

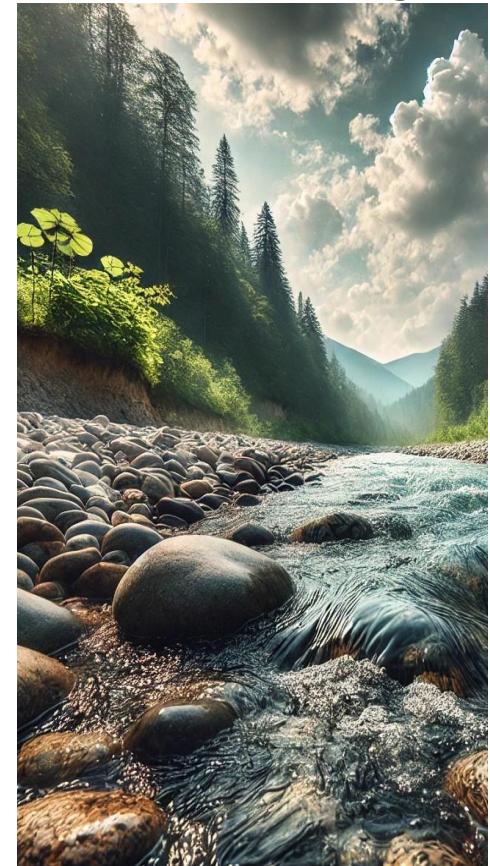
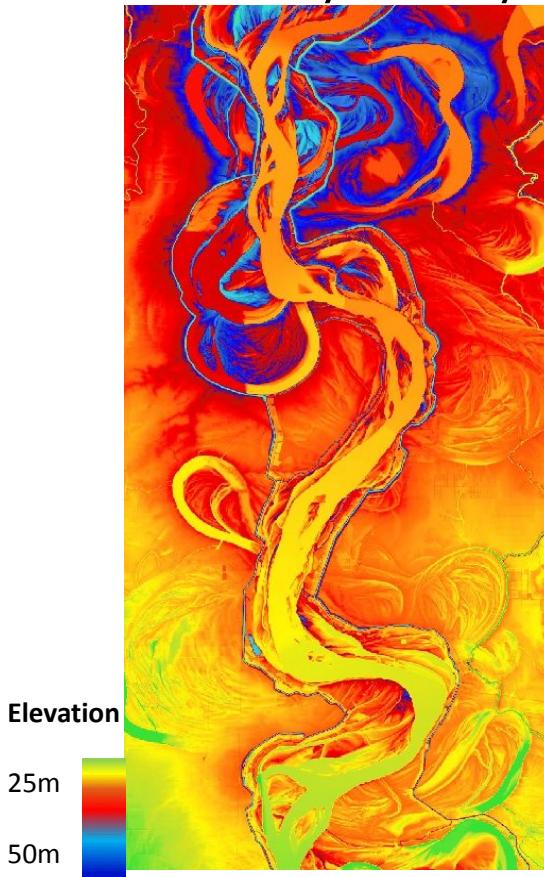
Machine Learning Techniques for Estimating River Channel Properties Nationwide

OWP | OFFICE OF
WATER
PREDICTION

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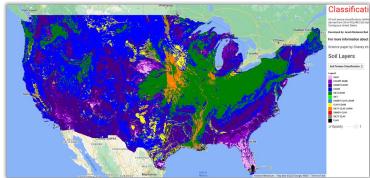
Accurate Flood Mapping

