



# Decadal Visioning Workshop 2024

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**JUNE 11 – JUNE 13**

*Hilton St. Petersburg Bayfront – 333 1st Street, SE*

# Decadal Visioning Workshop

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**2024**

## Welcome To Day 3

Dr. Diane Foster, USCRP Co-Executive Director



**JUNE 11 – JUNE 13**

*Hilton St. Petersburg Bayfront – 333 1st Street, SE*

# Decadal Visioning Workshop

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**2024**

## Research Example: Compound Flooding

Dr. Thomas Wahl, Assistant Professor, University of Central Florida

# The state of compound flooding research

---

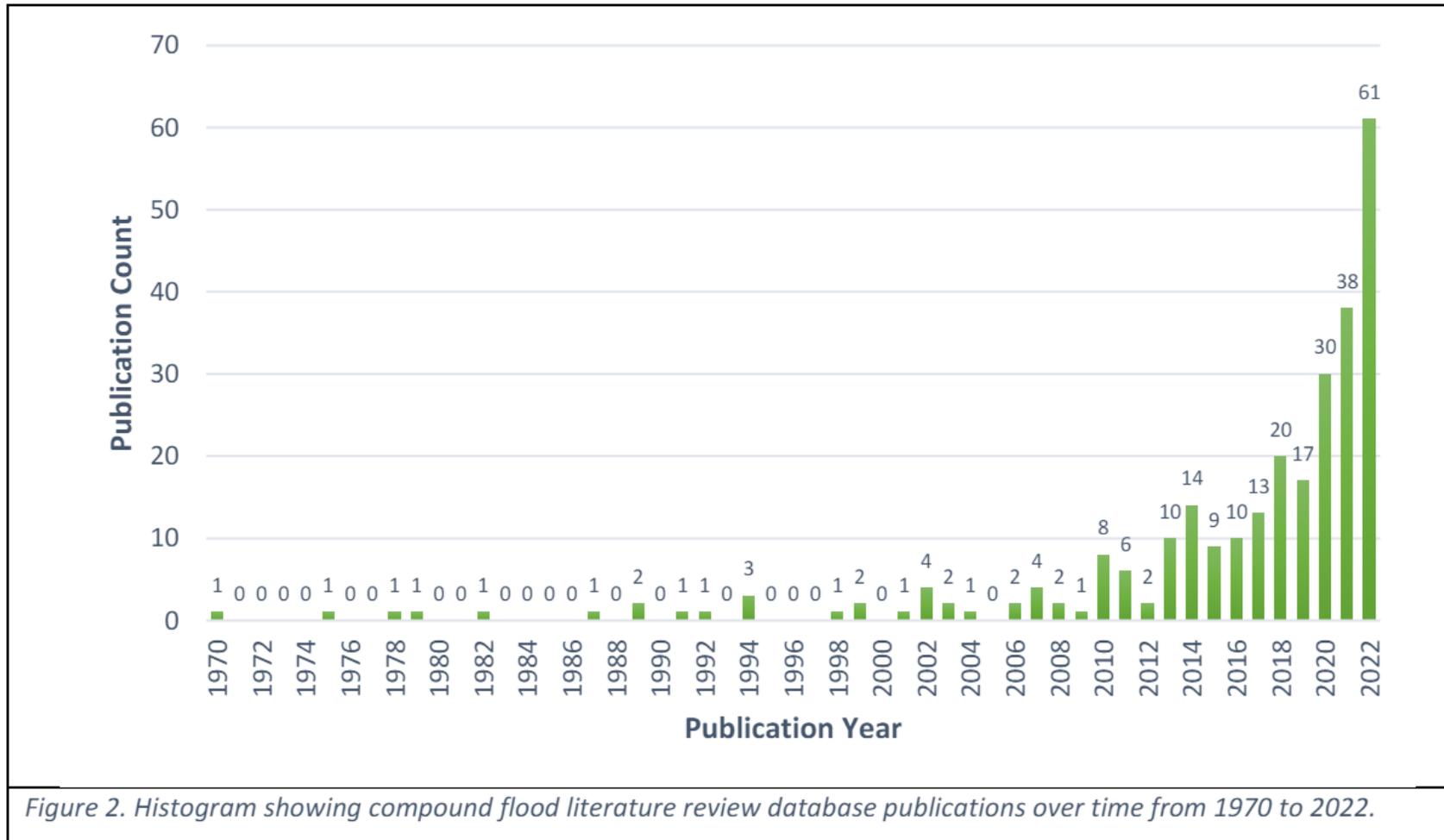
Thomas Wahl

## **Compound events:**

*“The combination of multiple drivers and/or hazards that contributes to societal or environmental risk.”*

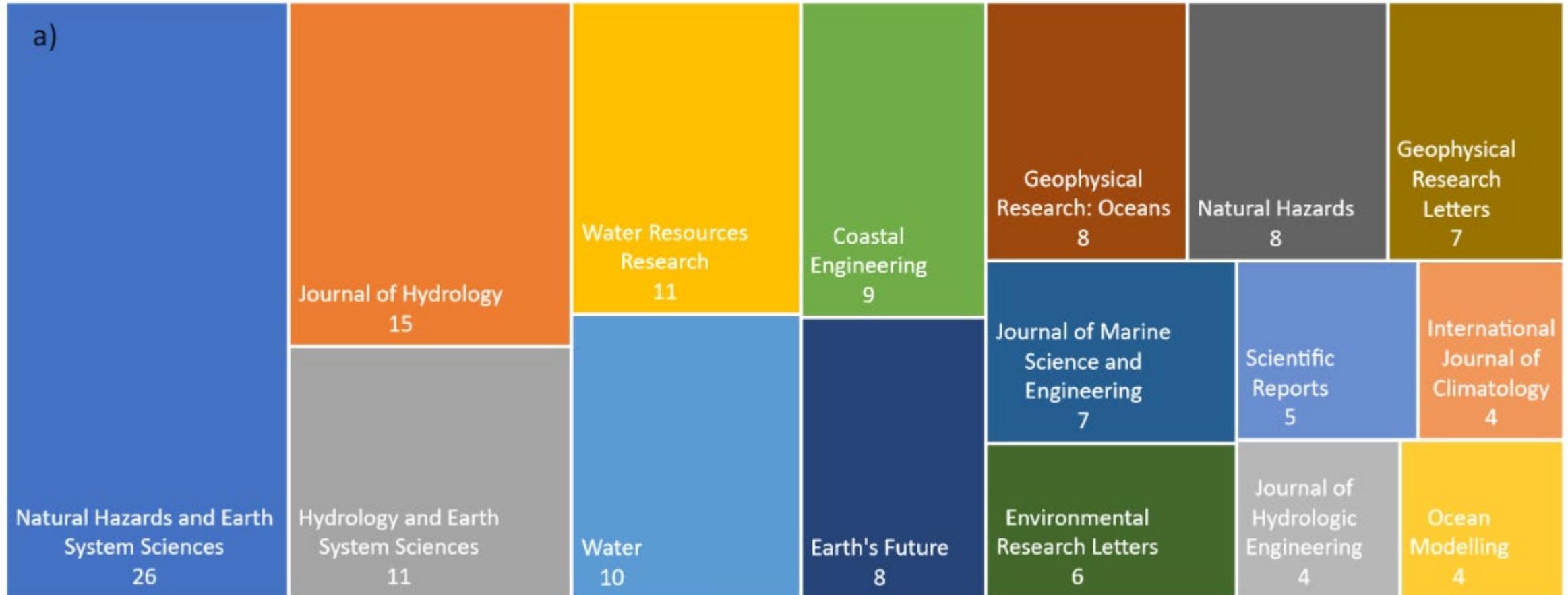
Zscheischler et al. (2018)

# Compound flooding is an active area of research



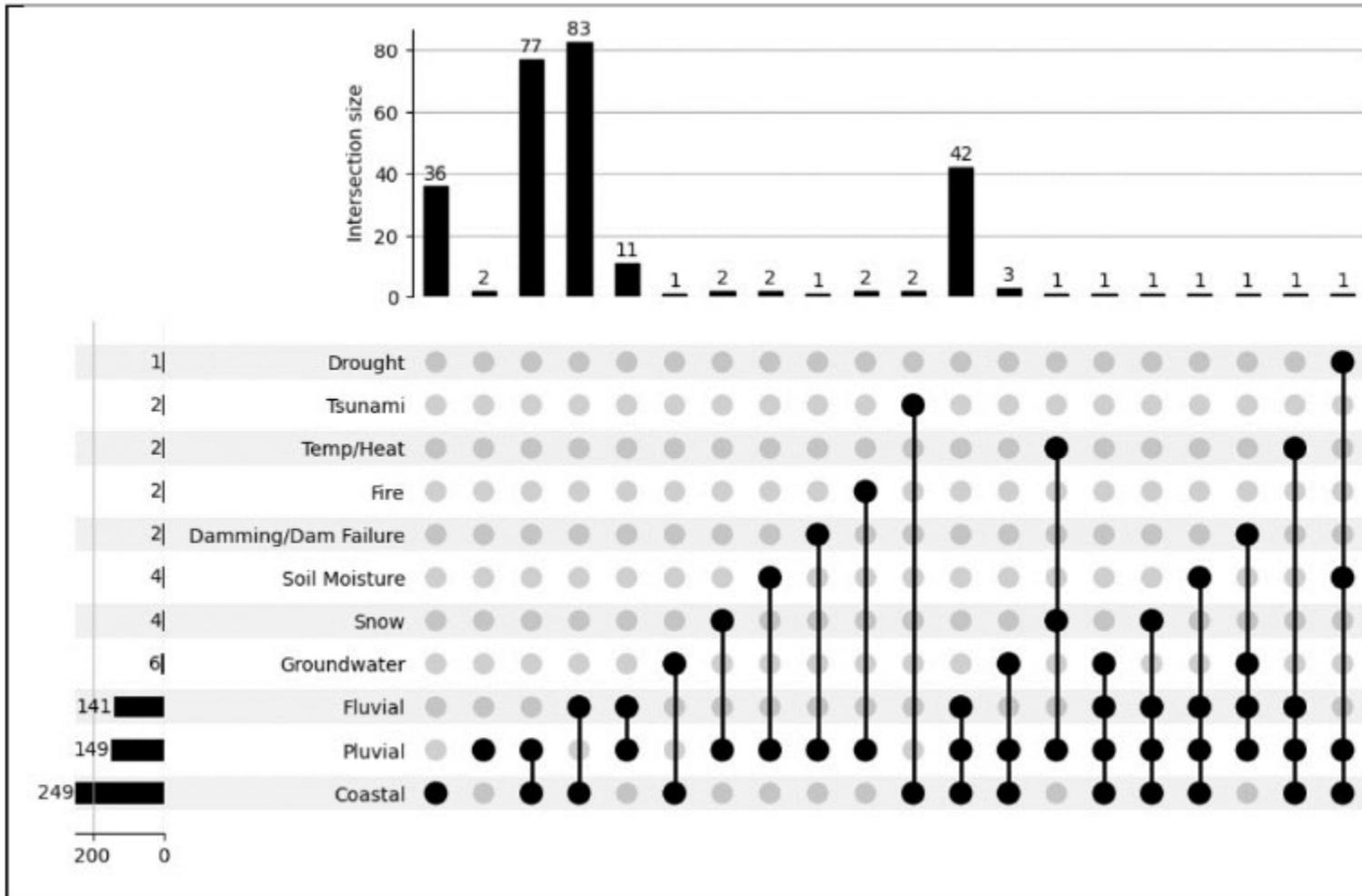
Green, J., Haigh, I.D., Quinn, N., Neal, J., Wahl, T., Wood, M., Eilander, D., de Ruyter, M., Ward, P. and Camus, P., 2024. A comprehensive review of coastal compound flooding literature. *arXiv preprint arXiv:2404.01321*.

