# A national-scale real-time data analytics application for assessing the potential impacts of flooding on communities

Credit: PSU

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AGU 100 FALL MEETING

# Hydrosystem and Hydroinformatics Research (HHR) Group

### Ryne Philips

*Ph.D. Student*
*email: ryne@email.sc.edu*
*Ryne joined HHR in 2016 after completing his MS degree at Clemson University. He is studying flood frequency analysis and design metrics for water infrastructure systems. His research will play an important role in developing regional-scale flood analysis systems in environments with successive flood events.*

### Sadegh Sadeghi Tabas

*Ph.D. Student*
*email: sadegh@email.sc.edu*
*Sadegh has two BS degrees respectively, in water resources engineering and civil engineering. He is researching the application of cyber-GIS and cyber-physical systems approaches for environmental and watershed modeling. His work focuses on Columbia, SC as a case study region.*

### Mahdi Erfani

*Ph.D. Student*
*email: merfani@email.sc.edu*
*Mahdi is working on using Geographic Information System for environmental monitoring assessment and applications. He develops GIS-cyberinfrastructure to assess the impacts of civil infrastructure on environmental systems.*

### Nattapon "PK" Donratanapat

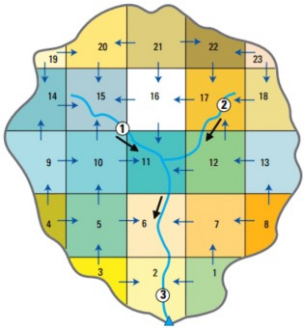
*M.S. Student*
*email: nattapon@email.sc.edu*
*PK is studying intelligent technologies, incorporated with the data analytics and machine learning computing systems, to monitor and compute flooding events in the Carolinas. He has developed python tools and smart applications to asses flooding impacts.*

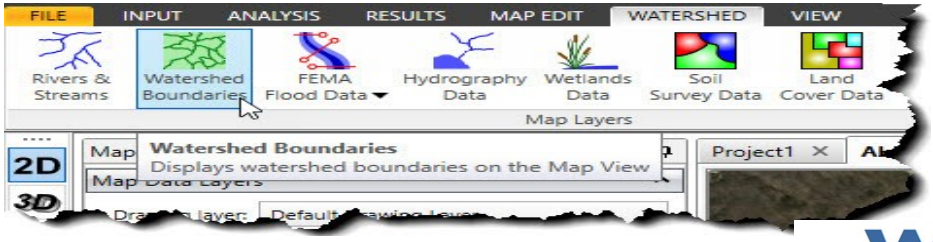
### Romeer Desai

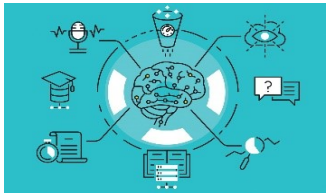
*B.S. Student*
*email: merfani@email.sc.edu*
*Romeer joined HRR in 2019 and studying environmental and biological assessment for mitigation projects.*

### Ellie Y. Chao

*Research Technician*
*email: echao@email.sc.edu*
*Ellie is studying hydrology and water resources modeling. She is currently spending majority of her time at the Oak Ridge National Lab (ORNL) for her fellowship study.*








# Successive hurricane events have brought new challenges to human life in south and southeast US

Hurricane Joaquin—the 2015 floods (52 dams failed/breached --47 regulated, 4 unregulated, and 1 federal)

