

VIRTUAL WALL OF WIND MITIGATION CHALLENGE

(Week of March 22, 2021)

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**Extreme Events
Institute**



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WHAT IS STEM EDUCATION?

WHAT IS STEM EDUCATION?

- SCIENCE
- TECHNOLOGY
- ENGINEERING
- MATH



WHAT IS THE SCIENCE OF WEATHER?

WHAT IS THE SCIENCE OF WEATHER?

METEOROLOGY

- REQUIRES MATH CLASSES
- REQUIRES SCIENCE CLASSES

A photograph of a lightning strike at night. A bright, branching lightning bolt strikes a single tree in a field. The ground is dark, and the sky is a deep purple. Other trees are visible in the background.

Meteorology

STEM Career

- SCIENCE
- TECHNOLOGY
- ENGINEERING
- MATH

METEOROLOGY IS THE STUDY OF WEATHER AND CLIMATE



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WHEN DOES THE HURRICANE SEASON START AND END?

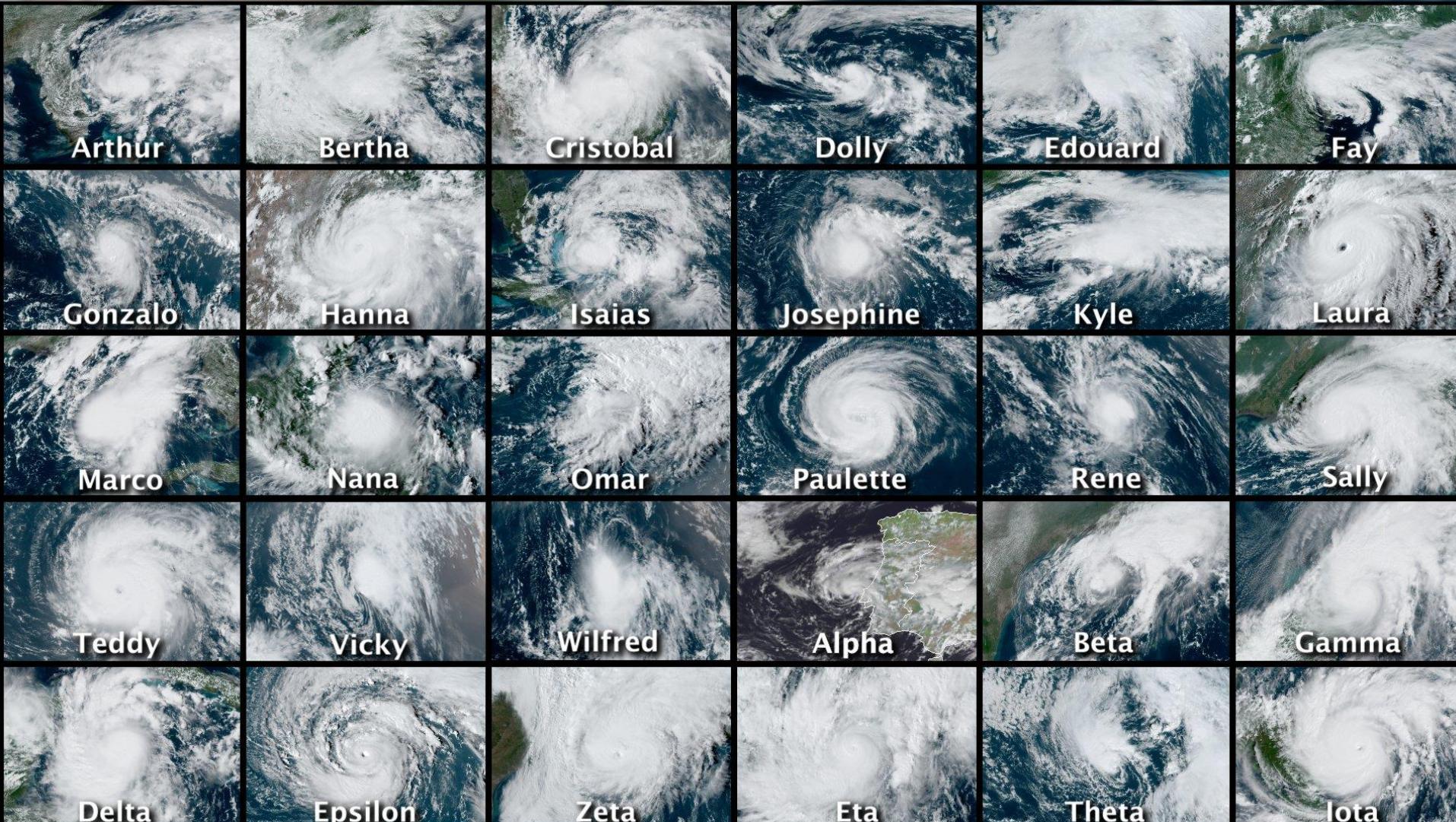
WHEN DOES THE HURRICANE SEASON START AND END?

Starts: June 1st

Ends: November 30th



The 2020 Atlantic Hurricane Season





2020 Atlantic Tropical Cyclone Names

~~Arthur~~
~~Bertha~~
~~Cristobal~~
~~Dolly~~
~~Edouard~~
~~Fay~~
~~Gonzalo~~

~~Hanna~~
~~Isaias~~
~~Josephine~~
~~Kyle~~
~~Laura~~
~~Marco~~
~~Nana~~

~~Omar~~
~~Paulette~~
~~Rene~~
~~Sally~~
~~Teddy~~
~~Vicky~~
~~Wilfred~~

~~Alpha~~
~~Beta~~
~~Gamma~~
~~Delta~~
~~Epsilon~~
~~Zeta~~
~~Eta~~
~~Theta~~

~~Iota~~
~~Kappa~~
~~Lambda~~
~~Mu~~
~~Nu~~
~~Xi~~
~~Omicron~~
~~Pi~~

Rho
Sigma
Tau
Upsilon
Phi
Chi
Psi
Omega

Be prepared: Visit [hurricanes.gov](https://www.hurricanes.gov) and follow @NWS and @NHC_Atlantic on Twitter.

11/24/20

Hurricane Numbers:

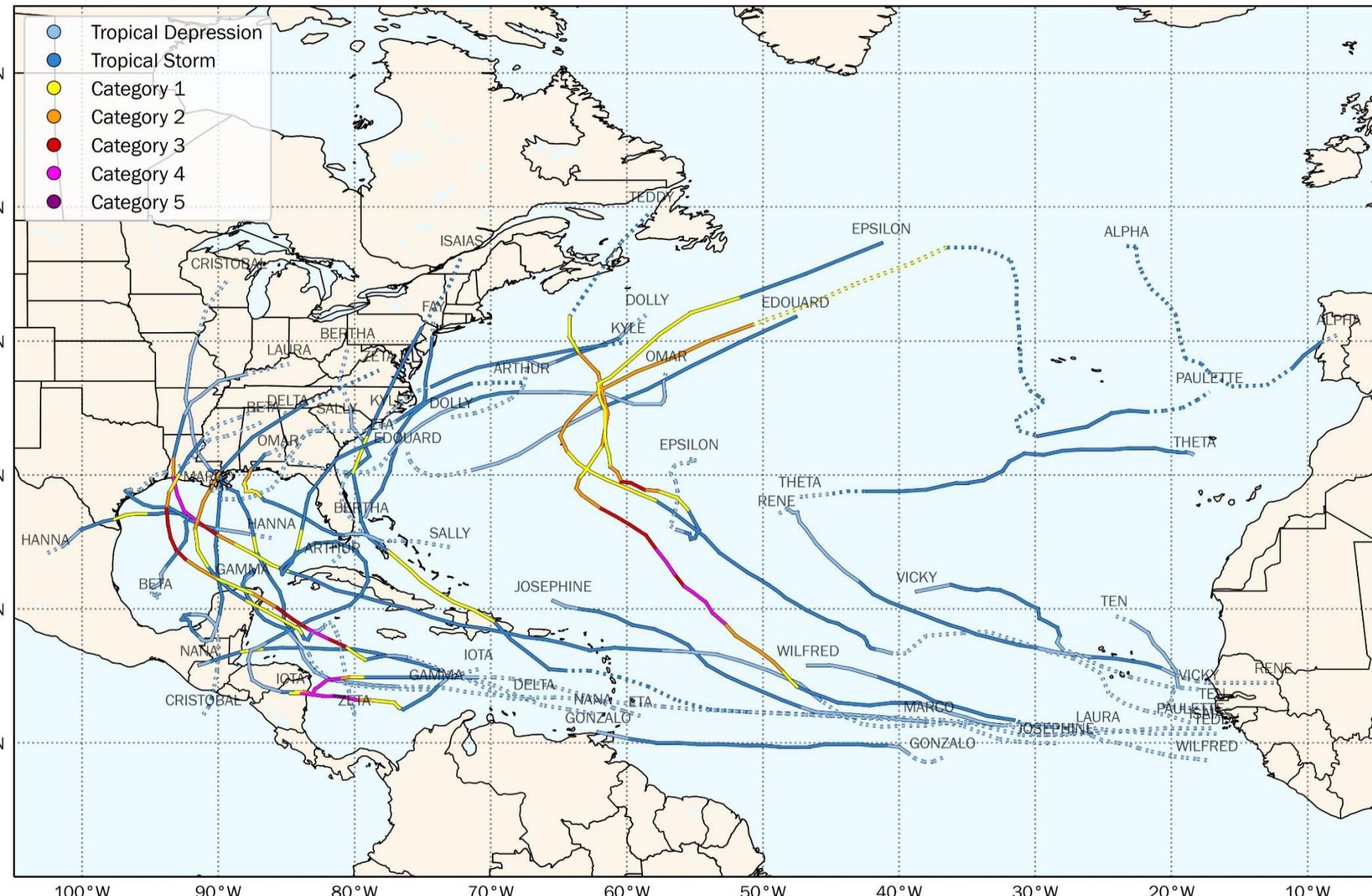
	Avg.	2020
Named Storms	12	30
Hurricanes	6	13
Majors (Cat. 3,4,5)	3	6

*We are in an active cycle that lasts 25 to 30 years.

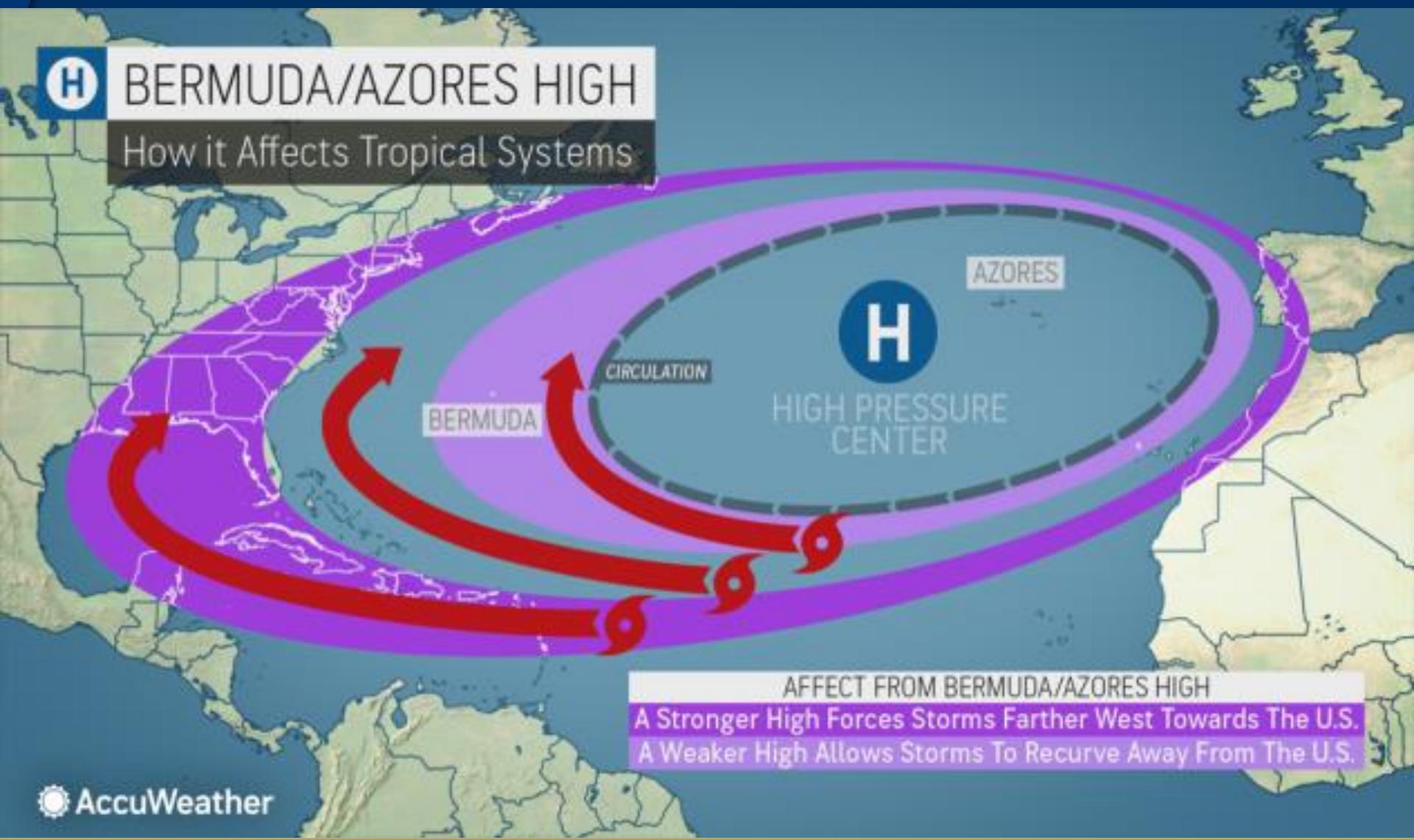
*The active cycle started in 1995.