Harmonized Modelling Bathymetry Riverbed Roughness



ML approach to model missing bathymetry

Polaris



StreamCat

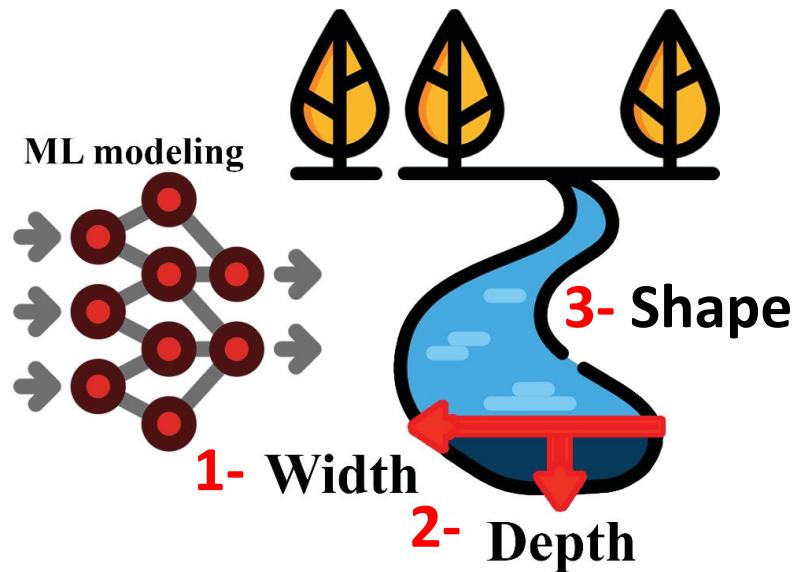
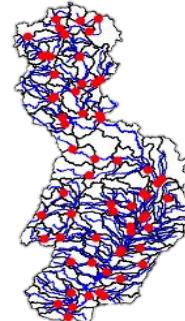


NWM



HYDRoSWOT

Paper: <https://joss.theoj.org/papers/10.21105/joss.06145>

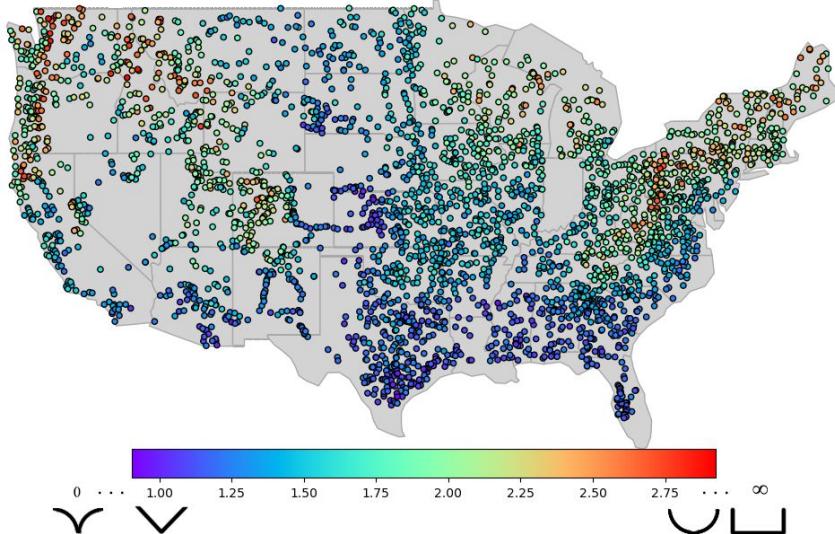
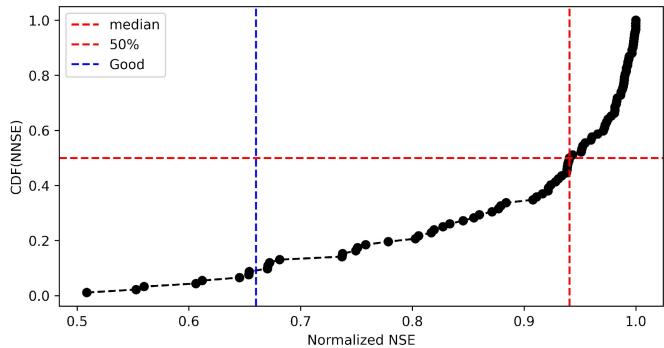
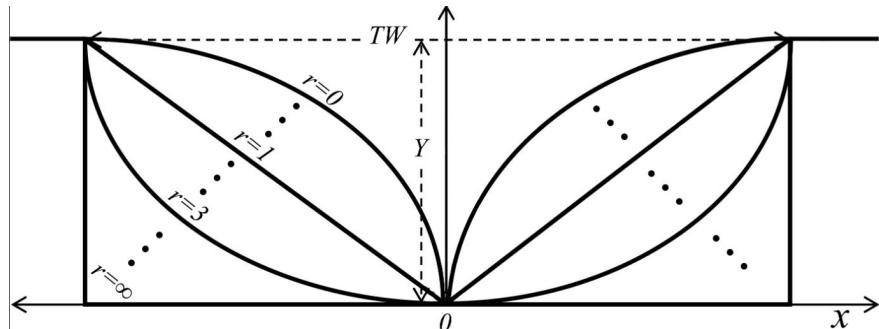


