

# Determination of Extraordinary Storm Classification for Recent Florida Events

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Credit: St. Augustine Beach Police Department



Credit: NBC News2



Credit: Fox Weather



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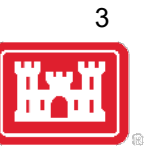
# TODAY'S TALK



- USACE guidance on extraordinary storm determination
- Recent events impacting the state
  - November 2021 Nor'easter
  - Hurricane Ian (September 2022)
  - Hurricane Nicole (November 2022)
- Summary
- Questions



# HSPP REHABILITATION ASSISTANCE



- Civil Emergency Management (CEM) Program of the U.S. Army Corps of Engineers under the authorities of 33 USC 701n (commonly referred to as Public Law (PL) 84-99)
- If HSPP is active and there is reasonable evidence that the storm event can meet the definition of an extraordinary storm (ER 500-1-1, paragraph 5-20.d) the district will perform a field investigation to determine the extent of the damages
- If the field investigation provides sufficient evidence that major damages have occurred (for either hardened features of the project, or loss of significant quantities of sand), the district will prepare a complete Project Information Report (PIR)
- The PIR will contain detailed justification to substantiate a finding that the storm meets the criteria of “extraordinary storm”, as defined by ER 500-1-1, paragraph 5-20.d



# ER 500-1-1, “EMERGENCY EMPLOYMENT OF ARMY AND OTHER RESOURCES, CIVIL EMERGENCY MANAGEMENT PROGRAM”



ER 500-1-1 Paragraph 5-20(e). **The Extraordinary Storm.** To be eligible for Rehabilitation Assistance, the HSPP must be substantially eroded/damaged by wind, wave, or water action of an other than ordinary nature. USACE defines this as an "extraordinary storm". An extraordinary storm is a storm that, due to length or severity, creates weather conditions that cause significant amounts of damage to a Hurricane/Shore Protection Project.

ER 500-1-1 Paragraph 5-20(e)(1). "Length or severity" refers to a Category 3 or higher hurricane as measured on the Saffir-Simpson scale, or a storm that has an exceedance frequency equal to or greater than the design storm of the project.

ER 500-1-1 Paragraph 5-20(f). **Extraordinary Storm Justification.** The PIR must include justification that substantiates the occurrence of an extraordinary storm. The determination of whether a storm qualifies as extraordinary will be made by the Director of Civil Works, in consultation with the Assistant Secretary of the Army for Civil Works (ASA(CW)) if necessary. PIR justification will include relevant data from the National Weather Service. Saffir-Simpson scale Category I and Category II hurricanes (as measured at the HSPP project) are presumed to be ordinary storms in the absence of a preponderance of evidence that indicates a different conclusion.



# NOVEMBER 2021 NOR'EASTER

- Classic mid-latitude cyclone directly impacted Northeast FL 5 - 6 November
  - Peak wind gusts of 70 mph
  - 2 – 4 inches of rainfall
  - Tidal flooding and extreme erosion
- Indirect impacts from waves and elevated water levels continued for days



NOAA/STAR 11/07/21 15:51Z GOES-East  
Credit: NOAA

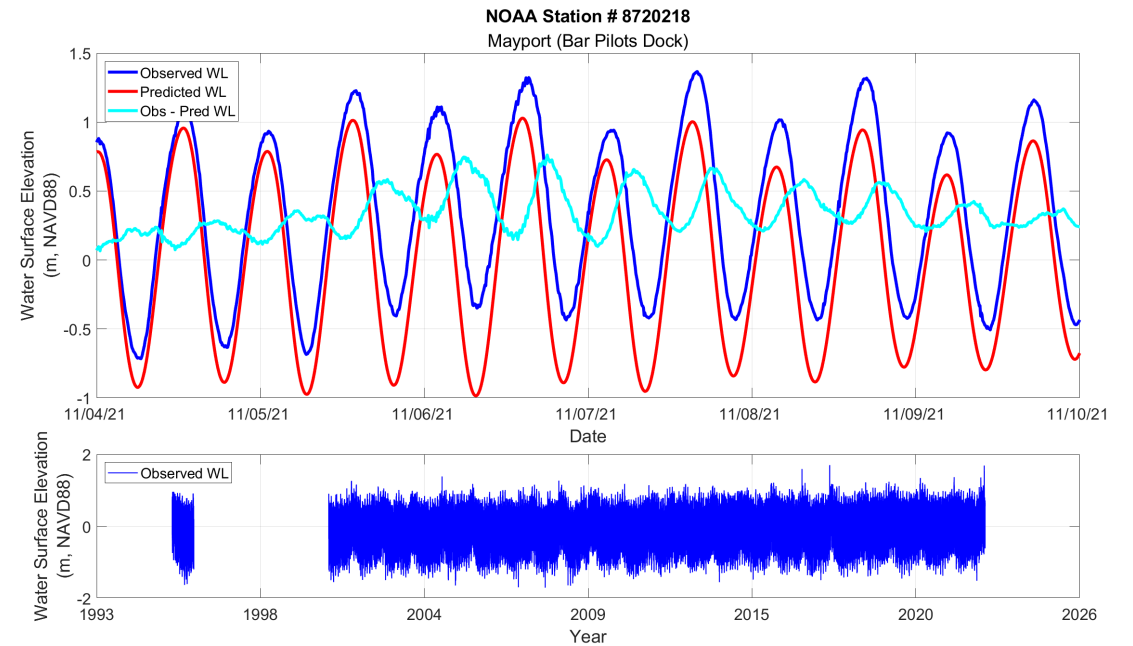
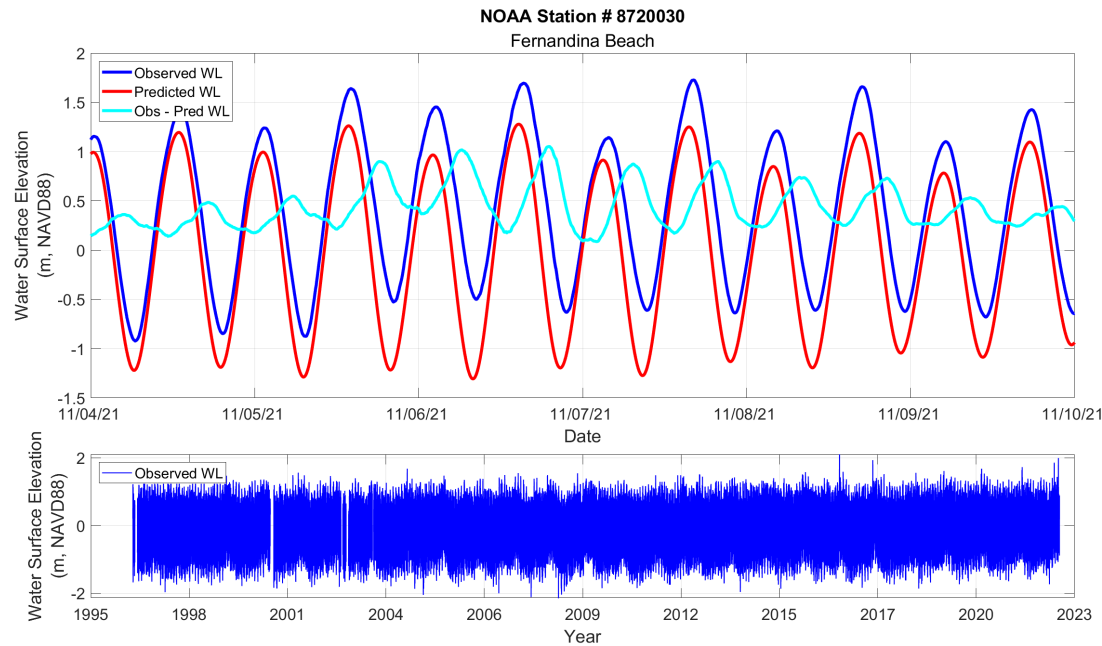