Successive Hurricanes

Hurricane Driven Floods

Damaged Infrastructure

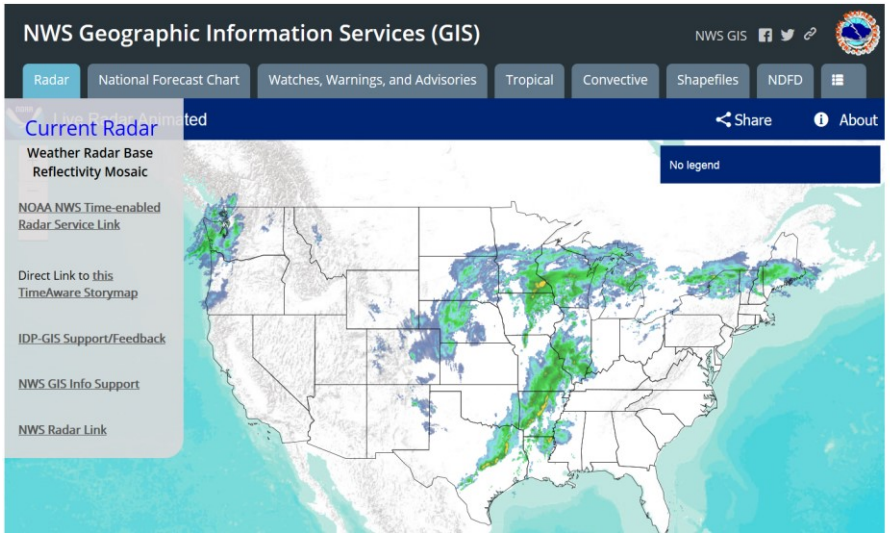
Road Flooding– Columbia, SC Oct. 2019

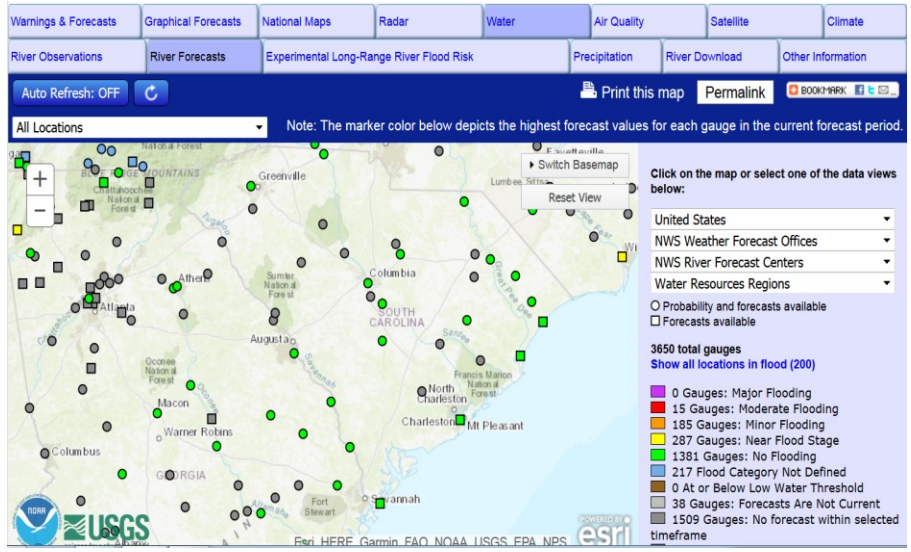

**Flood impacts:** loss of human life, damages to critical infrastructure, disruption to crops and livestock, health impacts, property damage, social and economic disruption.

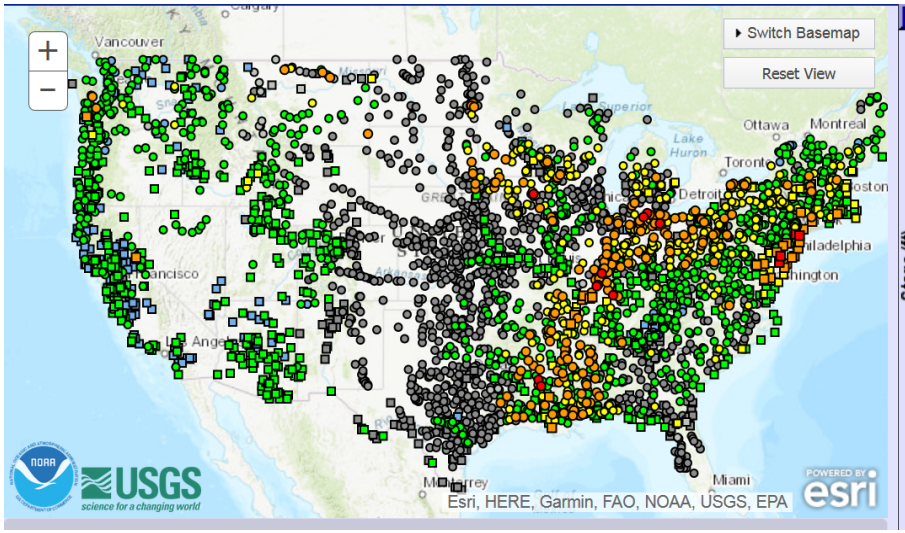
# What are we doing now?

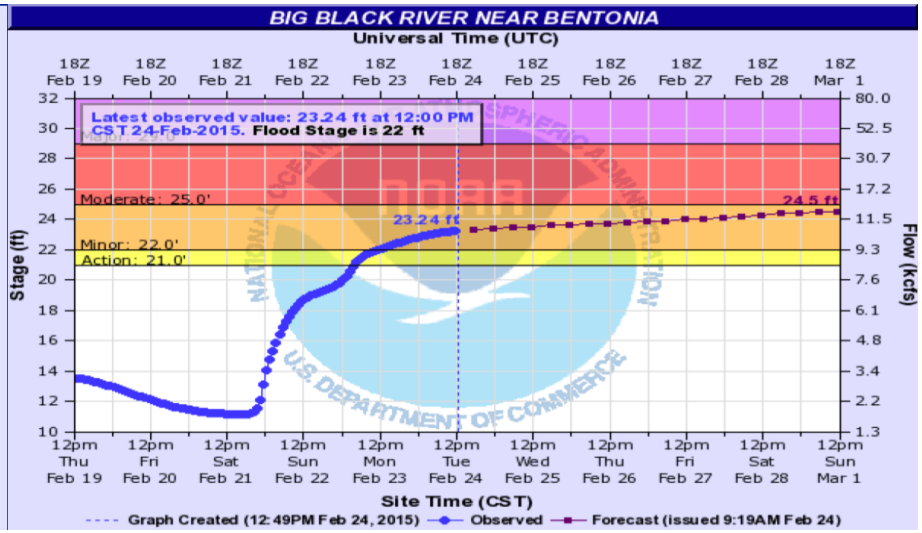
## No interface to collect floods data--We have many ungagged catchments

## Plan with confidence and efficiency--Better meet the needs of decision makers



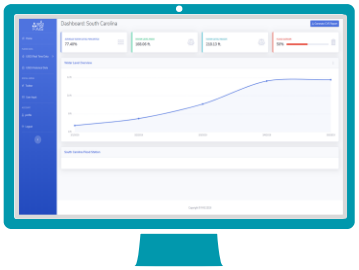



# Flood Analytics Information System (FAIS)

**Nattapon "PK" Donratanapat**

Donratanapat et al., 2019 a
Donratanapat et al., 2019 b

Open source web application based on real-time flood warnings and river level information, and natural language processing of tweets (crowdsourced data) during flooding events.



