



Probabilistic Flood Mapping Using Volunteered Geographical Information

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Collaborators: Marc Girons Lopez², Jan Seibert², Barbara Minsker³

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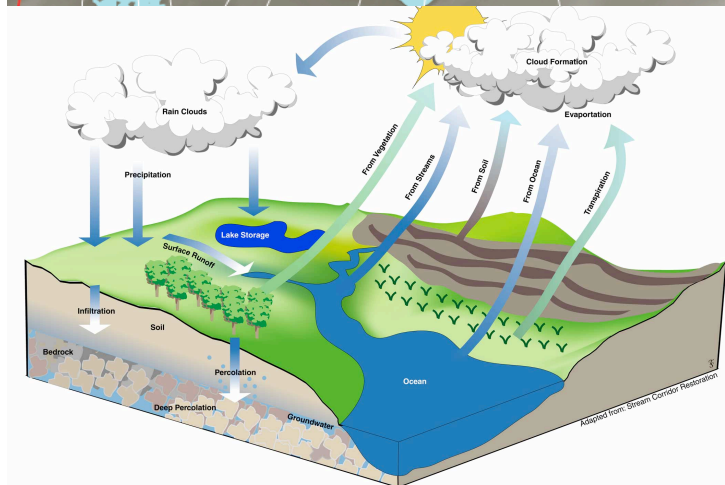
³ Southern Methodist University, TX





Motivation

- ❖ **Traditional flood inundation maps**
 - 1-D, 2-D or 3-D hydrologic model and/or remote sensing
 - Limited by spatiotemporal resolution of input data



Motivation



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❖ Wealth of real time flood information

- Social media, news, emergency calls, etc.

Parts of Downtown Austin are underwater
@foxaustin #txflood2015 #atxflood
#ShoalCreek #AustinFloods