# A multi-disciplinary problem



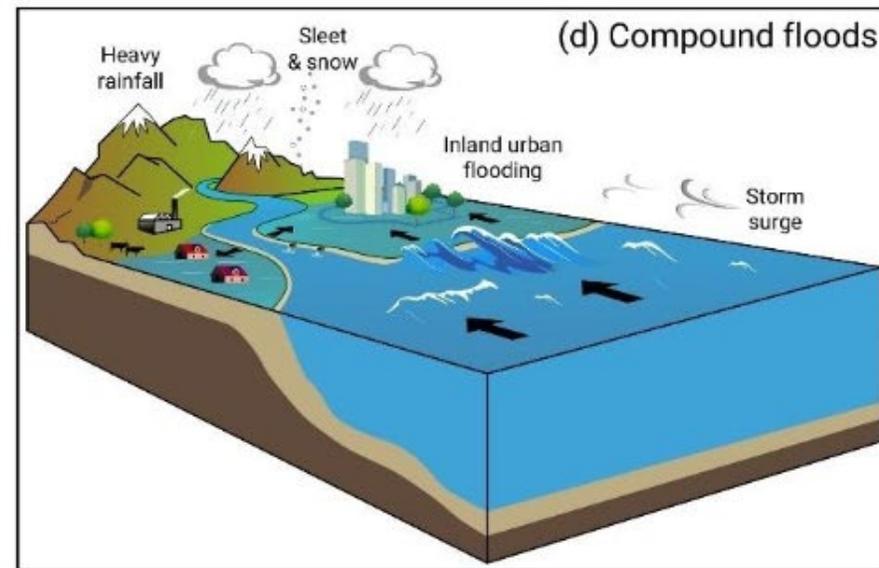
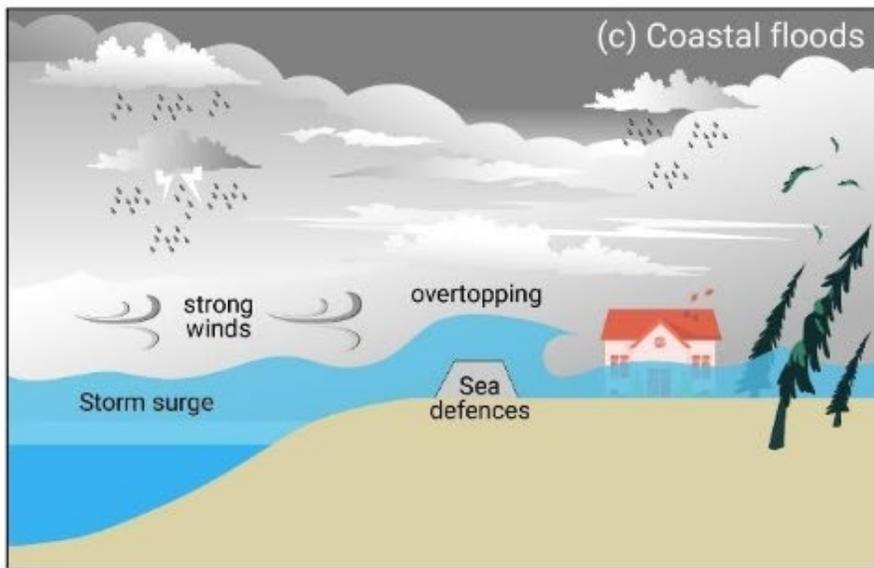
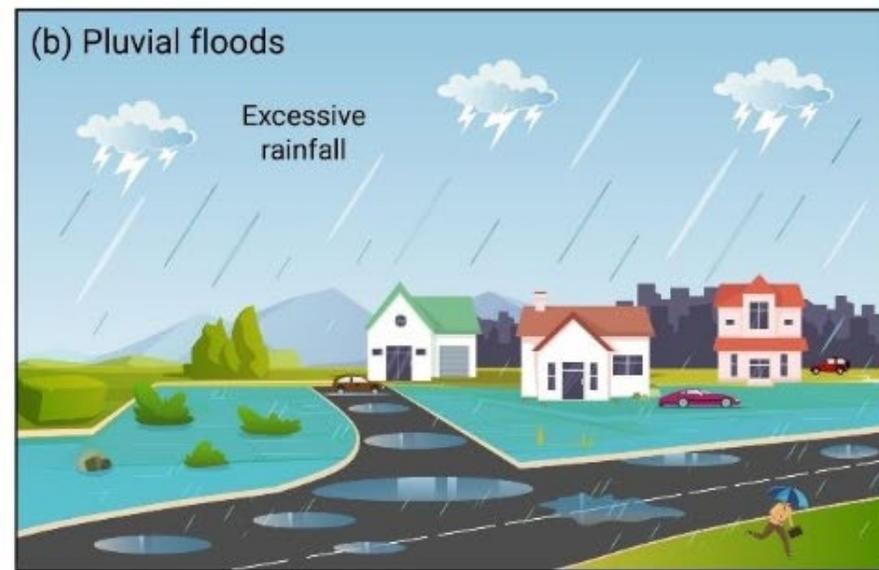
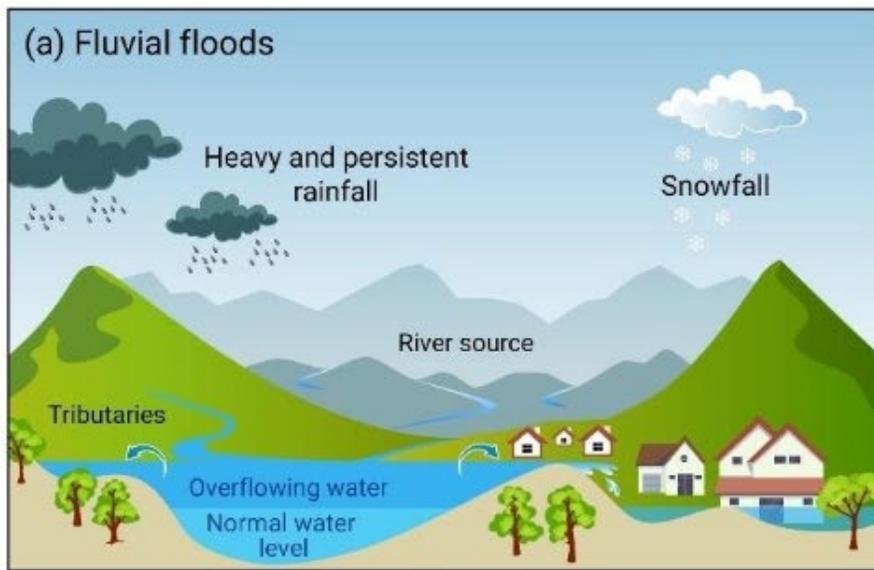
Green, J., Haigh, I.D., Quinn, N., Neal, J., Wahl, T., Wood, M., Eilander, D., de Ruiter, M., Ward, P. and Camus, P., 2024. A comprehensive review of coastal compound flooding literature. *arXiv preprint arXiv:2404.01321*.

# It can mean different things



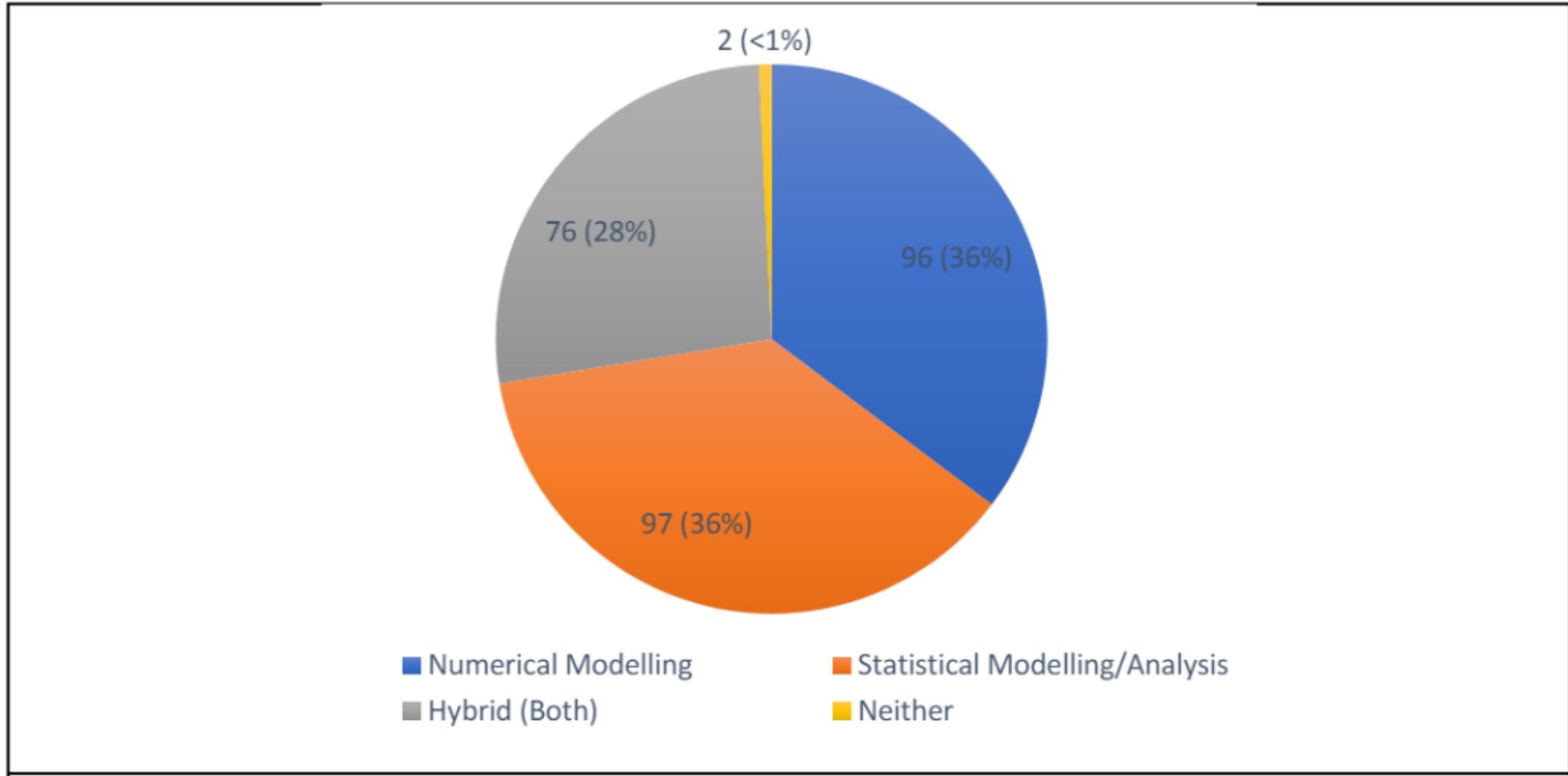
Combinations and frequency of driver multi-classifications assigned. The vertical histogram presents the total count of studies considering each of the eleven drivers categorized nonexclusively, while the horizontal histogram presents the total count for each driver multi-classification combination exclusively.

Green, J., Haigh, I.D., Quinn, N., Neal, J., Wahl, T., Wood, M., Eilander, D., de Ruyter, M., Ward, P. and Camus, P., 2024. A comprehensive review of coastal compound flooding literature. *arXiv preprint arXiv:2404.01321*.



Green, J., Haigh, I.D., Quinn, N., Neal, J., Wahl, T., Wood, M., Eilander, D., de Ruiter, M., Ward, P. and Camus, P., 2024. A comprehensive review of coastal compound flooding literature. *arXiv preprint arXiv:2404.01321*.

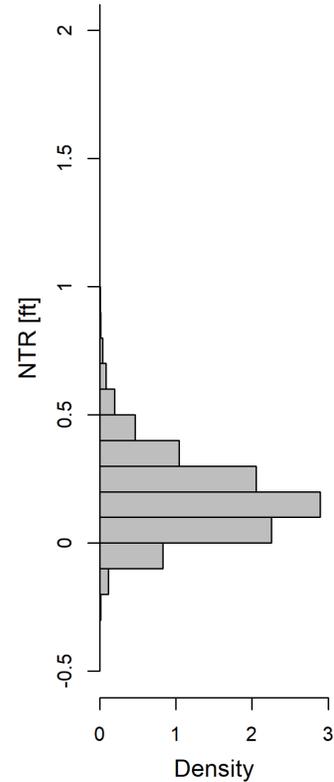
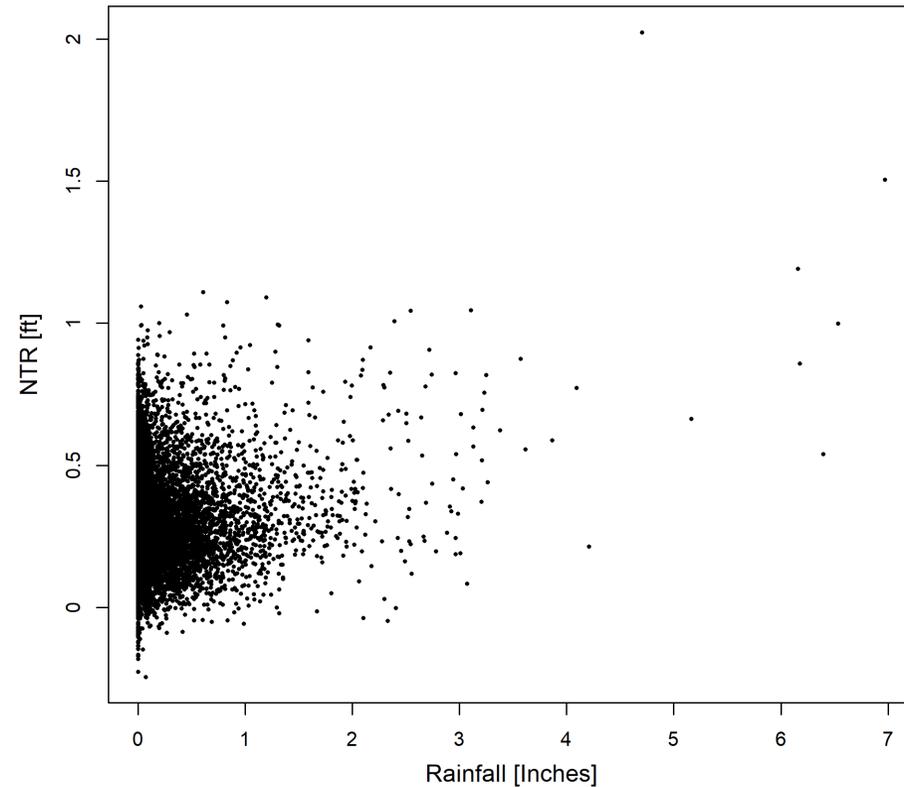
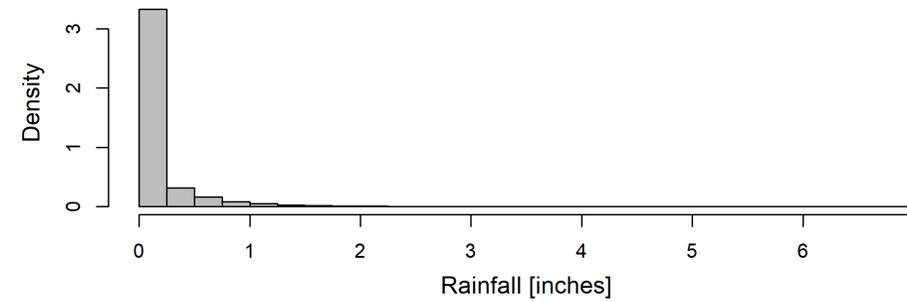
# Different methods to study compound flooding



Green, J., Haigh, I.D., Quinn, N., Neal, J., Wahl, T., Wood, M., Eilander, D., de Ruiter, M., Ward, P. and Camus, P., 2024. A comprehensive review of coastal compound flooding literature. *arXiv preprint arXiv:2404.01321*.