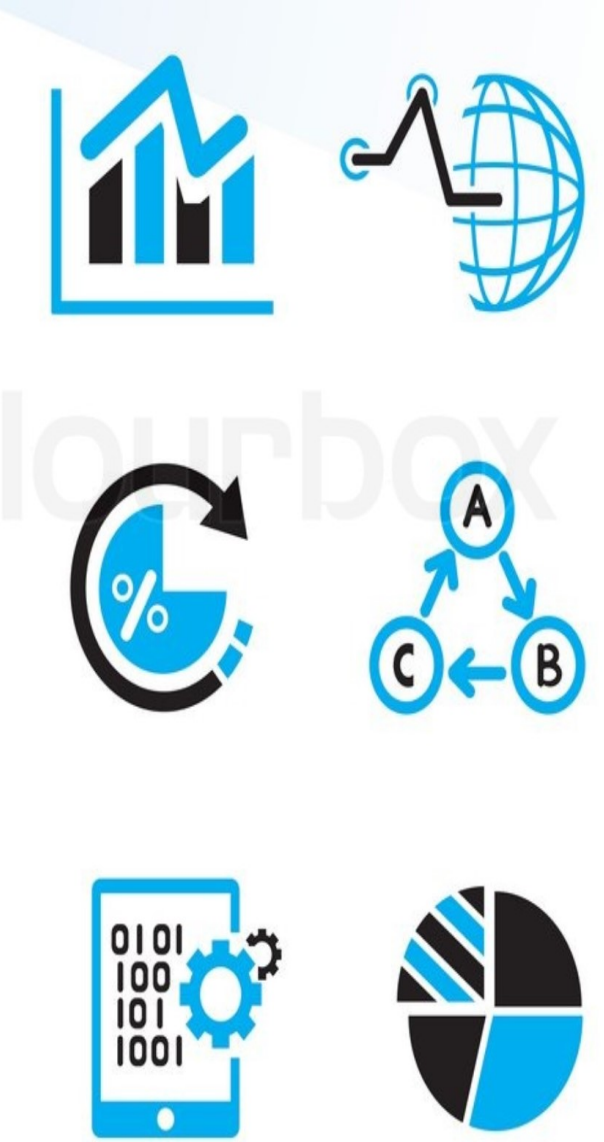
**Funding Sources:** This research is supported by the National Science Foundation's (NSF) Directorate for Engineering (Grant # CBET1901646).

**Software Information**
**Name:** Flood Analytics Information System (FAIS v0.1B)
**Developer:** Nattapon Donratanapat
**Year First Available:** 2019
**Hardware Required:** Windows, Linux, MacOS, Intel i3 or mid-performance PC
**Software Required:** Python and Python library dependencies
**Software Release:** Software and source code are released under the Massachusetts Institute of Technology License.

# Flood Analytics Studies

## Integration

## Analytics




## Intelligence

# Big Data Analytics in Flood Assessment

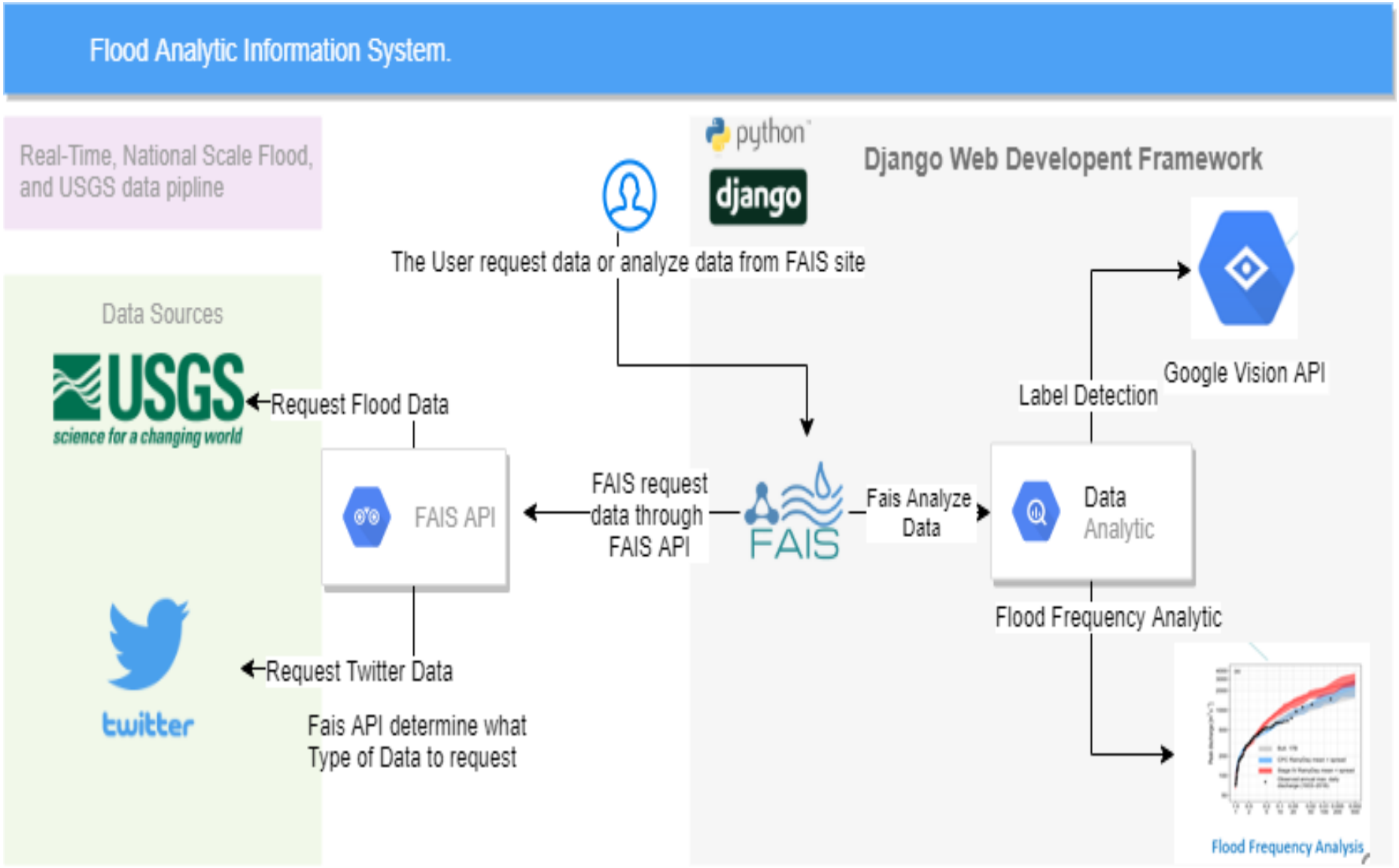
**Unstructured big data:** Satellite images, USGS flood records, photographs and video, radar or sonar data, mobile data, social media data, website content, etc.

