Hurricanes -Tornadoes and Hot Water

HURRICANES

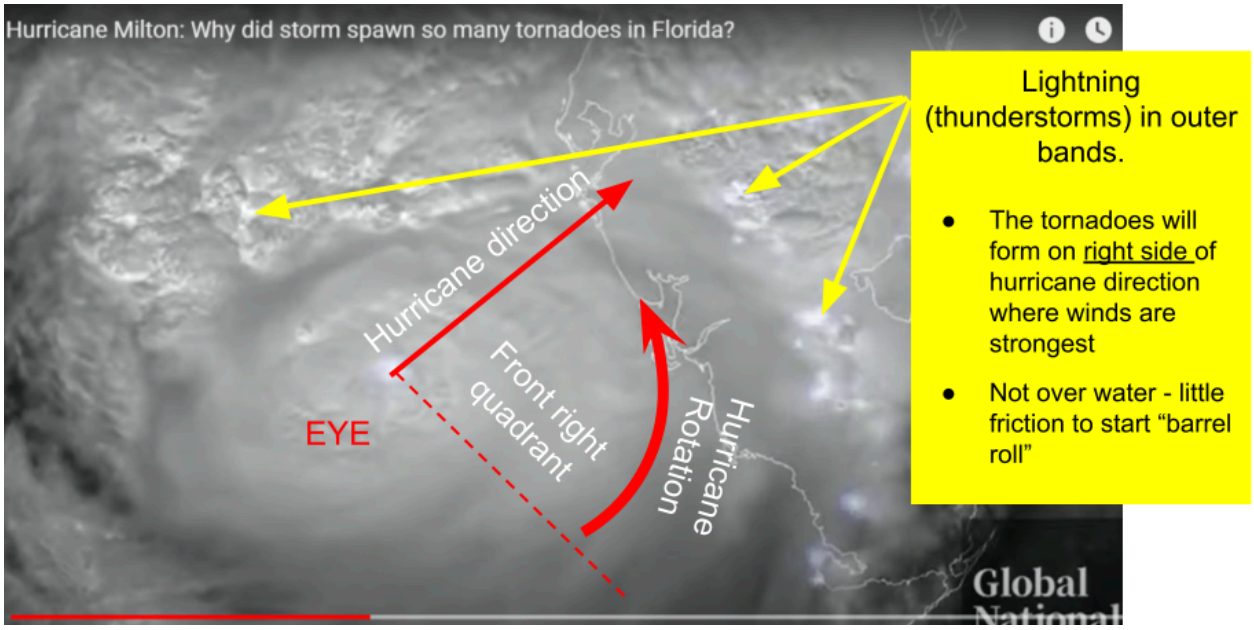
For Background on hurricanes, see: CSSG-2.22 Hurricanes and Climate Change and CSSG-2.43 Hurricane Milton - A Big Deal, where we saw how they worked in general, then looked more closely at the most recent landfall threat - Milton. In this Study, we'll look at a couple of more general points: why tornadoes often show up (Milton had 50 tornadoes!) and how sensitive hurricanes are to the ocean temperatures along their paths.

HURRICANES WITH TORNADOES

[Thanks to WCNC-TV for some excellent graphics]

It is not uncommon for a hurricane or tropical storm to produce at least one tornado after landfall. Some hurricanes have had more than 100 tornadoes. This is why this happens.

First, the hurricane's right front quadrant comes over the land, where it encounters friction at the surface…



When a hurricane is over water, the smooth surface is not conducive for tornadoes to form. But when a hurricane or tropical storm moves over land, the friction increases at the surface. Friction slows the winds at the surface while the winds remain stronger in the upper levels.