RETWEETS 55 FAVORITES 17
5:29 PM - 25 May 2015

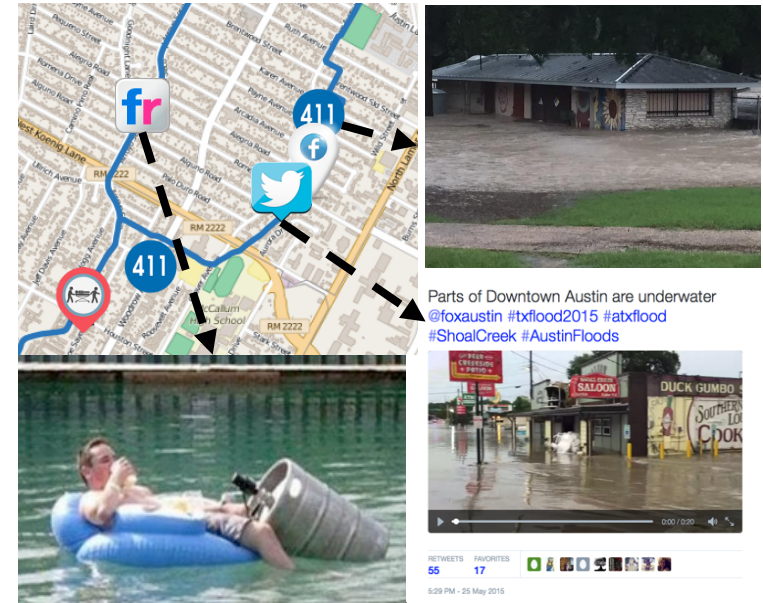


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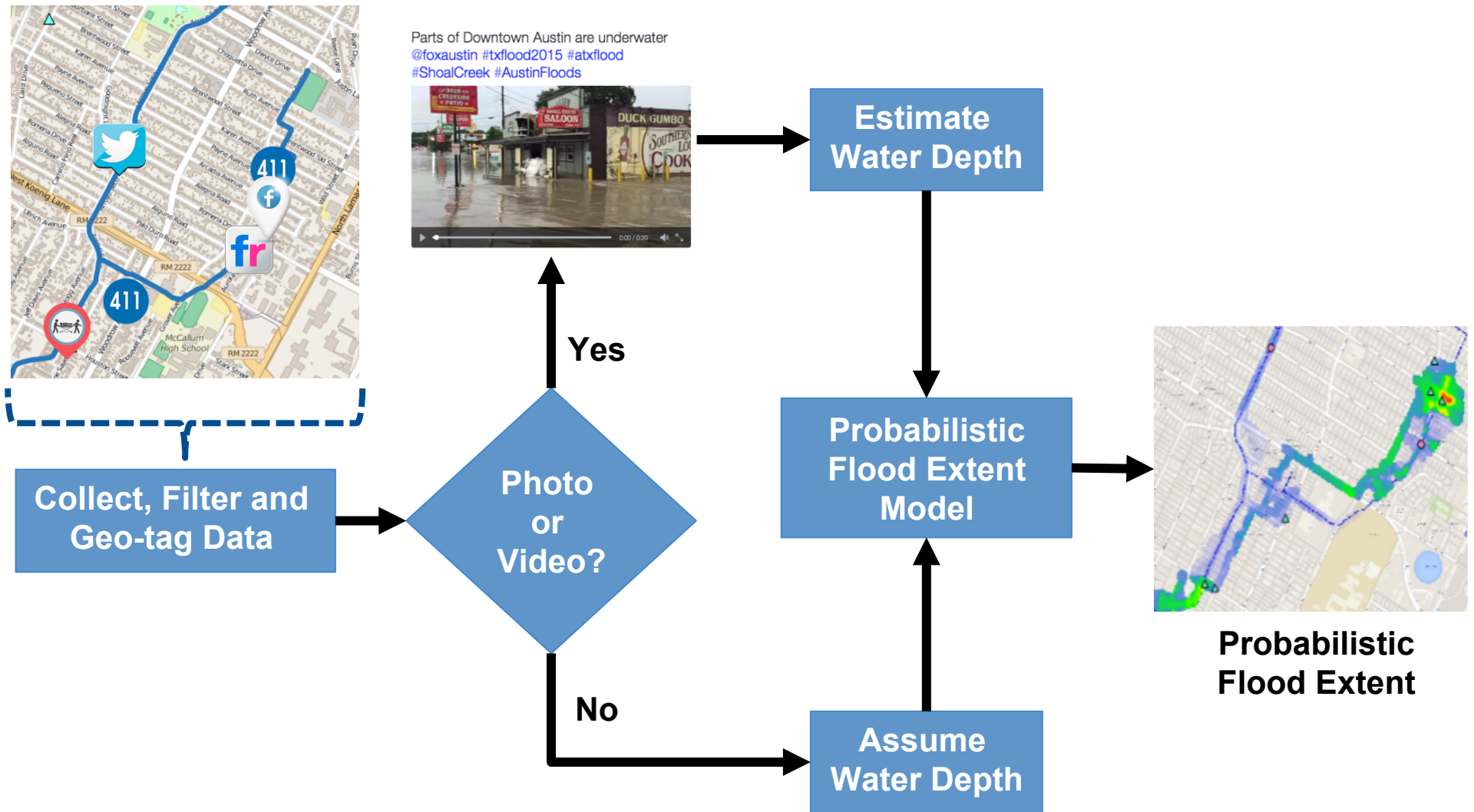


Research question:

*How can **volunteered geographical information (VGI)** be used to provide reliable **probabilistic flood maps**, especially in areas where no model and/or gauge data is available?*