Images and image sequences (videos) make up **about 80 percent** of all corporate and public unstructured big data.

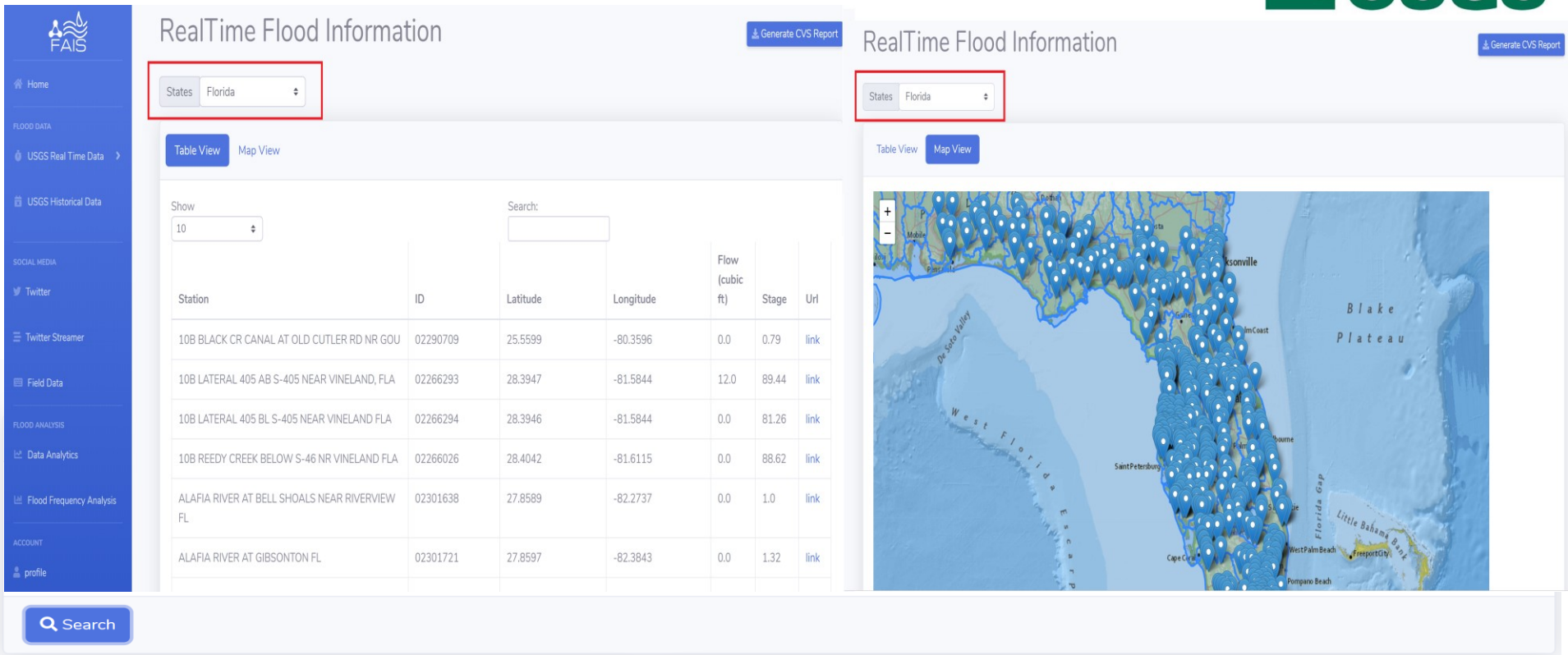
**Solution: Machine (Deep) Learning Methods for Image Processing**

