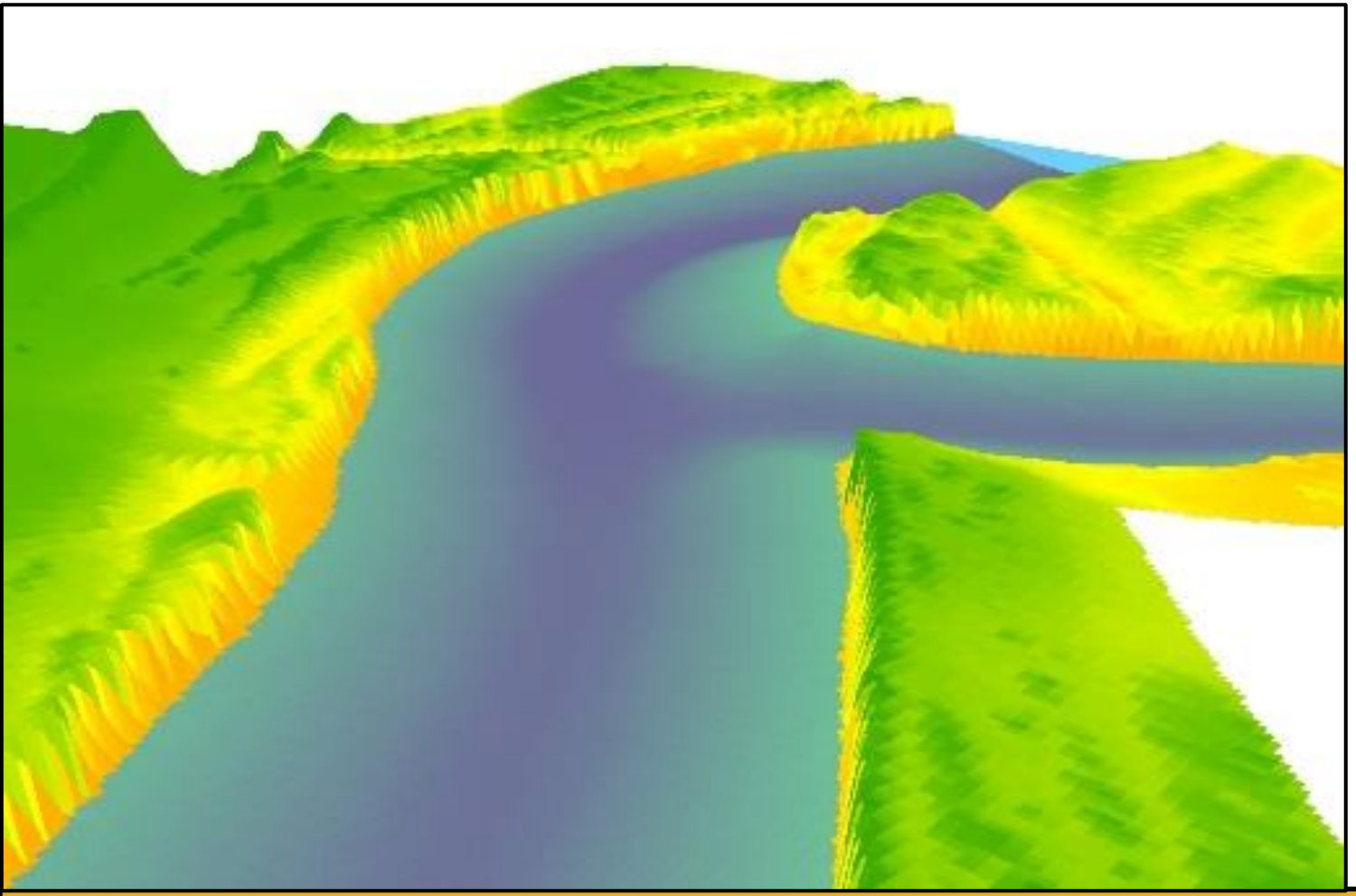
Bathymetry Processing Tools for Catering to Varied User Applications in Rimorphis



Rimorphis Workshop - 1

May 19th, 2021

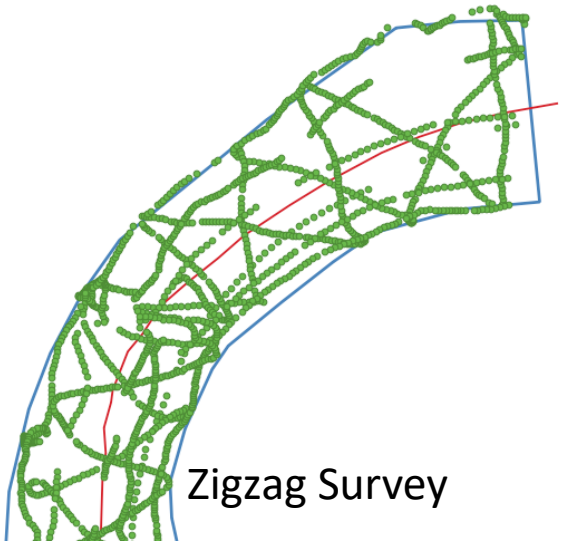
Wednesday

Sayan Dey, Chung-Yuan Liang, and Venkatesh Merwade

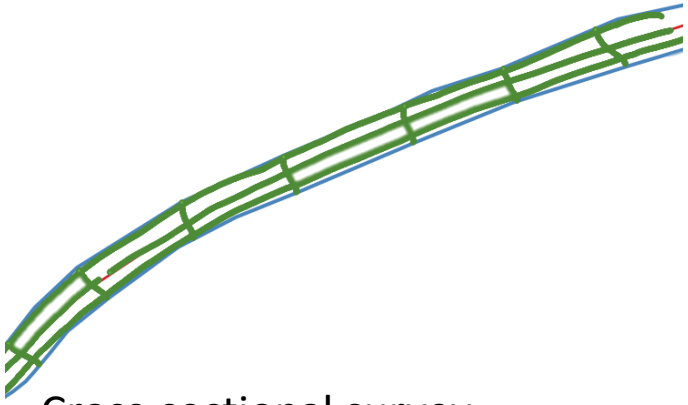
Purdue University, West Lafayette, IN

Reach-Scale Analysis: Post-Processing Bathymetric Surveys

- Survey data needs post-processing before being implemented in reach-scale studies
- Different spatial patterns or density depending on sites and instruments
- Automated conversion to survey points to 3D mesh representing channel morphology
- Input: Survey points, river centerline, channel boundary
- Output: 3D mesh at user-defined resolution



