The Convergence of IoT, Machine Learning, and Big Data for Advancing Flood Analytics Knowledge

Credit: Unknown

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(on behalf of many collaborators and students)

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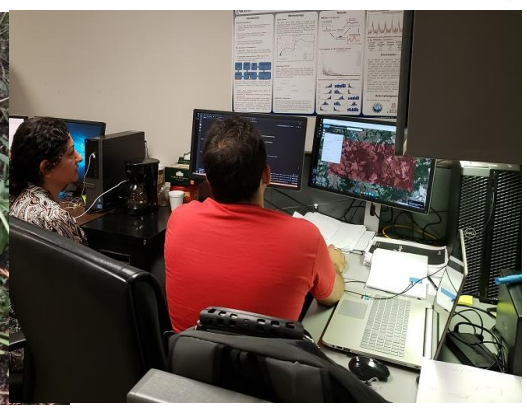
The Hydrosystem and Hydroinformatics Research (HHR) Team Welcomes You!

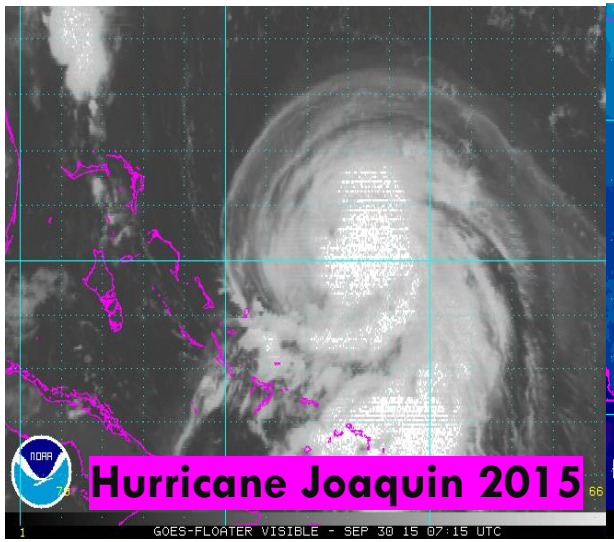
Our focus is on Flood Computational Modeling and Forecasting and Impacts of Flooding on Critical Infrastructure.