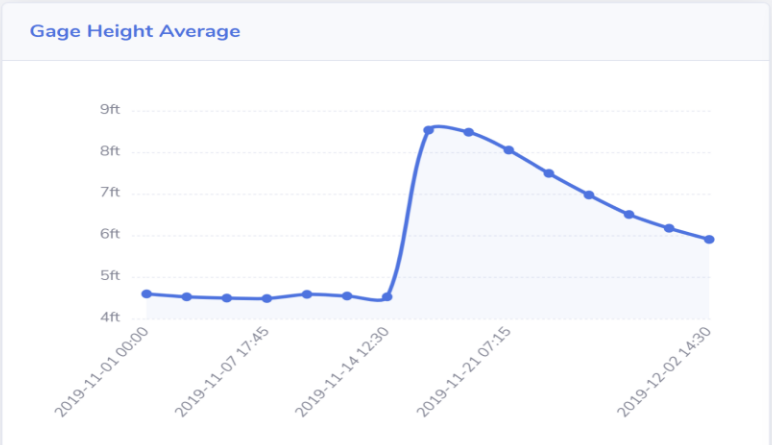
# FAIS workflow and structure

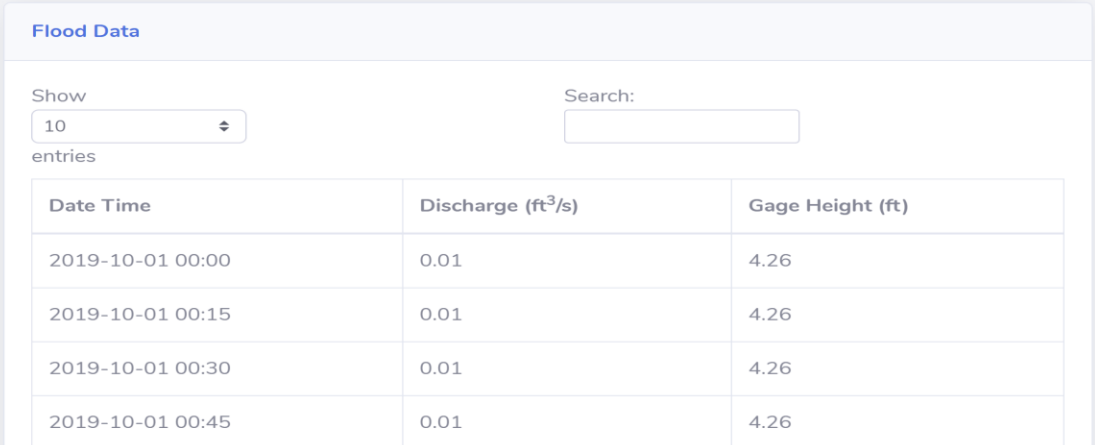
**FAIS prototype offers an end-to-end, open source, web-based, pipeline architecture to improve flood situational awareness for risk management and decision making.**



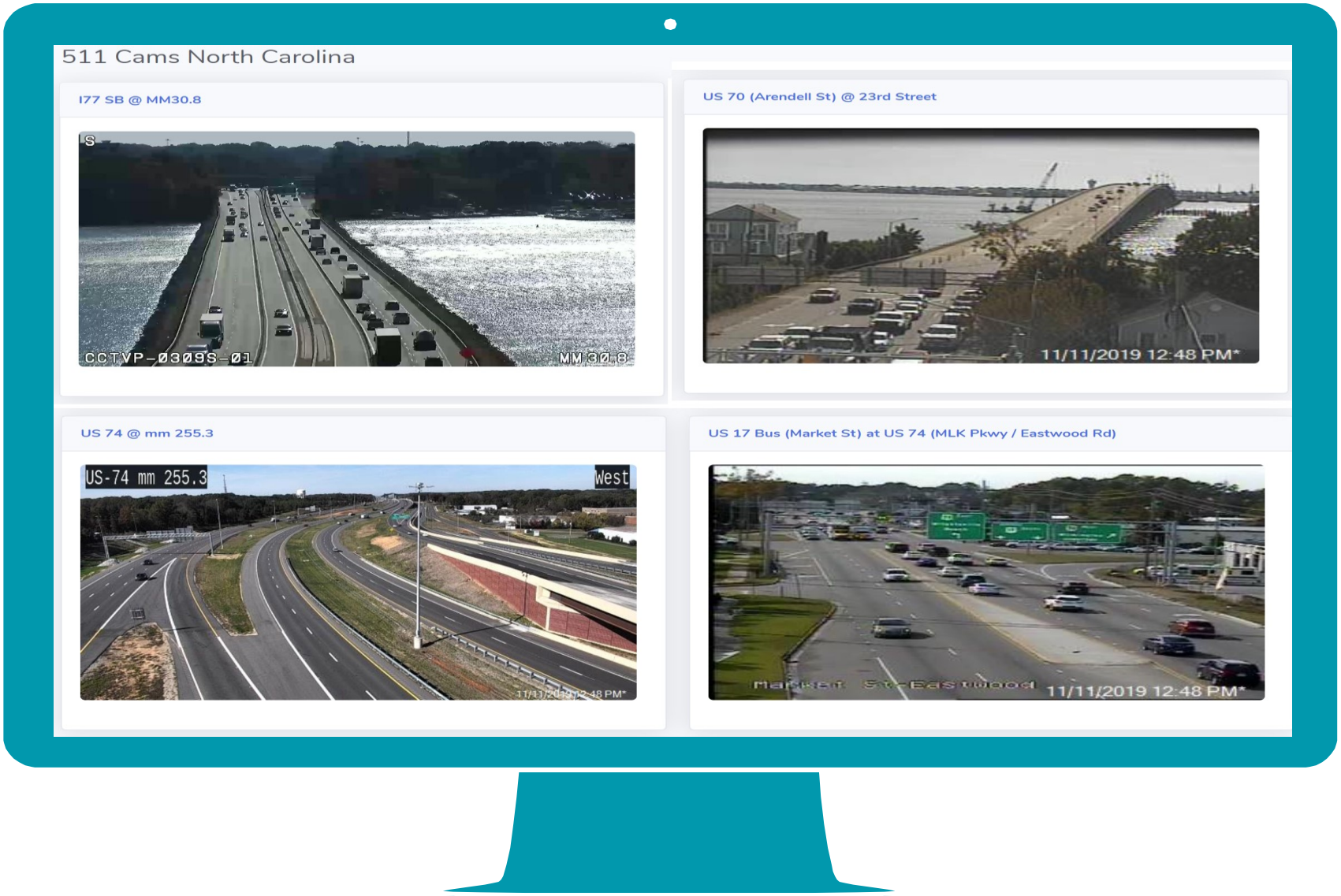
# Real-time and historical USGS data gathering and analysis



