RIMORPHIS - Use Cases

River Morphology Information System

1st Annual Stakeholder Workshop

May 12 & 19, 2021

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University of Colorado Boulder

IOWA

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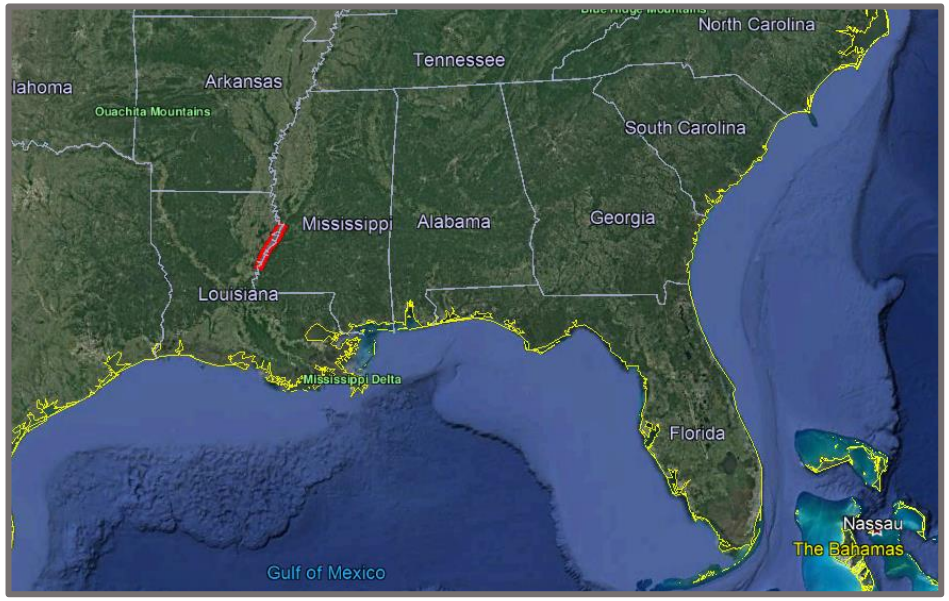
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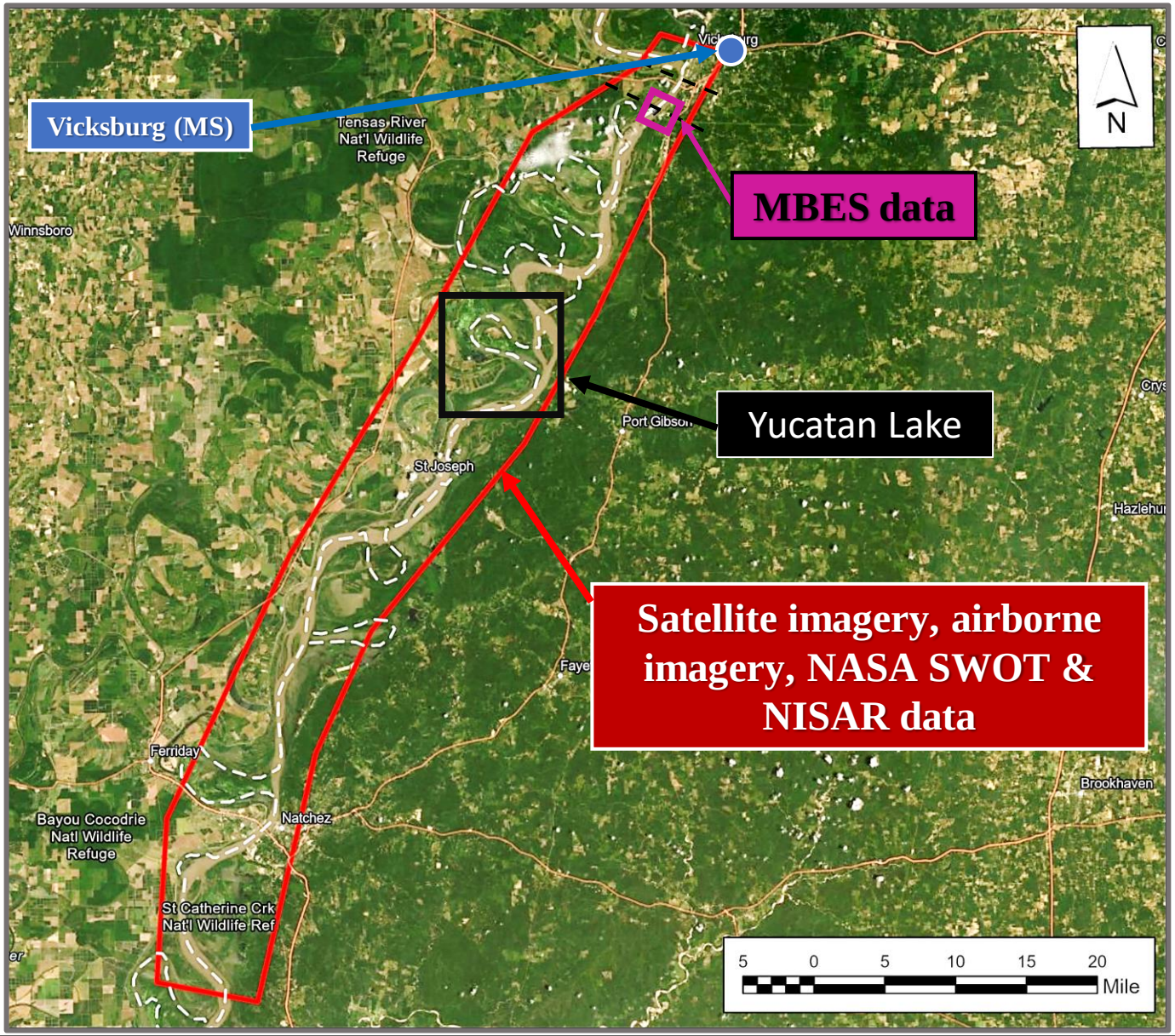
RIMORPHIS Use Case # 1:
Data discovery over wide spatio-temporal scales

