Hurricanes Forecasting & Hurricane in the Models

The Good the Bad & the Ugly

Weather Workouts:
Feb 9th, 2021

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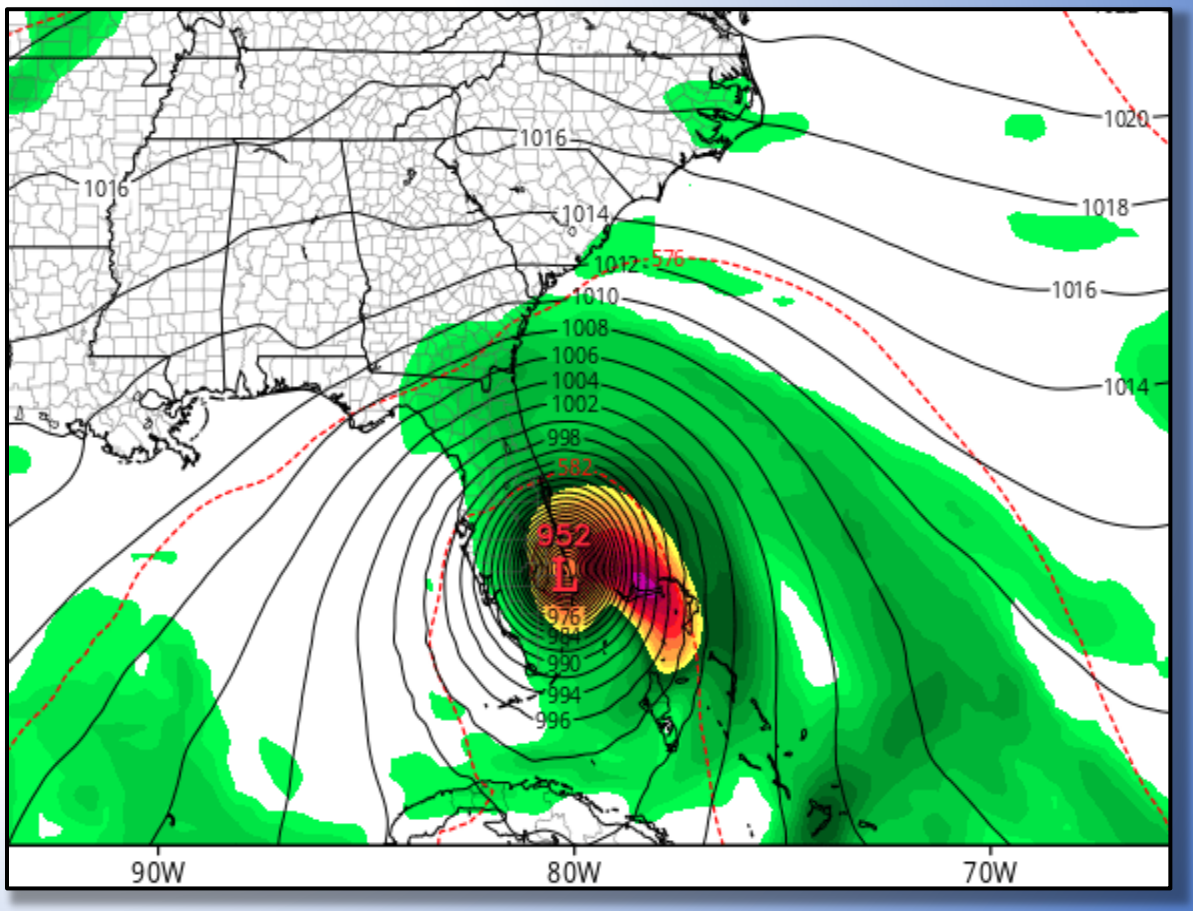


Numerical Weather Prediction = “Weather Models”

Disclaimer: I am going to discuss the facts about numerical weather prediction in the following slides. Some of these points are not flattering. However, this is in no way an “anti-model” presentation. I want to make very clear that Numerical Weather Prediction (“The Models”) are a huge advantage to the science of meteorology. Their development and constant improvement over the past 40 years has allowed the science to shift from “the stone age” to the “space age” in terms of our ability to predict impacts in a timeframe that allows decisions and preparation to be achieved.

The Models are part of the fabric of meteorology now. There is no going back. However, one must know how they work, and certaionly their limitations to properly incorporate the data into a useable, impact based forecast & decision process…

The Boring Slide

The one with all the words

The Model Foundation: The foundation for models are mathematical equations based on physics that characterize how the air moves and heat and moisture are exchanged in the atmosphere.

Initial State: Weather observations obtained from ground sensors and weather satellites are fed into these equations to produce and "initial state" of the atmosphere.

- The initial state is not complete. It is an approximation of the atmosphere. A complete initial state would require infinite data. We do not have it. So, many details are missing that will become very important to the final model solution the further out in time we go.

- Initial conditions are far superior today to what we had even 10 years ago. Initial conditions have the biggest influence on the accuracy of a computer model.

Starting the Model: The atmosphere is divided into a three-dimensional grid and each grid point is given a unique "initial state". Then at each grid point, the mathematical equations are applied and stepped forward in time. The outputs over many time steps specify future weather at all grid points.

Models Vary Widely: Each particular model assimilates data differently to create a unique "initial state", solves the equations in different ways, and has varying sizes the grid cells it is solving the equations in. The difference in grid sizes, changes the types of equations that can be used and how they are solved.

- These differences between varying models will result in different final solutions. Sometimes, vastly different solutions. The spread in final solutions will increase as the forecast time gets further into the future and minor details early on in the forecast become major influencers on the model equations.

The conclusion:

- No two models will ever come out with exactly the same solution.
- Varying accuracy of initial conditions causes run to run changes for even a single model.

THE FOLLOWING **PREVIEW** HAS BEEN APPROVED FOR

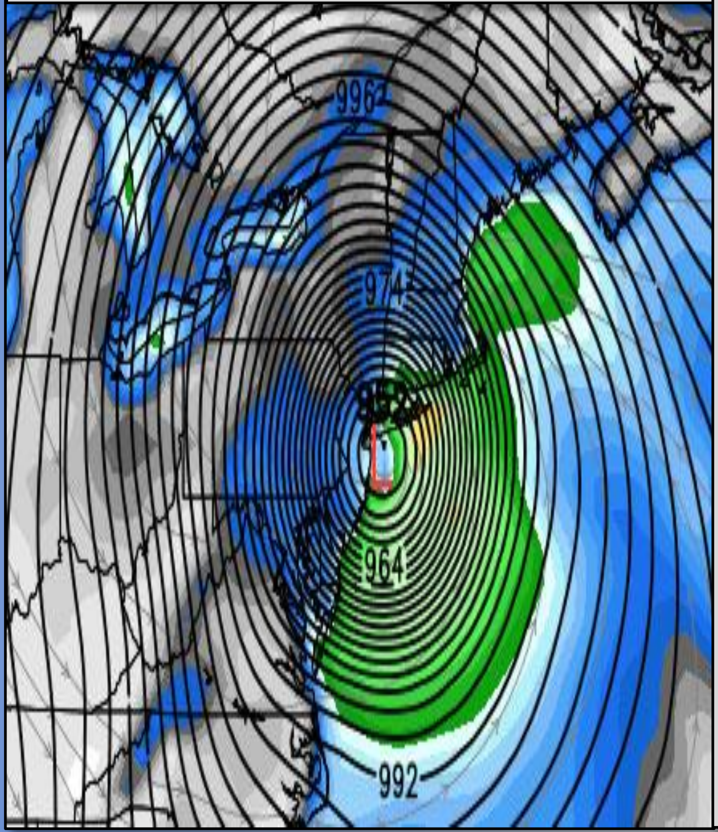
ALL AUDIENCES

BY THE MOTION PICTURE ASSOCIATION OF AMERICA, INC.

