New Jersey's Rising Seas and Changing Coastal Storms An Overview of the 2025 NJ STAP Report

- December 16, 2025 -

RUTGERS–NEW BRUNSWICK
New Jersey Climate Change Resource Center

Agenda

- Introduction
- Sea-level Rise and Flooding Findings
- Coastal Storms Findings
- Questions

Recognition and Thanks

- **Science and Technical Advisory Panel (STAP) Members**
  - Dr. Robert Kopp, Dr. Anthony Broccoli, Glen Carleton, Dr. Sönke Dangendorf, Dr. Rob DeConto, Dr. Ryan Frederiks, Dr. Andra J. Garner, Emily Grover-Kopec, Dr. LeeAnn Haaf, Dr. Benjamin Hamlington, Dr. Ning Lin, Dr. Jorge Lorenzo-Trueba, Dr. Jon Miller, Dr. David Robinson, Dr. Gabriel Vecchi, Dr. Thomas Wahl, Dr. Jennifer Walker
- **Review Editors**
  - Dr. Donald F. Boesch, Dr. William Hallman
- **Reviewers**
  - Dr. Richard Lathrop, Dr. Kenneth Miller, Dr. William Veatch
- **Practitioner Panel Members**
  - Coastal planners, coastal restoration, developers, emergency management specialists, engineering firms, industry specialists, local governments, non-profits and more.
- **Science and Managing Support Team**
  - Janine Barr, Dr. James Shope, Diana K. Apoznanski, Dr. Praveen Kumar, Lucas Marxen, Ashlyn Spector, Dr. Karen O'Neill, Lisa Auermuller, Dr. Marjorie Kaplan
- **Funders**
  - NJDEP and the New Jersey Climate Change Resource Center

Introduction

Science and Technical Advisory Panel (STAP) Background

- Purpose of the STAP:
  - To identify and evaluate the most current science on sea-level rise projections and changing coastal storms for New Jersey.
  - Be policy-relevant, not policy-prescriptive. The report does not make recommendations about how decision makers should use projections.

- The 2025 STAP Report is the third STAP Report:
  - 2016 led by Rutgers at request of NJ Climate Change Alliance
  - 2019 led by Rutgers at request of NJDEP
  - 2025 led by Rutgers at the request of NJDEP

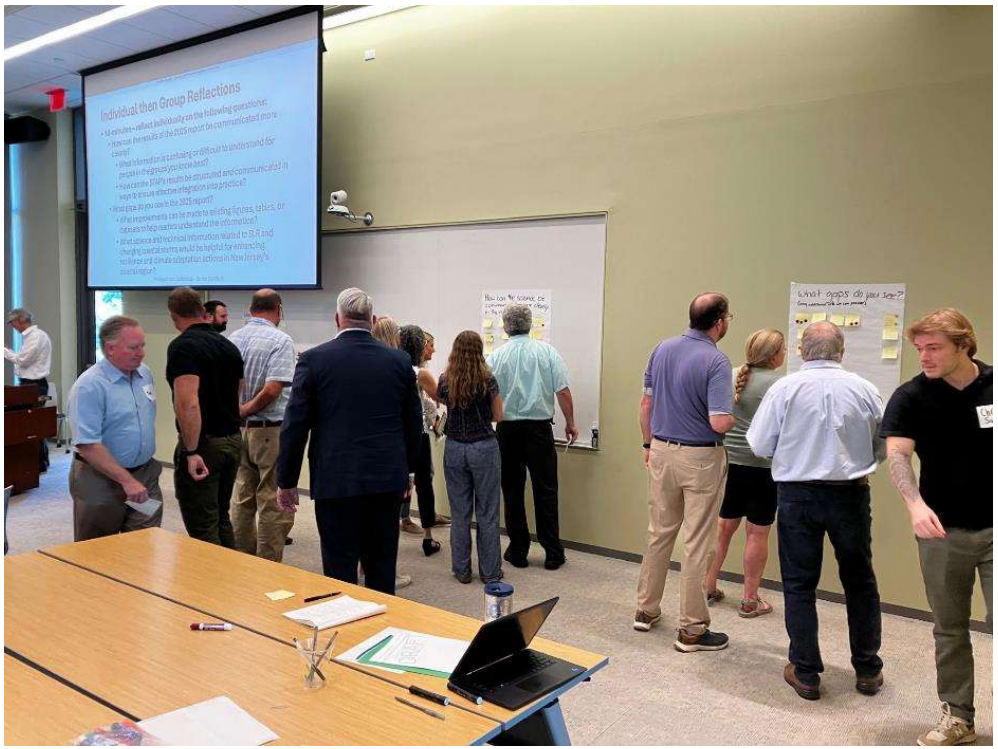
- STAP Reports updated periodically
  - Previous STAPs have recommended their estimates be reviewed and updated regularly, not to exceed 5 years, and after the publication of relevant global (*i.e.*, IPCC) or national assessments.

STAP Process

- Data Gathering
  - Call for literature and data (144 scientists contacted, 95 materials provided)
  - FACTS 1.1 sea-level rise estimates generated
  - Figure development and writing
- Data Discussion and Draft STAP Report
  - STAP Meeting
  - Subject Matter Expert Drafting Sessions
- Review of Draft STAP Report
  - Review Editors and Reviewers
  - Practitioner Panel
- Refining Draft STAP Report to Reflect Input
  - STAP Meeting
- Report Published (November 2025)