2020 Atlantic Hurricane Season

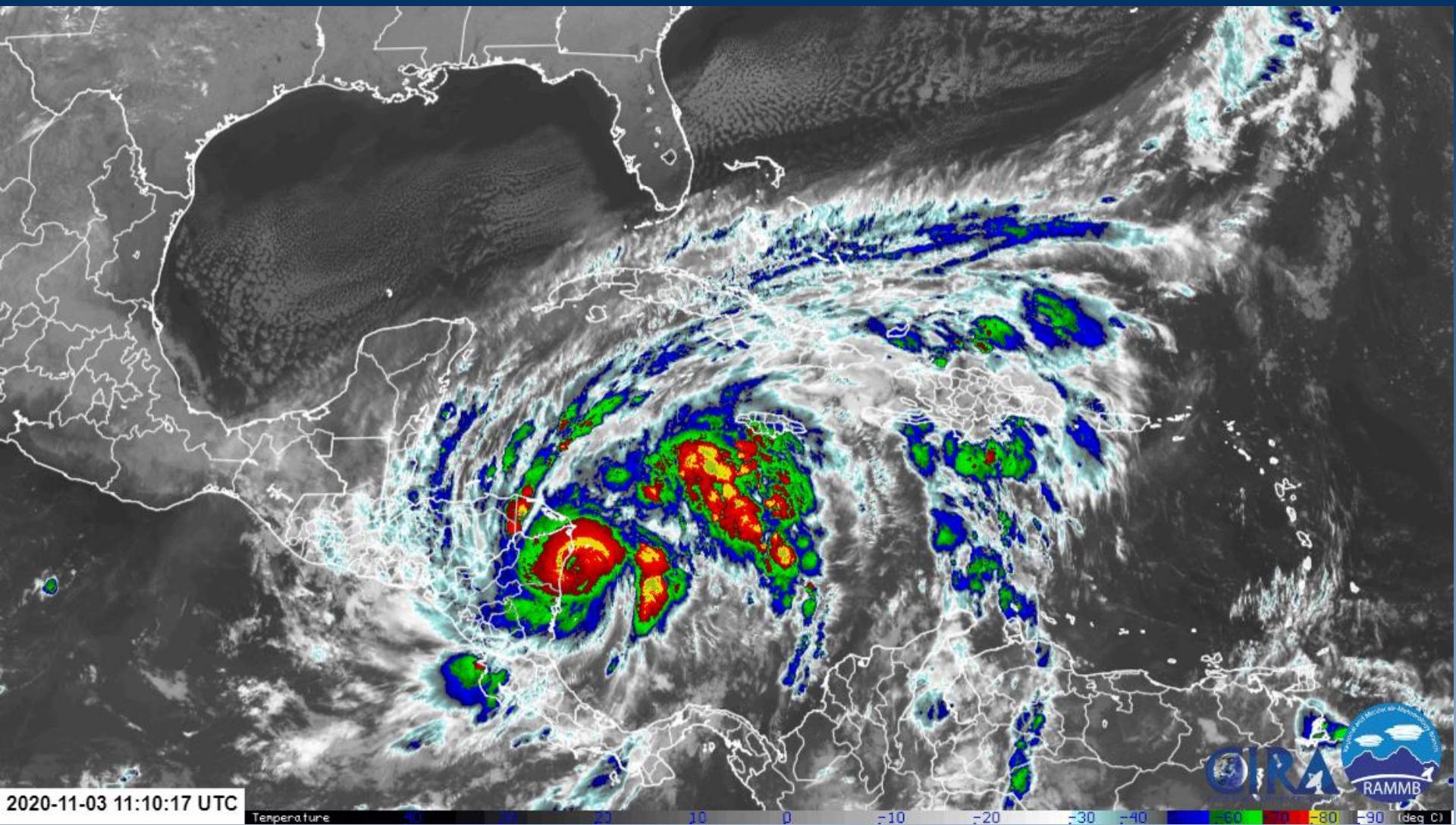
30 named • 13 hurricanes • 6 major
179.8 Cumulative ACE



Steering Currents



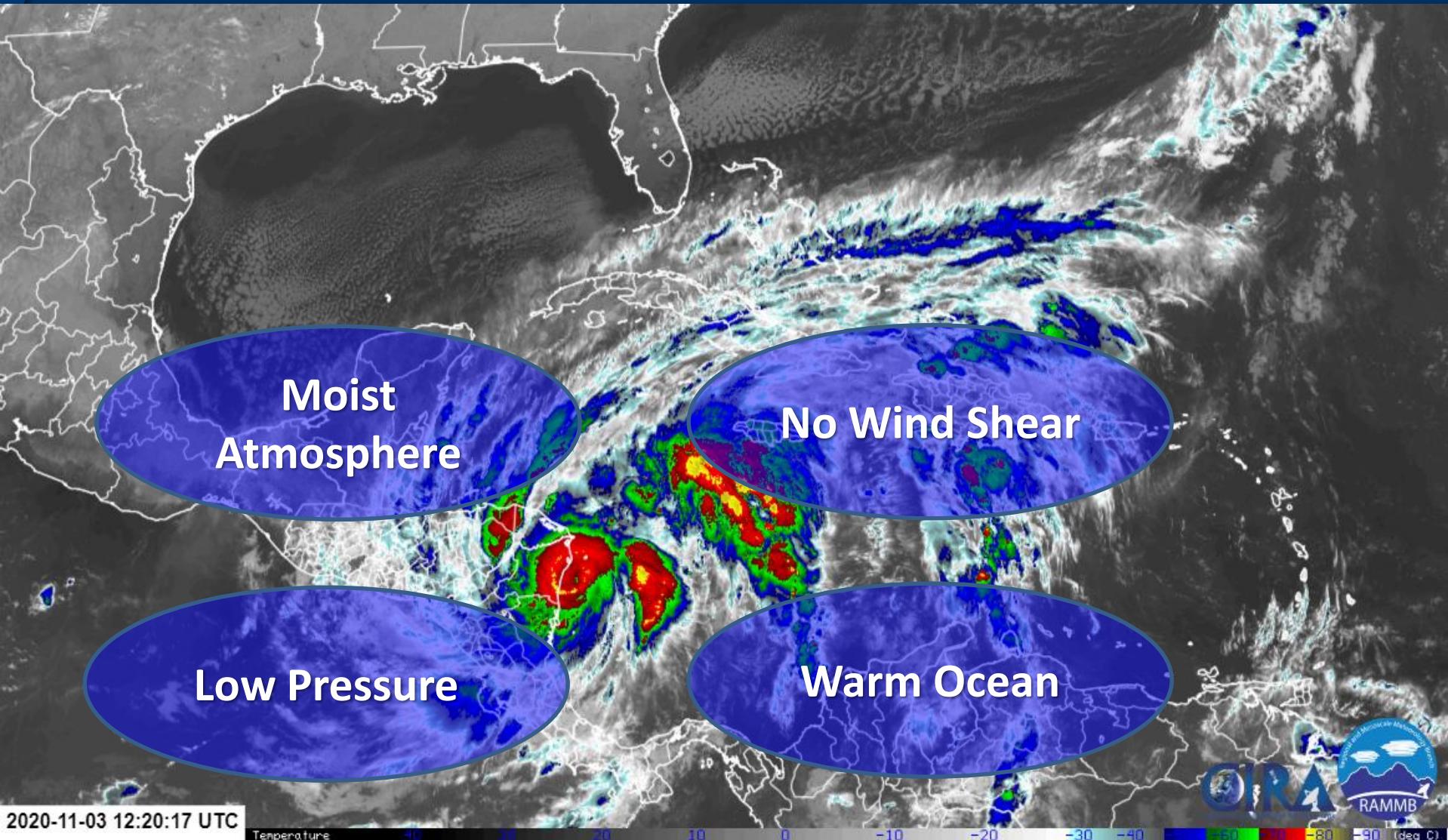
Hurricane Eta



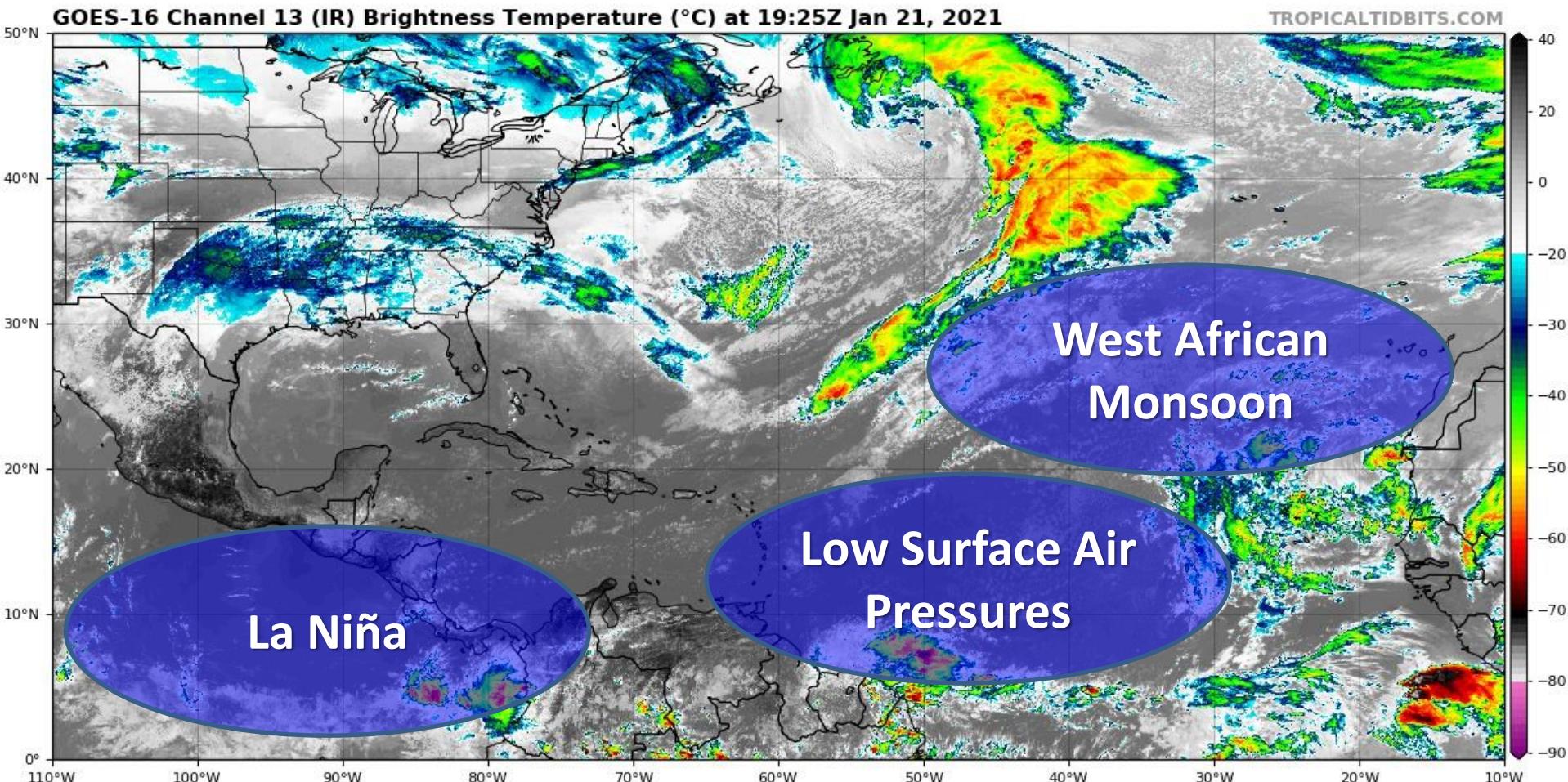
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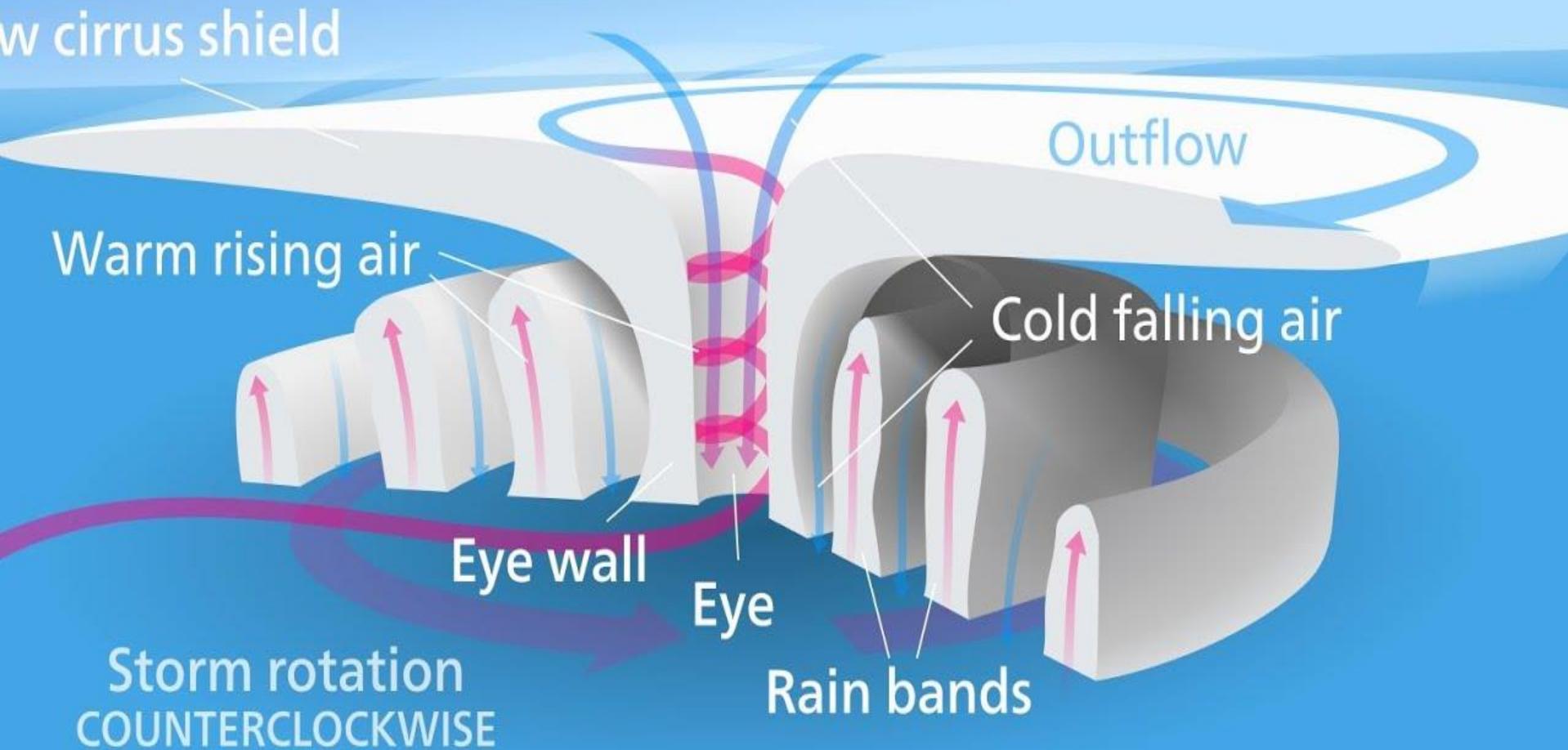
Hurricane Recipe



