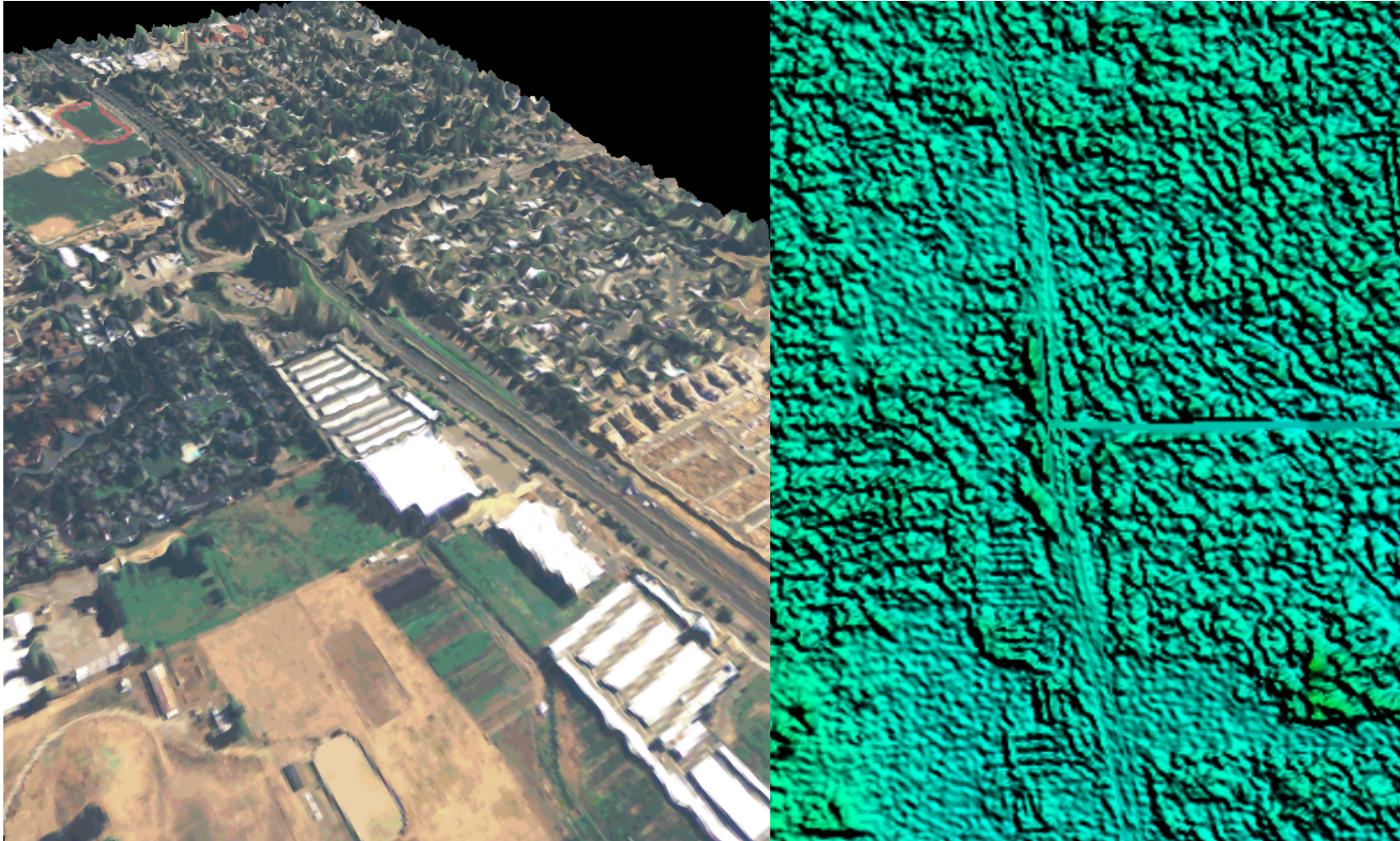


# Ortho Rectification Example



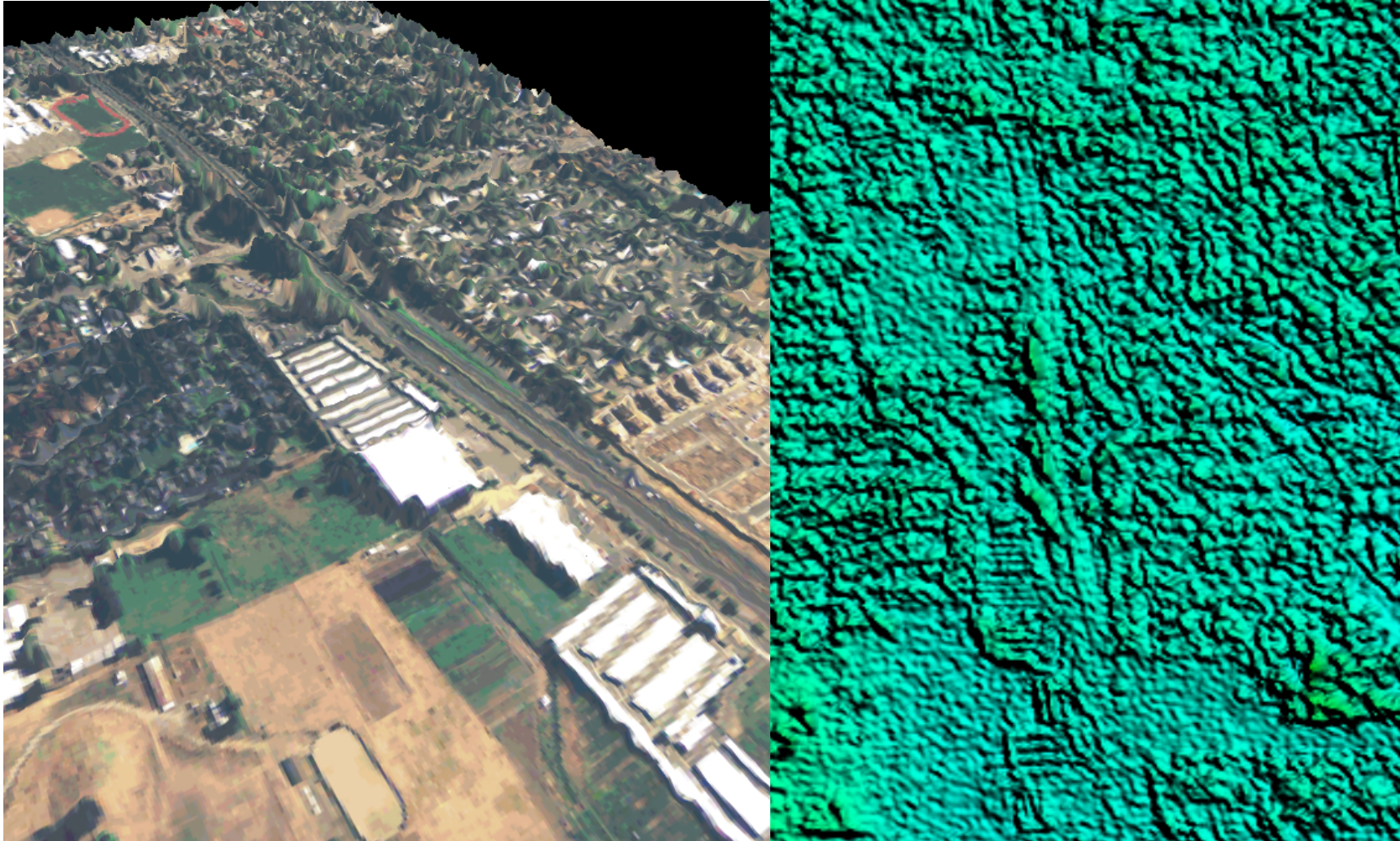
▲ New DTM – no first surface distortion

# DSM Visualization Example



Legacy DSM – major roads edited

# DSM Visualization Example



DSM – no major roads edited

# NEXTMap Enhanced DTM

- ▀ One DTM specification (not multiple vintages)
- ▀ Edit rules and processes fully tested, documented and in production
- ▀ Operator training is complete across the organization
- ▀ All data acquired after September 1<sup>st</sup> 2006 to be edited to the new specifications
- ▀ Existing data acquired prior to September 1<sup>st</sup> 2006 to be re-edited as required

*... thank you ...*