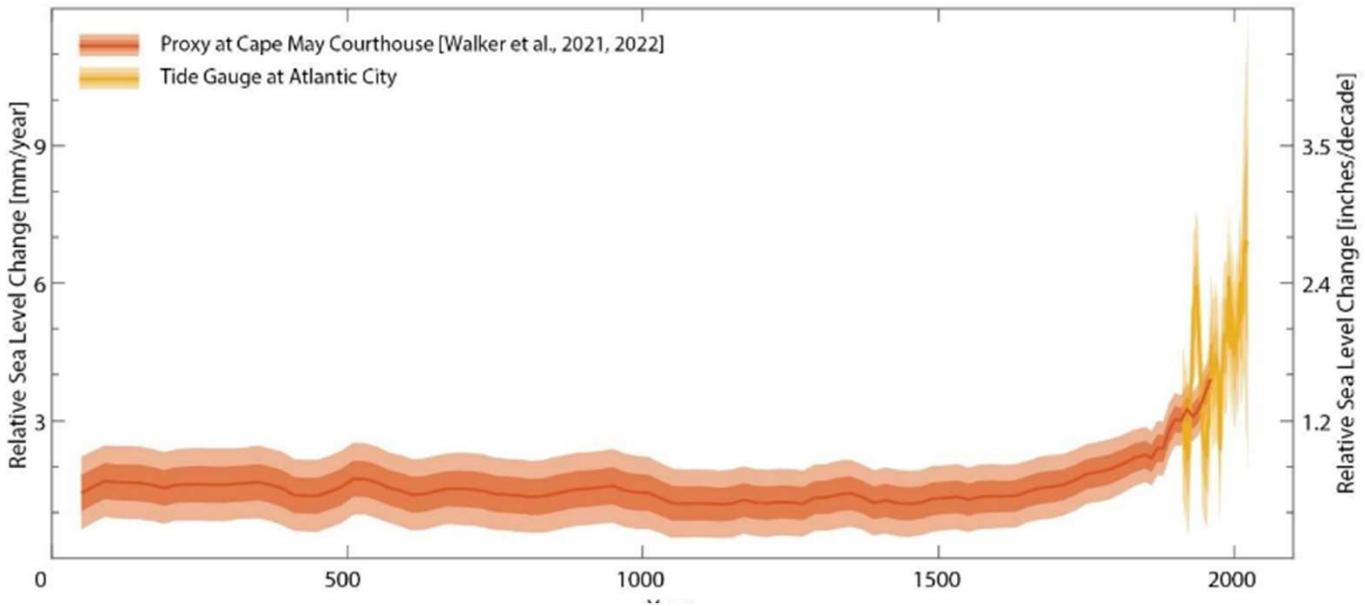
Engaging a Range of Experts

- *Academia/Science* – Recreate the rigor of the peer review process using the National Academies of Sciences, Engineering, and Medicine's guidelines for report review
- *Practitioners* – Offer insights to ensuring the report was understandable, applicable, and implementable by practitioners.



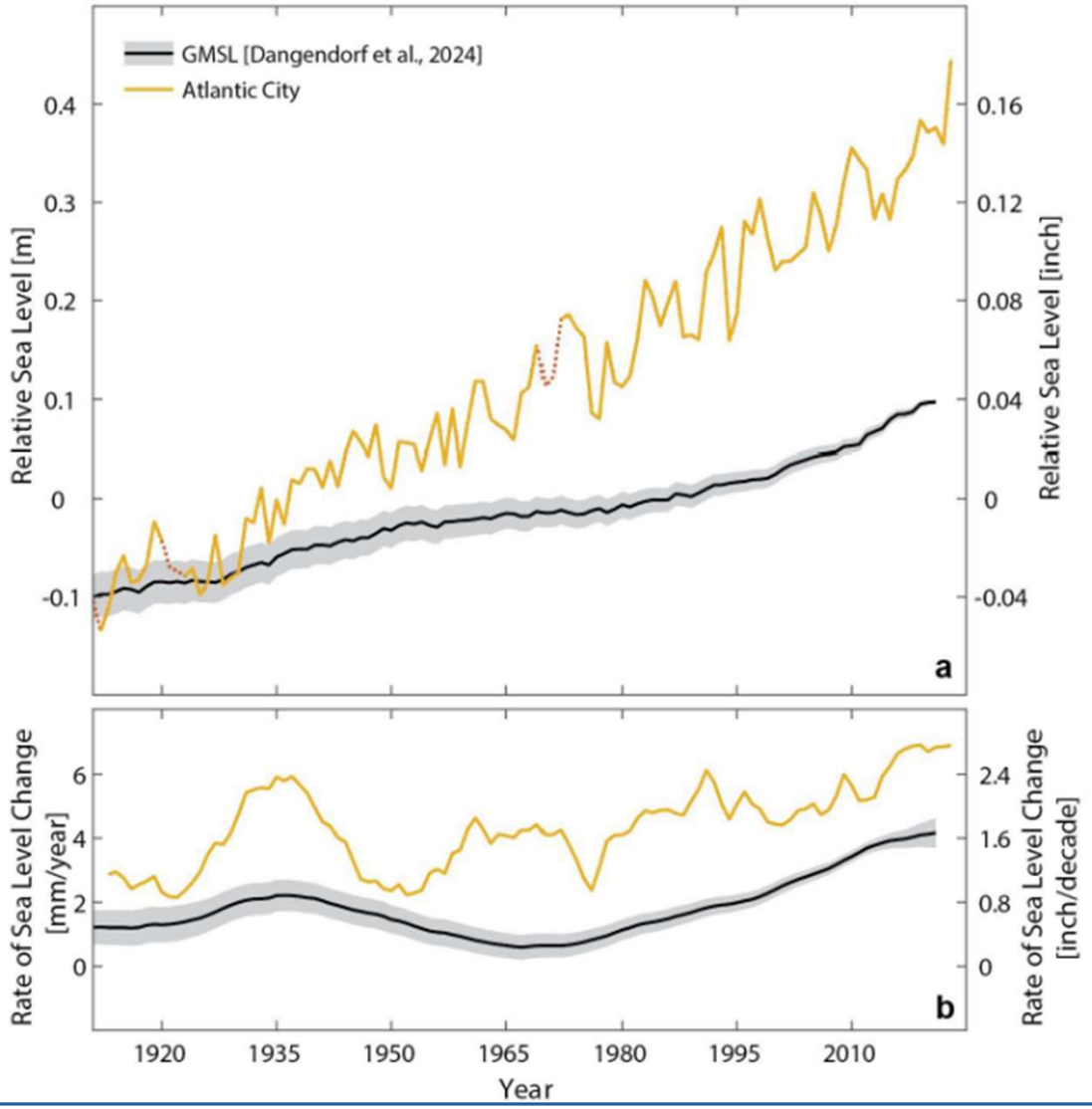
Sea-Level Rise and Flooding Findings

Sea-level rise is accelerating in New Jersey and globally



Based on geological data, over the Common Era prior to the late nineteenth century, in New Jersey sea-level rose at an average rate of about 0.5 ± 0.1 inches/decade (1.4 ± 0.2 mm/yr). This rate is due to regional GIA (Walker et al., 2021). Over this time period, the GMSL change was minimal.