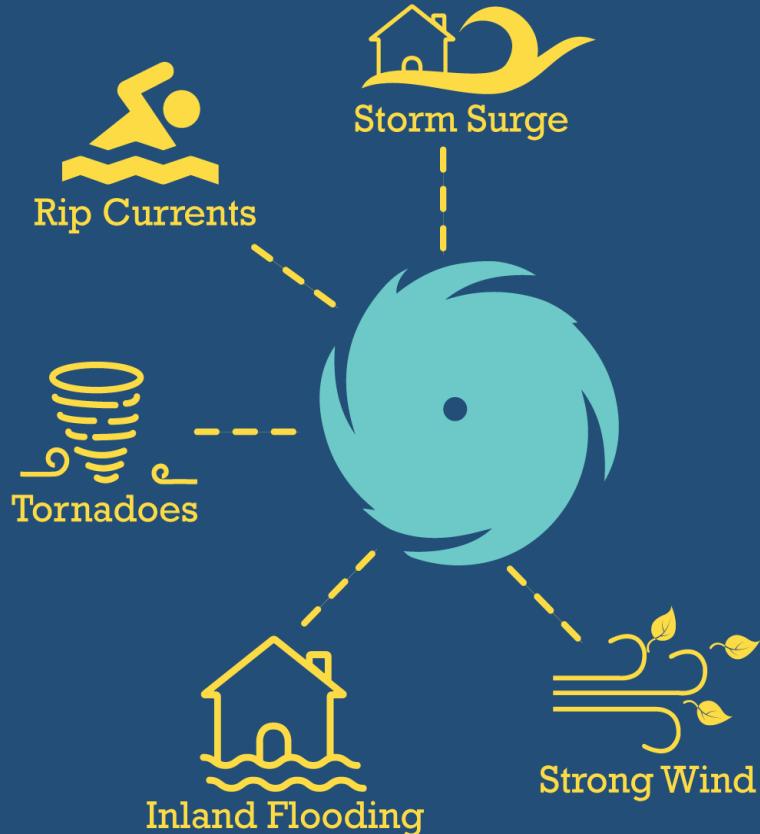
2020 Hurricane Recipe



HURRICANE STRUCTURE IN THE NORTHERN HEMISPHERE



Weapons of a Hurricane



Determine Your Risk

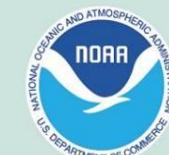
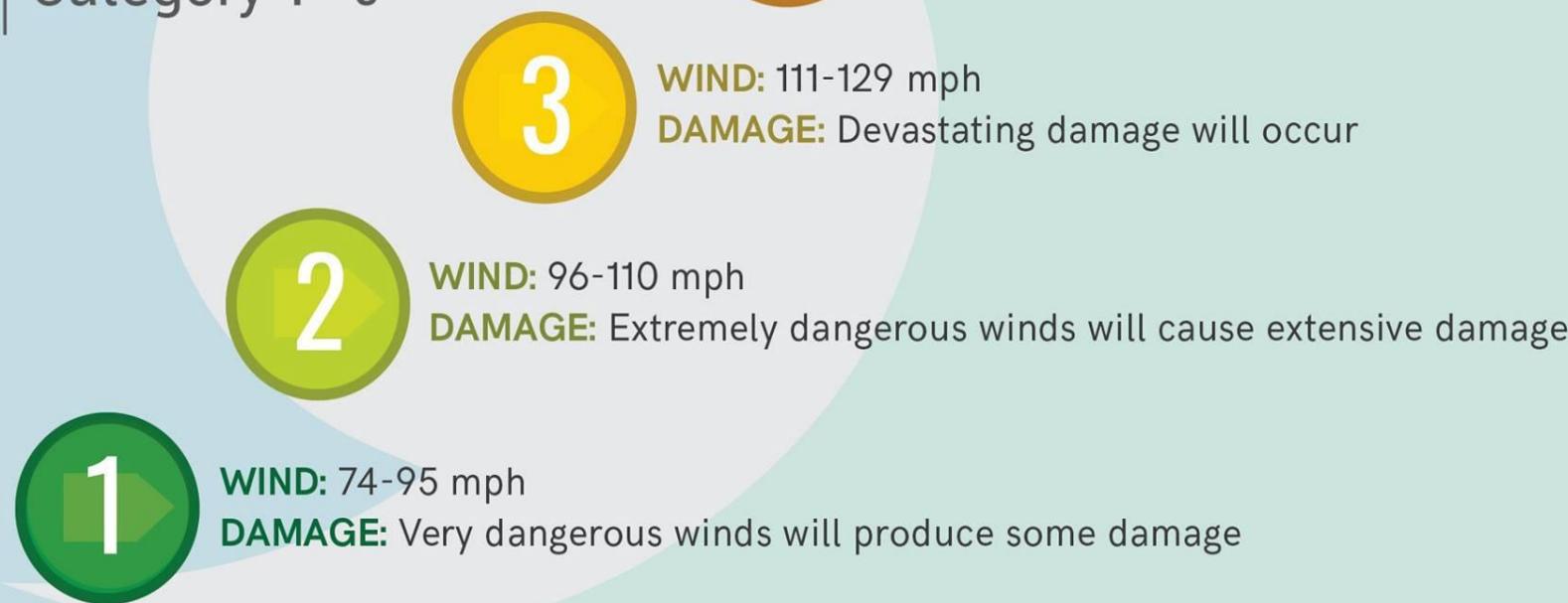
Hurricanes bring many hazards to U.S. coastlines and inland areas, including storm surge along the coast, inland flooding due to heavy rainfall, tornadoes, strong wind, rip currents and large waves.



Hurricane Categories

Saffir-Simpson Hurricane Wind Scale

Category 1 - 5



Storm Surge



Storm Surge

Storm Surge Warning

There is a **danger of life-threatening inundation** from rising water moving inland from the shoreline generally **within 36 hours**.

Promptly follow evacuation and other instructions from local officials.

Storm Surge Watch

There is a **possibility of life-threatening inundation** from rising water moving inland from the shoreline generally **within 48 hours**.

Promptly follow evacuation and other instructions from local officials.



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Flooding

Never Walk Into Flood Waters



It only takes 6 inches of swiftly moving water to knock an adult off his or her feet



Weather-Ready Nation

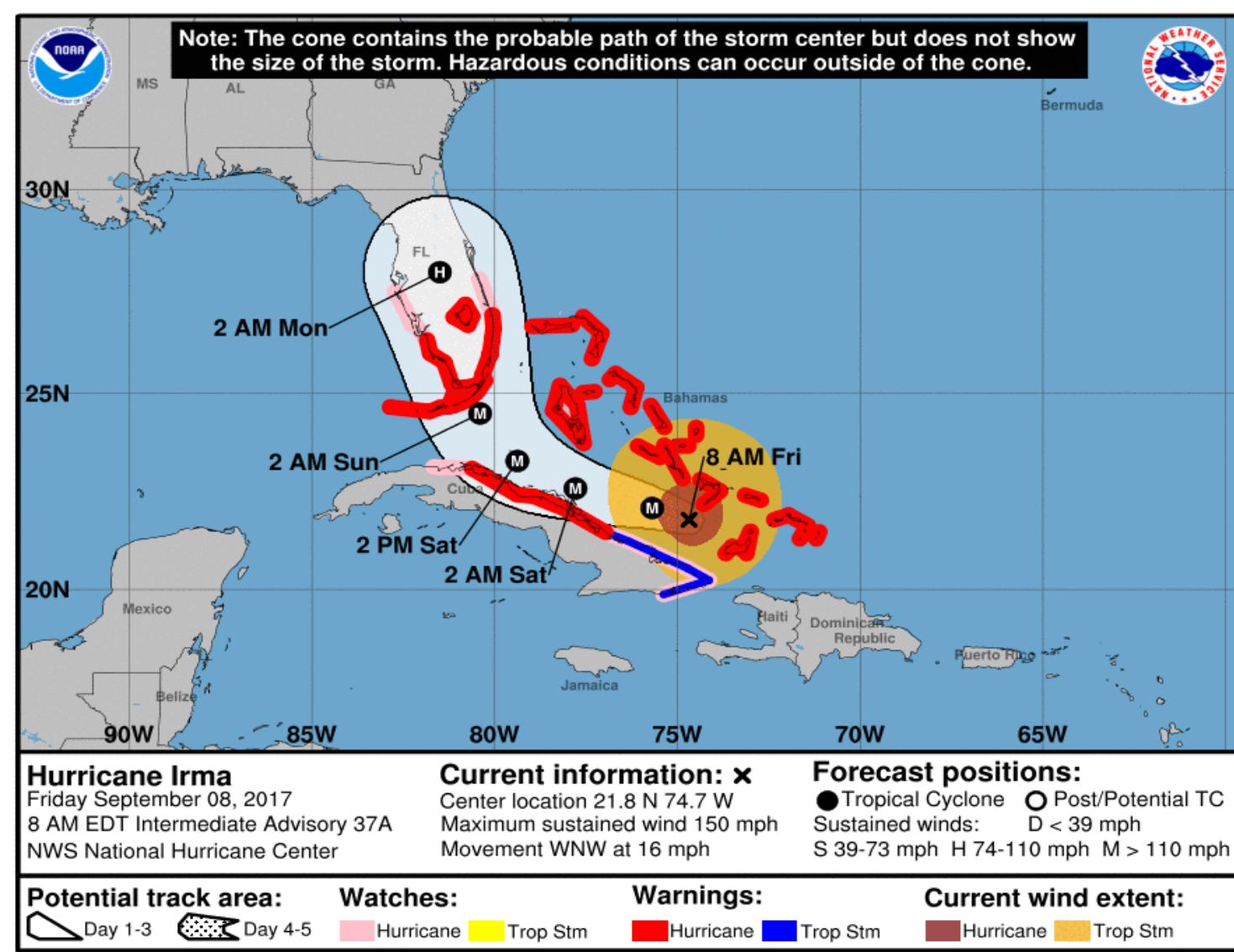
National Oceanic and Atmospheric Administration

National Weather Service
weather.gov/flood

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Forecast Cone



Hurricane Irma

Friday September 08, 2017
8 AM EDT Intermediate Advisory 37A
NWS National Hurricane Center

Current information:

x
Center location 21.8 N 74.7 W
Maximum sustained wind 150 mph
Movement WNW at 16 mph

Forecast positions:

● Tropical Cyclone ○ Post/Potential TC
Sustained winds: D < 39 mph
S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:



Day 1-3

Watches:



Day 4-5

Hurricane Trop Stm

Warnings:



Hurricane

Trop Stm

Current wind extent:



Hurricane



Trop Stm

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How is the forecast cone created?