# 2021 NOR'EASTER EXTRAORDINARY STORM DETERMINATION

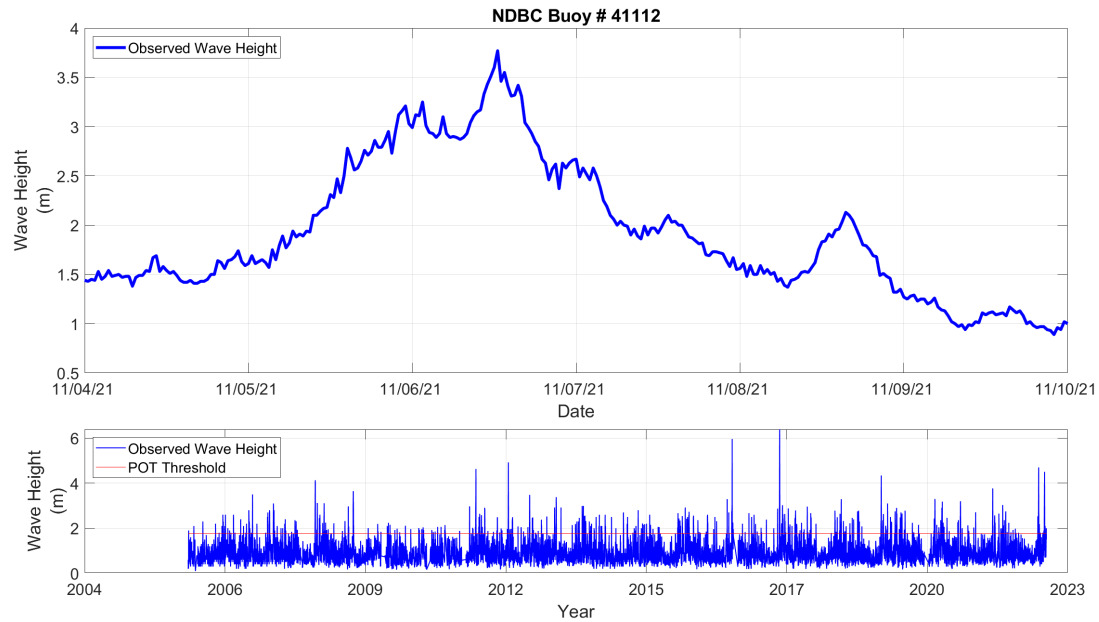


- Storm was not a Category 3 storm or higher
- Local HSPF do not have a specific “design storm”
- Need to show a “preponderance of evidence” that indicates the storm was extraordinary
- Short time frame to complete analysis – multiple priorities in immediate post-storm

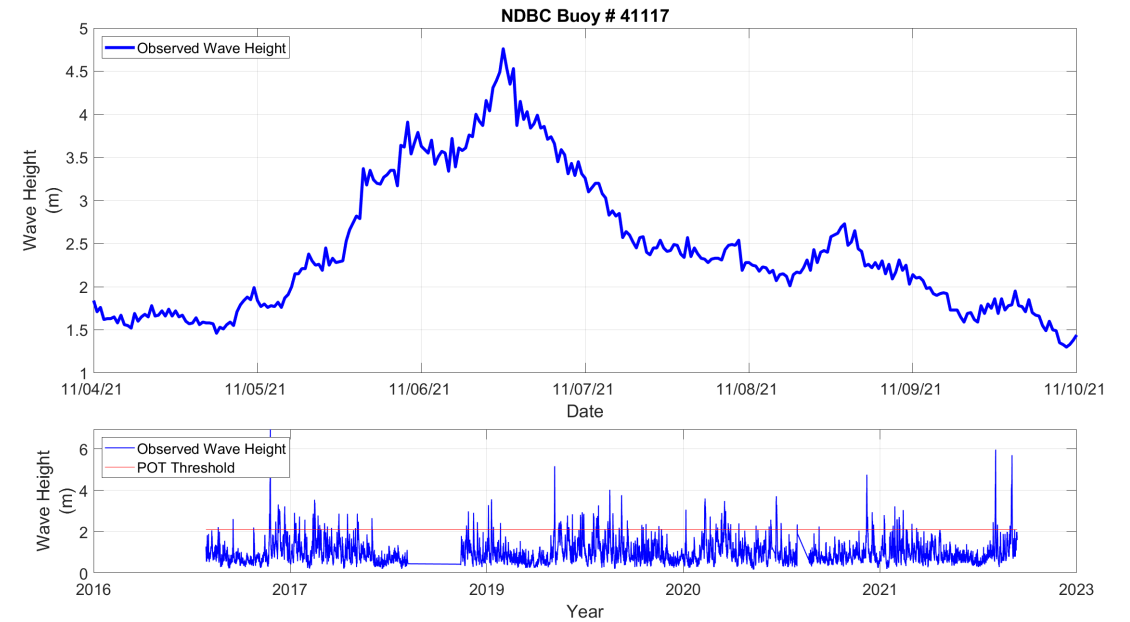




# 2021 NOR'EASTER EXTRAORDINARY STORM DETERMINATION



Fernandina Beach

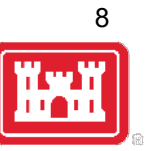


St. Augustine

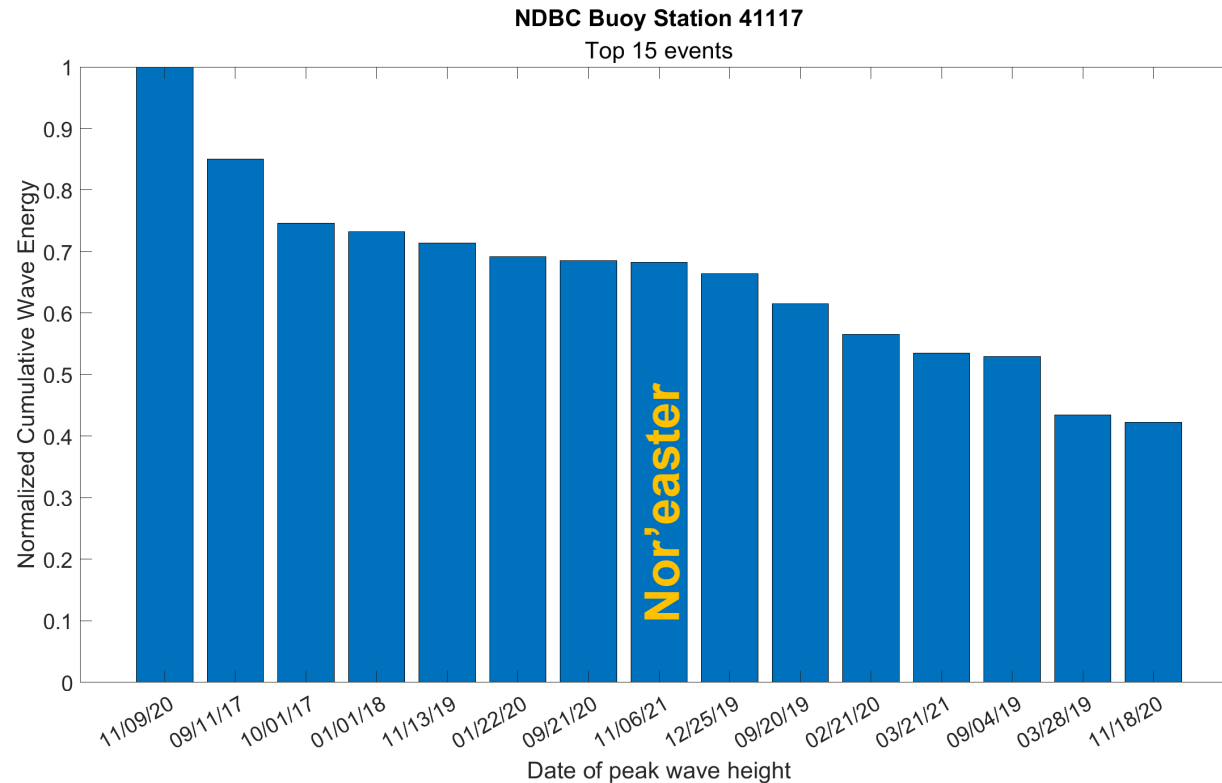
- Elevated water levels and waves for multiple days
- Peak values are high, but not necessarily extraordinary
- Field surveys show tremendous erosion in Northeast FL