Toby Minear University of Colorado Boulder **Marian Muste** IOWA

RIMORPHIS Use Case #1: Data Discovery

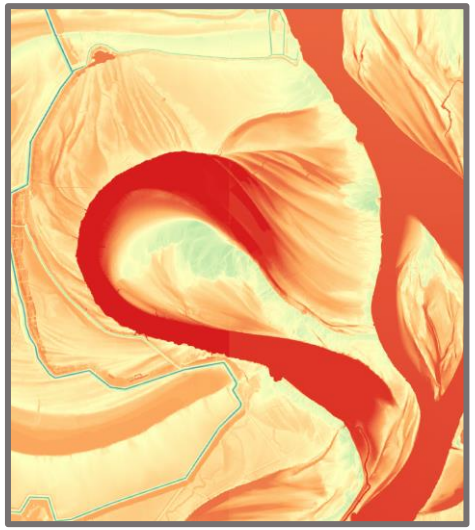


Location: Mississippi River near Vicksburg, MS



RIMORPHIS Use Case #1: Data Discovery

Lidar DEM

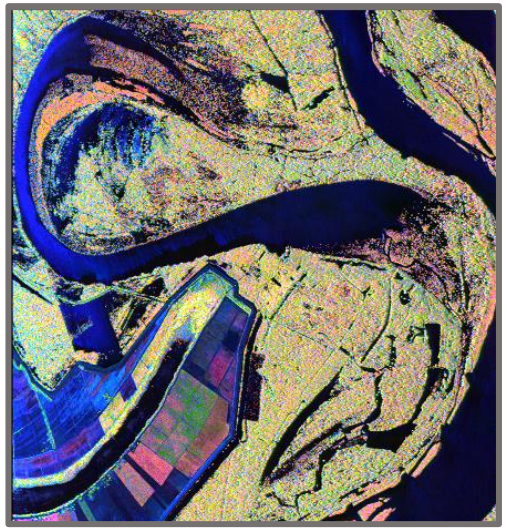


Yucatan Lake, LA

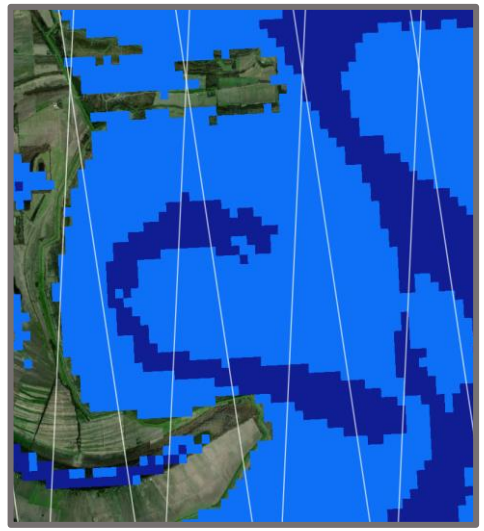
Optical imagery



Radar imagery (UAVSAR)



Satellite green lidar, MODIS inundation



Field data

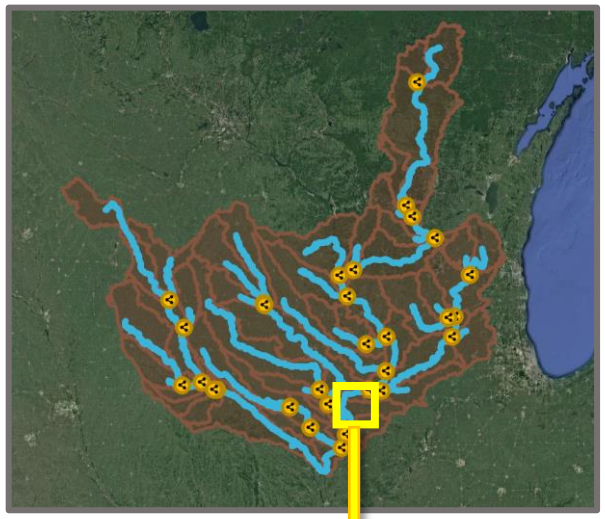


Concept: Easily access data across a range of sources and types

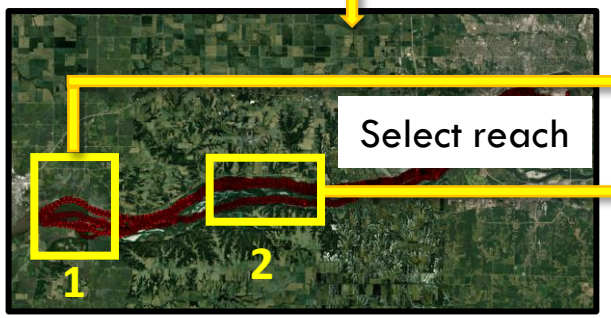
RIMORPHIS Use Case # 1: Data discovery

Location: Pool 16, Upper Mississippi River

Locate watershed of interest
(NHDWaterbody)



Locate river segment
(NHD HYDRO_NET)



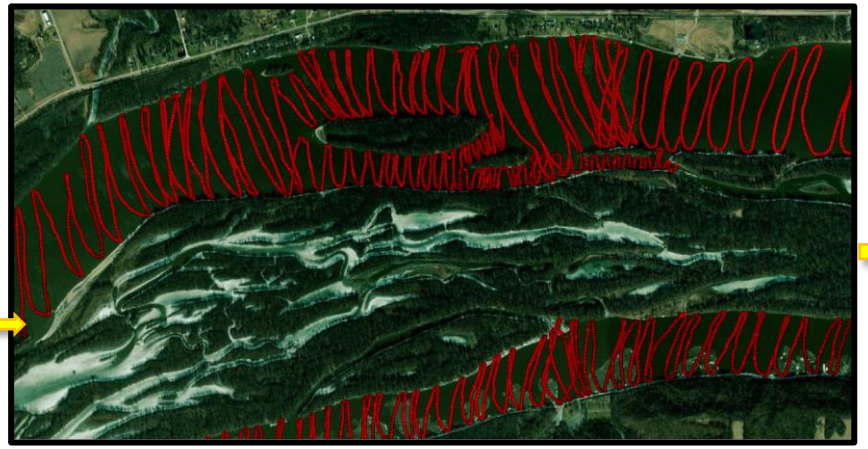
Show ADCP measurements



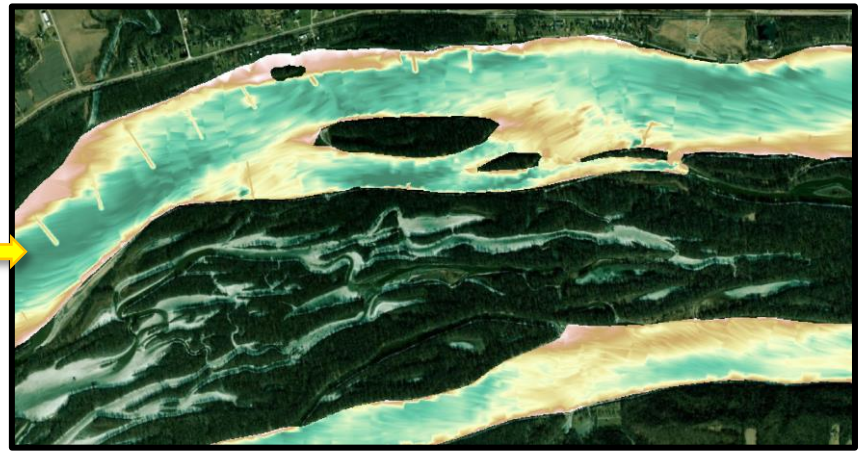
Show transects & create **cross sections**