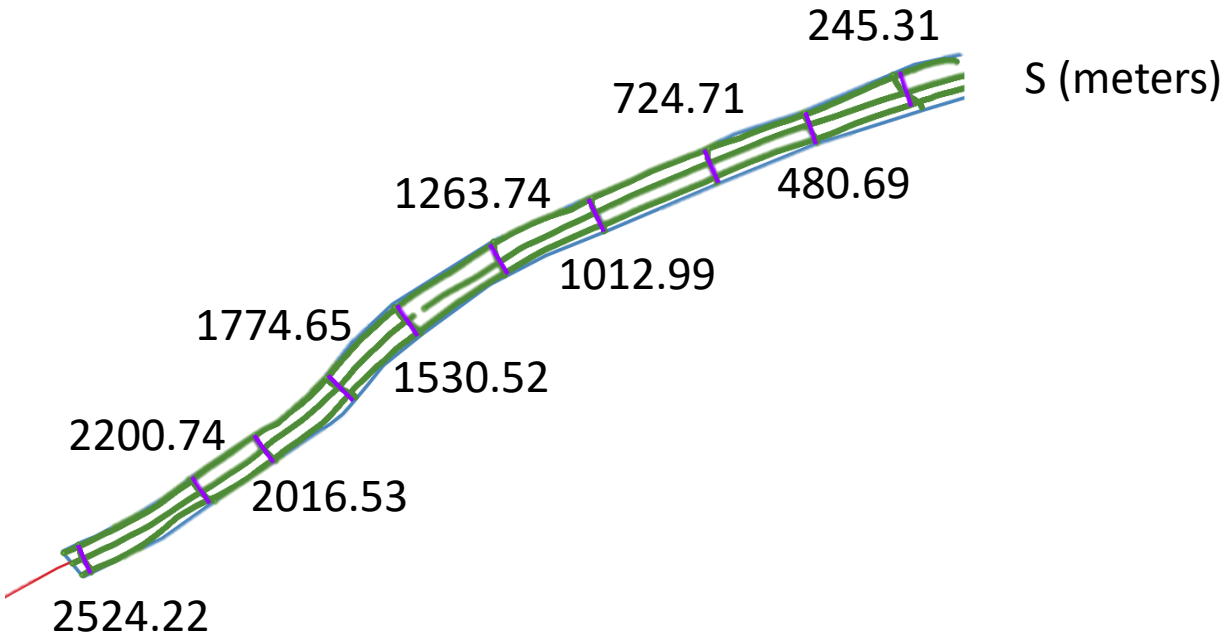
Zigzag Survey

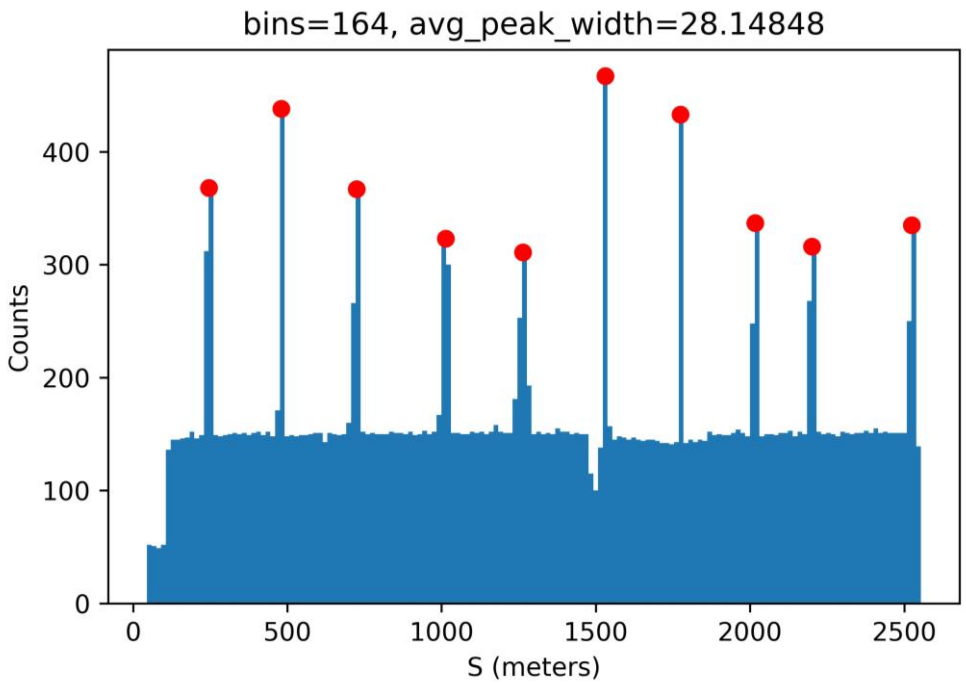


Cross-sectional survey

PURDUE UNIVERSITY

Mesh Generation Tool: Cross-Sectional Survey

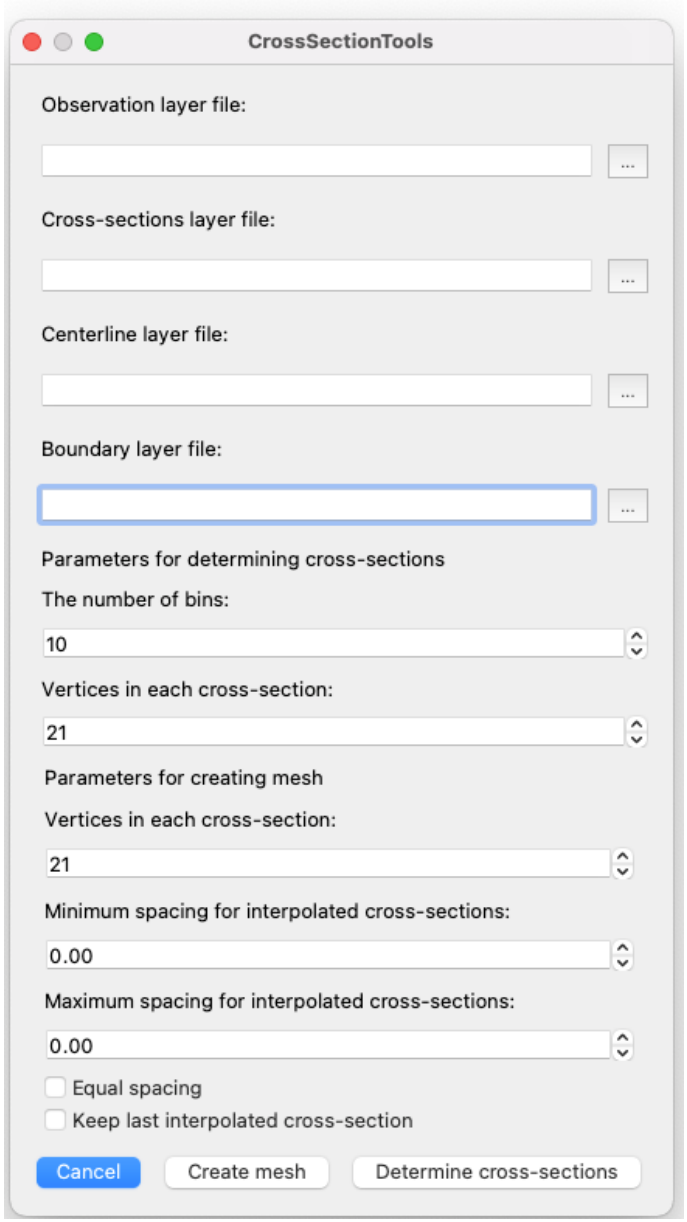




- Locates optimal positions for placing cross-sections and extracts elevation from survey points
- Curvilinear interpolation between optimal cross-sections to create 3D mesh at user specified spacing (resolution)

