Methodology for Estimating Floodwater Depths from Remote Sensing Flood Inundation Maps and Topography

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U.S. Flood Inundation Map Repository (USFIMR)

- Commenced in 2016 in collaboration with the Dartmouth Flood Observatory and scientists at the National Water Center (NWC)
- Support NWC Flood Prediction System – model calibrations and validations
- Currently nearly 30 flood maps (more added weekly) based on Landsat and Sentinel-1 (SAR) imagery
- Open web-interface (one-stop-shop for modelers)
- **Accept requests for flood mapping (if imagery is available)**

http://sdml.ua.edu/usfimr

UCAR COMMUNITY PROGRAMS | COMET

NWC | NATIONAL WATER CENTER

NOAA – NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION – U.S. DEPARTMENT OF COMMERCE

College of
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U.S. Flood Inundation Map Repository (USFIMR)

The USFIMR project commenced in August 2016 with funding from NOAA. The project's main goal is to provide high-resolution inundation extent maps of past U.S. flood events to be used by scientists and practitioners for model calibration and flood susceptibility evaluation. The maps are based on analysis of Remote Sensing imagery from a number of Satellite sensors (e.g. Landsat, Sentinel-1) with some ground proofing based on secondary sources (e.g. news reports, social media). The maps are accessible via the online map repository below. The repository is currently under development and new maps are added on a weekly basis.

For information, requests and data contribution contact the project PI: Dr. Sagy Cohen (sagy.cohen@ua.edu) or Lead Developer: Dinuke Munasinghe dsnanayakkaramunasinghe@crimson.ua.edu (formerly Bradford Bates).

Flood inundation maps are listed on the map side panel and at the table below.

Flood layer properties and download links* will be listed once a layer is selected from the side panel or the map.

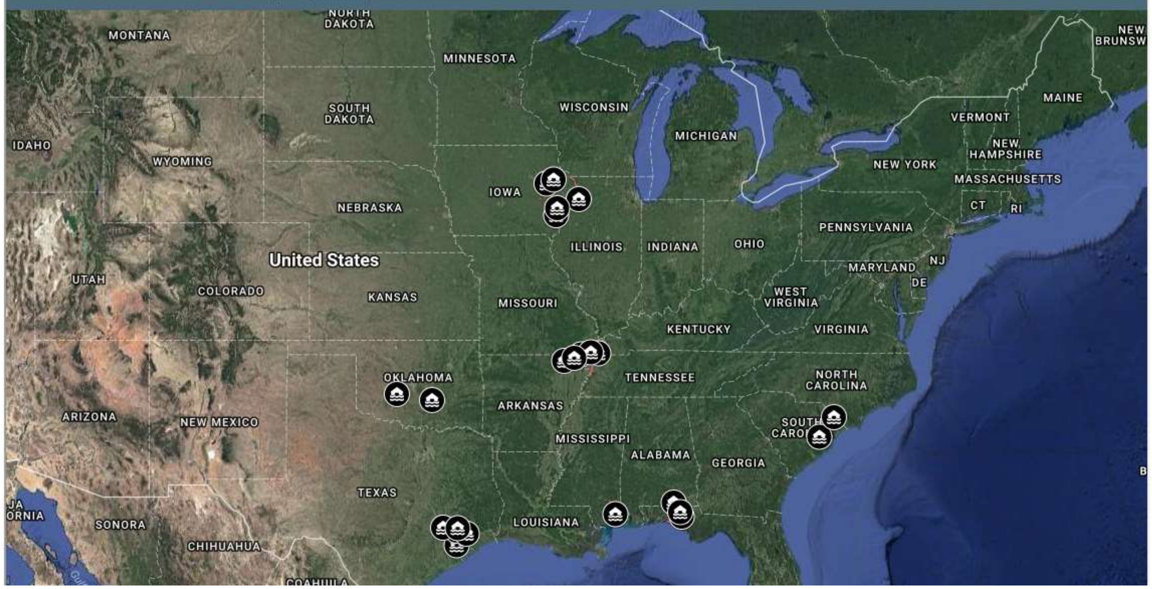
** Download links will not work when using '**Safari**' web browser*

The dataset can also be accessed directly via Google Maps or through the SDML Datasets Portal.

