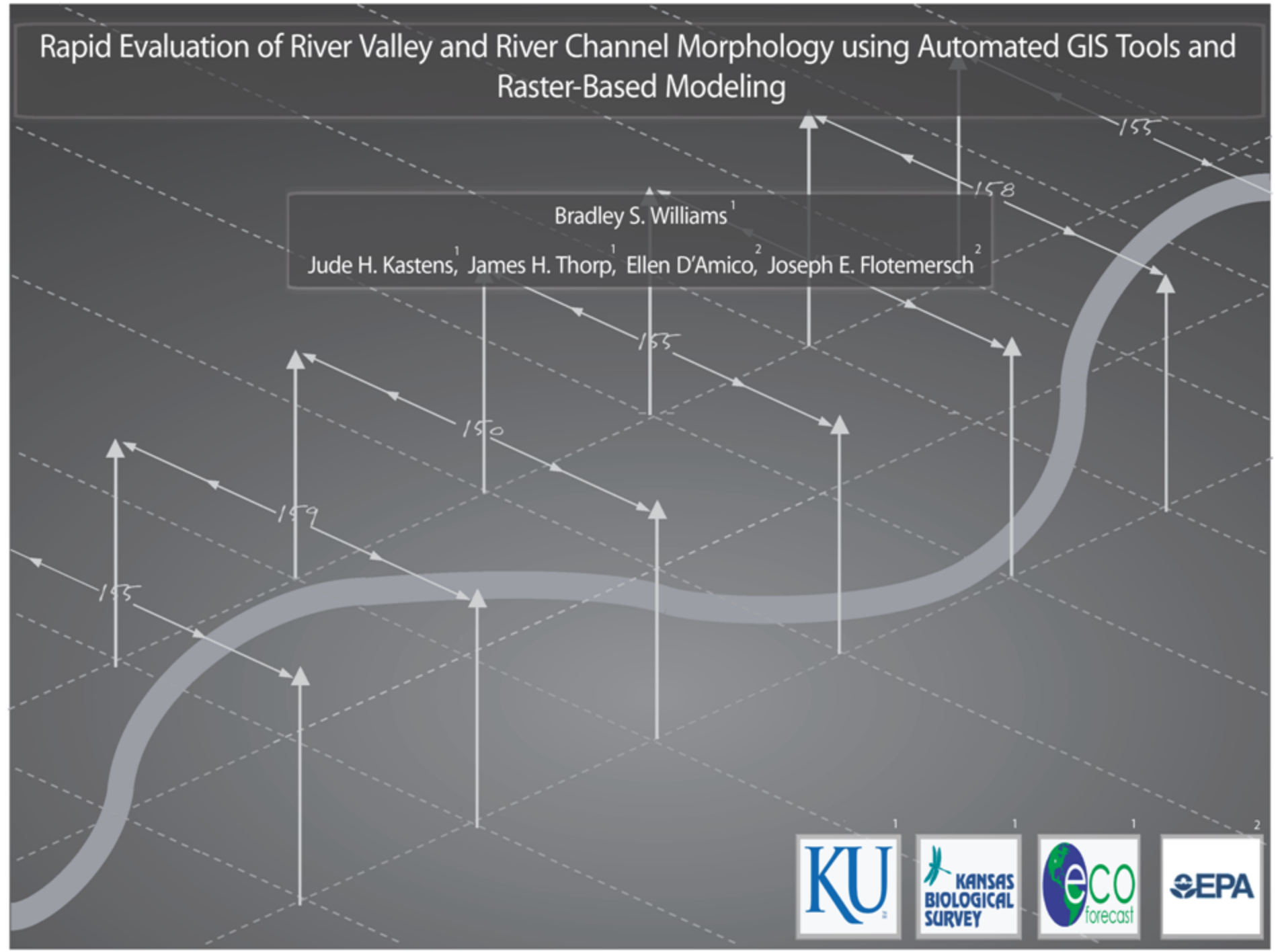
Rapid Evaluation of River Valley and River Channel Morphology using Automated GIS Tools and Raster-Based Modeling

