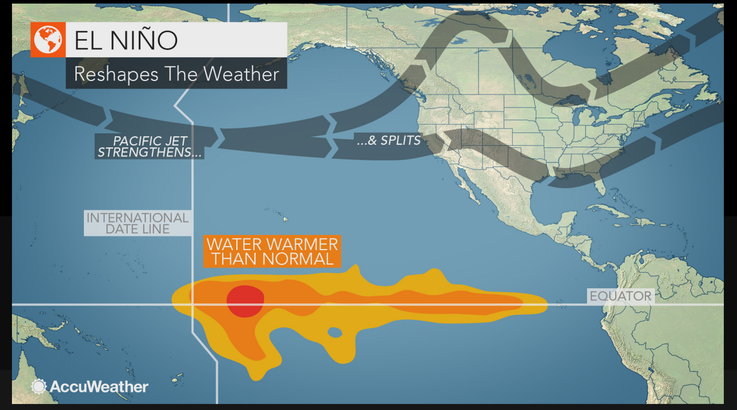
http://paocweb.mit.edu/images/uploads/medium/hurricane_fran_nasa.jpg

https://cms.accuweather.com/wp-content/uploads/2018/07/el-nino-reshapes-the-weather.jpg?w=632



Tropical Meteorology Vs. Infrastructure

Final Capstone Project for INT 250

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May 11th, 2021

Justyce Countryman

What is Tropical Meteorology?

- Researching, modeling, and observing the tropical atmosphere.
- Crucial for analyzing hurricanes, winter storms, monsoons, dust storms, precipitation, severe thunderstorms, and El Niños.
- Modern technological advancements have made it possible to create fewer inaccuracies.

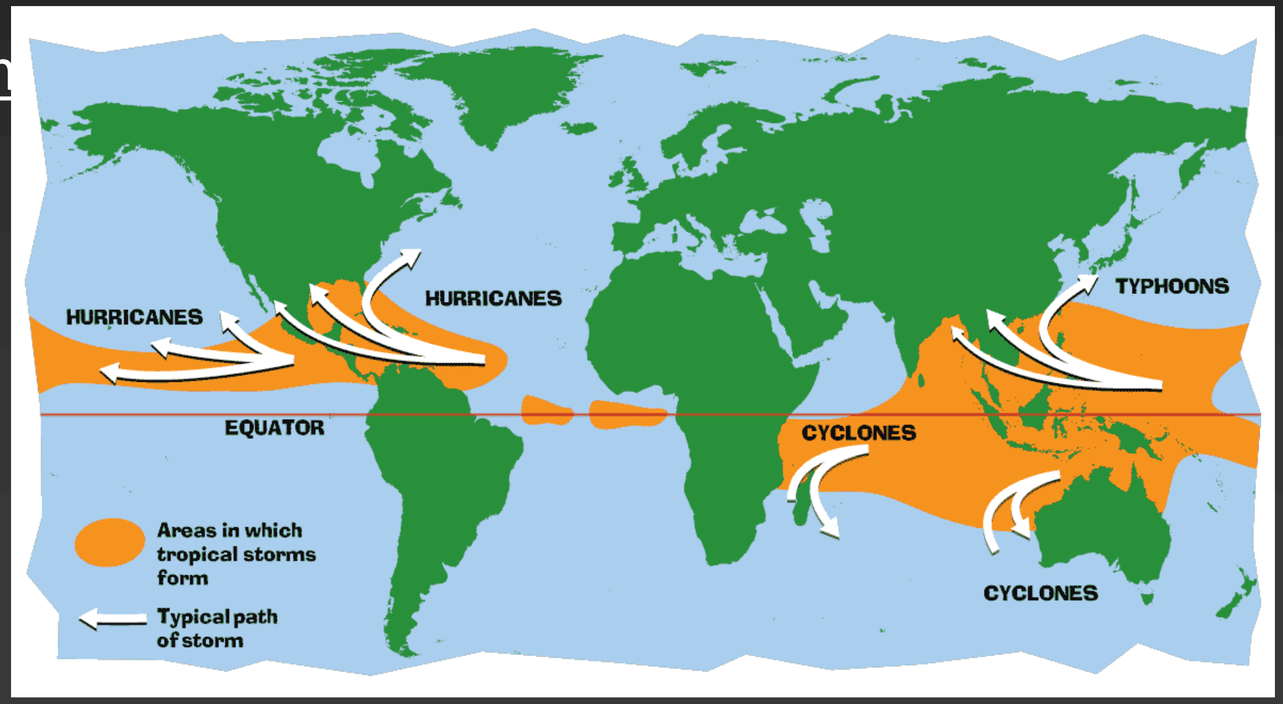
Examples: A pair of satellites from NASA specifically used for tracking hurricanes, access to a variety of tropical meteorology fields, and frequent validity in scientific and mathematical data from weather balloons.

The Science Behind Hurricanes

What Makes them Extremely Dangerous Yet Interesting?