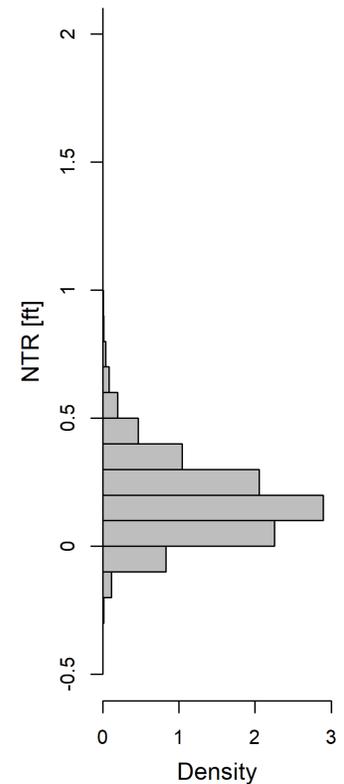
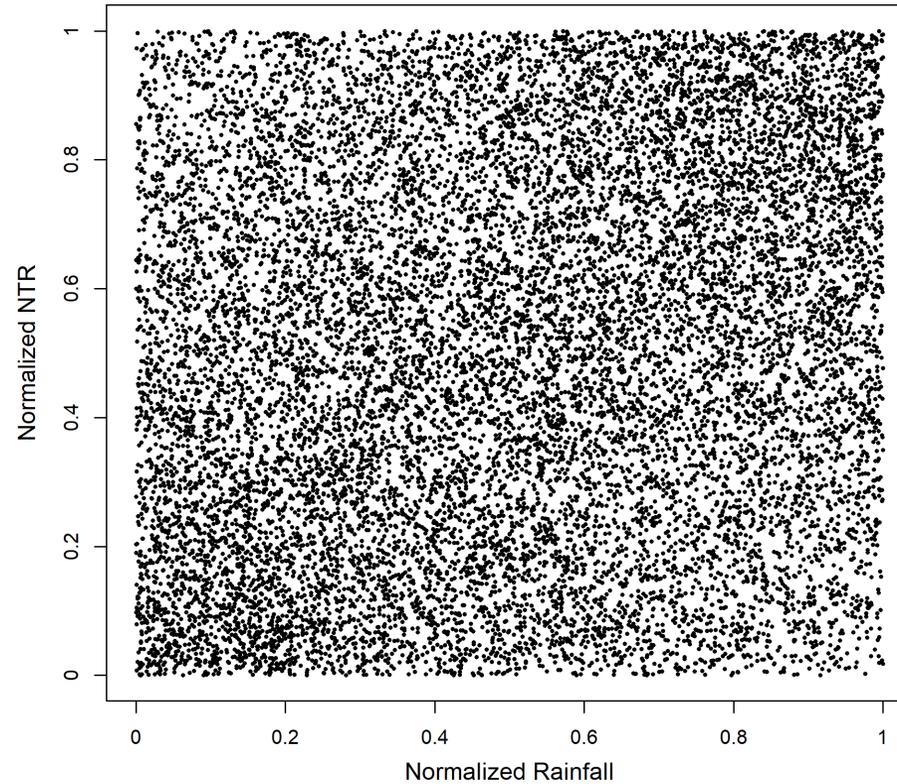
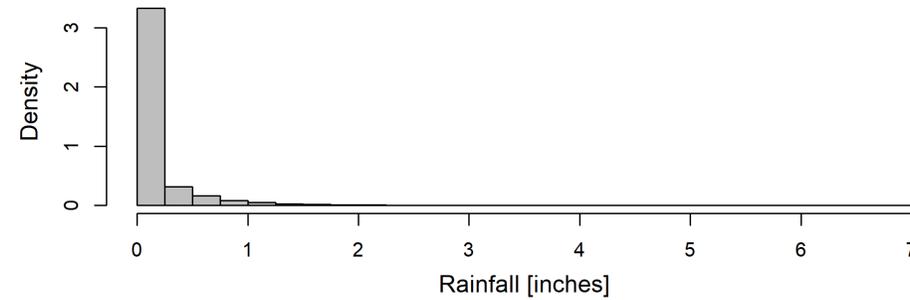
# Statistical modelling

- Different flooding drivers often exhibit partial dependence which needs to be accounted for when calculating joint probabilities



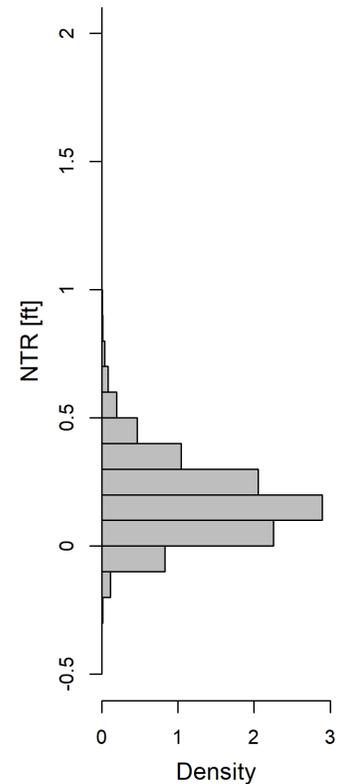
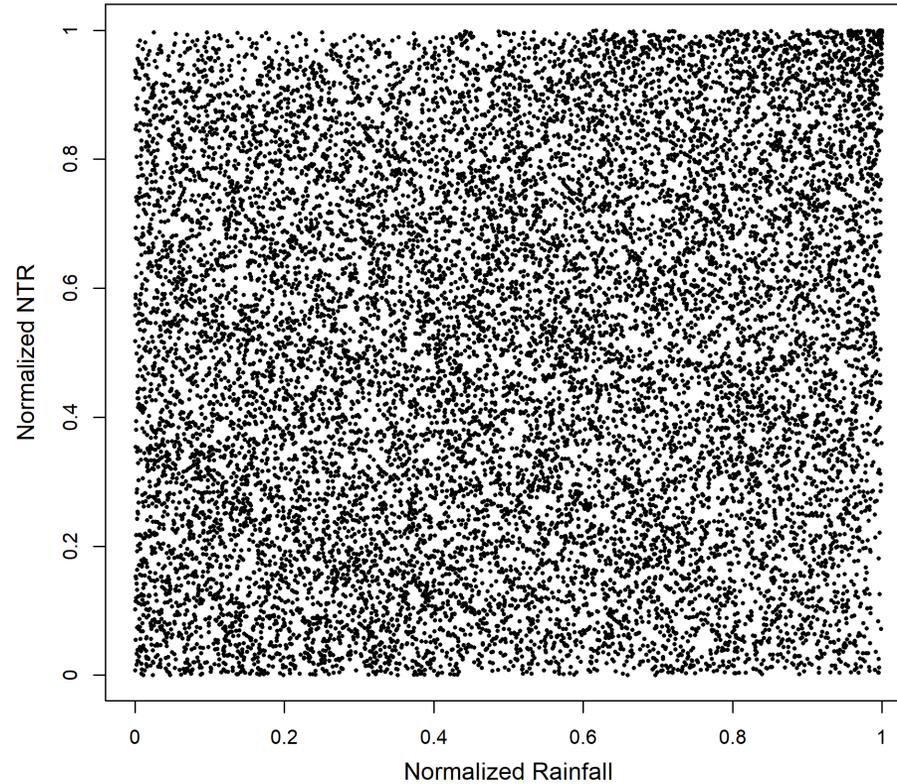
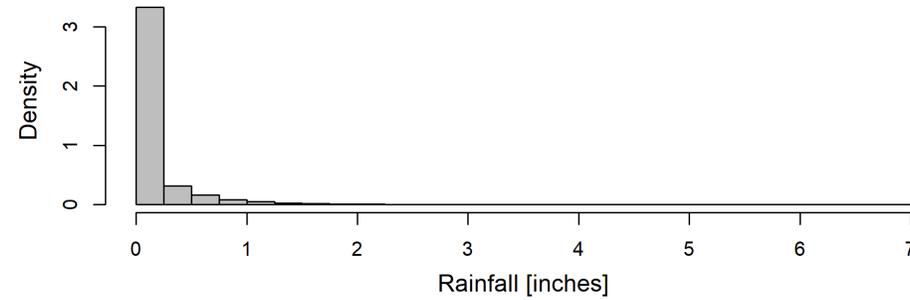
# Statistical modelling

- Different flooding drivers often exhibit partial dependence which needs to be accounted for when calculating joint probabilities
- Copula-based methods decouple the marginal analysis from the dependence analysis offering a lot of flexibility



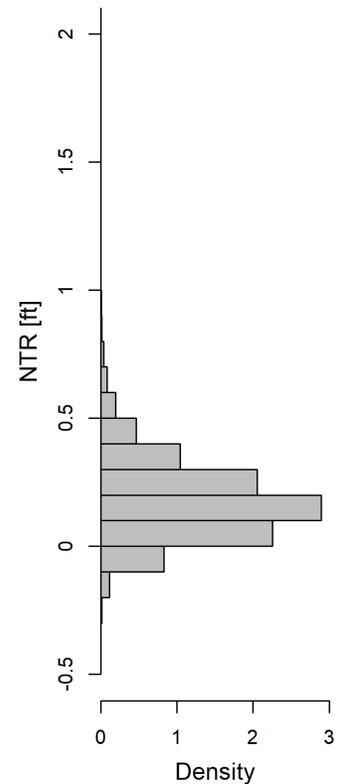
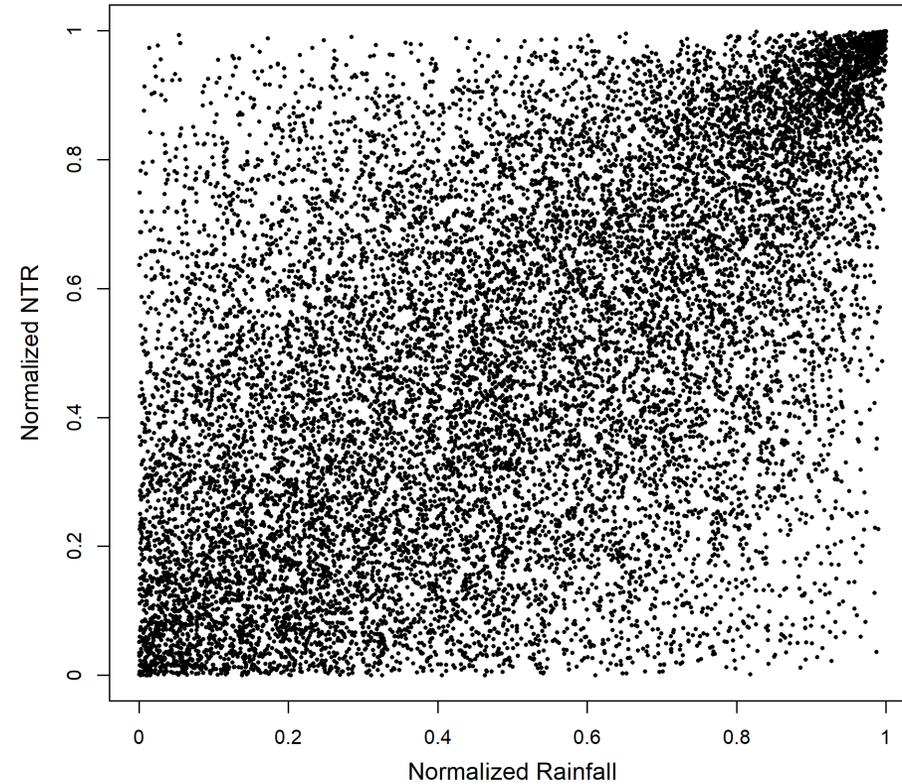
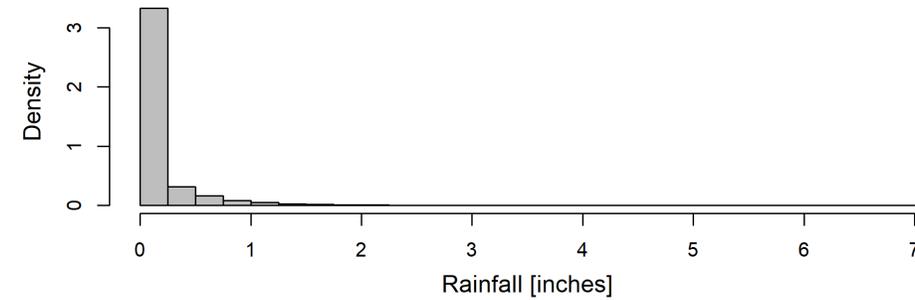
# Statistical modelling

- Different flooding drivers often exhibit partial dependence which needs to be accounted for when calculating joint probabilities
- Copula-based methods decouple the marginal analysis from the dependence analysis offering a lot of flexibility



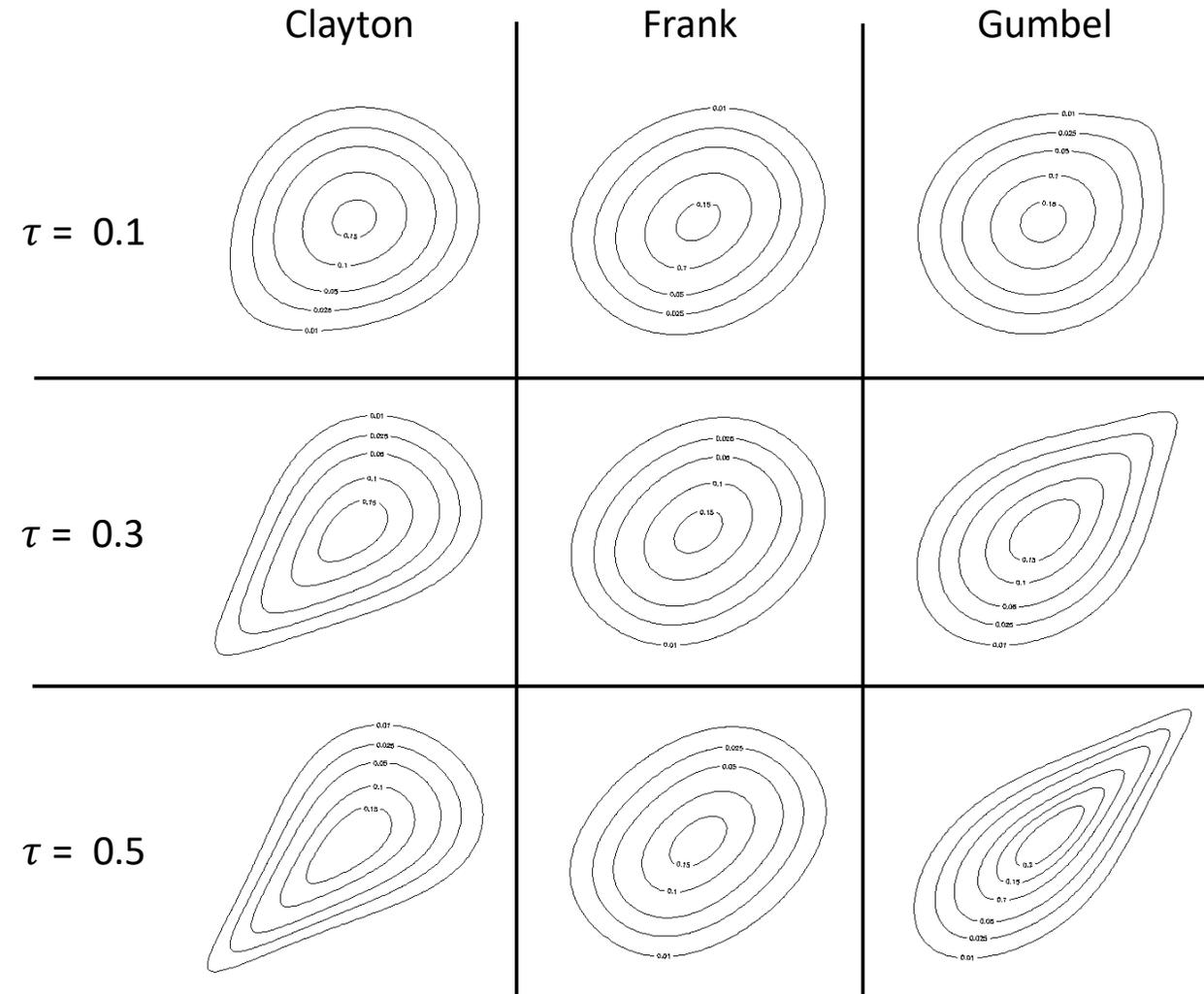
# Statistical modelling

- Different flooding drivers often exhibit partial dependence which needs to be accounted for when calculating joint probabilities
- Copula-based methods decouple the marginal analysis from the dependence analysis offering a lot of flexibility