A physics constrained channel shape deep learning model

$$\begin{aligned} TW &= aQ^b \\ Y &= cQ^f \\ U &= kQ^m \end{aligned}$$

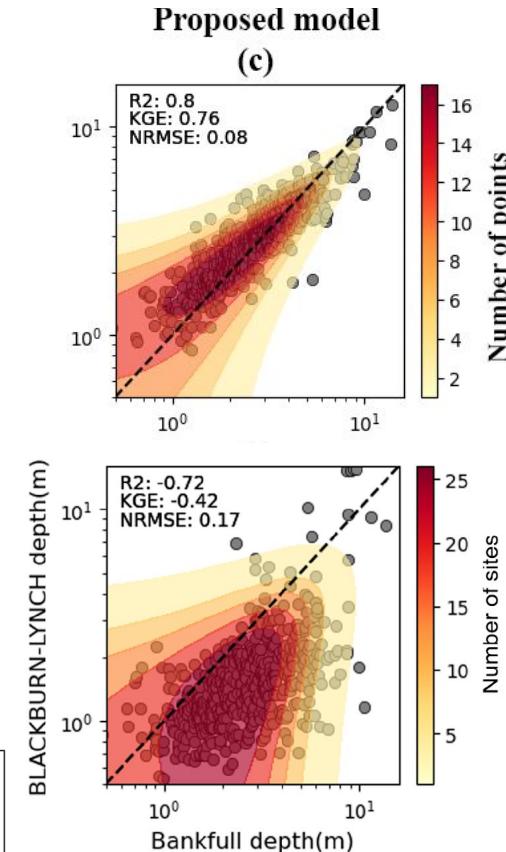
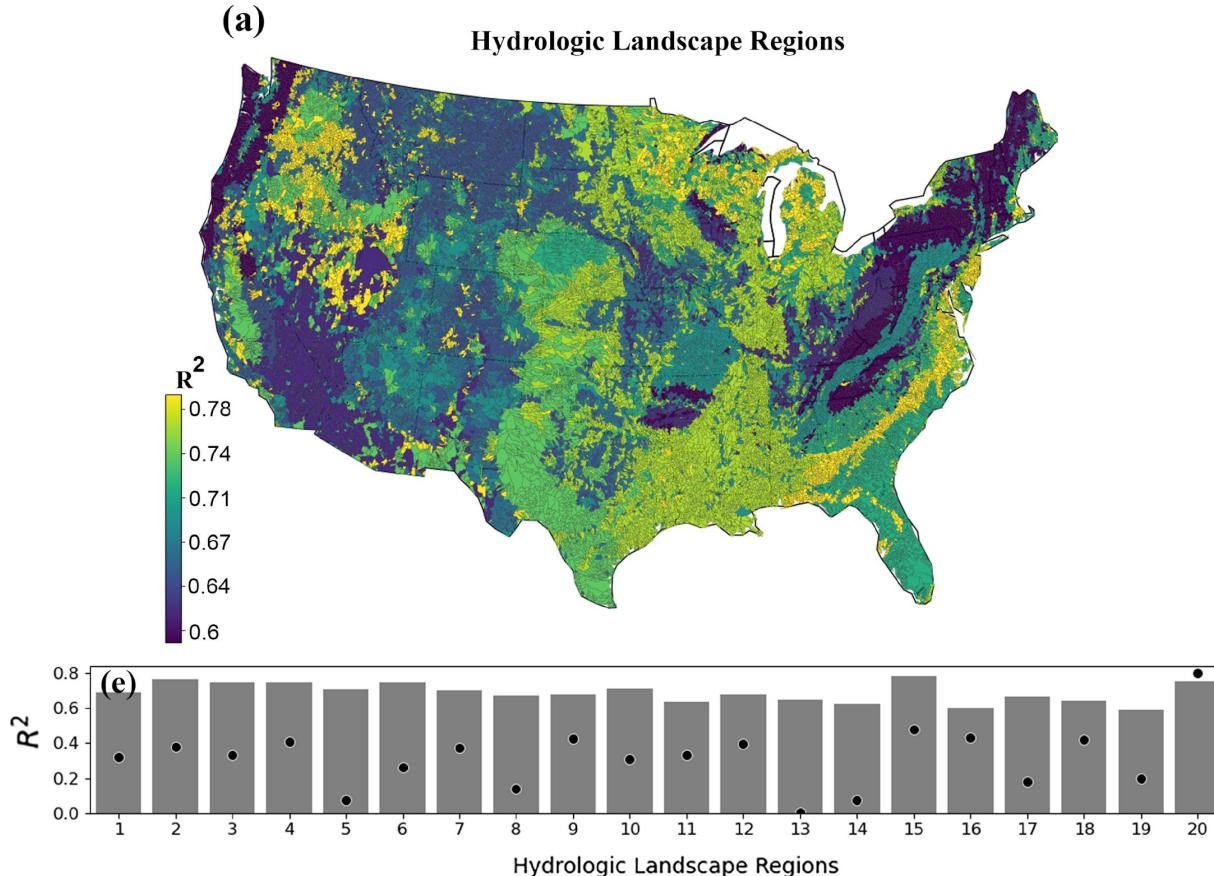
$a \times c \times k = 1$
 $b + f + m = 1$