Show ADCP measurements



Create **bathymetric maps**



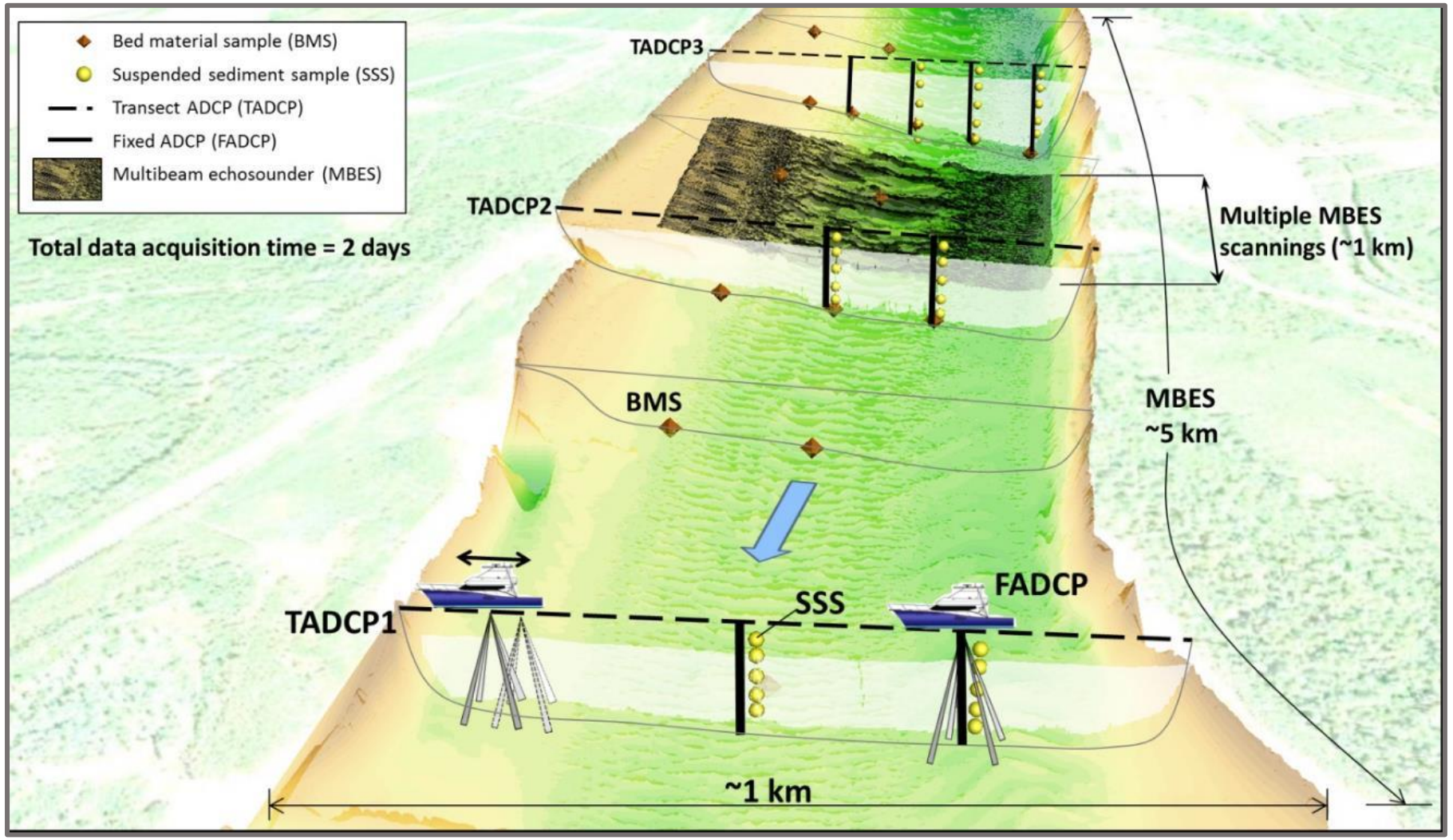
RIMORPHIS Use Case # 2: Reach-scale analysis