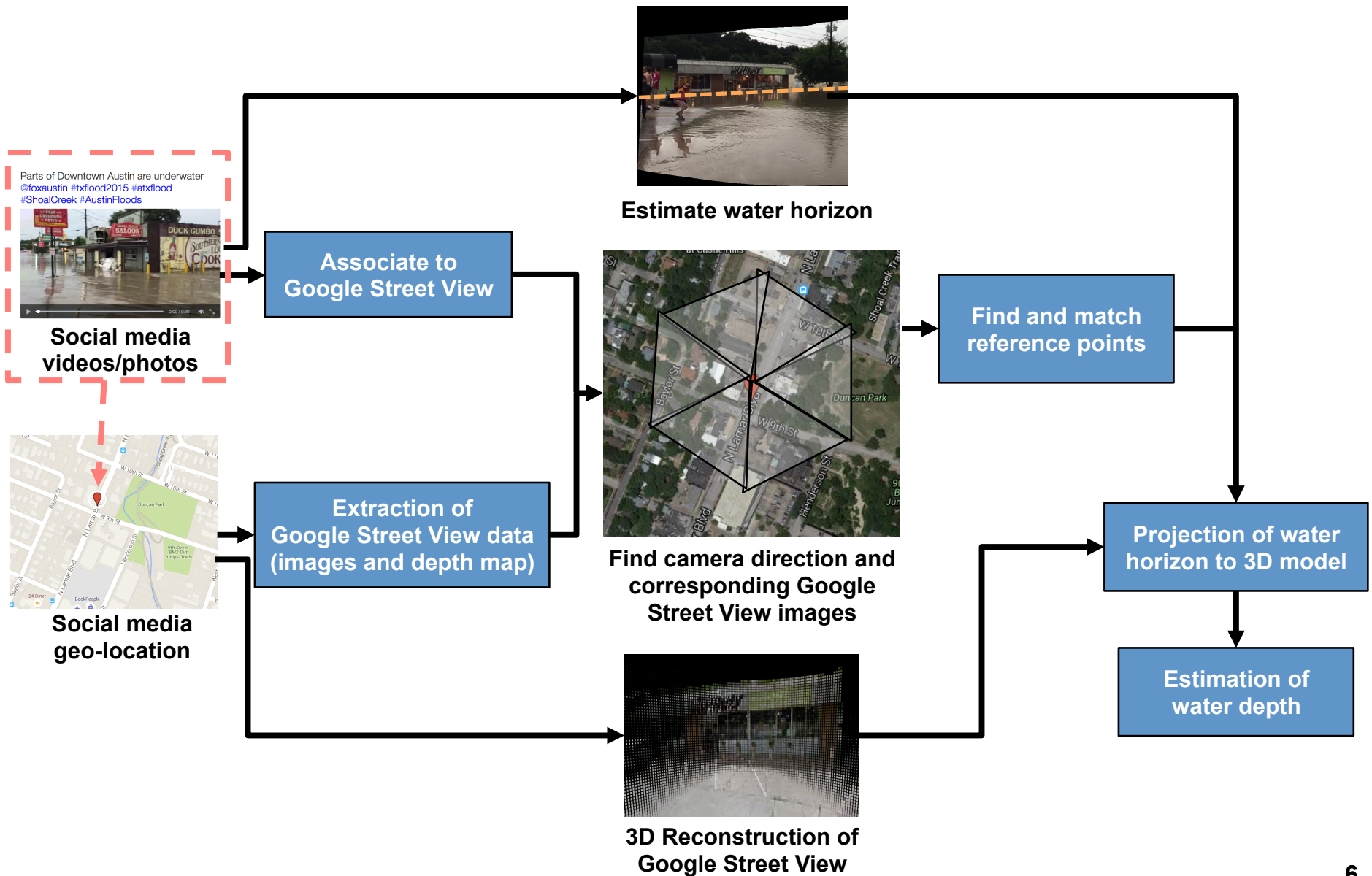


Conceptual Overview



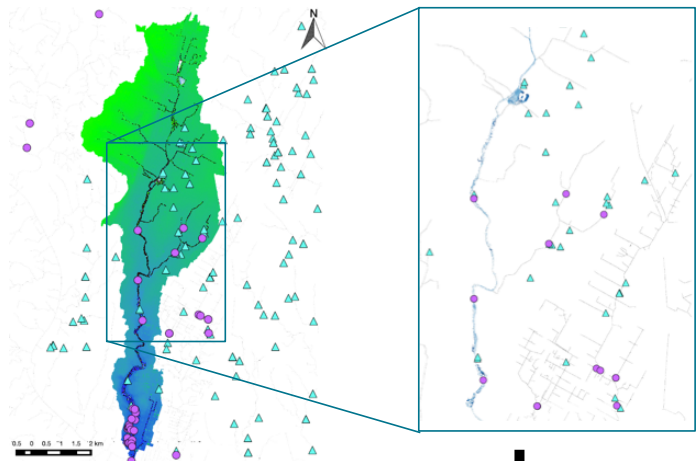