Download the entire USFIMR in Shapefile format.

NOTE: Rendering of the flood inundation layers in the Google Maps display is at considerably lower spatial resolution than the actual (shapefile) layers.

U.S. Flood Inundation Map Repository ★



Future Developments

- Ground proofing (USGS HWM)
- Under-canopy classification algorithms
- Floodwater depth

See poster by **Dinuke Munasinghe** tomorrow!

Floodwater Depth Algorithm

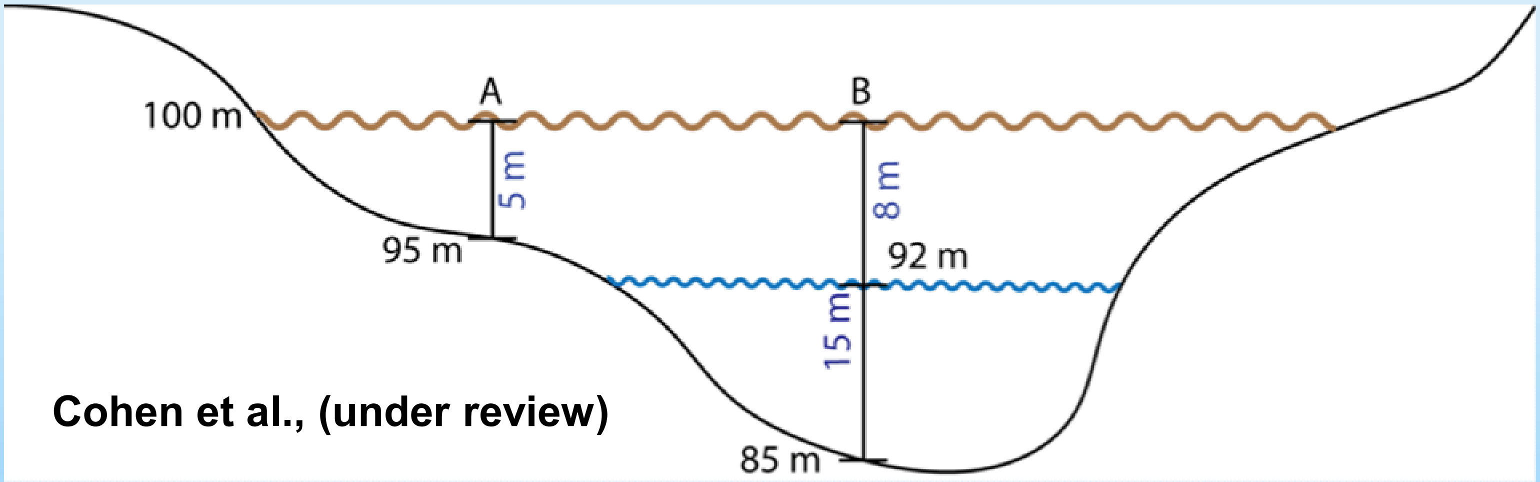
- **Why?**
  - Information on floodwater depth is critical for first responders, recovery efforts and resiliency planning.
  - Spatially-explicit estimation of floodwater depth for medium and large flood events is challenging.
  - Hydraulic models can be used but these require detailed flow and morphology information.

https://www.prlekija-on.net

http://cdn.msf.org

Floodwater Depth Algorithm

- **How?** (so far)
  - Start with a simple concept:
    - Floodwater depth is easy to estimate at a cross-section scale based on local max flow elevation:



Cohen et al., (under review)

  - Expend spatially:
    - Use nearest flood boundary location (from flood extent map) to compile a spatially-explicit estimate.

