Extracting Fluvial Geomorphic Features from LiDAR

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July 9, 2015
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U.S. Department of the Interior
U.S. Geological Survey

Problem:

How to accurately assess fluvial geomorphic characteristics relevant to understanding rates of floodplain deposition and bank erosion from available LiDAR data.

Desired Fluvial Geomorphic Metrics:

- Bank height
- Bank angle
- Channel width
- Channel profile slope
- Floodplain elevation range
- Floodplain width
- Floodplain profile slope
- Drainage area

Solution:

Someone must have done this before, right?

Review existing tools: River Bathymetry Toolkit, GeoNet, Riparian Topography Toolbox, etc.

Finding: Existing tools are not scalable to automate for large and multiple watersheds or do not compute the complete set of desired metrics.

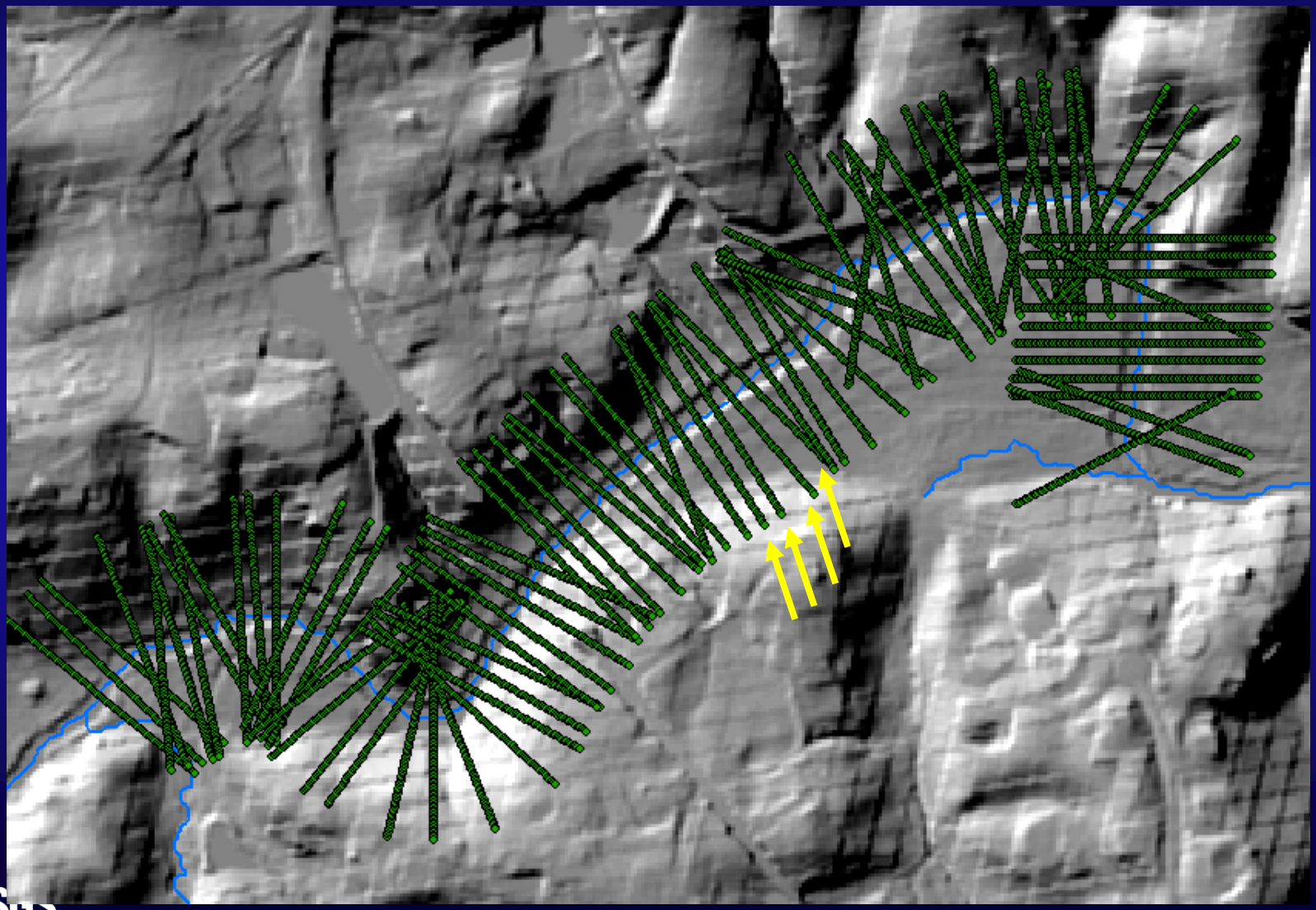
USGS's Bank Detection and Floodplain Analysis Tool Parameters