Methodology: Floodwater Depth Estimation





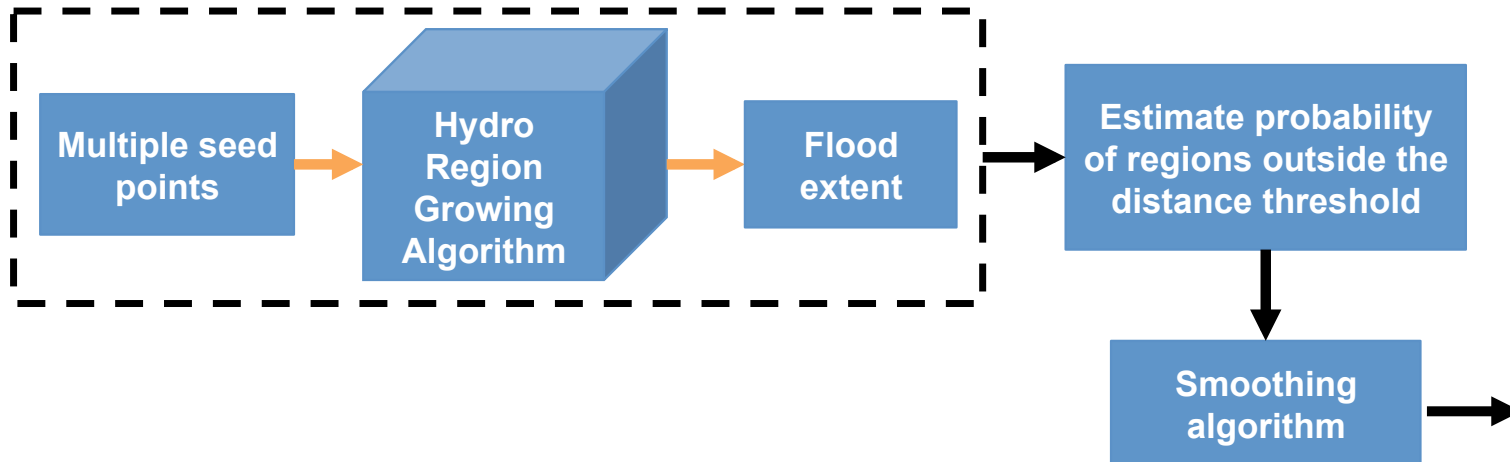
Methodology: Probabilistic Flood Mapping