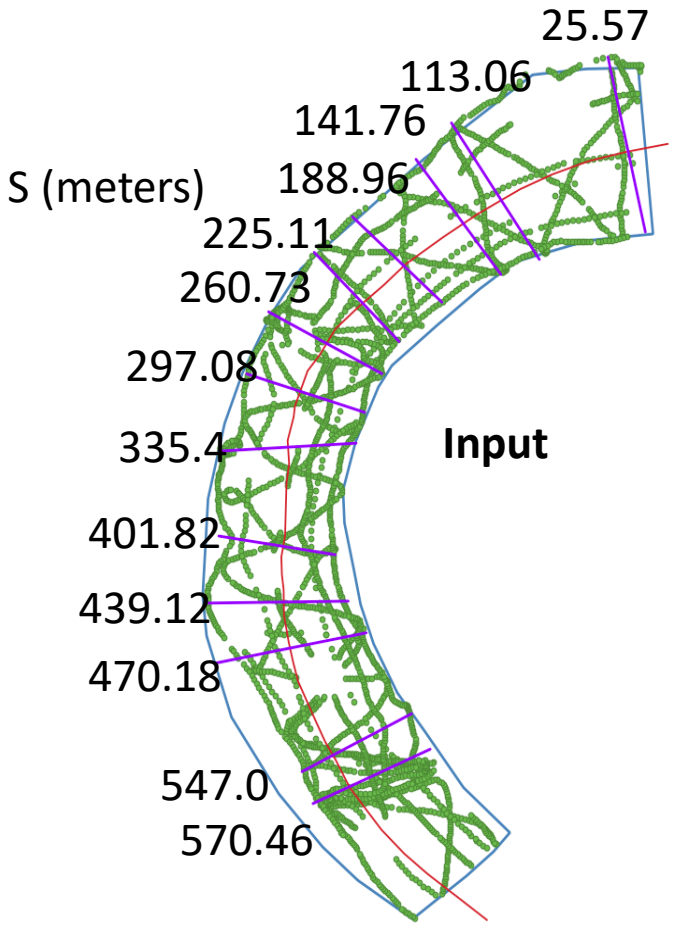
PURDUE UNIVERSITY

Mesh Generation Tool: Live Demo

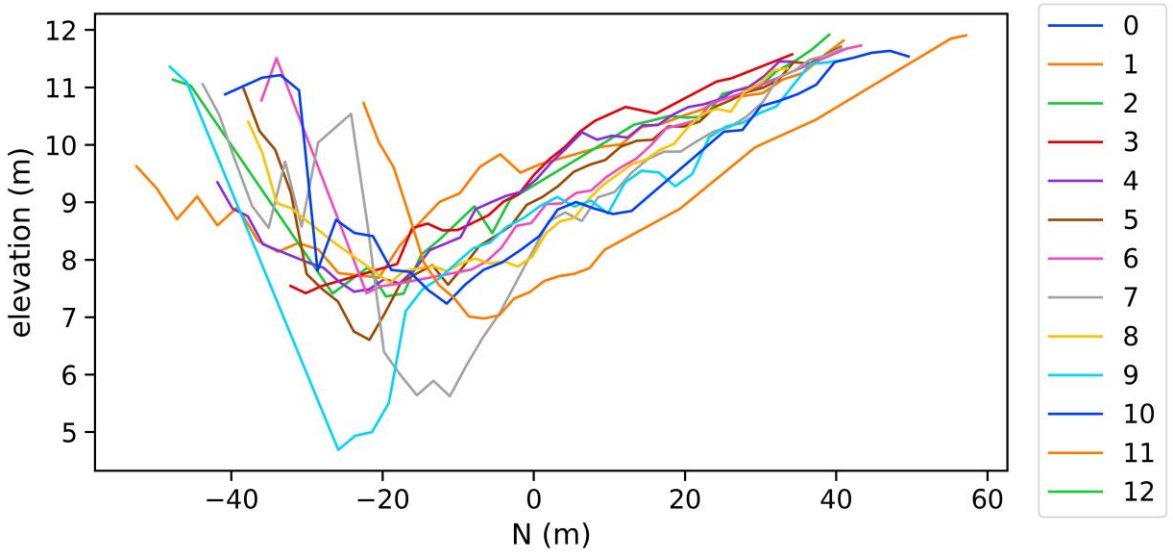


PURDUE UNIVERSITY

Mesh Generation Tool: Zigzag survey



Output

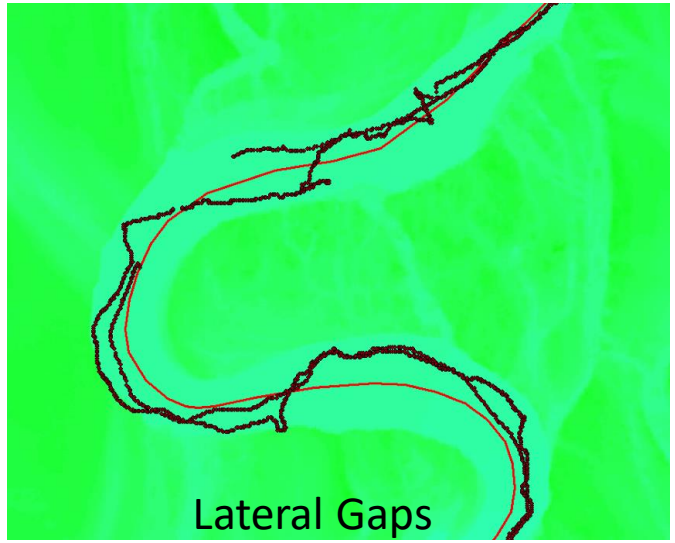


- Additional information from survey points between cross-sections are incorporated directly into the mesh

PURDUE UNIVERSITY

Network-Scale Analysis: Limitations of Conventional Datasets

- River Centerline:
  - Manual Digitization: Impractical for large scale applications
  - USGS's National Hydrography Dataset (NHD): may or may not match with latest DEM
  - Flow accumulation based methods (D8 and D∞): Improper spatial attributes such as curvature and length
- River bathymetry → Field Surveys:
  - Impractical for large scale applications
  - Often limited to the main stem of a river network
  - Longitudinal and lateral gaps in dataset
  - Not often available for lower order streams