- Spacing between cross sections (m)
- Channel cross section linear fit length (m)
- Channel cross section length (m)
- Point spacing along cross sections (m)
- Bank detection slope break ratio
- Bank detection slope break between points (%)
- Channel slope break vertical increment (cm)
- Valley cross section length (m)
- Valley cross section linear fit length (m)
- Floodplain parameter: Search radius (m)
- Floodplain parameter: Height threshold (m)

DEM Processing Issues

- DEM resampling procedure (from 1m to 3m DEM)
- Flow direction algorithms (D8 vs. D-infinity)
- Synthetic stream definition thresholds
- Customizing WVU tool parameters by physiographic province and stream order.
- Validating results
- Structuring output (statistical summaries by stream reach and reachshed).

Automatic Stream Cross-Sections



USGS

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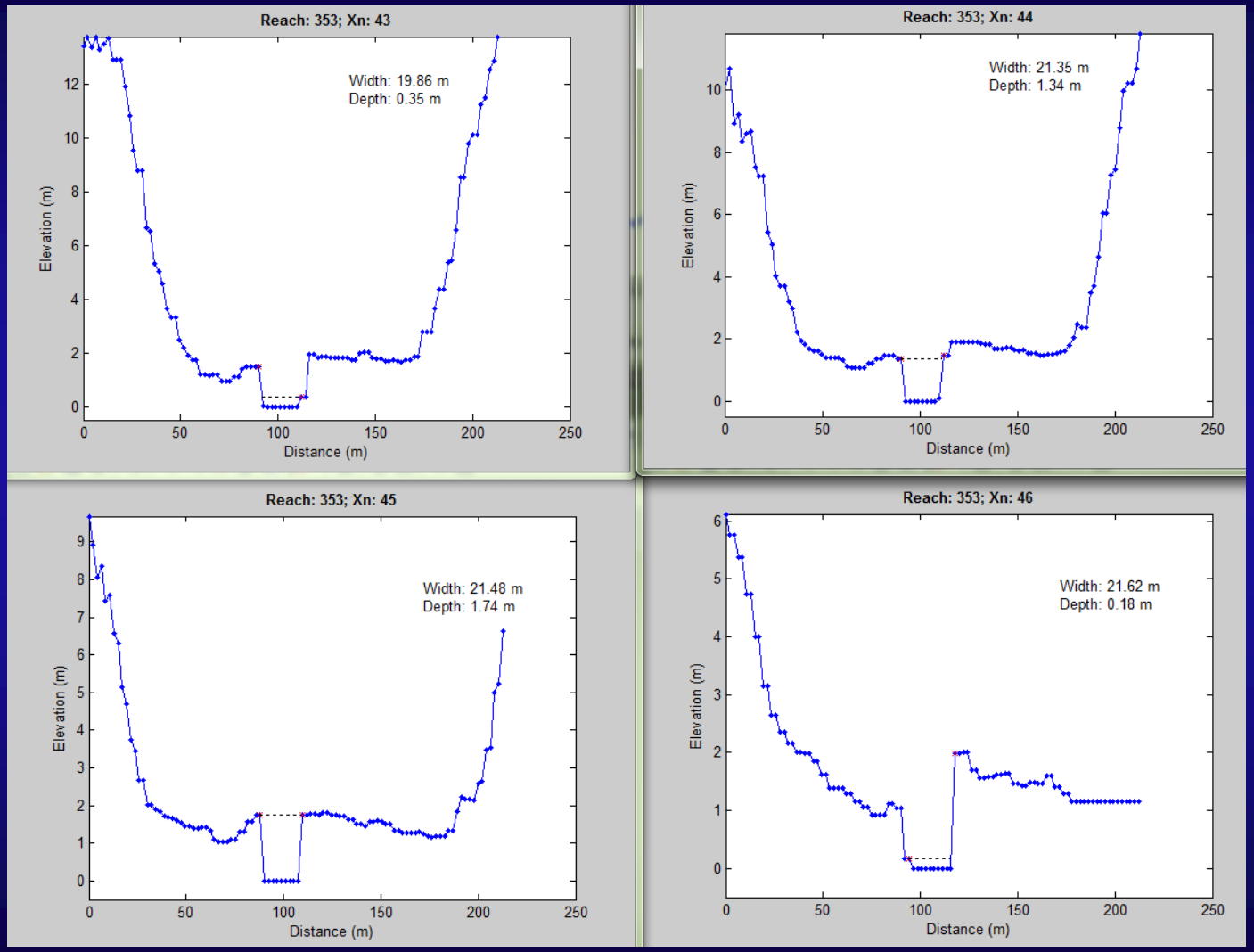