www.filmratings.com www.mpaa.org

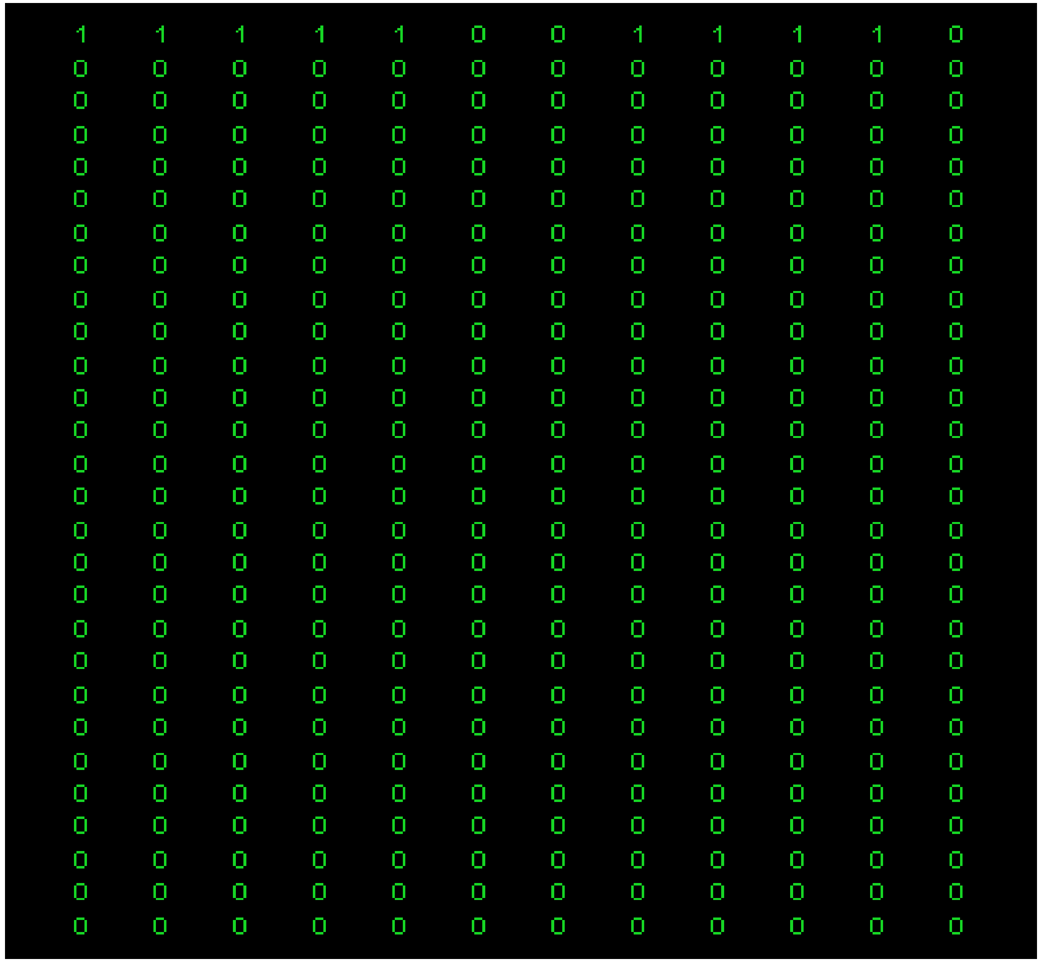
“The Model Prediction”

Coming Summer 2021



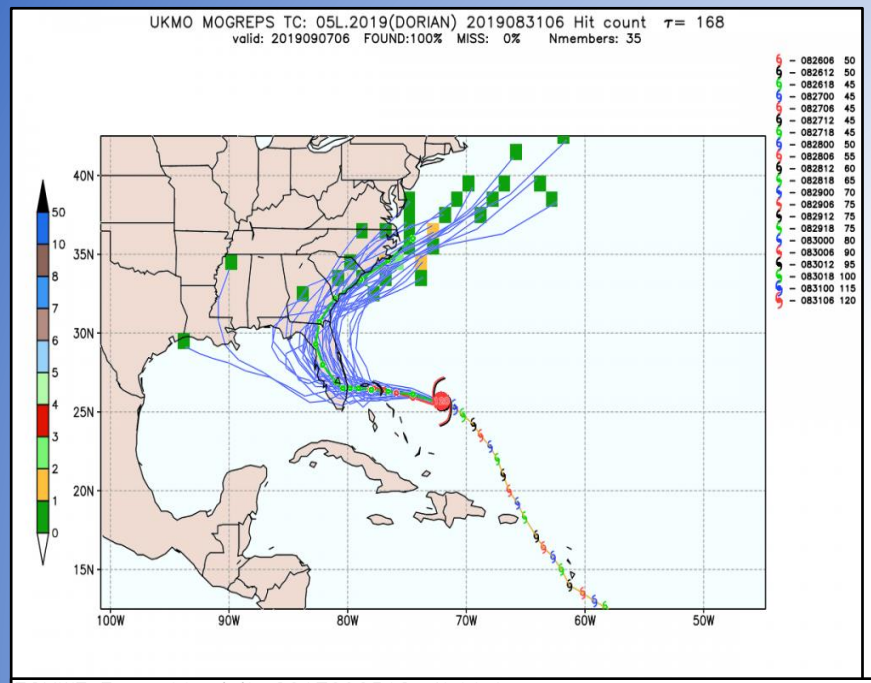
PG-13 | 120 min | Fantasy

When the atmosphere threatens to unleash a storm of epic proportions, some models say it will happen, some say it won’t. A rogue band of meteorologists and emergency managers must band together to determine whether the storm will form, where it might threaten, and to somehow stop the evil forces of social media from getting in the way of the message. “The Model Prediction” is a non-stop ride of uncertainly and changing day 10 forecasts. The theatre will sell you the whole seat…but you’ll only NEED THE EDGE!!!



Let’s break down what a single model solution really is…

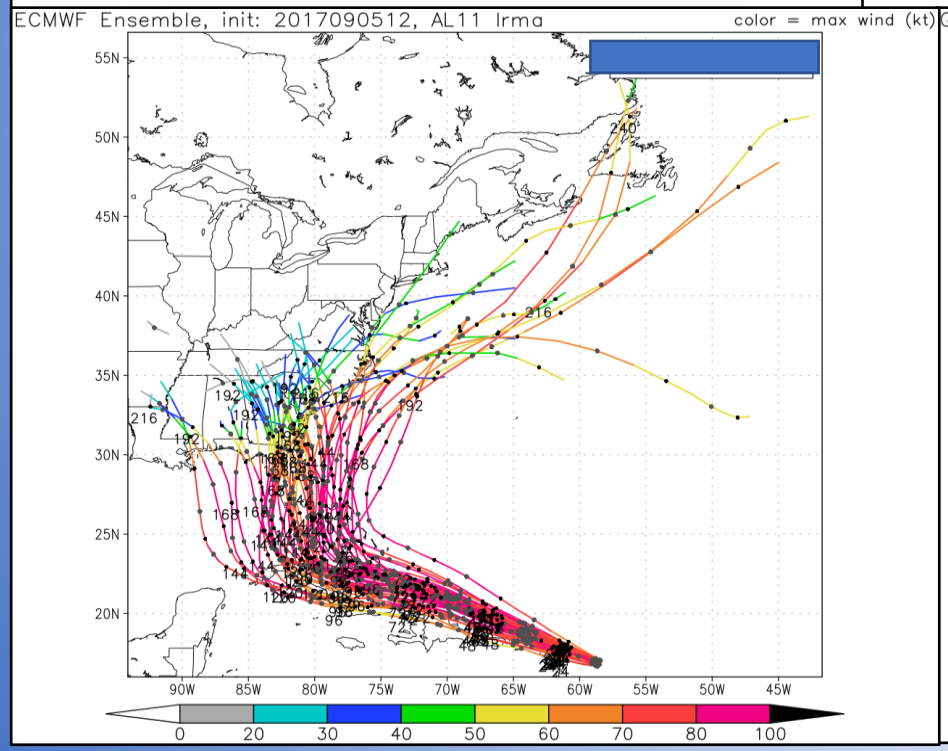
- If a model was a movie, it would be classified as a “Fantasy”.
- A weather model solution is a sophisticated computer generated fantasy representing just one out of an infinite number of possible atmospheric states / solutions.
- **Just 1’s and 0’s -** Numbers inside a computer.