Lateral Gaps


Longitudinal Gaps

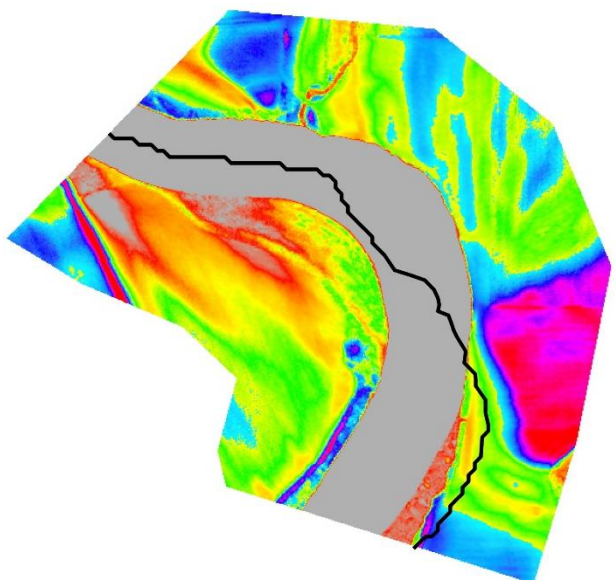
PURDUE UNIVERSITY

SPRING: System for Producing RIver Network Geometry

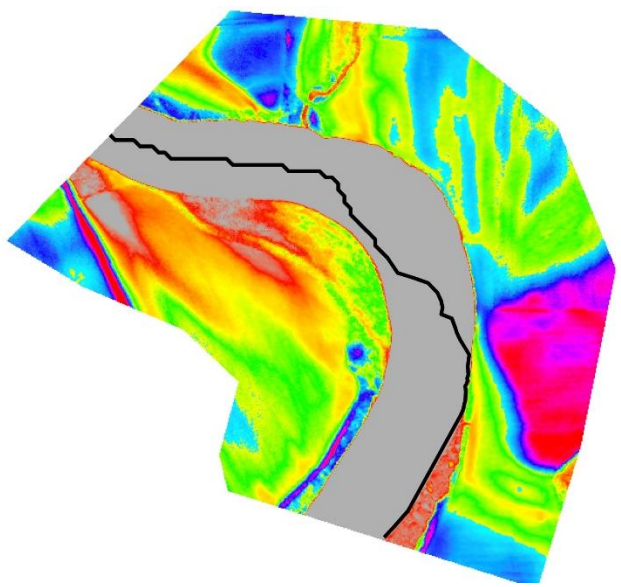
- Improving spatial attributes of hydrologic/hydraulic/topographic descriptors
  - Correcting river centerline network corresponding to input DEM
  - Estimating channel boundary for the corrected centerlines
  - Incorporating synthetic bathymetry for entire river network using centerline & banks
- Inputs:
  - Centerline (may be erroneous)
  - DEM
- Outputs:
  - Corrected Centerline and channel boundary
  - Synthetic cross-sections and 3D mesh representing channel morphology

PURDUE UNIVERSITY

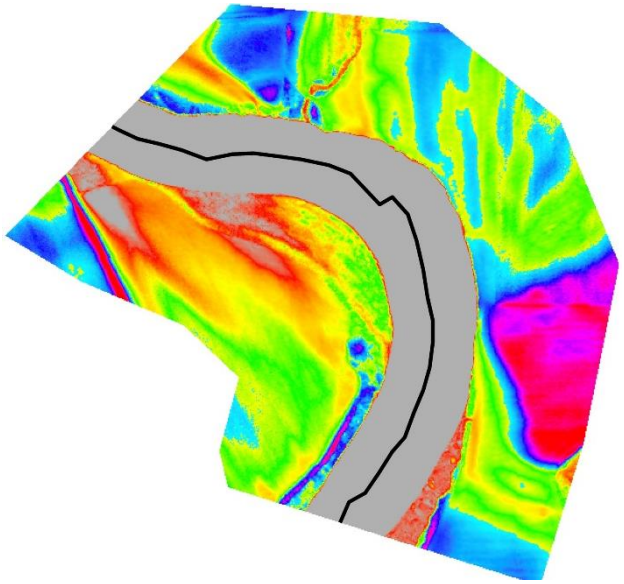
SPRING: Centerline Correction



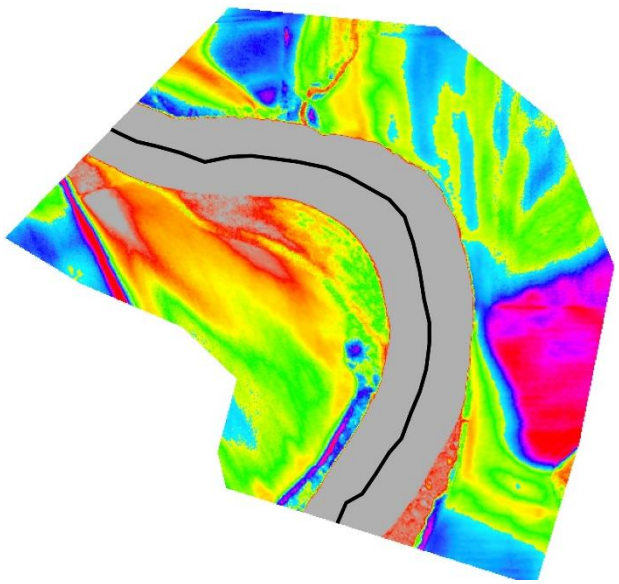
<u>Input Centerline</u>
Erroneous spatial attributes