Rates of sea-level rise in New Jersey, and globally, exceed pre-industrial variability beginning in the late nineteenth century.

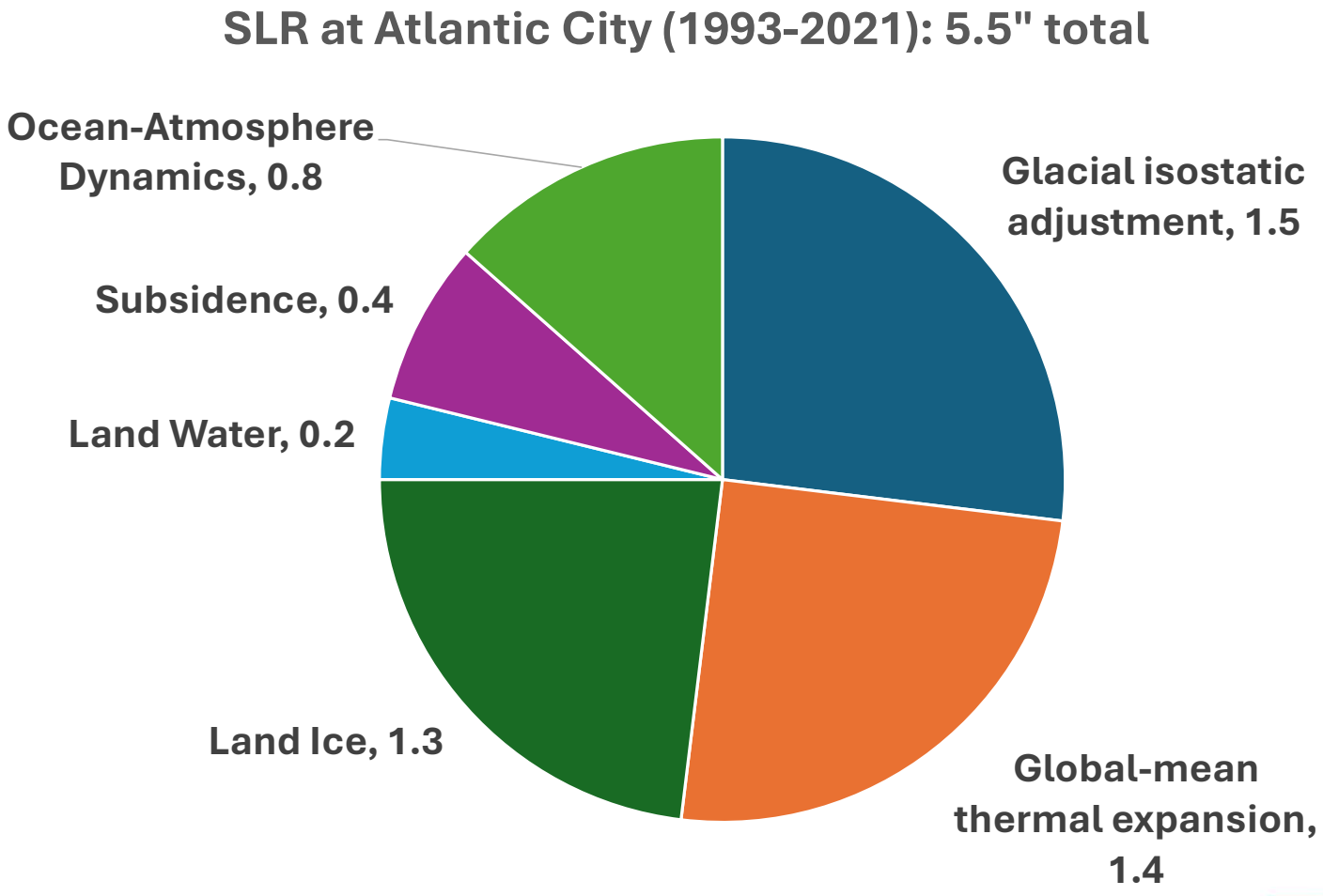


Sea-level rise is accelerating in New Jersey and globally

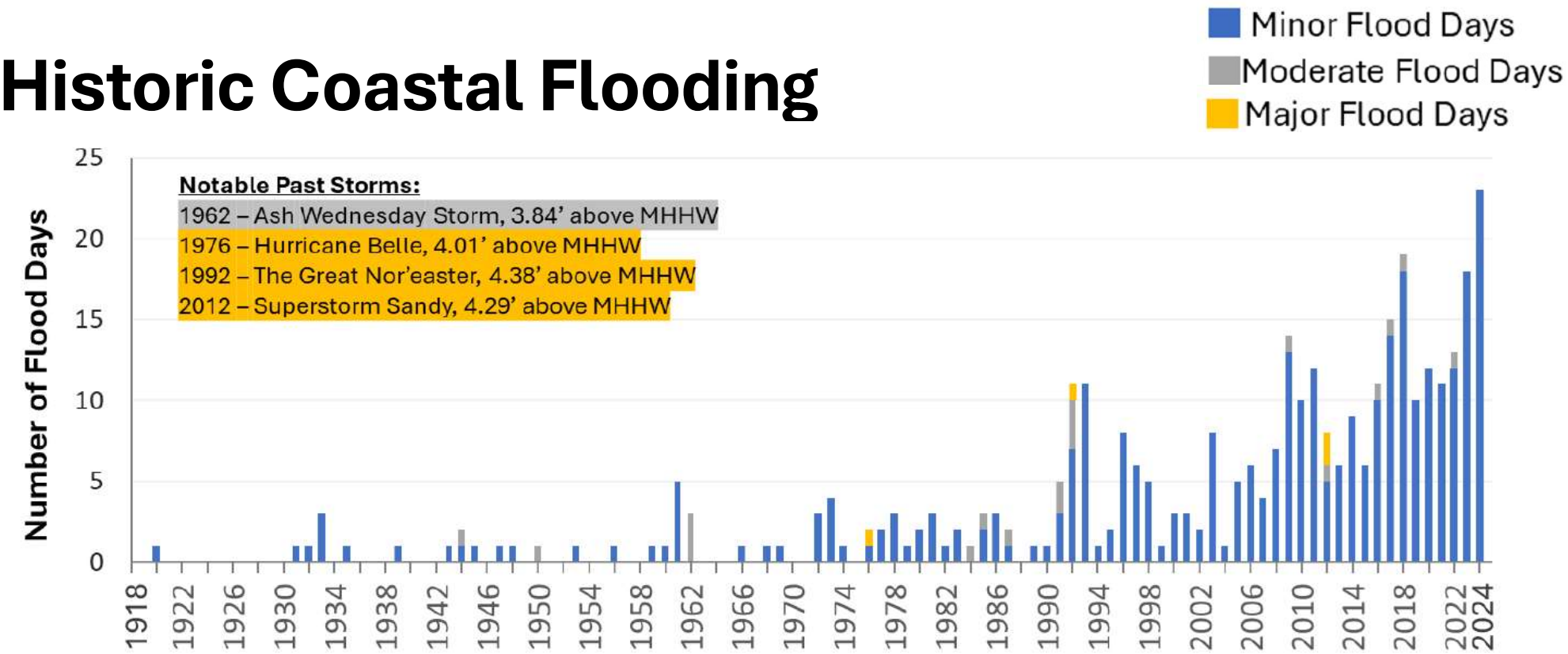
From 1912 to 2021, sea-level rose 1.7 ± 0.1 inches/decade (4.2 ± 0.2 mm/yr) at the Atlantic City tide-gauge, compared to a GMSL rise of 0.6 ± 0.1 inches/decade (1.5 ± 0.2 mm/yr).