# 2021 NOR'EASTER EXTRAORDINARY STORM DETERMINATION



- To develop a “preponderance of evidence” additional metrics need to be looked at:
- This event was long duration - Cumulative Wave Energy
  - Separated storm events from timeseries using POT = mean + 2 x std. dev.
  - Sum of wave energy (taken as  $H_s^2$ )



St. Augustine

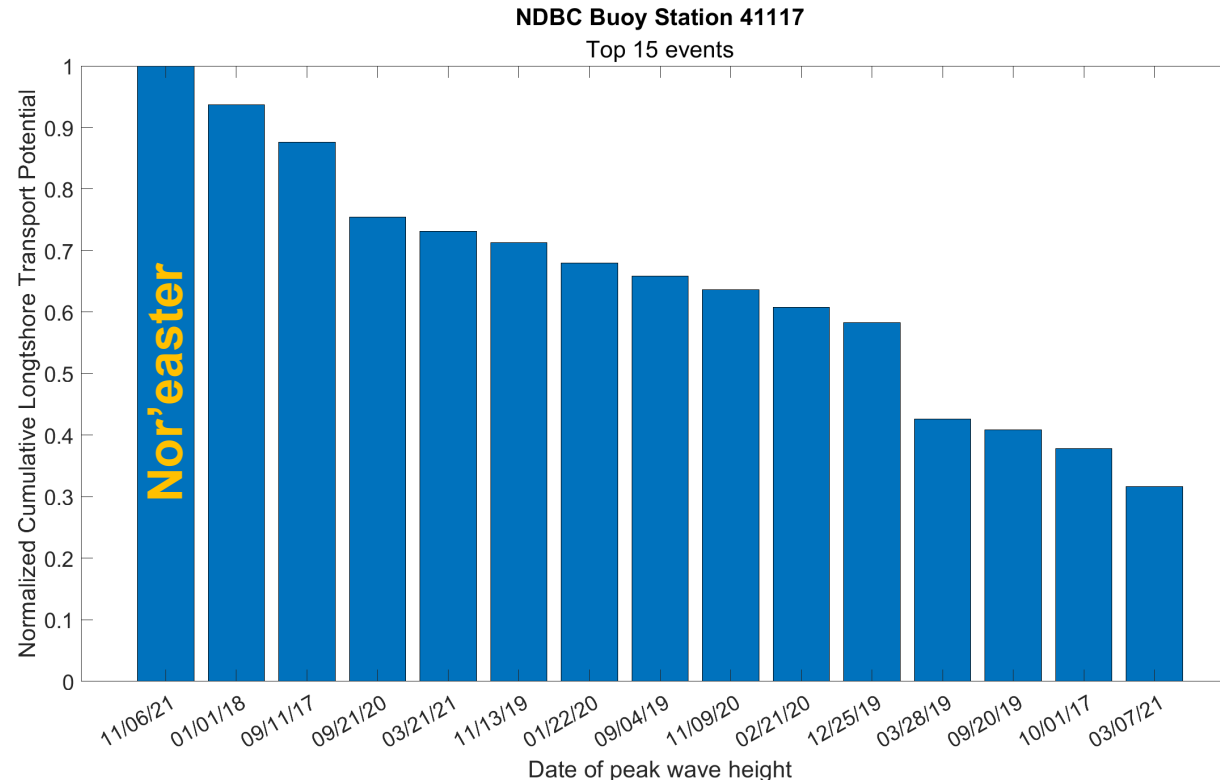




# 2021 NOR'EASTER EXTRAORDINARY STORM DETERMINATION



- To develop a “preponderance of evidence” additional metrics need to be looked at:
- Ranked 8<sup>th</sup> in buoy’s record for Cumulative Wave Energy
  - Not necessarily extraordinary
- Impacts appeared worse than many events ranked higher
- Utilized CERC equation to estimated longshore transport potential for each storm event
  - Sum of CERC equation (linear wave theory from buoy to nearshore)



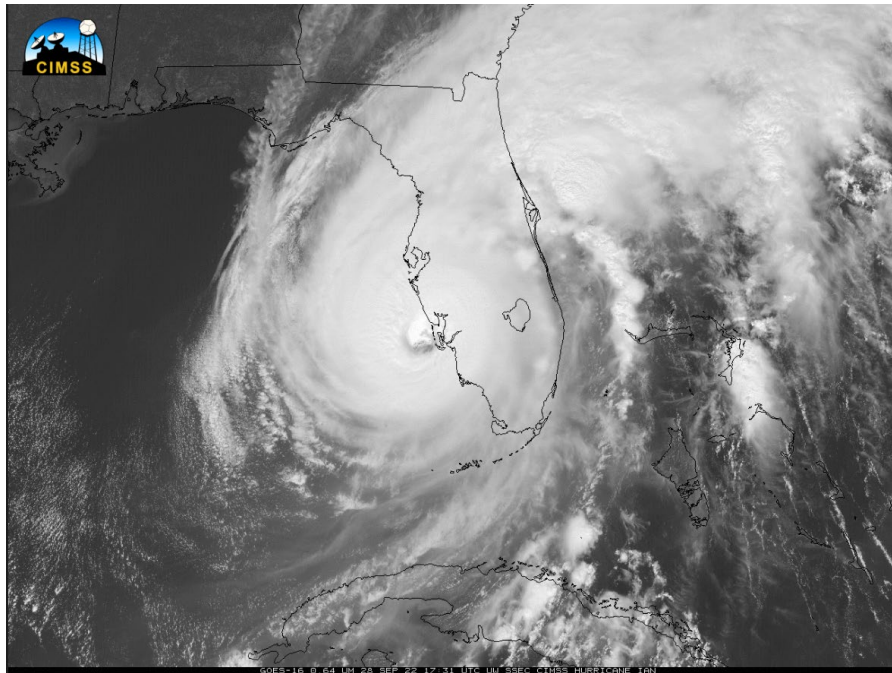
St. Augustine



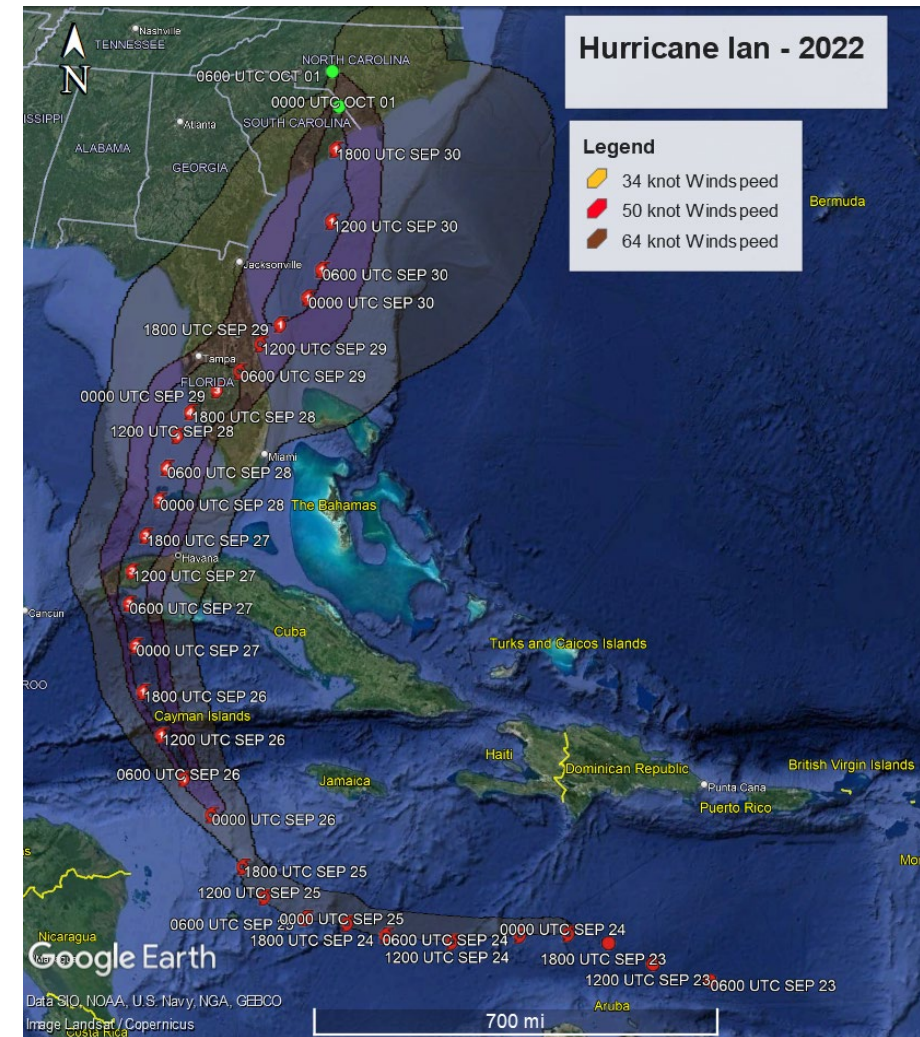
# HURRICANE IAN SEPTEMBER 2022



- Meets the definition of extraordinary in SW FL
  - Cat 4 at landfall
  - Record surge
  - Large storm size
- Heavy erosion on East Coast beaches
  - TS / Cat 1