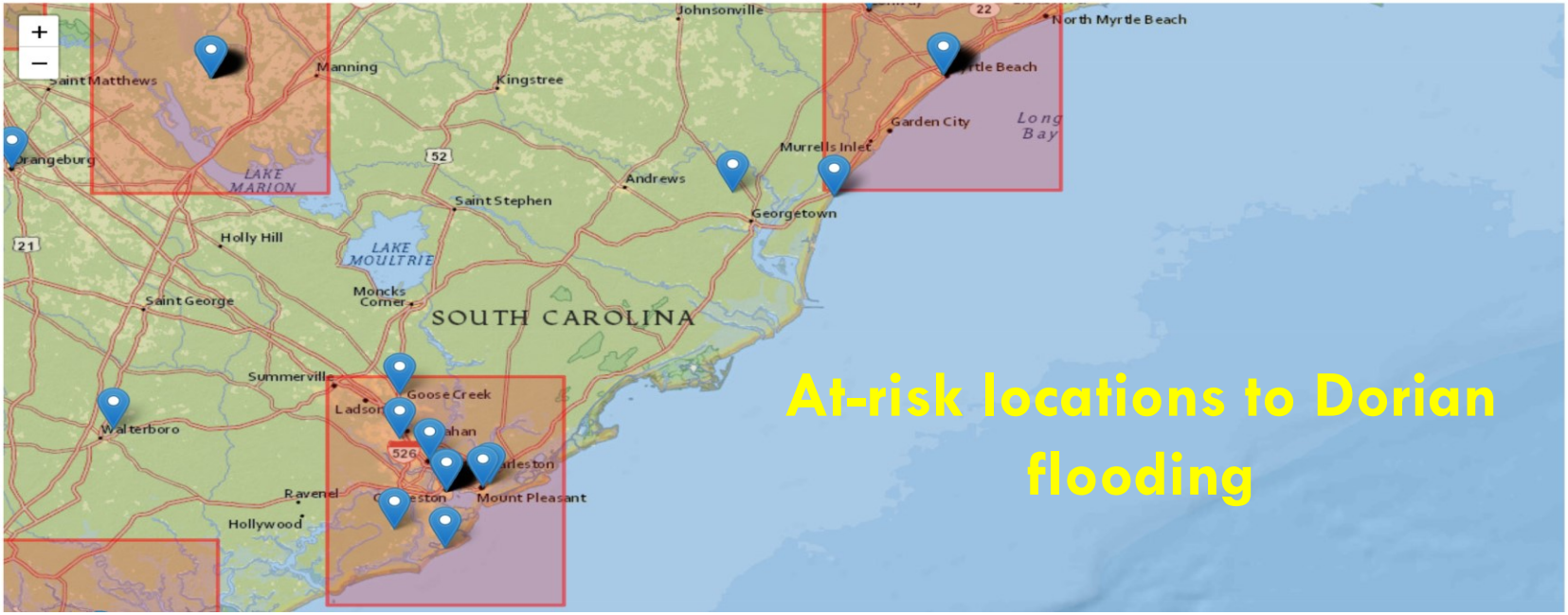
# Real-Time River Webcam Image/ 511 Traffic Cameras Image Collection



# Crowdsourced Processing of Tweets

| Tweets | Date | Source | Image | Sentiment |
|---|---|---|---|---|
| # Dorian timeline & impacts in a nutshell: Tues-Wed: close to the Florida east coast Wed-Thurs: close to the Georgia and South Carolina coasts Potential impacts: life-threatening storm surge, dangerous winds, flash floods, isolated tornadoes http://noaa.gov/dorian pic.twitter.com/JsTg9PD3PG | 2019-09-03 01:11:55 | | | -1 |
| A Flash Flood Emergency continues for New Orleans, LA this morning. These emergencies are issued for exceedingly rare situations when a severe threat to human life and catastrophic damage from a flash flood is happening. https://twitter.com/NWSFlashFlood/status/1148955662837137409 ... | 2019-07-10 14:36:55 | | | 1 |
| Don't let your little ones, furry and human, go into flood waters. There's a lot of dangerous stuff in there - some of which you can't see! pic.twitter.com/KqOecNP2kl | 2019-07-13 18:39:08 | | | -1 |
| During a flood, water levels and the rate at which the water is flowing can quickly change. Get to higher ground. Do not drive or walk into water. It only takes 6 inches of water to knock you off your feet. http://weather.gov/safety/flood # WeatherReadypic.twitter.com/VhE5F7rQjg | 2019-09-19 14:50:26 | | | 1 |
| Here's the distinction between a Flash Flood Emergency and a Flash Flood Warning... pic.twitter.com/k9zmwGxf2b | 2019-07-10 14:38:51 | | | 0 |

Table View | Map View



# Google AI and Image Processing

Upload Image

Drop files here to upload

Label and Score
Flood : 0.91
Water : 0.81
Residential area : 0.8
Suburb : 0.71
Floodplain : 0.68
Event : 0.63
Photography : 0.62
Road : 0.58
Thoroughfare : 0.58
Tsunami : 0.54

Label and Score
Flood : 0.94
Vehicle : 0.83
River : 0.83
Waterway : 0.82
Water : 0.81
Event : 0.72
Car : 0.71
Tree : 0.69
Watercourse : 0.66
Geological phenomenon : 0.62