From 1970–2021, sea-level rose 1.9 ± 0.2 inches/decade (4.9 ± 0.6 mm/yr) along the New Jersey coast, compared to a GMSL rise of 0.9 ± 0.2 inches/decade (2.2 ± 0.5 mm/yr).

Sea-level rise is accelerating in New Jersey and globally

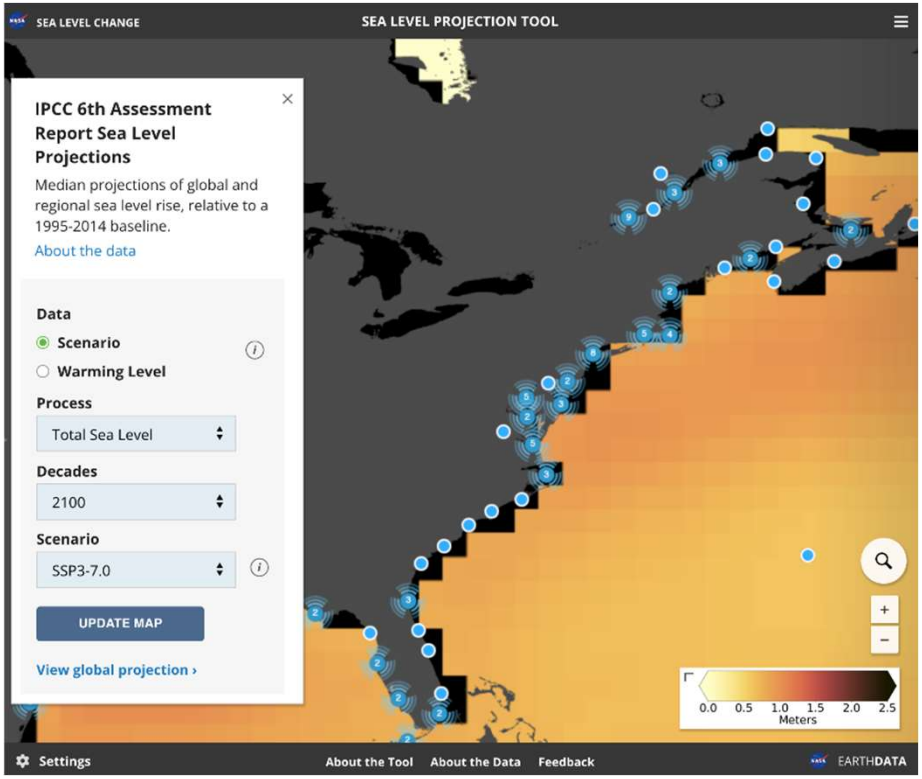


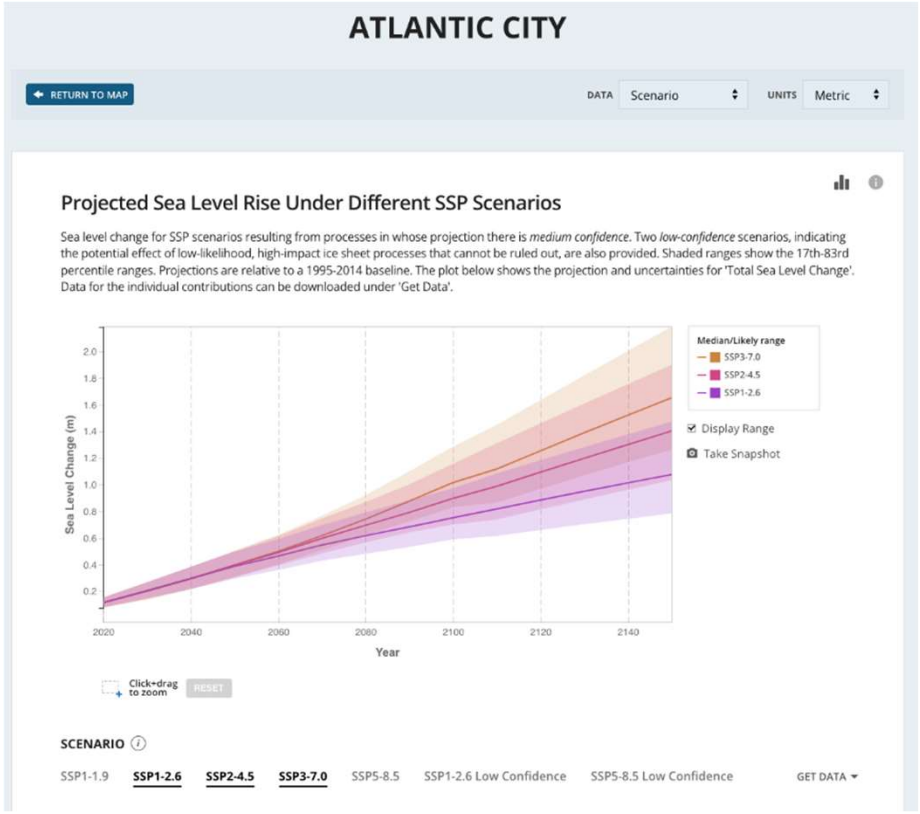
Historic Coastal Flooding



- The total number of New Jersey coastal flood days has increased in frequency and magnitude over time as a result of sea-level rise.
  - In the 1950s, Atlantic City experienced an average of less than one coastal flood day per year.
  - Over 2007–2024, there were an average of twelve coastal flood days per year, with annual totals ranging between four coastal flood days in 2007 and an all-time high of 23 coastal flood days in 2024.

The New Jersey sea-level projections produced by the IPCC Sixth Assessment Report (AR6) accurately represent the state of the science and provide a solid foundation for the work of the STAP.