Marian Muste IOWA

RIMORPHIS Use Case # 2: Reach-scale analysis

Assembly & visualization of multi-instrument data acquisition

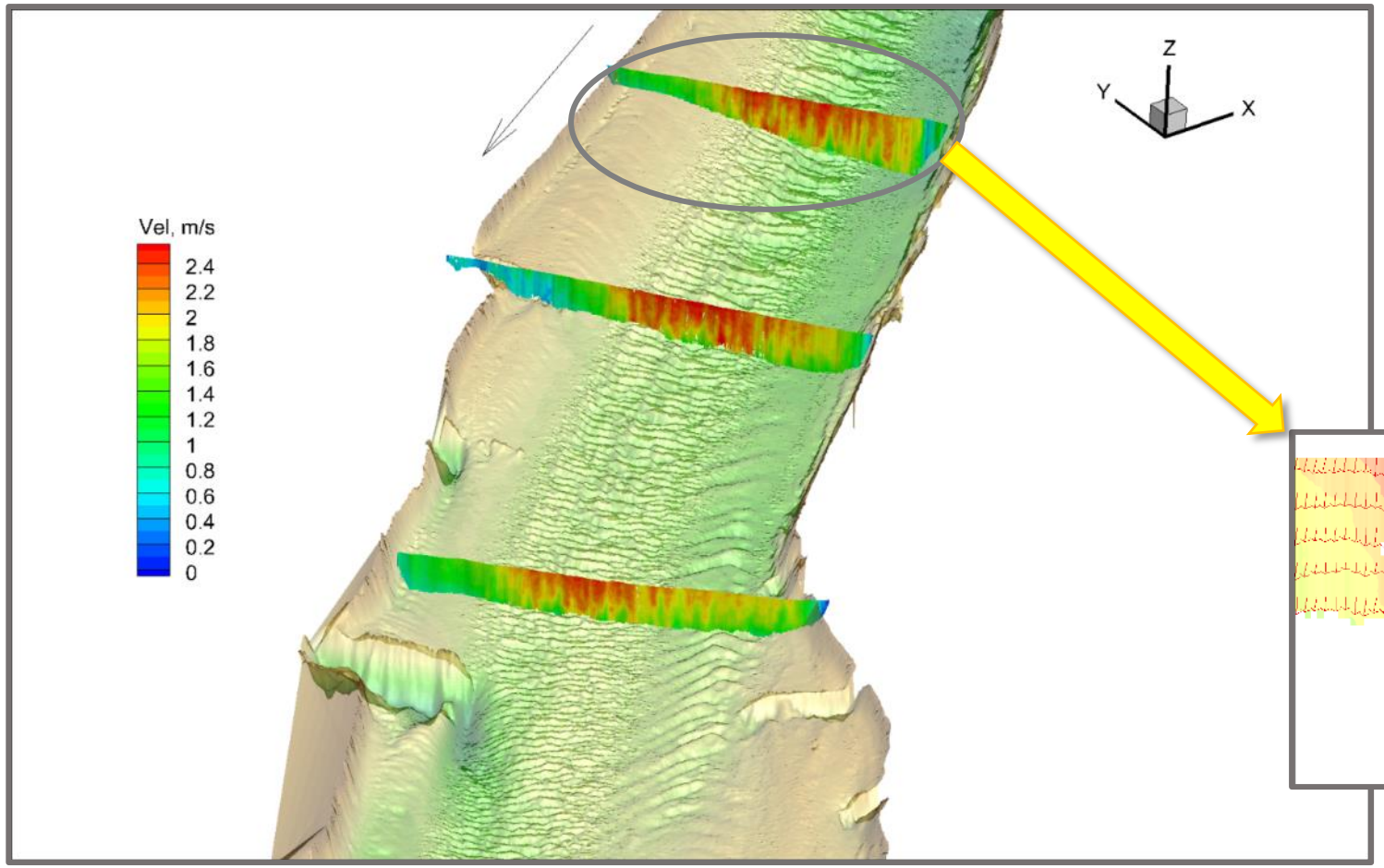
Location: Mississippi River near Vicksburg, MS



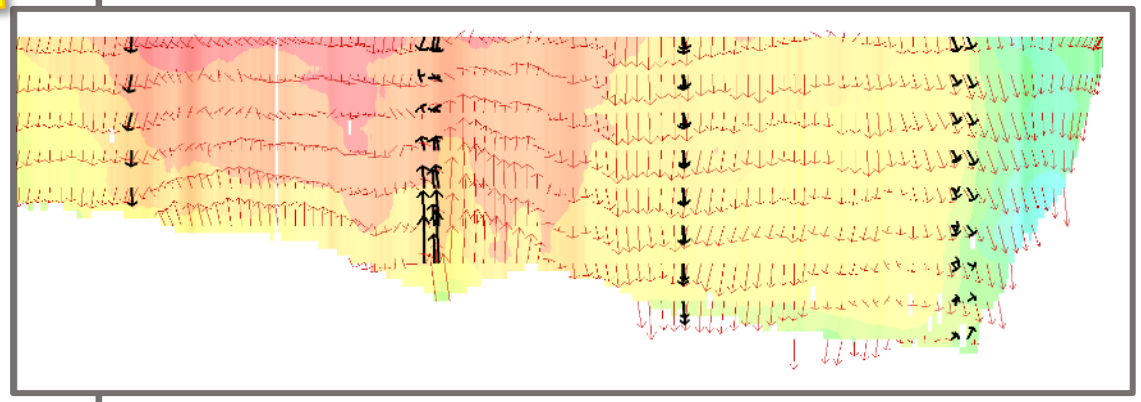
Courtesy of T. Pratt (USACE)

RIMORPHIS Use Case # 2: Reach-scale analysis

Visualization of stream hydrodynamics: Multi-beam Echo Sounder (MBES) & moving-boat Acoustic-Doppler Current Profilers (ADCP) transects



Cross-sectional velocity distribution



Courtesy of T. Pratt (USACE-ERDC)

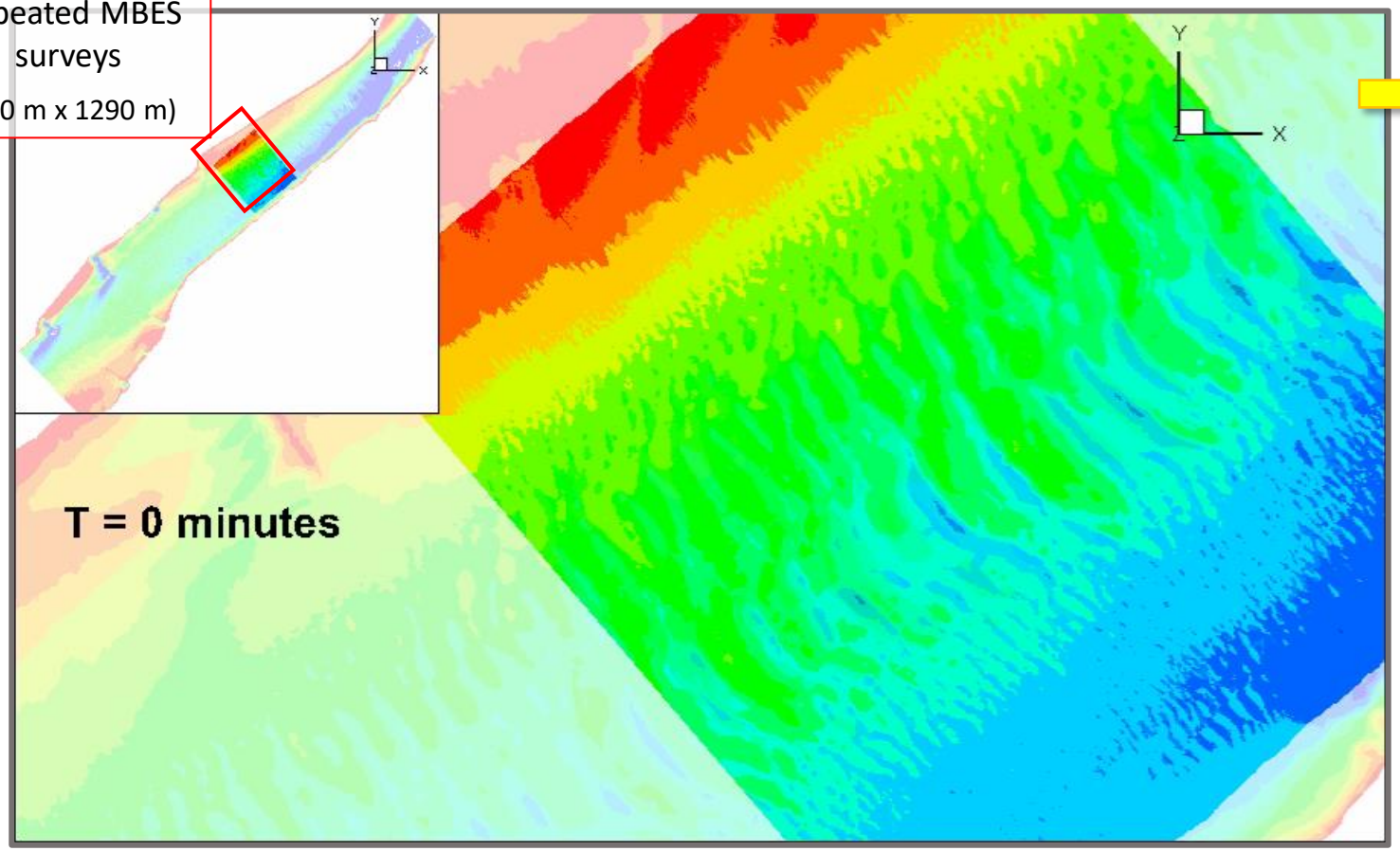
RIMORPHIS Use Case # 2: Reach-scale analysis

