# InVEST Urban Development

## Incorporating Earth Observation Data into the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Urban Flood Risk Mitigation Model Python API


## Abstract

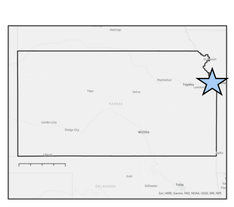
Urban flooding poses as one of the biggest issues for cities today, as its impacts are amplified by both climate change and urbanization. The Natural Capital Project's Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Urban Flood Risk Mitigation (UFRM) model, which benefits from its simplicity and robustness, is commonly used in NASA DEVELOP projects for disaster mitigation, urban planning, and environmental justice issues. While InVEST UFRM model was able to produce the surface water runoff and retention map sufficient for the scopes of past projects, the model accuracy and spatial variability need improvement. Since the current InVEST UFRM model employs constant rainfall depth for all pixels in the area of interest (AOI), the model suffers from inaccurately estimating rainfall depth, runoff volume, and flood depth. Therefore, we adapted the model so that satellite-based precipitation raster datasets (i.e., Integrated Multi-satellitE Retrievals for Global Precipitation Measurement [GPM IMERG]) can be used instead of a single constant value. We simulated the flood events on August 21st and August 22nd, 2017 in Wyandotte County, Kansas using both our modified and the original InVEST UFRM model and then compared the results after incorporating the rainfall raster into the model. Areas with developed land on the land use map predicted moderate to high flood volume in the original volume regardless of the actual amount of precipitation. The modified model considered the rainfall depth's spatial variation achieving less overestimation of flood runoff and volume at low-to-moderate rainfall area.

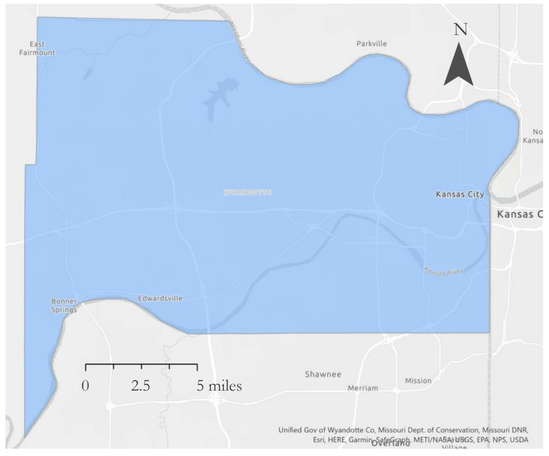

## Objectives

- **Integrate** Earth observation data into the InVEST UFRM model
- **Enhance** the model's current capabilities
- **Illustrate** the benefits of incorporating a rainfall raster in the model
- **Test** the sensitivity of the model
- **Compare** the original and improved model
- **Validate** the improved model
- **Prepare** the documentation to assist future users

## Study Area

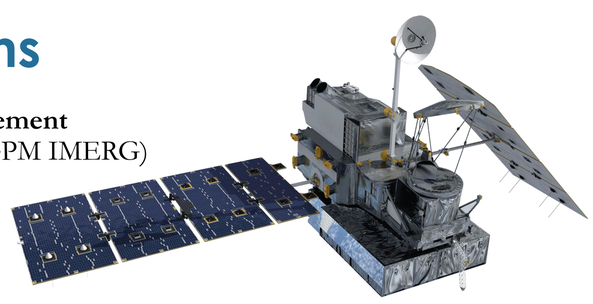
- Kansas City, KS (Wyandotte County)
- Storm Events August 2017 and June 2019






## Earth Observations

**Global Precipitation Measurement**
Integrated Multi-satellitE Retrievals (GPM IMERG)
Rainfall Depth



**Sentinel-1 C-SAR**
Flood depth for model validation

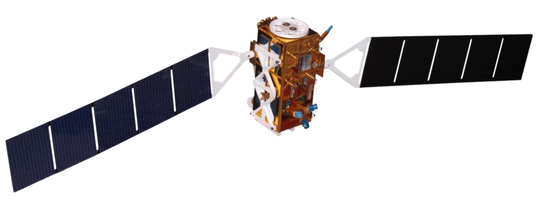
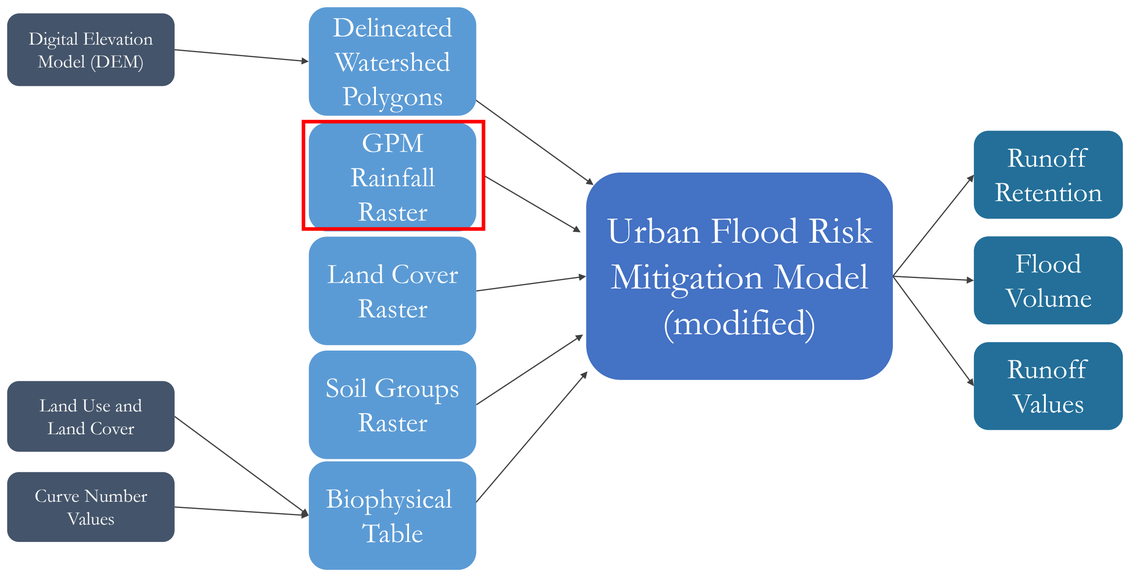