$$\hat{r} = \frac{f}{b}$$



Modeled river channel width and depth

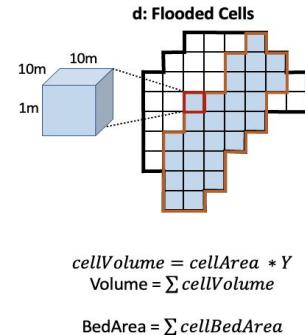
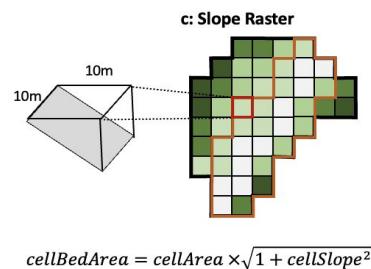
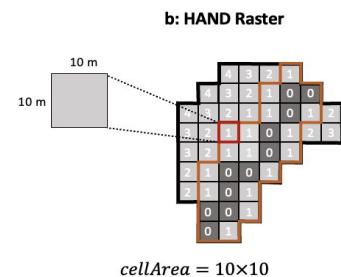
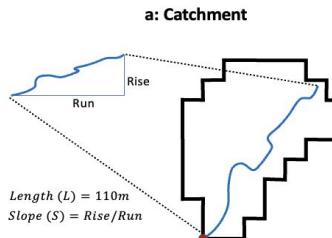
Paper: <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2024JH000173>



A harmonized ML model for channel roughness

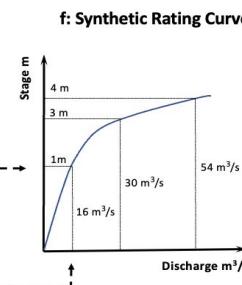
ML model was **4 times** better than conventional methods

$$Q = VA = \left(\frac{1.49}{n} \right) AR^{\frac{2}{3}} \sqrt{S}$$



e: Manning's Equation

$$Q(y) = \frac{A * R^{2/3} * \sqrt{S}}{n}$$



Flood Inundation Mapping Experiment

Validation experiments:

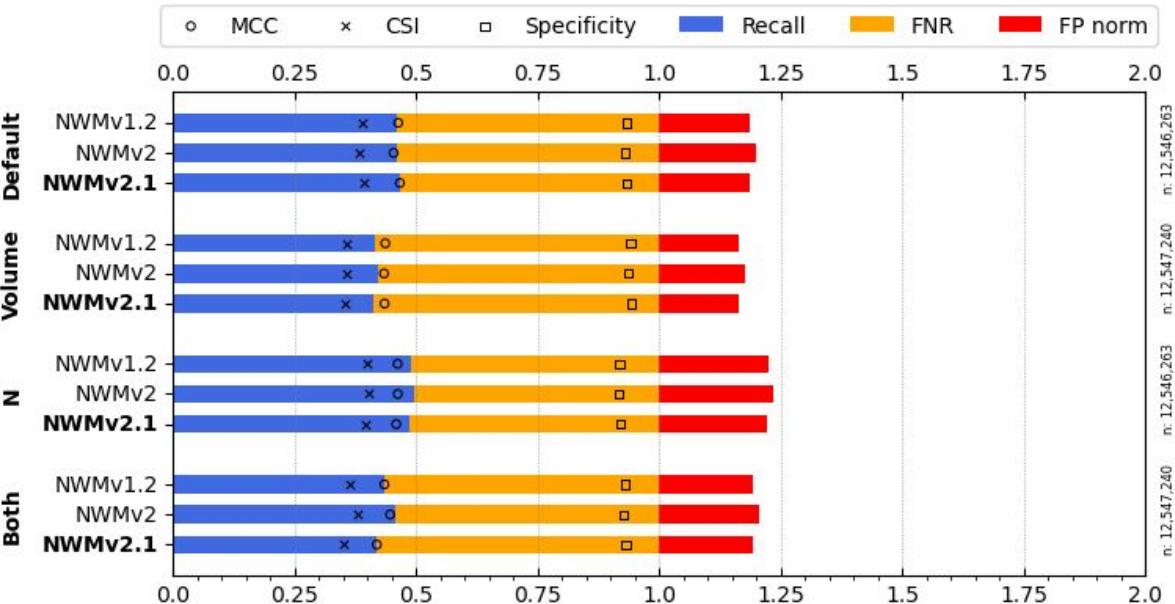
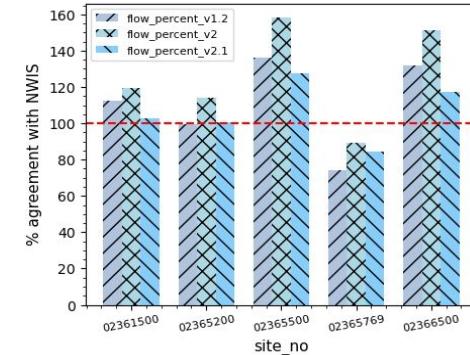
- **Base** CFIM SRCs
- Supplemented with ML derived **volumes**
- Supplemented with ML **roughness**
- Supplemented with both ML derived **volume and roughness**