<u>Step 1</u>
Search river like features in vicinity of input centerline



<u>Step 2</u>
Move to center of river like feature

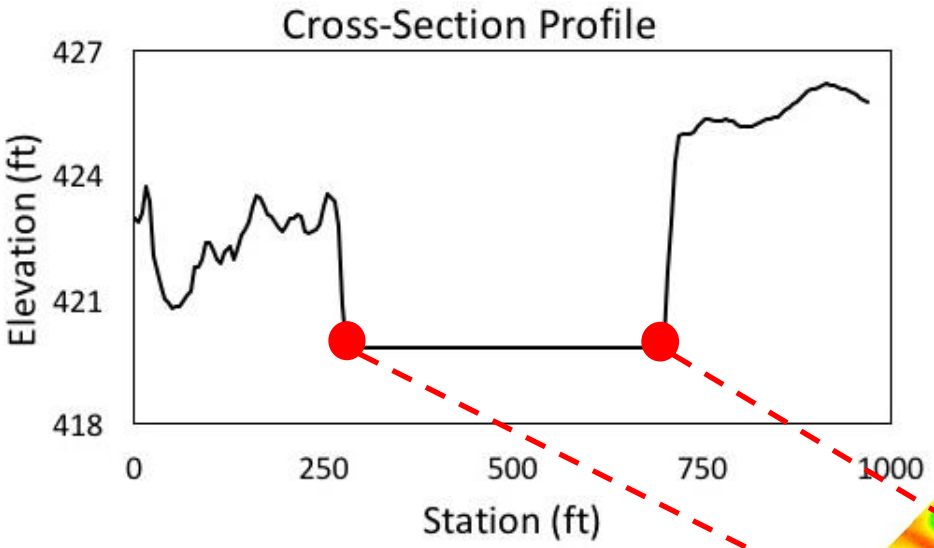


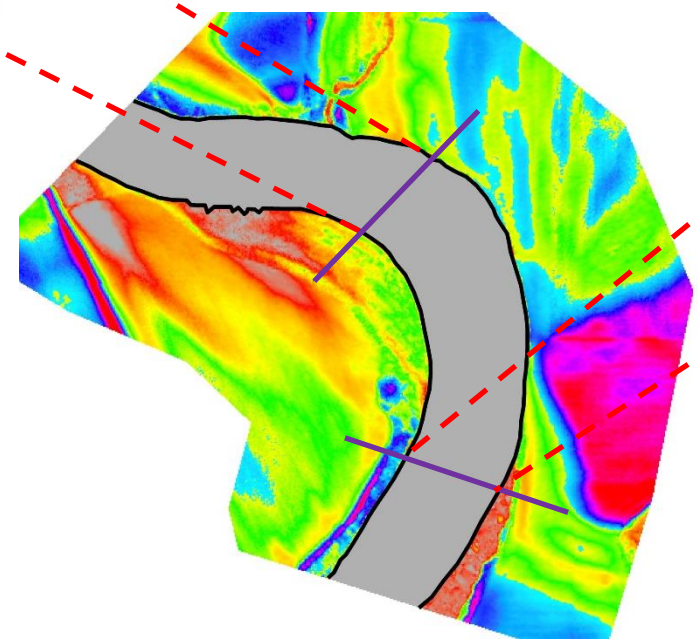
<u>Step 3</u>
Remove kinks

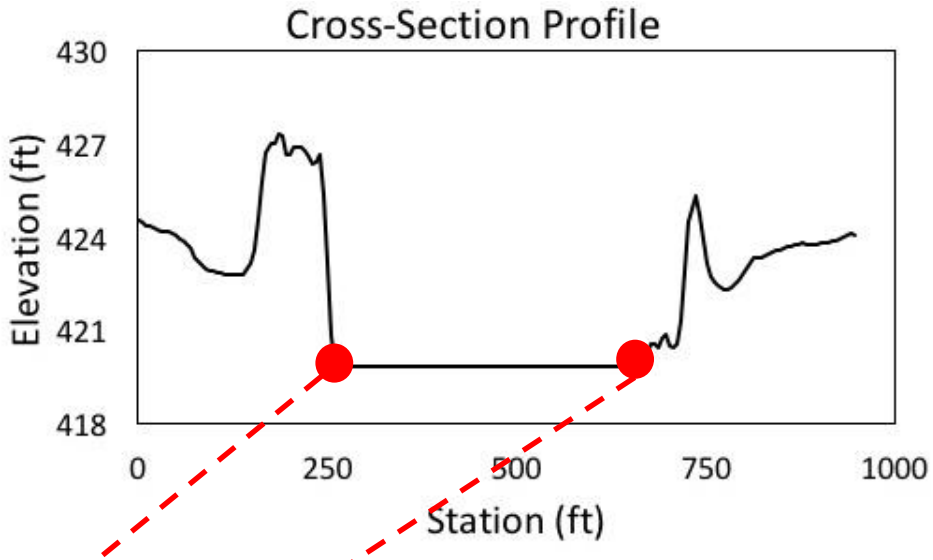
PURDUE UNIVERSITY

SPRING: Channel Boundary Delineation

End of flat part: Region of missing bathymetry

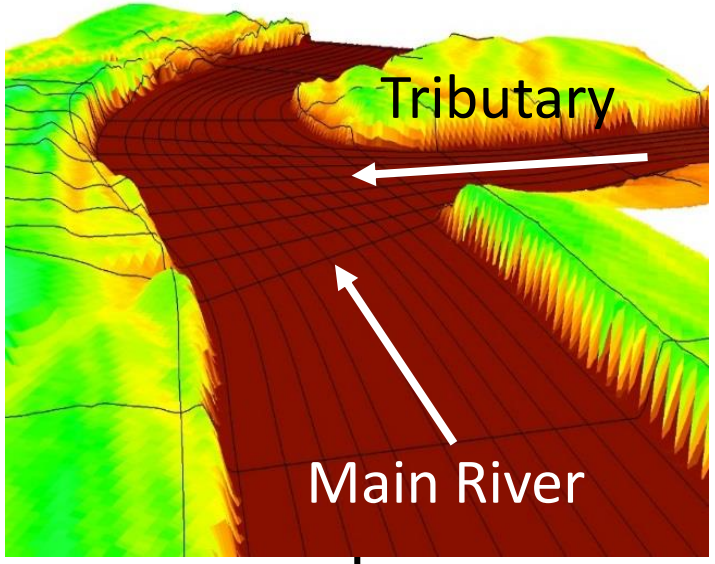




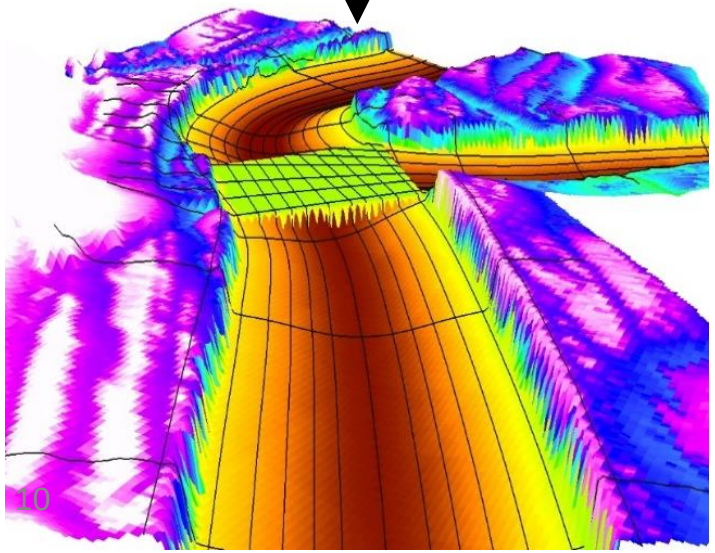


PURDUE UNIVERSITY

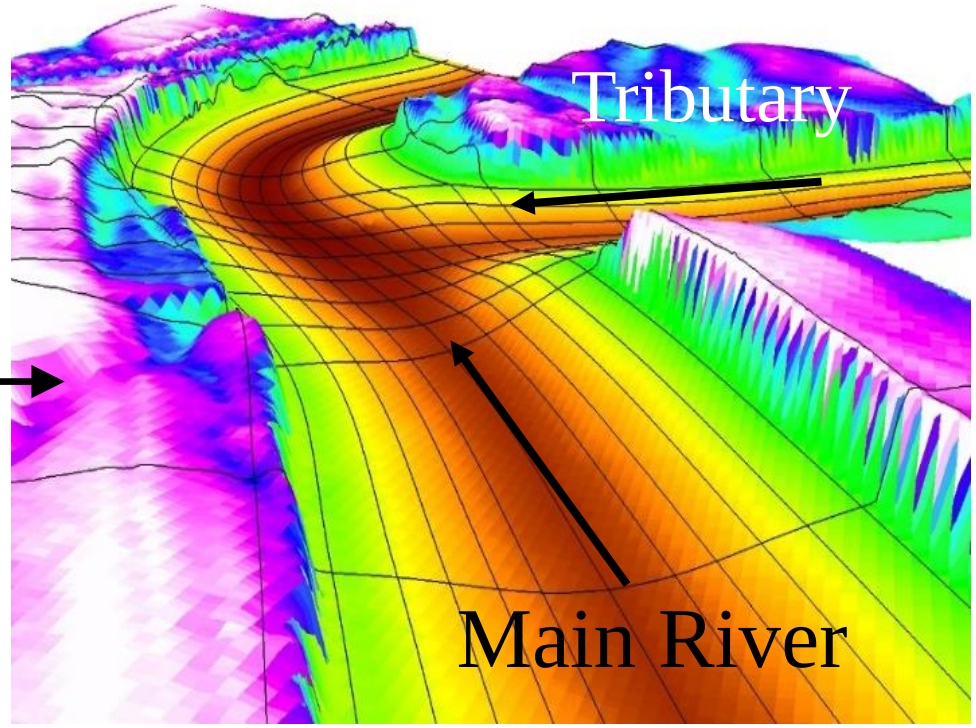
SPRING: Incorporating Synthetic Bathymetry