Visualization & Quantification of stream morphology: MBES repeated surveys & Acoustic Mapping Velocimetry (AMV) tool

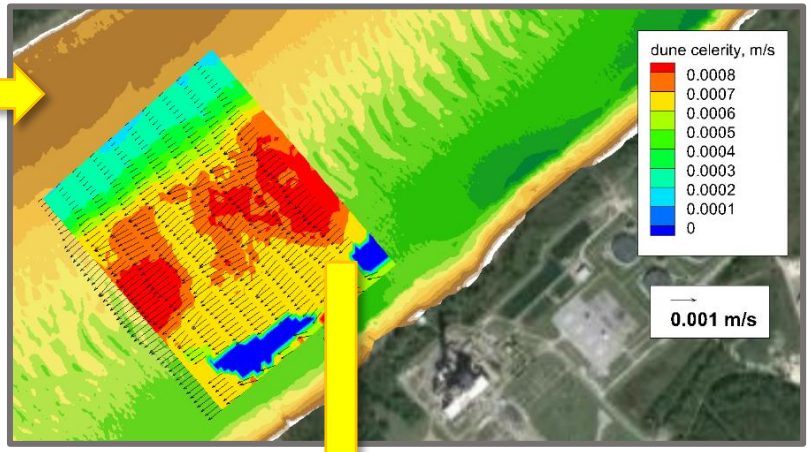
Repeated MBES surveys

(990 m x 1290 m)

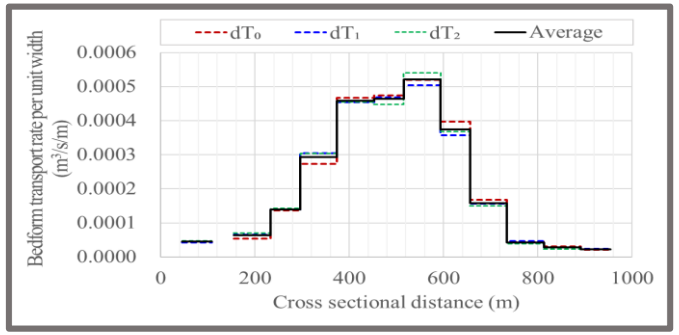
Visualization of bedform migration



Bedform velocity field (PIV)



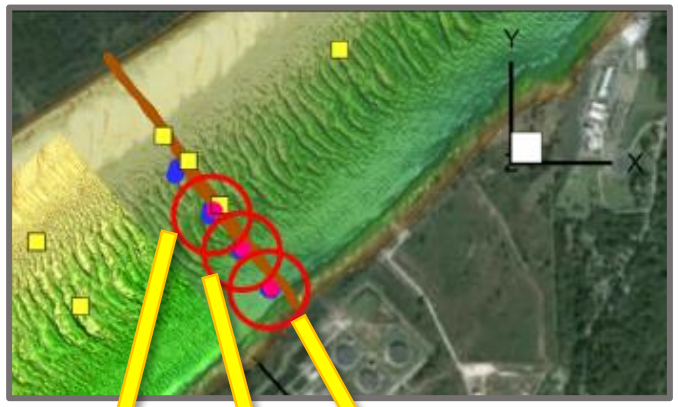
Bedform transport rates



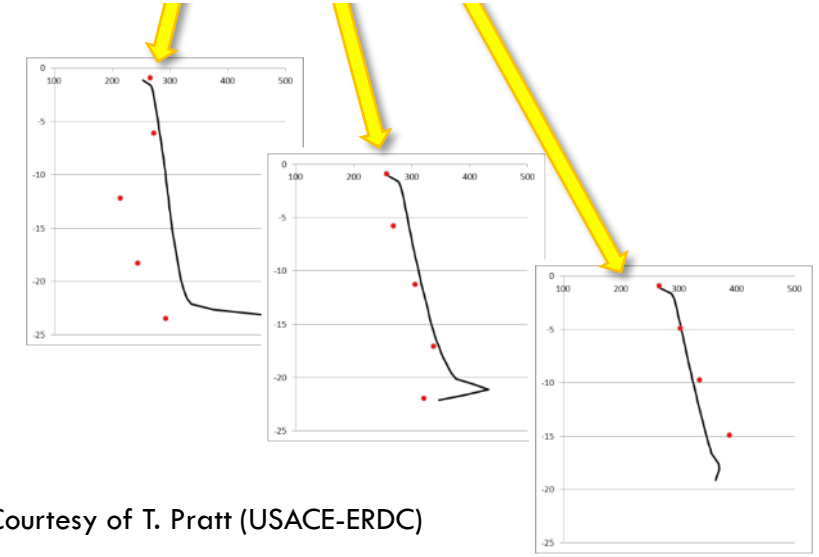
RIMORPHIS Use Case # 2: Reach-scale analysis

Visualization & Quantification of suspended sediment: ADCP fixed-point measurements