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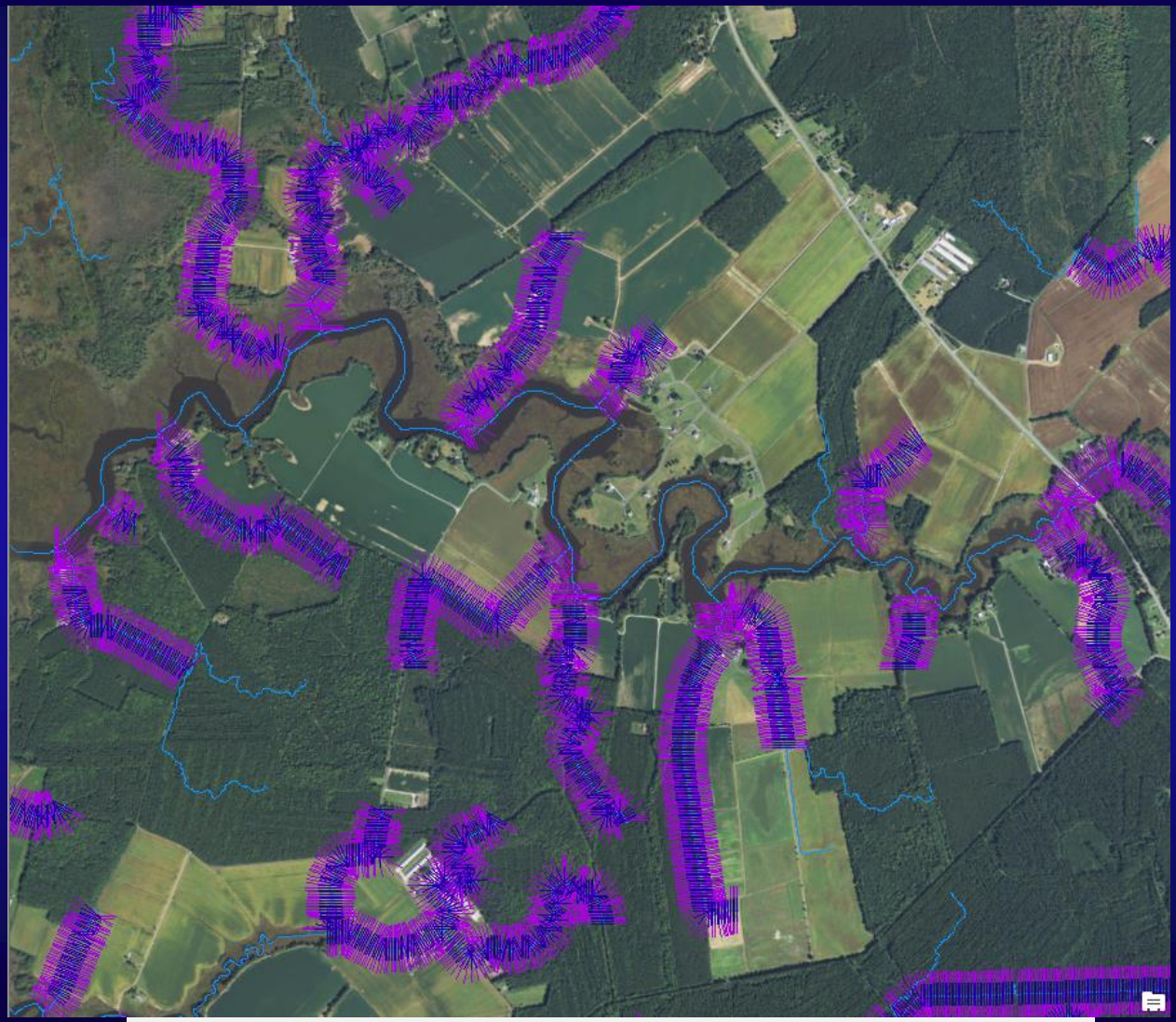
Need to Develop Multiple Parameter Sets for Different Stream Orders