Credit: CIMMS





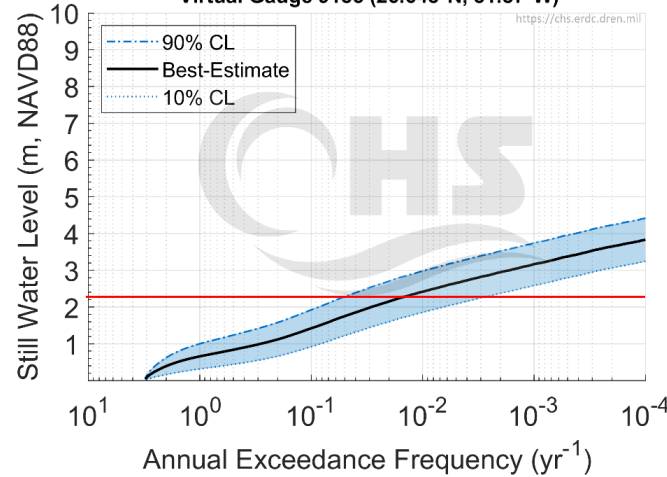
# HURRICANE IAN EXTRAORDINARY STORM DETERMINATION



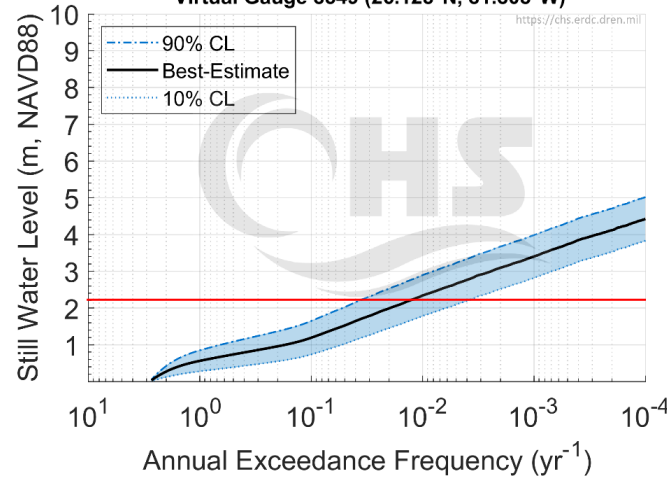
## Southwest FL

- Storm meets definition of extraordinary
- Category 4 at landfall
- SWL Comparison with Coastal Hazards System (CHS) Hazard Curves
- ~0.02 AEF (50 yr)

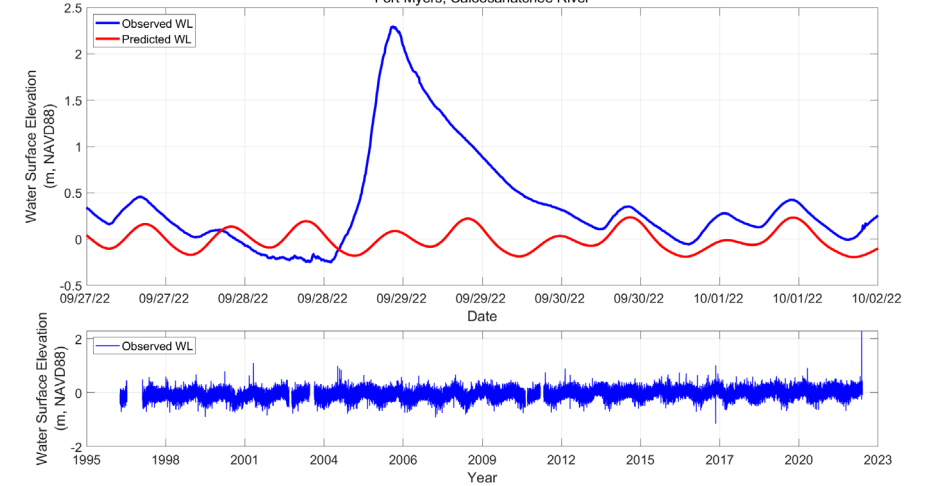
CHS-GoM: Combined Cyclone, SLC0  
Virtual Gauge 9185 (26.648°N, 81.87°W)



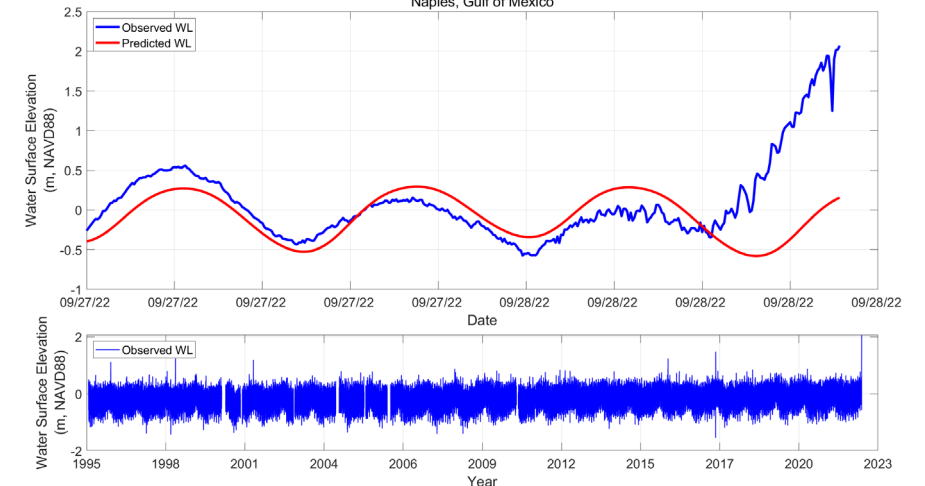
CHS-GoM: Combined Cyclone, SLC0  
Virtual Gauge 8549 (26.128°N, 81.808°W)



