Mapping Channels and Floodplains with FACET

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Acknowledgments & Timeline

Funding

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Timeline

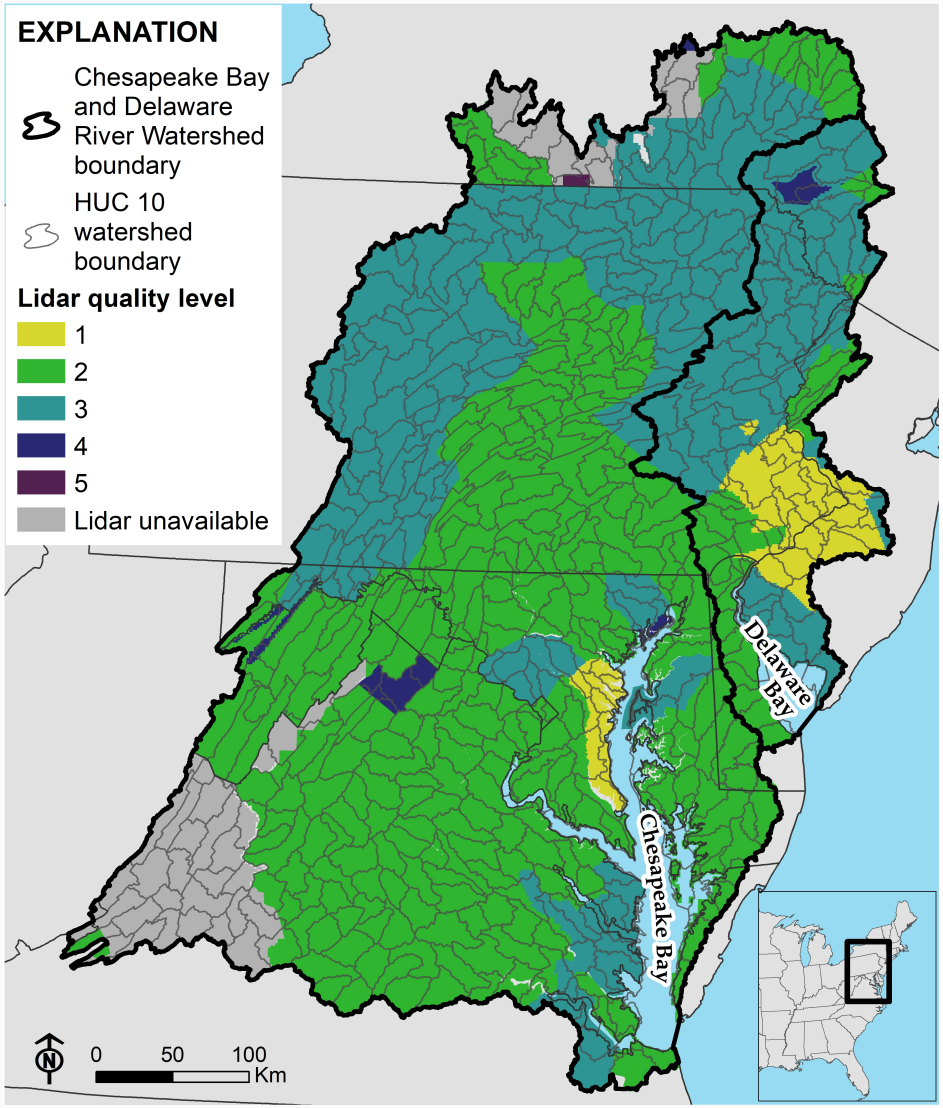
- Code release: December, 2019
- Data release for Chesapeake and Delaware: April, 2020
- Manuscript on methods and validation: In-review

What is FACET?

- Floodplain and Channel Evaluation Tool (FACET) is an automated tool to measure fine-scale geomorphometry using high resolution digital elevation models (DEMs)
- Open-source written in Python and R
- Only ***required input is a DEM (3-meter or finer resolution)***