- Formation often starts near warm waters.
- Usually at or near the Equator for moist air.
- The air combination goes aloft and far away from its regular surface.
- Original surface is then filled with low atmosph pressure.

https://gpm.nasa.gov/education/sites/default/files/article_images/cyclone_map_large.en.gif



Hurricanes (Continued)

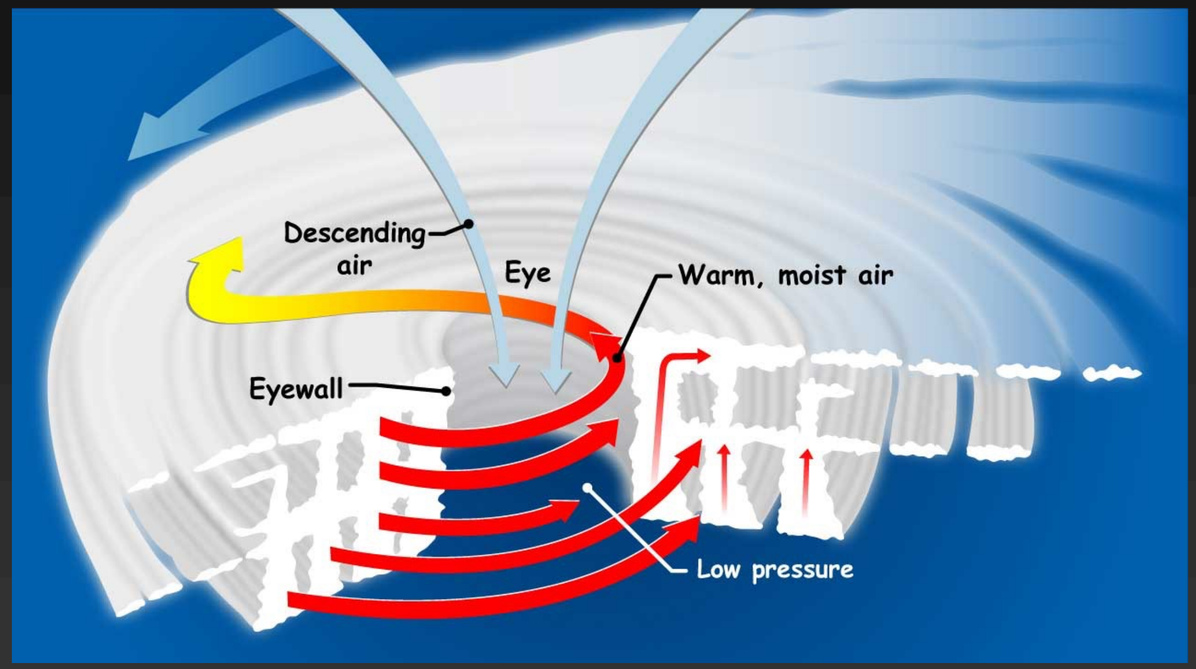
What Happens with that Low Pressure?

- Nearby areas with high pressure transfer their air to the location with lower pressure.
- This combination of air on the surface results in another round of elevating air.
- Produces high temperatures and moisture again.
- This continuous process results in air spirals with additional neighboring air.
- The upward air creates an arrangement of clouds and wind.
- Strengthens by oceans and their high water temperatures, especially during evaporation.

https://gpm.nasa.gov/education/sites/default/files/article_images/cumulonimbus-lrg.en.jpg

Why Do Hurricanes Have A Center Eye?

- The formation of a hurricane “eye” requires a lot of speed from the created wind and cloud structure.
- Produces very little to no significant weather conditions.
- Contains low atmospheric pressure initially.
- High pressure from above the surface then travels down to the eye.



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When A Hurricanes Makes Landfall…

…It Is Often Not As Bad As It Possibly Can Get

- Hurricanes usually decrease in strength.
- Occurs because of energy depletion once the system is far away from moist or warm ocean conditions.
- They can still move hundreds of miles.
- May produce inches or even feet of precipitation and 74+ mph winds.
- Environmental features and infrastructure could be damaged or destroyed.

Category	Wind Speed (mph)	Damage at Landfall	Storm Surge (feet)
1	74-95	Minimal	4-5
2	96-110	Moderate	6-8
3	111-130	Extensive	9-12
4	131-155	Extreme	13-18
5	Over 155	Catastrophic	19+

Question: Why do you Think There is No Such Thing as a Category 6+ Hurricane?

An Infrastructure Perspective

- The damages from hurricanes are more critical and widespread than other weather phenomena.
- “Electric distribution lines” are impacted by extreme winds or heavy rain.
- Decreasing the vulnerability of the lines is a possible precautionary action.
- Placing lines below the ground are more efficient, yet costly.
- Underground lines could still be at risk due to flooding or “storm surges” (“Hurricanes and Electricity Infrastructure Hardening,” Web).

Examples: More trims on trees that are near the electrical lines or poles, tougher materials to replace weak poles, like substituting “metal or concrete poles” for “wooden poles,” and “guy” wires to keep the line poles sturdy and straight (“Hurricanes and Electricity Infrastructure Hardening,” Web).

“Problems like these often reflect an inclination of governments to spend as little money as possible” (Flavelle et al., Web).