Inputs

- DEM
- VGI data points & flood water depth
- Stream centerlines

Monte Carlo Simulation



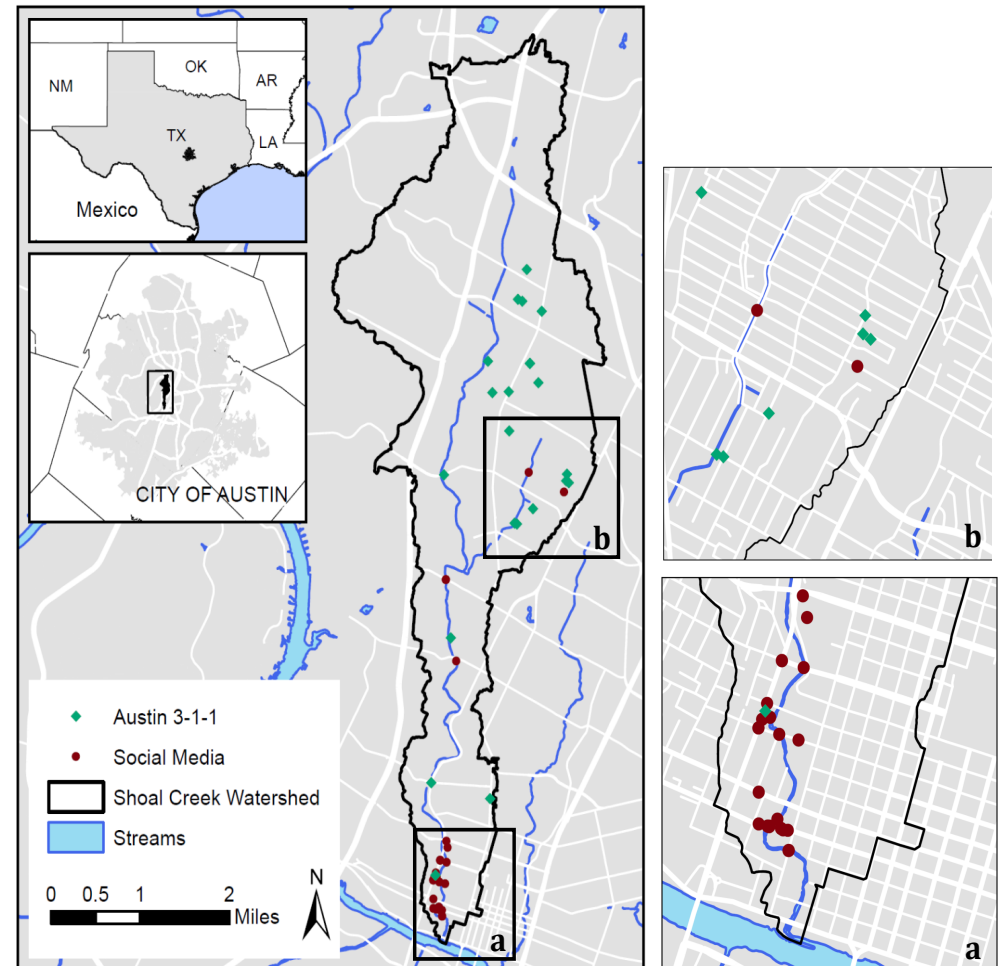
Output

- Probabilistic flood extent



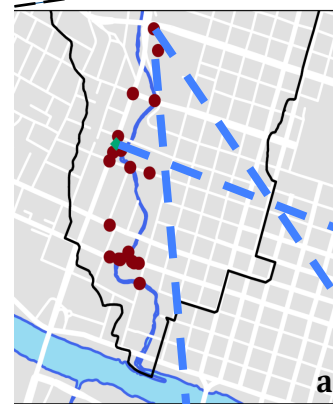
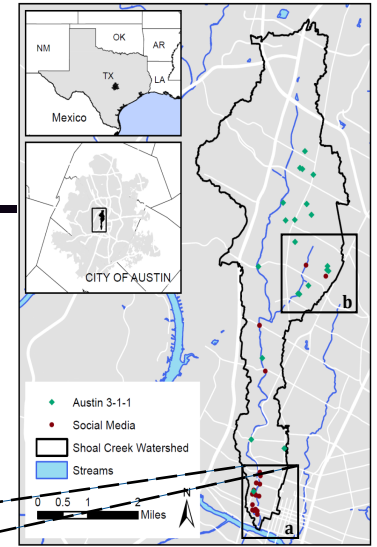
Case Study

- **Shoal Creek catchment**
 - Austin, TX
- **Memorial Day flood**
 - *May, 25 2015 – 2-6 PM*
 - 17 water rescues
 - 20.5 ft max. flood depths
- **Sub-locations:**
 - **a:** Downtown Austin
 - **b:** Dry Creek
- **Validation**
 - HEC-RAS hydraulic modeling results
 - FEMA 25 & 100 yrs maps



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Preliminary Results: Floodwater Depth Estimations



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Tweeted video

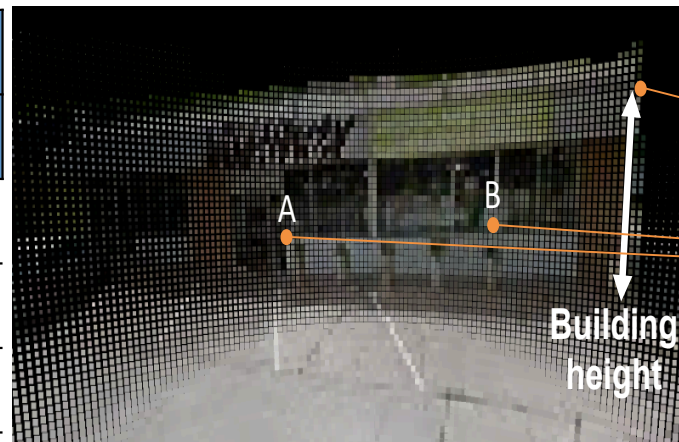


Panorama image created from video



3D reconstruction of Google Street View

Flood depth		
Estimation (ft)	Modeled (ft)	
A	4.5 - 5.2	4.6 - 5.7
B	6.5 - 7.2	5.5 - 7.22
C	3.1 - 3.8	2.7 - 2.9