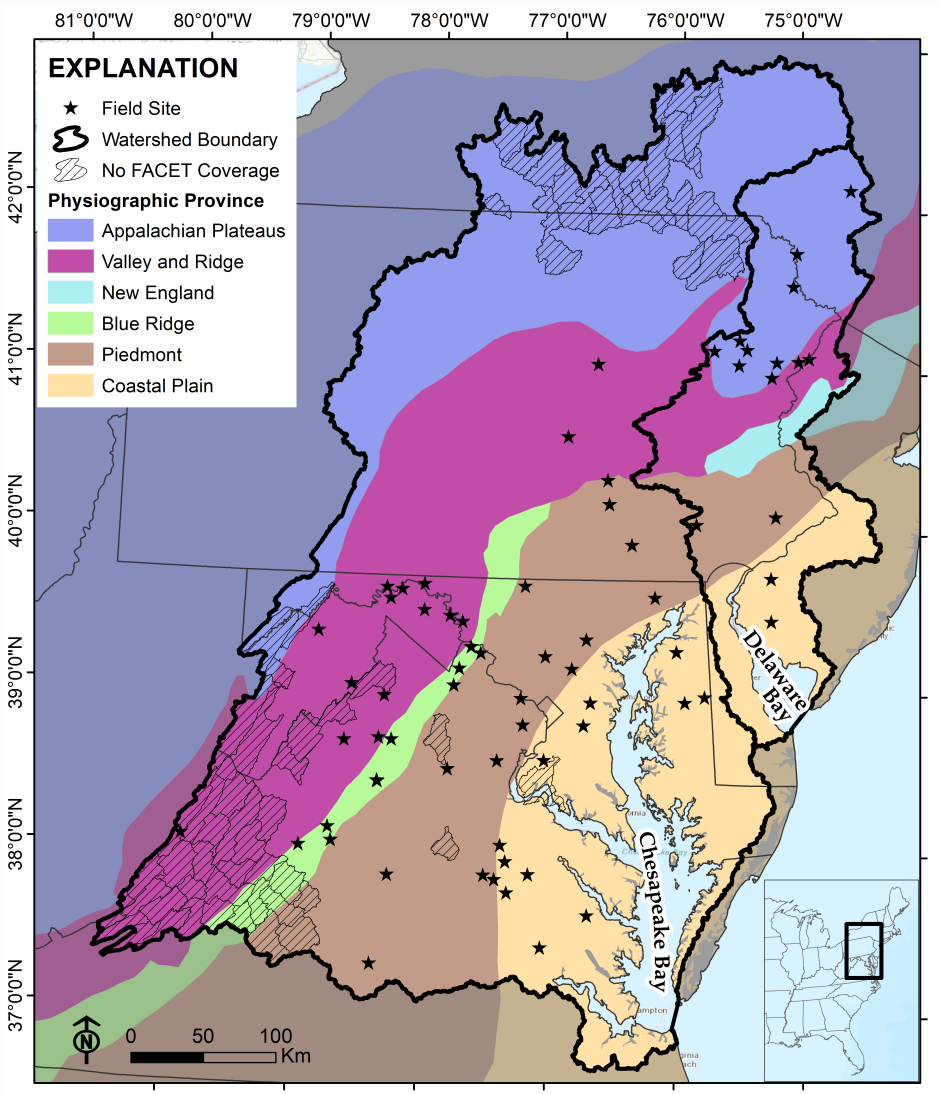
LiDAR: Availability and Coverage

- Study area: Chesapeake Bay Watershed (CBW) and Delaware River Basin (DRB)
- Ran FACET on 3-m DEMs in 85% CBW and 100% in DRB



Calibration and Validation

Bank and floodplain geomorphic measurements validated against field data at 67 reaches