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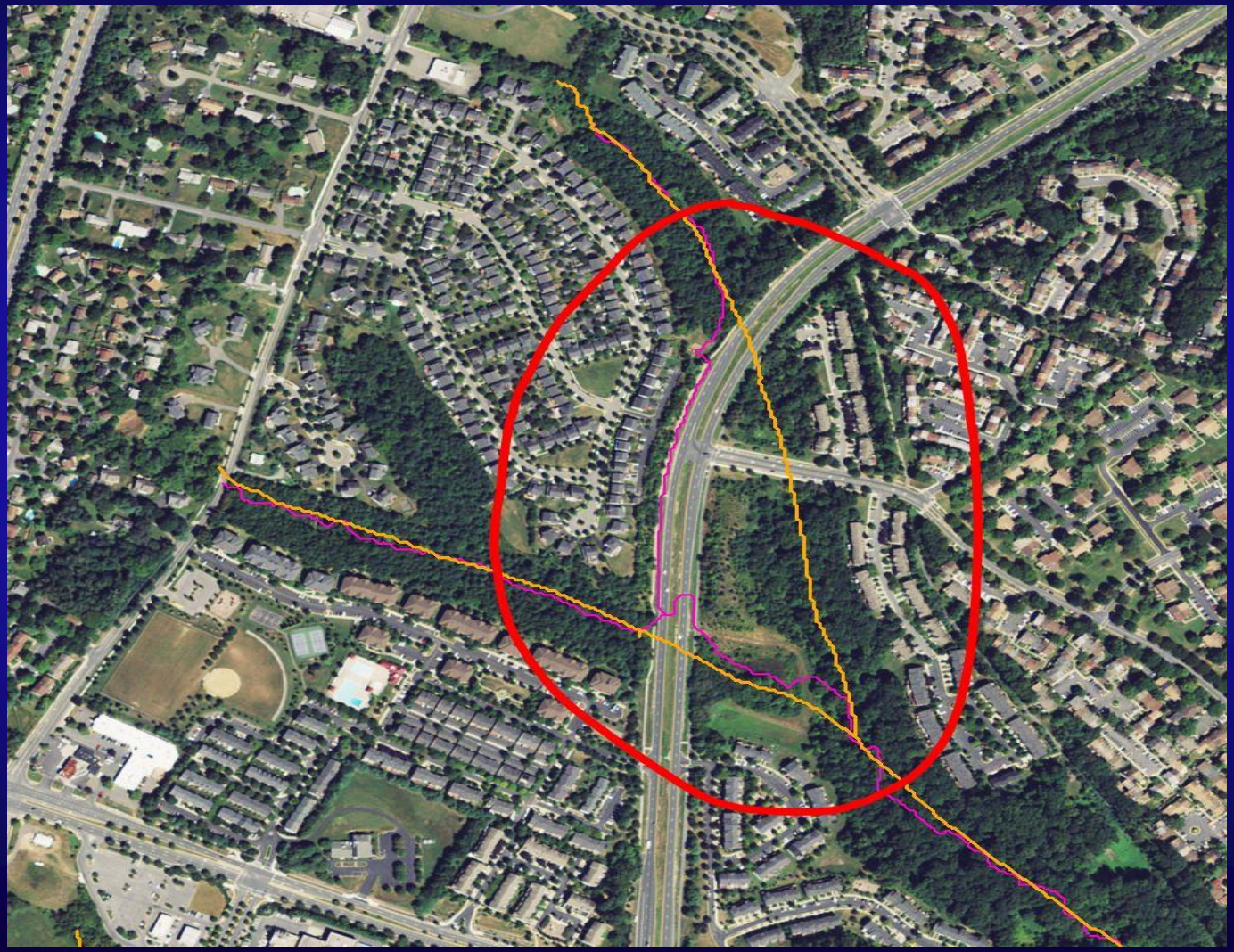
Spatial Accuracy of NHD vs Synthetic Streams