NOAA Station # 8725520  
Fort Myers, Caloosahatchee River



NOAA Station # 8725110  
Naples, Gulf of Mexico



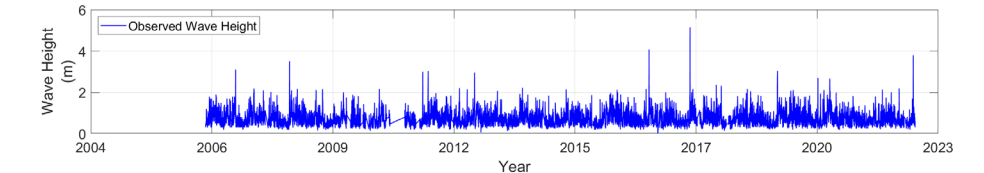
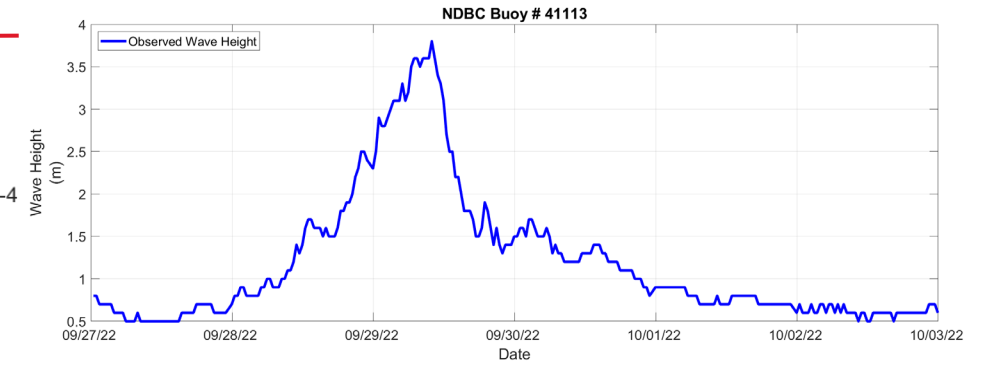
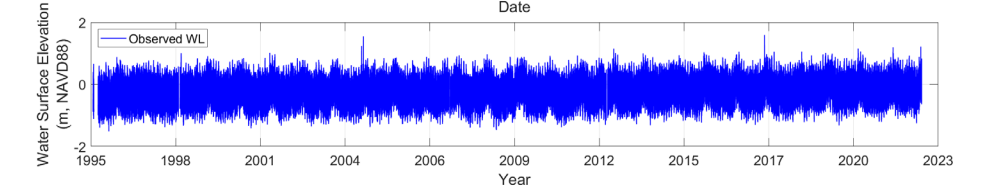
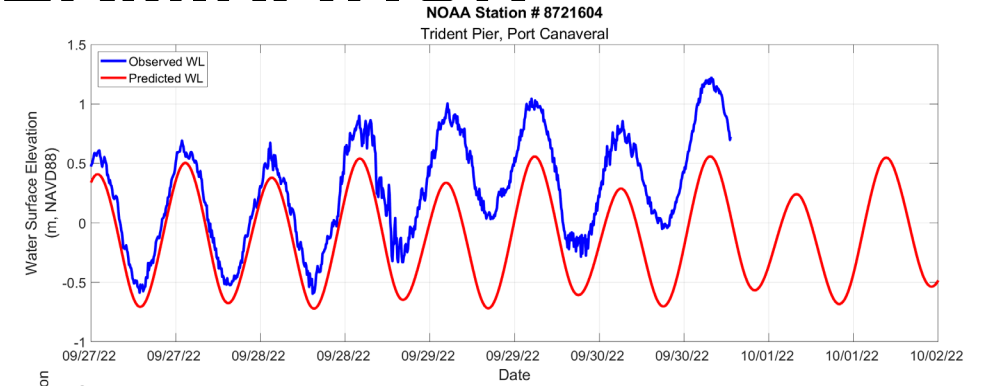
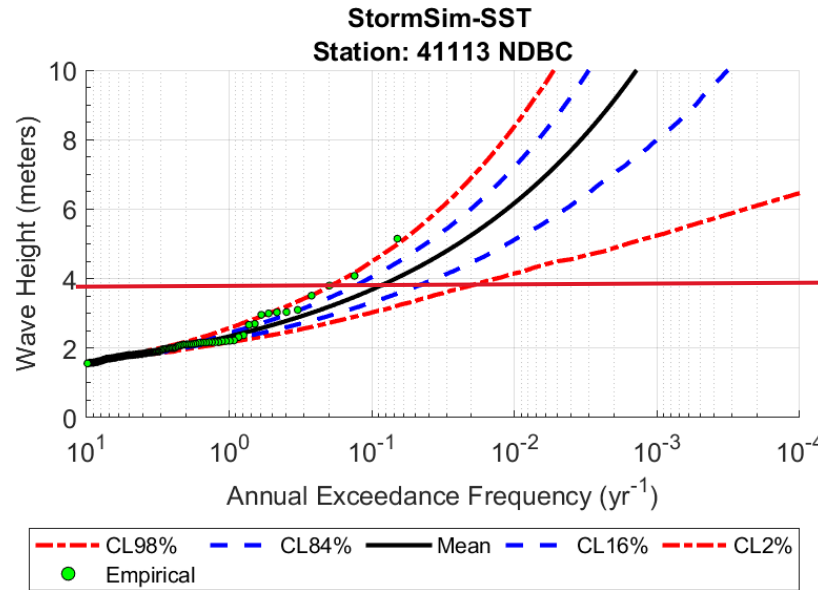


# HURRICANE IAN EXTRAORDINARY STORM DETERMINATION



## Central FL

- TS while exiting, Cat 1 offshore
- SWL Comparison with Coastal Hazards System (CHS) Hazard Curves
- ~0.35 AEF (3 yr)
- Peak waves 3<sup>rd</sup> highest at buoy
- StormSim-SST ARI ~ 11 yr
- Extraordinary



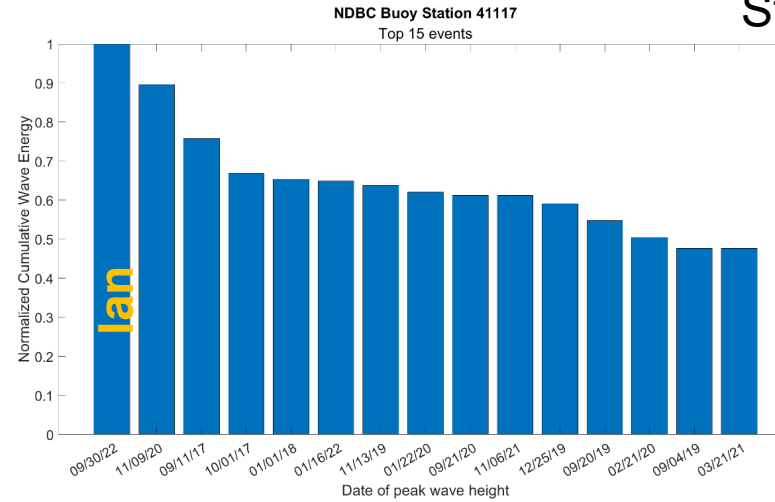


# HURRICANE IAN EXTRAORDINARY STORM DETERMINATION

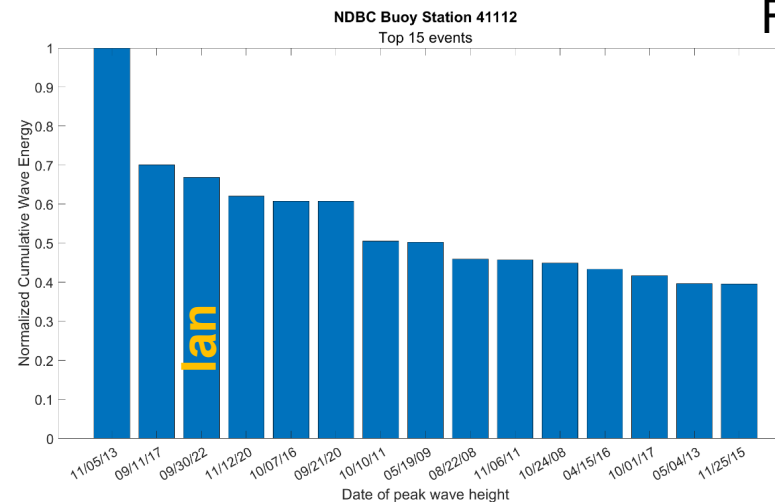
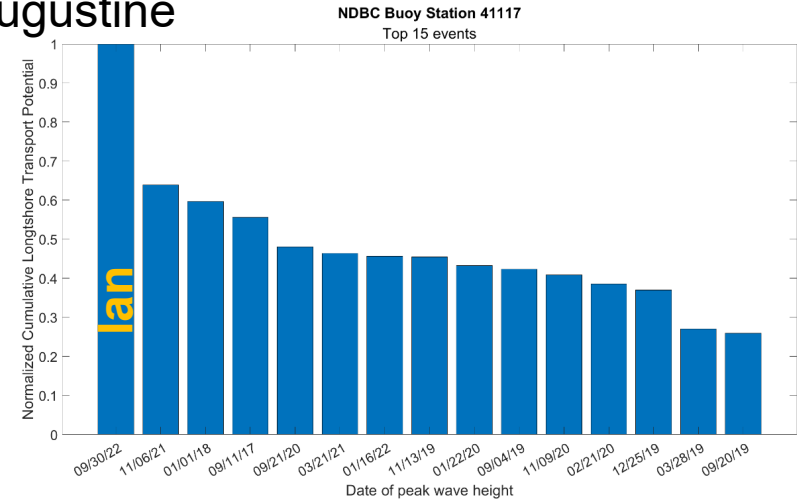