What does the cone show us and what does it not show us?

POTENTIAL PATHS

DORIAN

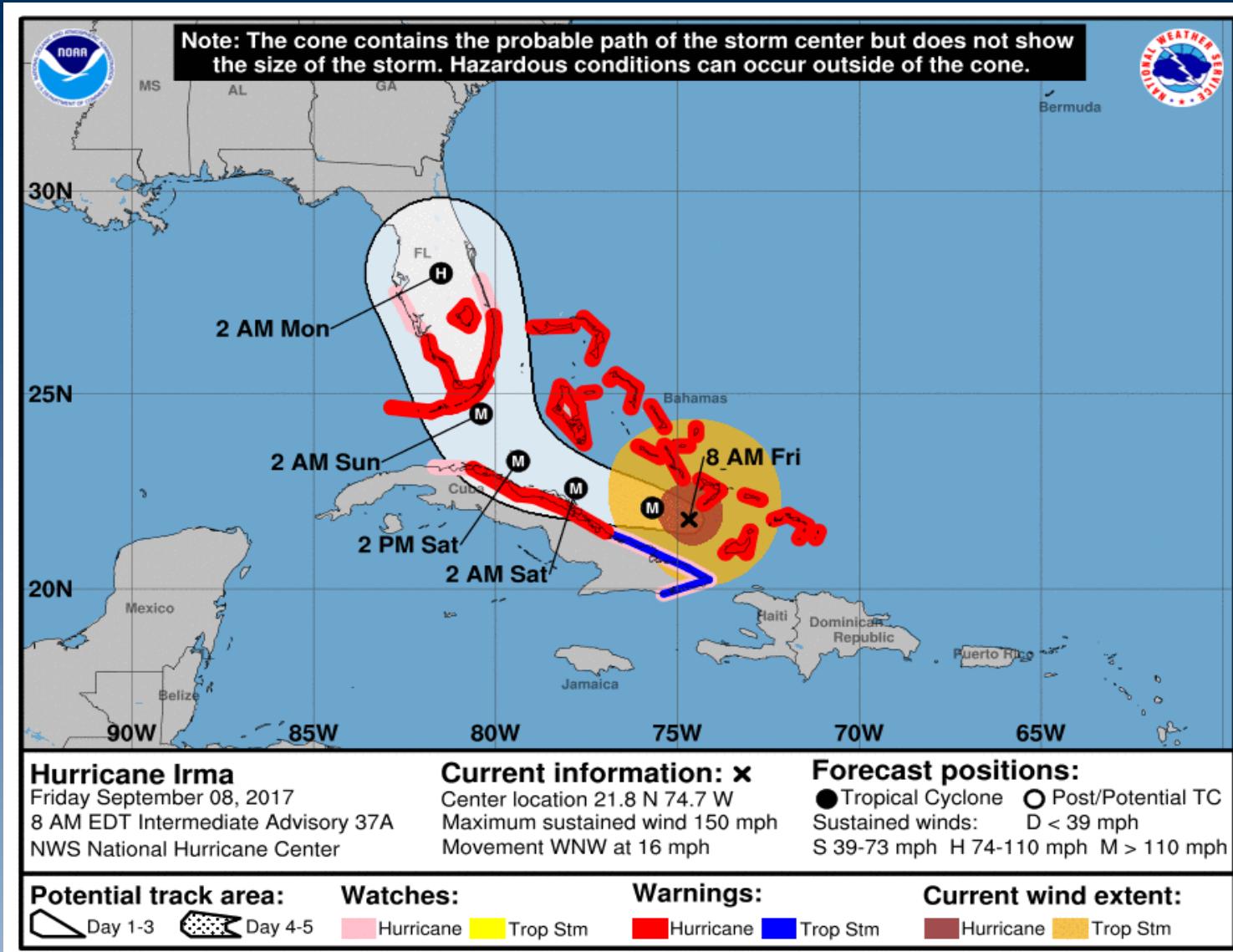
Florida Public Radio
FPREN
Emergency Network



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Cone Shows Location but Not Hazards



Hurricane Hazard Graphics

Forecast Cone Watches / Warnings



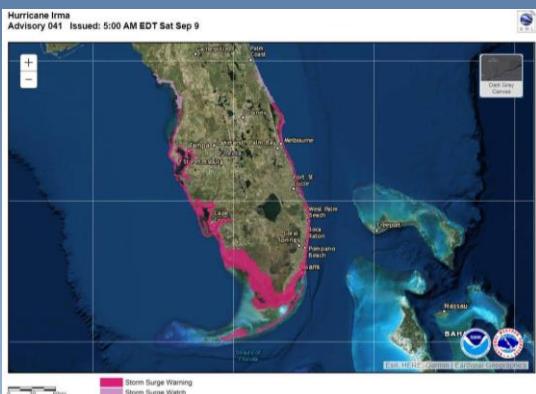
Wind Speed Probabilities



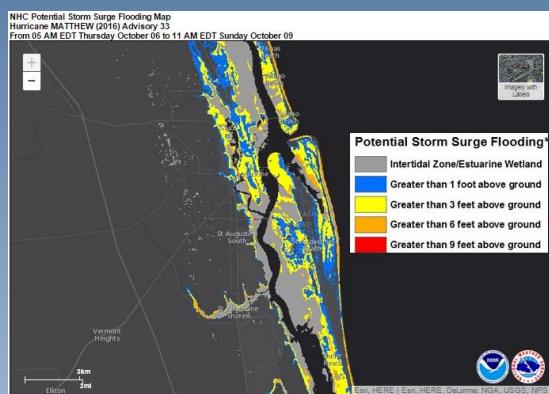
Arrival Time of Winds



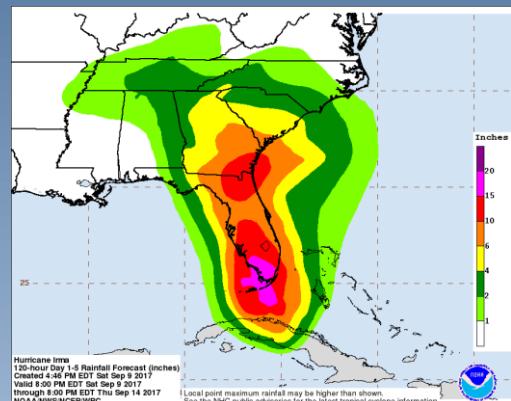
Storm Surge Warnings



Storm Surge Potential Inundation



Weather Prediction Center Rainfall





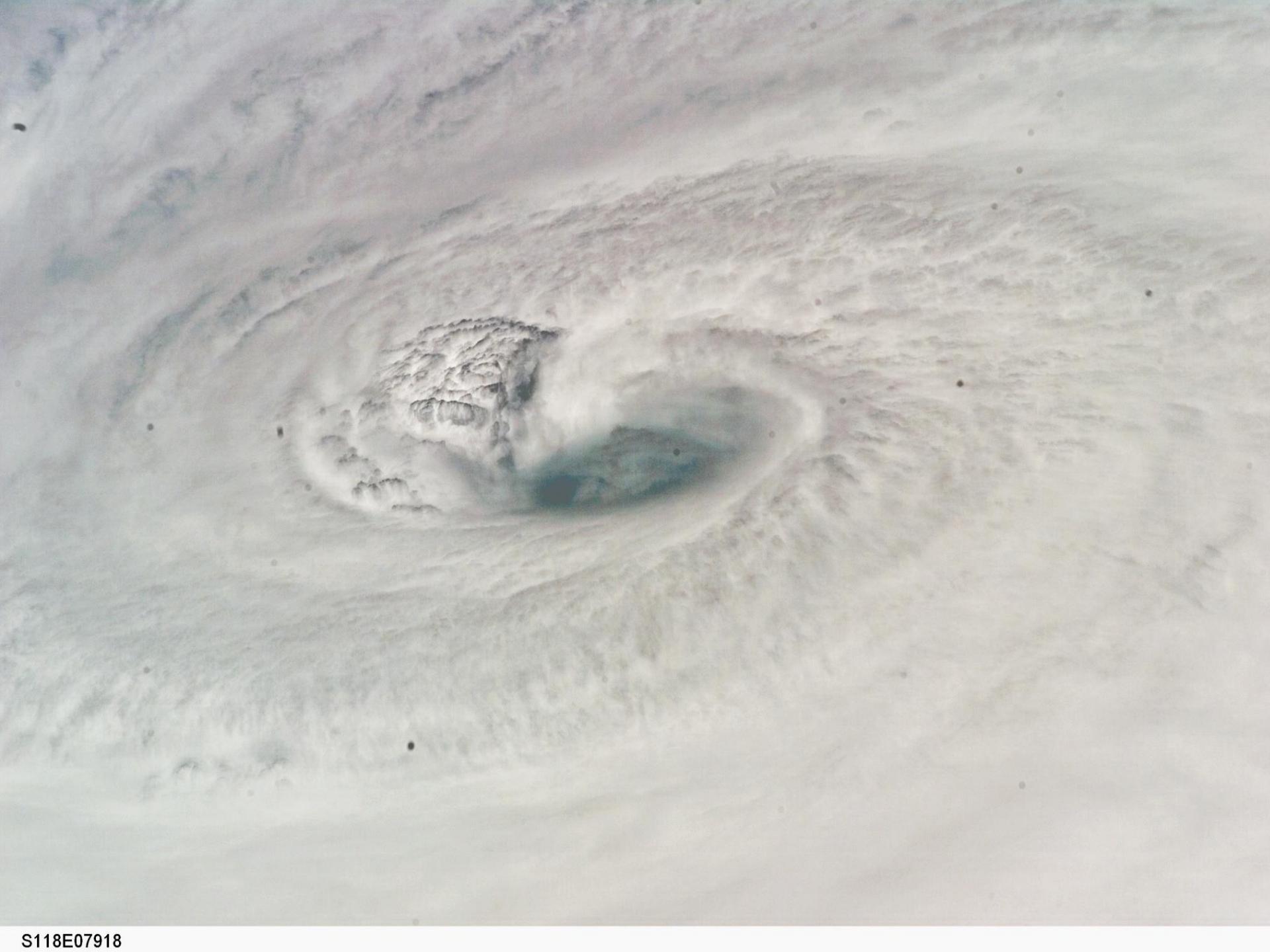
DOES ANYONE FLY INTO HURRICANES?