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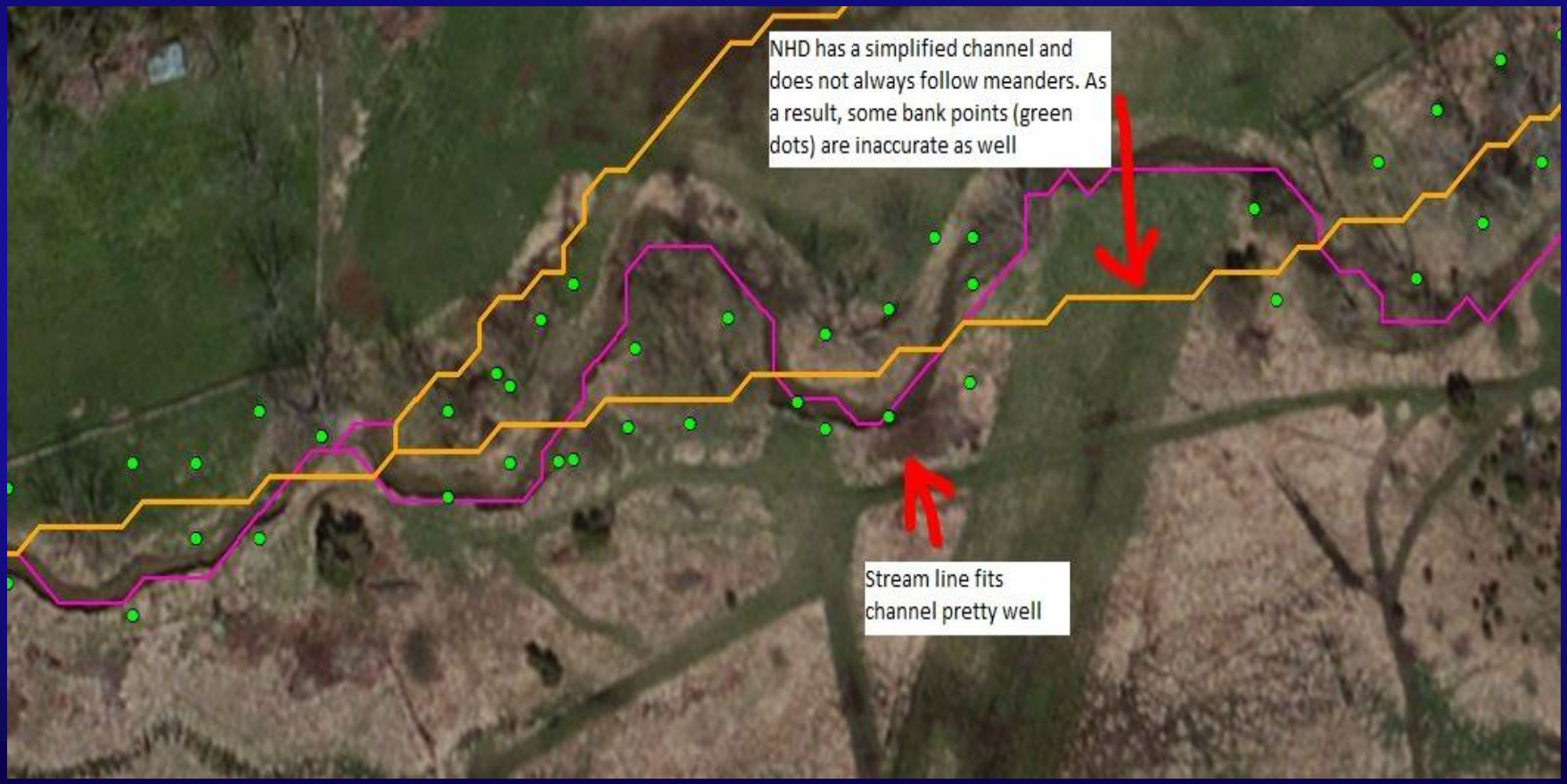