Bradley S. Williams [1]

Jude H. Kastens, [1] James H. Thorp, [1] Ellen D'Amico, [2] Joseph E. Flotemersch [2]



1 KU

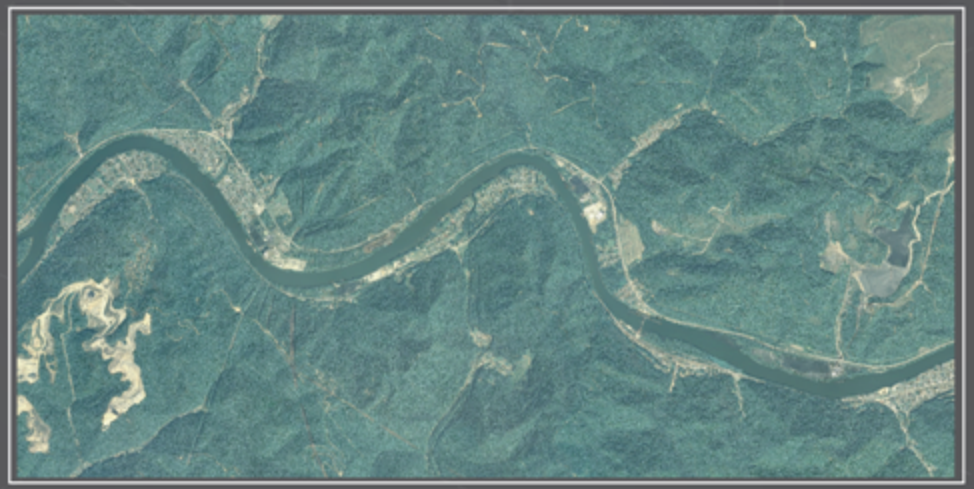
1 KANSAS BIOLOGICAL SURVEY

1 eco forecast

2 EPA

Introduction

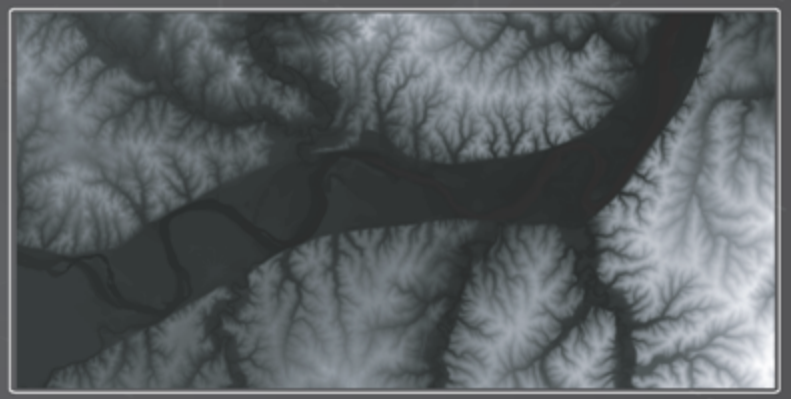
- Traditional methods for measuring river valley morphology require intensive ground-based surveys
- Traditional methodologies limit our ability to assess river valley morphology for large scale studies and management plans
- We developed an inexpensive GIS-based alternative that uses GIS automation and novel raster modeling techniques to rapidly assess the valley morphology of vast river networks



River Valley Morphology

Key Geomorphic Variables

- Valley Width
- Valley Floor Width
- Valley Width : Valley Floor Width
- Valley Side Slopes
- River Elevation
- Down Valley Slope