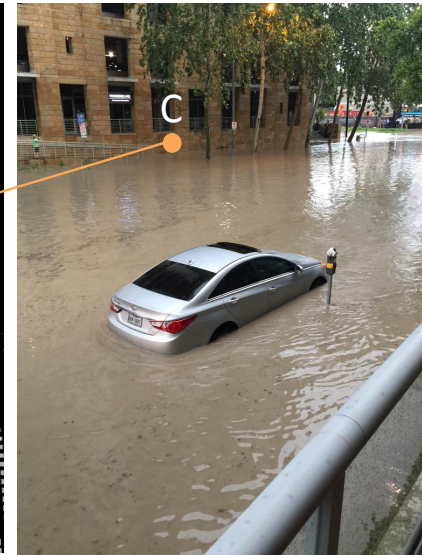
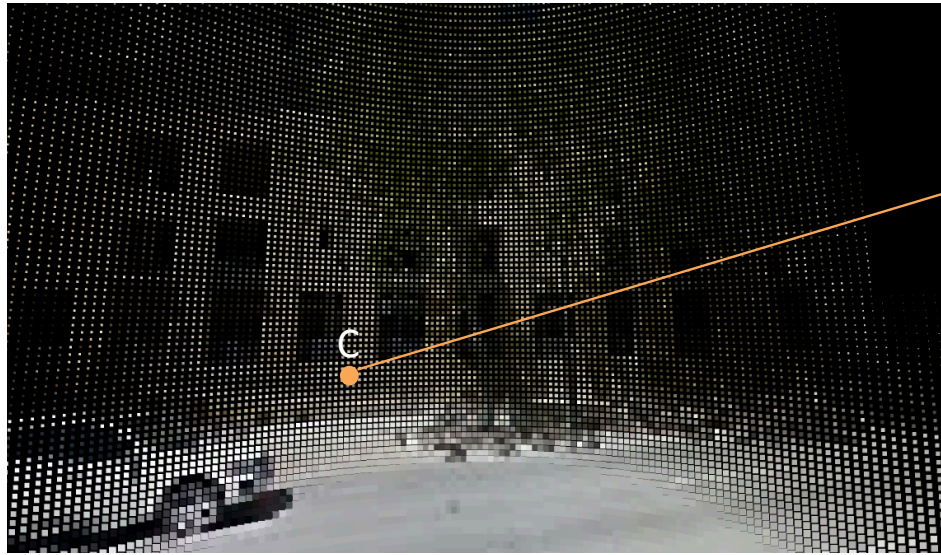


Building height

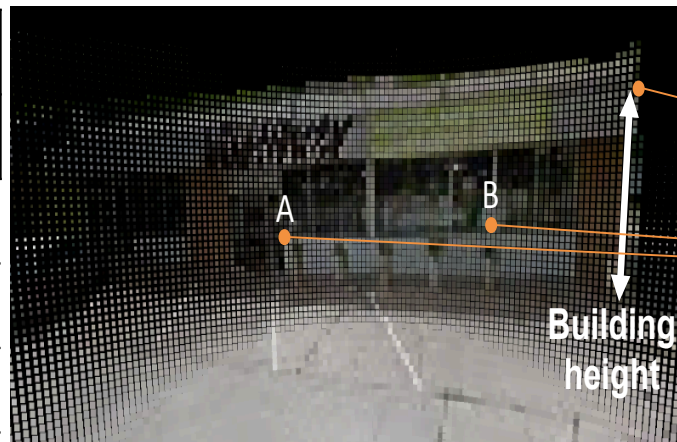
Preliminary Results: Floodwater Depth Estimations