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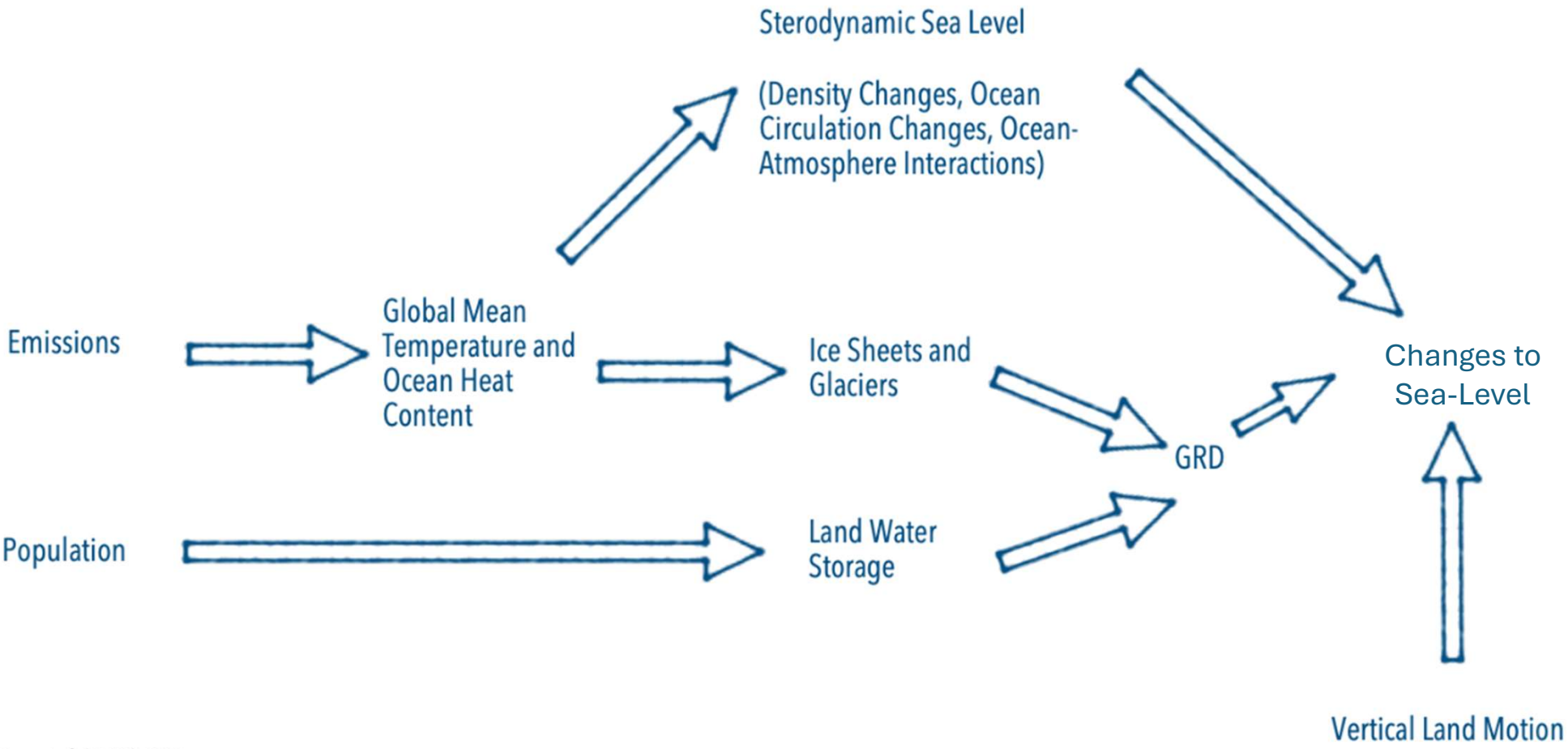
A typical experiment in FACTS, the Framework for Assessing Changes To Sea-level



Kopp et al. (2023), GMD

The 2025 STAP employs the Shared Socioeconomic Pathway scenarios, consistent with AR6.

Shared Socioeconomic Pathway Scenario	Anticipated Warming by 2081-2100 Units: Median (90% likely range)	Notes
SSP1-2.6 (Low emissions)	1.8°C (1.3-2.4°C)	Comparable to **STAP 2019 Low (2°C)** scenario
SSP2-4.5 (Intermediate emissions)	2.7°C (2.1-3.5°C)	Comparable to current global policies
SSP3-7.0 (High emissions)	3.6°C (2.8-4.6°C)	Comparable to **STAP 2019 Moderate (3.5°C)** scenario and to global policies as of 2016
SSP5-8.5 (Very high emissions)	4.4°C (3.3-5.7°C)	Comparable to **STAP 2019 High (5°C)** scenario