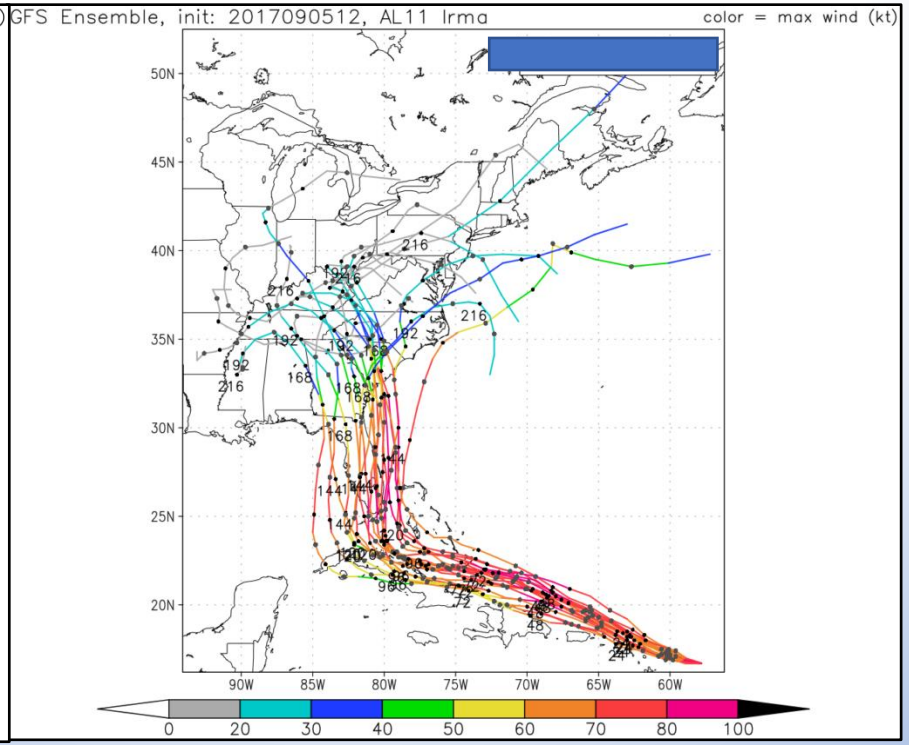


Looking at the forecast in terms of ensembles – Not a single run or even single model

To get a sense of the uncertainty in a forecast, meteorologists rely on **model ensemble systems**.

- Various simulations of the same model comprising a family of alternative predictions obtained by tweaking the initial conditions.
- Helps capture the range of uncertainty in the forecasts, and leads to a better understanding of the range of possible outcomes in a certain situation.



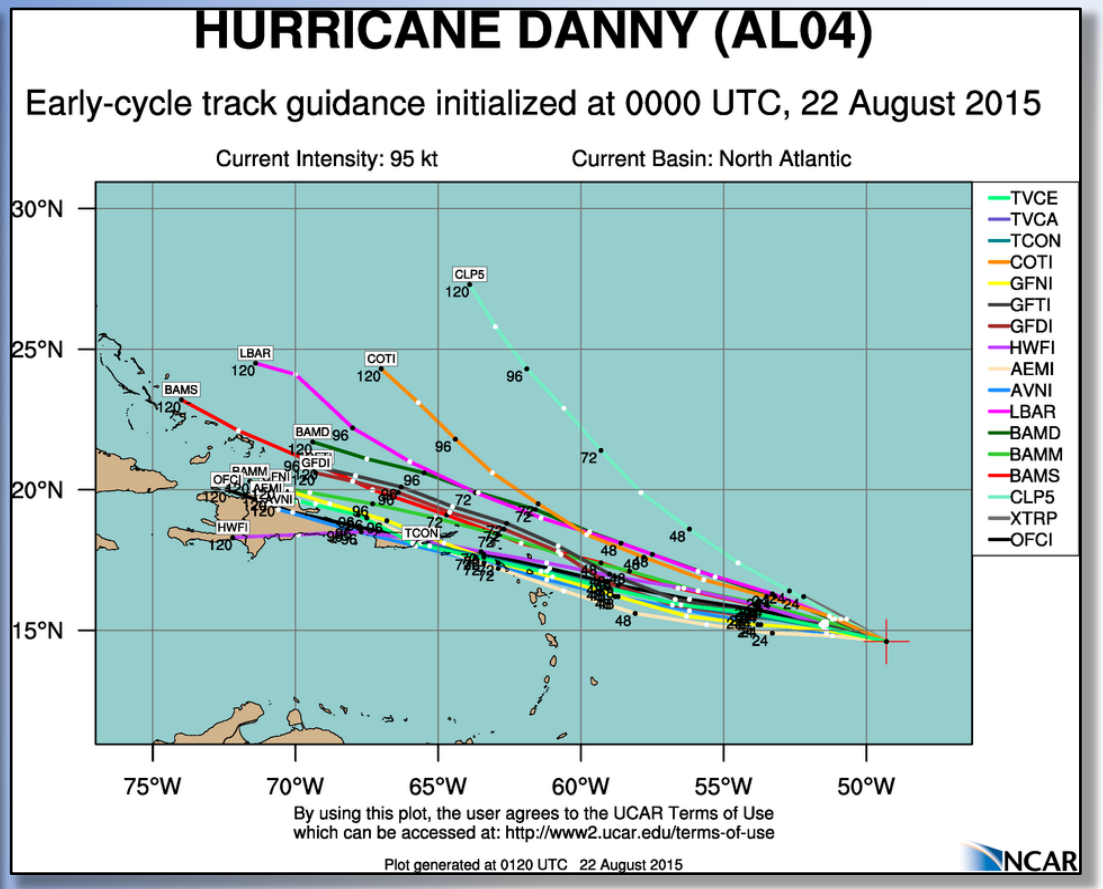


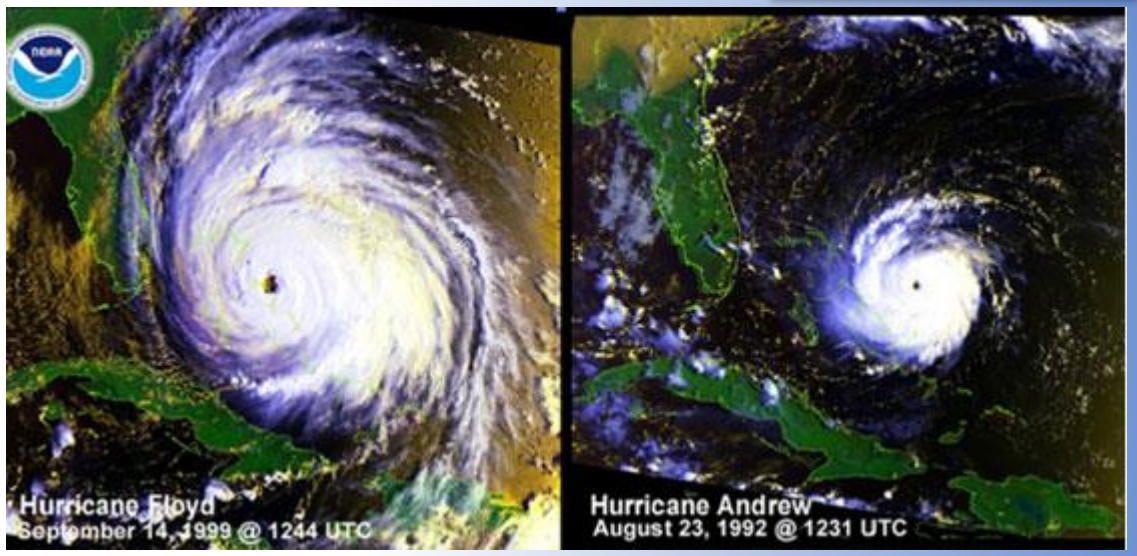
Meteorologists must consider the entire universe of models together, and take their strengths, limitations and known biases into account when making predictions.