NOAA Hurricane Hunters



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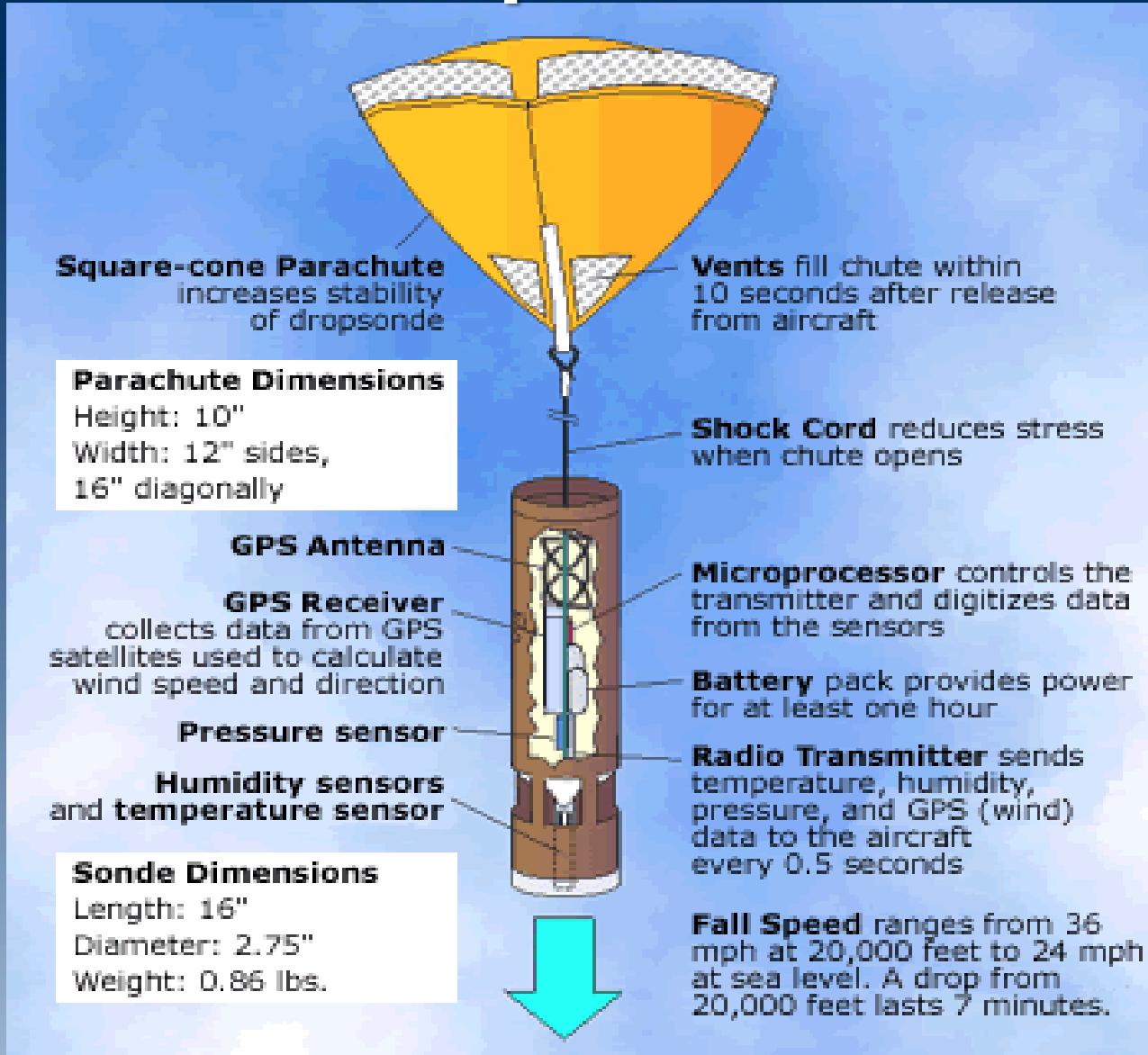


Photo: M. Black HRD



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Dropsonde





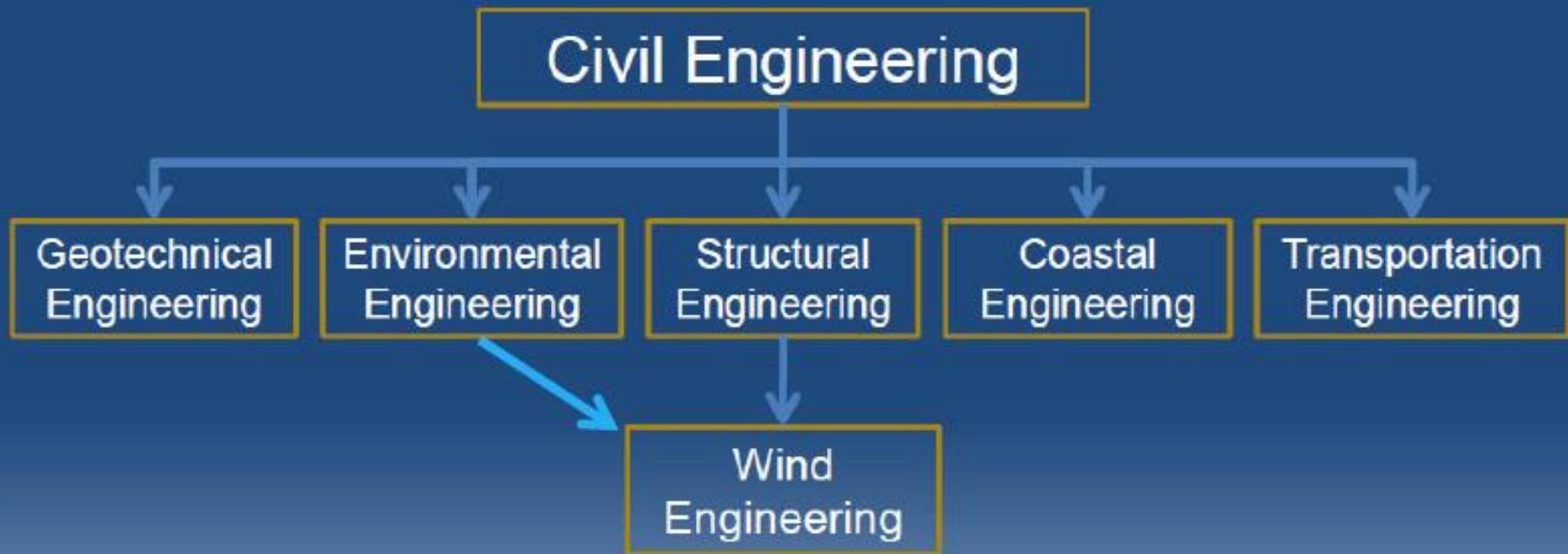


Wind
Engineering
STEM Career

- SCIENCE
- TECHNOLOGY
- ENGINEERING
- MATH

Introduction

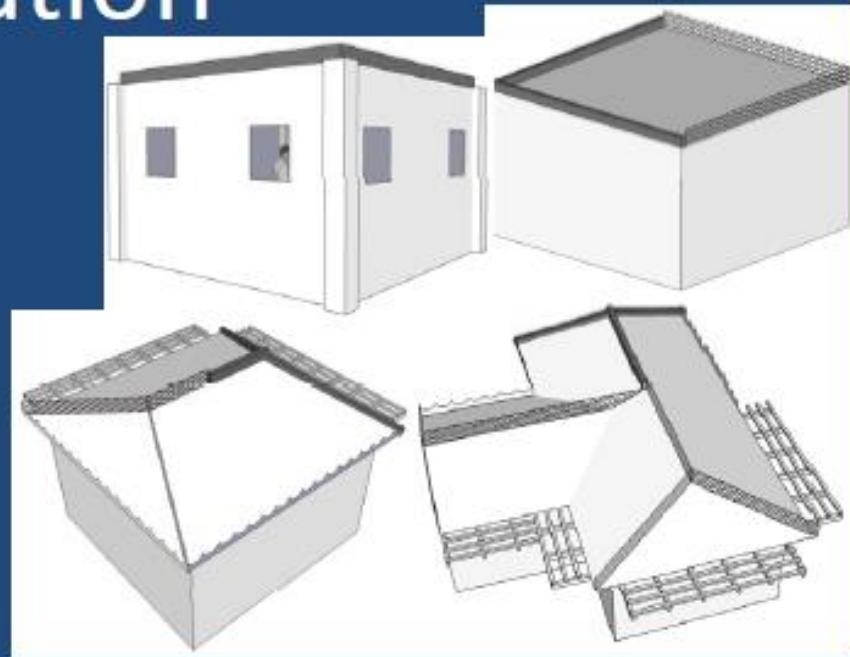
What is Wind Engineering?



- Wind engineers study the effects of wind on the natural and built environments

Aerodynamic/shape mitigation, optimization

- Low-rise roofs/wall corners
- High-rise buildings
- Energy infrastructure
(wind farm optimization, wind load mitigation on solar panels etc.)



WHAT IS WIND MITIGATION?

WHAT IS WIND MITIGATION?

PROTECT YOUR HOME FROM HURRICANE WIND.

