FIVE MINUTE RESEARCH
POSTDOC COMPETITION

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Civil and Environmental Engineering

Into the Hurricane: Unraveling Hurricane Ian's Terrifying Effects on Florida

The Office of Postdoctoral Affairs

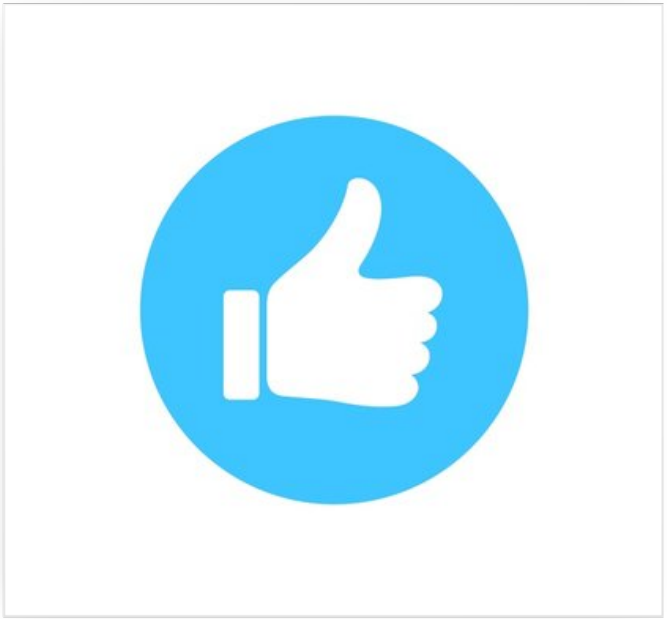
The Graduate School | Florida State University