## Northeast FL

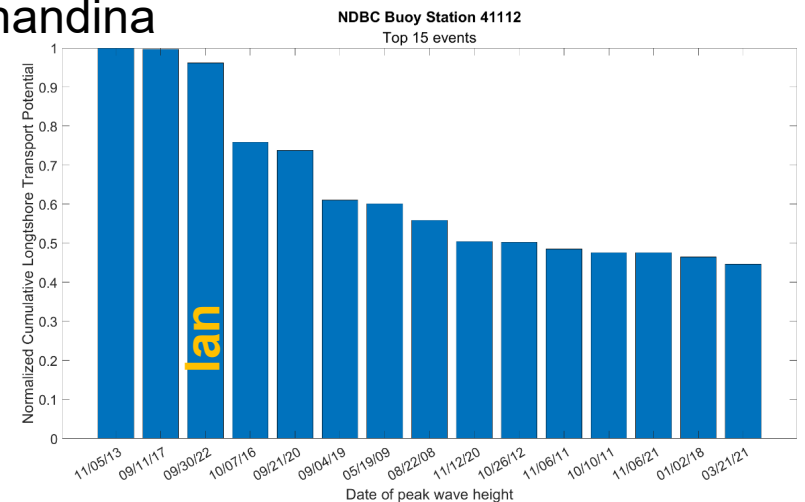
- Cat 1 offshore
- SWL Comparison with Coastal Hazards System (CHS) Hazard Curves
- ~0.9 AEF (1 yr)
- Peak waves 2<sup>nd</sup> and 4<sup>th</sup> highest at 41117 and 41112
- High rank in cumulative wave energy and longshore transport potential
- Extraordinary



## St. Augustine



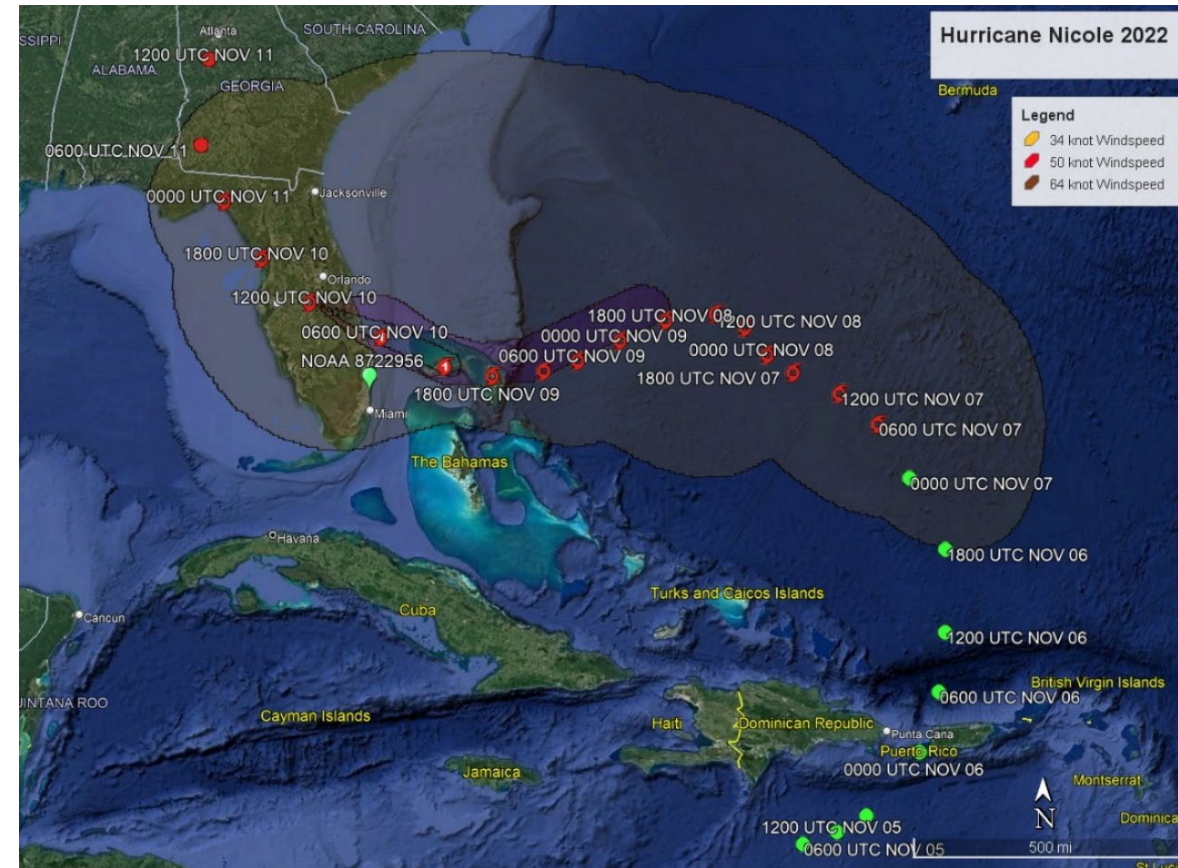
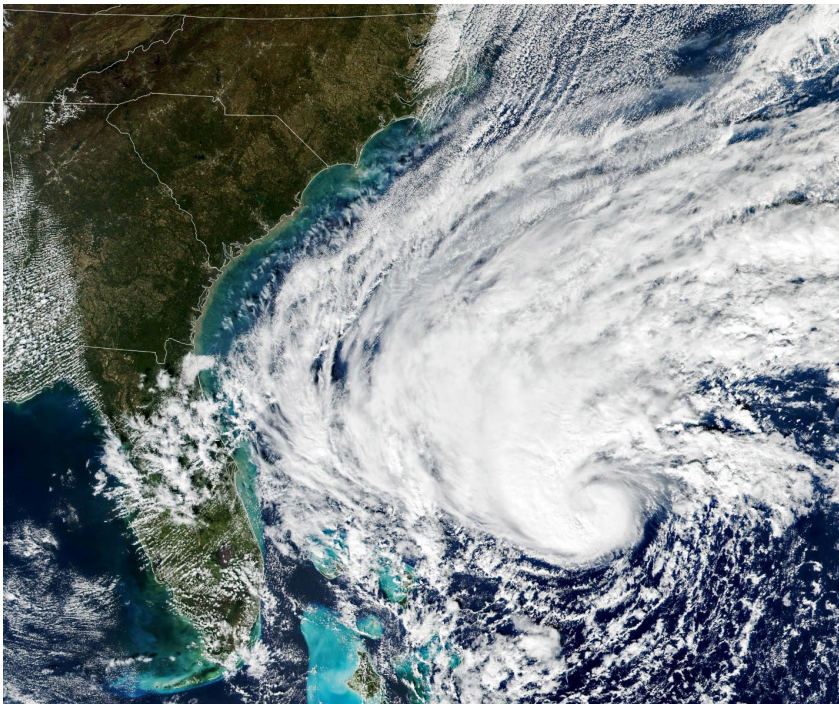
## Fernandina





# HURRICANE NICOLE NOVEMBER 2022

- Category 1 storm offshore east Florida
- TS briefly offshore west coast
- Large wind field = long duration of impacts
- Heavy erosion on already eroded east coast beaches