Hurricane Wind Mitigation







Media Demonstration Video #1

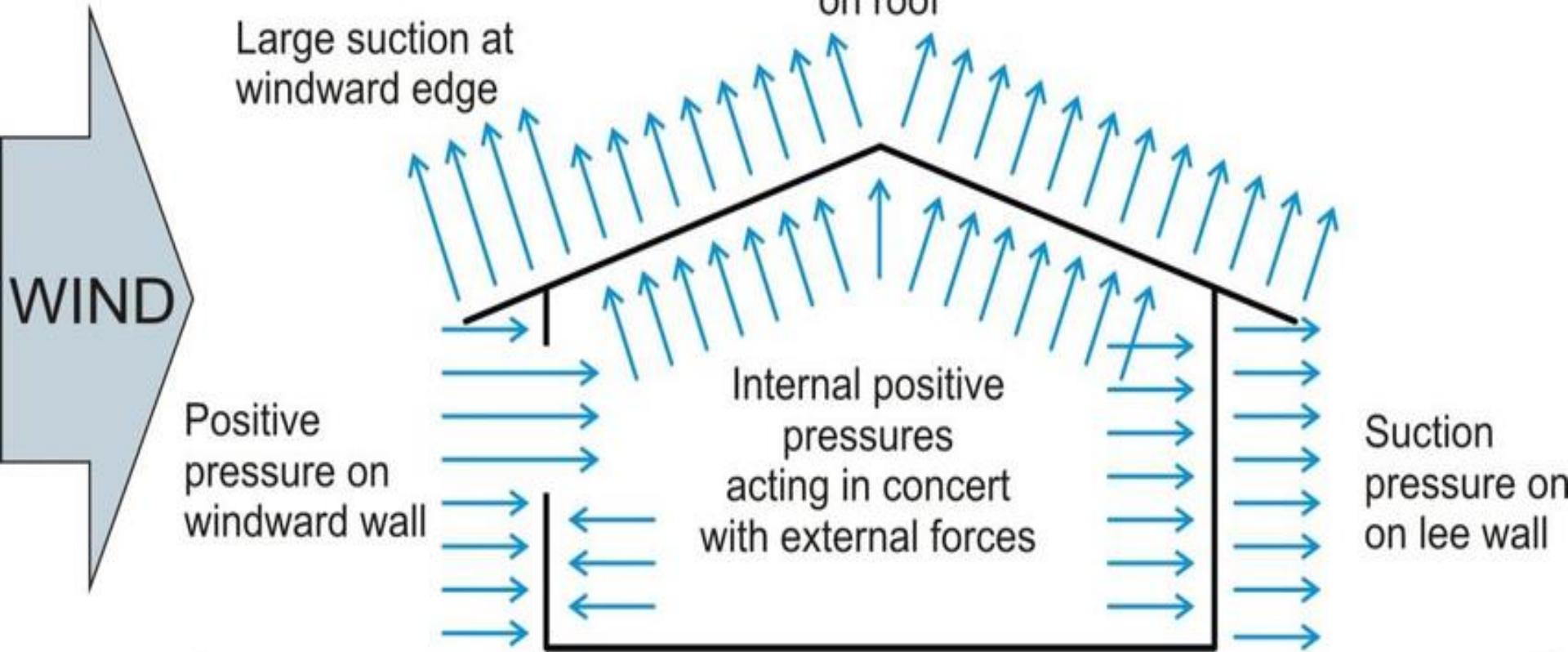
<https://youtu.be/d5qjZO7dVDg>



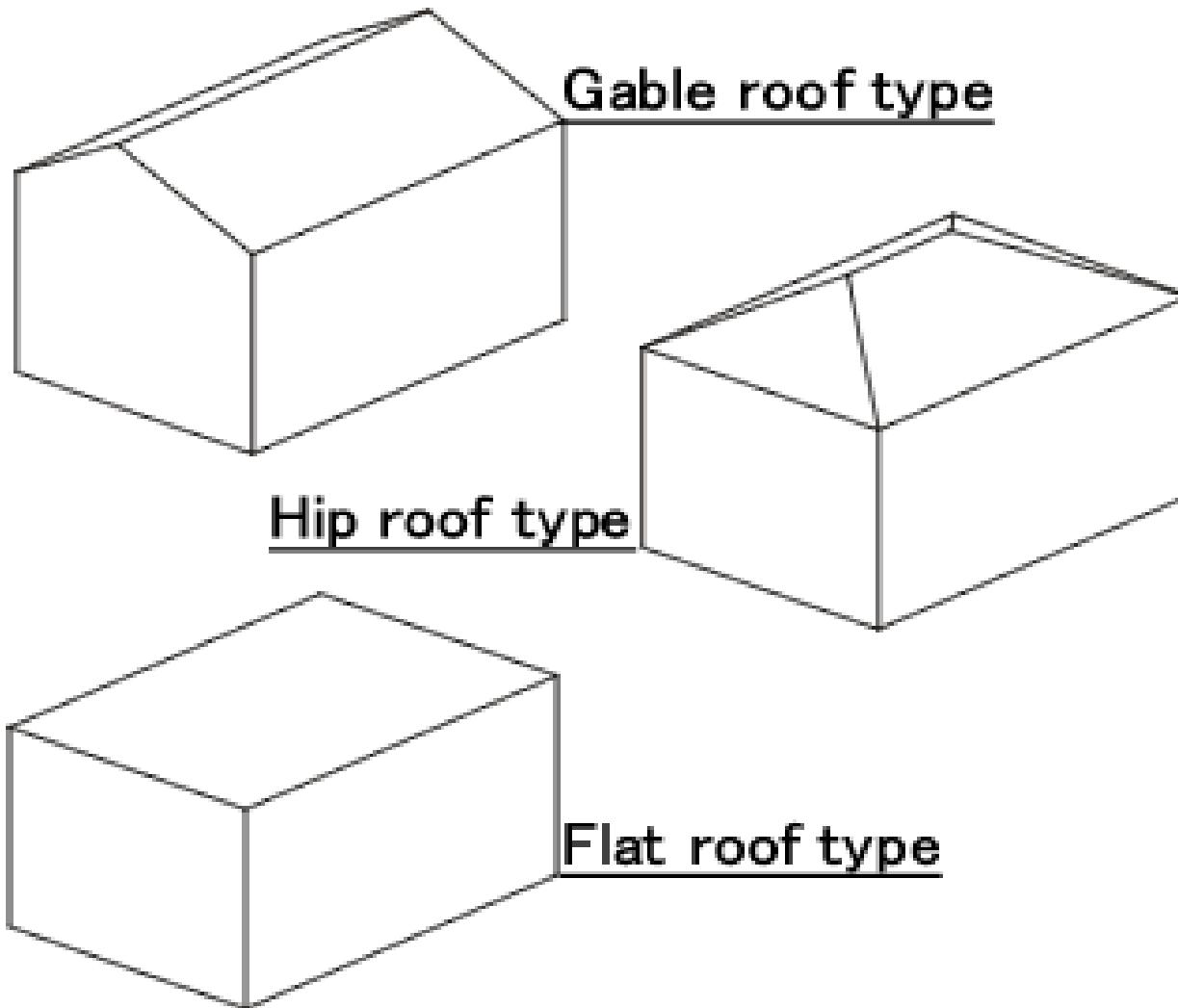
Media Demonstration Video #2

<https://youtu.be/OBxoIZrvY3k>

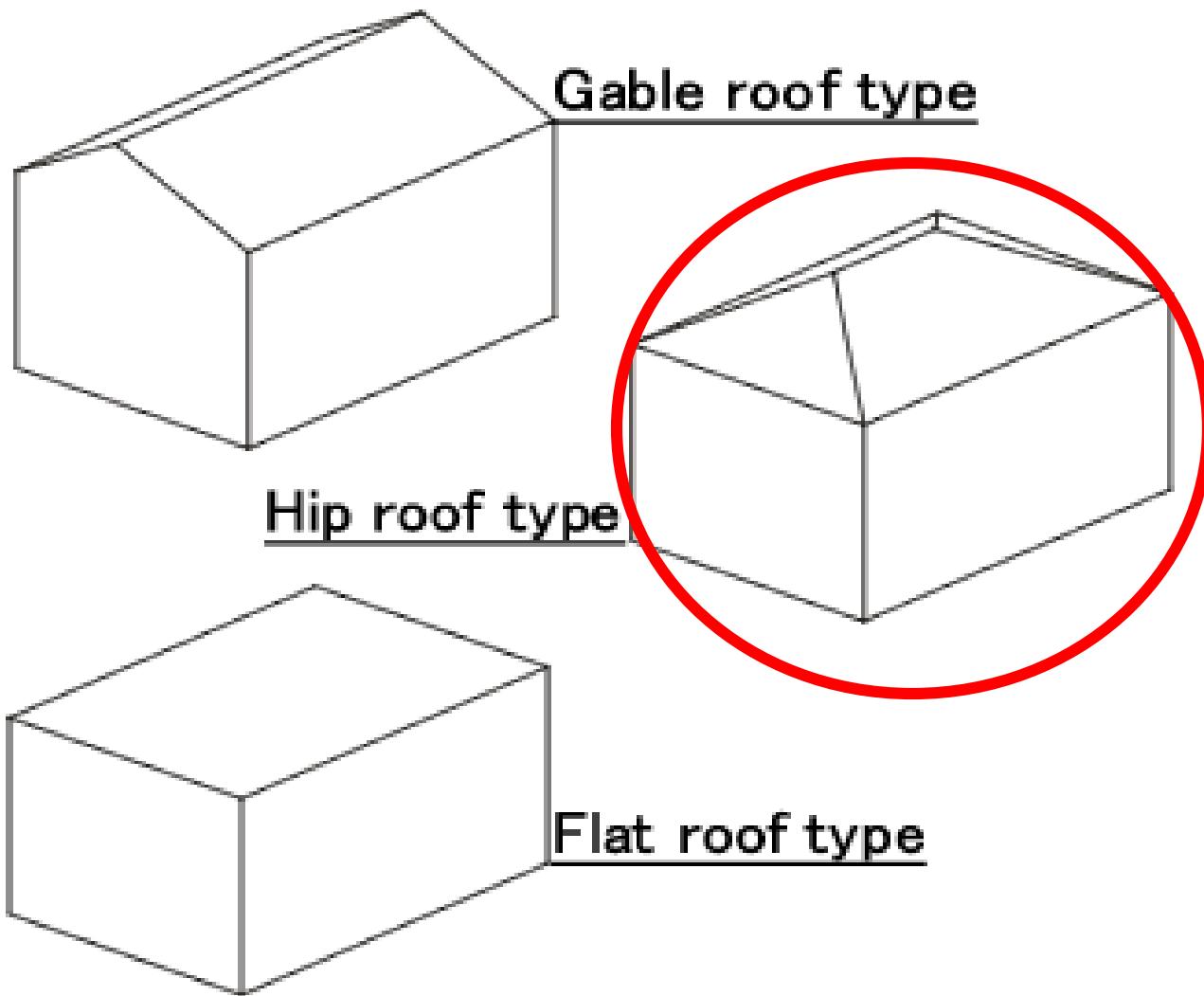
Positive and Negative Forces



Which roof shape is best in a hurricane?



Which roof shape is best in a hurricane?



Hurricane Straps



Garage Door Failure



Code-Approved Garage Door



Hurricane Maria

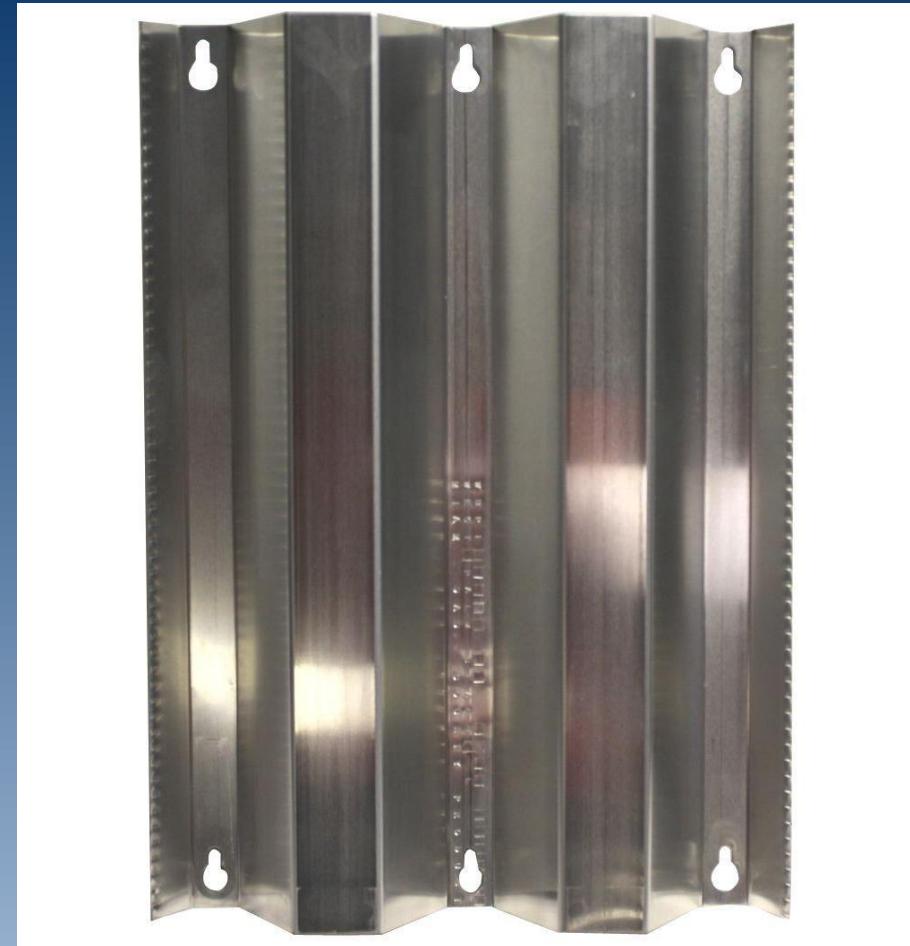


Hurricane Maria



Hurricane Shutters

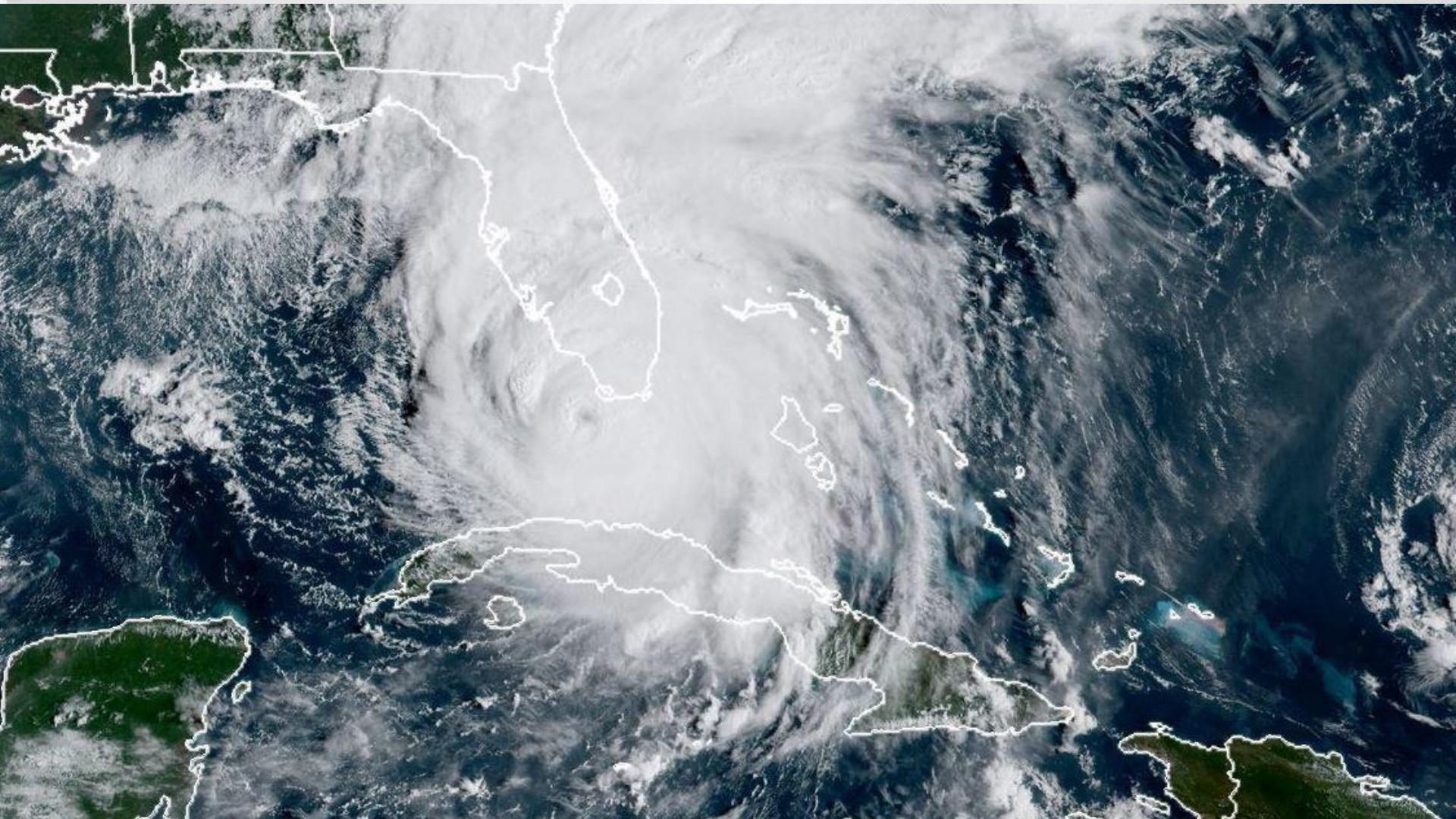
What is stronger, plywood or metal?