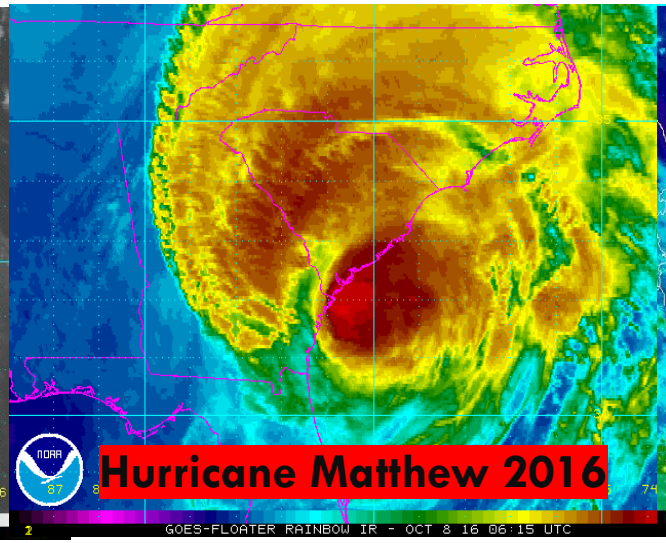


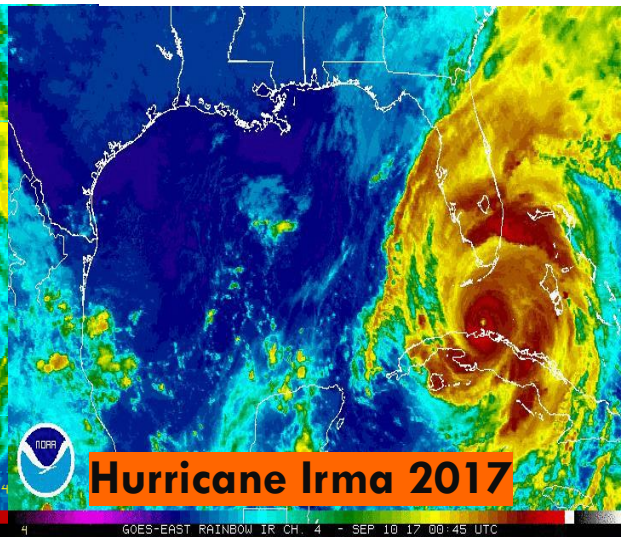
WEB GIS

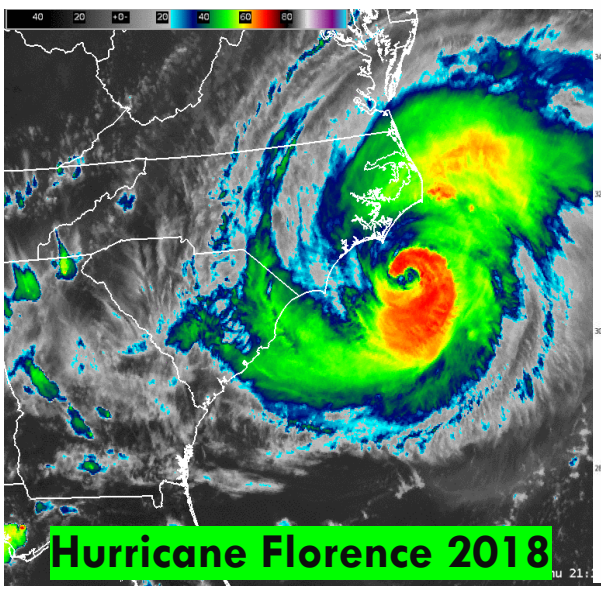
python + django

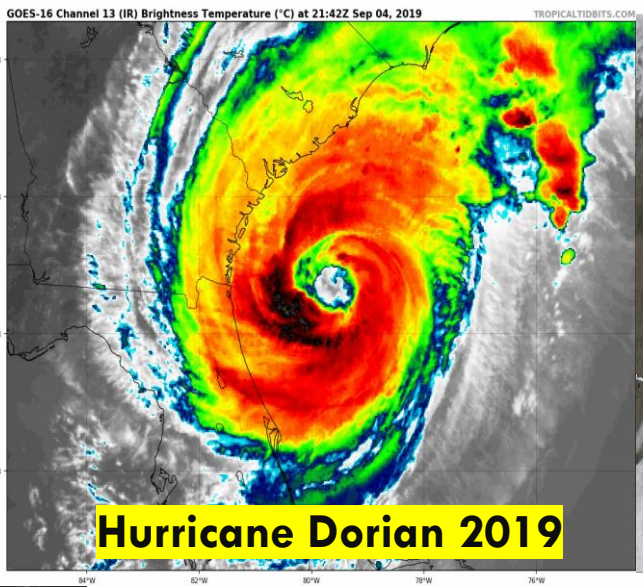
Successive hurricane events have brought new challenges to human life in US