Suspended sediment profiling

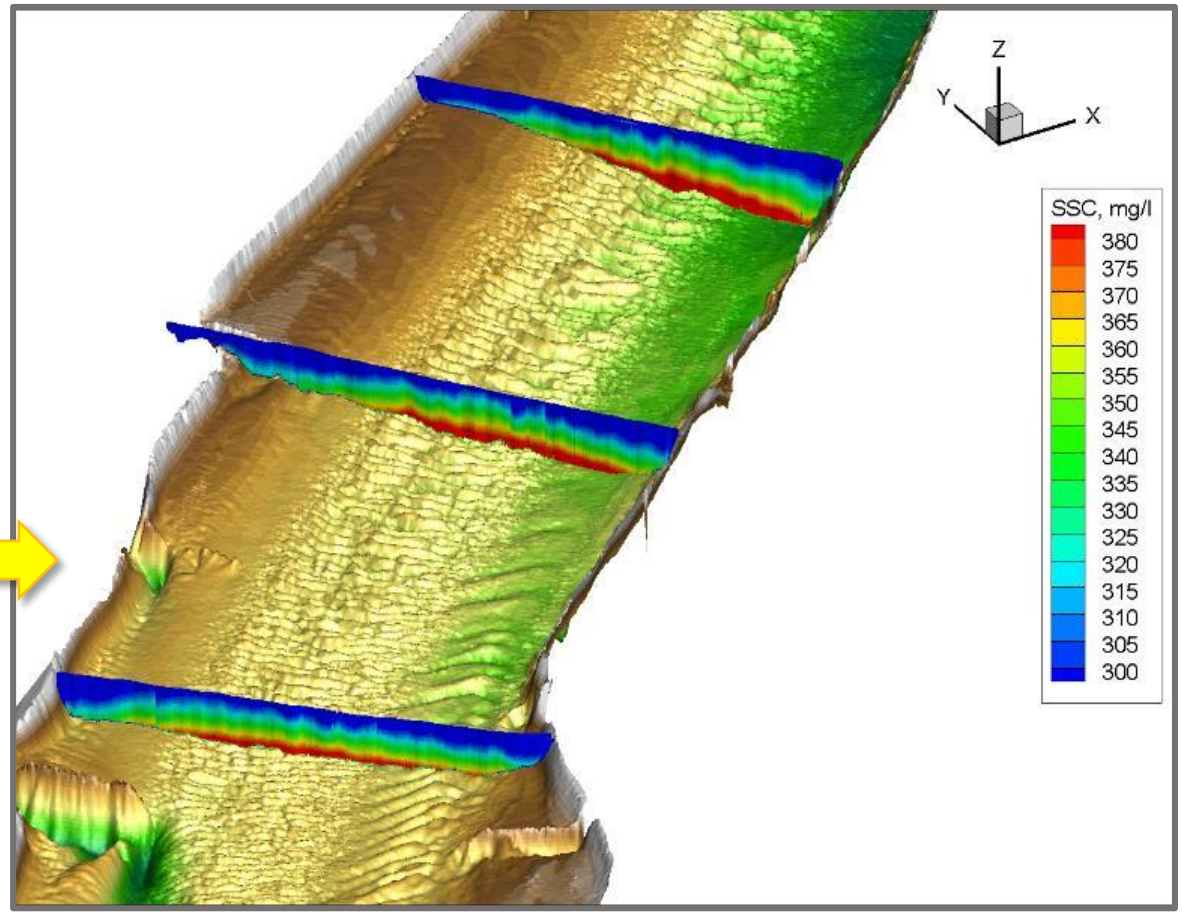


Calibration against LISST



Courtesy of T. Pratt (USACE-ERDC)

Suspended sediment mapping



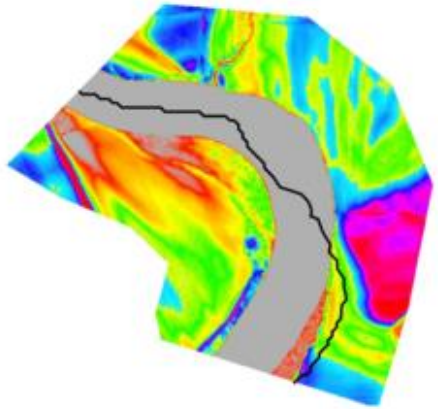
RIMORPHIS Use Case # 3: Network-scale analysis

Venkatesh Merwade

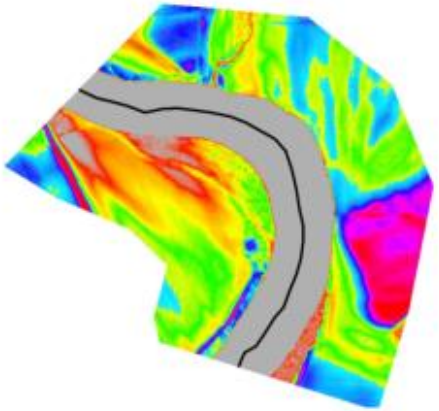
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RIMORPHIS Use Case # 3: Network-scale analysis