Floodwater Depth Algorithm - Methodology

- We developed the Floodwater Depth Estimation Tool (***FwDET***)
- Simple Python script that utilize ArcGIS tools (arcpy)
- Calculation steps:

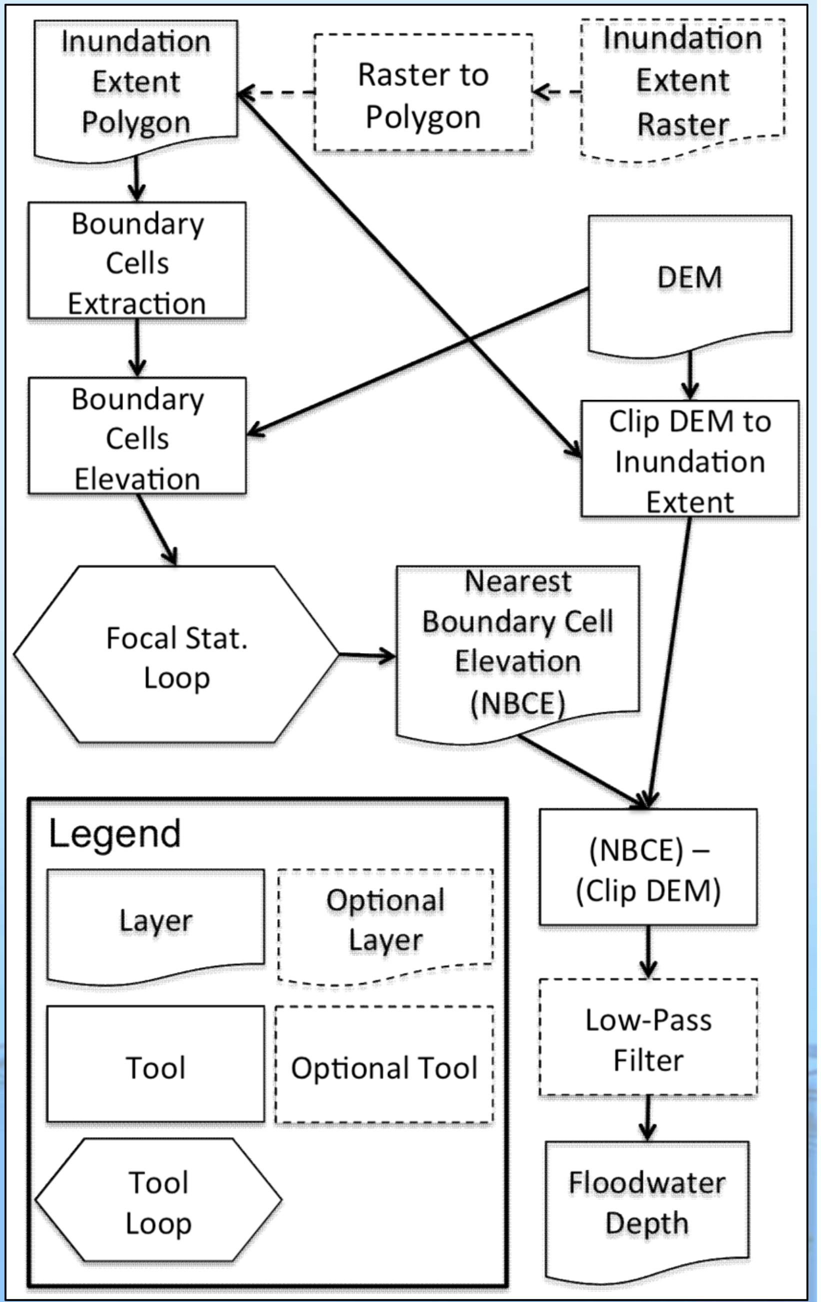
Step 1 – Identifying Boundary Cells

Step 2 – Extracting Elevation of Boundary Cells

Step 3 – Assigning Boundary Cells Elevation to Domain Cells

Step 4 – Floodwater Depth Calculation

Step 5 – Smoothing



Cohen et al., (under review)