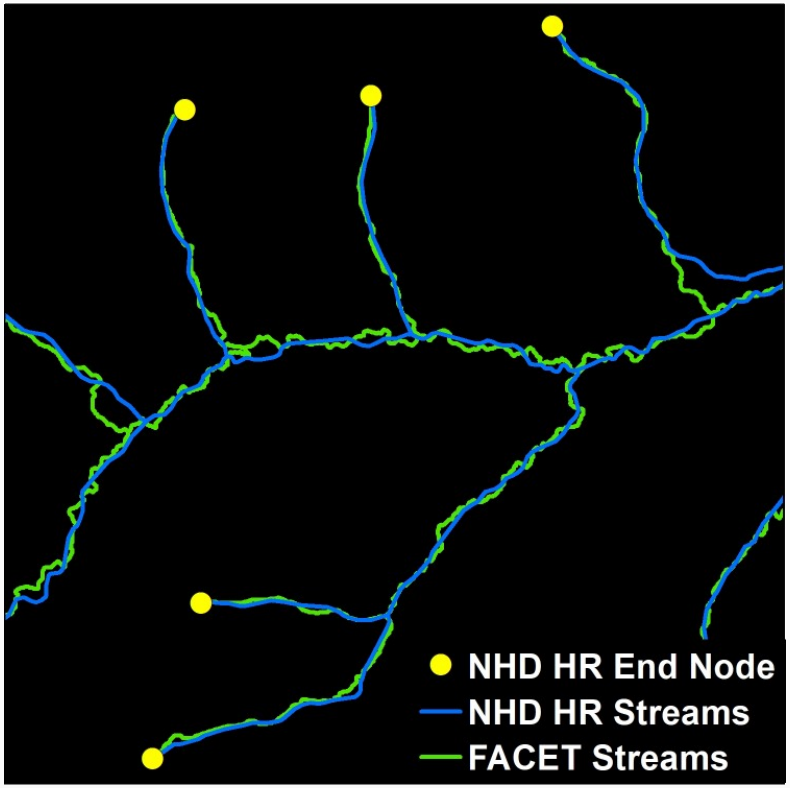


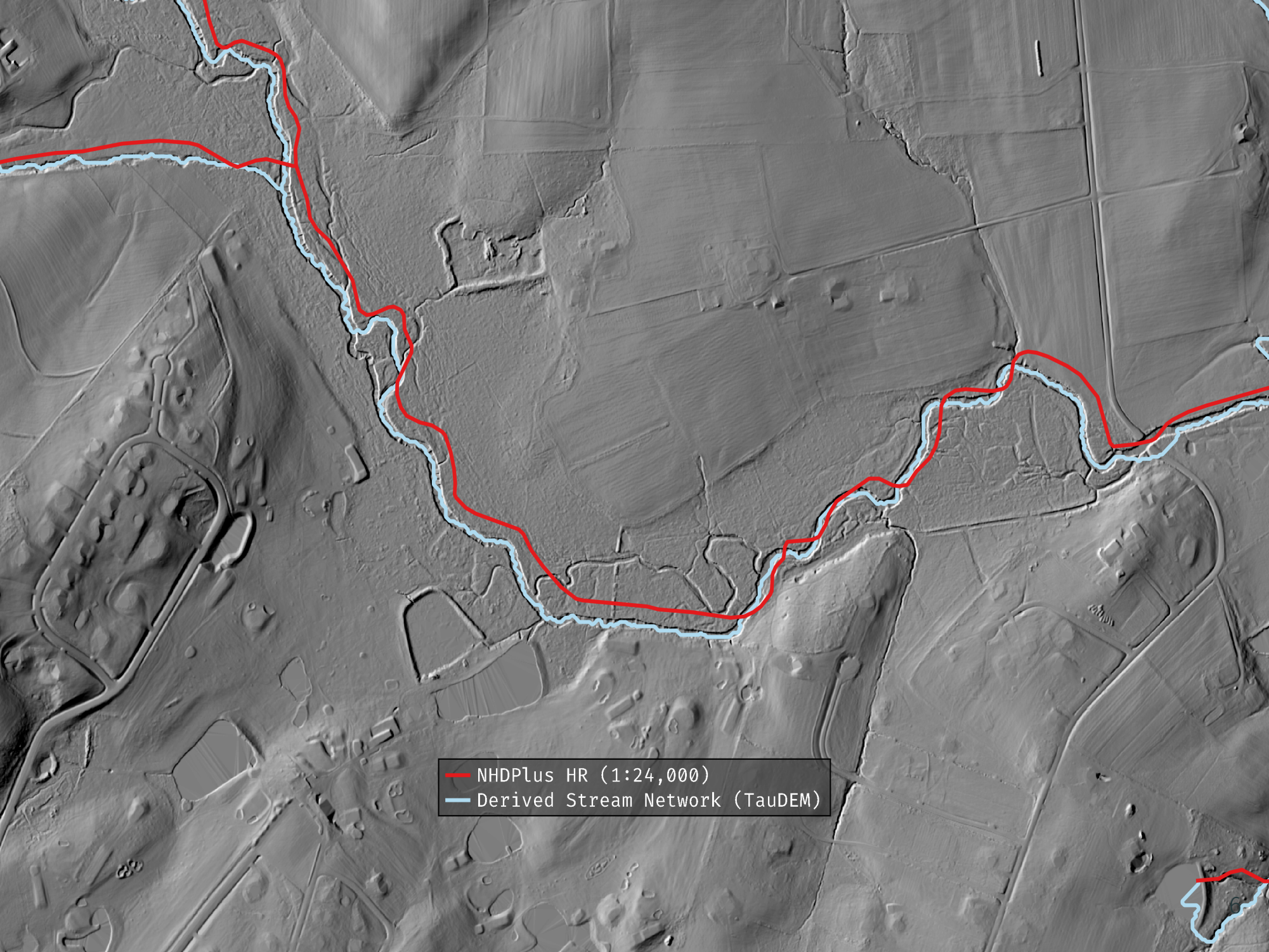
Workflow

- Hydrologically conditions DEM and generates a synthetic stream network
- Identifies ***stream-banks*** and calculate ***channel width***, ***bank height***, ***bank angle***, channel shape and area
- Identifies ***active floodplain extent*** and calculate ***floodplain width***, elevation and depth along the floodplain

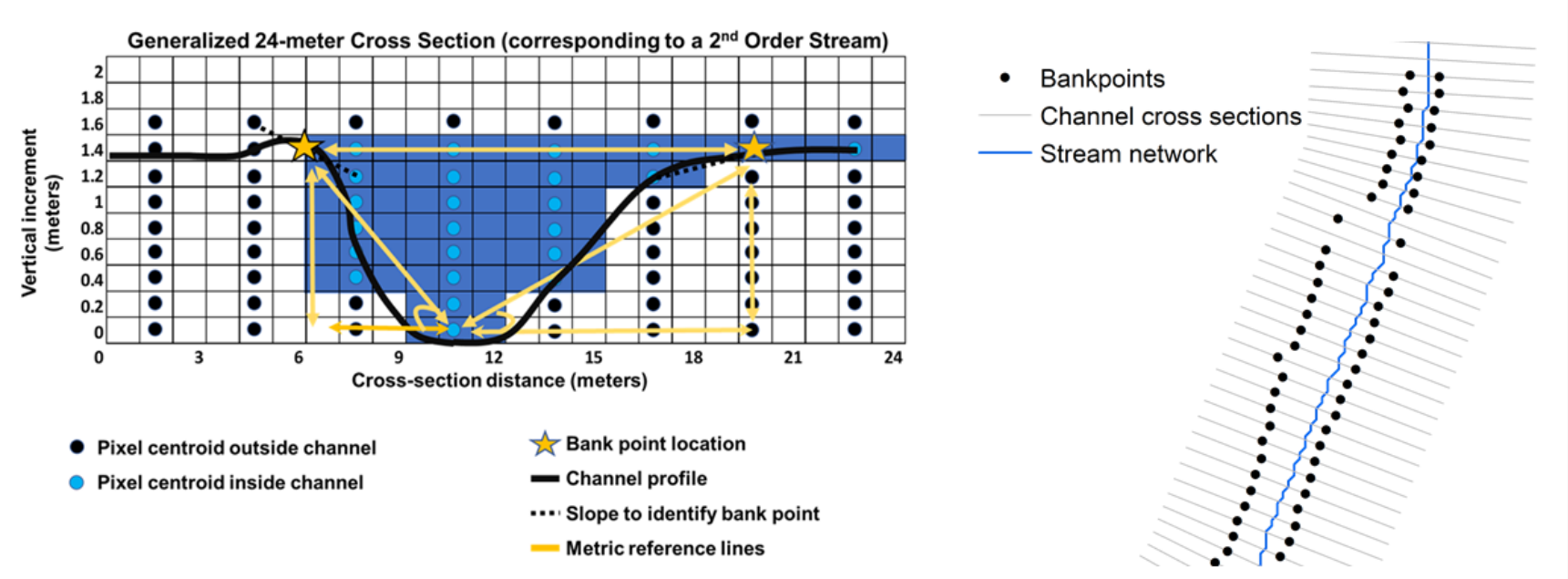
Hydrologic Conditioning

- NHDPlus HR (1:24,000 scale) stream network's end nodes are used as channel initiation points
- Hydro-condition the DEM to improve breaching through road and railroad embankments then run Whitebox's BreachDepressions algorithm
- Generate D8 flow direction and flow accumulation (TauDEM 5.3) to derived a stream network