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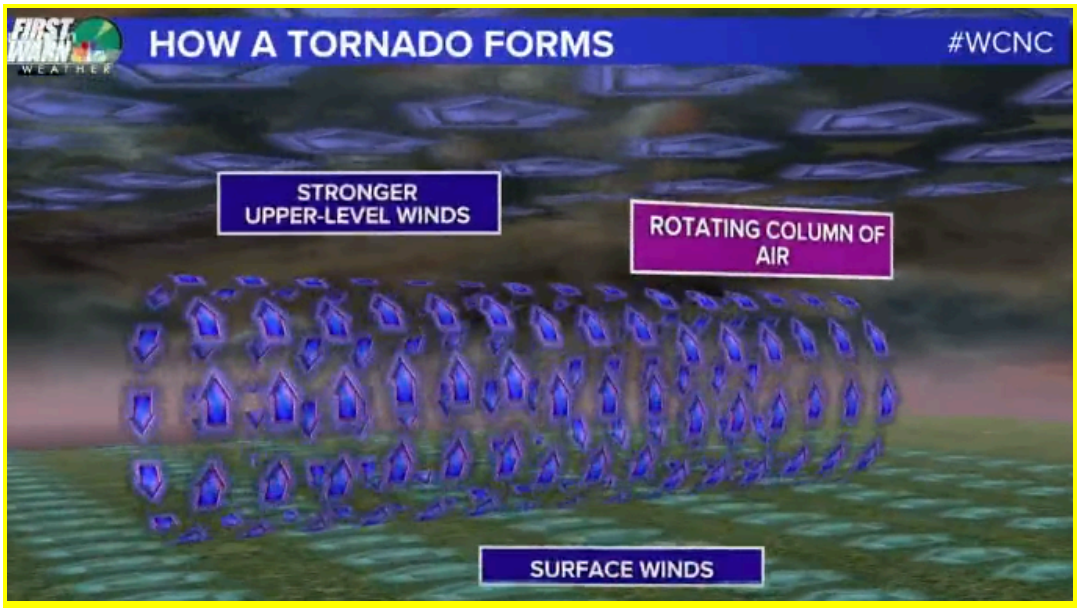
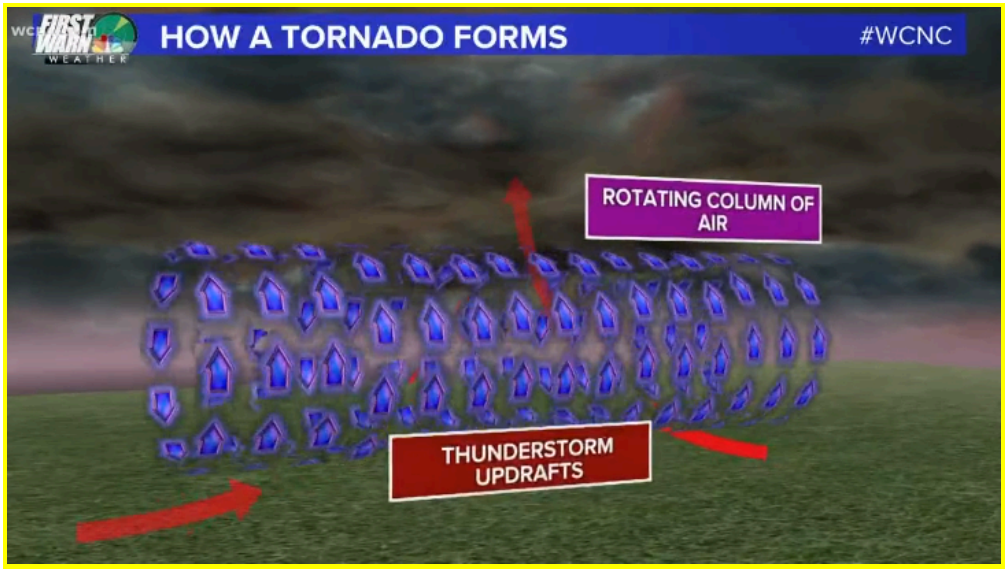
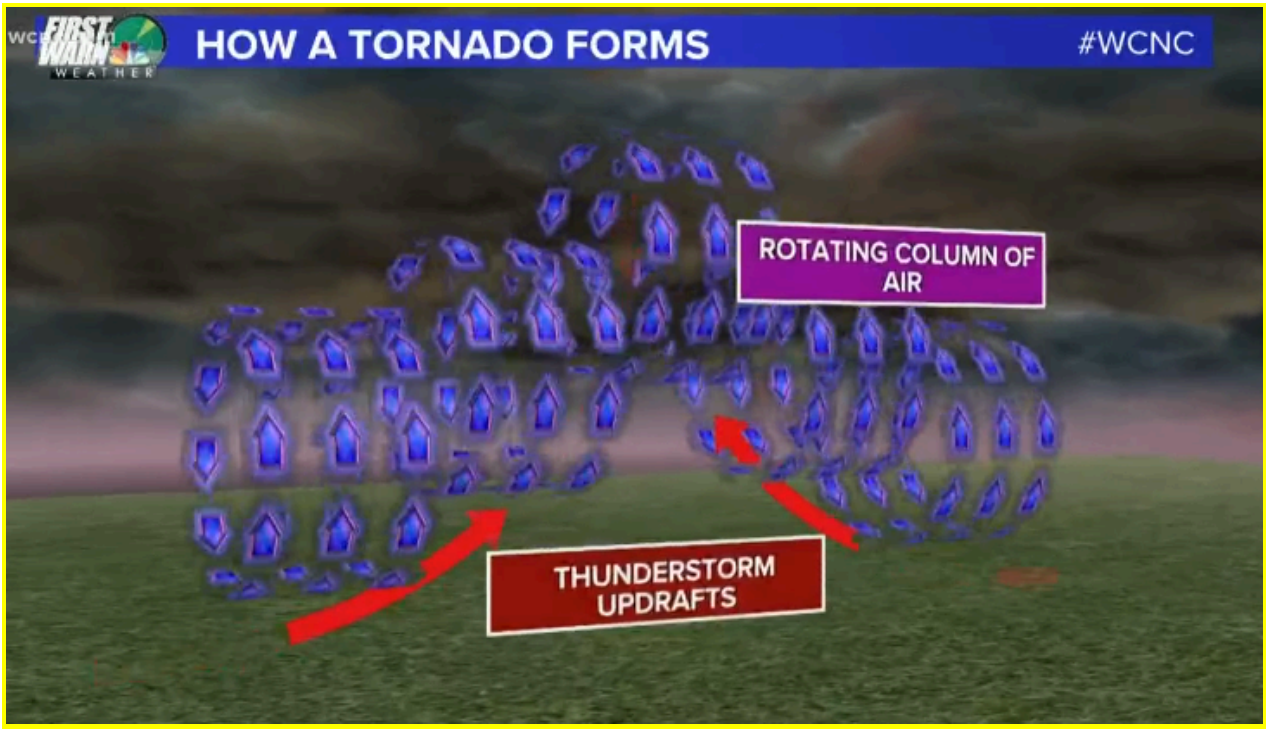
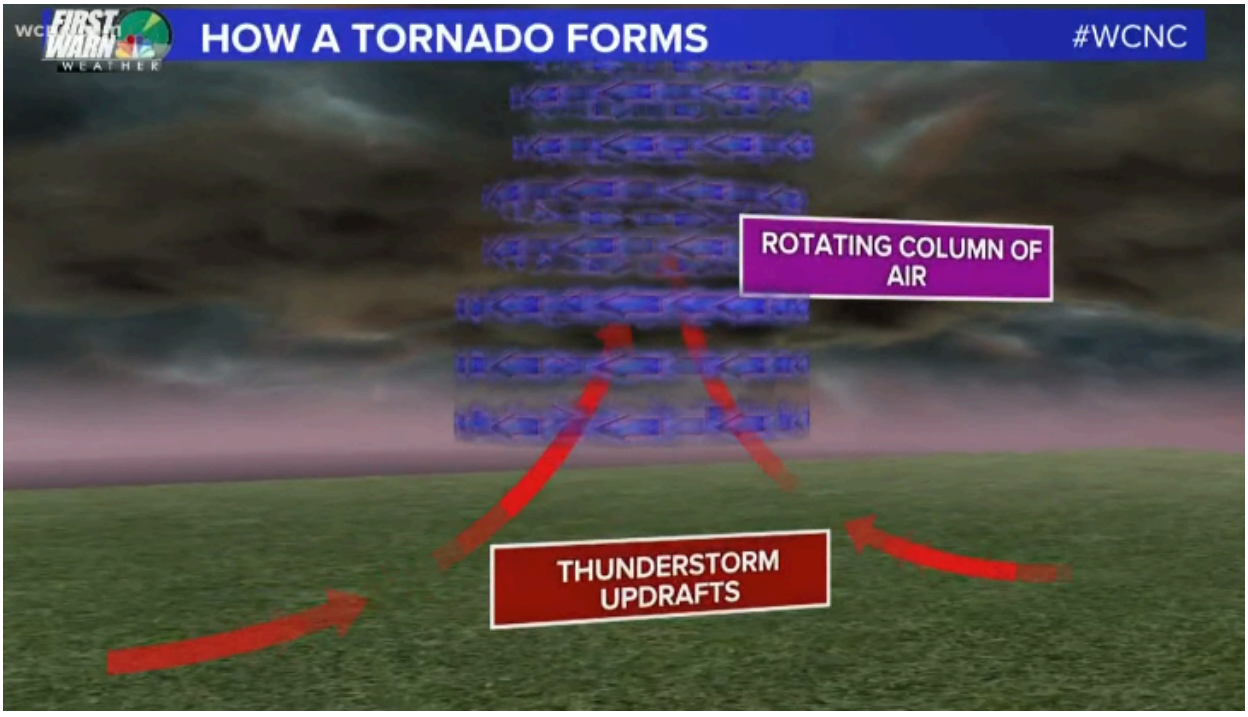
This creates the key ingredient for tornadoes, *wind shear*. **Wind shear is the change in wind speed and direction with height**. This creates a **spin** to the atmosphere.