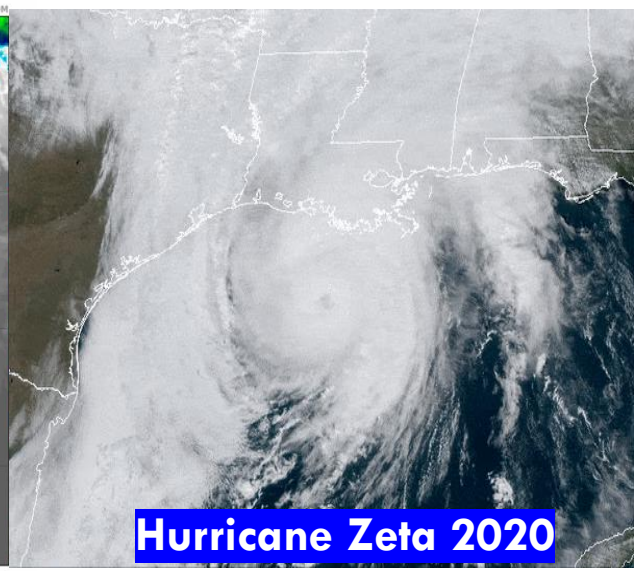






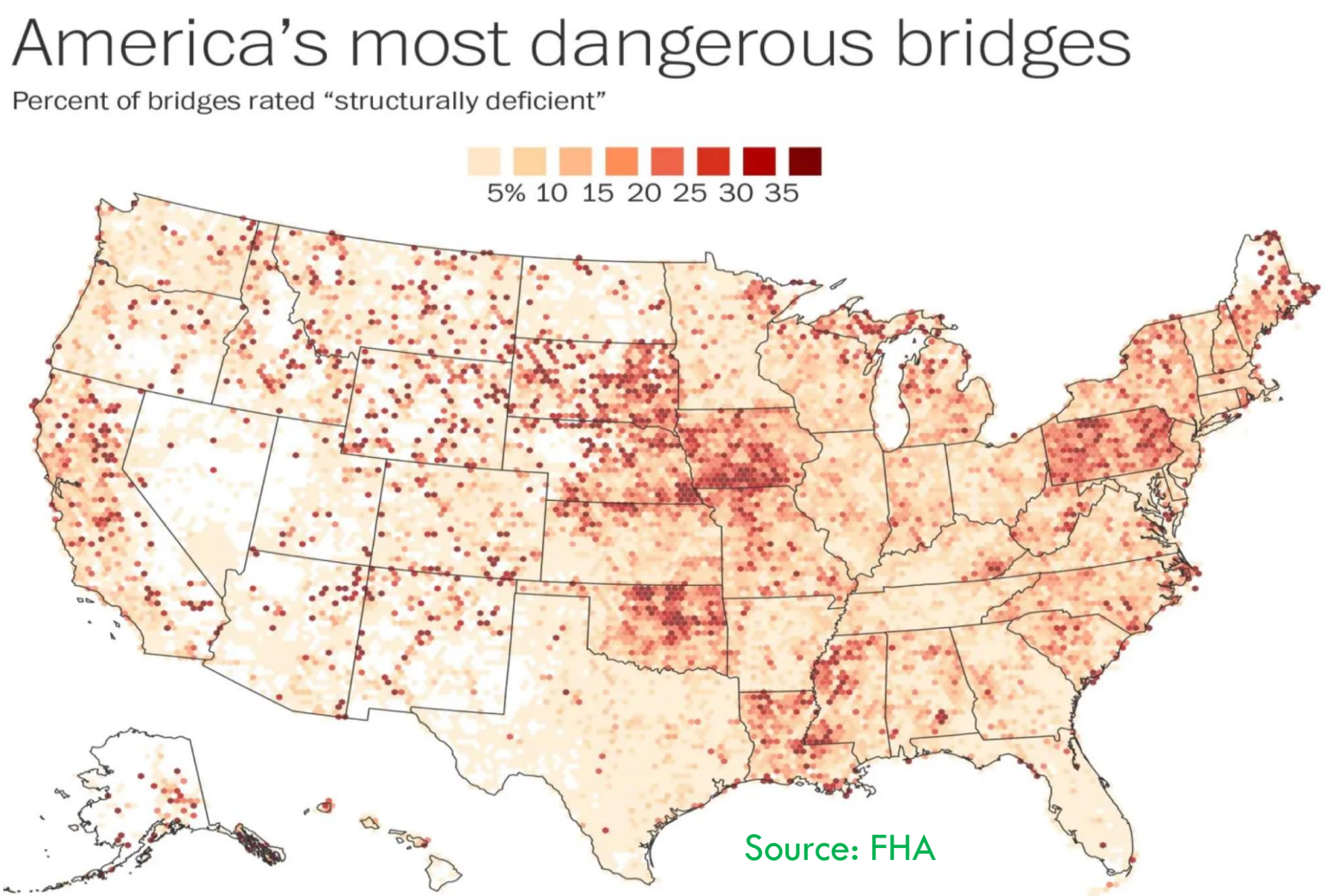






Planning ahead is essential for flood evacuations

Regions in the U.S. with the highest percentage of bridges deemed by the Federal Highway Administration as "structurally deficient"



https://www.washingtonpost.com/news/wonk/wp/2015/02/04/mapping-americas-most-dangerous-bridges/?noredirect=on&utm_term=.98ca55d99c9b

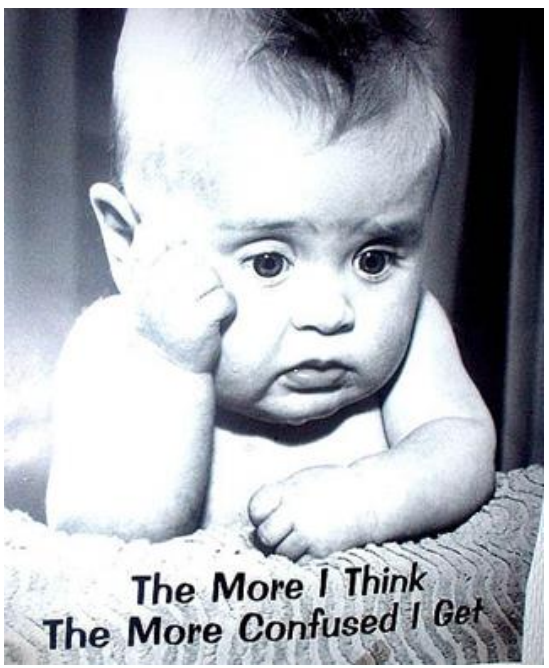
South Carolina has >1000 deficient bridges