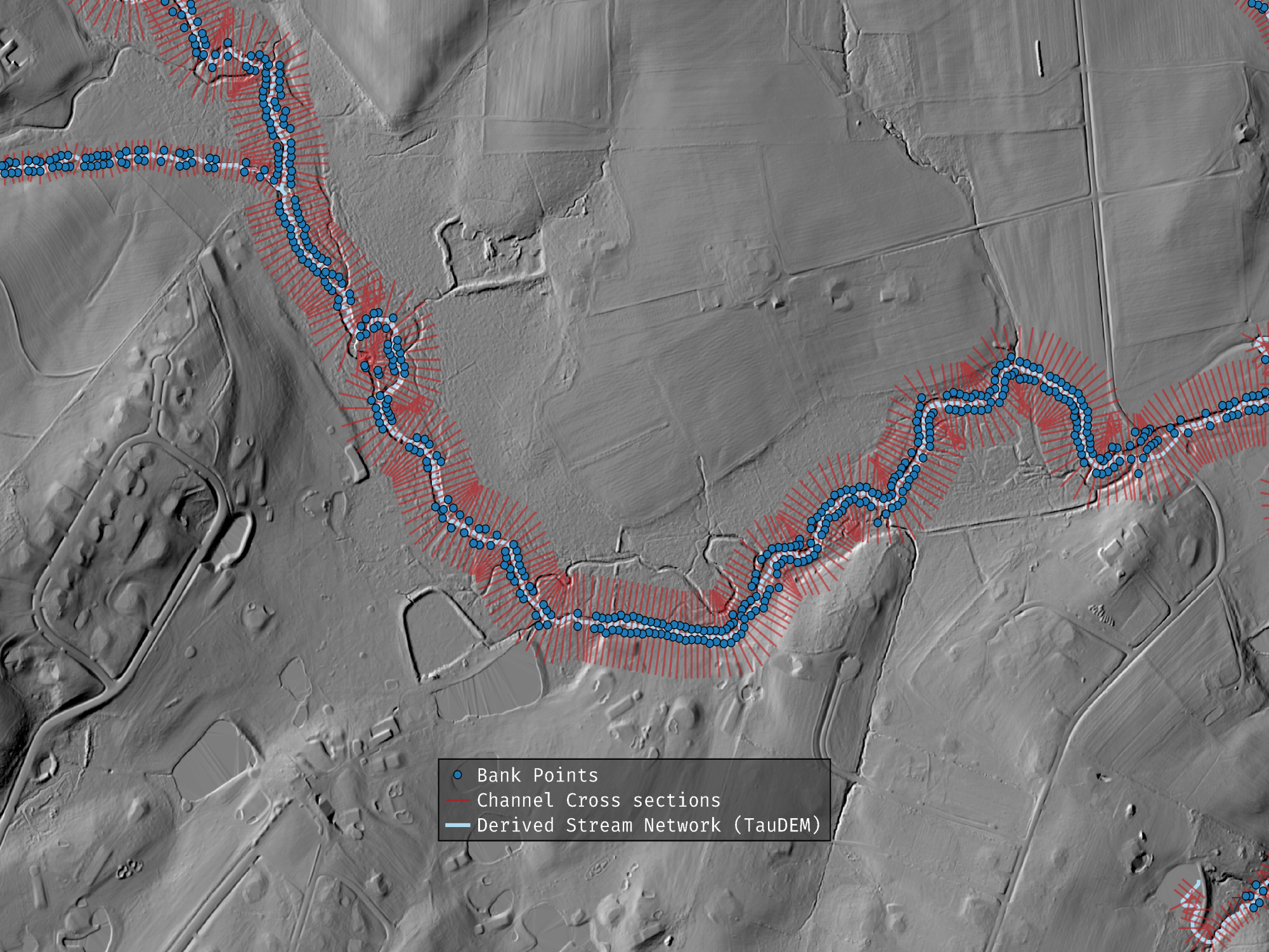



NHDPlus HR (1:24,000)
Derived Stream Network (TauDEM)