Air starts spinning horizontally but then the updraft of a thunderstorm will drag that column of air vertically which causes the cloud to spin and eventually could lead to a tornado.







Thanks to WCNC for these graphics: [How and why tornadoes spawn from hurricanes and tropical storms]

So, it's the wind shear caused by the friction of the hurricane crossing the land that gets tornadoes started.

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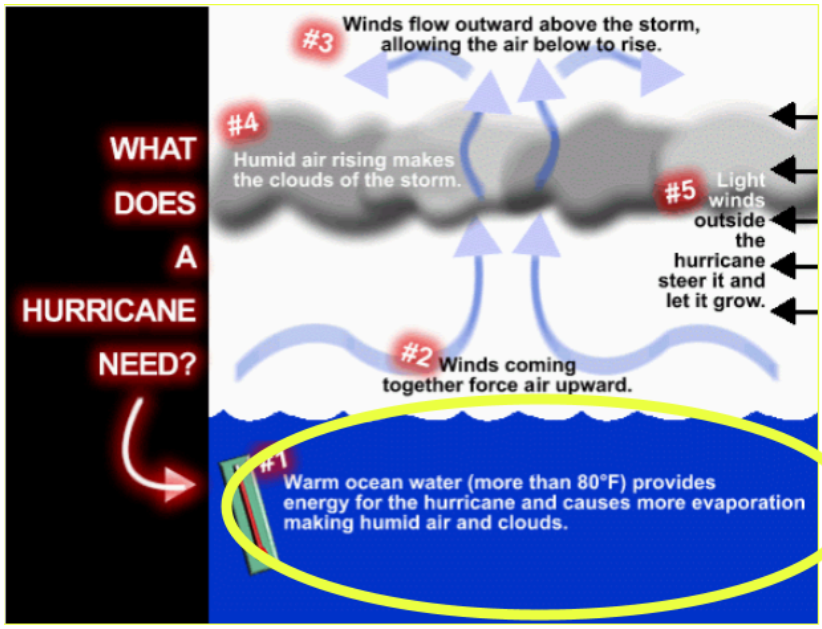
Hot Water and Hurricanes