Phase 1
(Individual Reaches)

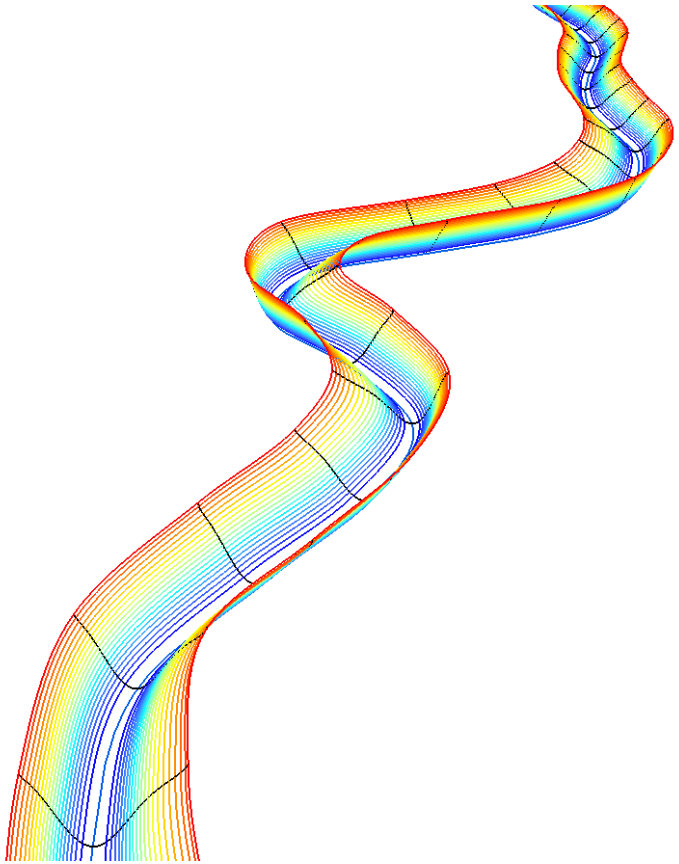


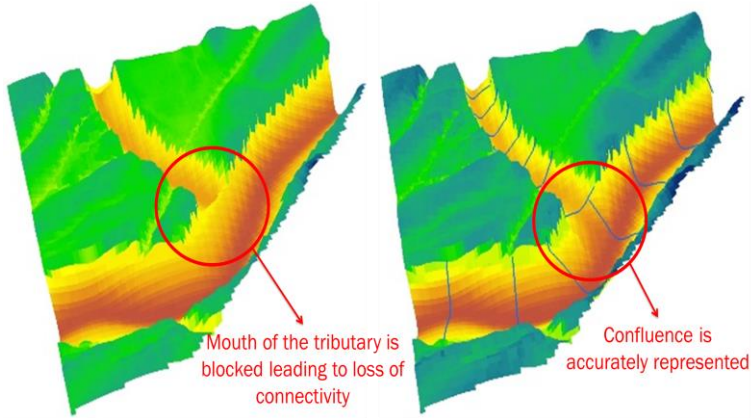
Phase 2
(Confluence Correction)