Properly communicating uncertainty when models disagree is as important as the “official” forecast in many ways.

Spaghetti Models

- XTRP
- TVCN
- NHC
- BAMD
- BAMM
- BAMS
- GFDL
- UKM
- NGPS
- AVNO
- AEMN
- HWRF
- CM
- APxx
- CLP5





BAMS = Only impacted by a shallow atmosphere (s)
BAMM = Only impacted by the middle of the atmosphere
BAMD = Only impacted by upper levels of the atmosphere

Essential to understand what each member of a spaghetti plot is designed for, and what it is not designed for

Positives – Provides an idea of consistency between different model runs

Negatives – Provides very limited / None for information on potential impacts or location/scope of potential impacts (storms above look similar on a spaghetti chart)

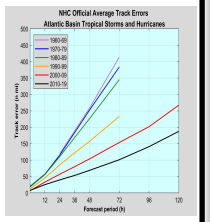
What Day is this forecast?

Day 1?

Day 2?

….

Day 7+?



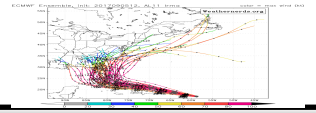
Forecaster Experience 1?

Which models do well under current conditions? Which DO NOT…

Computer Models Solutions

All of them!

Not Just GFS & ECMWF



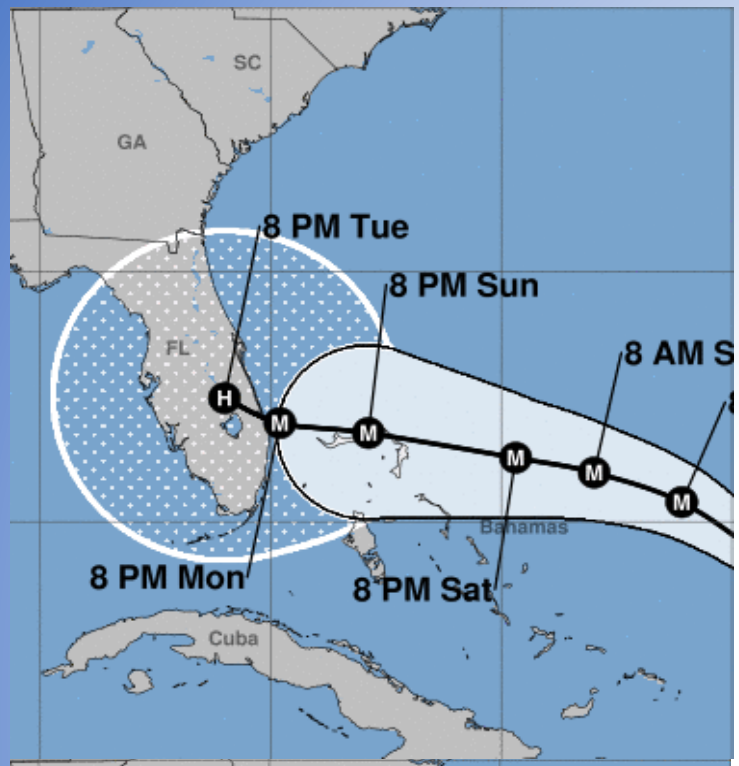
Forecaster Experience 2?

Seasons are different. How has this season going. Any Biases need to be applied?

Time of Year "Climatology"

Is it time to get Serious?