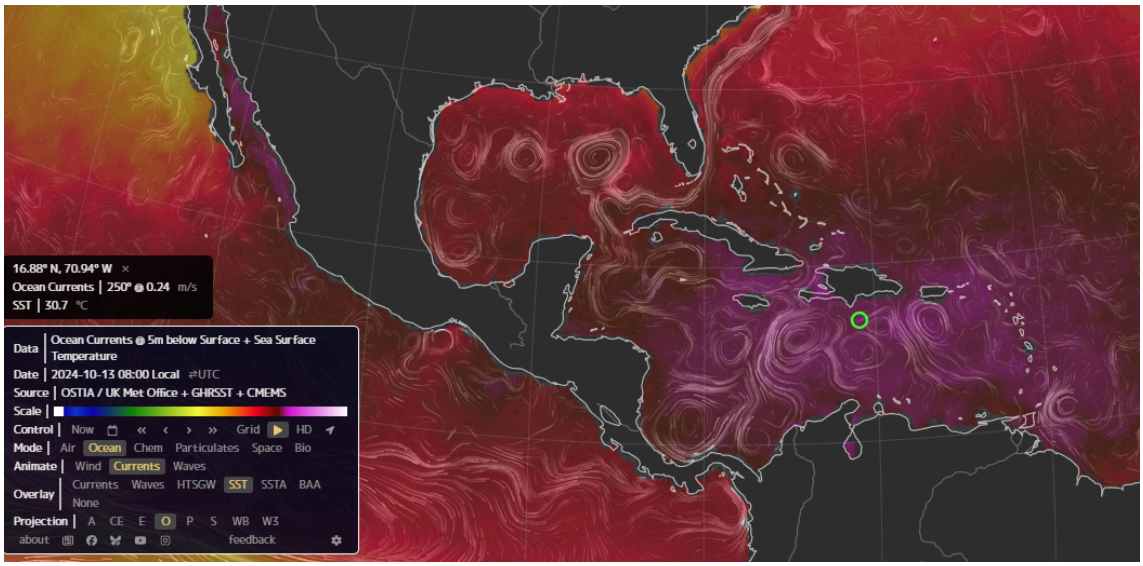
We talk about warmer water (exacerbated these days by climate change) intensifying a hurricane. Let's go backwards first:

Minimum Temperature for a Hurricane to Form: about **80 F = 26.5 C**



Hurricane Facts.

Temperature in the Gulf recently has been far warmer. Let's look at the temps today (10/14/2024). The darker red is about **84-86 F = 29-30 C; The purple is about 86-88 F = 30-31 C, These values are still strongly above the minimum for a hurricane 80 F = 26.5 C**



Here are some more impacts of Temperature (actual impacts will depend on the speed of the hurricane across the region, its ultimate diameter and the diameter of its eye, etc.)

- Increased **wind speed**: around 4-5% per degree C (about 2 F)
- Increased **moisture**: around 7% per degree C
- Increased **Destructive Power**: around 40-50% per degree C

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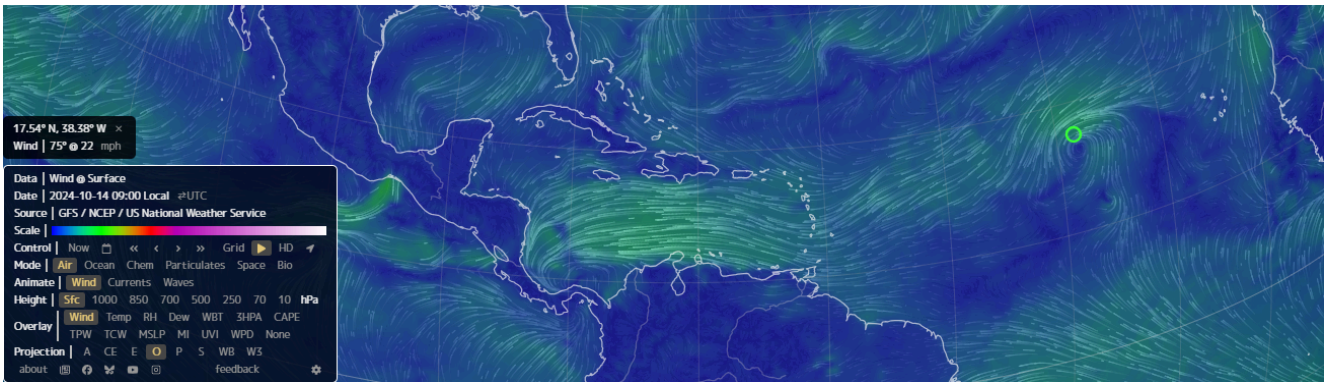
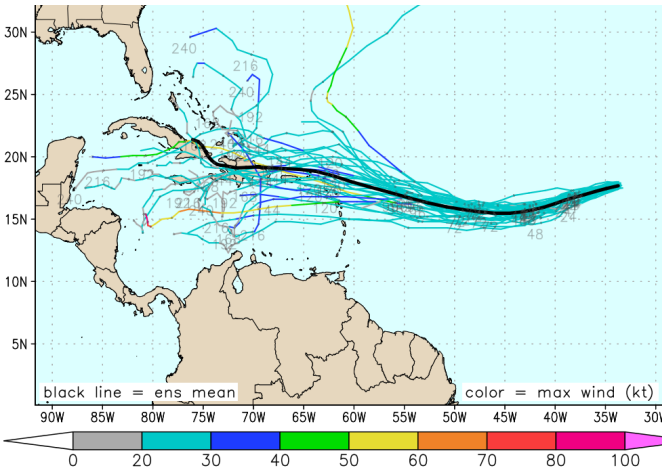
(As a side note, there is a low pressure area (green circle) forming right now in the Atlantic which might use that energy. Note the wind directions.)