New Jersey Sea-Level Rise Projections Table (values in feet)*

	Across Emissions Scenarios		Low Emissions (SSP1-2.6)			Intermediate Emissions (SSP2-4.5)			High Emissions (SSP3-7.0)		
Degrees of Warming (°C)†	***1.7*** *(1.3-2.5) °C Warming*	***1.9*** *(1.3-3.1) °C Warming*	***1.7*** *(1.3-2.4) °C Warming*	***1.6*** *(1.2-2.3) °C Warming*	***1.5*** *(1.1-2.3) °C Warming*	***2.3*** *(1.8–3.0) °C Warming*	***2.6*** *(2.0-3.6) °C Warming*	***2.8*** *(2.1-4.0) °C Warming*	***2.8*** *(2.2- 3.5) °C Warming*	***3.8*** *(3.0-5.0) °C Warming*	***5.1*** *(3.9-7.0) °C Warming*
Year	**2040**	**2050**	**2070**	**2100**	**2150**	**2070**	**2100**	**2150**	**2070**	**2100**	**2150**
***Extremely Likely* to be Exceeded, Including or Excluding Potential Rapid Ice-Sheet Loss Processes**											
> 95% Chance SLR Exceeds*	0.5	0.7	1.1	1.3	1.7	1.2	1.8	2.5	1.3	2.1	3.2
***Likely* Range, Excluding Potential Rapid Ice-Sheet Loss Processes**											
> 83% Chance SLR Exceeds*	0.7	0.9	1.3	1.8	2.3	1.5	2.2	3.1	1.6	2.6	3.9
~50% Chance SLR Exceeds	1.0	1.3	1.8	2.4	3.5	1.9	2.9	4.5	2.0	3.3	5.5
<17% Chance SLR Exceeds‡	1.3	1.7	2.3	3.3	4.9	2.5	3.8	6.3	2.6	4.3	7.7
Extended *Likely* Range, Including Potential Rapid Ice-Sheet Loss Processes											
<17% Chance SLR Exceeds*	1.4	1.9	2.5	3.7	5.8	2.8	4.5	12.0	3.0	5.2	16.2
***Extremely Unlikely* to be Exceeded, Including Potential Rapid Ice-Sheet Loss Processes**											
< 5% Chance SLR Exceeds*	1.7	2.3	3.2	5.1	9.4	3.5	6.2	17.9	3.9	7.5	20.2

Consistent with previous STAP Reports, Atlantic City, which has the longest tide gauge record in the state, was selected to represent the New Jersey coast. Projections for Sandy Hook and Cape May are similar. Projections for the Battery and Philadelphia are modestly lower, primarily due to lower subsidence.

*values are also relative to a 2005 baseline (averaging over 1995-2014)

Future Coastal Flooding

Even without considering future changes to storm characteristics, future coastal flooding will be more frequent and intense due to rising sea levels.

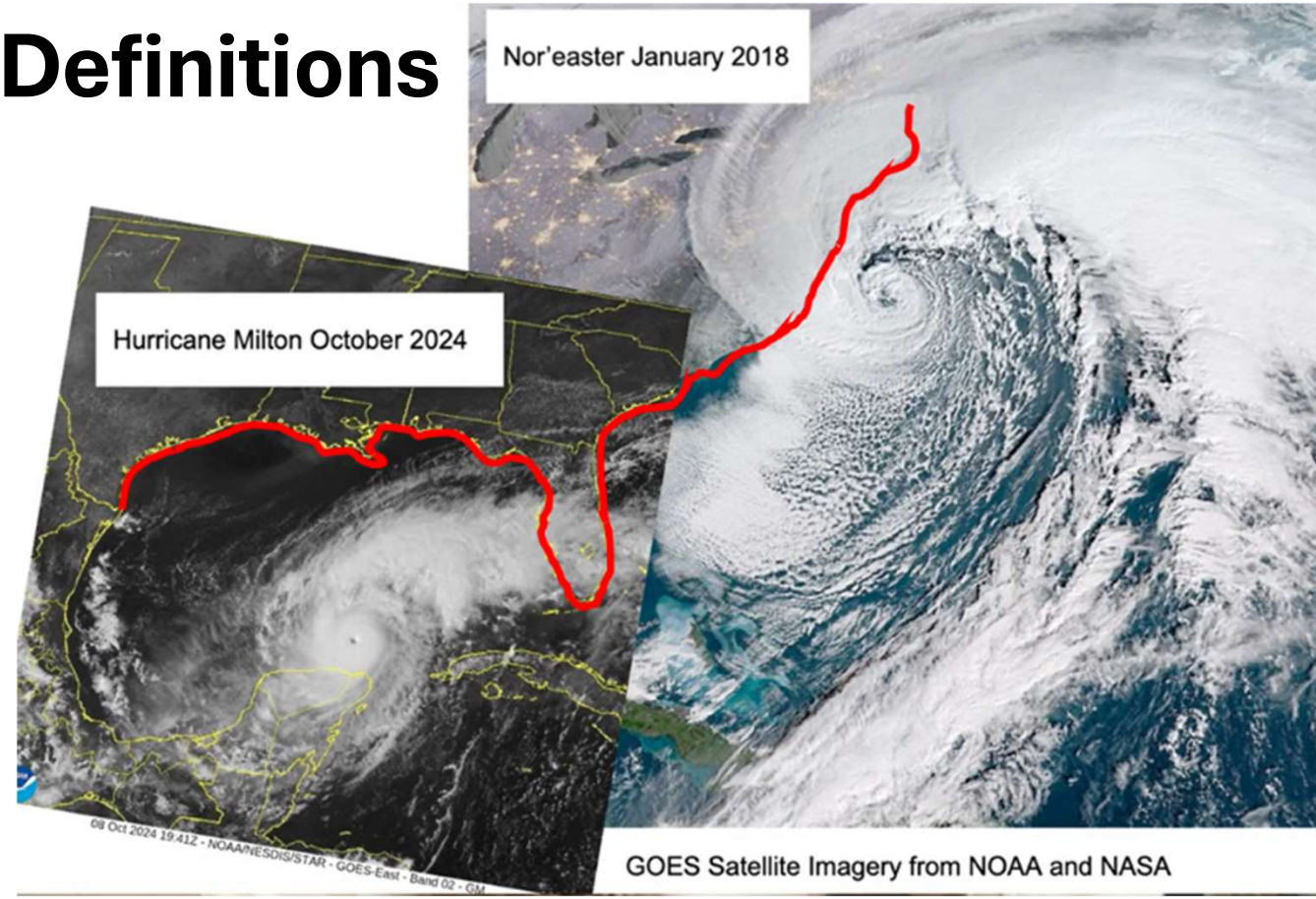
	Average Days Per Year of Coastal Flooding (Minor, Moderate, and Major) under the Intermediate-Emissions Scenario for Atlantic City							
	Year	2020	2030	2040	2050	2070	2100	2150
Minor Flooding	***Extremely Likely* to be Exceeded, Including or Excluding Potential Rapid Ice-Sheet Loss Processes**							
	> 95% Chance SLR Exceeds*	5	6	9	15	54	131	257
	***Likely* Range, Excluding Potential Rapid Ice-Sheet Loss Processes**							
	> 83% Chance SLR Exceeds	6	9	15	29	97	227	331
	~50% Chance SLR Exceeds	8	16	35	72	194	326	363
	<17% Chance SLR Exceeds‡	13	34	80	148	297	359	365
	Extended *Likely* Range, Including Potential Rapid Ice-Sheet Loss Processes							
	<17% Chance SLR Exceeds*	13	36	93	178	326	364	365
	***Extremely Unlikely* to be Exceeded, Including Potential Rapid Ice-Sheet Loss Processes**							
	< 5% Chance SLR Exceeds*	17	61	151	262	356	365	365