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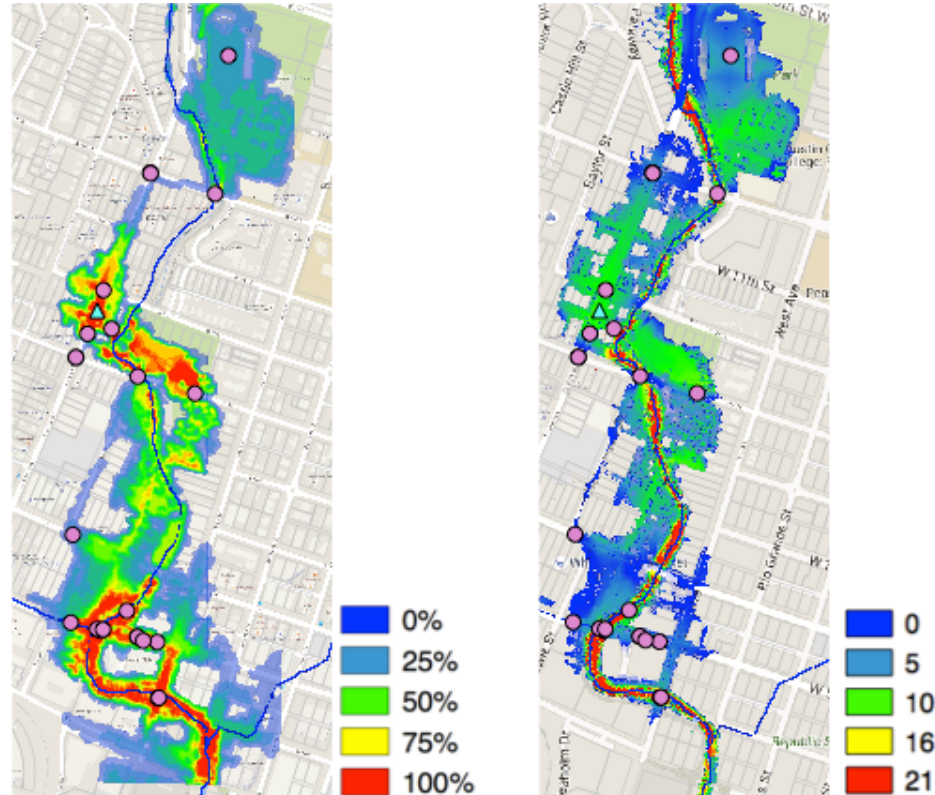
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Preliminary Results: Flood Extent Estimation



A: Downtown Austin

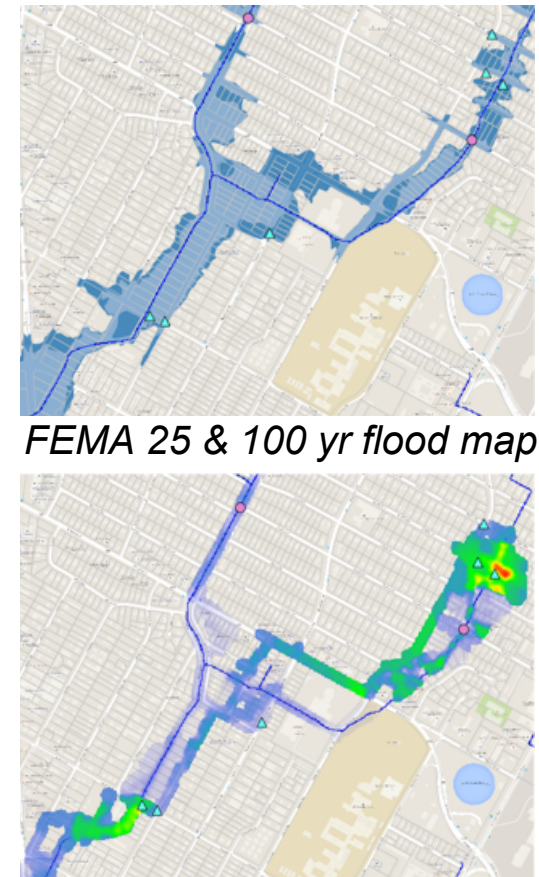


HRGA
probabilistic
extent

HEC-RAS
modeled flood
depth (ft)

**85% of overlap with
HEC-RAS modeled flood extent**

B: Dry Creek *un-modeled / un-gauged creek



FEMA 25 & 100 yr flood map

HRGA probabilistic extent

**75 - 82% of overlap with
FEMA flood extents**



Conclusions & On-going Work

- **Preliminary study was intended as an initial exploration of the feasibility of using VGI for real time probabilistic flood mapping**
- **Preliminary results demonstrated promising results which encourage the further development**
 - **Further validation of the proposed approaches**
 - Estimation of water depths from social media photos/videos
 - Additional case study: Onion Creek, Austin, Texas
 - **Assess the effects of current challenges and limitations**
 - Spatial distribution/coverage of VGI data
 - Limitations associated with considering the different levels of confidence in the social media data
- **Propose a methodology for the identification of critical areas from where VGI data is most needed**



Acknowledgments

- National Flood Interoperability Experiment Summer Institute (NFIE)
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 - National Science Foundation
- The National Water Center
- The National Oceanic and Atmospheric Administration
- The National Weather Service
- The University of Alabama



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