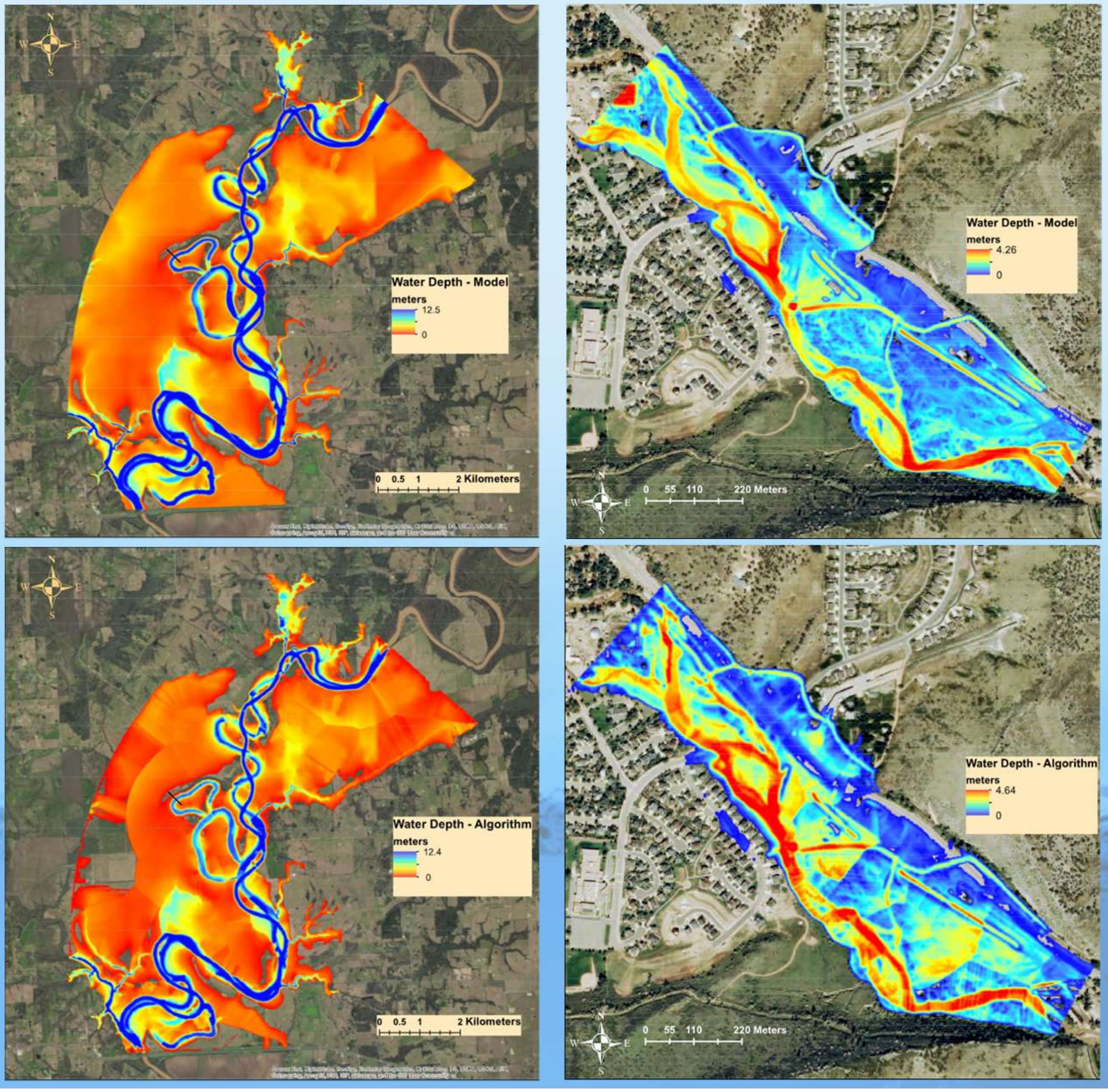
Floodwater Depth Algorithm - Evaluation

Water depth estimations by FwDET were compared to simulated depth with a hydraulic model (iRIC; USGS) for two flood events:

1. May 2016 at Brazos River (Texas, USA)
2. Sep 2013 at St. Vrain Creek near Lyons (Colorado, USA)

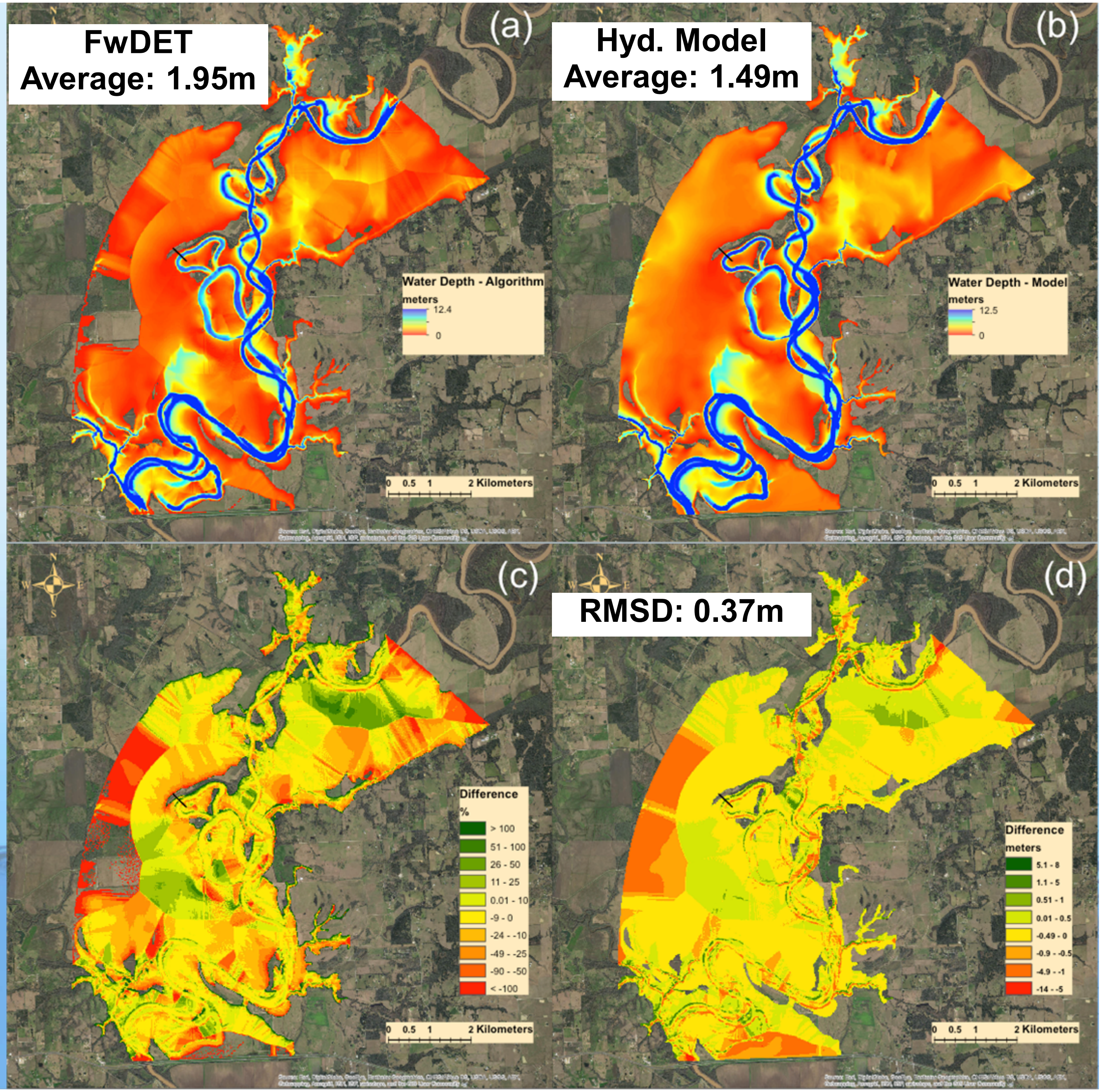
Brazos River, TX
10m DEM (NED)

