Evaluating the Effectiveness of OSM Data in Enhancing HAND-Based Flood Inundation Mapping for Bridge Risk Assessment

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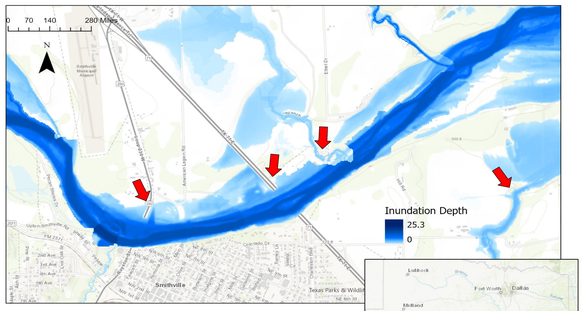
Problem

National Water Center Flood Inundation Mapping (FIM) services employ the Height Above Nearest Drainage (HAND) methodology for flood estimation. This method leverages Digital Elevation Models (DEMs)), significantly enhancing the accuracy of flood mapping and modeling. However, a notable limitation of the HAND-based flood inundation mapping is the absence of bridge information in DEMs. This gap can lead to inaccuracies in identifying inundated bridges, thereby impacting risk assessments and emergency response plans.

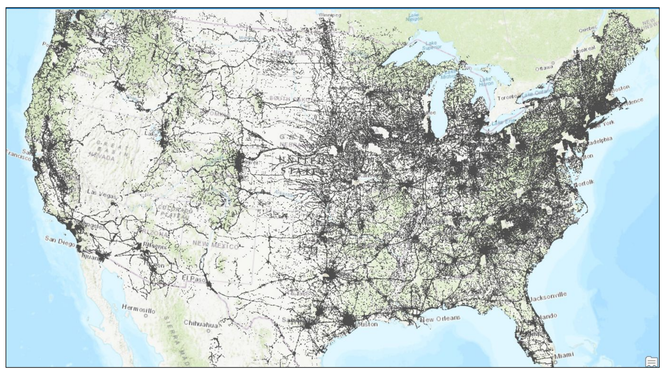


Base HAND for 100-year NWM recurrence flows

Red arrows showing bridges as being incorrectly inundated.

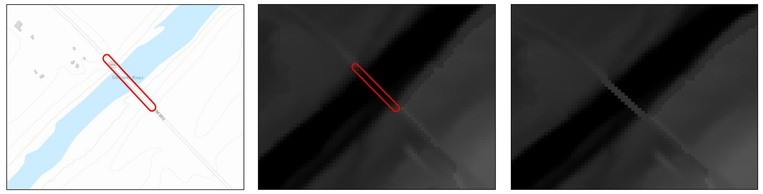
Solution

To address this limitation, the FIM services integrate OpenStreetMap (OSM) data, an open-source repository, to incorporate bridges into the HAND grids.

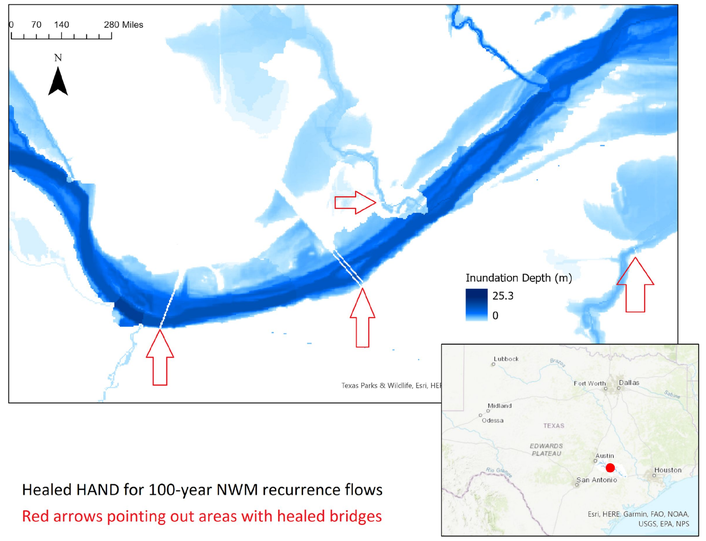


The OSM dataset contains 650,000 bridge data points across the CONUS.

OSM Bridge Healing

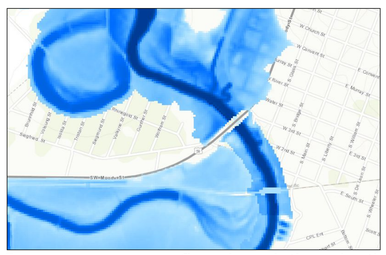


- Download OSM bridge lines.
- Buffer the bridge lines by 10 m to create bridge polygons.
- Overlay bridge polygons onto the HAND grids.
- Identify max HAND values. This value is assumed to represent one of the bridge approaches.
- Rasterize the maximum HAND value across the entire bridge polygon area, aligning with the original HAND grid.
- Replace the original HAND grid values with the new, healed bridge values.
- Use the healed HAND grids in the inundation process instead of the original grids.
- Using the OSM data is valuable for **defining bridge inundation** and **informing users about bridge usability**.



Healed HAND for 100-year NWM recurrence flows
Red arrows pointing out areas with healed bridges

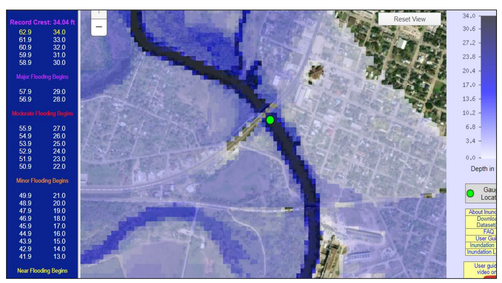
Next Step



5-year recurrence flow inundation depth with OSM bridge healing

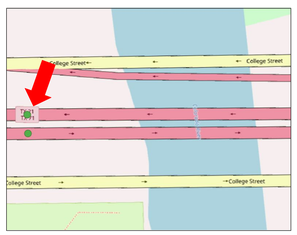
100-year recurrence flow inundation depth with OSM bridge healing

- Despite some limitations of OSM data, such as limited coverage in non-urban areas, lack of metadata, and incomplete bridge details (e.g., bridge shape), it is valuable for defining bridge inundation and informing users about the bridge's usability.

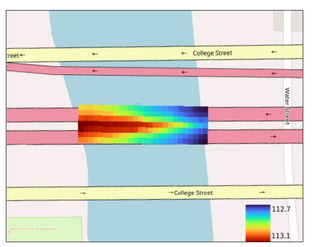


AHPS site showing record crest inundation (corresponding to >500-year recurrence streamflow)

- Combine lidar point cloud data with bridge polygons to improve bridge shape and elevation information.



Current workflow, bridge points do not have elevation information.



Lidar points with elevation information.

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- **Zheng, X., Tarboton, D.G., Maidment, D.R., Liu, Y.Y. and Passalacqua, P., 2018. River channel geometry and rating curve estimation using height above the nearest drainage. *JAWRA Journal of the American Water Resources Association*, 54(4), pp.785-806.**

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