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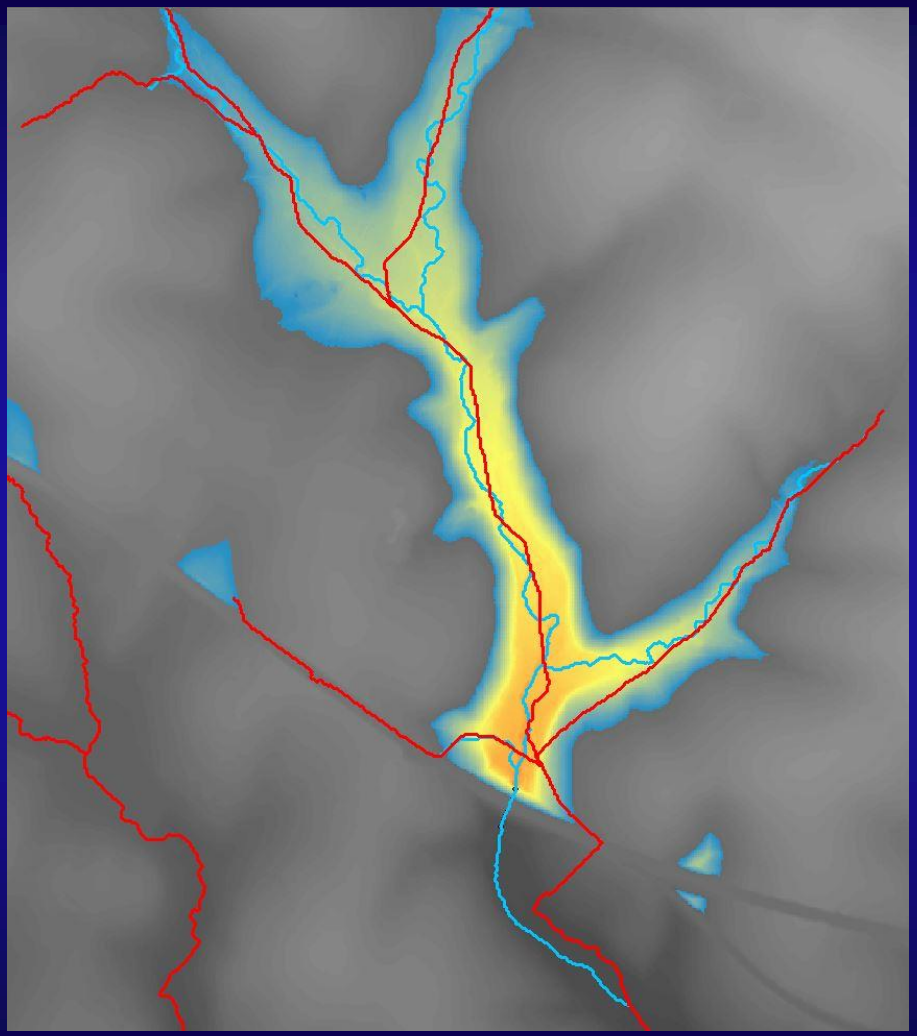