St Vrain Creek, Lyons CO
1m LiDAR



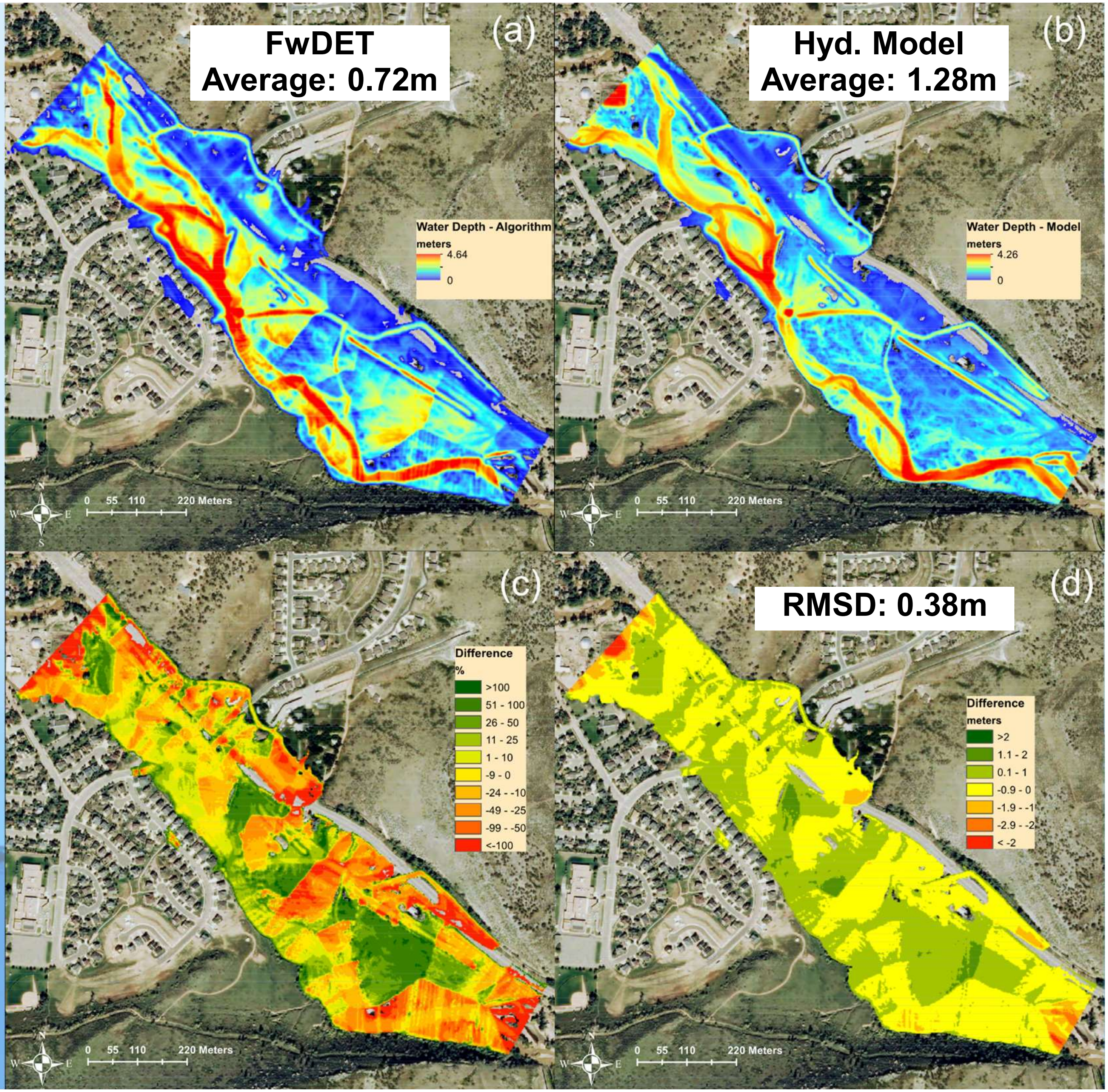
Brazos River

10m DEM (NED)