# Statistical modelling

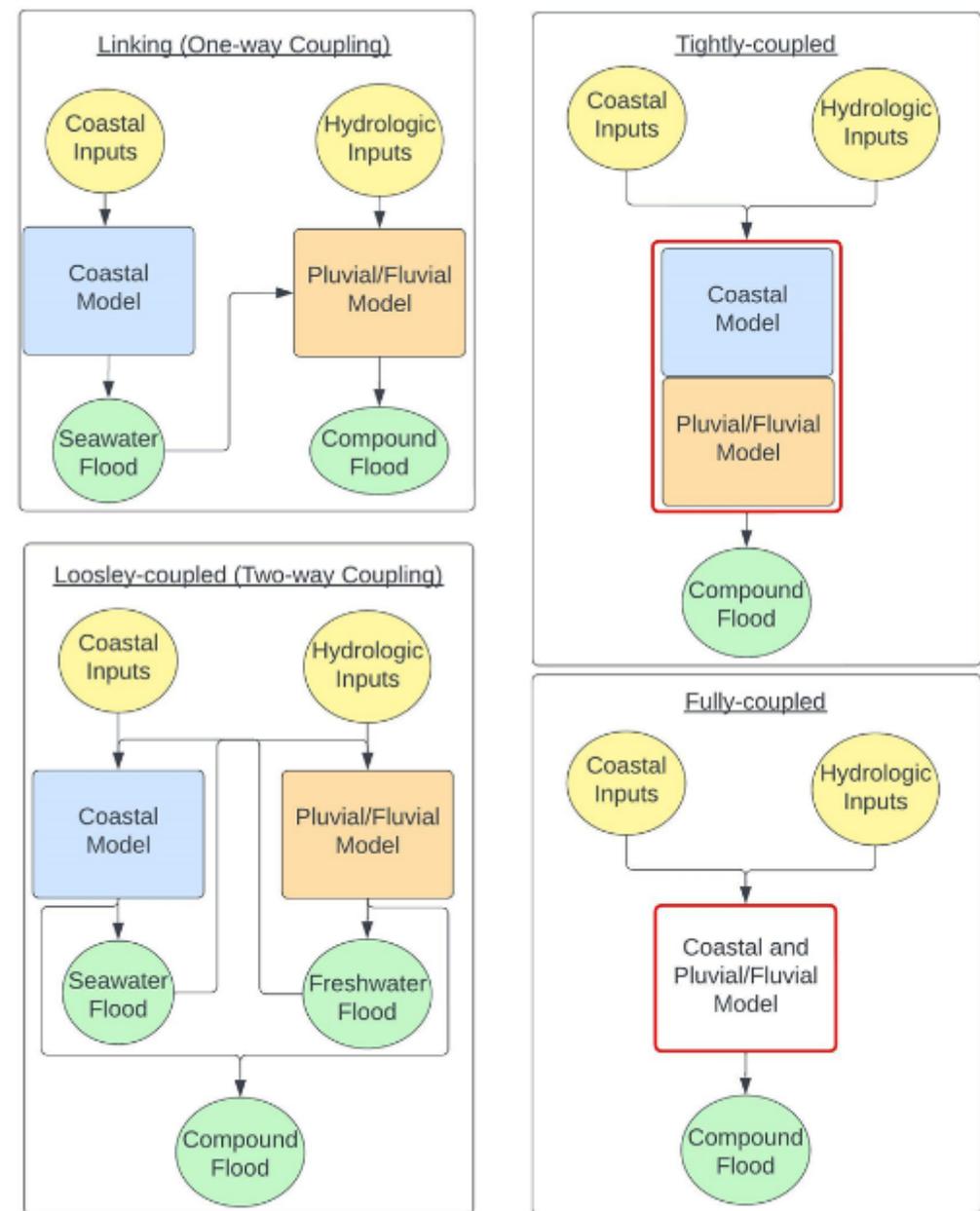
- Different flooding drivers often exhibit partial dependence which needs to be accounted for when calculating joint probabilities
- Copula-based methods decouple the marginal analysis from the dependence analysis offering a lot of flexibility
- Once an appropriate copula and marginal distributions have been identified joint probabilities can be calculated or events can be simulated



Tools: MvCAT (Matlab), MultiHazard (R), Copula (Python)

# Process-based modelling

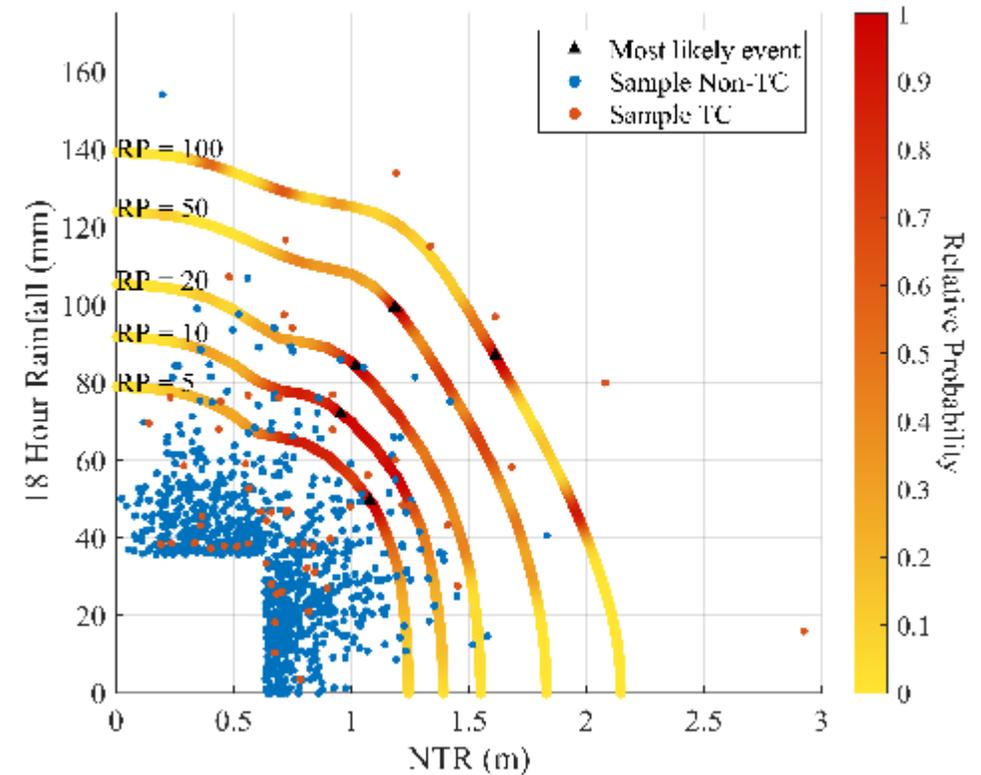
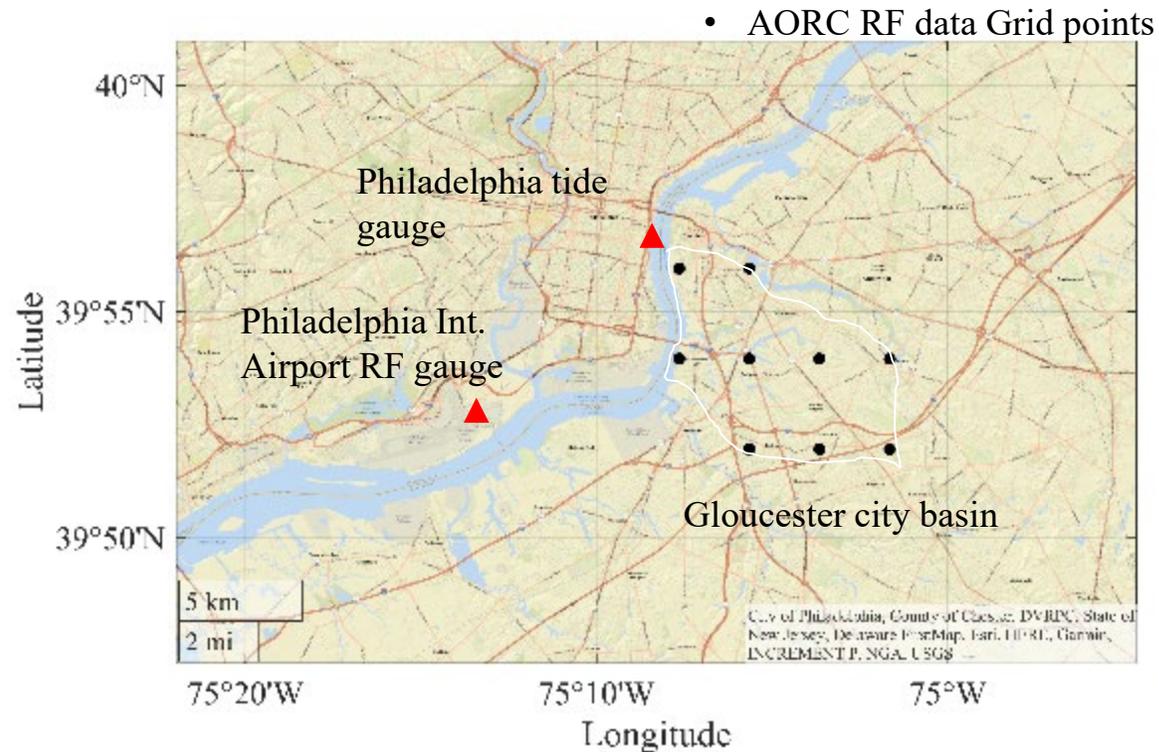
- Past compound flood modelling efforts coupled coastal models (e.g., ADCIRC), hydrologic models (e.g., HEC-HMS), and hydraulic models (e.g., HEC-RAS) in different combinations and different ways
- Few studies also included groundwater models (e.g., MODFLOW)
- Few models exist which can absorb coastal, pluvial, and fluvial flood drivers as boundary conditions (e.g., SFINCS)



Modified from Santiago-Collazo et al. (2019)

# Hybrid modelling

Example for Gloucester City, NJ, where rainfall and tide gauge data (left) are used to fit a multivariate statistical model (right) to TC and non-TC events separately.

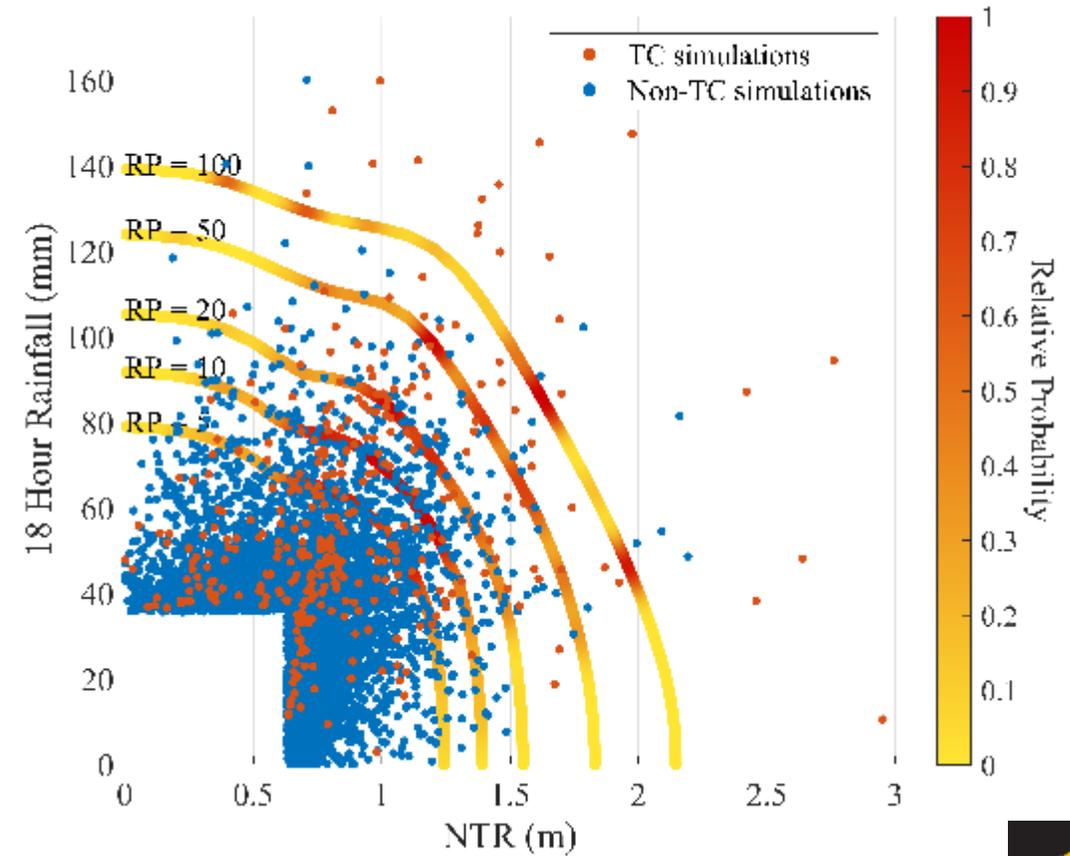
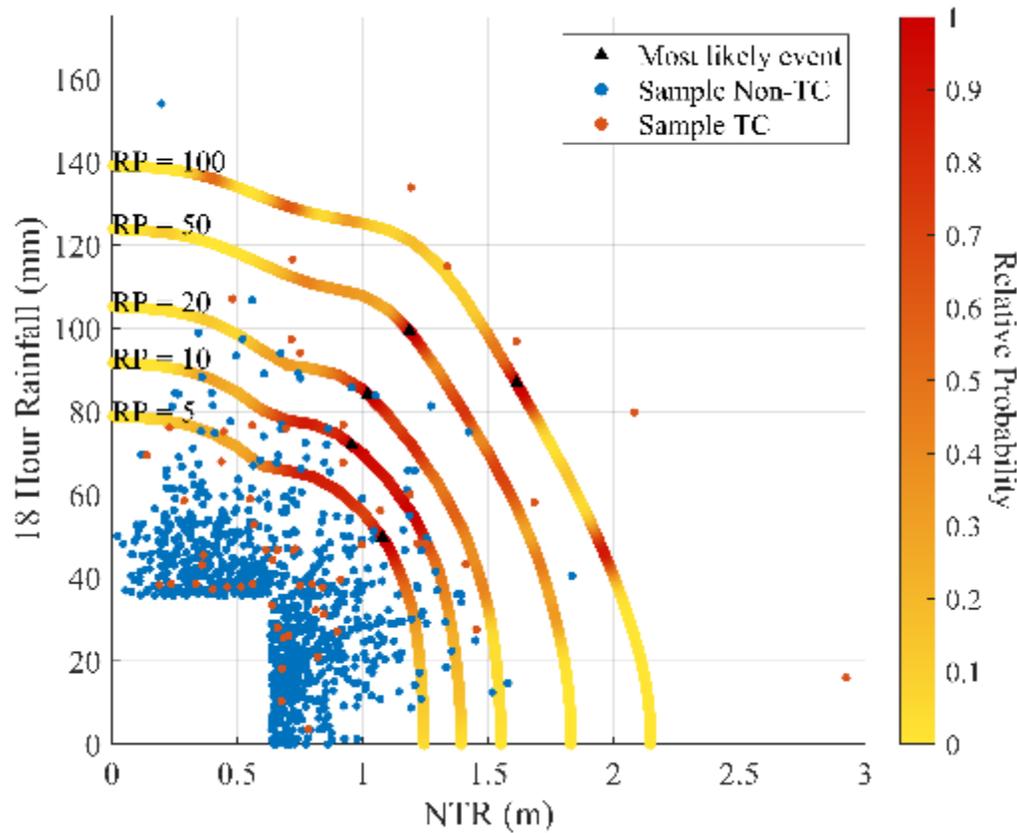