Stream-bank: cross-section method

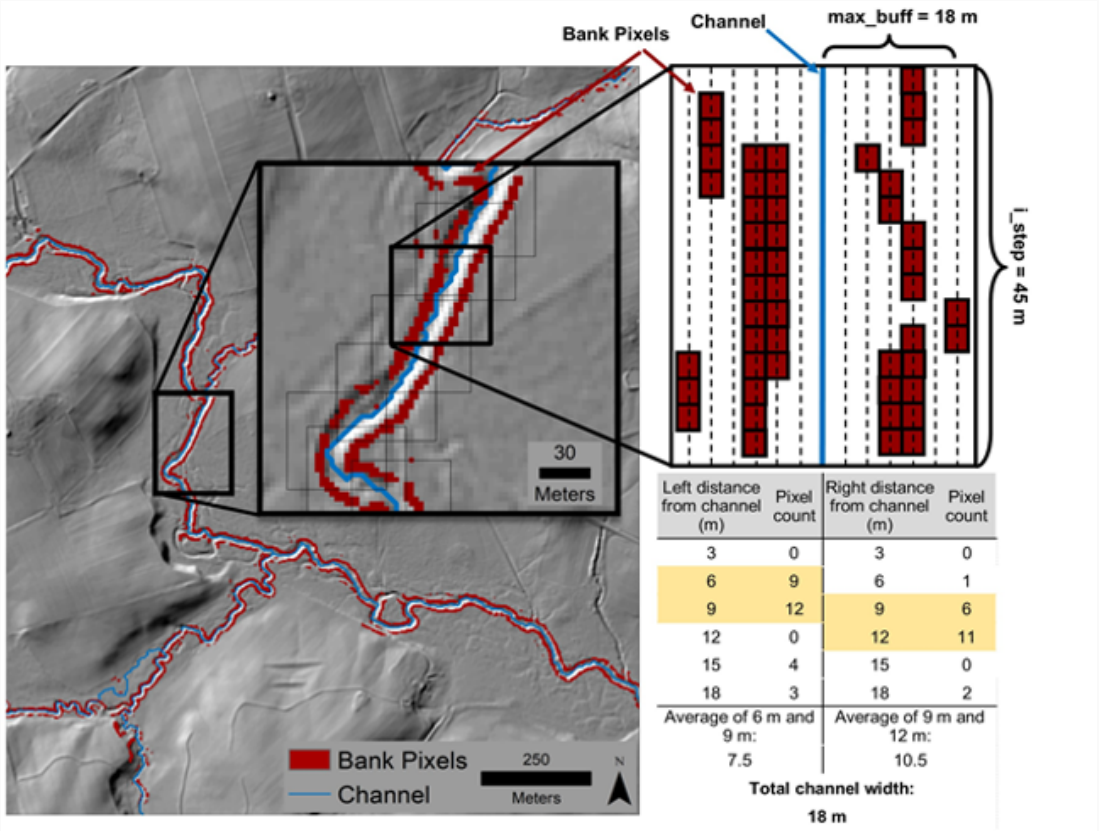


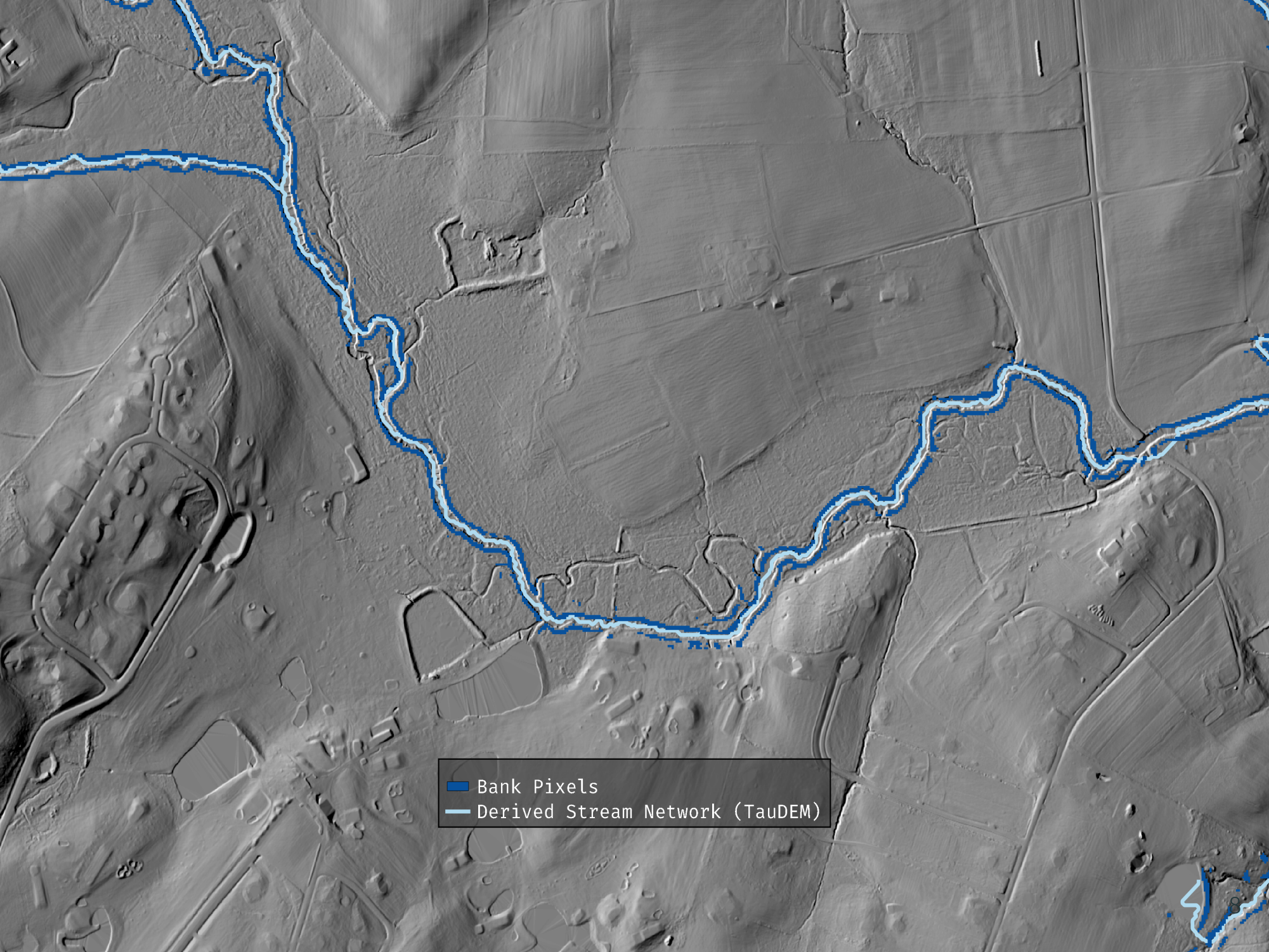
1-D Cross-sections are automatically created parallel to the reach at user defined spacing (9-meters).
Metrics calculated: ***Bank height*** and ***channel width***


Bank Points
Channel Cross sections
Derived Stream Network (TauDEM)