State	Total bridges	Deficient bridges	Obsolete bridges	Percent deficient	Percent obsolete
FLORIDA	12,137	243	1,760	2.00	14.50
GEORGIA	14,795	785	1,623	5.31	10.97
MARYLAND	5,305	317	1,104	5.98	20.81
NORTH CAROLINA	18,117	2,199	3,135	12.14	17.30
SOUTH CAROLINA	9,338	1,031	891	11.04	9.54
VIRGINIA	13,800	1,120	2,454	8.12	17.78

Source: FHA https://www.washingtonpost.com/news/wonk/wp/2015/02/04/mapping-americas-most-dangerous-bridges/?noredirect=on&utm_term=.98ca55d99c9b

The way that data is organized can enhance or inhibit the analysis and action that can be done

I have your information right here …

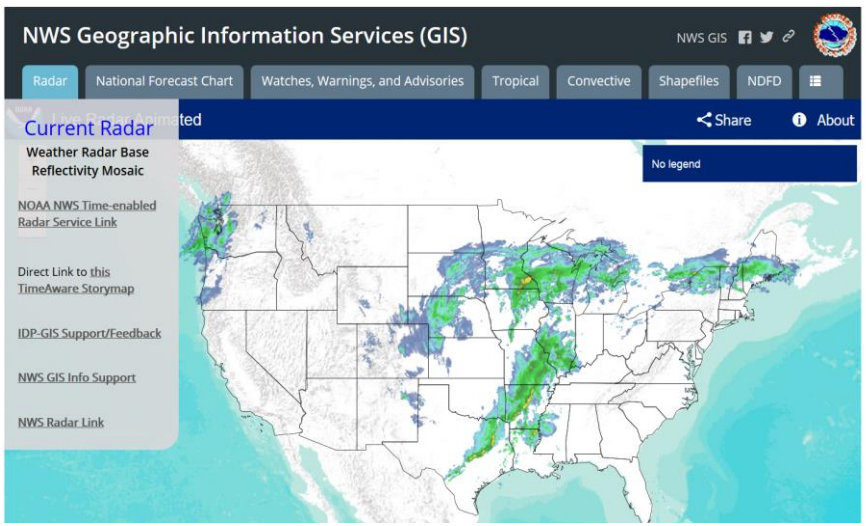


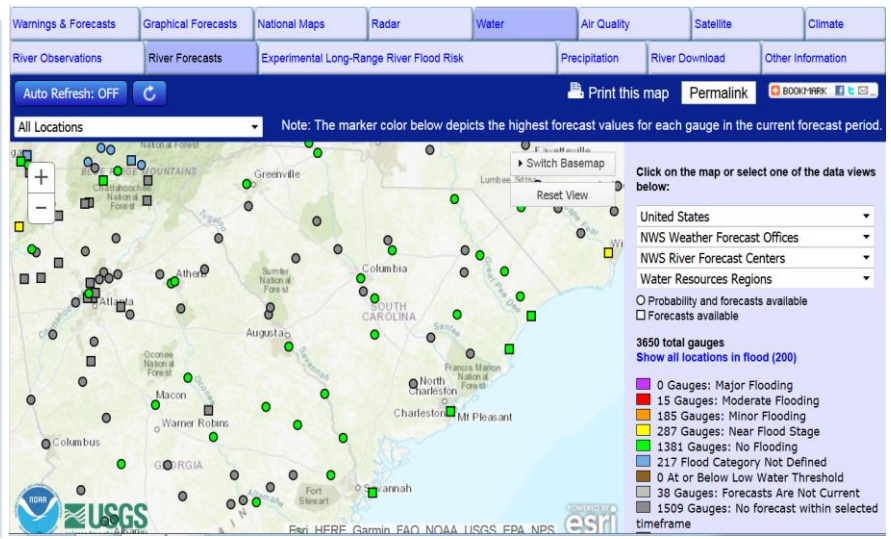
Picture from: http://initsspace.com/

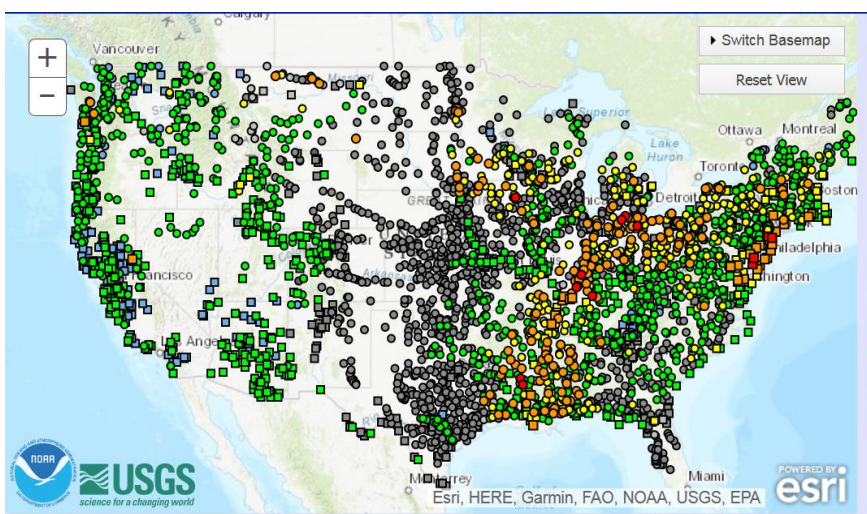
What are we doing now?

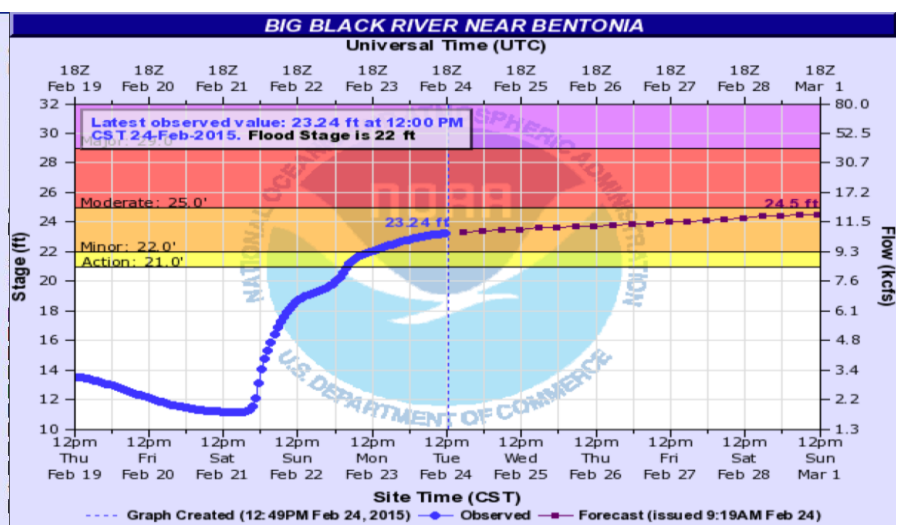
No interface to collect floods data—We have many ungagged catchments