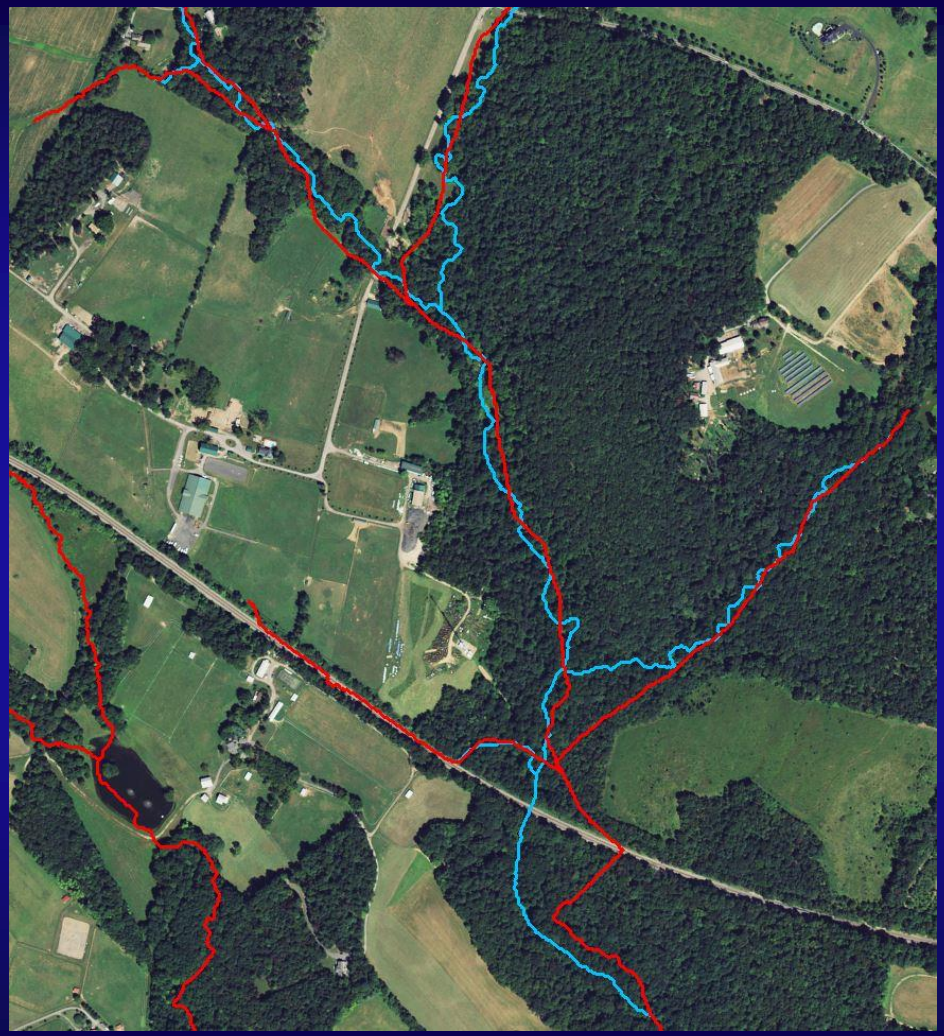
Correcting DEM for Obstructions