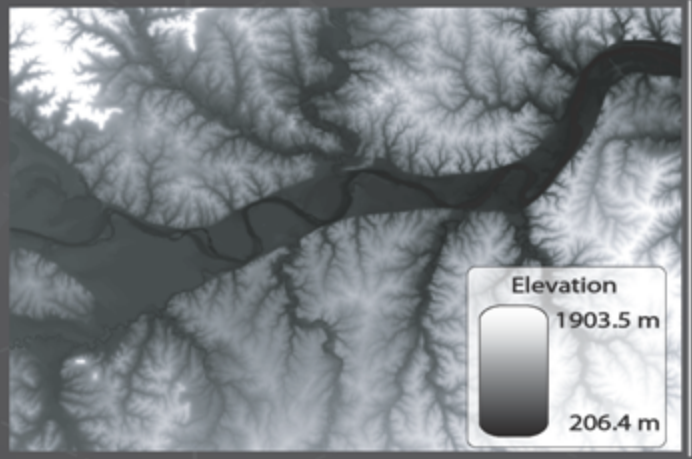


FLDPLN Model

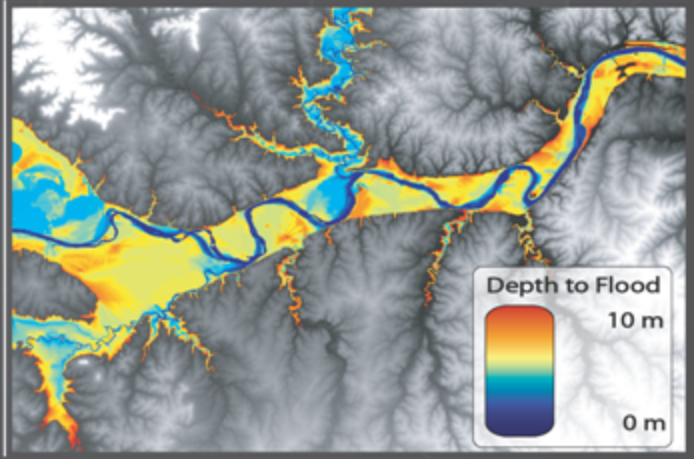
- The MATLAB® - based FLDPLN model uses backfilling and spillover flooding procedures to determine a depth to flood (DTF) value for each pixel in a surface raster

- Required Data
  - DEM or LIDAR data
  - Flow Direction raster
  - Flow Accumulation raster
  - Stream raster