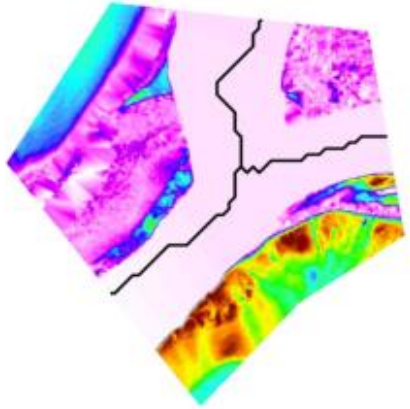
Watershed-scale bathymetry generation

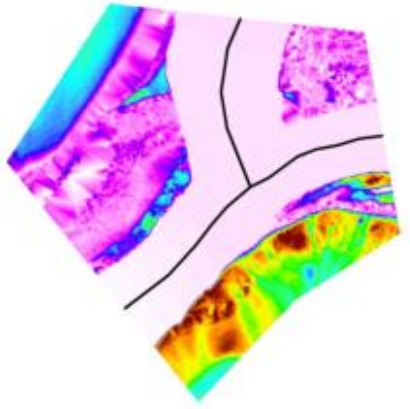


Erroneous Centerline:
Misalignment of channel centerline and river location

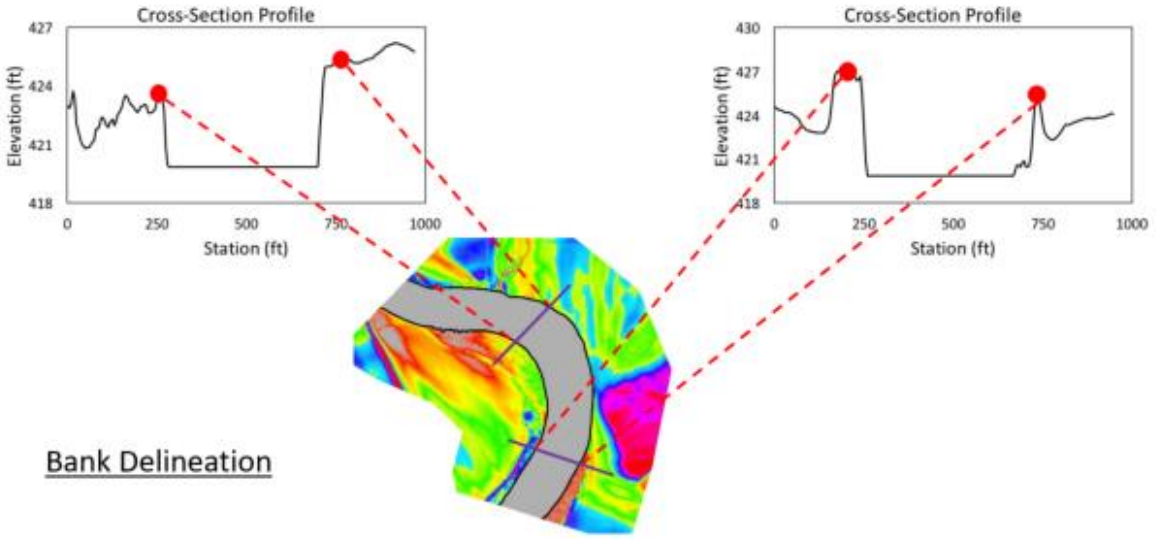


Corrected Centerline:
Automated correction for proper river characterization

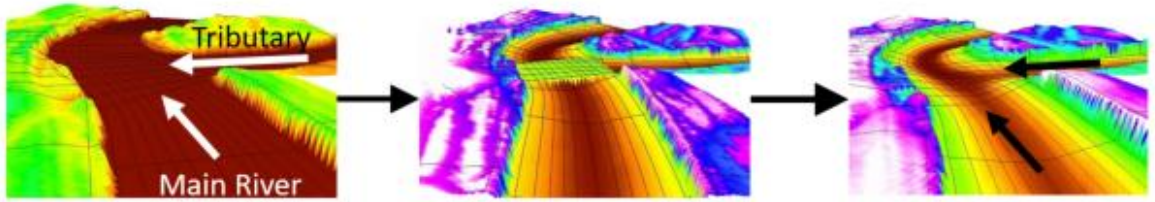




Confluence Location Correction:
Ensures proper channel connectivity in a river network



Bank Delineation



Phase 1
(Individual Reaches)

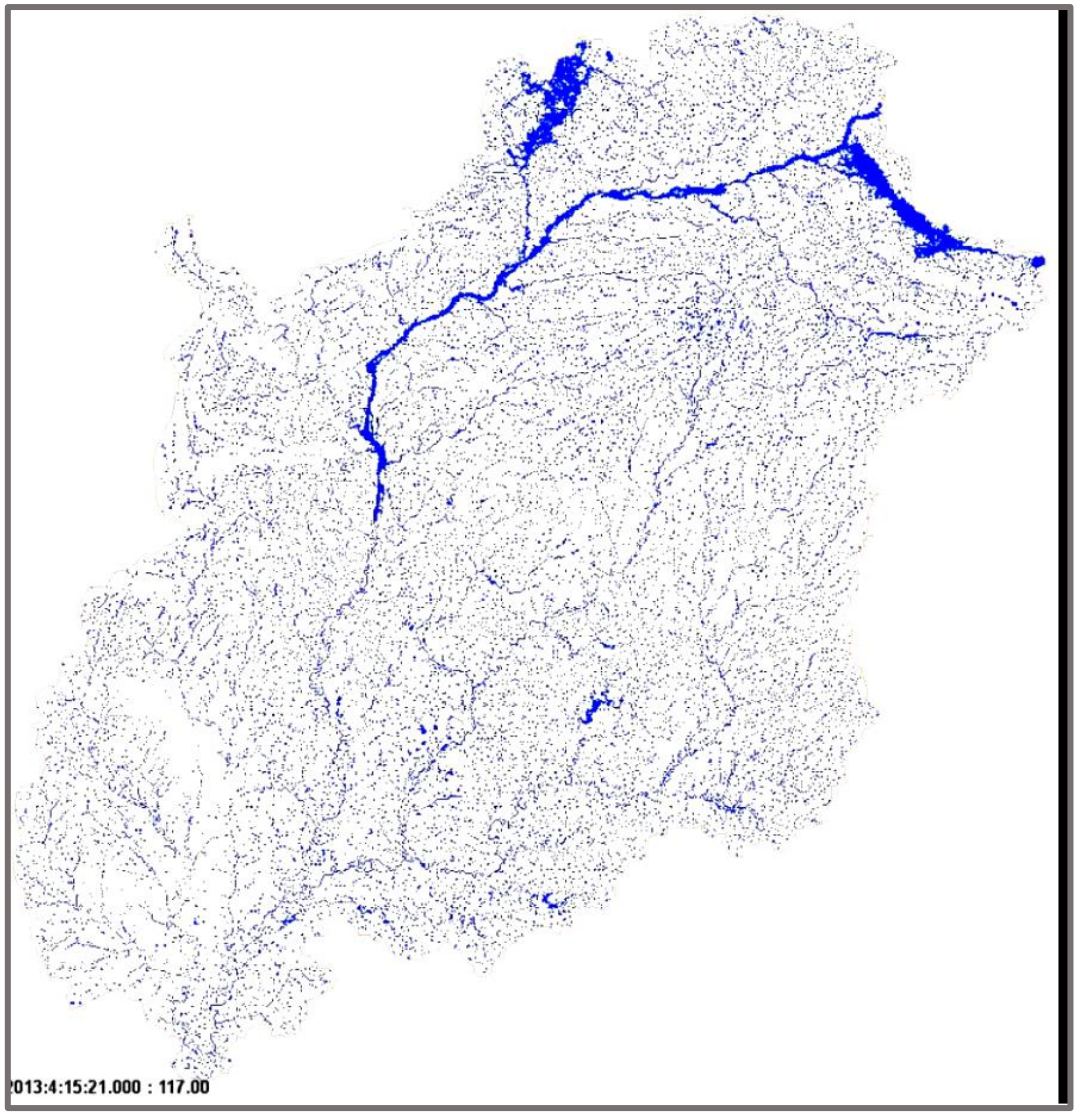
Phase 2
(Confluence Correction)

3D Bathymetry Generation

RIMORPHIS Use Case # 3: Network-scale analysis

Large-scale hydrodynamic modeling

Location: Wabash River Basin (drainage area – 85,000 km^2)



RIMORPHIS Use Case # 4:

Long-term forecasting

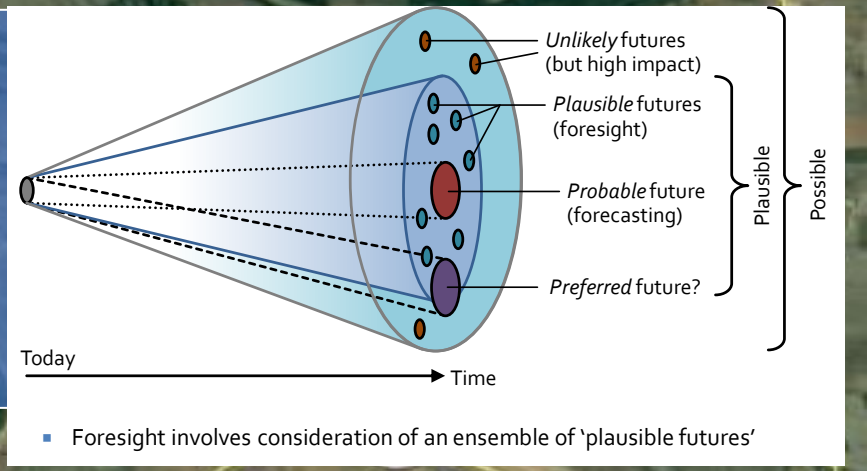
Amanda Cox

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RIMORPHIS Use Case # 4: Long-term forecasting of river morphology

FRAME – Future River Analysis and Management Evaluation Tool

- **Forecasting approach –** incorporate complexity/uncertainty of model inputs
- **Hybrid model** – allows for complex channel response
- **Channel Indicators** – to inform watershed management



- Foresight involves consideration of an ensemble of 'plausible futures'

Inputs

From RIMORPHIS

Channel Geometry and Roughness

Channel Material Properties

Other

Durations of Varying Flows

FRAME Model

1-D Hydraulic Processes

Conservation of Energy and Momentum

Energy Loss

1-D Sediment Transport Processes

Sediment transport rates

Aggradation or degradation of channel bed

Rules for Geomorphic Response

Channel widening

Dike fields

Changes in sinuosity

Outputs

Depth of Flow

Extent of Inundation

Channel Maximum Flow Capacity

Changes in bed elevations and channel material properties

Channel Indicators

Land use planning

Channel planform

Erodible corridor

Channel morphology

Hazzard Avoidance / Asset Management

Riverbank erosion rate

Floodplain hydrological connectivity

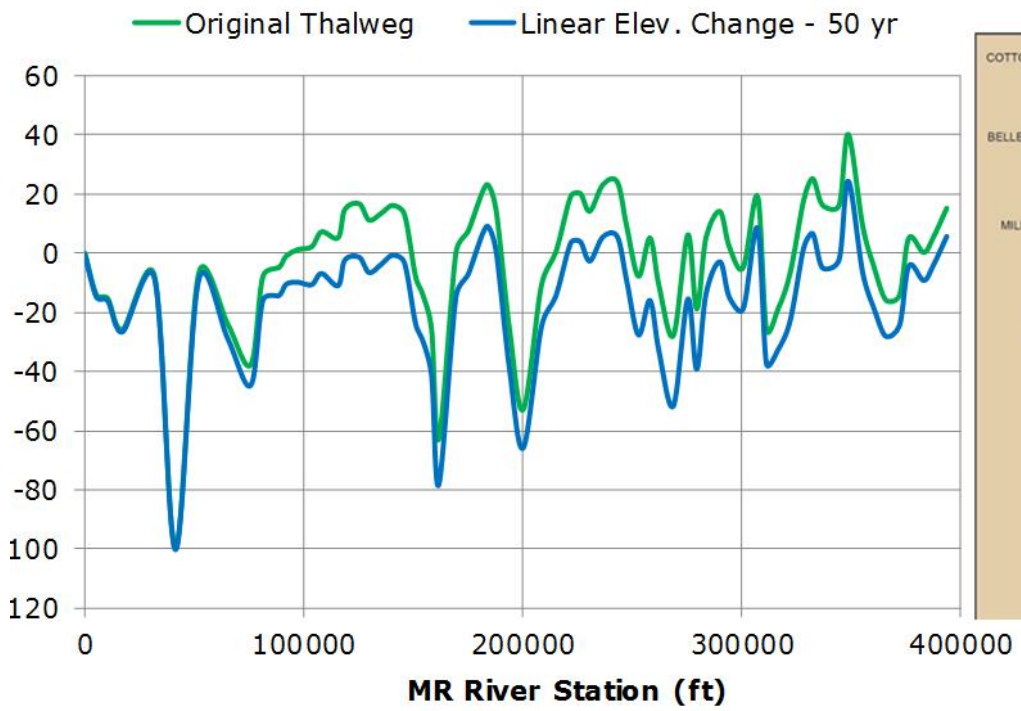
Conservation Management

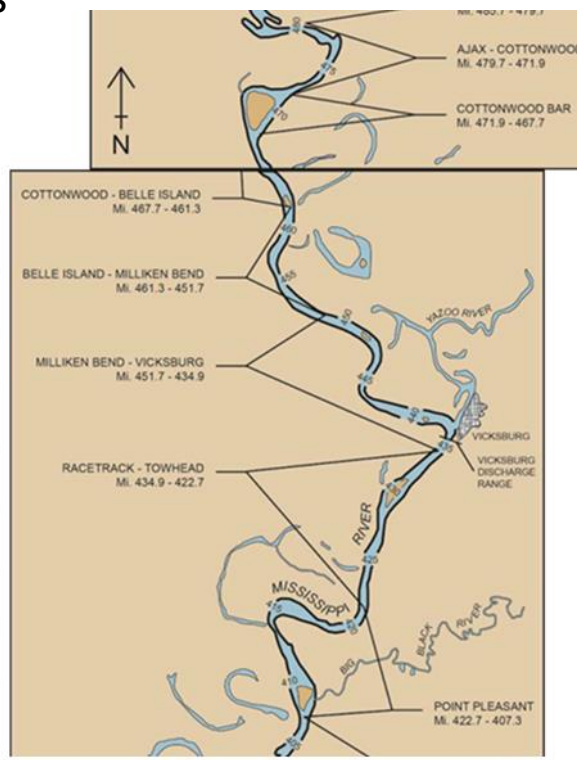
Reach habitat type

Environmental flow conditions

RIMORPHIS Use Case # 4: Long-term forecasting of river morphology

Sample Scenario of 50-yr Forecasted Bed Elevations





Evaluate long-term impacts:

- Changing hydroclimate
- Changing river management
- Changing sediment inputs
- Epistemic uncertainty in river processes