# Flood Frequency Analysis (FFA)

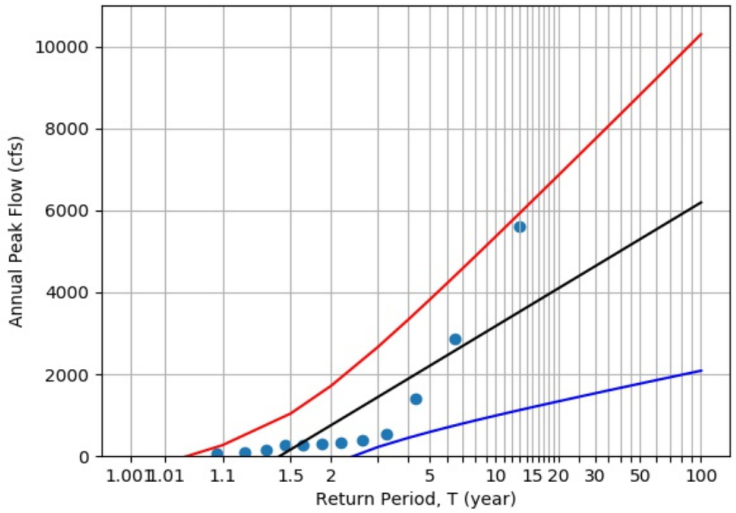
FAIS computes design flow values corresponding to specific return periods that can help engineers in designing safe structures and in protection against economic losses due to maintenance of civil infrastructure.

## USGS 02172035 TURKEY CREEK ABOVE HUGER, SC

Flood Frequency Analysis

USGS Peak Flow Rate Analysis

Flood Station 02172035




Show 10 entries

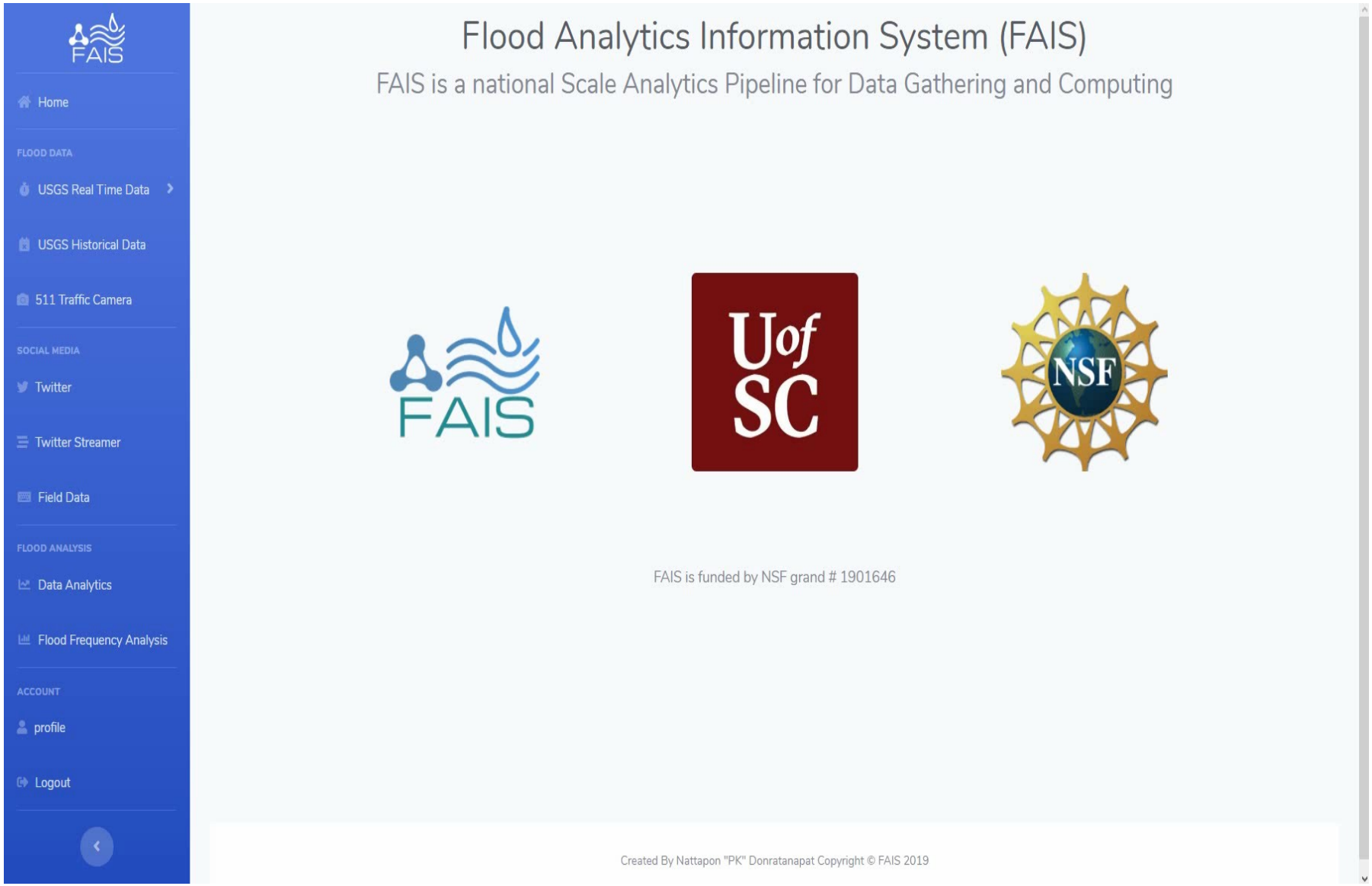
Search:

| Station | Date Time | Peak Value | Peak Gage Height |
|---|---|---|---|
| 02172035 | 2011-02-09 | 78.0 | 5.83 |
| 02172035 | 2012-06-13 | 85.0 | 6.12 |
| 02172035 | 2007-02-02 | 157 | 6.39 |
| 02172035 | 2014-04-19 | 271 | 7.11 |
| 02172035 | 2013-06-20 | 288 | 7.19 |
| 02172035 | 2008-09-06 | 297 | 7.17 |
| 02172035 | 2015-02-26 | 339 | 7.32 |
| 02172035 | 2005-10-07 | 391 | 7.05 |
| 02172035 | 2009-12-19 | 547 | 7.93 |
| 02172035 | 2008-10-25 | 1410 | 9.52 |