And the computer models as of today(10/14/2024) are:



Can't say how this new tropical depression might evolve, but it is heading for waters which could make it into a major storm.

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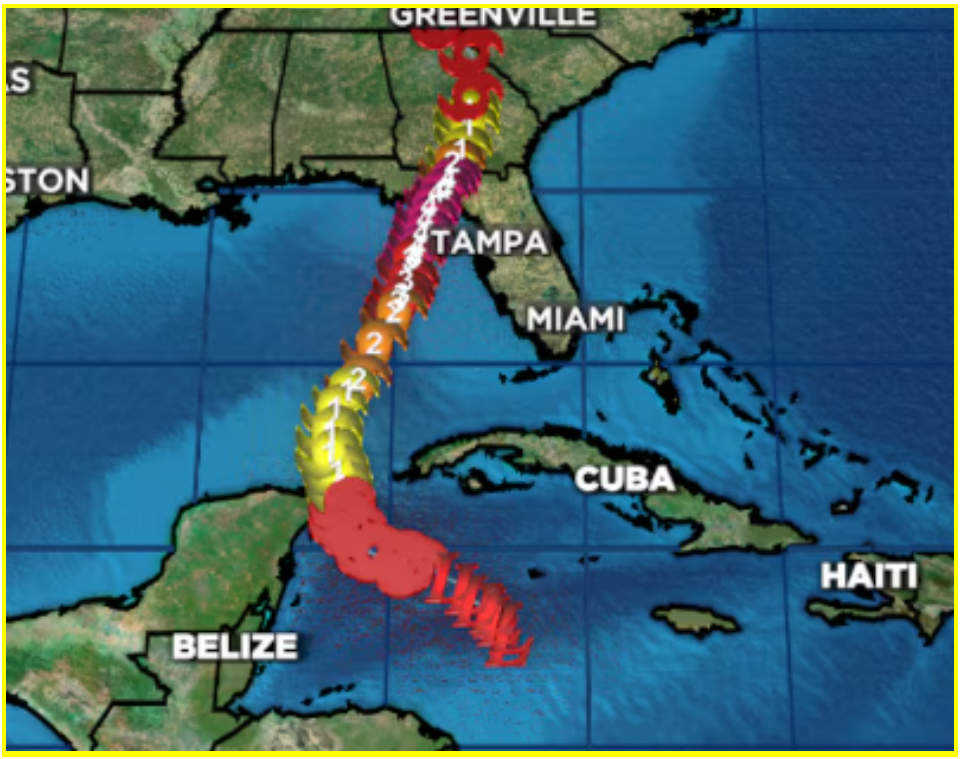
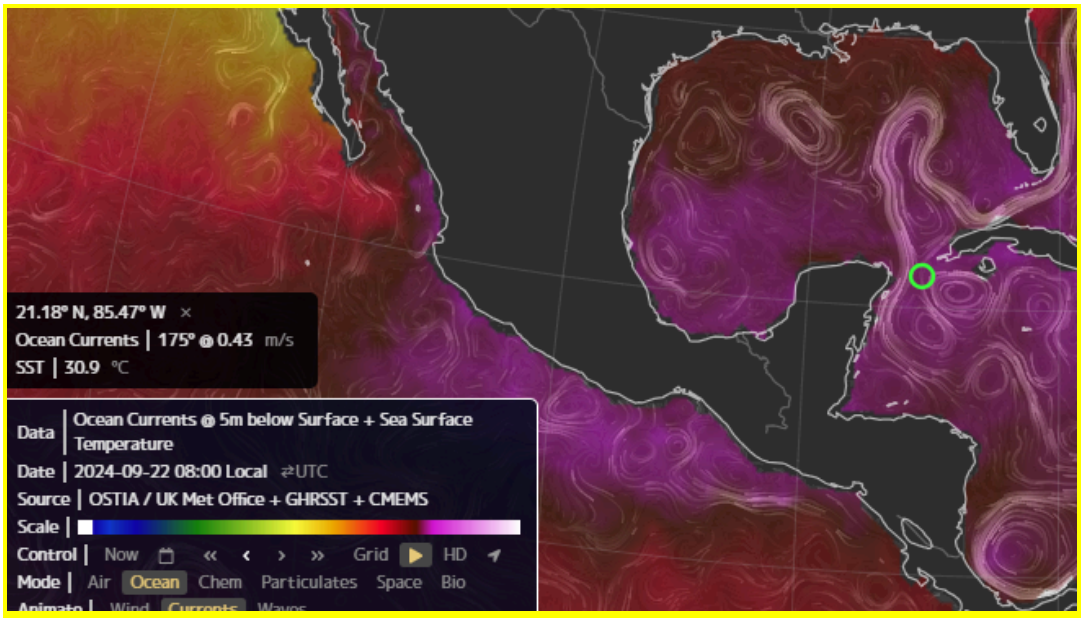
A quick look at Helene (Landfall 9/26/2024)