- Can be used to identify the extent of the river valley floor



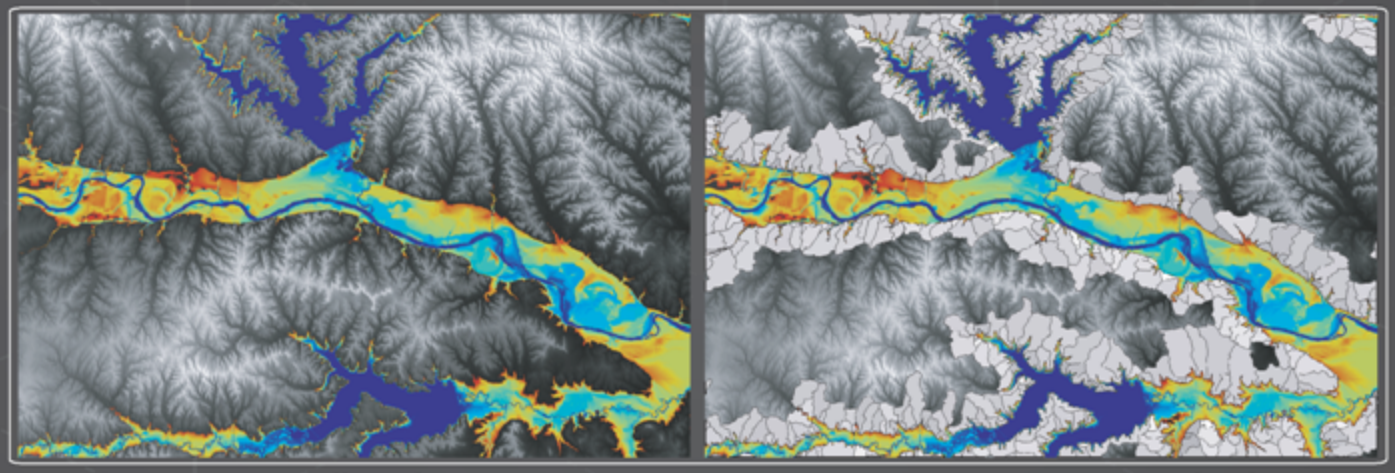
DEM of Lower Kansas River



10m Flood of Lower Kansas River

Using Micosheds to Locate River Valley Peaks

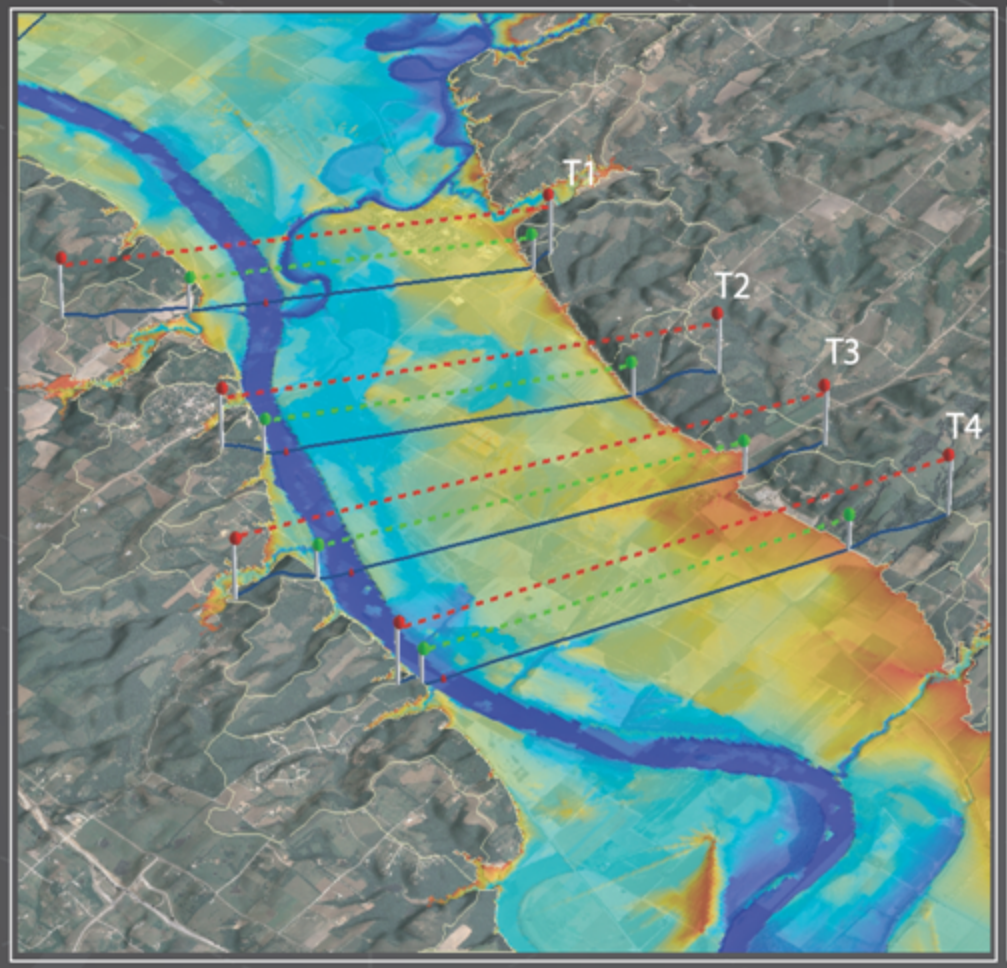
- We use ArcHydro to generate extremely small watersheds or "microsheds"
- Microshed boundary lines within the FLDPLN valley floor layer are deleted
- The remaining microshed lines give us the location of the major flow divides on either side of the river valley (valley peaks)
- The composite FLDPLN and microshed layer can be used by automated GIS scripts to determine the key valley variables for entire river networks