Showing 1 to 10 of 12 entries

Previous 1 2 Next

# Show and Tell ☺



# Next Step

## Flood Forecasting System

**Looking for a postdoc fellow and two Ph.D. students in system engineering (developer).**

**Our Communities/Our People**---We need to develop community level inclusive solutions to recover from flooding and empower diverse partners-A new way of thinking about how to evolve from flood victim to expert.

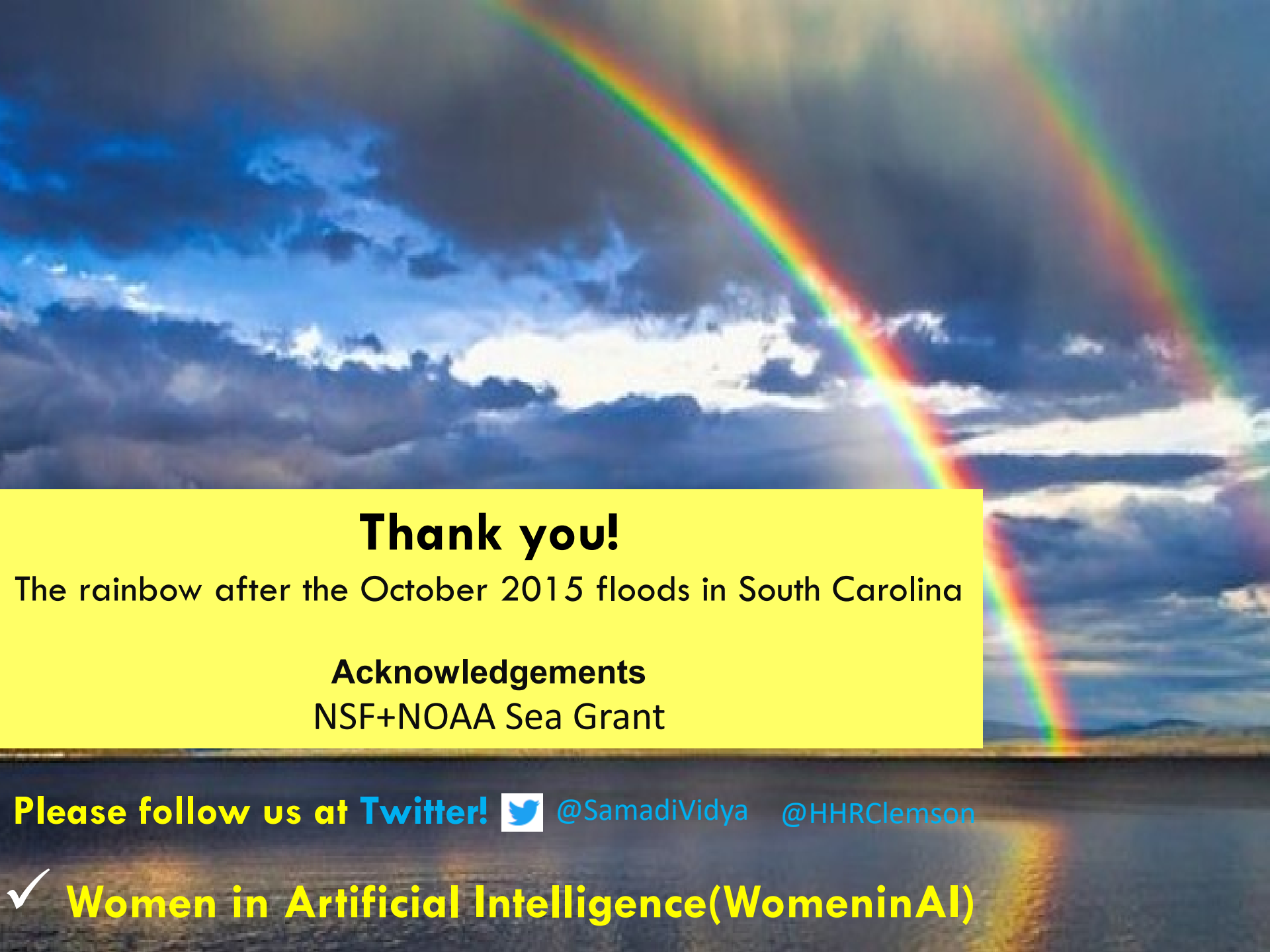


**Global warming** causes major damage to the global economy and **increases the risk of catastrophic events!** -- how to **respond** to the new awareness of the Climate Crisis?

Climate Protests

Greta!

**Are we doing enough to communicate?**



# Thank you!

The rainbow after the October 2015 floods in South Carolina

**Acknowledgements**

NSF+NOAA Sea Grant

**Please follow us at Twitter!** @SamadiVidya @HHRClemson

✓ **Women in Artificial Intelligence(WomeninAI)**