Coastal Storm Findings

Coastal Storm Definitions

- **Tropical Cyclones (TC)**- including hurricanes, are rapidly rotating warm-core low pressure systems that begin over tropical oceans and vary in wind speed, size, and intensity.

- **Extratropical Cyclones (ETC)**- called nor'easters along the US Atlantic coast, are large storms that form outside of the tropics and are typically larger than TCs and affect coastal New Jersey more frequently than TCs.



Compilation courtesy of Diana Apoznanski.

Coastal Storm Findings

- Higher sea levels will increase flooding and the impacts from high tides and coastal storms, which include hurricanes and nor'easters.

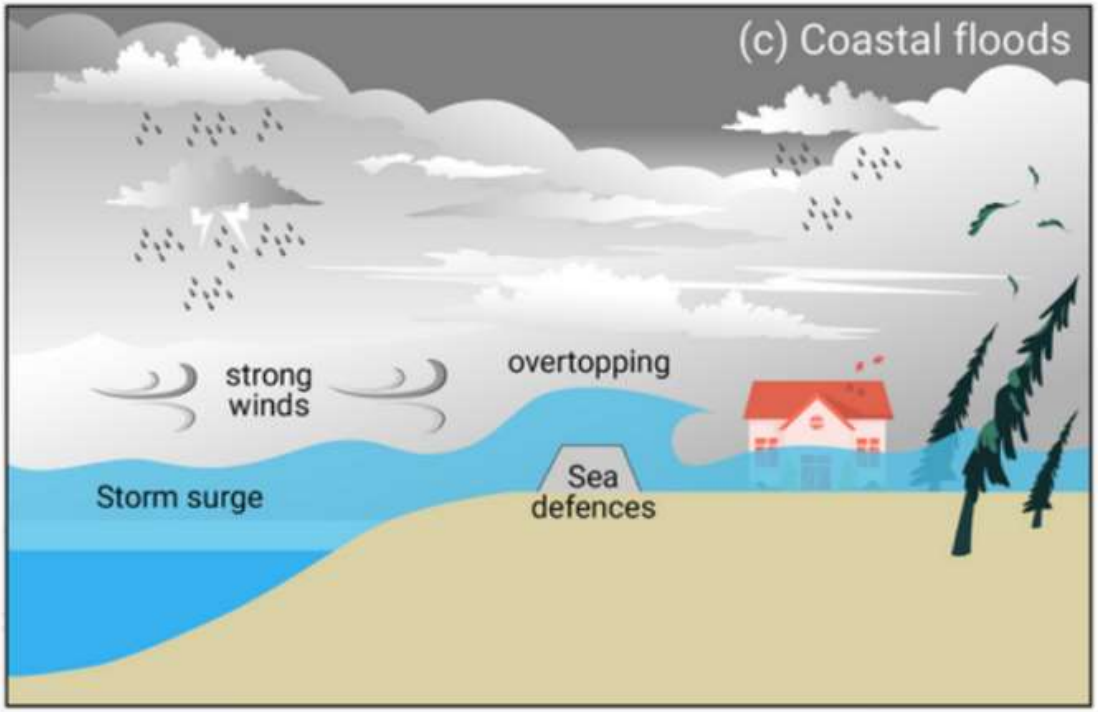
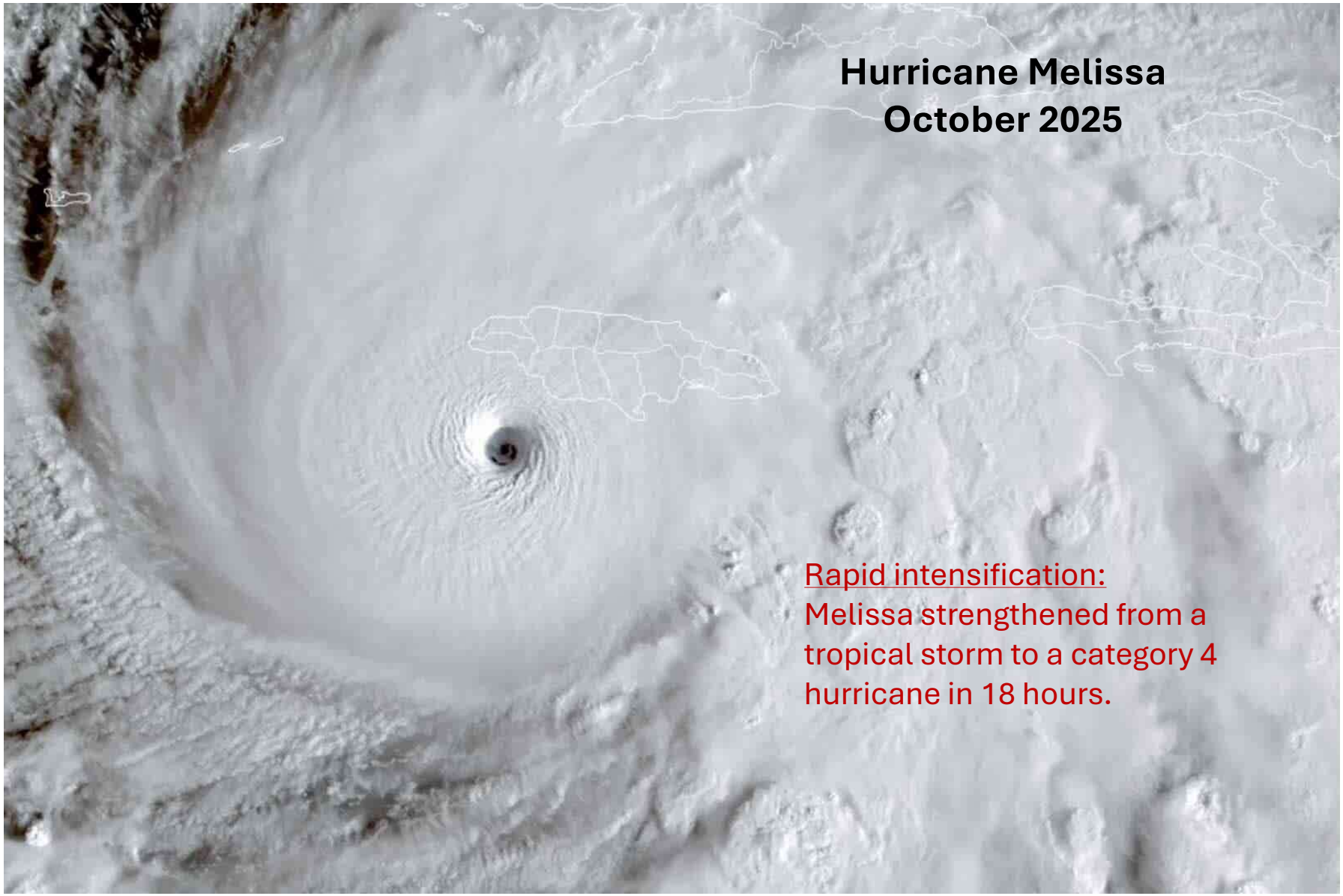