Stream-bank: Raster-based curvature analysis

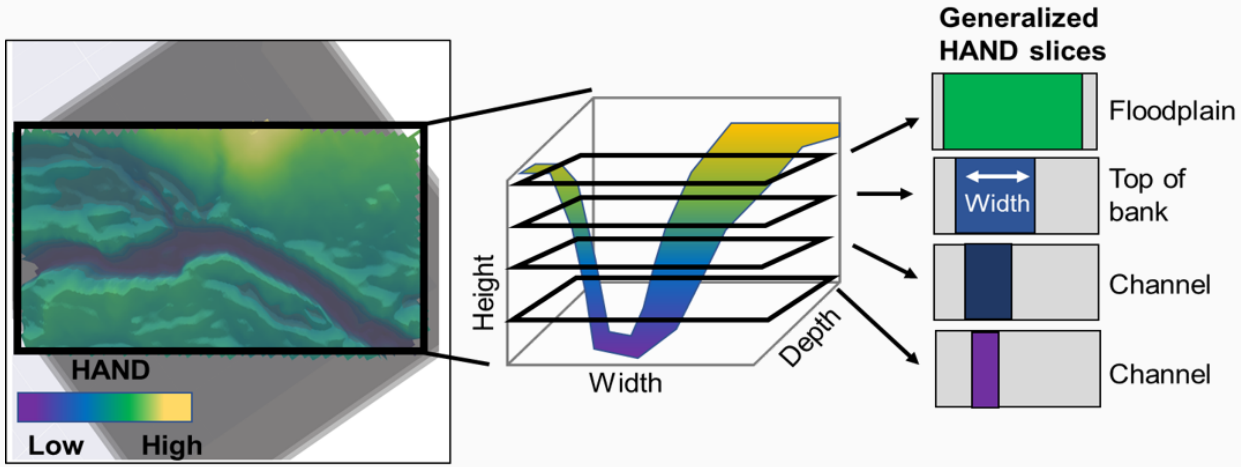
- Curvature is calculated within a moving window that traverses the stream network
- Threshold applied to identify the bank pixels
- Buffer window used to estimate ***channel width*** based on the pixel counts




Bank Pixels
Derived Stream Network (TauDEM)

Stream-bank: Height Above Nearest Area (HAND) Analysis

- HAND grid within a window are extracted for each reach
- 50 vertical slices used to identify location of the channel
- Slices used to estimate ***channel width*** and ***bank height***

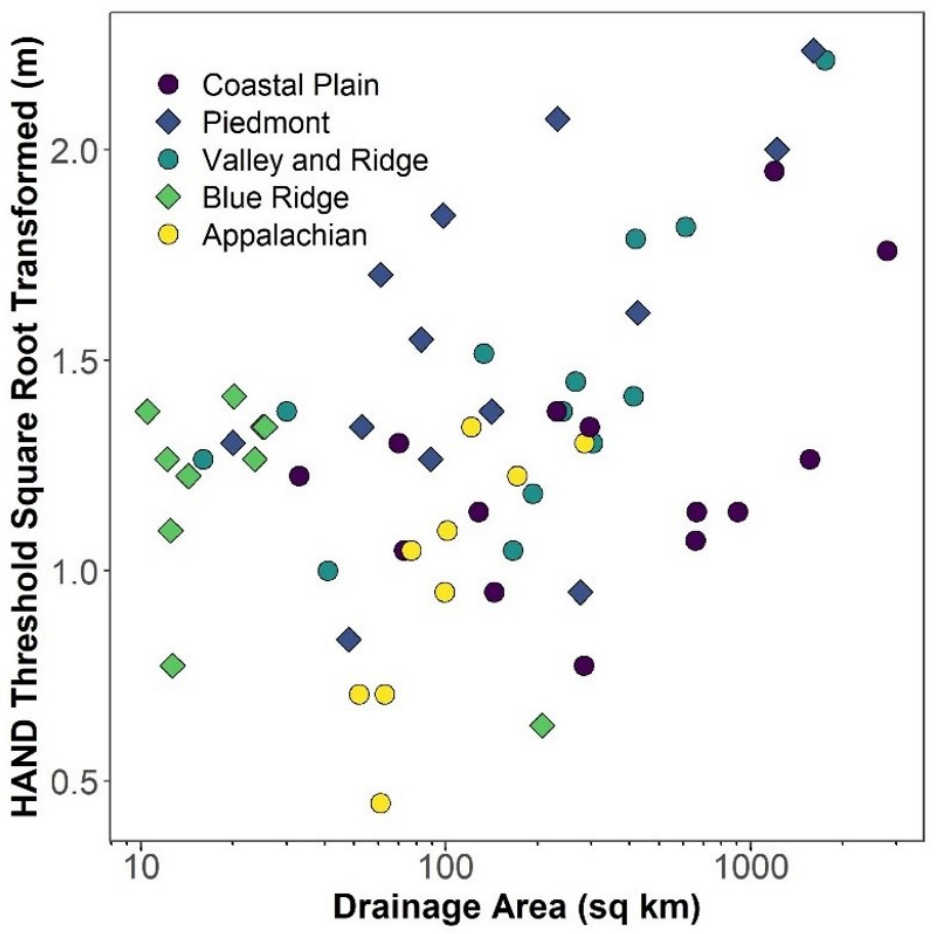


Floodplain Width

- Identify active floodplain extent in field
- Identify HAND threshold aligning with field measured floodplain extent at each site
- Predictive linear model related HAND height thresholds to drainage area and physiographic province