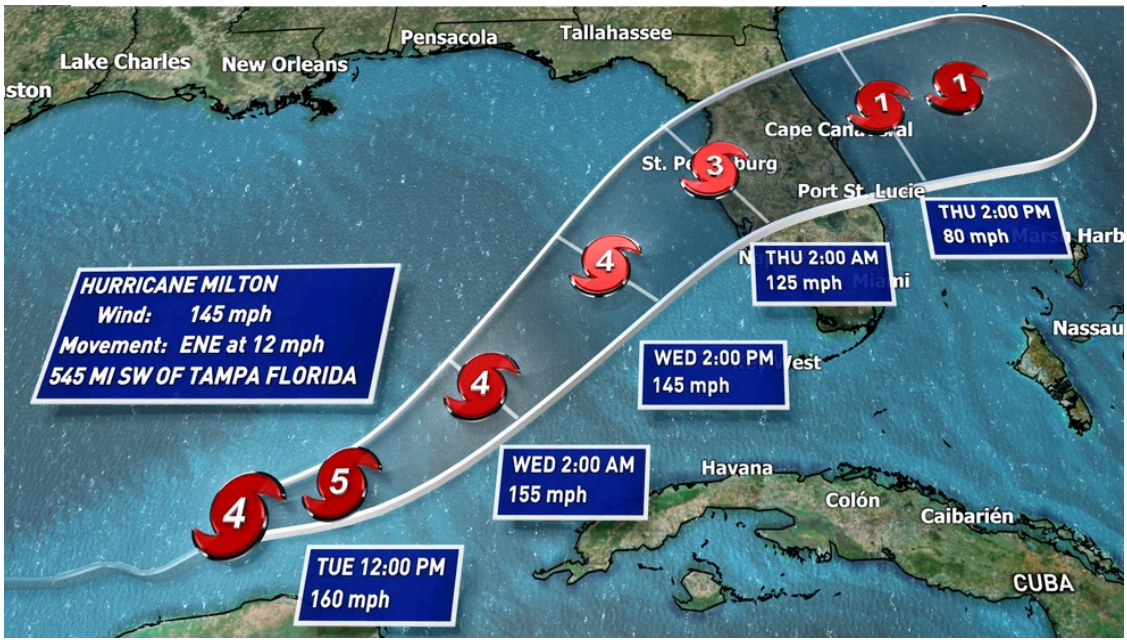


Landfall Sept 26. Here's the Gulf temps just before on Sept 22:

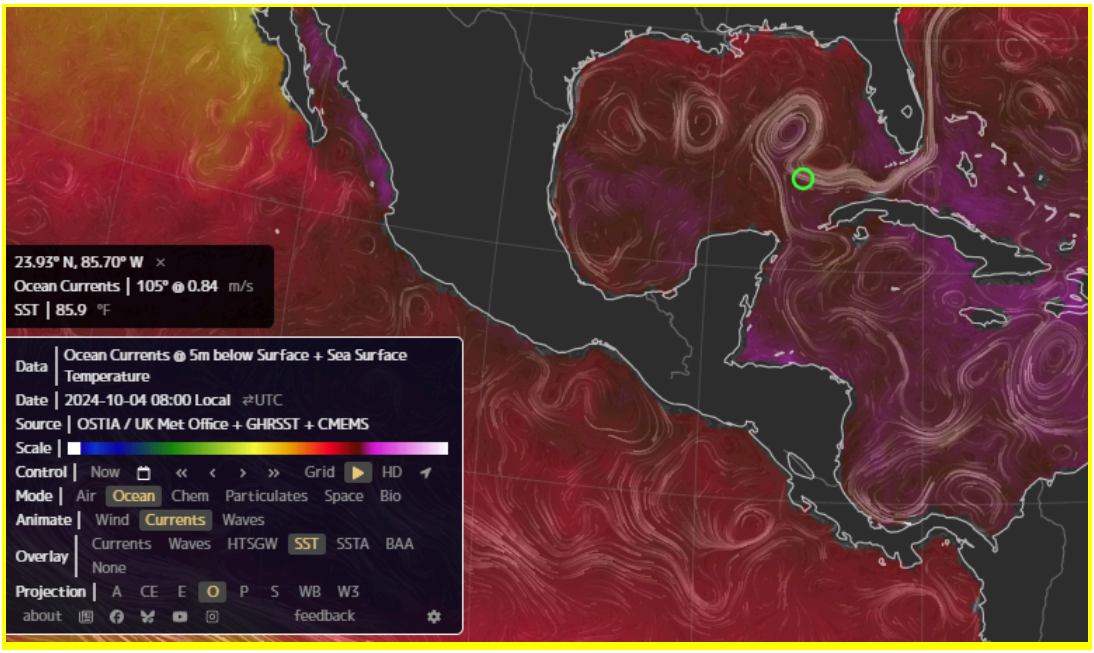


Gulf Temp was about **87.3 F = 30.7 C** as Helene crossed it. Remember the **Minimum Temperature** for a Hurricane to Form: about **80 F = 26.5 C**

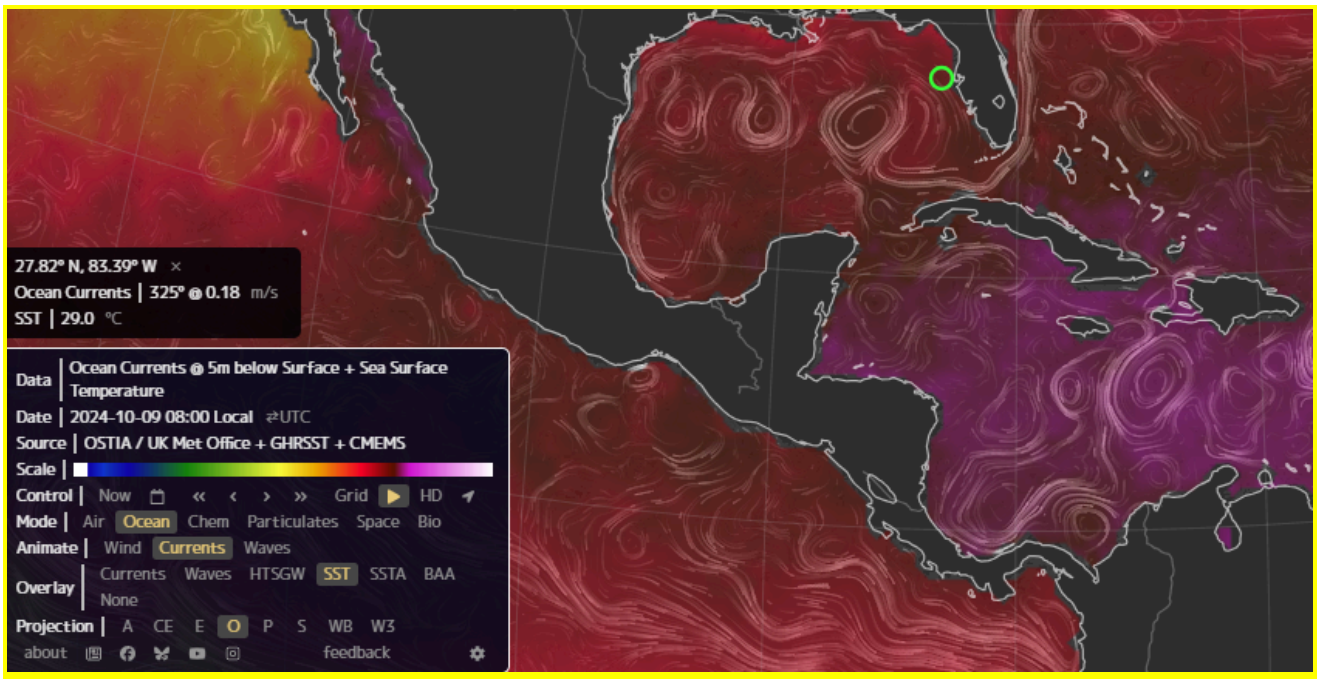
Now let's take a look at Milton, just two weeks later (Landfall 10/9/2024):



Milton crossed water cooled a bit by Helene. This was 5 days before Milton made landfall on October 9, 2024 (below). Temps were about **86 F = 30 C at the green dot. They were cooler than the temps where Milton was a Category 5.**