Tape Does Nothing!



Hurricane Irma



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International
Hurricane Research
Center

BUILDING CODE

1980s building codes on Left and Right; 2014 Building Code in Center

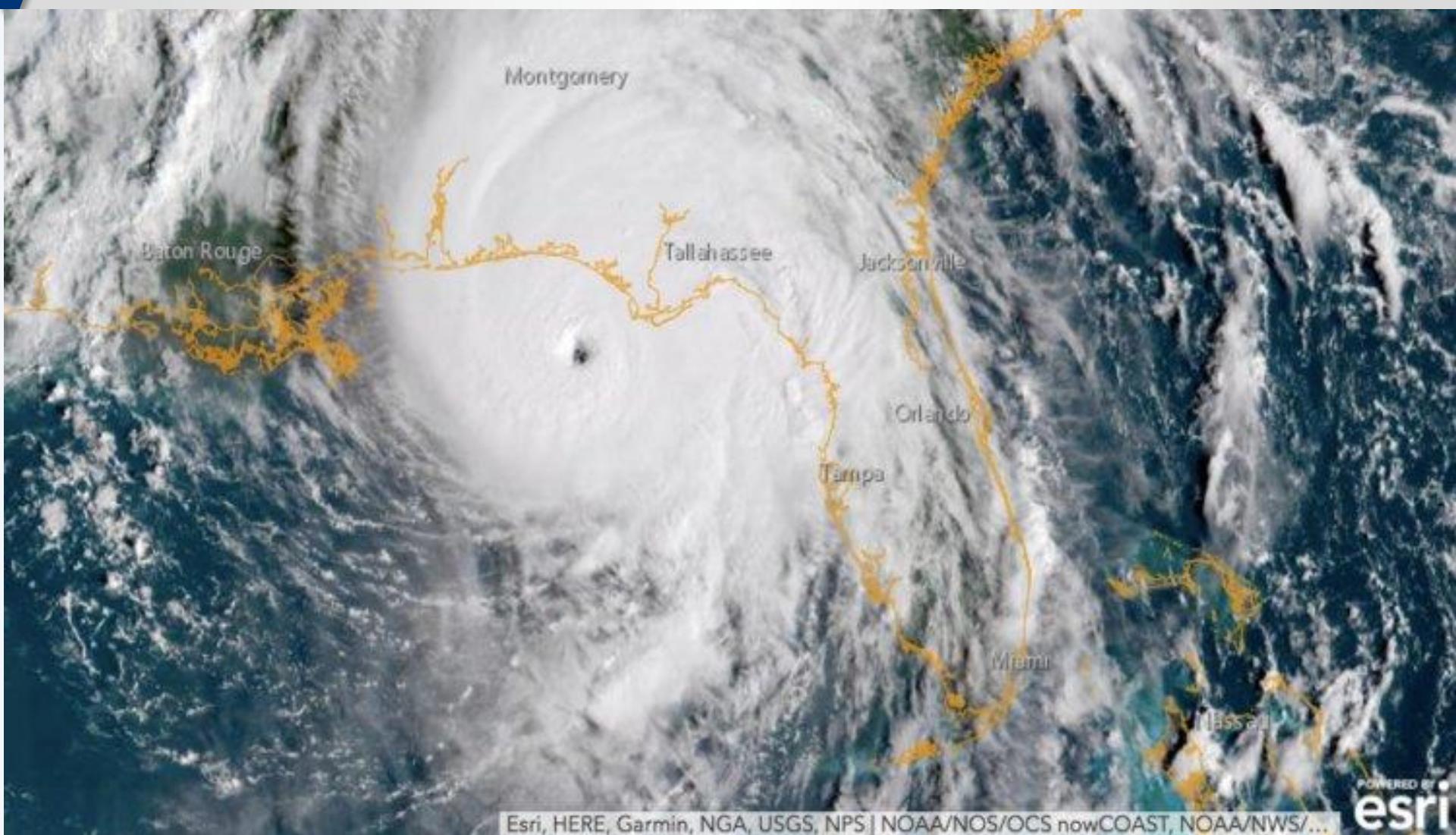


Florida Keys Irma Damage

Picture Credit: Andy Newman

Hurricane Michael

Category 5 (160 mph) in the Florida Panhandle, October 10th, 2018



Esri, HERE, Garmin, NGA, USGS, NPS | NOAA/NOS/OCS nowCOAST, NOAA/NWS/...

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BUILDING CODE

1980s building codes on Left and Right; 2017 Building Code in Center



Florida Panhandle Hurricane Michael Damage
Picture Credit: DeVoreDesign.com



2021 VIRTUAL WALL OF WIND MITIGATION CHALLENGE

(Week of March 22, 2021)



Wall of Wind Mitigation Challenge

FIU News Video Story

<https://youtu.be/QQRIf8uy8eQ>

2021 Wall of Wind Challenge

- Students will prepare three components for the competition: a physical test (March 26th), an oral presentation (March 23rd), and a written technical paper due March 22nd.
- The top 3 winning teams will be determined by a cumulative weighted score: physical (50%), oral (25%), paper (25%).
- Each high school will be allowed to enter one team; it is up to each teacher from each school to determine how many students will participate as a Team for this competition; however, only 4 students from the Team will be allowed to do the oral presentation; less than 4 can compete, but not more.

2021 Wall of Wind Challenge

- Oral presentations should effectively communicate some scientific process and analysis involved with the development of the hurricane wind mitigation solution for their building model; oral presentations should also consider the values and benefits of their mitigation solution, similar to a new business presentation to potential investors. **The oral presentation will be a recorded Zoom video of no more than 7 minutes.**
- Written technical papers should include any scientific or mathematical analysis involved with the development of their hurricane wind mitigation solution for their building model and describe how hurricane wind mitigation is being addressed with their solution. The calculation of their porosity must also be described.

2021 Wall of Wind Challenge

- **The objective of the 2021 Wall of Wind Mitigation Challenge** is for students to design a way to reduce the impact of wind scour on a building's flat roof. Each team's task is to develop a mitigation solution that will improve the building's aerodynamic performance in order to prevent the gravel on the roof from being blow away (scouring) by hurricane-force winds. The mitigation solutions will actually be tested by the real NSF-NHERI 12-Fan Wall of Wind in a controlled wind field to evaluate the effectiveness of the mitigation solution.



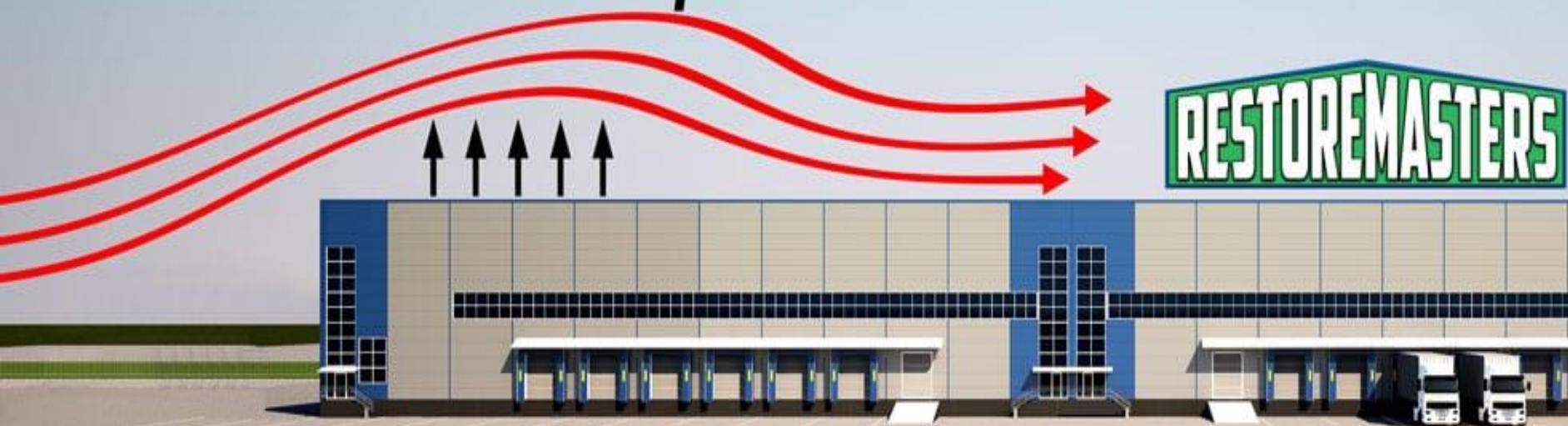
2021 Wall of Wind Challenge

Examples of Wind Scouring

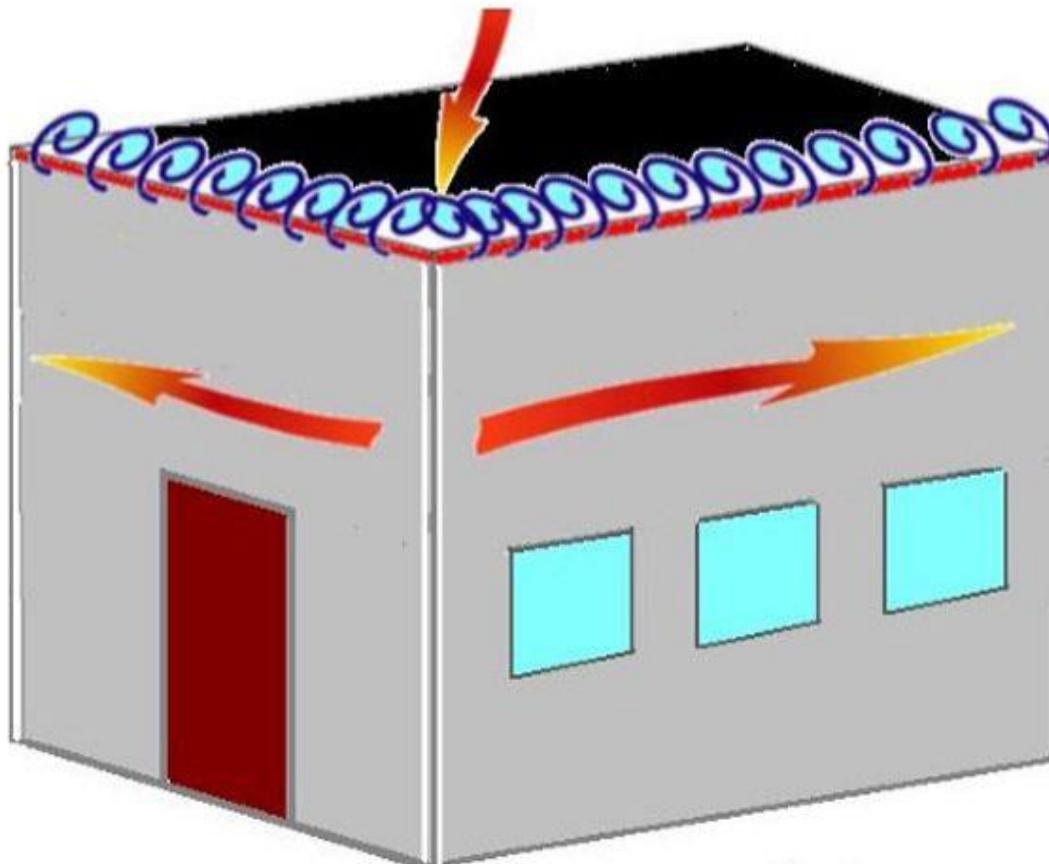


WIND FORCES ON FLAT ROOF

Suction & uplift can tear roof



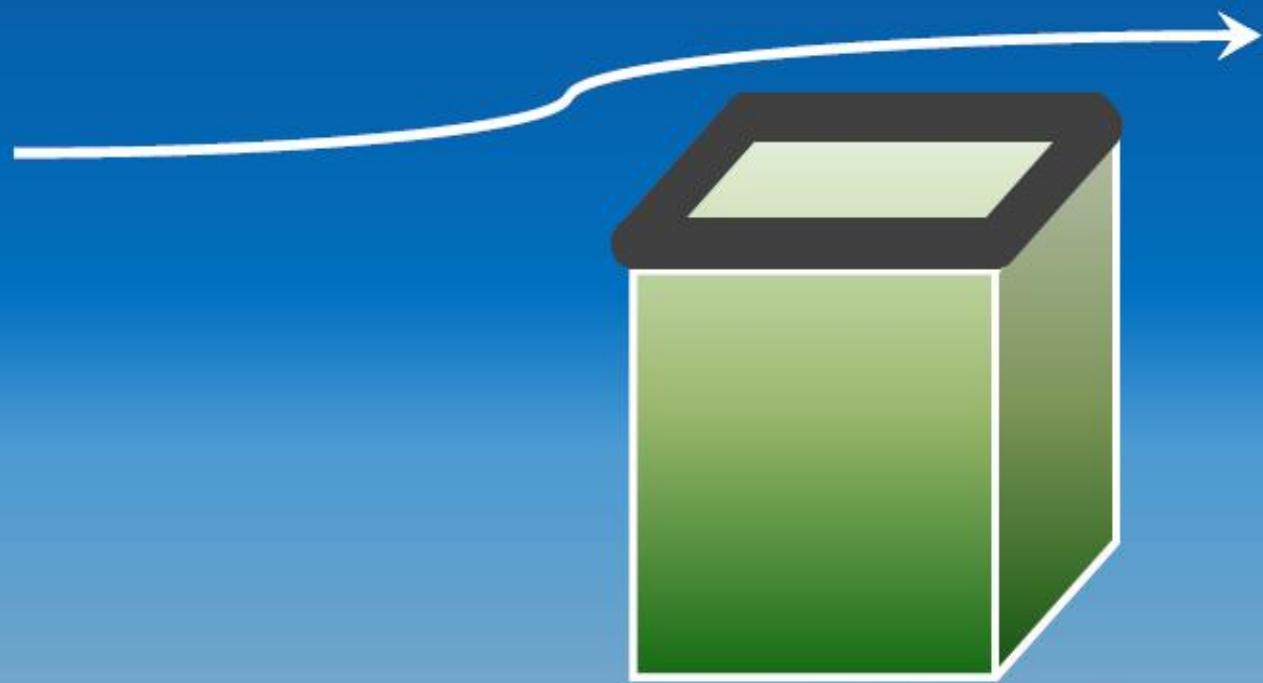
Vortex Patterns on a Rooftop



- Positive Wind Pressure
- Negative Wind Pressure

2021 Wall of Wind Challenge

Design simple and inexpensive aerodynamic devices
to suppress vortices along roof and wall edges