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







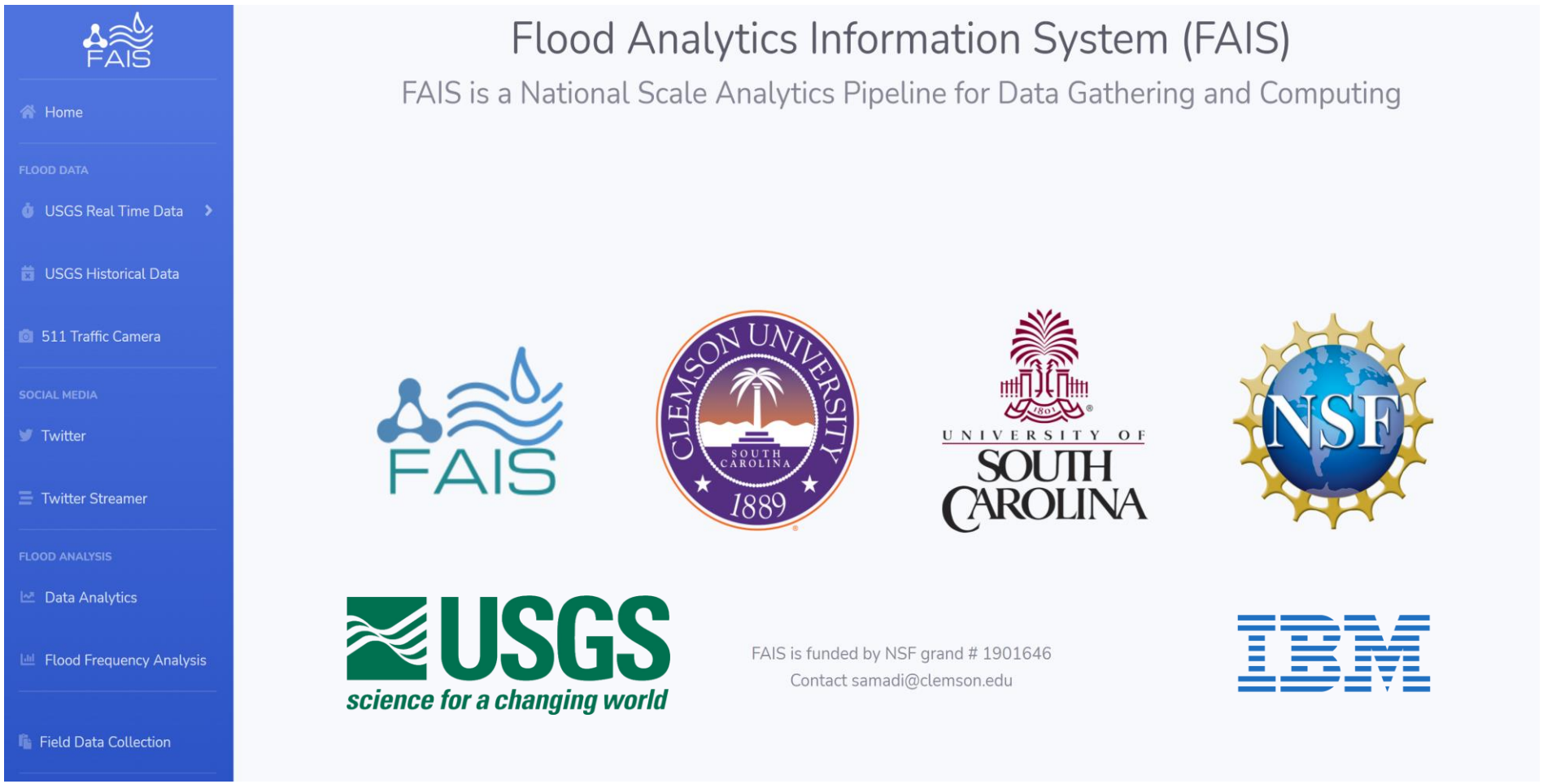


… and what we have developed!

Flood Analytics Information System (FAIS)

FAIS application helps researchers, scientists, and decision makers gather Big data and assess flood emergency situations in a more intelligent and user friendly way.

Overall, we developed 12 python modules for the FIAS development.



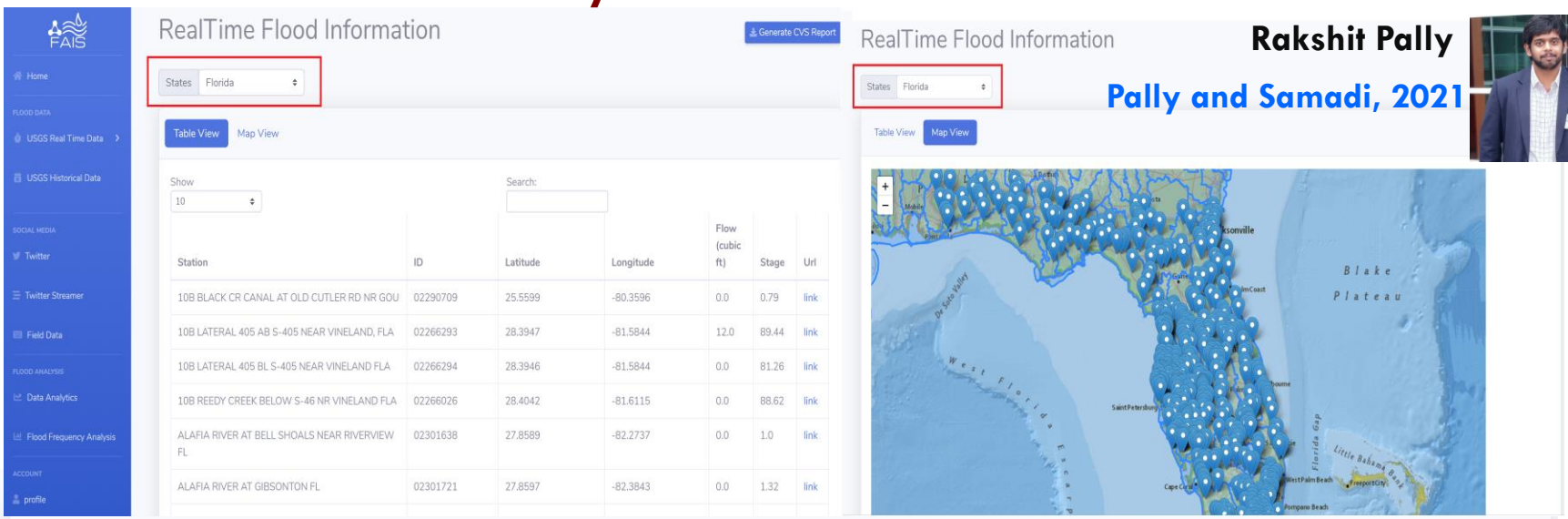
Real-time and historical USGS data gathering and analysis