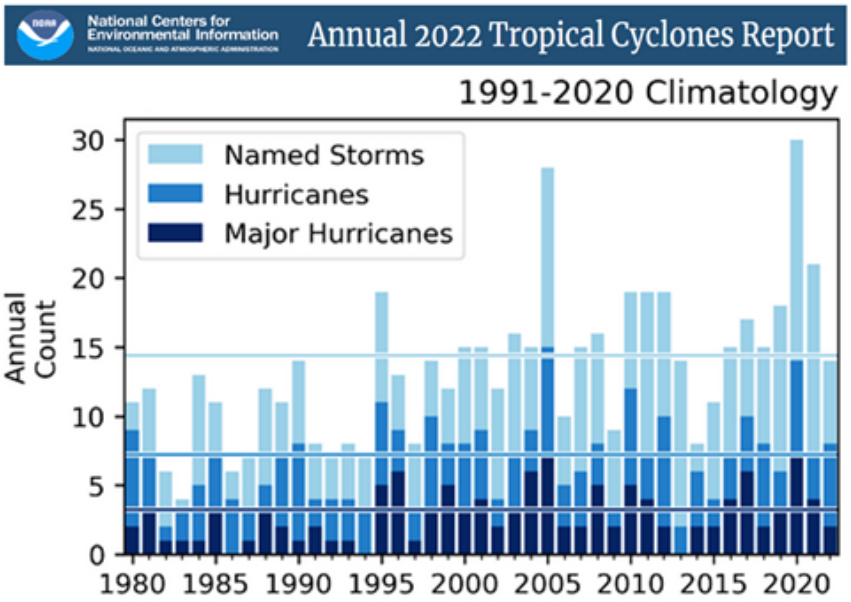


Notice the temperature just off the coast as Milton hit, below. Remember it weakened just before landfall. The temperature of the water had come down a full degree C (to 29 C = 84 F) and the storm hit as a Category 3, after having been up to a Category 5, which would be consistent with the projected 40-50% increase in destructive power with a 1 C increase in temperature.



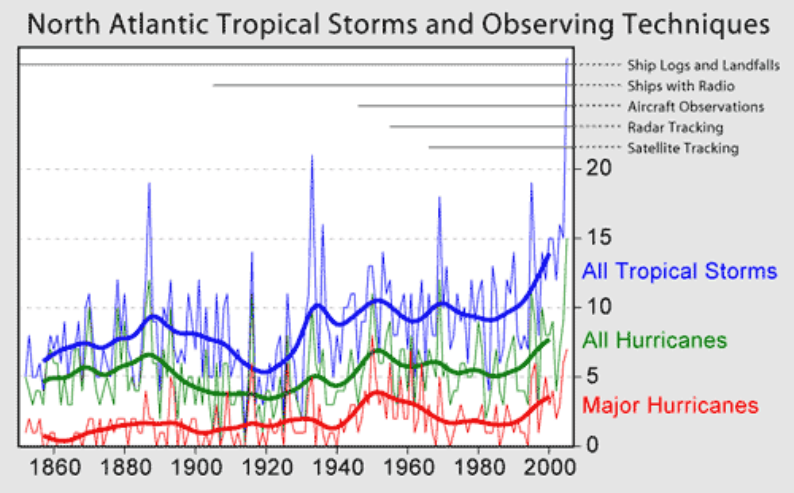
Climate Change and the number of powerful storms

Just a final note, because the question is appropriate: Is global warming affecting the number, the strength, the speed, the total energy, etc. of hurricanes? To keep this at the simplest level, here are the storms and powerful storms since 1980 - based on satellite data:



There is evidence that the number of hurricanes may not be changing much, but that there may be a small general increase in the number of major hurricanes.

But the chart below is a reminder that older data may be less reliable, considering the sources. We have to expect some global effects of such warming, but I don't think things are clear…



What is the link between hurricanes and global warming?

PUNCHLINES

- Tornadoes are occasional guests of hurricanes and I haven't been able to learn if they are directly impacted by climate change.
- Climate change has increased the ocean water temperatures on the average of around 1.5 C. This can be expected to increase precipitation and strength of hurricanes (depending on the actual temperatures where they form and develop). The global trends are not yet clear, I believe.
- Water temperatures below a hurricane can have a large and immediate impact.

Approximate "Cheat Sheet":

1 meter → 3 feet **1 degree Celsius (^{0}C)** → 2 degree Fahrenheit (^{0}F)
ppm = parts per million **CO_2** = Carbon Dioxide
1 tonne = 1000 kilograms = 2205 pounds **1 gigatonne (1 Gt)** = 1 billion tonnes
1 trillion tonnes (1Tt) = 1000 gigatons

GOOD NEWS CORNER

As parts of Florida went dark from Helene and Milton, the lights stayed on in this net-zero, storm-proof community

By Rachel Ramirez, CNN
Updated 10:58 PM EDT, Sat Oct 12, 2024

Julian Quinones/CNN/File

A drone image shows Hunters Point homes in Cortez, Florida, in April 2024. Billed as the first "net-zero" single-family home development in the US, Hunters Point boasts some of the most sustainable, energy-efficient and hurricane-proof homes in the country.

As parts of Florida went dark from Helene and Milton, the lights stayed on in this net-zero, storm-proof community

Our Natural World

Winner of Behaviour: Birds category

A peregrine falcon (Falco peregrinus) practises its hunting skills on a butterfly, above its sea-cliff nest in Los Angeles, USA. Should this young peregrine falcon make it to adulthood, tests have shown it will be capable of stooping or dropping down on its prey from above, at speeds of more than 300 kph (186 mph). Photo by Jack Zhi/WPOTY

https://apple.news/Ah5jbcaJgQriPMuJ9Z_-Oaw