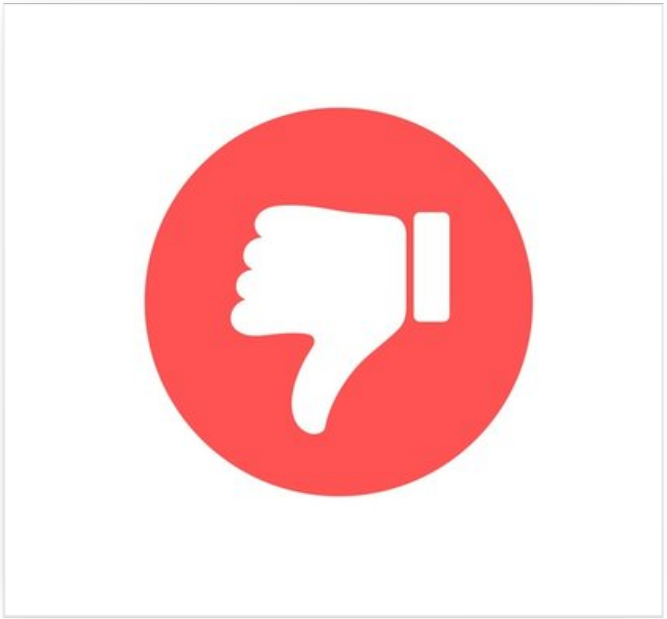
Easy Quiz Game

for 2023 5MR Competition

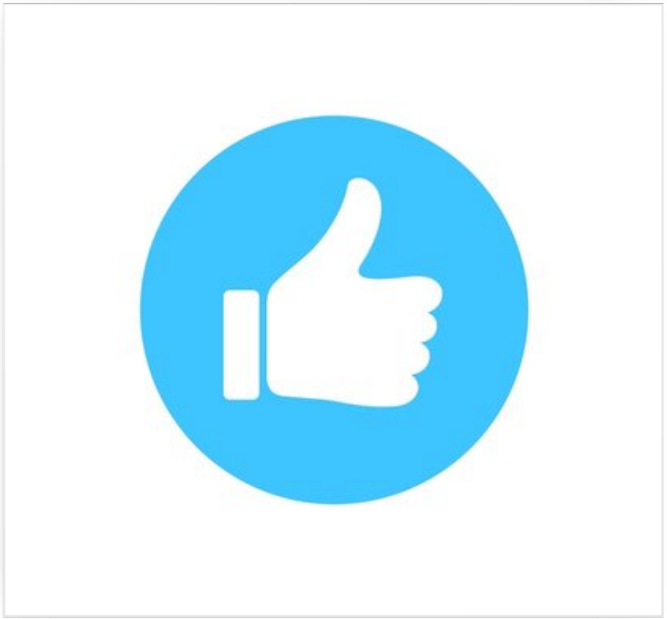
Start Quiz

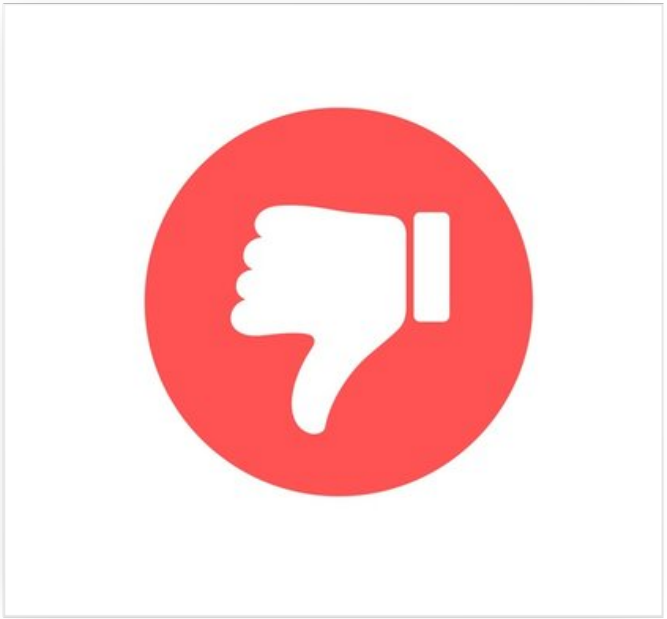
Can we say that
Hurricane Ian (2022, Sep)
was catastrophic to Florida?





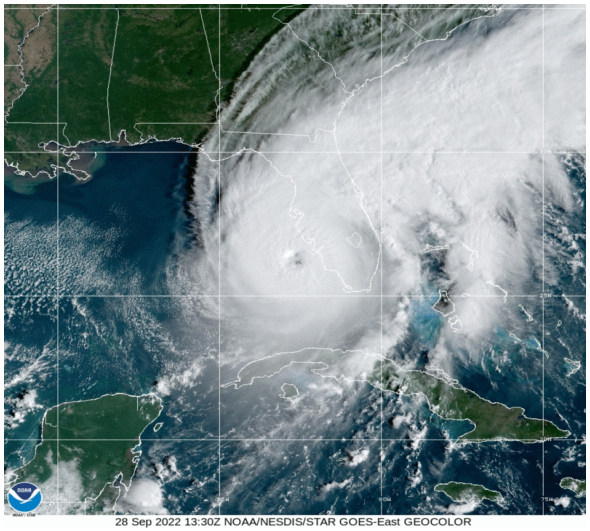
Can we say that
Hurricane Ian (2022, Sep)
was catastrophic to Tallahassee?

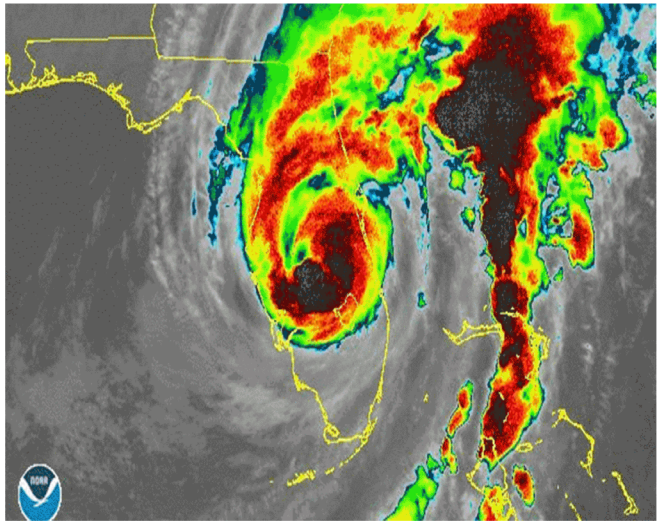




Research Objective

- The objective of this study is to develop a framework for assessing hurricanes using frequency analysis techniques.
- We demonstrate this framework on Hurricane Ian, a hurricane in September 2022 that affected a large area of the Southeastern United States.