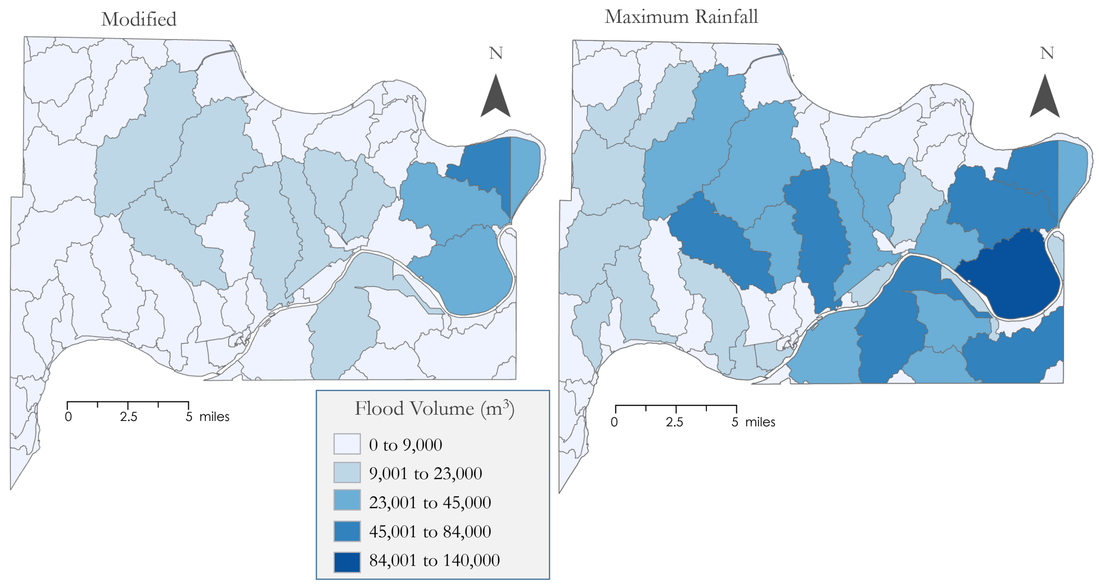
Image Credit: NASA, ESA

## Methodology

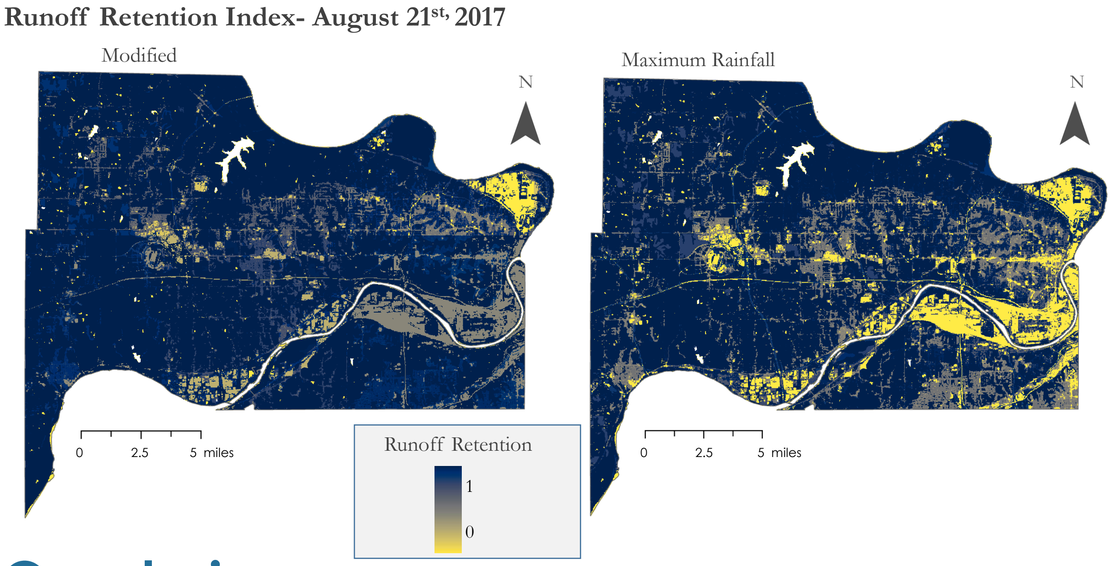



## Results

**Flood Volume- August 21st, 2017**




**Runoff Retention Index- August 21st, 2017**




## Conclusions

- GPM raster rainfall input into the InVEST UFRM model improves the prediction of flood volume and runoff values.
- As there is more accurate prediction, there is improved resiliency.
- With the improved model, we hope the improved accuracy will allow more users the opportunity to improve urban flood predication in their communities.

## Team Members

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Project Lead

**Jessica Besnier**

## Future Work

- Downscaling GPM and using higher resolution precipitation input
- Incorporate infiltration calculation
- More in-depth validation
- Application in other locations


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**DEVELOP Fellow:** Caroline Williams


25TH DEVELOP ANNIVERSARY

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