2021 Wall of Wind Challenge

Each Team Receives One Flat Rooftop

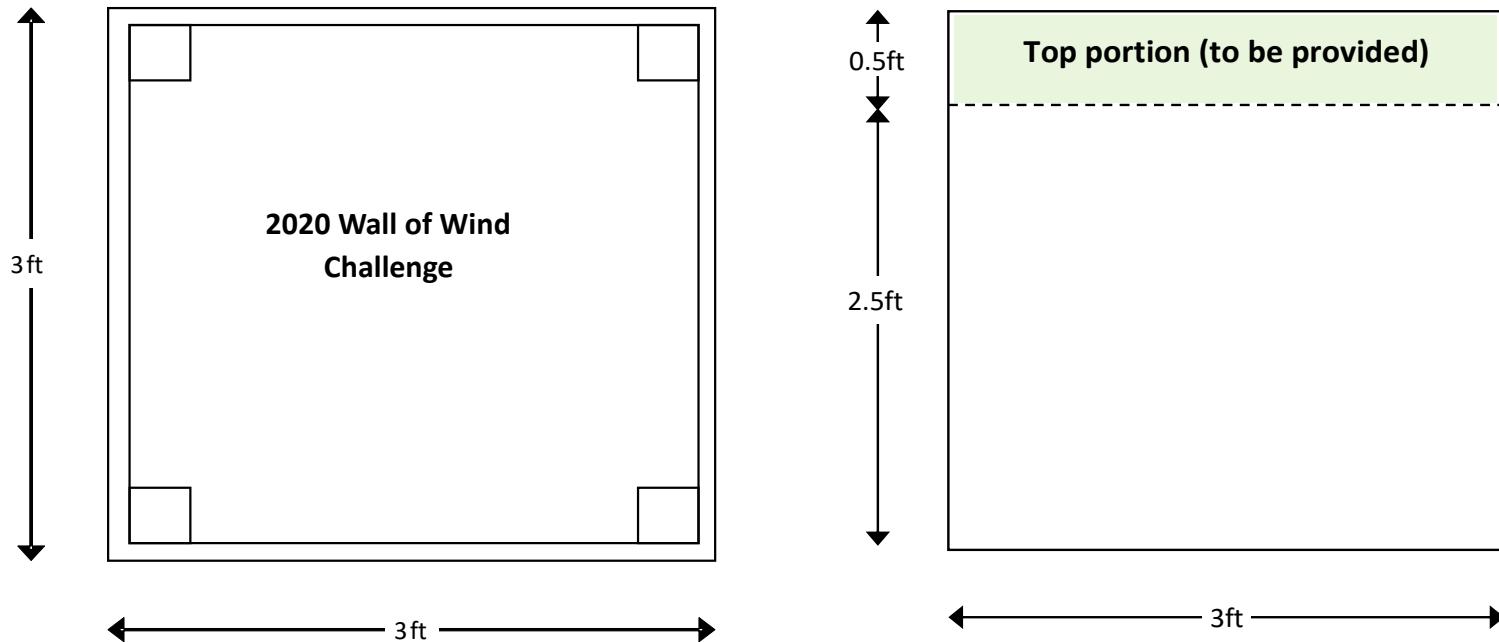


2021 Wall of Wind Challenge

- **The flat roof mitigation solution may be created by:**
 - Constructing a parapet on the flat roof.
 - Constructing and attaching a mitigation device along the upper edges of the building's walls.
 - Constructing and attaching a mitigation device along the perimeter of the flat roof.
 - Any combination of options (1) and (2) and (3).
- Scoring for the WOW Challenge will be based partially on the ability of the mitigation solution to reduce scouring on the roof (physical test).
- Judges will also evaluate the building models on aerodynamic performance, aesthetics, practicality, marketability and feasibility, and how innovative.

2021 Wall of Wind Challenge

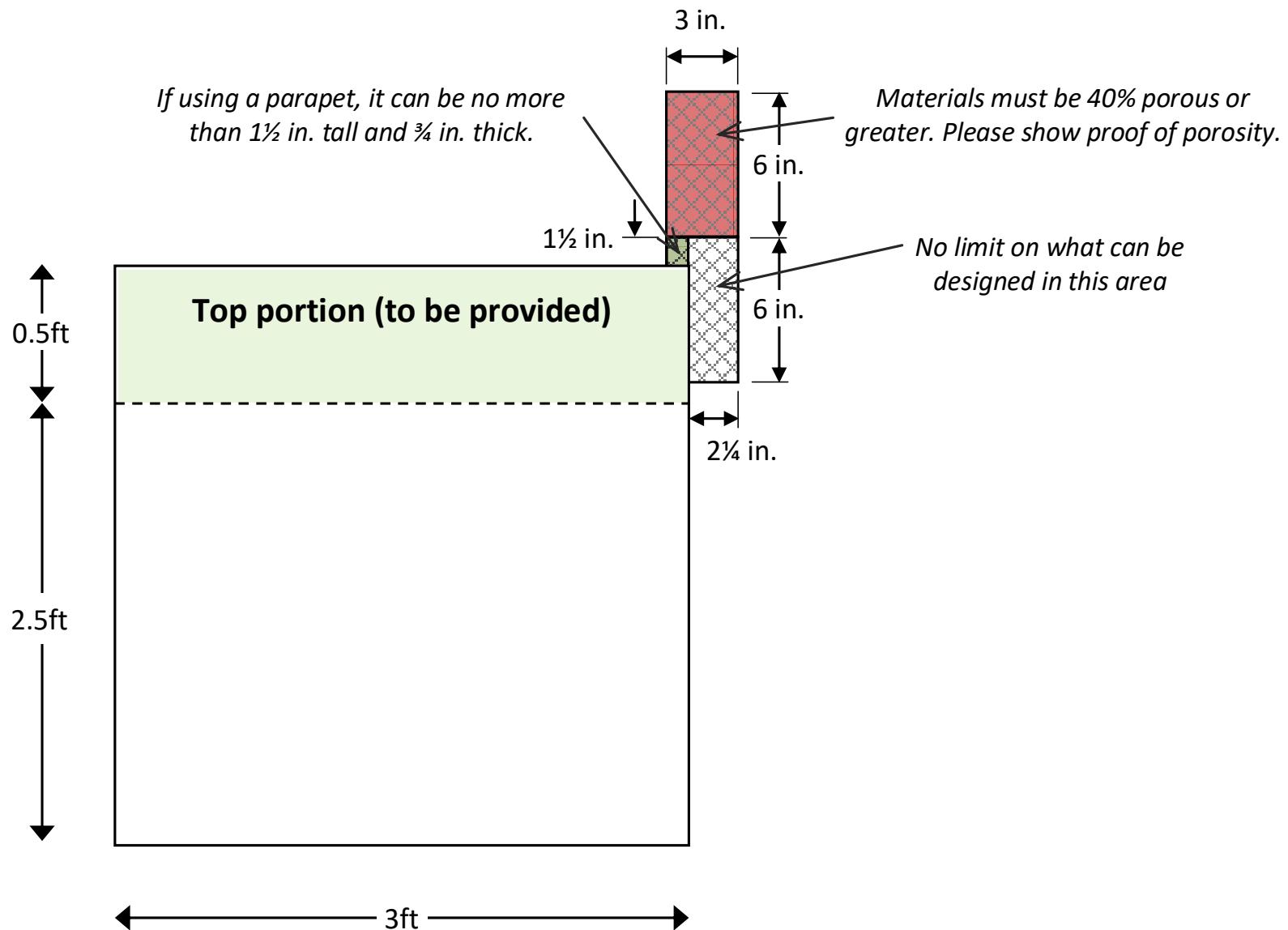
- Physical tests will occur on a uniform cube (3ft x 3ft x 3ft). These cubes are to represent a building with a flat roof. Teams will be provided with the top portion of the cube (3ft x 3ft x 0.5ft), which will represent the flat roof, on which they will attach their mitigation solution



2021 Wall of Wind Challenge

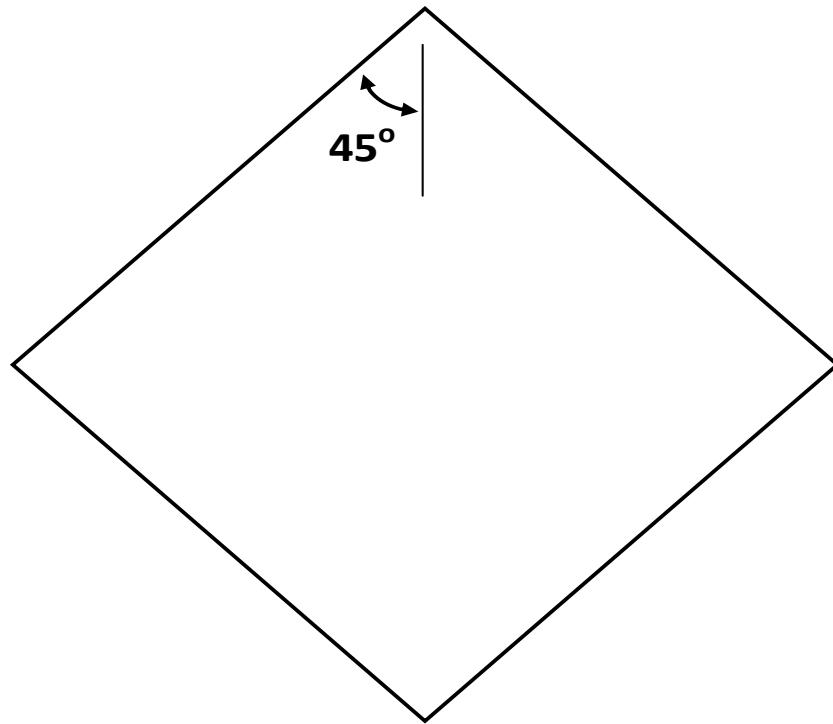
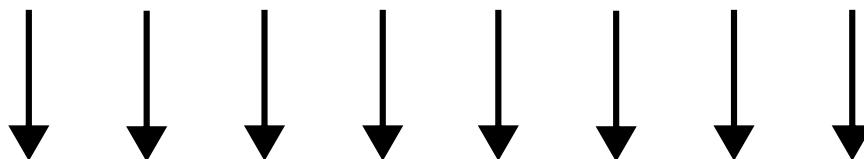
- The flat roof mitigation solutions shall adhere to the following restrictions:
- If using a solid parapet, it can be no more than 1½ inches tall and ¾ inch thick. This parapet can be made out of any material.
- There will be no restriction as to what can be placed in the area that extends 2¼ inches out of the top outer corner of the parapet and 6 inches below this same point. Any material may be used here.
- In the 3" by 6" area above the area shaded in red, **any material used must be 40% porous or greater. Proof of porosity will be required and should be included in the Team's written technical paper.**
- **Teams may submit photographs of the proposed mitigation solution for preliminary review. This is strongly encouraged.**

2021 Wall of Wind Challenge



2021 Wall of Wind Challenge

45° wind angle of incidence will be used during testing of the flat roofs.



2021 Wall of Wind Challenge

Awards for 1st Place, 2nd Place and 3rd Place



Thank You

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