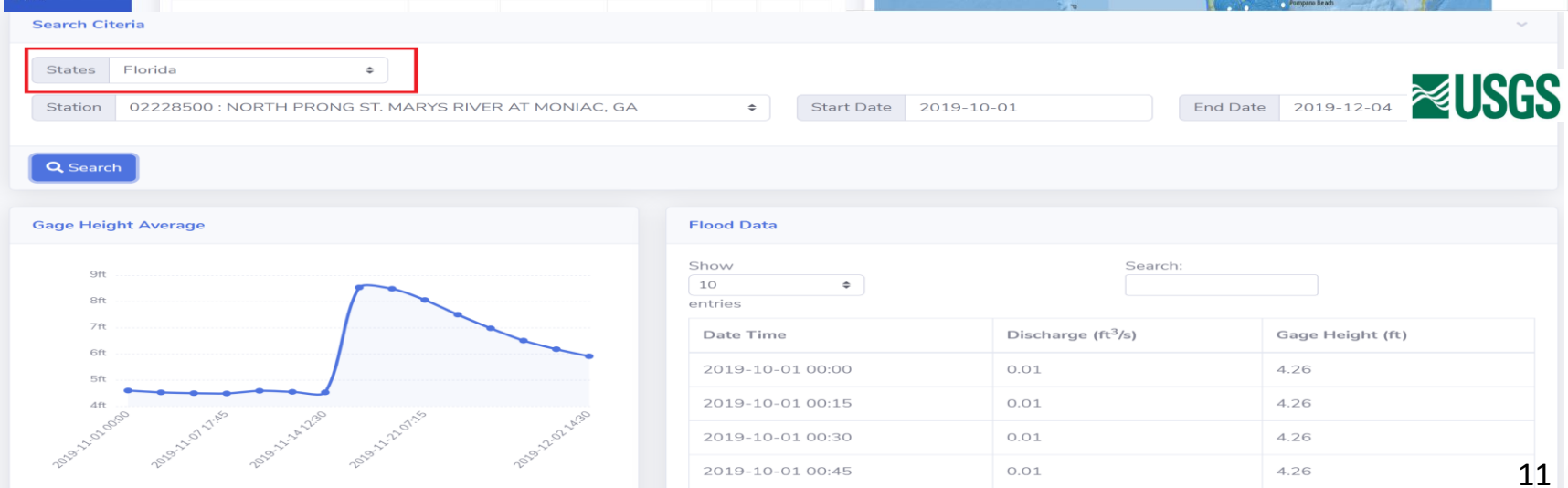
Nattapon "PK" Donratanapat

Donratanapat et al., 2020

Rakshit Pally

Pally and Samadi, 2021





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

On the hunt for a webcam that shoots high resolution photos…

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

511 Cams North Carolina

I77 SB @ MM30.8

US 70 (Arendell St) @ 23rd Street

US 74 @ mm 255.3

US 17 Bus (Market St) at US 74 (MLK Pkwy / Eastwood Rd)

Image Processing- 4 new python modules

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.