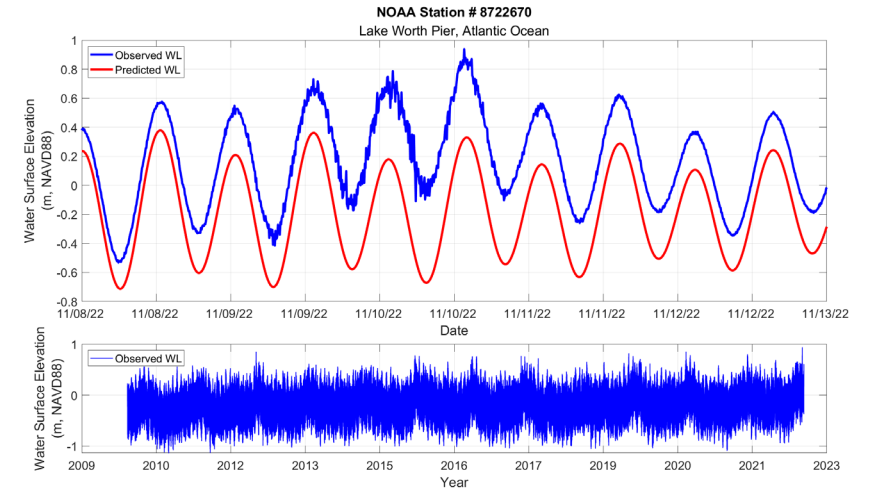
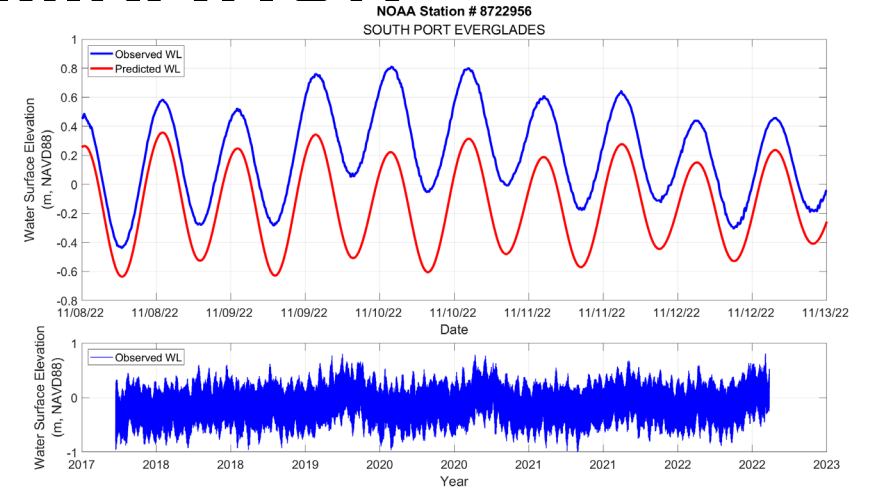
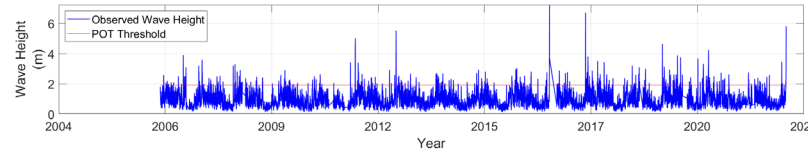
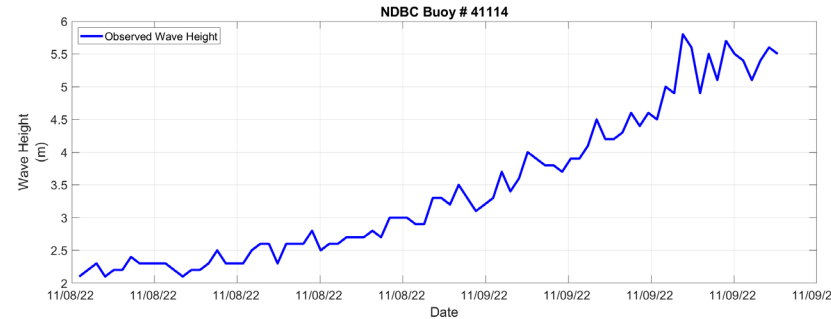


# HURRICANE NICOLE EXTRAORDINARY STORM DETERMINATION



## Southeast FL

- Highest water level on record at South Port Everglades and Lake Worth Pier
- Ft. Pierce buoy went offline during event
  - 3<sup>rd</sup> highest wave height
- Combined with Ian impacts
- Extraordinary



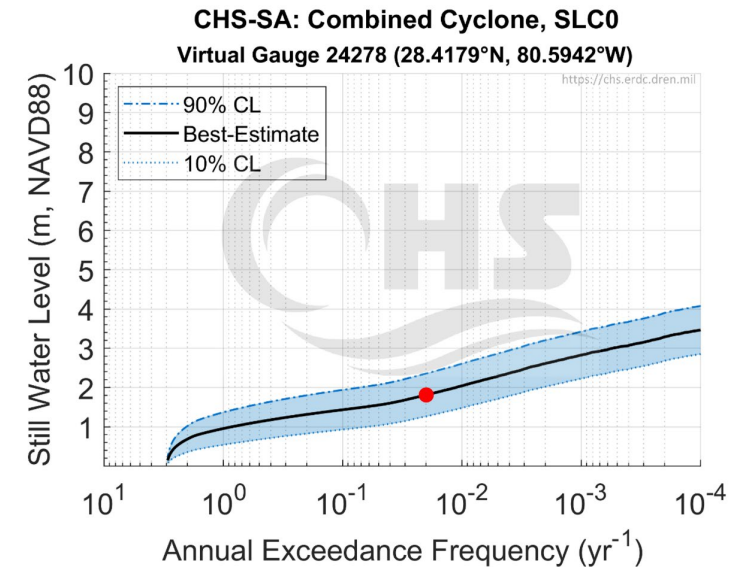
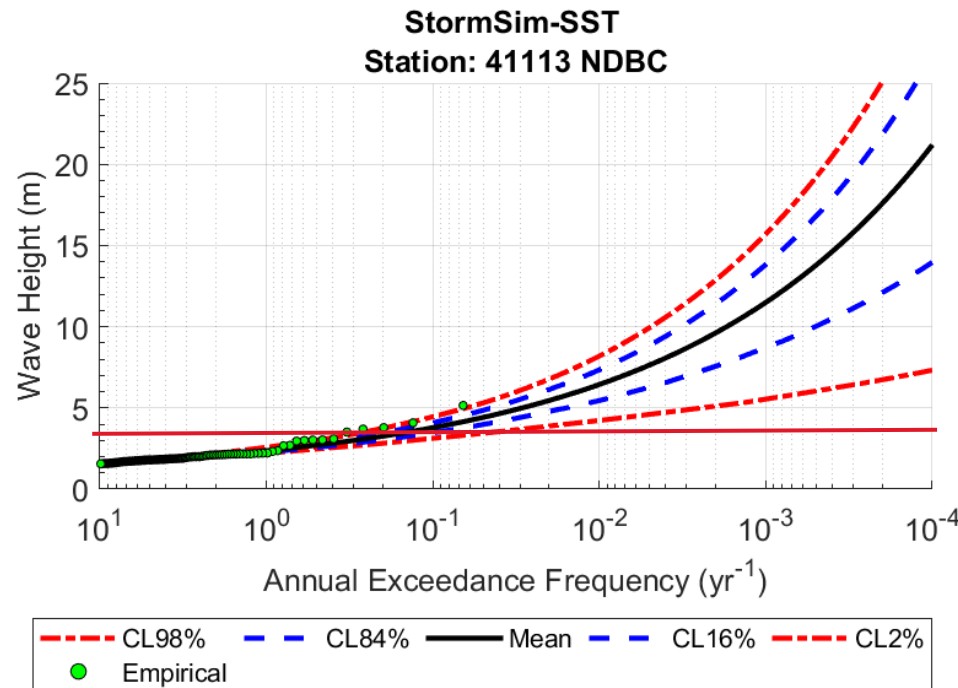
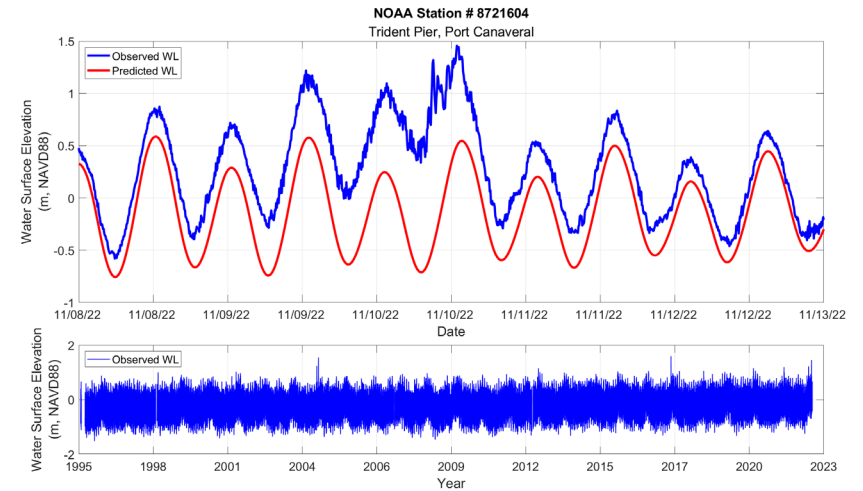
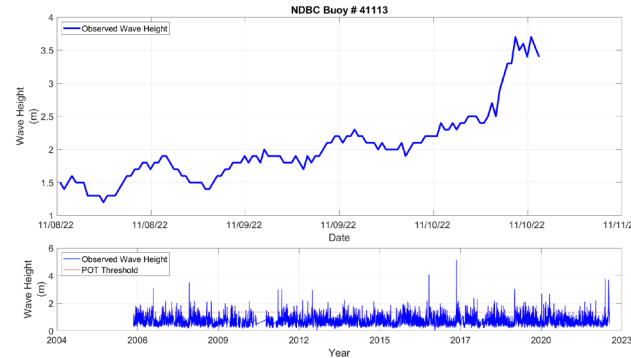