Does the threat and reasonable worst case scenario now outweigh the uncertainly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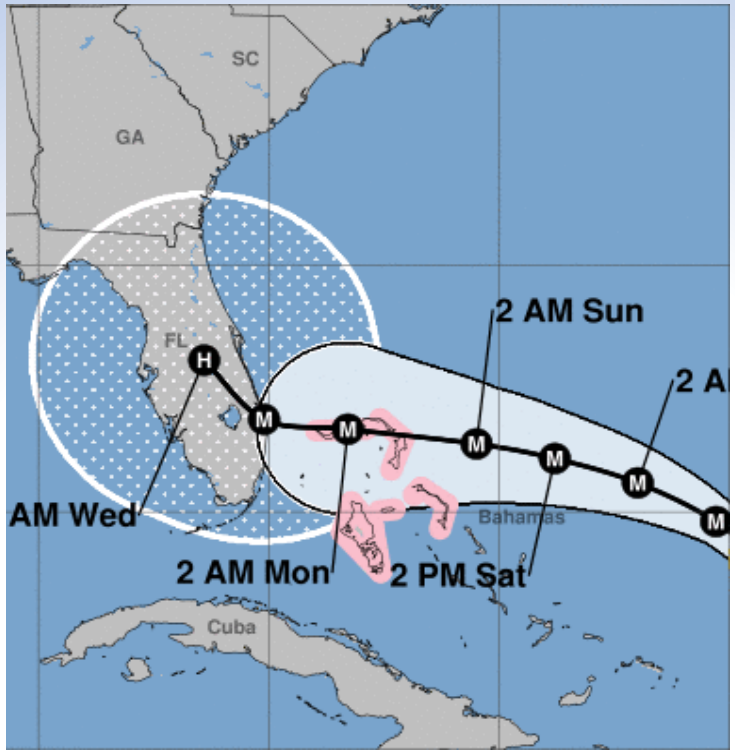
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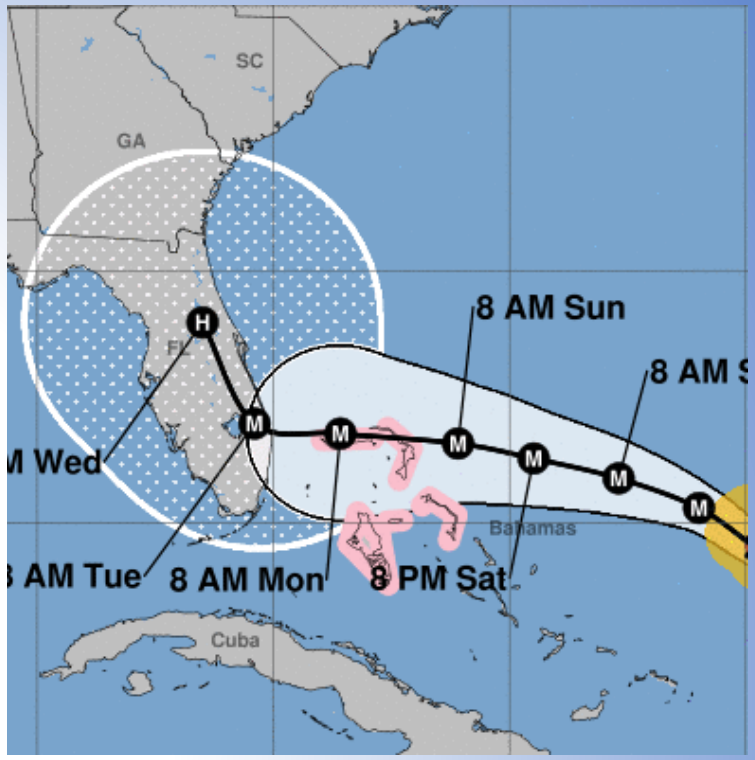
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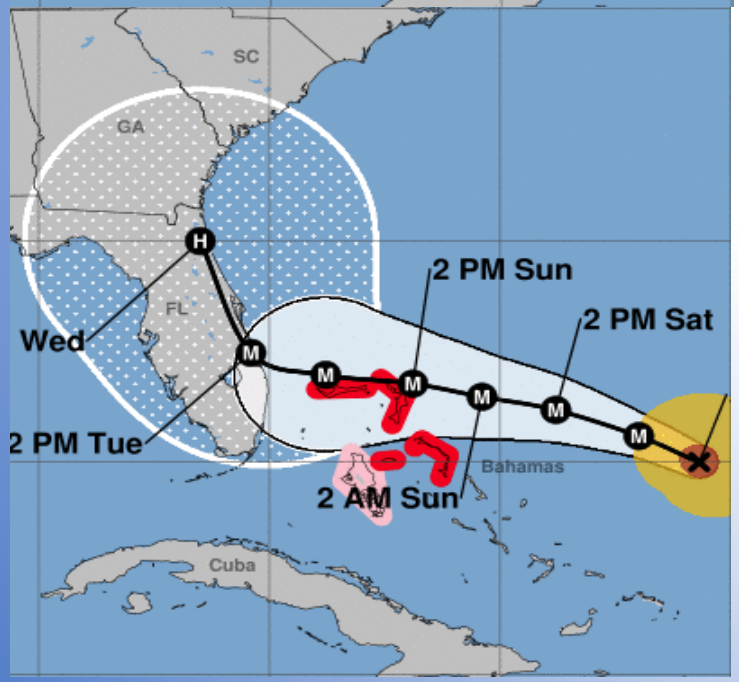