Image from Green et al. 2025.

Tropical Cyclone Findings

- TC frequency has increased over the North Atlantic since the 1980s. The overall intensity (i.e., wind speed) that Atlantic TCs achieve, and the rate at which they intensify, has also increased in recent decades. However, the relative role of various drivers (such as increases in greenhouse gases, decreases in particulate matter pollution, and natural variability) for such intensity changes is unclear.
- The historic rainfall intensity of tropical storms is increasing with climate change.
- While the annual average number of hurricanes is not expected to change in the future, hurricane wind speed, intensification rate, and rainfall intensity are expected to increase with warming.


Hurricane Melissa
October 2025
Rapid intensification:
Melissa strengthened from a tropical storm to a category 4 hurricane in 18 hours.

Hoboken PATH Station
December 1992 Nor'easter

Manasquan, NJ
October 2025 Nor'easter

Extratropical Cyclone Findings

- As with TCs, the precipitation intensity of ETCs has been increasing over time. However, long-term historical trends in ETC frequency, intensity, and trajectory remain an area of active research; currently, there is no definitive consensus regarding such changes.
- Likewise, predictions of long-term trends in ETC changes are limited and an active research area.

Hurricane Irene (2011)

Coastal Storm Findings

- Higher sea levels will increase flooding and the impacts from high tides and coastal storms, which include hurricanes and nor'easters.

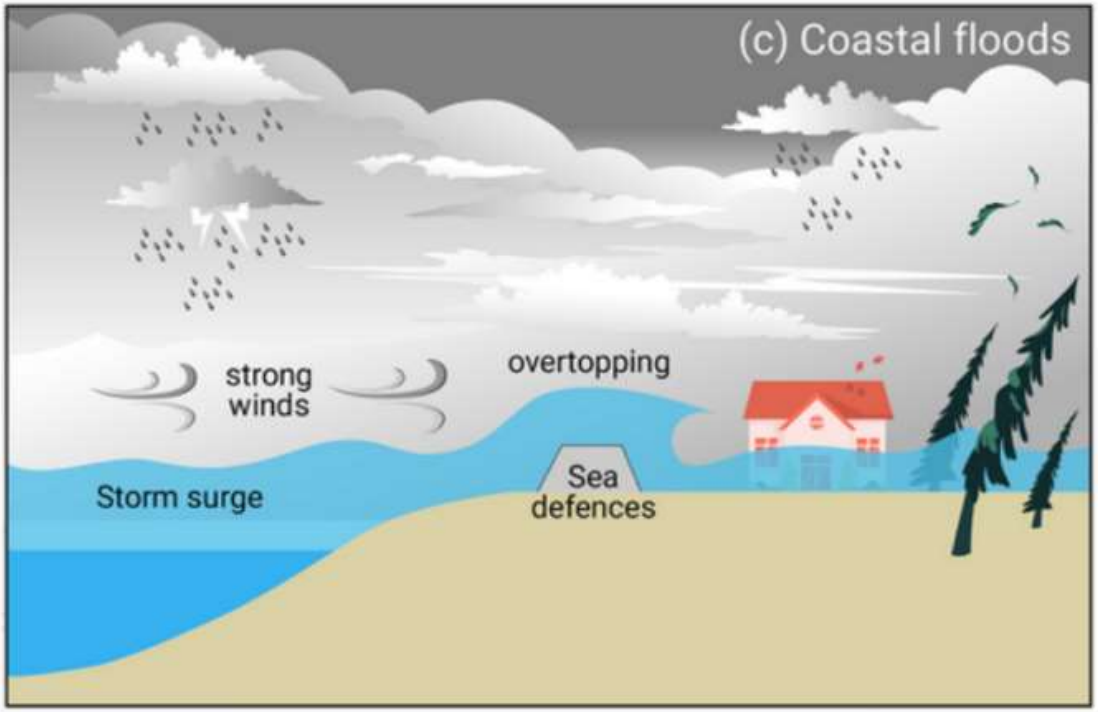


Image from Green et al. 2025.

Questions?

2025 STAP Report

Summary and FAQ Document

Digital Appendix