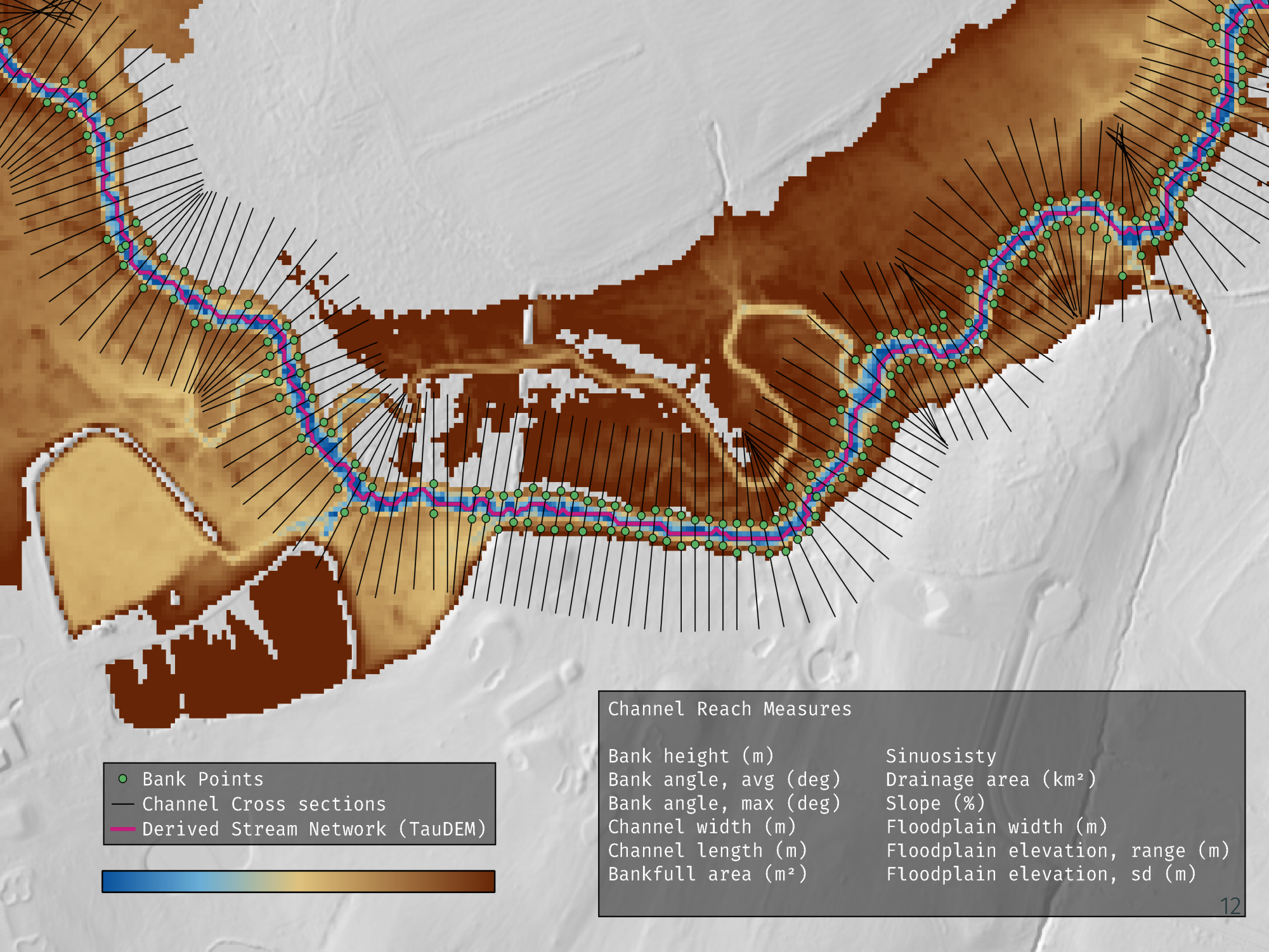
Contd.

- The ***mean HAND threshold*** for the ***Coastal Plain*** sites ***1.65 meters)*** and ***Blue Ridge (1.56 meters)*** were used to define the active floodplain (1.5 year)
- Other three provinces, a ***linear model was developed relating the HAND threshold to drainage area and physiographic province*** (R^2=0.59, $p < 0.001$)



FACET output: HUC 0206000604 (Patuxent River @ Route-50)

- Stream network
- 1-D Cross-section bank points
- Raster-based curvature bank pixels
- Floodplain extent Raster (HAND)



Channel Reach Measures

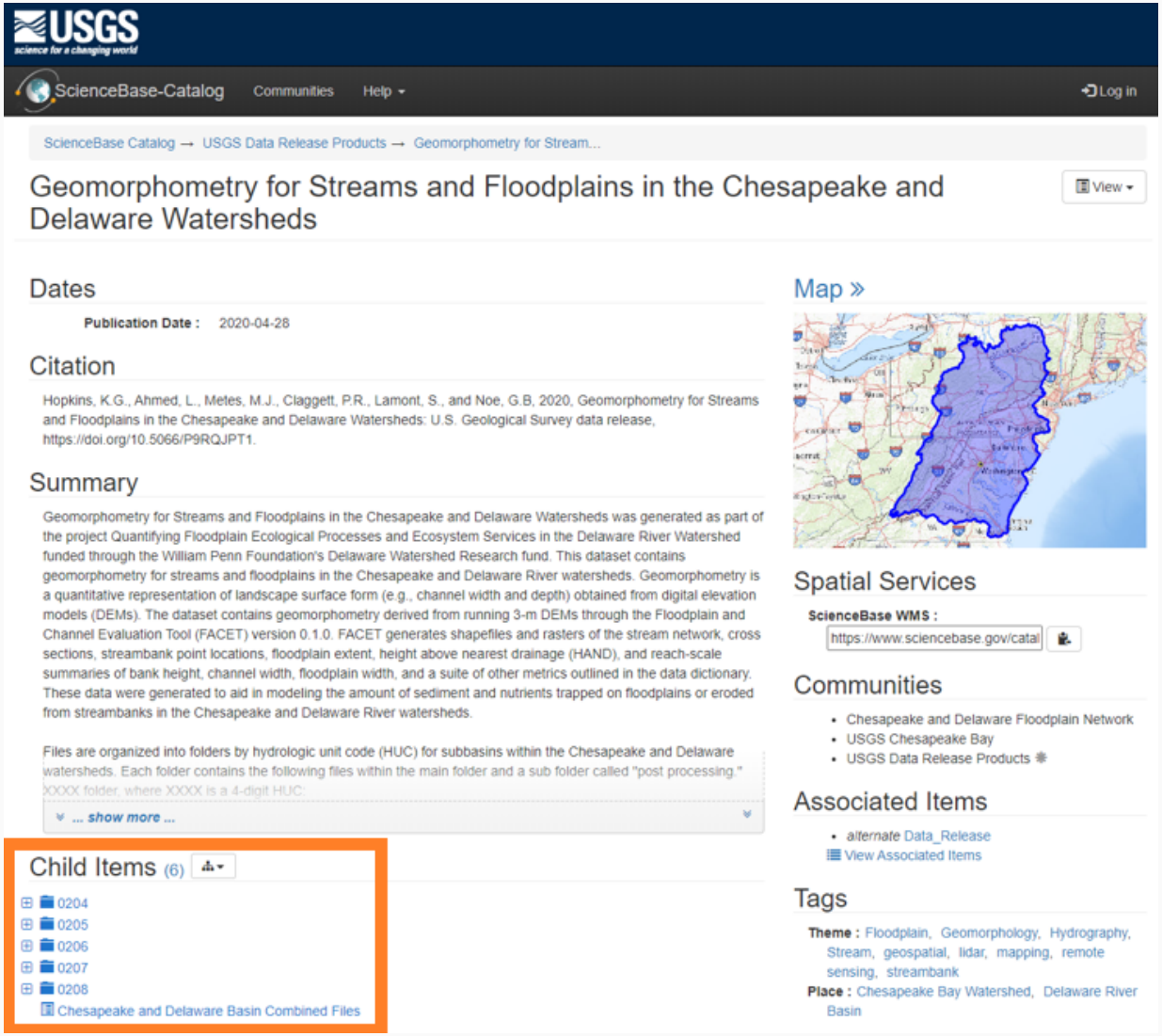
Bank height (m)	Sinuosisty
Bank angle, avg (deg)	Drainage area (km²)
Bank angle, max (deg)	Slope (%)
Channel width (m)	Floodplain width (m)
Channel length (m)	Floodplain elevation, range (m)
Bankfull area (m²)	Floodplain elevation, sd (m)