Maduwantha, P., Wahl, T., Santamaria-Aguilar, S., Jane, R. A., Booth, J. F., Kim, H., and Villarini, G.: A multivariate statistical framework for mixed populations in compound flood analysis, EGU sphere [preprint], <https://doi.org/10.5194/egusphere-2024-1122>, 2024.

# Hybrid modelling

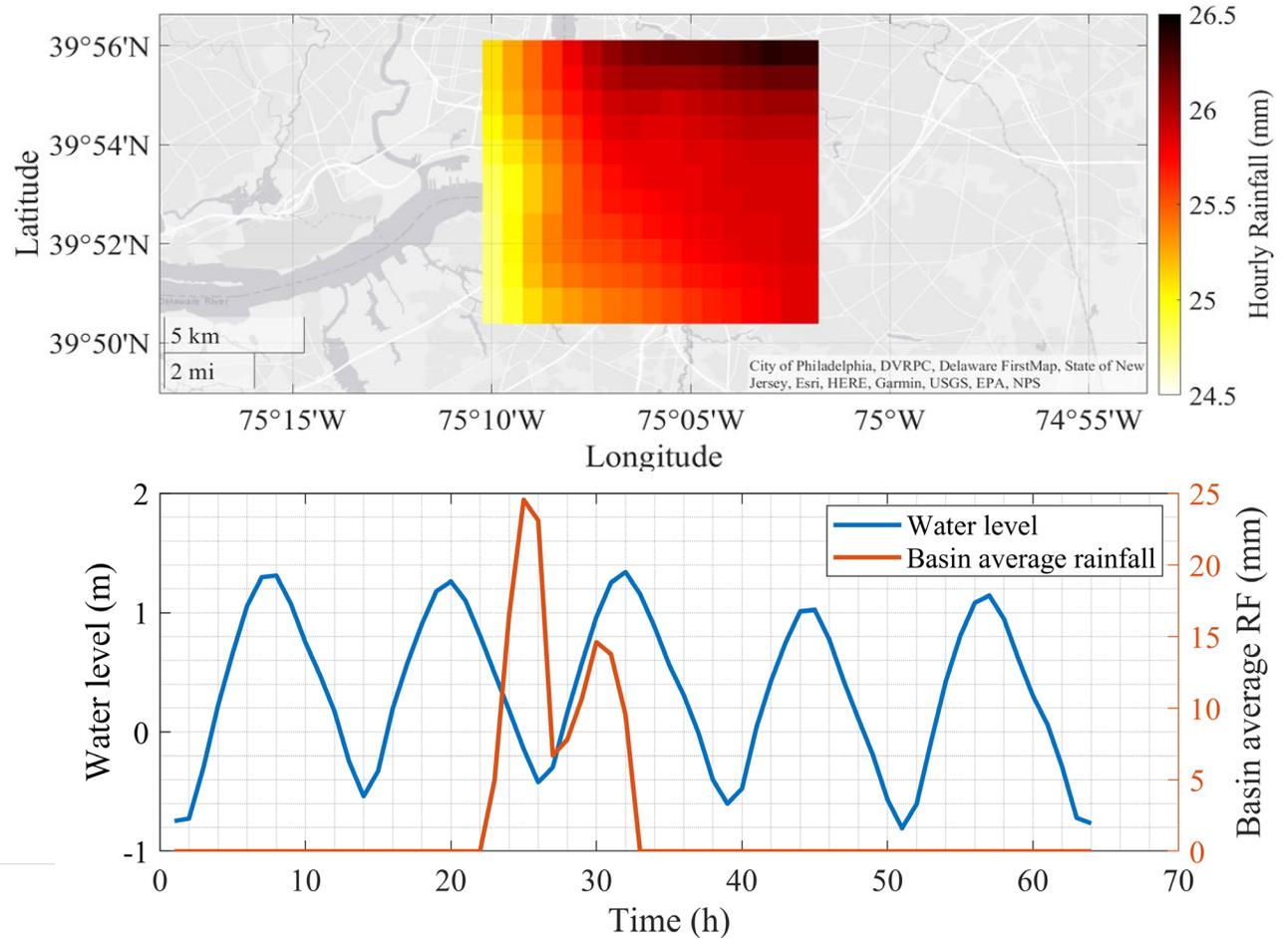
Going from few observed extremes...

...to a large number of synthetic ones



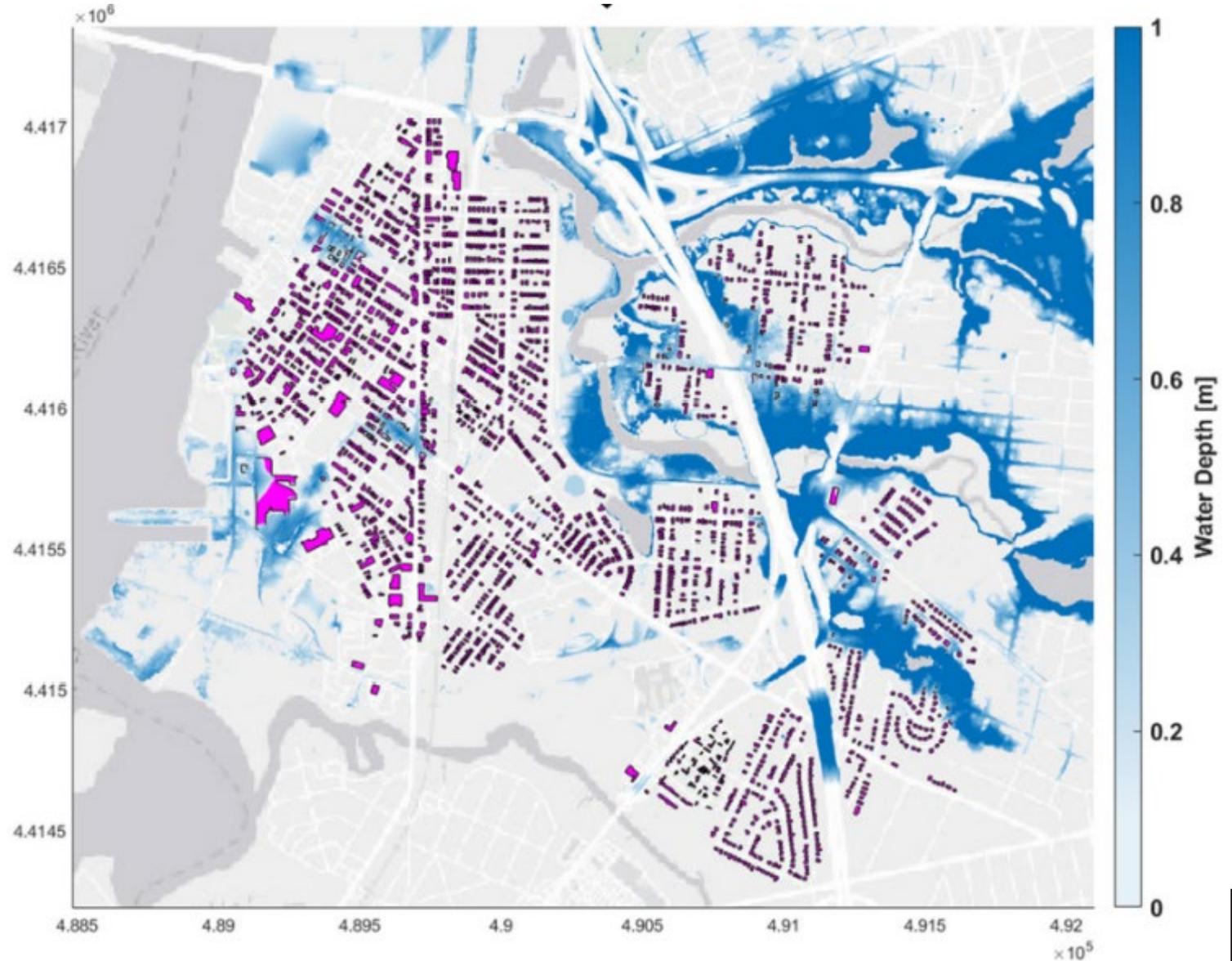
# Hybrid modelling

- Observed NTR and rainfall events are scaled to match the synthetic peak values
- Then we add the following:
  - Mean sea level variability
  - Tide values
  - Time-lag between peaks
  - We also account for rainfall duration-peak-intensity relationships
- This leads to many physically consistent hydro-hyetographs (where rainfall also varies spatially)



# Hybrid modelling

- All synthetic events are run through a SFINCS model
- Horizontal resolution is 1m using the sub-grid option
- We follow a ***response-based approach*** and will compare against various ***event-based approaches***
- Flood hazard data is combined with updated building footprints and first-floor elevations



# Research challenges and opportunities

- Effective delineation of transition zones (along-river and in the flood plain)
- Uncertainty quantification and propagation
- Accounting for storm water drainage systems
- (In-)ability of climate models to capture the complex interactions in the atmosphere/ocean leading to compound flooding
- Adaptation challenges
- AI/ML in compound flooding research

# Check out <https://www.hazardaware.org/>



[Home](#) [Learn More](#) [About HazardAware](#) [Compare](#)

## Know Your Risk. Be Risk Ready.

We provide information about homes along the Gulf Coast. Enter a home address below to learn about the property's:

- Natural hazard risks
- HazardReady<sup>BETA</sup> score
- Risk preparation options
- And more...

This is a free service and we do not track any information you enter. You can also request a free custom report on your region by clicking on the link below the address bar.

[Need help ?](#)

Type in a home address (the address should autofill as you type)



# Check out <https://www.hazardaware.org/>

Property Summary Know Your Risks Know Your Community Be Risk Ready Property Report

## HazardReady<sup>BETA</sup> Score

HazardReady<sup>BETA</sup> Score

**81**  
More Resilient

0 Less Resilient More Resilient 100

The HazardReady<sup>BETA</sup> Score in WINTER PARK, FL is "81" and combines the characteristics in the chart to the right. The higher your scores are, the more resilient your home is. The average score for homes in your area is "81".

### Factors Affecting the HazardReady<sup>BETA</sup> Score

- 1. Community Resilience (BRIC)** ⓘ  
0 Less Resilient More Resilient 100
- 2. Social Vulnerability (SoVI)** ⓘ  
0 More Vulnerable Less Vulnerable 100
- 3. Environmental Vulnerability (EVI)** ⓘ  
0 More Vulnerable Less Vulnerable 100
- 4. Average Annual Losses (AALs)** ⓘ  
0 Higher Losses Lower Losses 100
- 5. Hazard Resilient Construction** ⓘ  
Your home was built when your community did not require flood and wind resilient home construction practices.  
Outdated Building Code 2015 or Newer

### Aerial View of the Property



### Interactive Map

Click the **Map Layers** to see more options. Selecting a shaded area on the map will provide more detail.

#### Map Layers

- Census Block
- FEMA 100-year Flood Map



# Thank You!

Any questions?

Email: [t.wahl@ucf.edu](mailto:t.wahl@ucf.edu)

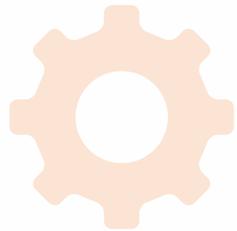
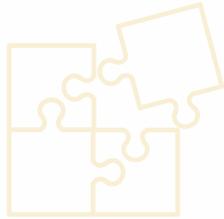


## Challenges

**Discuss what the community needs:**  
What challenges will we face in the next 10 years?

## Co-developed Solutions

**Discuss how we move forward:**  
How can we address these challenges?



## Tools and Approaches

**Discuss implementation strategies:**  
What ways will we achieve the solutions?

## Research Questions

**Discuss the gaps:**  
What basic research questions and data gaps need to be addressed in order for the tools and approaches to be successful?