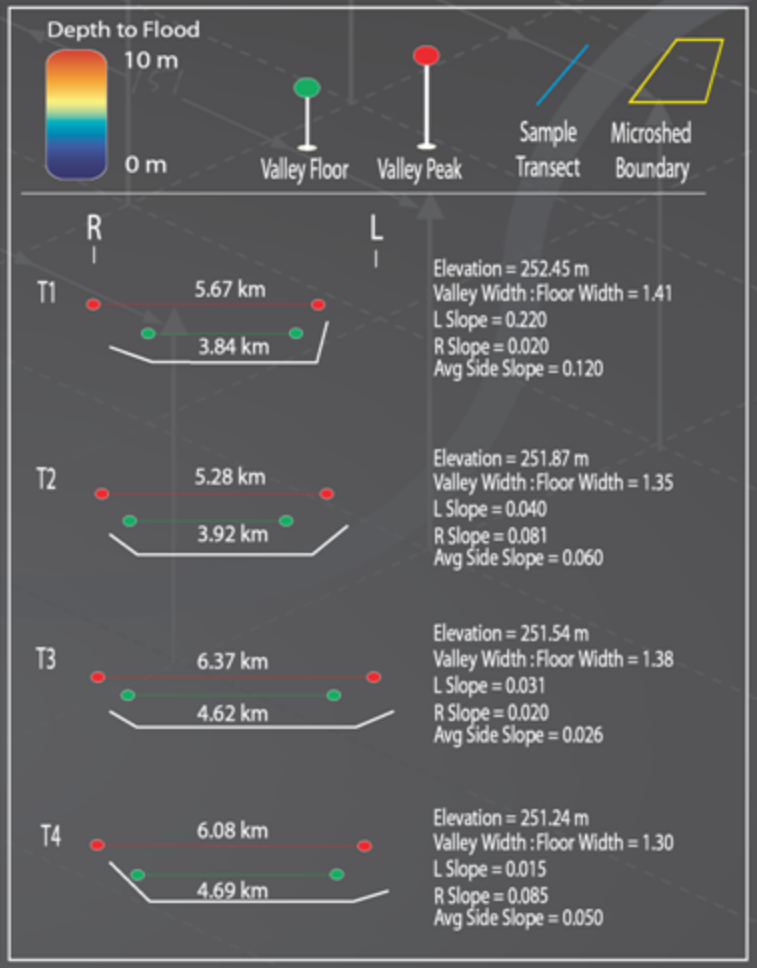


FLDPLN Valley Floor Layer

Composite FLDPLN / Microshed Layer

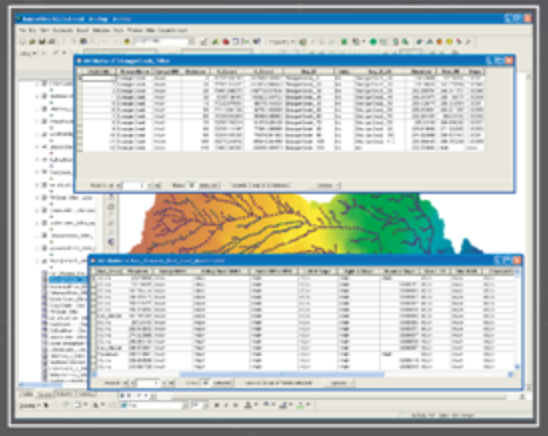
Automated Valley Morphology Scripts





Applications

- Other scripts have been written that automatically extract relevant watershed and river channel scale geomorphic variables
- Watershed, river valley, and river channel scale geomorphic variables are used in an objective river classification that identifies geomorphically distinct sections of river termed functional process zones (FPZs)
- FPZs provide the spatial extent for network scale ecological studies and river management plans
- This approach is being used by the U.S. EPA to study and manage a number of U.S. rivers



Acknowledgements

Funding Sources

U.S. Environmental Protection Agency

National Science Foundation - EPSCoR Program

Kansas Academy of Science

University of Kansas

Other Collaborators

Martin Thoms - University of Canberra