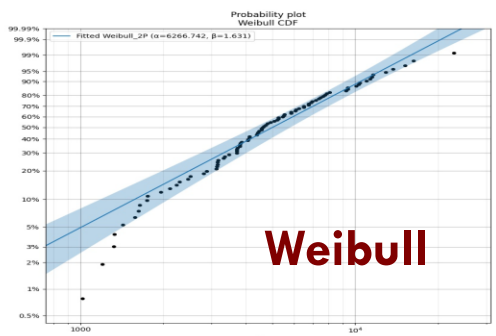
USGS 02155500 PACOLET RIVER NEAR FINGERVILLE, SC

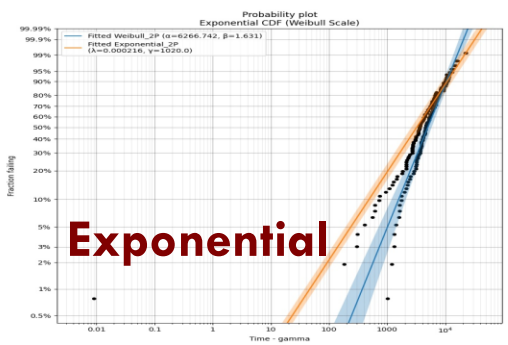
Flood Frequency Analysis

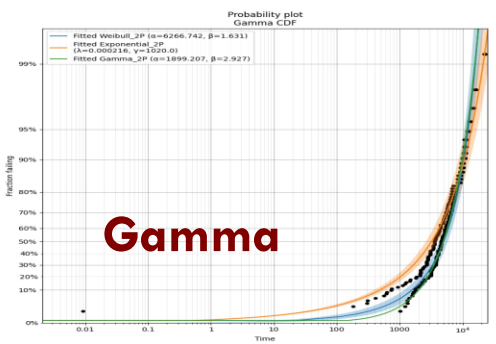
USGS Peak Flow Rate Analysis

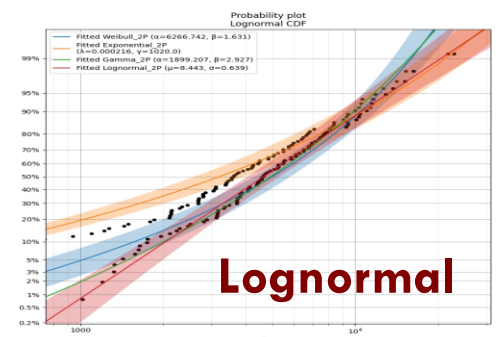
Flood Station 02155500 Search

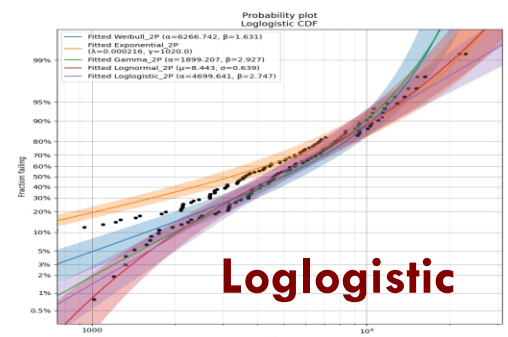
Date Time	Peak Value (cfs)
1903-06-00	
1930-12-06	1020
1931-12-15	3810
1932-10-17	11000
1934-03-04	3810

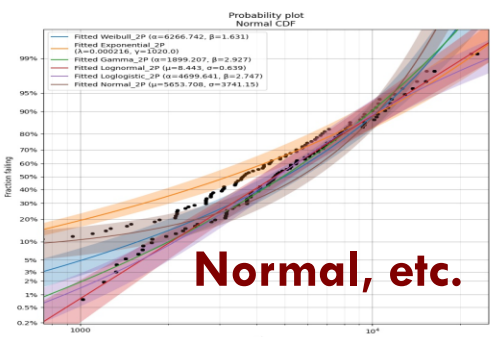












The best fitting distribution was Lognormal_2P with which had parameters [8.44

Flood Data Collection

First Name | First Name

Last Name | Last Name

Email ID | Email Address

Location | Location

Latitude | Latitude

Longitude | Longitude

Time Stamp | --:-- --

Date | mm/dd/yyyy

Flood Depth (in ft) | Flood Depth

Additional Info

Submit

Upload Media

Choose File | No file chosen

Upload Documents

python™

+

django

HR

Next Step

Flood Depth & Inundation Mapping

THANK
YOU!