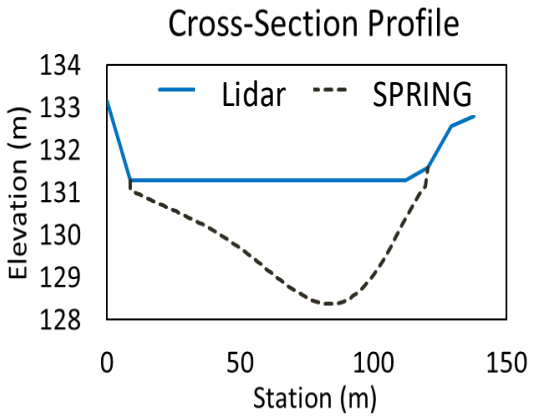


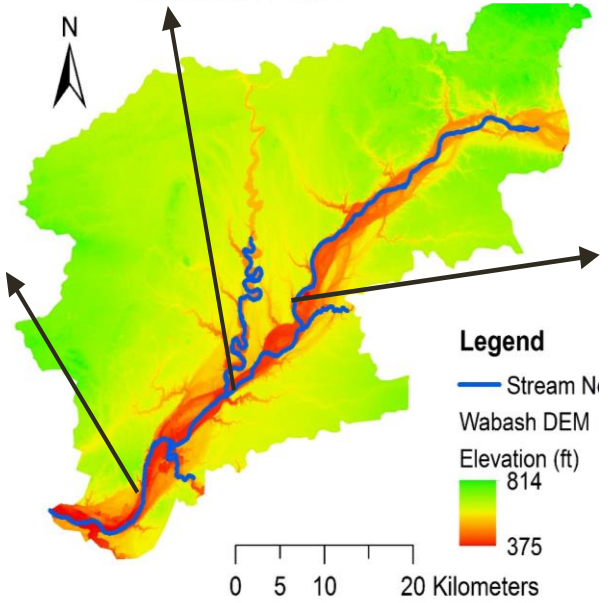
PURDUE UNIVERSITY

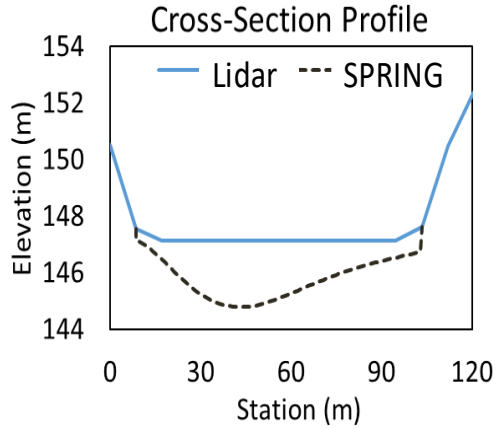
SPRING: Live Demo











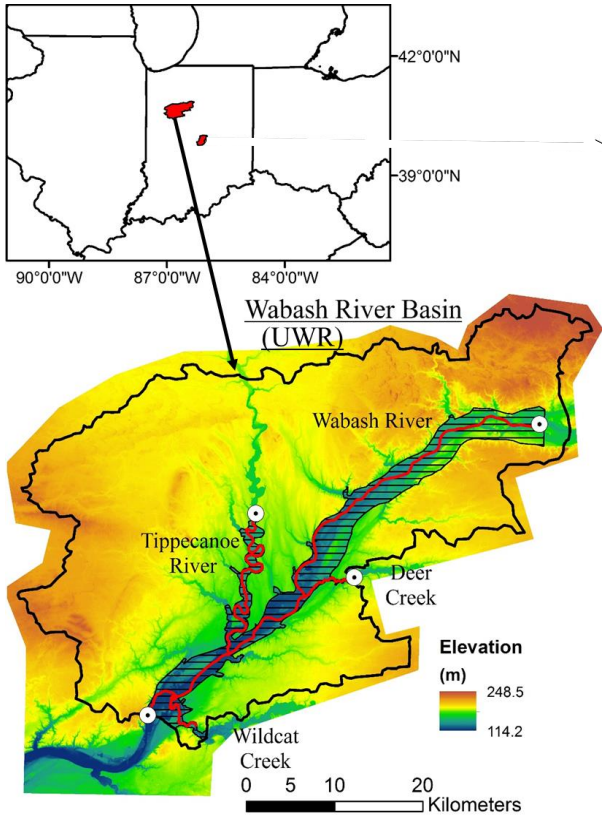
PURDUE UNIVERSITY

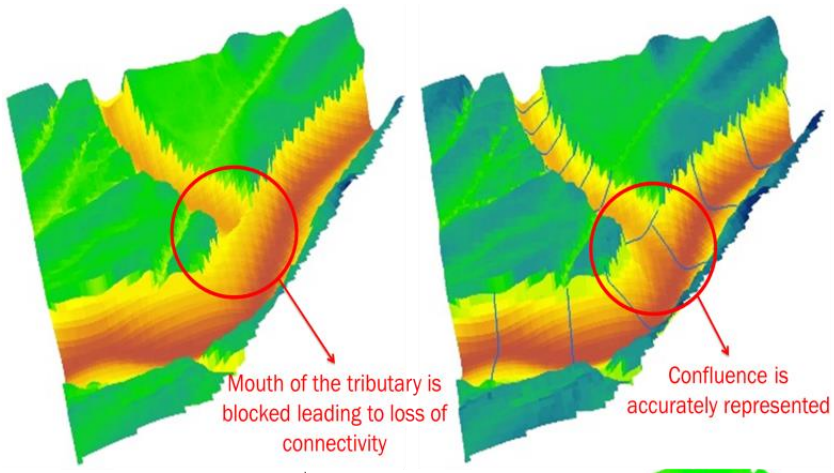
Summary

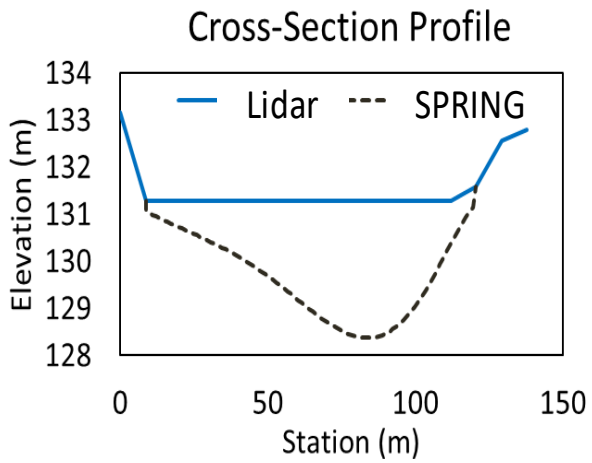
- Fast and efficient tools for improving 3D representation of river morphology for reach- and network-scale applications
- Automated development of 3D mesh from surveyed data
- SPRING: smart interpolator/extrapolator for improving river morphology representation for entire river networks
- Minimal user input → Ideal for large-scale implementation
- GUI based applications → To be integrated as a web-based tool in Rimorphis

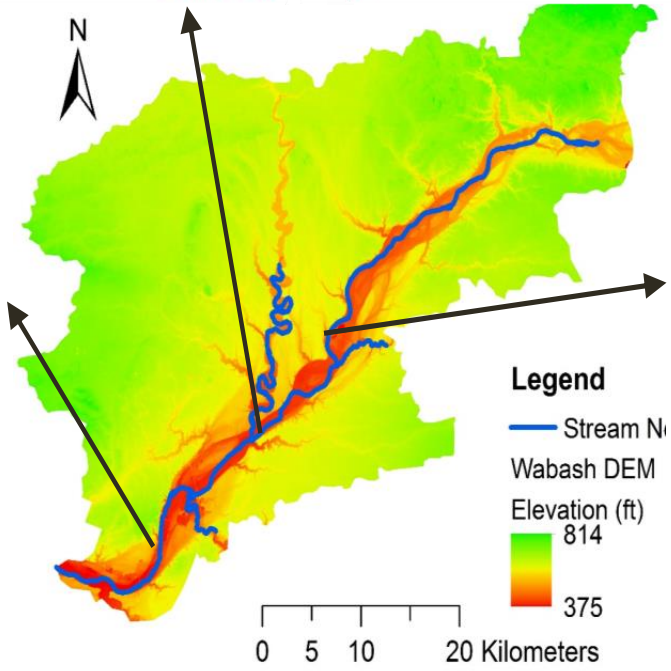
https://doi.org/10.4211/hs.5f997ec440ea41859bc329ea4a5d7289

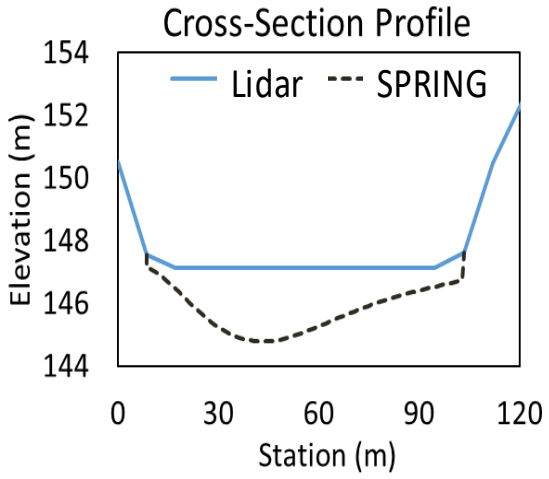
Moving Beyond Single Reaches: Wabash River, IN