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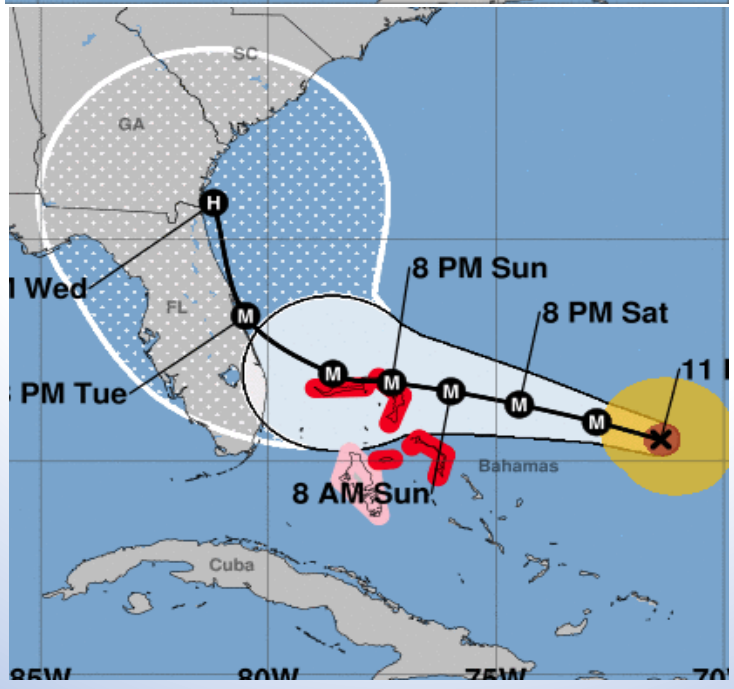
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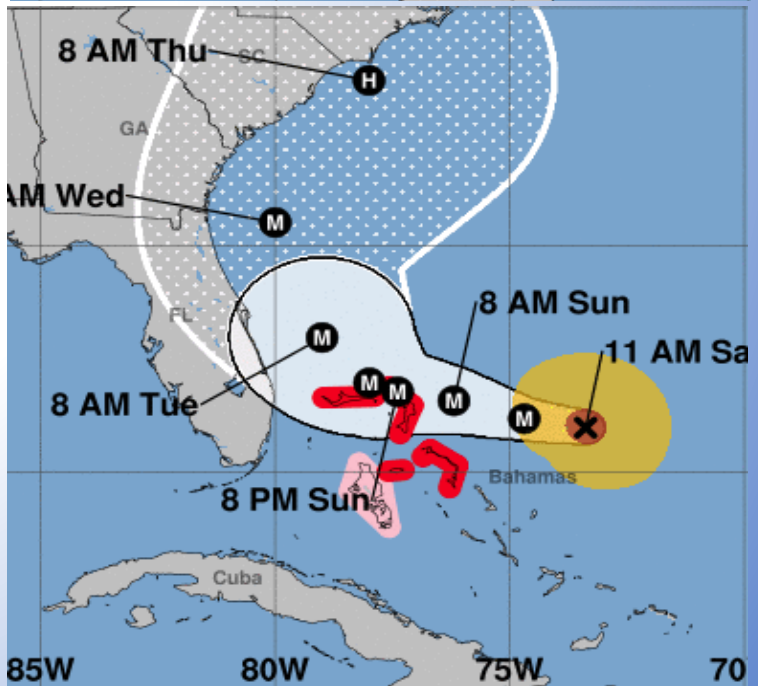
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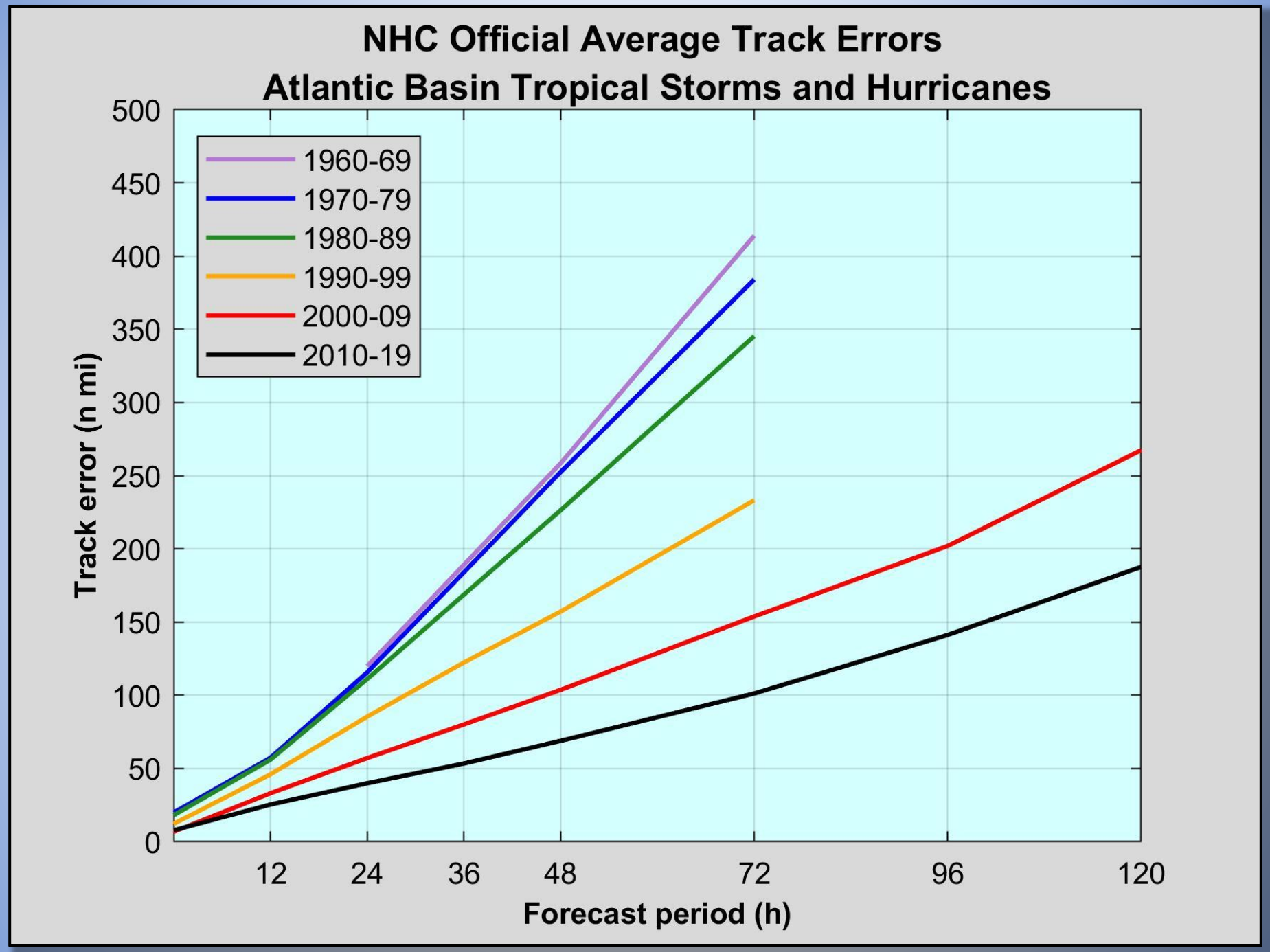
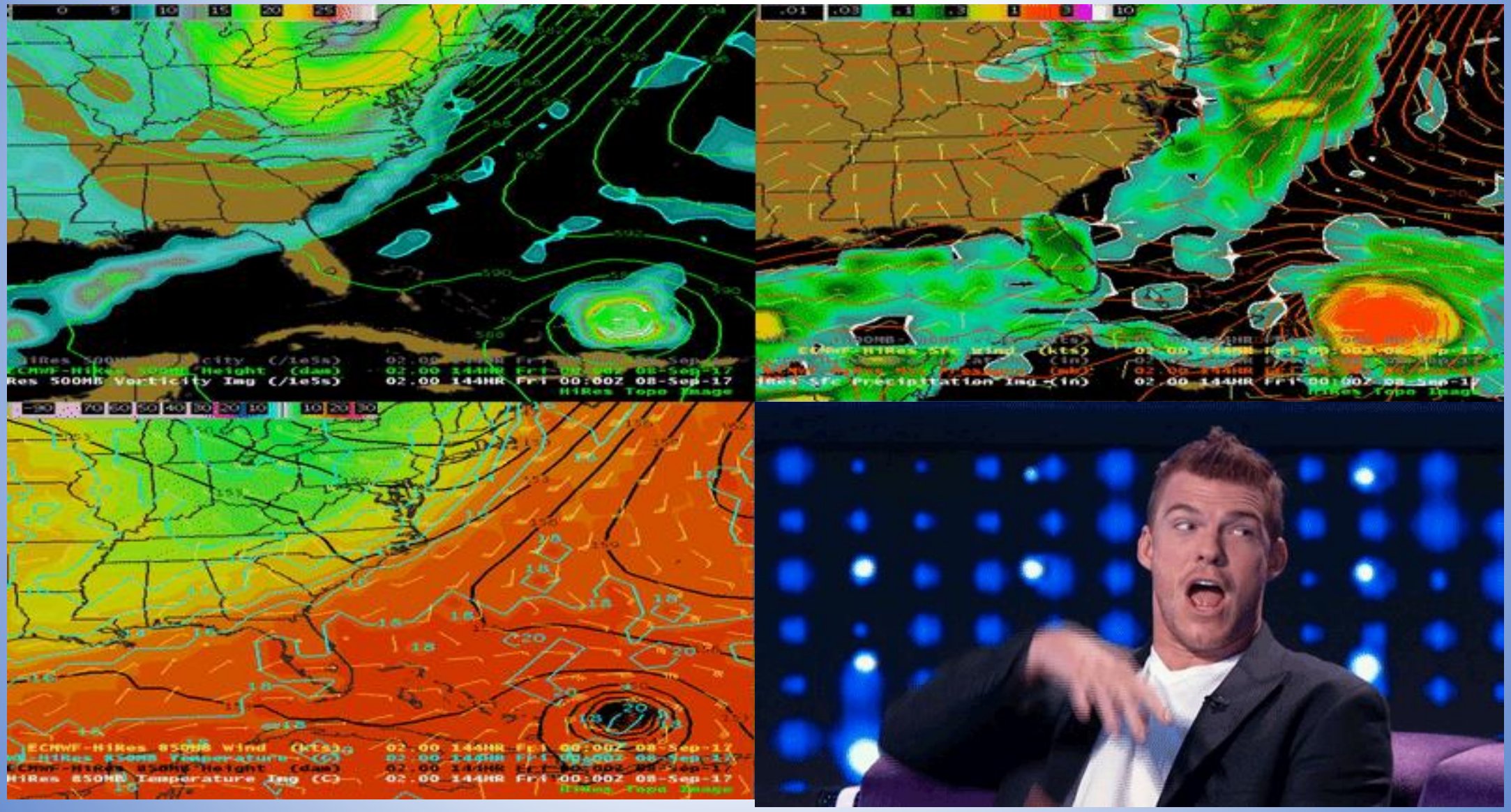
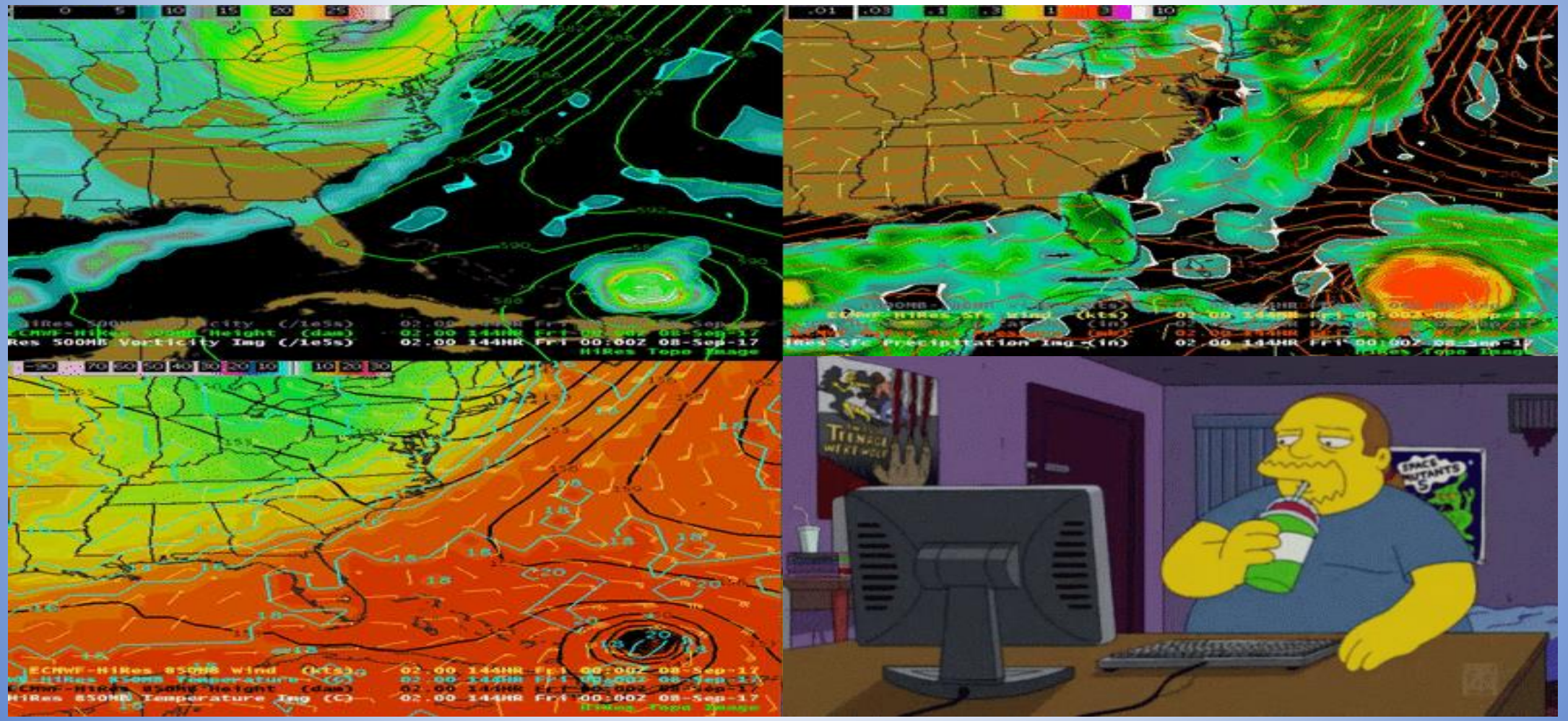