Get Code

https://code.usgs.gov/water/facet/-/releases/v0.1.0

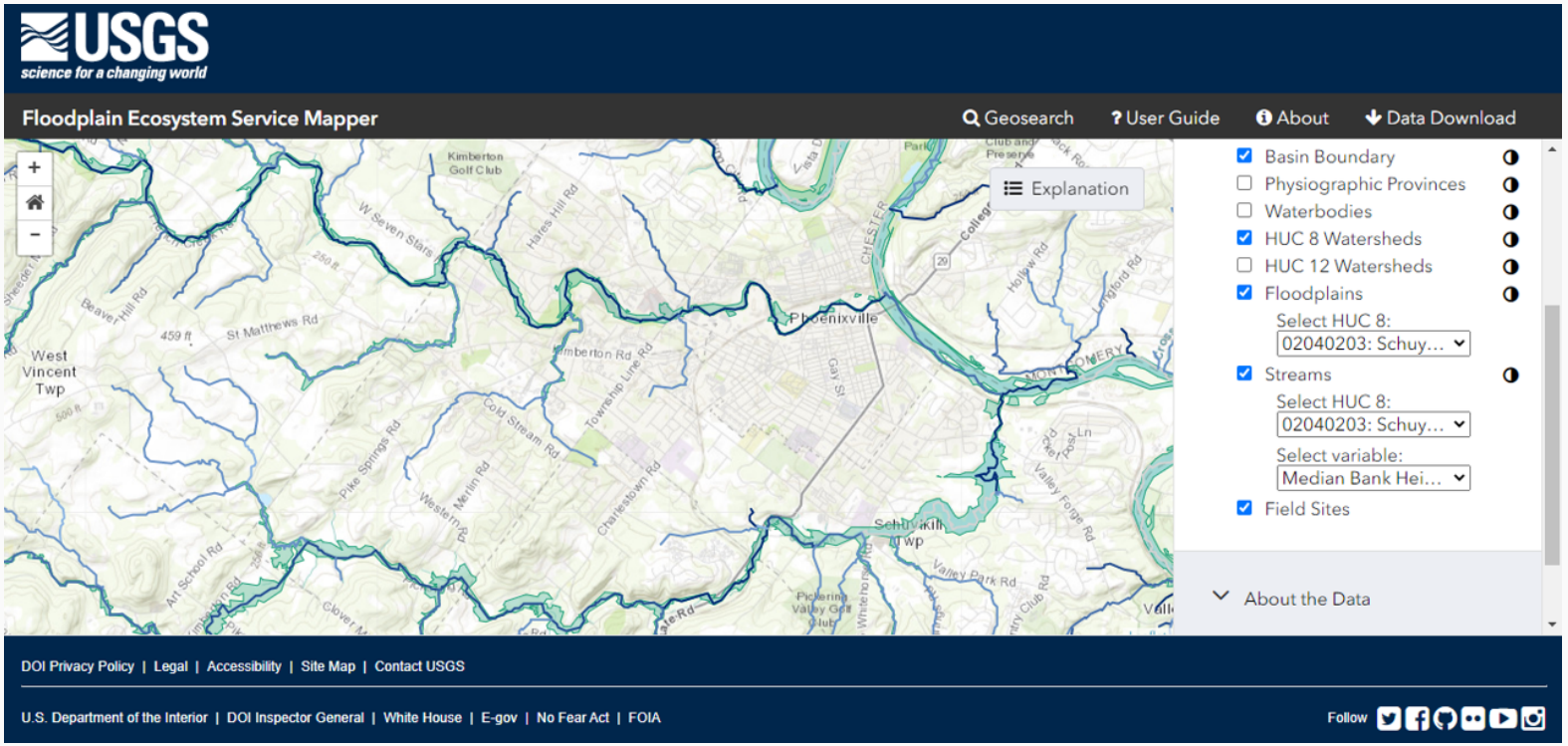
Download Data

https://doi.org/10.5066/P9RQJPT1



Floodplain Ecosystem Service Mapper

https://www2.usgs.gov/water/southatlantic/projects/floodplains/

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Questions?

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