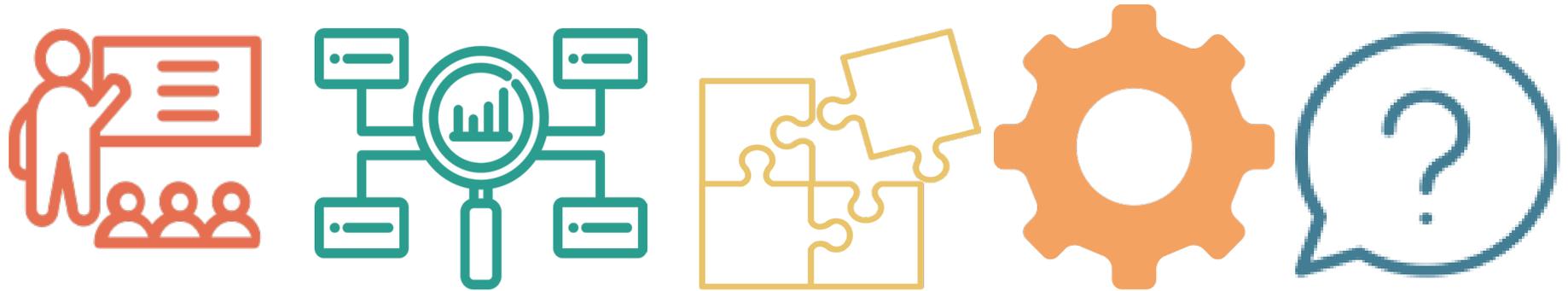


# BREAKOUT #4

## Research Questions and Data Gaps

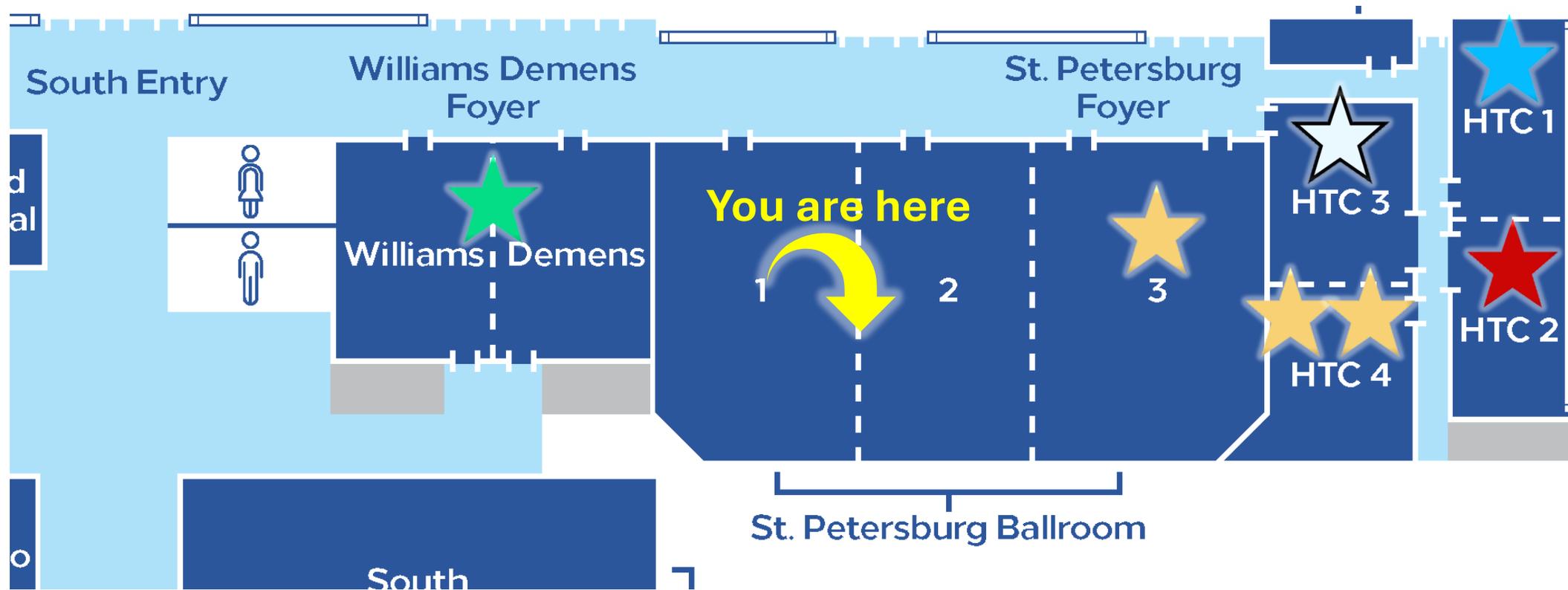
# How the Agenda is Built

Working through challenges and solutions to actionable research



## WHAT'S MY BREAKOUT ROOM?

Your badge has a star on it that corresponds to one of the following breakout rooms:





**JUNE 11 – JUNE 13**

*Hilton St. Petersburg Bayfront – 333 1st Street, SE*

# Decadal Visioning Workshop

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**2024**

**Break**



# Decadal Visioning Workshop 2024

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**JUNE 11 – JUNE 13**

*Hilton St. Petersburg Bayfront – 333 1st Street, SE*

# Decadal Visioning Workshop

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**2024**

**Plenary Discussion: Articulating Workforce Development Needs**

Tiffany Briggs, Florida Atlantic University

Dr. Brett Webb, Co-Executive Director, USCRP

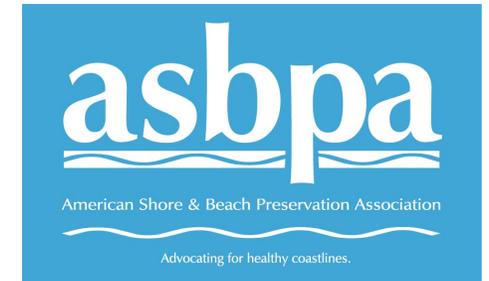
# Articulating Workforce Development Needs

**Tiffany Roberts Briggs**

Chair & Associate Professor  
Department of Geosciences  
Florida Atlantic University



American Shore & Beach Preservation Association  
Secretary, Science & Technology Co-Chair



*Decadal Visioning Workshop: The Future of Coastal Processes Research*  
*June 11-13, 2024 | St. Petersburg, Florida*

A close-up photograph of a pen drawing a coastline on a map. The pen is silver and black, and the map is blue and white. The coastline is drawn in a dark blue ink. The background is a light blue gradient.

# Session Objectives

- Prioritize workforce development needs
- Identify potential approaches to filling anticipated needs

## Outline

- Summary of efforts, 2018
- Preliminary results, 2024
- Audience poll
- Q&A / Discussion



# 2018 Survey of Academics

n = 51

## Motivated by

- Concerns over reduced funding
- Number of coastal courses offered
- Declining workforce pipeline

## Results

- 62% said funding had decreased
- 84% said course offerings were stable
- Majority of programs consist of 1-10 graduate students, with many reporting that 75-100% of effort is basic research.

AN ASBPA WHITE PAPER:

## Training the next generation of U.S. coastal scientists and engineers

SCIENCE AND TECHNOLOGY COMMITTEE  
October 2018

By

Nicole Elko, Reza Marsooli, Alex Renaud, and Tiffany Roberts Briggs

In a February 2012 policy statement, the American Shore and Beach Preservation Association (ASBPA 2012) concluded that the U.S. coastal engineering and science profession was unhealthy. ASBPA's findings were that:

■ Coastal engineering and science programs at U.S. universities are or will be declining due to reduced funding.

■ Fewer coastal engineers are entering academia due to the difficulty obtaining funding, so retiring coastal faculty are not being replaced or are being replaced by non-coastal faculty and the number of traditional coastal courses offered is declining, and

■ U.S. Army Corps of Engineers (USACE) coastal research and development (R&D) funding has also declined dramatically since 1983.

The 2012 policy statement stated that ASBPA seeks to support the implementation of an updated version of recommendations from the 1999 National Research Council study, "Meeting the Research and Educational Needs in Coastal Engineering" (NRC 1999):

1) The coastal engineering and science academic community should establish a consortium to improve research and education through cooperative arrangements for leveraging major research facilities and educational capabilities.

2) The National Science Foundation (NSF) should establish a program to fund fundamental research on coastal engineering and science (in its Engineering Division and/or elsewhere).

3) The USACE and other federal agencies should establish a substantial program to fund applied research in academic coastal engineering and science programs and promote partnerships between academia, federal agencies, and private interests.

ASBPA has played a major role in some progress toward these recommendations in the last several years, particularly with the foundation of the new U.S. Coastal Research Program (USCRP), which begins to address recommendations 1 and 3 from above. The program is made up of federal agency partners, academics, and stakeholders. Through a competitive grant process, over \$900,000 has been

awarded to coastal graduate student research over the last two years, ranging from research on dune management challenges along developed coasts to innovations in forecasting storm processes and impacts. In addition, to address the lack of large-scale, multi-agency field experiments in recent years, USCRP is organizing DuNEX (During Nearshore Event eXperiment) which will occur in 2020. In a time of fiscal uncertainty in government funded coastal research, USCRP has also been attempting to organize its partners to better share research infrastructure and assets in order to do more with less. NSF has recently expressed increased interest in coastal science and engineering through its Engineering and Geoscience Directorates (e.g. <https://coastlinesand-people.org/>), thereby partially addressing recommendation 2.

In 2018, ASBPA sought to update the findings of the 2012 policy statement through a survey of coastal academic researchers. Appendix A includes the results of a survey of 51 coastal academics from Geology, Engineering, Oceanography, Planning, Marine and Wetland, and Environmental Science programs. The

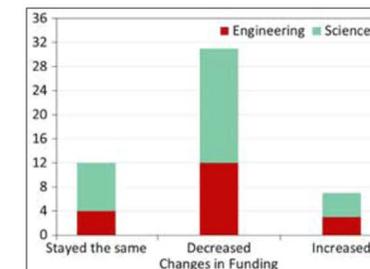


Figure 1. Online survey of coastal academics' responses to: "Has overall coastal science/engineering funding increased or decreased over the past five years?"

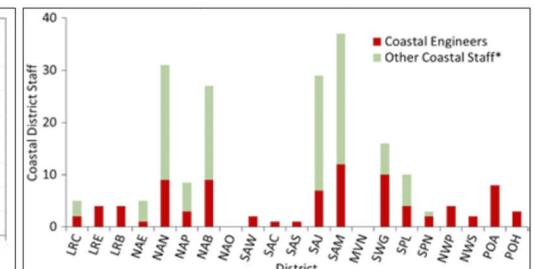


Figure 2. Coastal districts' coastal staff statistics. Districts with no data did not respond to the survey. \*May include engineers not classified as such (e.g. research engineers).

# Agency Perspective: USACE Coastal Working Group (2018)

## *Concerns*

- Loss of professionals/staff without replacement
- Students graduating with more knowledge in ecosystem/wetland restoration than with traditional coastal structural engineering

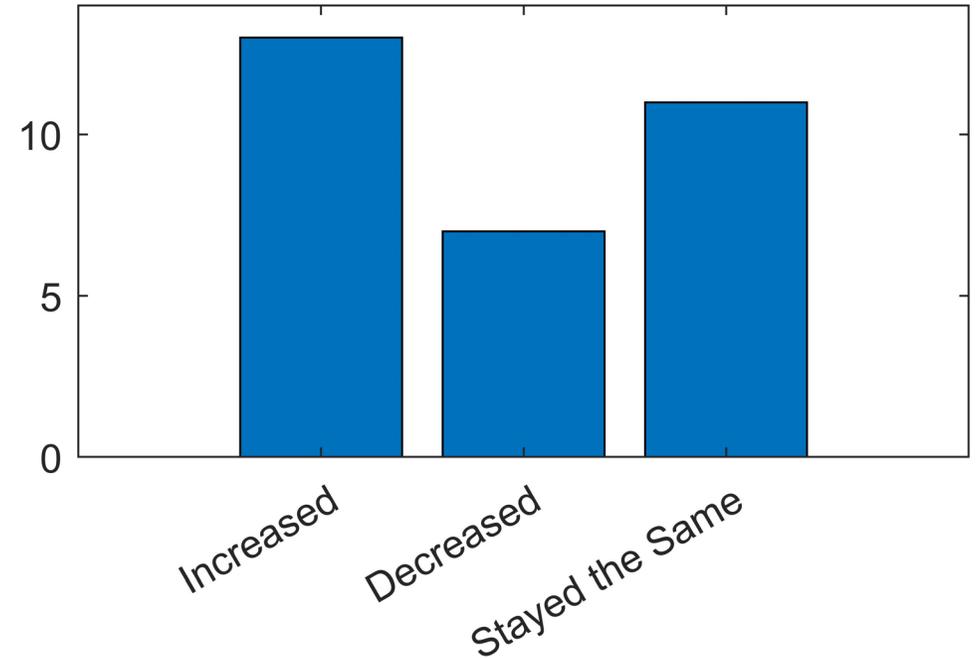
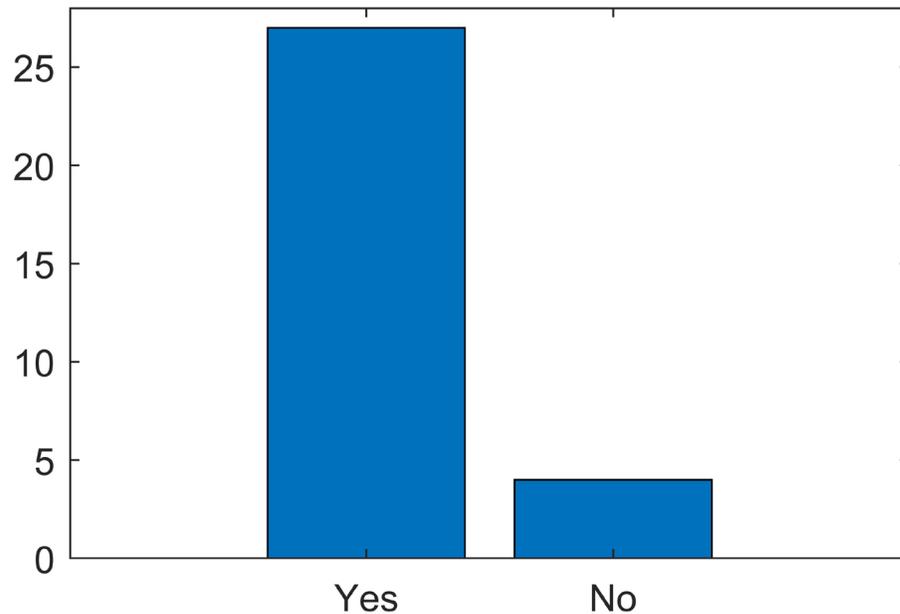
## *Recommendations*

- Students should receive training in fundamental science and engineering: underlying physics, traditional curriculum of waves, hydraulics, structural design, ocean/nearshore labs, etc.
- Training to maintain gray infrastructure: physics of open ocean/nearshore high energy areas, impacts on aging coastal infrastructure