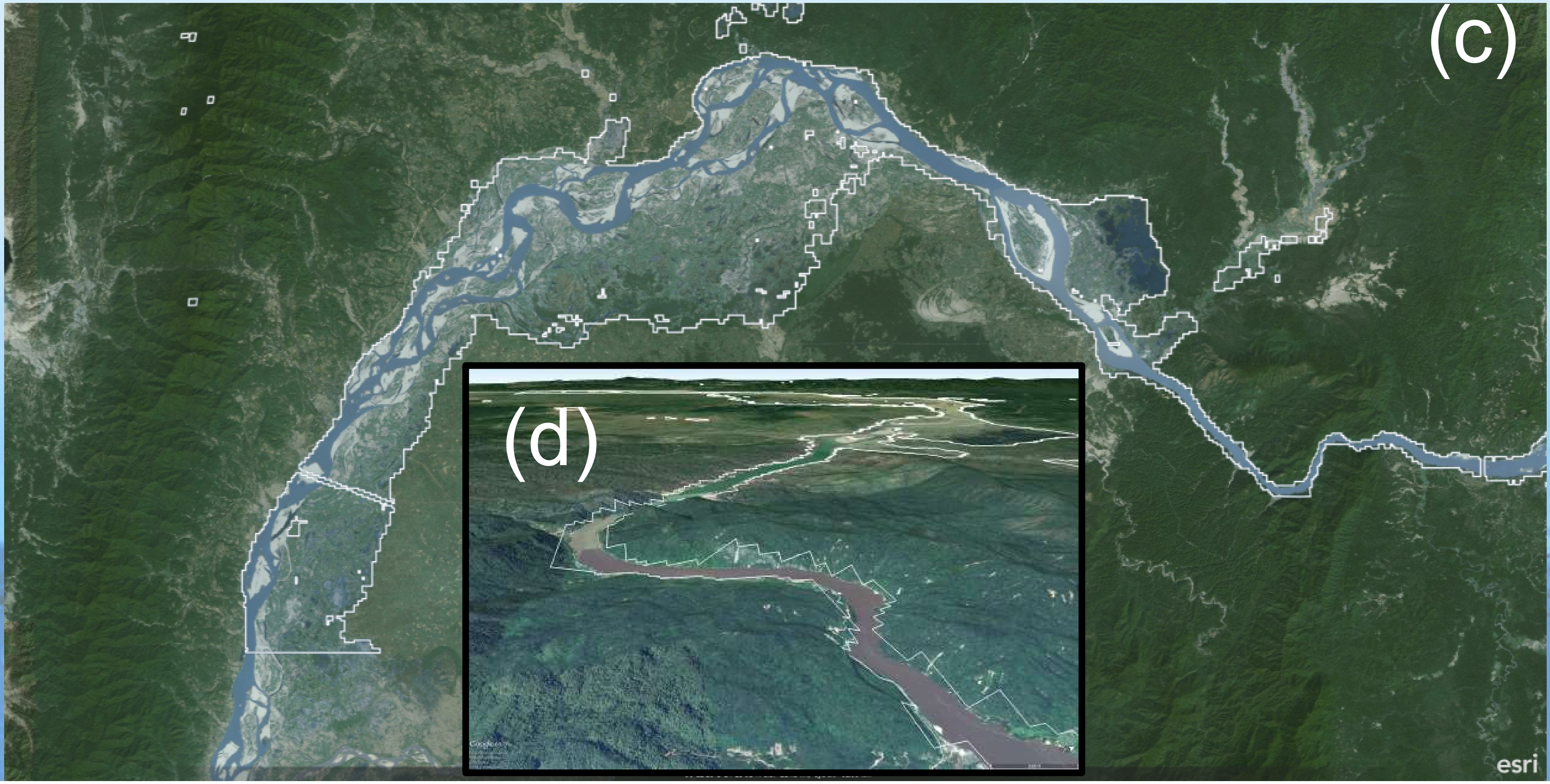
St Vrain Creek, Lyons CO

1m LiDAR

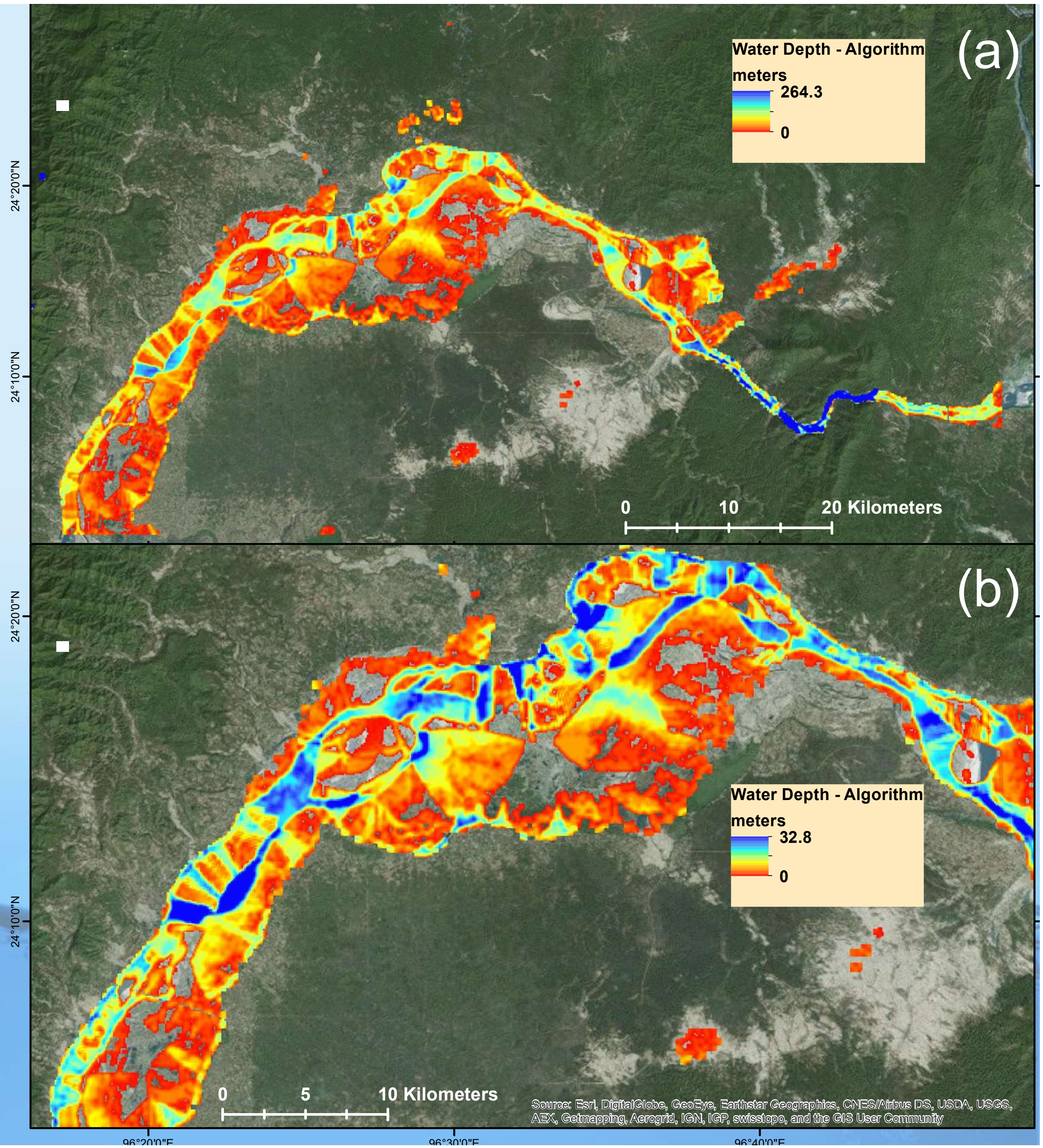


Floodwater Depth Algorithm - Demonstration

- August 2016 flood event at Irrawaddy River (Myanmar)
- MODIS-based water classification by DFO
- 15 arc-sec (~500 m) resolution DEM (HydroSHEDS)



August 2016 flood event at Irrawaddy River (Myanmar)



Floodwater Depth Algorithm – Conclusions

- Good agreement with hydraulic model-based water depth simulations.
- Steep terrain (e.g. narrow valley) may lead to considerable overestimations - highly sensitive to the resolution of the flood inundation map and DEM.
- Large water bodies are prone to underestimation due to because DEMs typically record surface elevation (large river channels will show similar biases).
- Complex inundation patterns and urban flooding are prone to localized hotspots of overestimation. Higher quality imaging and DEM inputs are found to limit the spatial extent of these hotspots.