Poppenga et al., 2010





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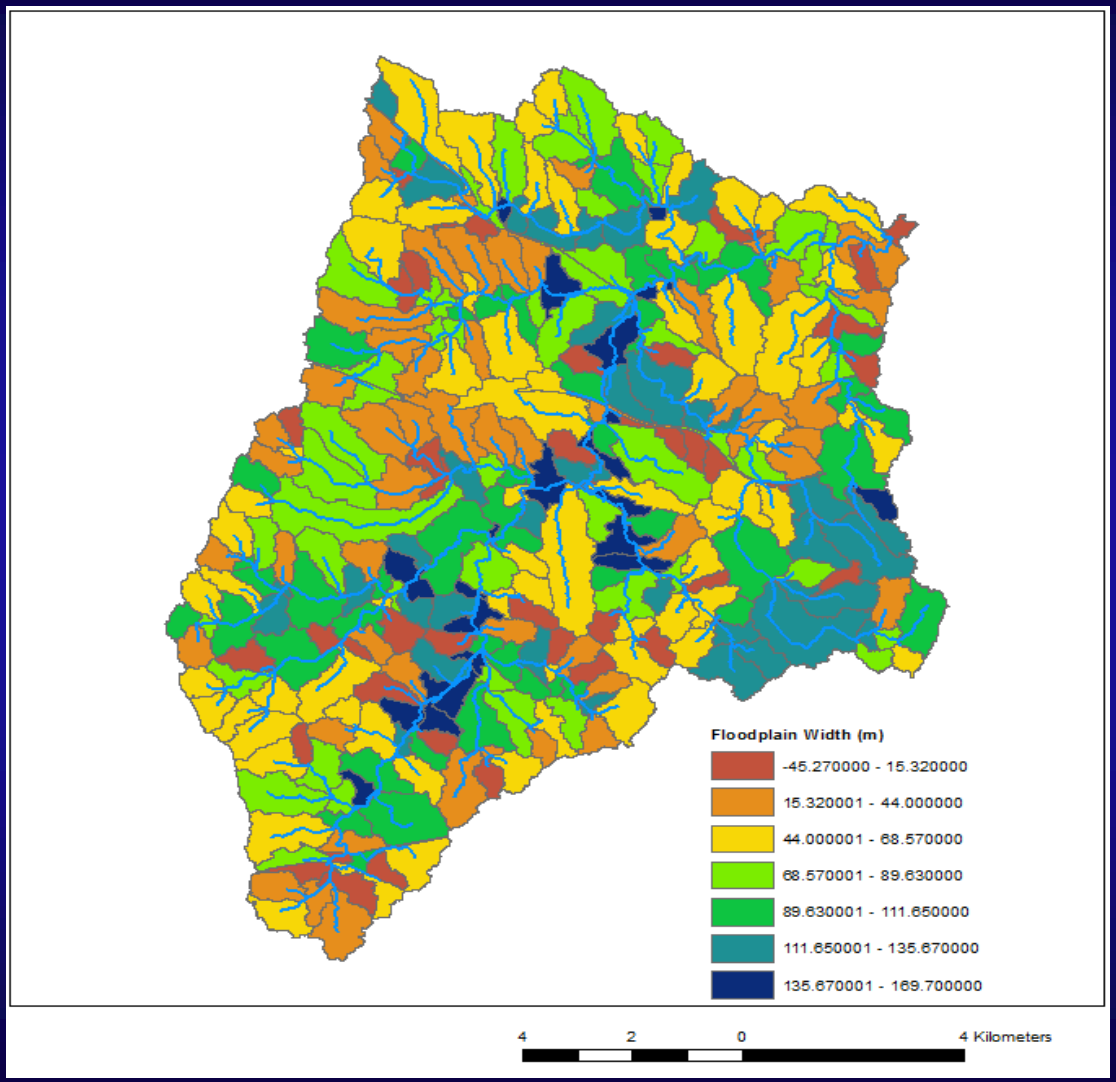
Extrapolating Cross-sections to Watersheds



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