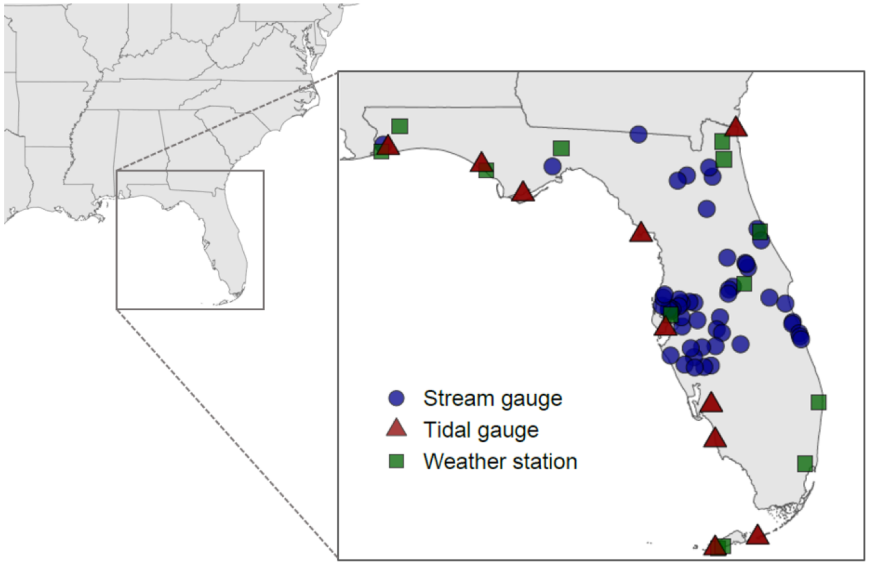


Hurricne Ian 2022 (category 5): 09/23/2022 ~ 09/30/2022

Source: NOAA NCEI

Data Collection

- For the analyses, we collected observed data from weather stations, stream gauges and tidal gauges with more than 30 years of record.
- Of the 1,411 stream gauges, 93 weather stations and 21 tidal gauges in Florida, only 53 stream gauges, 13 weather stations and 10 tidal gauge found to have sufficient data



Selected weather stations, stream gauges and tidal gauges across the study area, Florida.

Methodology: Bivariate Analysis

- **Bivariate return period was estimated based on the AND concept suggested by Yue and Rasmussen (2002) and Shiau (2003).**

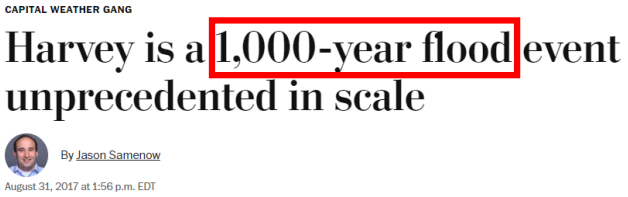
$$T_{bi} = \frac{1}{1 - F_X(x) - F_Y(y) + C(F_X(x),\ F_Y(y))}$$

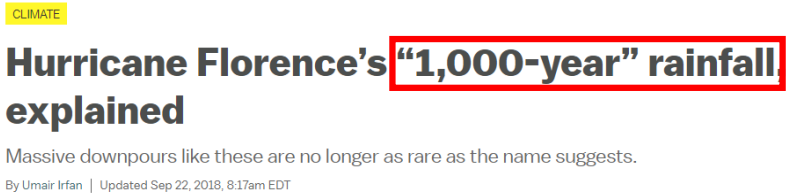
- **Joint cumulative probability was calculated by integrating two probability distribution function through copula model.**

Joint cumulative distribution function of copula considered in this study

Copula	Bivariate CDF
Clayton	$C(u_1,\ u_2) = (u_1^{-\theta} + u_2^{-\theta} - 1)^{-1/\theta}$
Frank	$C(u_1,\ u_2) = -\frac{1}{\theta}\ln[1 + \frac{(\exp(-\theta u_1) - 1)(\exp(-\theta u_2) - 1)}{\exp(-\theta) - 1}]$
Gumbel–Hougaard	$C(u_1,\ u_2) = \exp(-((-\ln(u_1))^{\theta} + (-\ln(u_2))^{\theta})^{1/\theta})$
Joe	$C(u_1,\ u_2) = 1 - ((1-u_1)^{\theta} + (1-u_2)^{\theta} - (1-u_1)(1-u_2)^{\theta})^{1/\theta}$
Gaussian	$C(u_1,\ u_2) = \int_{-\infty}^{\Phi^{-1}(u_1)} \int_{-\infty}^{\Phi^{-1}(u_2)} \frac{1}{2\pi\sqrt{1-\theta^2}} \exp(-\frac{s^2 + w^2 - 2sw\theta}{2(1-\theta^2)}) dsdw$