# HURRICANE NICOLE EXTRAORDINARY STORM DETERMINATION



## Central FL

- Cat 1 offshore
- SWL Comparison with Coastal Hazards System (CHS) Hazard Curves for WL
- ~0.09 AEF (11 yr)
- Canaveral buoy went offline
- StormSim-SST ARI ~ 9 yr
- Extraordinary





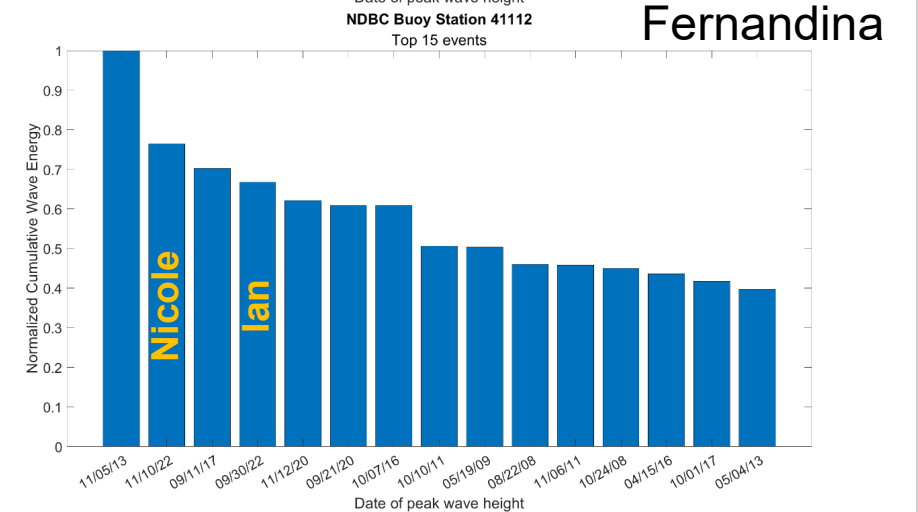
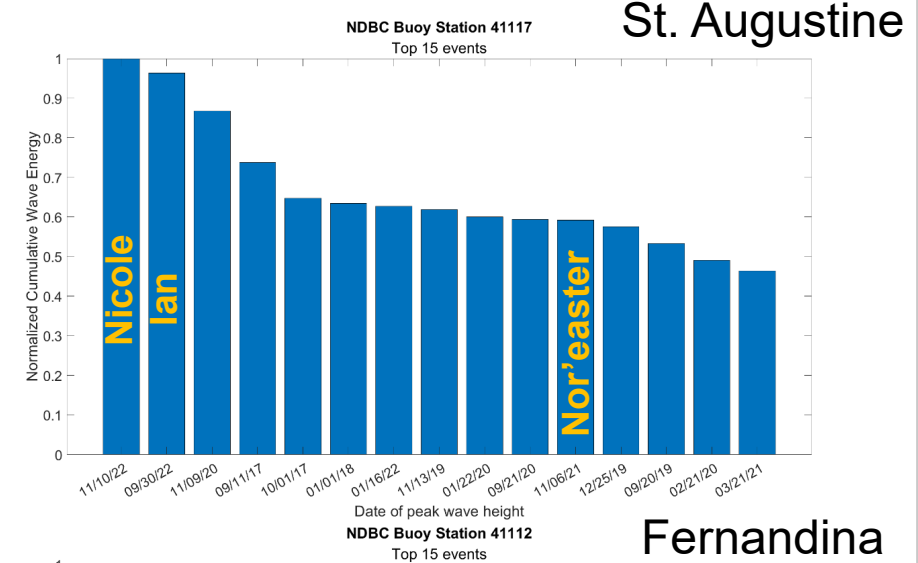
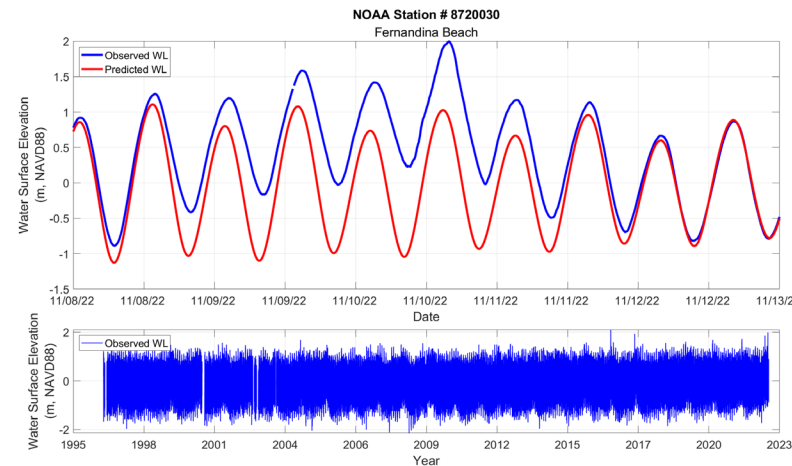
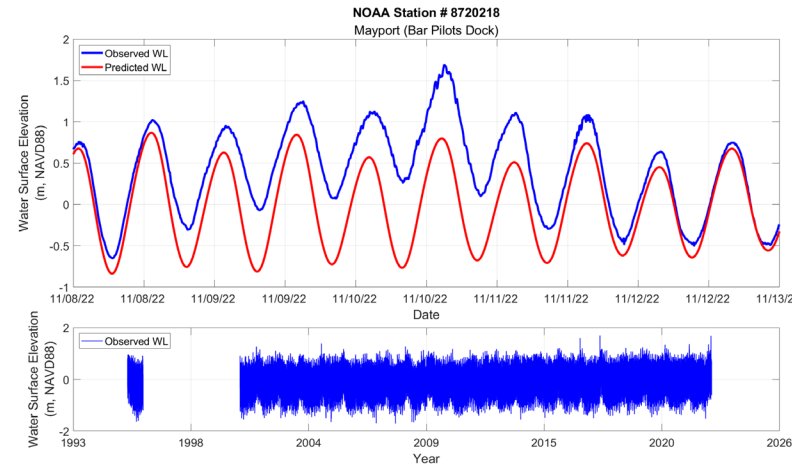


# HURRICANE NICOLE EXTRAORDINARY STORM DETERMINATION



## Northeast FL

- Long duration
- Water levels 2<sup>nd</sup> in 6-min WL record (~ 30 yrs)
- Peak waves 3<sup>rd</sup> highest at 41117 and 41112
- Highest rank in cumulative wave energy
- Extraordinary





# SUMMARY



- It's been a busy year in Florida
  - Catastrophic damage throughout Southwest FL from Ian
  - Repeated extraordinary erosional events in Northeast FL
  - Compound effects from Nicole and Ian led to large impacts in Southeast FL
- Guidance does not make Extraordinary Storm analysis straightforward
  - Hydrodynamic and morphodynamic impacts are not always correlated to Saffir-Simpson Scale Category
  - Projects are not designed to a single design storm or event
- Data is very important
  - We always need more observations
  - Often data / peaks are not captured in storm events
  - Wave observation voids off Southeast (soon to be improved) and Southwest Florida
  - Water level observations are sparse
  - USGS Flood Event Viewer can supplement some of the voids, but more permanent longer-term records would help



# EXTRAORDINARY STORM ANALYSIS



## Contact Information:

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