# 2024 Survey Results: *Funding/Research*

n = 31

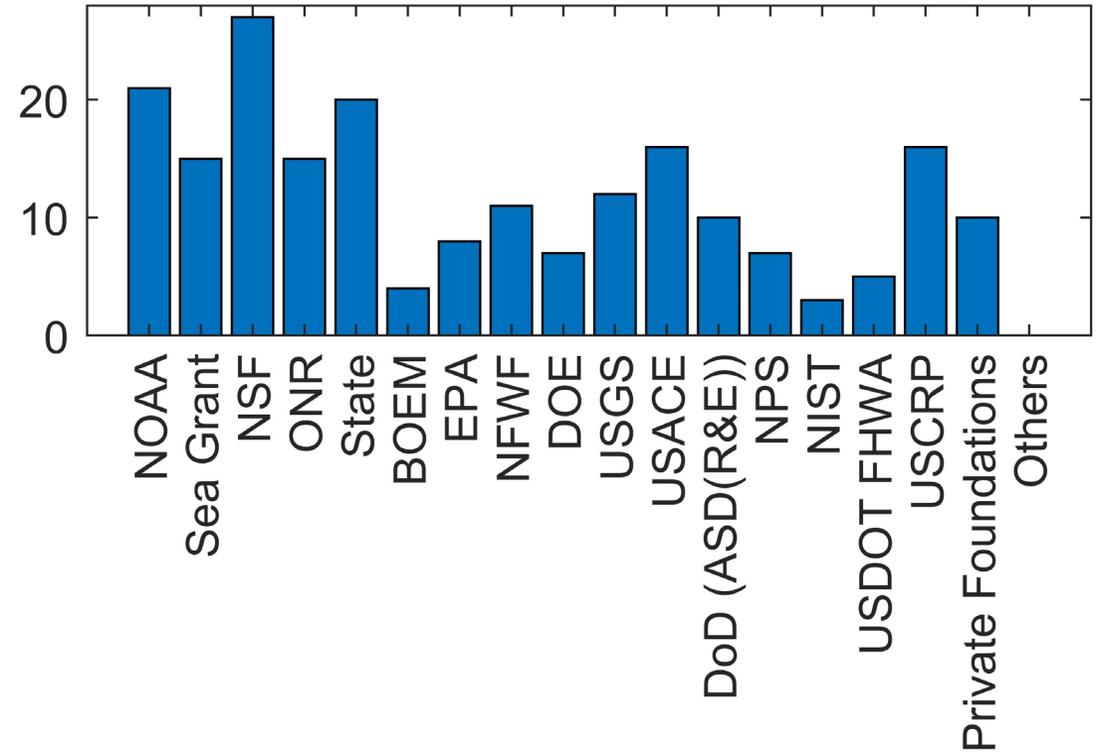
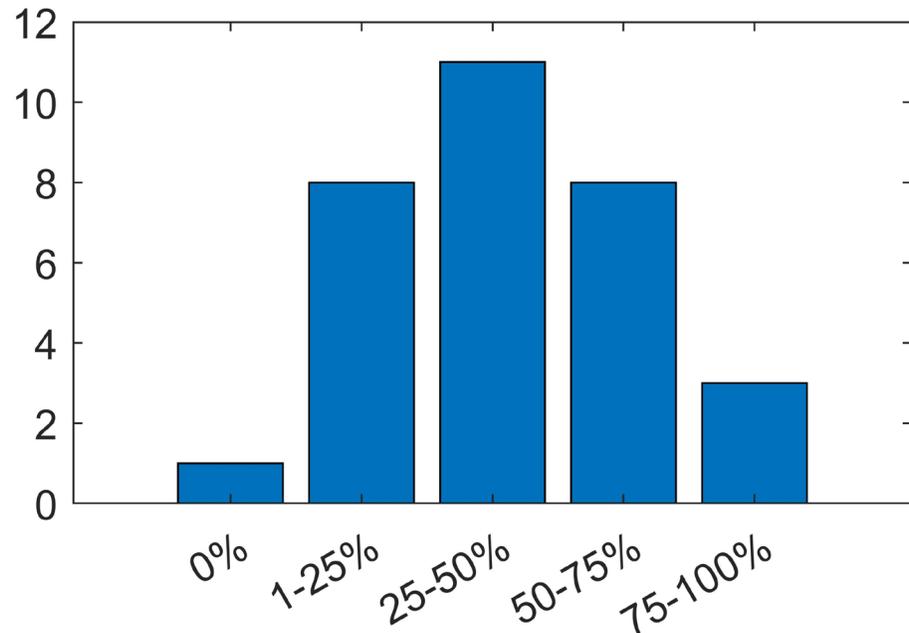
Has overall coastal science/engineering funding increased or decreased over the past 5 years?



Is funding difficult to obtain?

# 2024 Survey Results: *Funding/Research*

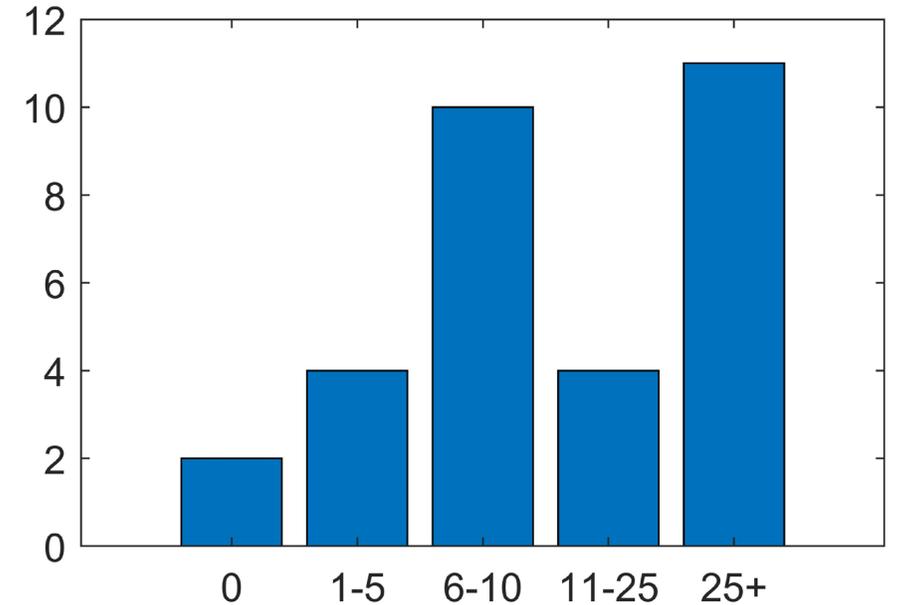
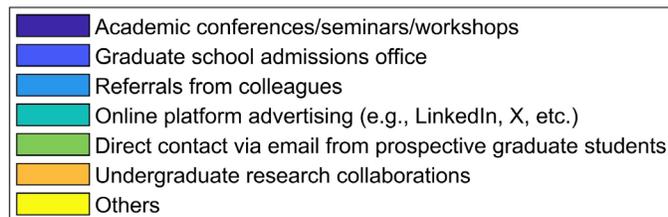
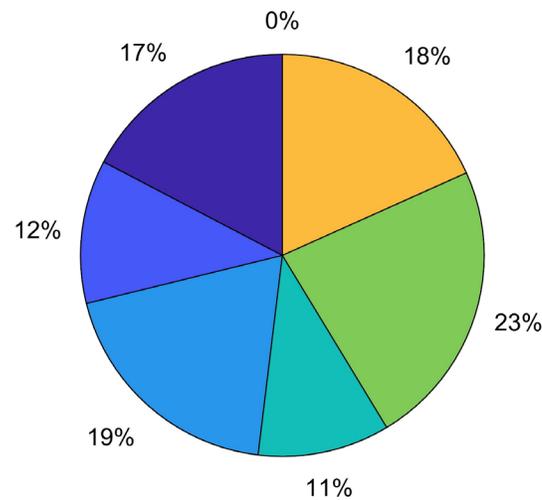
Where do you receive Federal funding from?



What percent of your research is basic (rather than applied)?

# 2024 Survey Results: *Graduate Training*

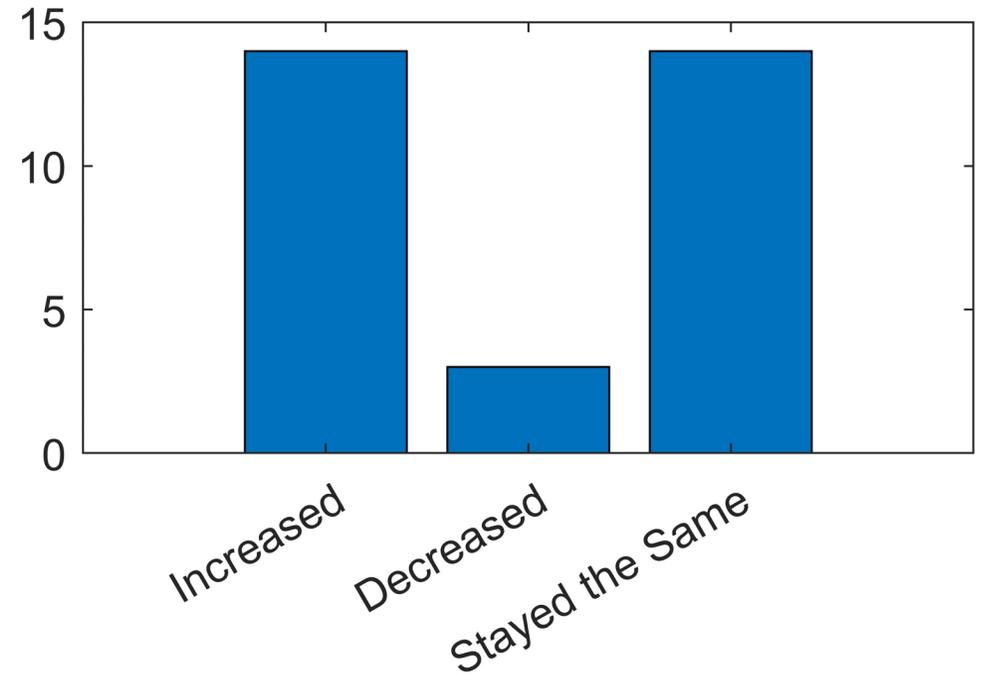
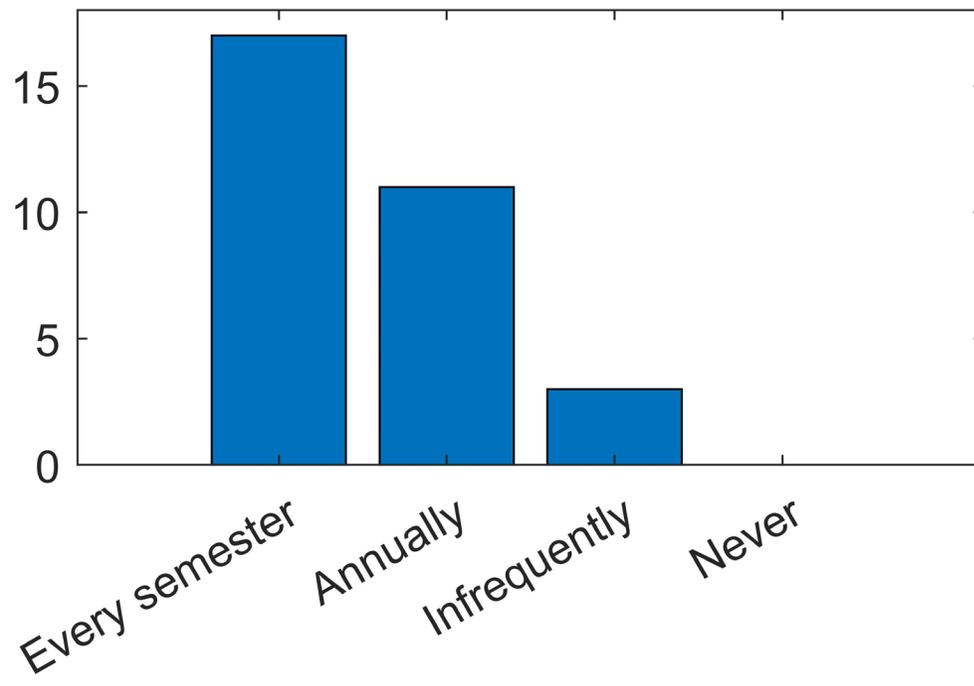
How many graduate students are in your program?



What are the primary sources for recruiting graduate students (in the last decade)?

# 2024 Survey Results: *Graduate Training*

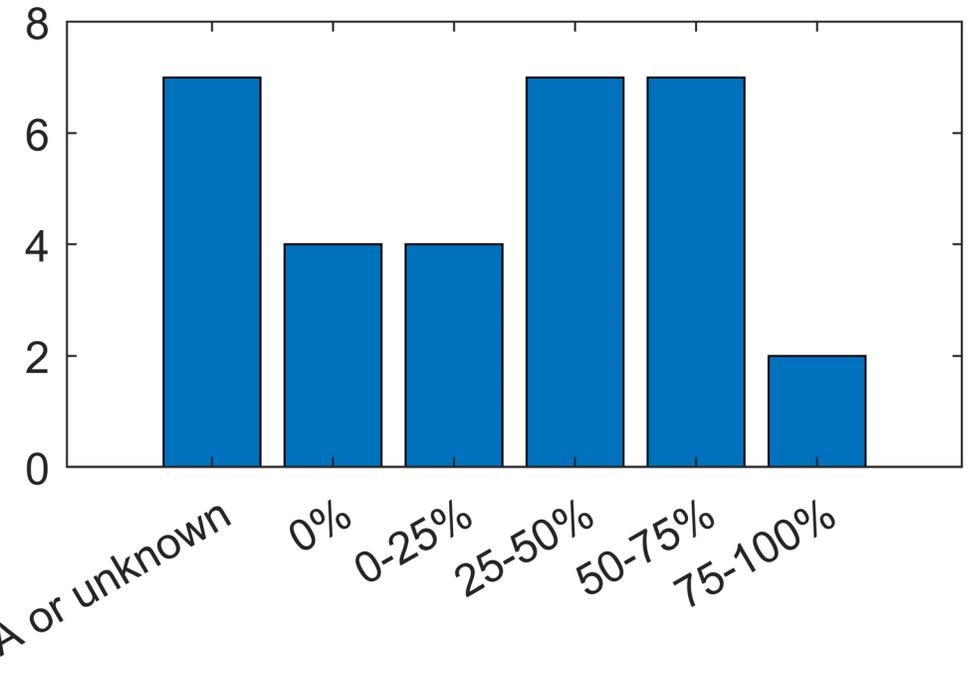
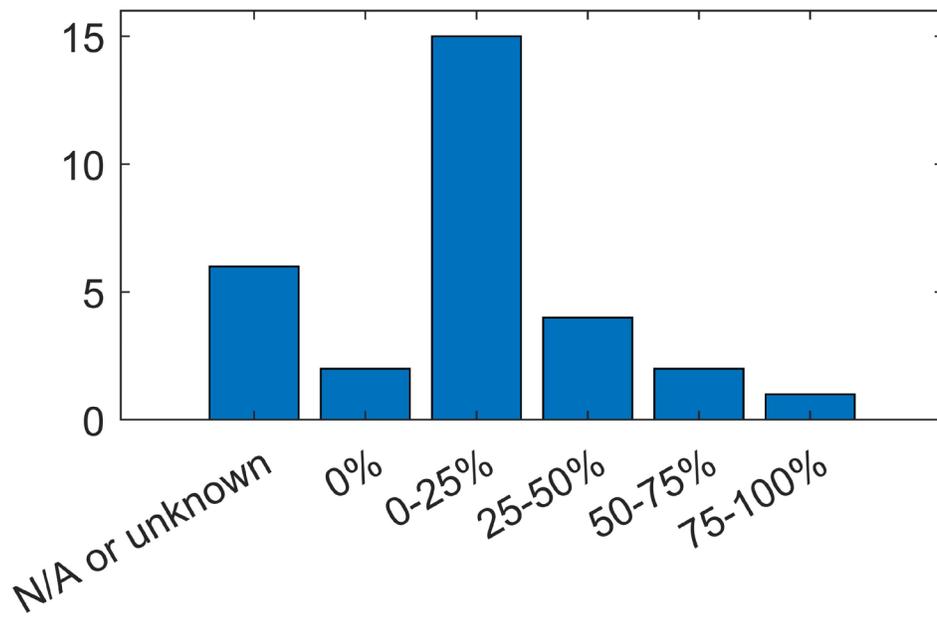
Has the number of coastal science/engineering courses increased or decreased over the past 5 years?