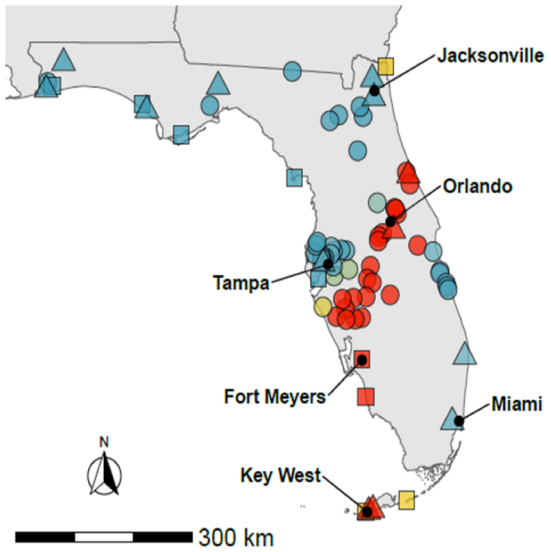
Result: Return Period



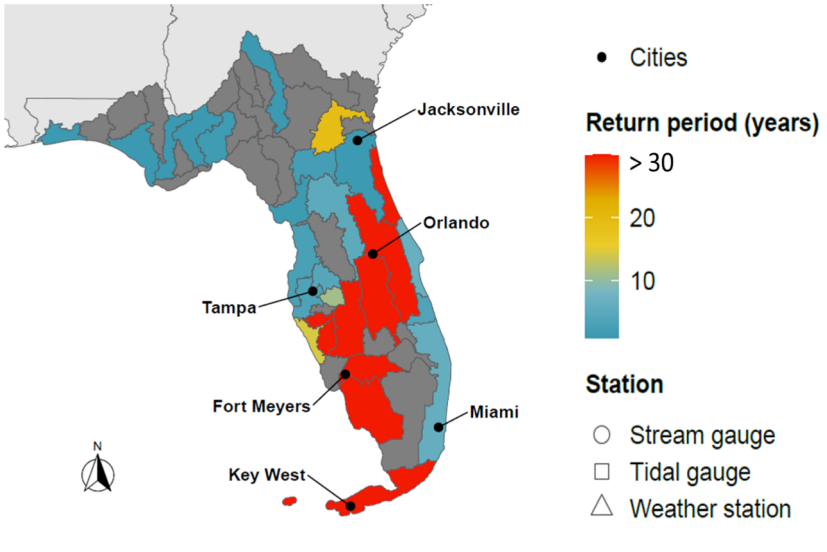


- **1,000-year flood means that the event is as extreme as it only happens once in 1,000 years.**

Hurricane Ian's Terrifying Effects on Florida



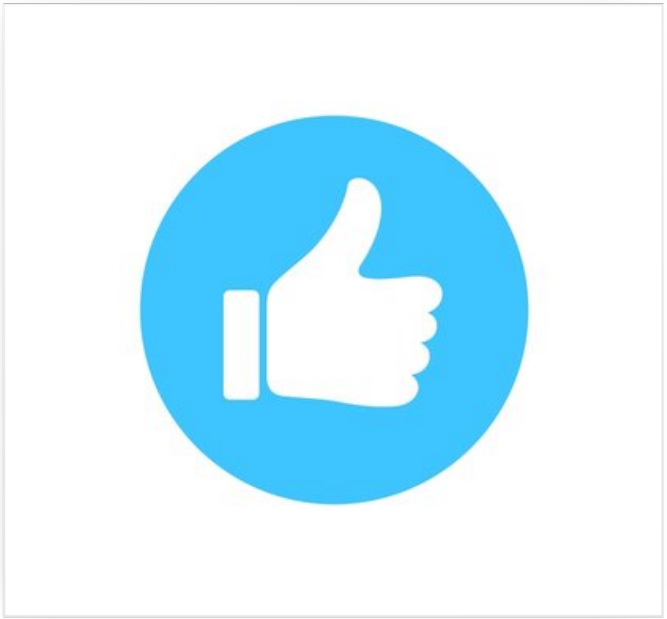
Station-based return period of Hurricane Ian