Shalini Vajjhala, Former Obama Administration Official

UNDERGROUND

PROS

- Not vulnerable to damage from tree branches
- Does not interfere with views
- No right of way (tree trimming) required
- Less susceptible to damage from vehicle collisions
- Not impacted by wind, ice and snow
- Less vulnerable to blinks when animals and branches contact lines

CONS

- More expensive to build
- Susceptible to flooding
- Difficult to locate faults
- Expensive to repair
- Fed by overhead lines at some point, making the lines vulnerable to outages and interruptions
- Limitations on voltages that can be buried underground
- Can be vulnerable to dig-ins

https://www.rock.coop/files/images/About%20Us/Underground.jpg

OVERHEAD

PROS

- Lower cost
- Quicker construction
- Easier to spot damage and faults
- Less expensive to repair and upgrade
- Can be built in any terrain
- Any voltage can be placed overhead

CONS

- Susceptible to wind, ice and snow
- More vulnerable to damage from trees and vegetation, which requires right of way trimming
- Vulnerable to blinks when animals and branches contact lines
- Susceptible to damage from vehicle collisions
- Less attractive

https://www.rock.coop/files/images/About%20Us/Overhead-graphic.jpg

Housing Infrastructure Vs. Weather

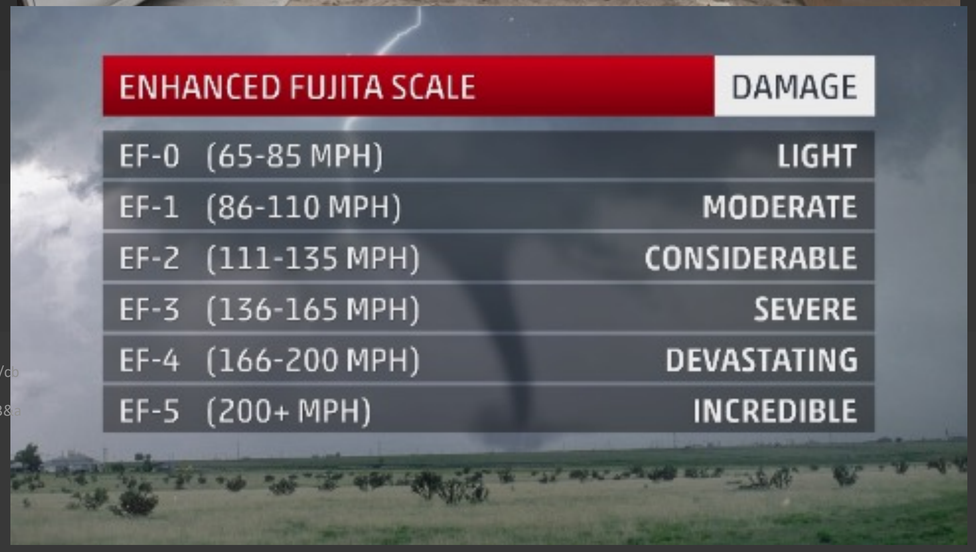
https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pinterest.com%2Fpin%2F222506037815917953%2F&psig=AOvVaw3E9lIRR2kyximCLTepTeZV&ust=1620793896459000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCOiz5_blwPACFQAAAAAdAAAAABAu

- During Superstorm Sandy, over 650,000 homes were destroyed.
- Over three hundred homes were lost in the district of Breezy Point in Queens, New York.
- Building Architect Illya Azaroff constructed a house in 2019 that may handle storms more severe than Sandy.

How Is The House Hurricane Resistant?

- House is situated thirty-six inches above mean flood levels.
- Foundation, floor, and walls are made of concrete.
- Anticipated to handle extreme precipitation and wind speeds of up to three hundred miles per hour.
- Contains “fiber cement board sidings” with flame resistance (Efstathiou and Gopal, Web).
- Rigid, overlapping “polymer roof shingles” secured by bolts (Efstathiou and Gopal, Web).
- Roof designed with robust “connectors” (Efstathiou and Gopal, Web).

https://www.insurancejournal.com/app/uploads/2019/05/storm-resistant-home-768x512.jpg



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Primary Concern: Many Lower Class Family and African American Homes Have Very Little Protection From Natural Disasters

- In 2017, Hurricane Harvey took over thirty thousand homes away in the southern United States.
- Some individuals with little income were living in old or frail houses.
- Others may have been in buildings that pose a high risk to indoor flooding.
- African Americans also run the potential of the same problems, as well as living near industries that utilize hazardous materials.
- Introduces exposure to chemicals or poisonous accidents.
- All connect to the idea of severe weather, especially hurricanes.

https://images.wsj.net/im-137414?width=1260&size=1.5

Additional Concerns for African Americans and The U.S. Lower Class

- No flood coverage
- Less than twenty percent of homeowners from the eight most stricken counties due to Hurricane Harvey had insurance.
- Uncontrollable decreases in “credit scores” (Krause and Reeves, Web)
- Inability to find reasonably protected shelters after storms
- Risk of homelessness
- Long-term bankruptcy
- Significant drops on property value, including expensive houses, could allow people with little money to find places to live.
- Could result in local officials refusing to establish futuristic advancements in infrastructure.

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