Choctawhatchee River, AL

Blue: Captured flood

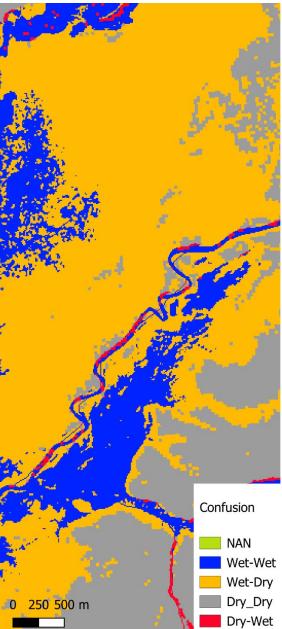
Orange: Underestimates

Red: Overestimates

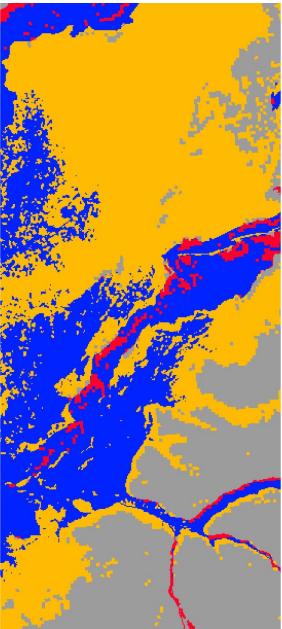


Flood Inundation Mapping Experiment

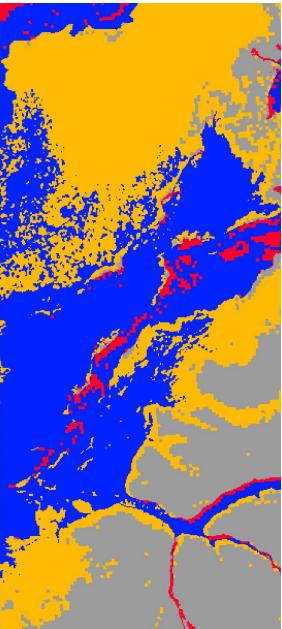
Volume



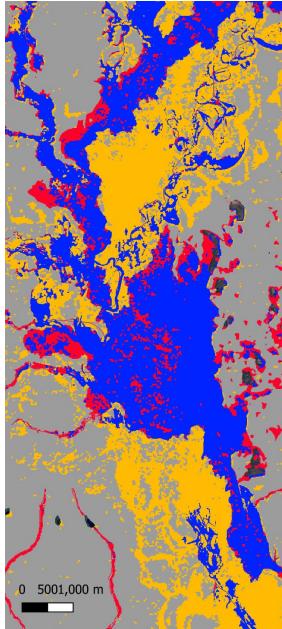
Default



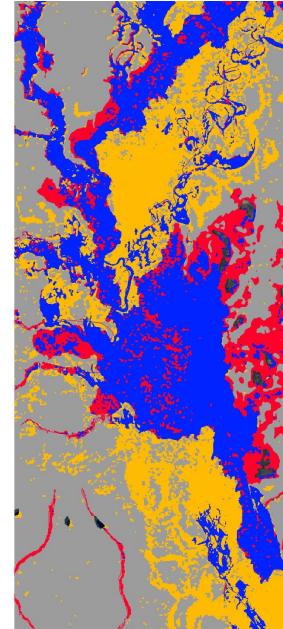
Roughness



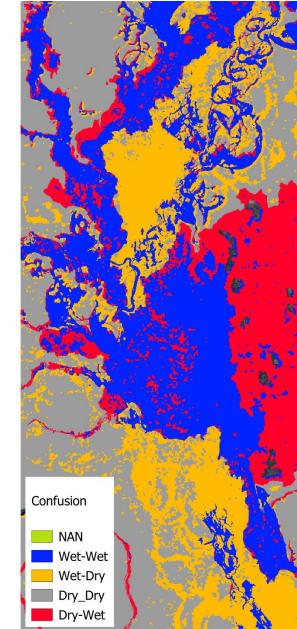
Volume



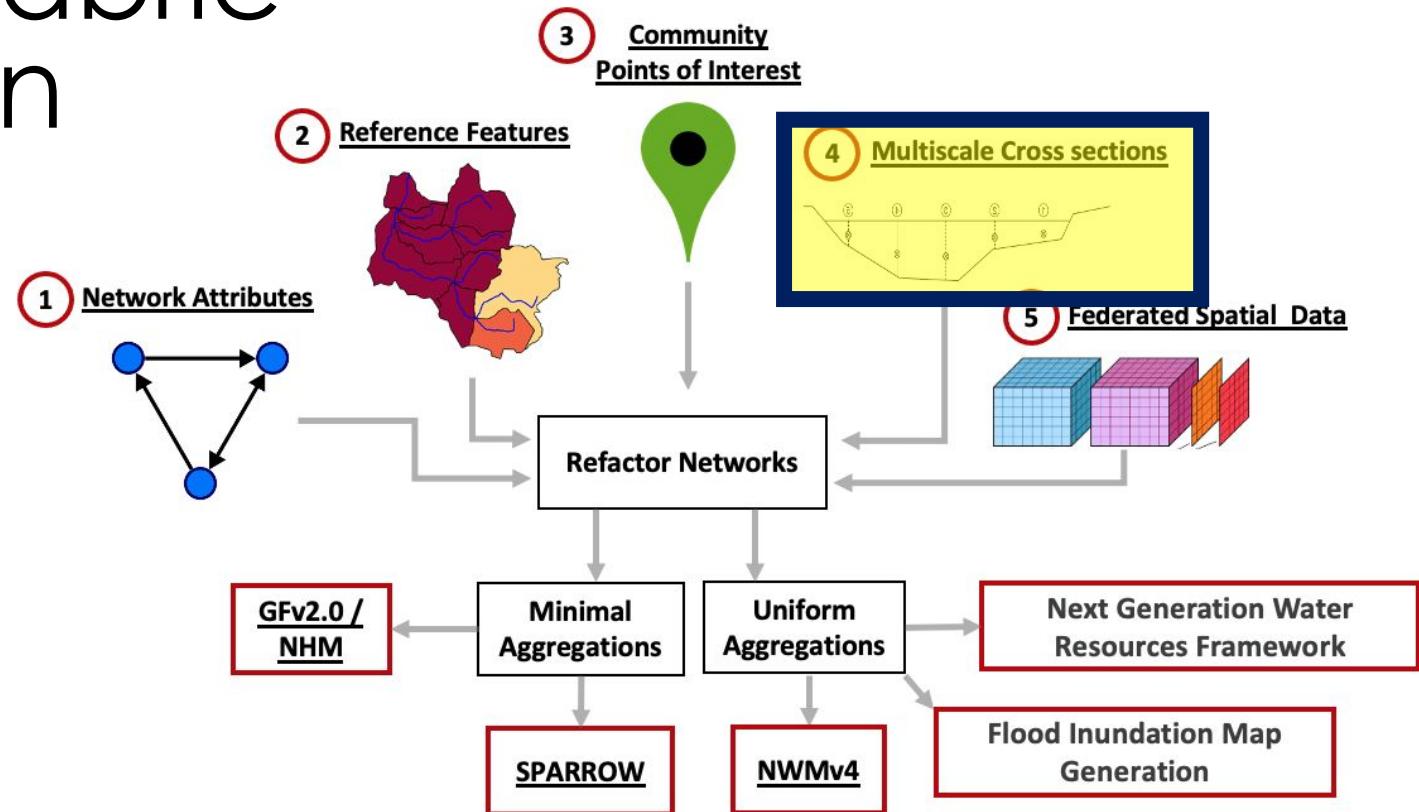
Default



Roughness

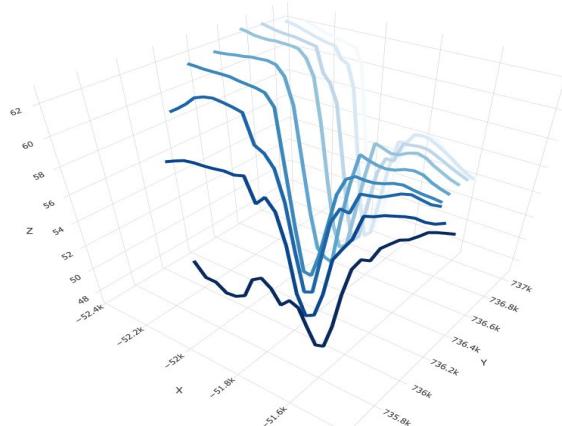
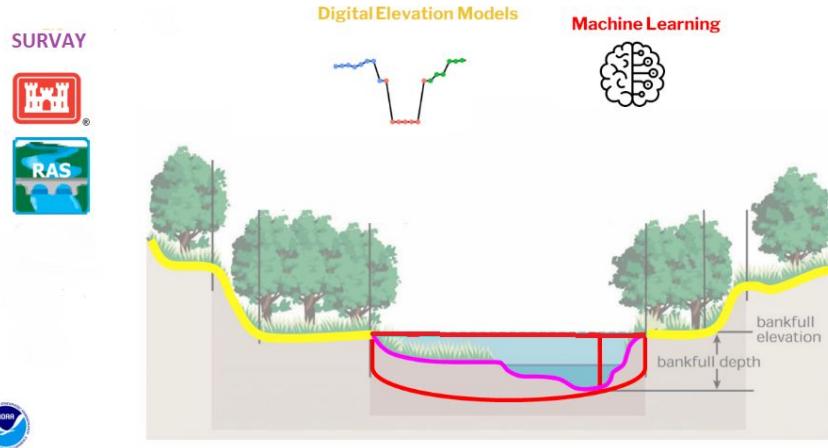


NOAA Hydrofabric Solution



Summary and Future work

- Providing data for width, depth and shape (and all AHG coefficients) ~2.7 million catchments
 - Data is infused with DEM derived cross sections to represent entire river geometry
 - The dataset indexes bathymetry-related data resources into the National Hydrologic Geospatial Reference Fabric, enabling exhaustive watershed-level queries.
 - Potential to enhance routing within hydrological models, improves representation of river bathymetry in Flood Inundation Mapping (FIM), and facilitates numerous comprehensive scientific analyses.
 - Moving beyond CONUS and developing global models of channel properties





Thank you!

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