NHC Official Average Track Errors
Atlantic Basin Tropical Storms and Hurricanes
Track error (n mi)
Forecast period (h)
1960-69
1970-79
1980-89
1990-99
2000-09
2010-19
0
50
100
150
200
250
300
350
400
450
500
12
24
36
48
72
96
120

The same reason why an model solution showing a storm over your location many days out should not necessarily be cause for panic, a solution where a storm misses your location should not necessarily be a cause for total relief and losing situational awareness.



Hurricanes are a low probability, but conditionally HIGH impact event. Even a category 5 hurricane has a very small radius of truly destructive winds. It is simply not possible to determine days in advance exactly here the worst impacts from any storm will cross the coast.

Remaining situationally aware and ready to take action (if/when required) is always the best plan of attack in the time before any watches or warnings are issued.

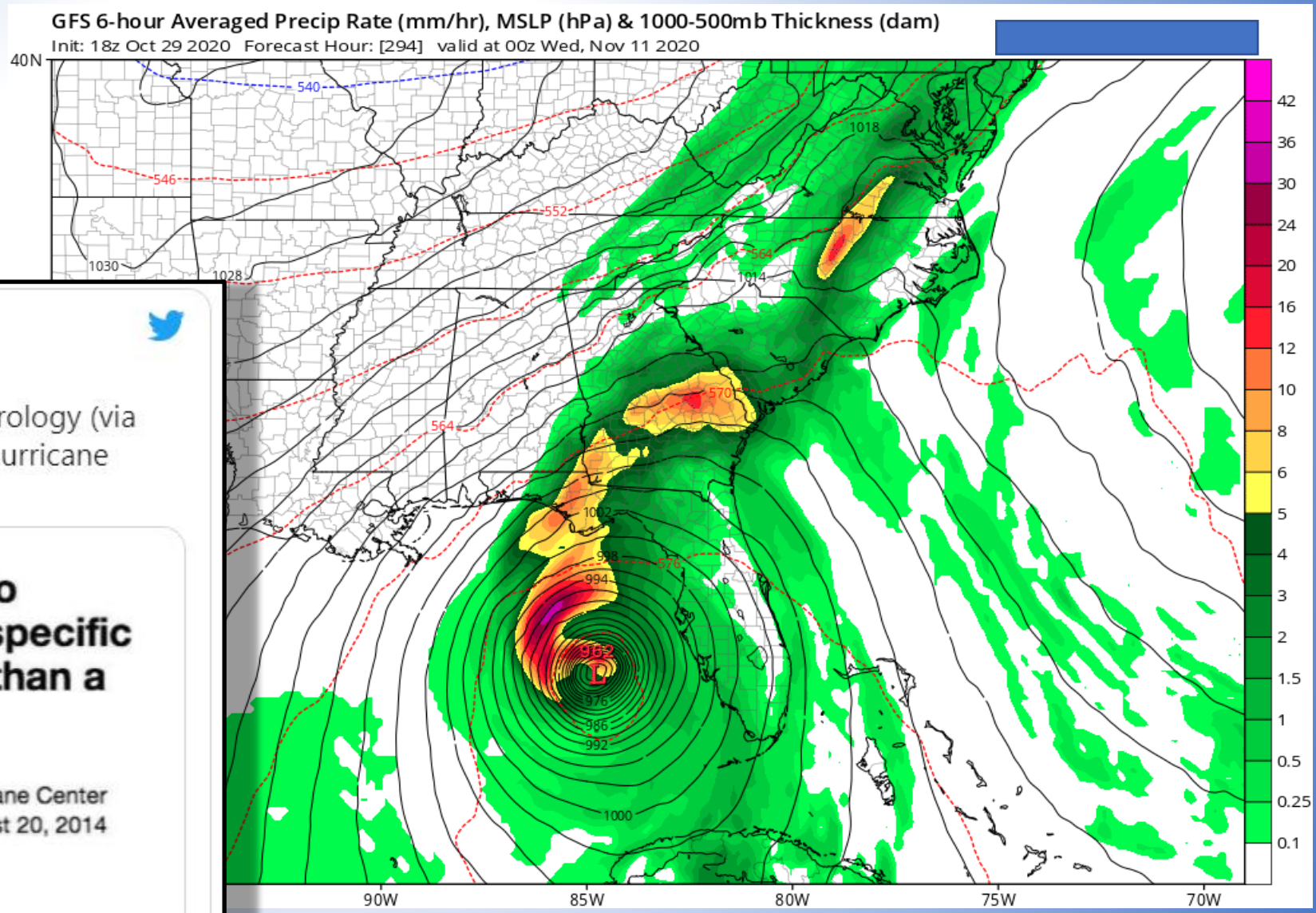


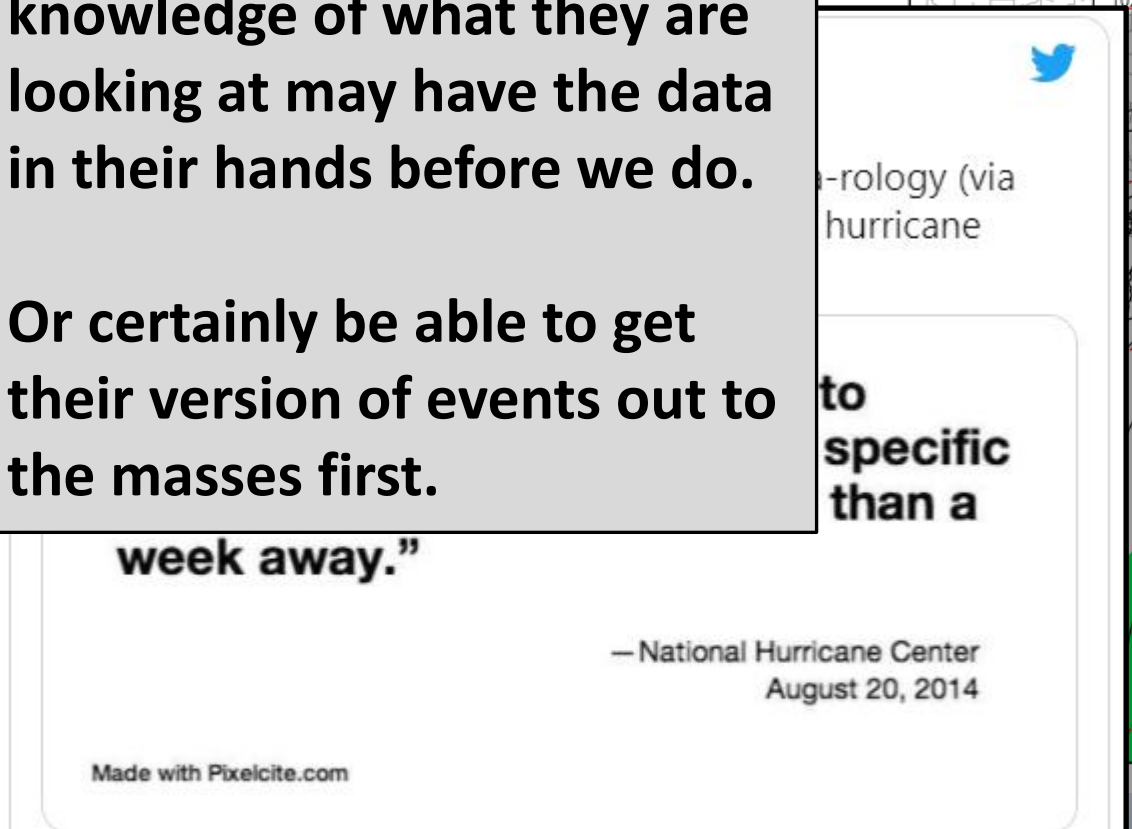
The Information Age has made the jobs of both meteorologists and Emergency management more difficult. We live in a world now where someone without the proper knowledge of what they are looking at may have the data in their hands before we do.

Or certainly be able to get their version of events out to the masses first.