How often does your university offer courses teaching fundamentals?

# 2024 Survey Results: *Workforce*

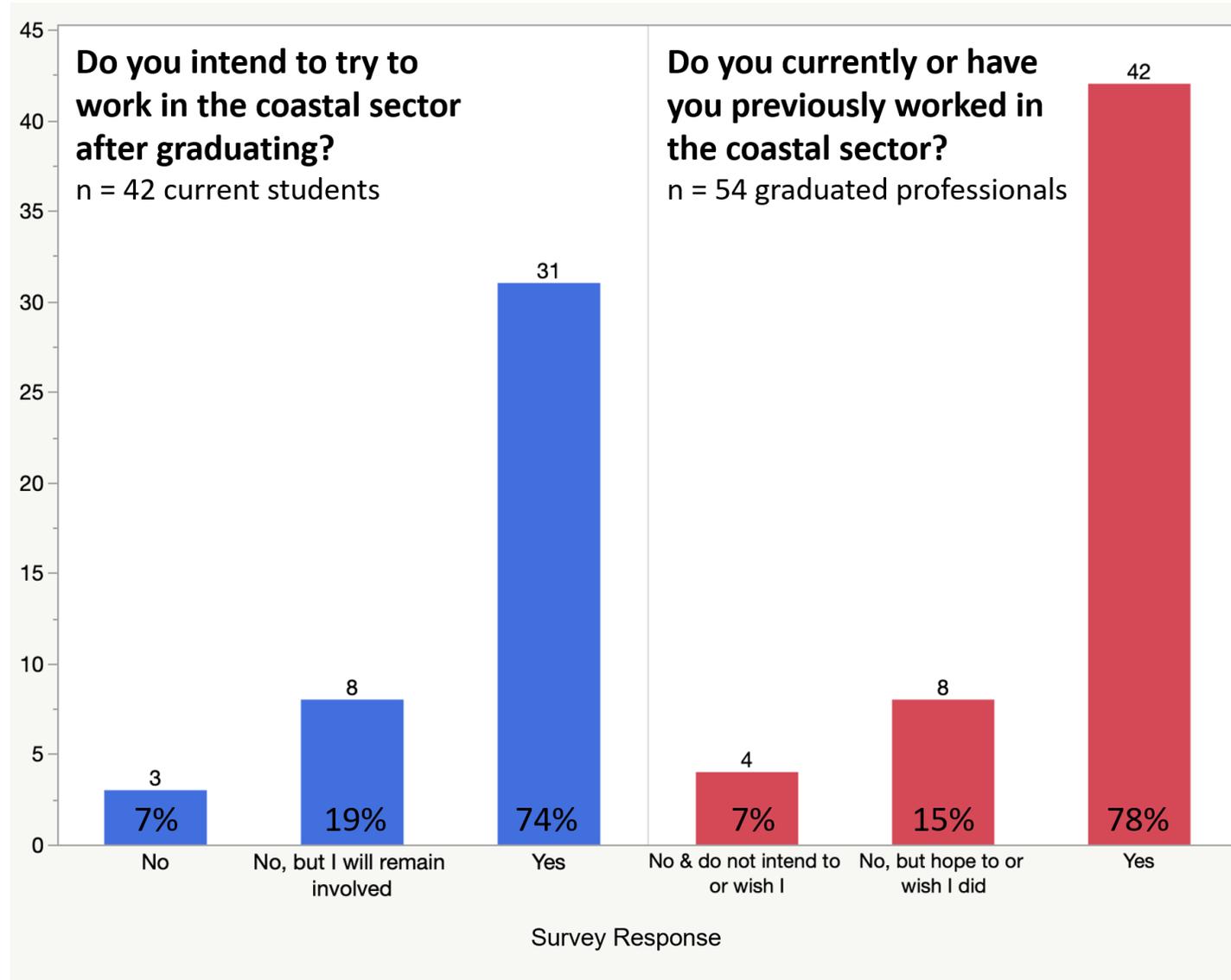
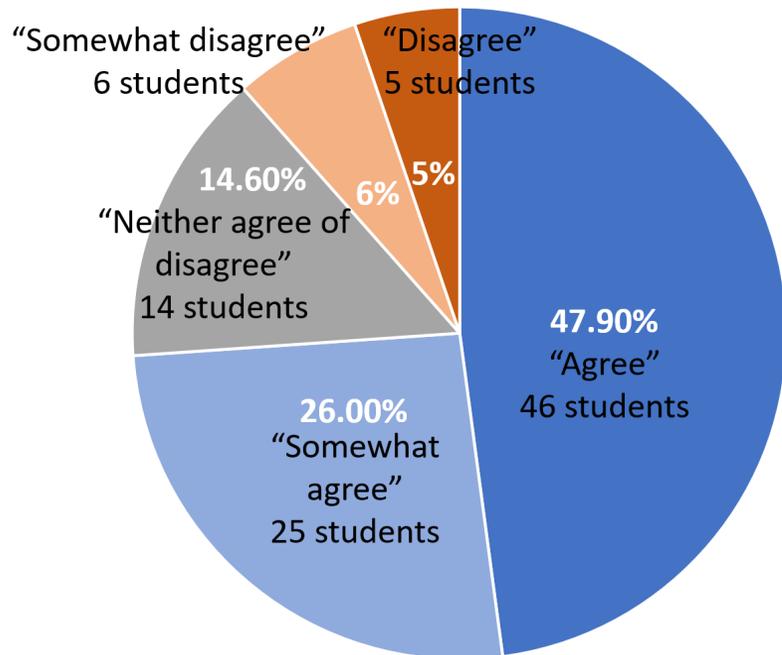
What percentage of international (non-US citizens) graduate students and post-docs joined the US workforce (non-academic) after concluding their training?



What percent of graduate students joined the US workforce and remained in academia?

# USCRP-Supported Students

I would not have pursued or considered pursuing a career in the coastal sector without exposure to coastal topics in an academic setting.



# Additional Comments

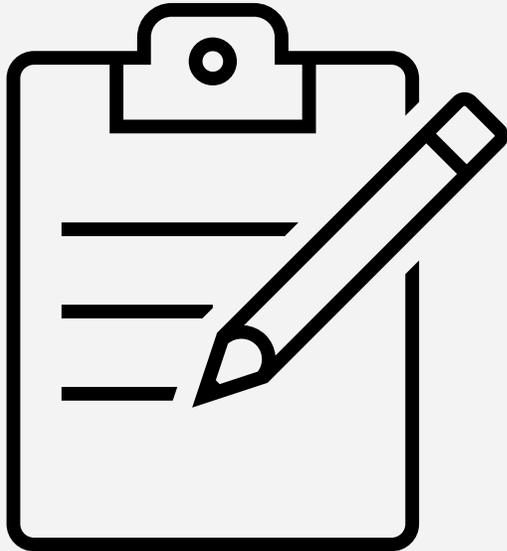
“Now we have access to more funding to support graduate researchers, but fewer people (especially domestic) interested in post-graduate work.”

“Wage and job conditions after graduating are making it hard to attract and retain qualified students.”

“We have been talking recently about the need to band together in some form to increase/broaden our course offerings, and to help one another recruit students.”

“Funding amounts seem smaller while cost of living (and thus reasonable salaries) and materials is going up.”

# Initial Takeaways



- Funding for research/graduate student training has increased. But it's still difficult to obtain.
- NSF and NOAA remain top funding sources. Is there a shift towards applied research over fundamentals?
- Graduate programs have stable or increasing course offerings, where fundamentals are taught regularly. But some note difficulty with recruitment.
- Fewer students are remaining in academia. While some international students are staying in the US workforce, many reported a rate of <50% or unknown.

# Acknowledgements

*Thanks to the ASBPA S&T team working on this project: Reza Marsooli, Bret Webb, Jon Miller, and Nicole Elko.*

*Thanks to Bianca Charbonneau for shared data & discussions on USCRP trends.*

**Contact:**

**Tiffany Roberts Briggs**  
**FAU Geosciences**  
**[briggst@fau.edu](mailto:briggst@fau.edu)**

**asbpa**

American Shore & Beach Preservation Association

Advocating for healthy coastlines.

# Please take the academic survey!



Take the Academic  
Survey



# Decadal Visioning Workshop 2024

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**JUNE 11 – JUNE 13**

*Hilton St. Petersburg Bayfront – 333 1st Street, SE*

# Decadal Visioning Workshop

**THE FUTURE OF COASTAL  
PROCESSES RESEARCH**



**2024**

## Workshop Observations and Wrap Up

Bret Webb, University of South Alabama

Nicole Elko, USCRP

**We heard...**



**This will be the decade  
of data.**

***Will AI be a solution?***

## We heard....



**Interdisciplinary work must be at the right scale, intentional, well-planned and inclusive.**

**We heard....**



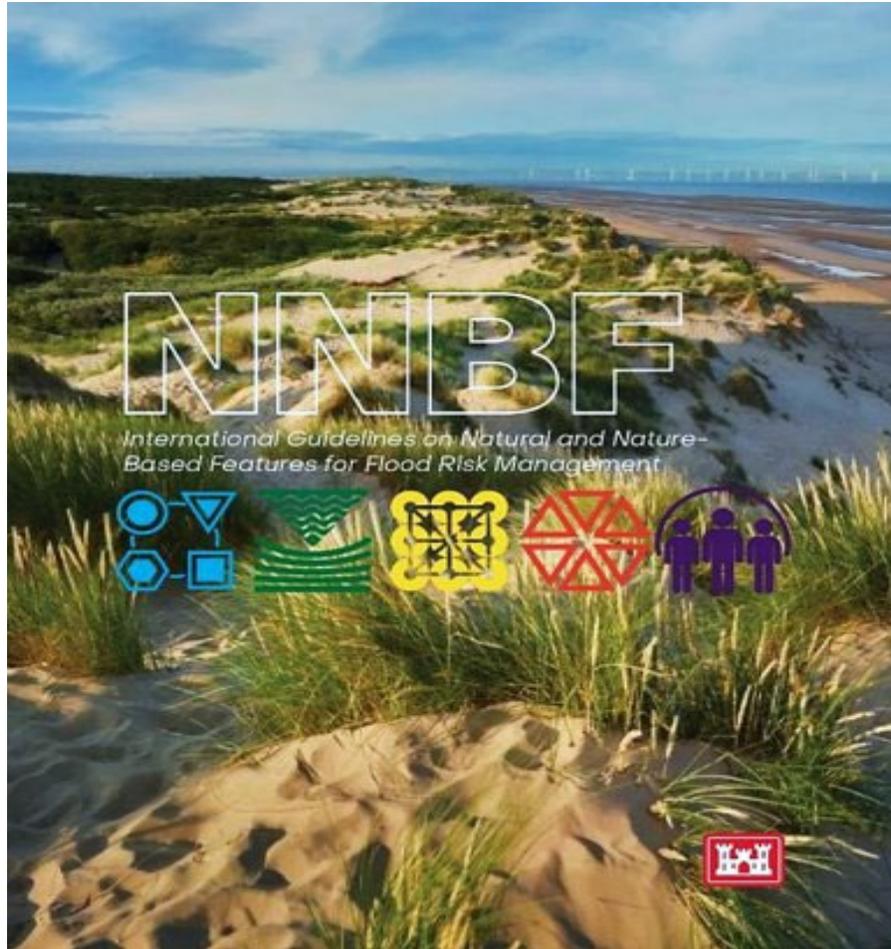
**Is there a bulldozer  
in your model?**

**We heard....**



**Simultaneously  
consider  
catastrophic and  
chronic flooding.**

# We heard....



**Nature-Based Solutions  
should be considered as  
a continuum.**

## We heard....



**Need an honest frank discussion of understanding of changing coastline in combination with high quality science.**

## We heard....



**We need methods  
to measure  
effectiveness in  
adaptation  
strategies.**

**We heard....**



**Engineers and geologists  
must collaborate with  
engagement experts – we  
need social scientists!**

**We heard....**



**We are still  
struggling with  
understanding  
sediment transport  
(Anon. 2024)**

# We heard....



**What regulatory challenges can be alleviated by better science?**

# We heard....



**Non-linear coupling of multi-scale, multi-hazard processes across spatial and time scale needed for decision-making.**

**We heard....**



**Research needed at all scales to transition from foundational science to operational models to public information.**

# NEXT STEPS

- Report Interest Meeting Today (12:15)
- Survey will follow
- Join our mailing list to stay appraised

**We heard....**

**What are the most important research themes for the next ten years?**

# NEXT STEPS



**Decadal Visioning Workshop: THE FUTURE OF COASTAL PROCESSES RESEARCH**