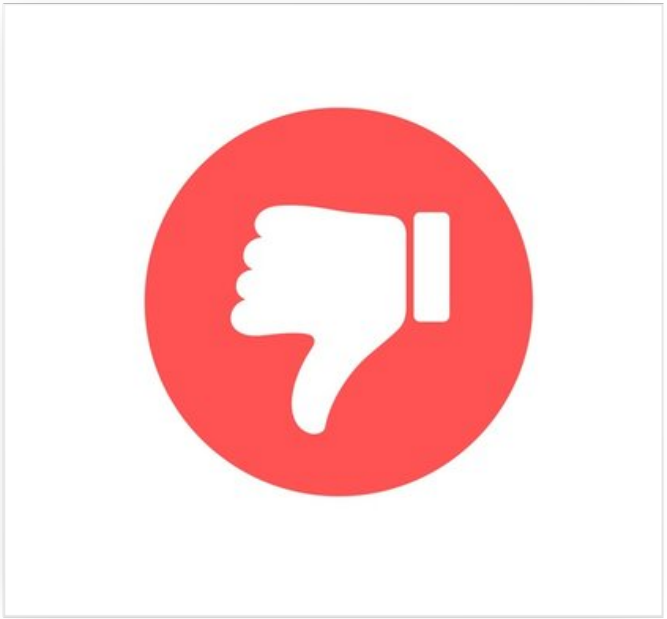


Hydrologic Unit Code based return period of Hurricane Ian

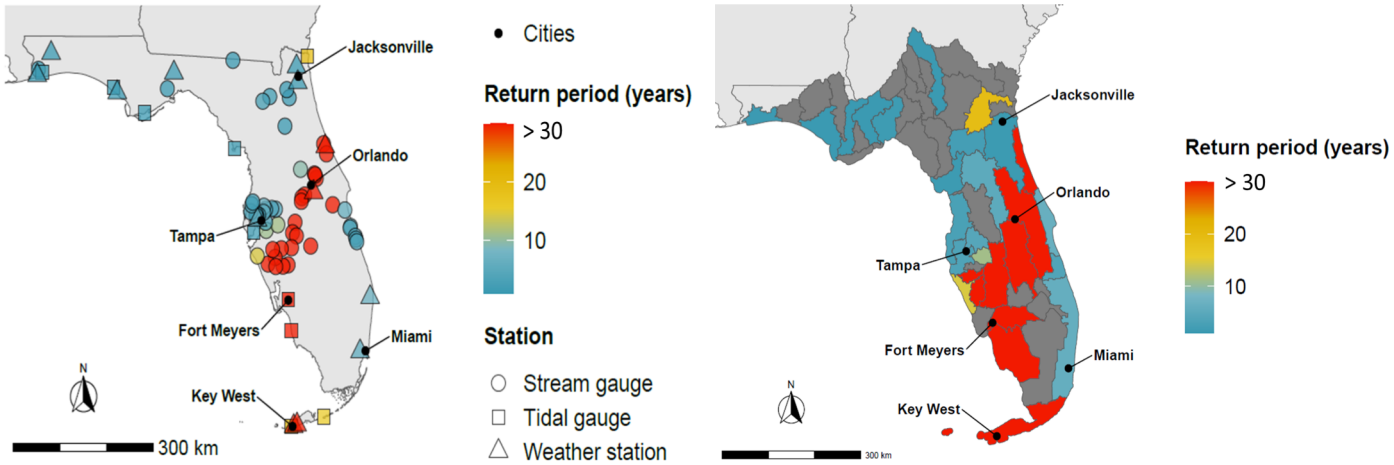
"The highest return period of Hurricane Ian was 2,593 years."

Can we say that
Hurricane Ian (2022, Sep)
was catastrophic to Florida?





YES!! Specifically, those area were highly damaged by Hurricane Ian.



"The highest return period of Hurricane Ian was 2,593 years."

YES!! Specifically, those area were highly damaged by Hurricane Ian.

Thank You!

Question & Answer

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