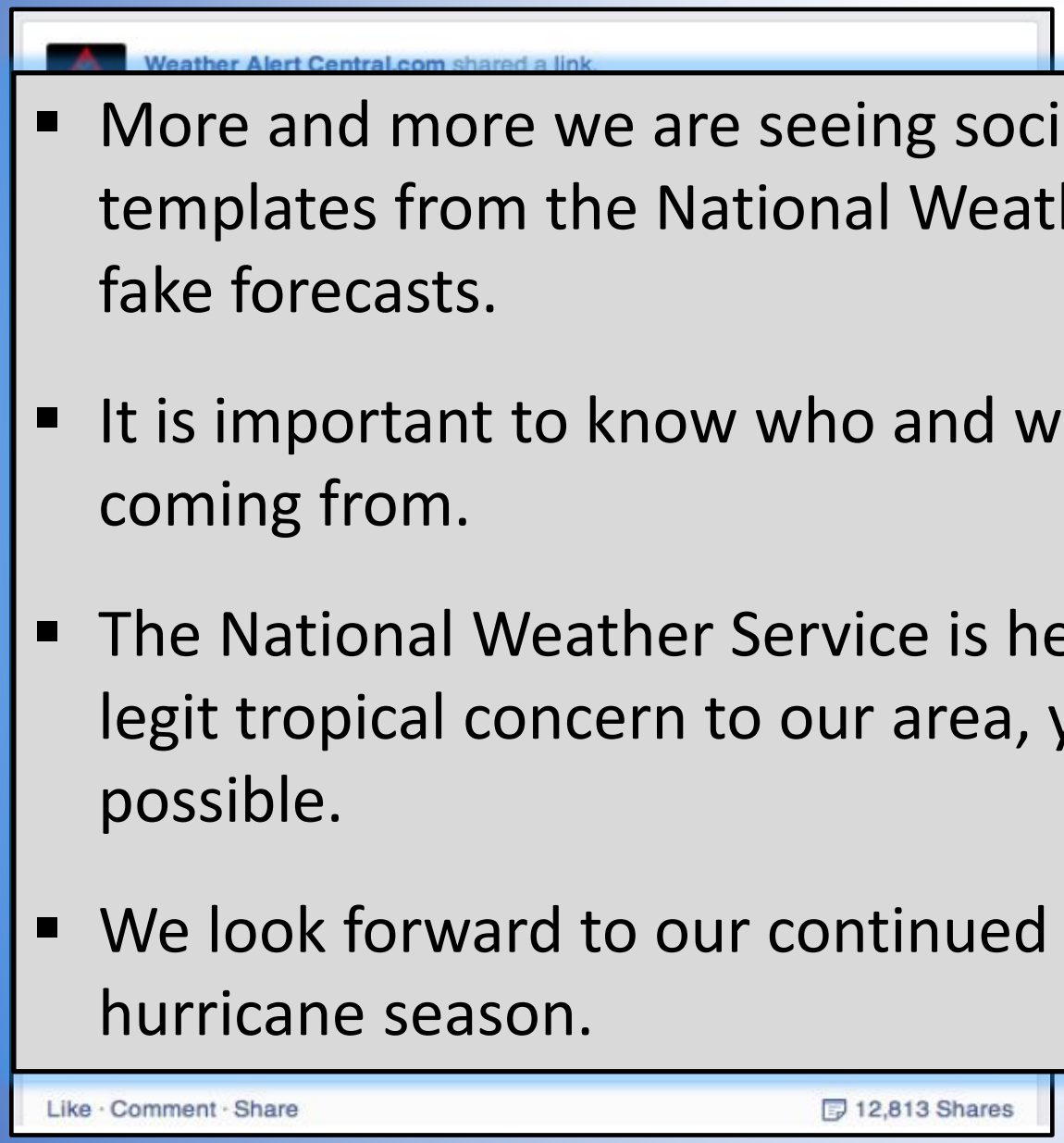
294 hourr Forecast = 11 days in the future.

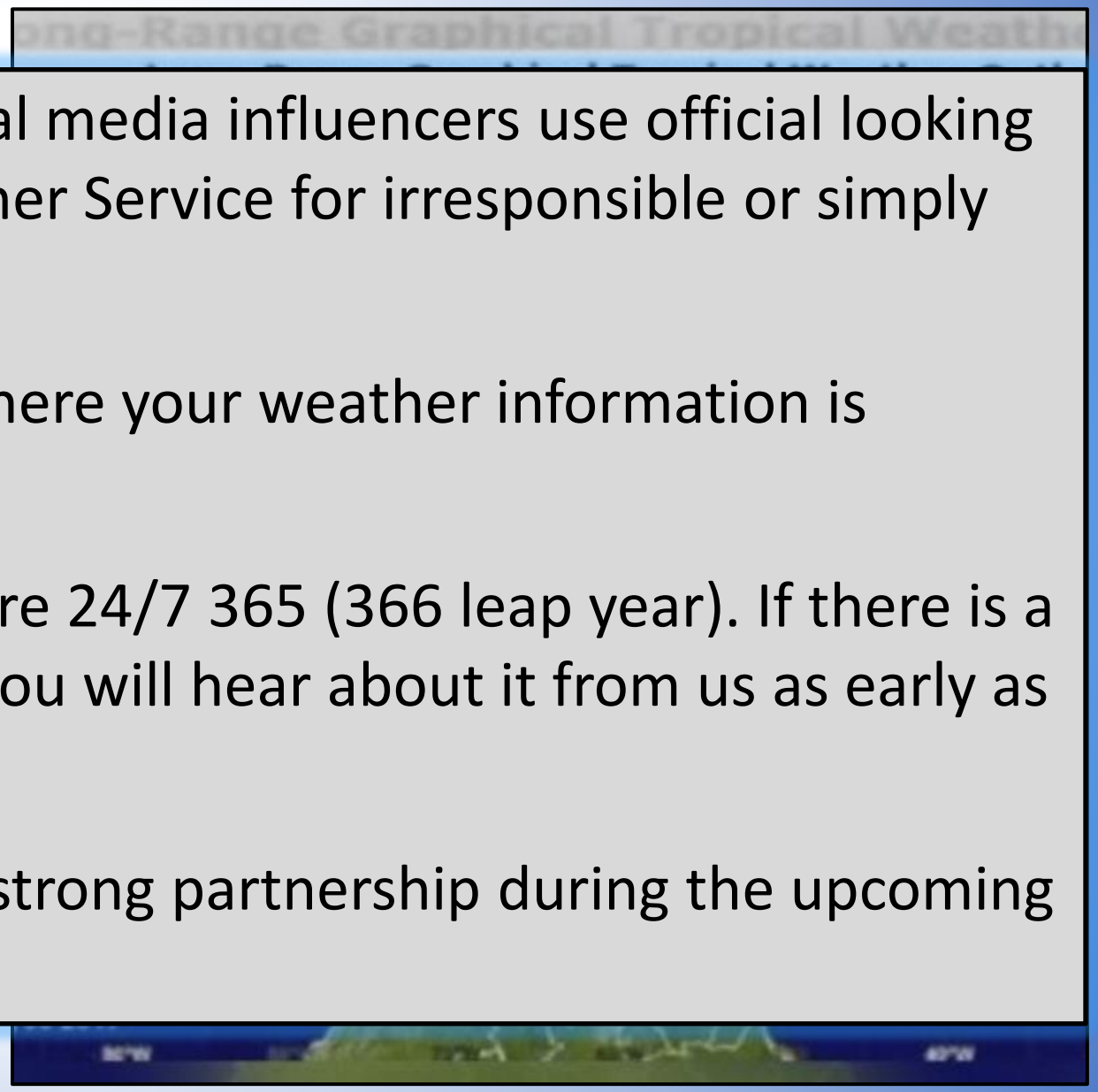
More than likely this storm has not even formed yet, and there is certainly no skill to be able to determine where it might, or how strong in 11 days.





Copy Cat Social Media Posts





- More and more we are seeing social media influencers use official looking templates from the National Weather Service for irresponsible or simply fake forecasts.
- It is important to know who and where your weather information is coming from.
- The National Weather Service is here 24/7 365 (366 leap year). If there is a legit tropical concern to our area, you will hear about it from us as early as possible.
- We look forward to our continued strong partnership during the upcoming hurricane season.

Any Questions?