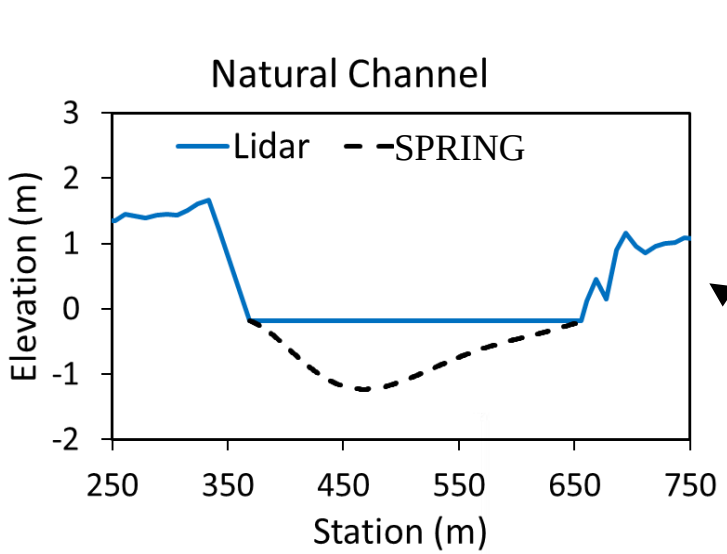


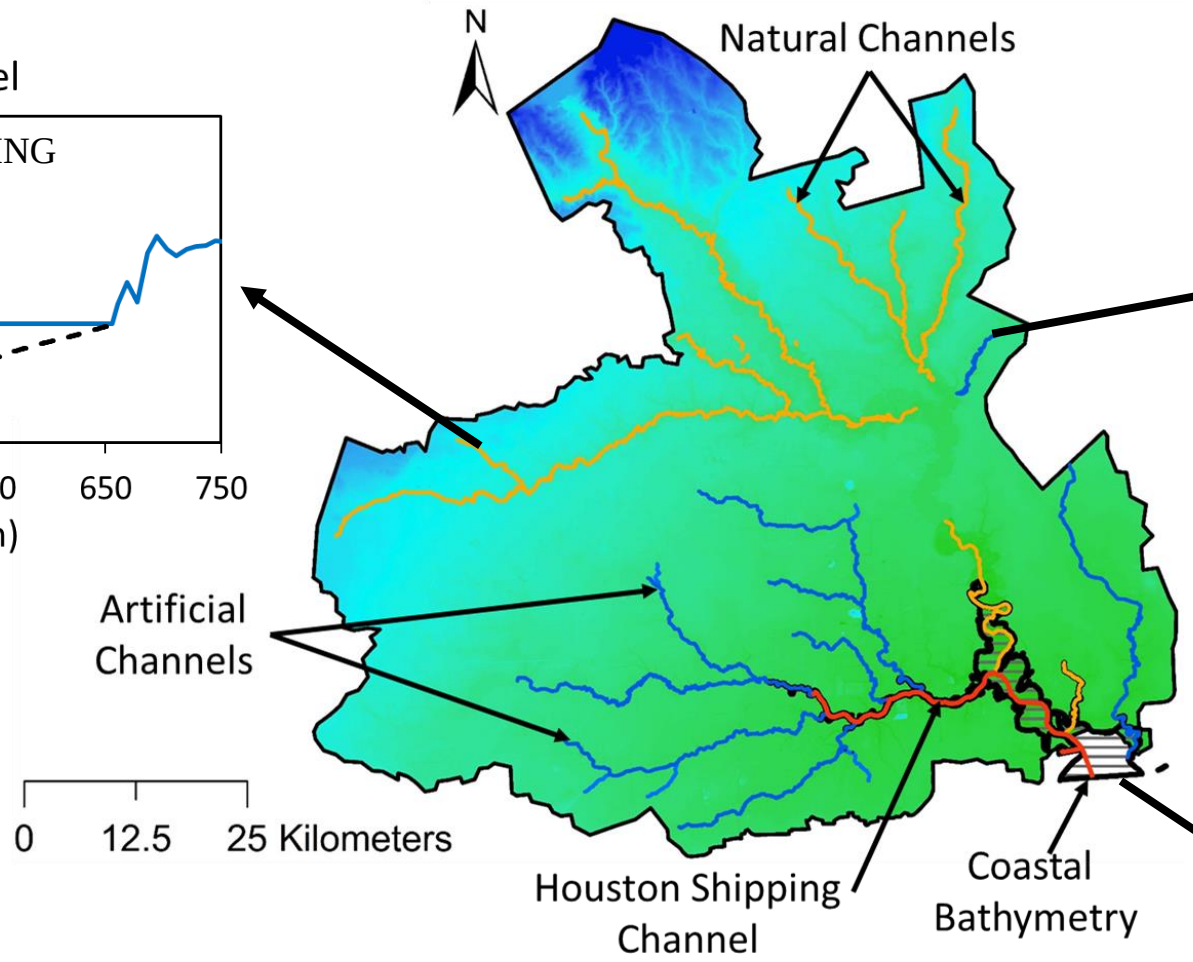


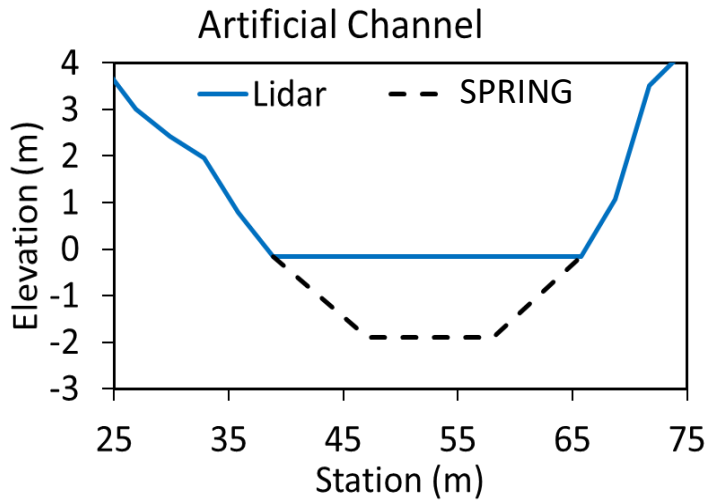


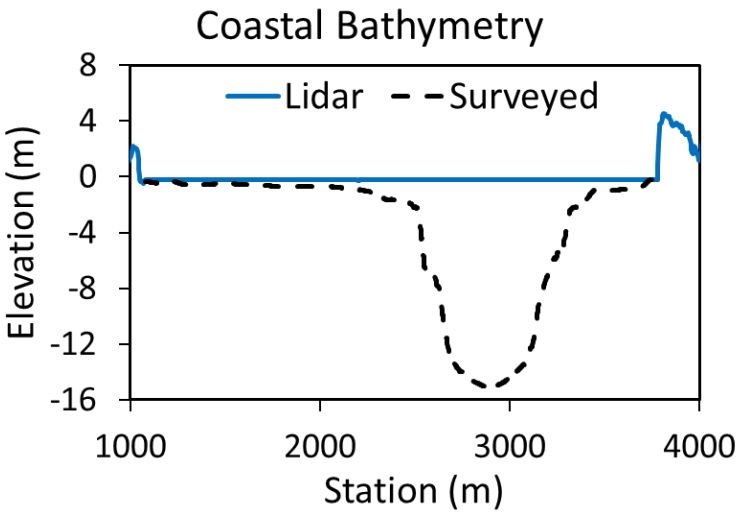
PURDUE UNIVERSITY

SPRING: Incorporating Different Channel Geometry









- Area → 5,342 km^2
- Beta-shaped, Triangular, Rectangular and Trapezoidal

PURDUE UNIVERSITY