



Florida Housing Coalition Hurricane Member Update Webinar

April 23, 2021
Sponsored by Fannie Mae

AGENDA

- Training Announcement
- Forecast for the 2021 Atlantic Hurricane Season



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THE FLORIDA HOUSING COALITION



Making Mitigation Work Webinar

The National Risk Index for Natural Hazards



- May 11 1:00 PM Eastern Time - Learn about the Federal Emergency Management Agency's interactive National Risk index, which identifies community risk to nearly 20 different hazards
- Use it to visualize risk for your community
- https://cuboulder.zoom.us/webinar/register/WN_IcGE7Ng1Slaca_lymPp69Q



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Forecast for the 2021 Atlantic Hurricane Season

Dr. Philip Klotzbach,
Colorado State University
philk@atmos.colostate.edu





**Atlantic Basin Seasonal Hurricane
Prediction**

**Phil Klotzbach
Department of Atmospheric Science
Colorado State University**

Florida Housing Coalition Webinar

April 23, 2021



Outline

- **Intro to Atlantic Seasonal Hurricane Prediction**
- **2020 Atlantic Hurricane Season Review**
- **2021 Atlantic Basin Seasonal Hurricane Forecast**
- **Long-Term Trends in Hurricane Activity**

In Memory of Bill Gray (1929-2016)



Klotzbach, P. J., J. C. L. Chan, P. J. Fitzpatrick, W. M. Frank, C. W. Landsea, and J. L. McBride, 2017: The science of William M. Gray: His contributions to the knowledge of tropical meteorology and tropical cyclones. *Bull. Amer. Meteor. Soc*, **98**, 2311-2336.

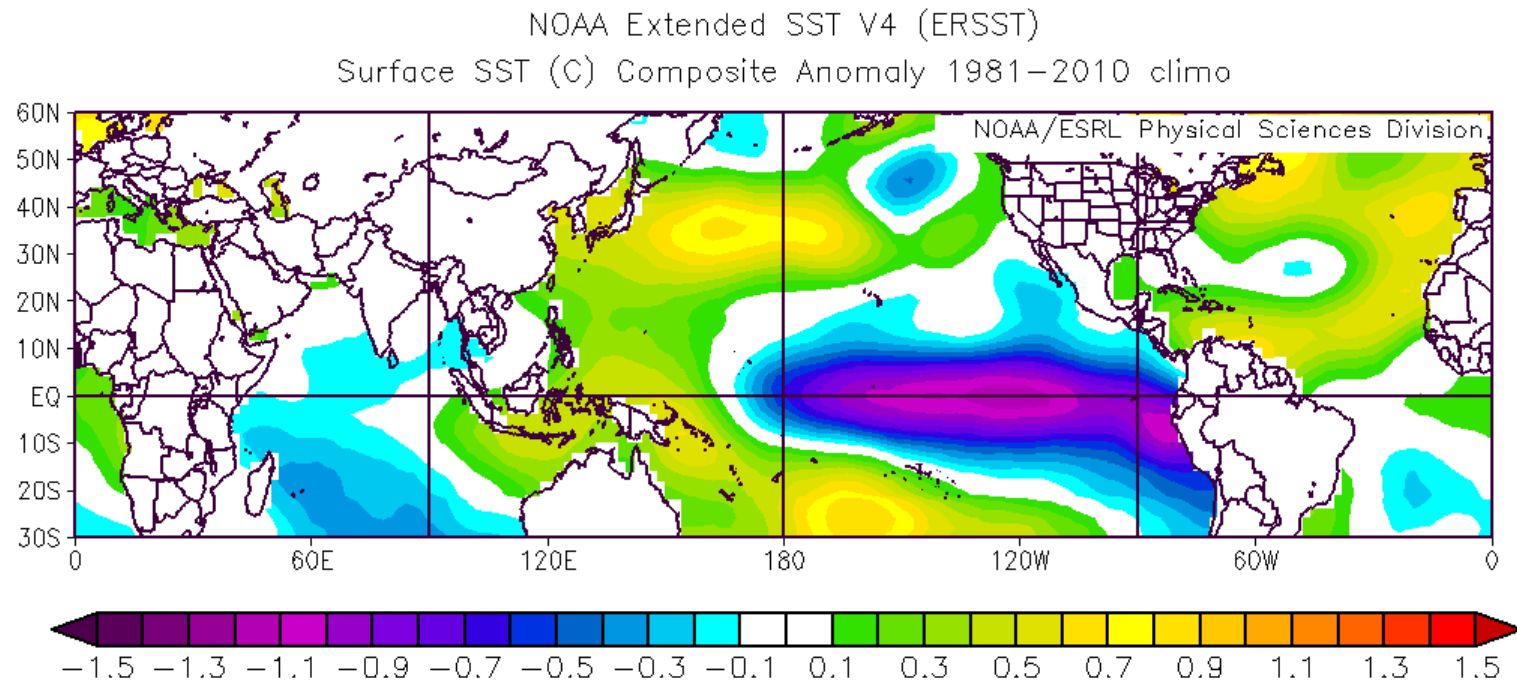
**“It's tough to make predictions,
especially about the future”**

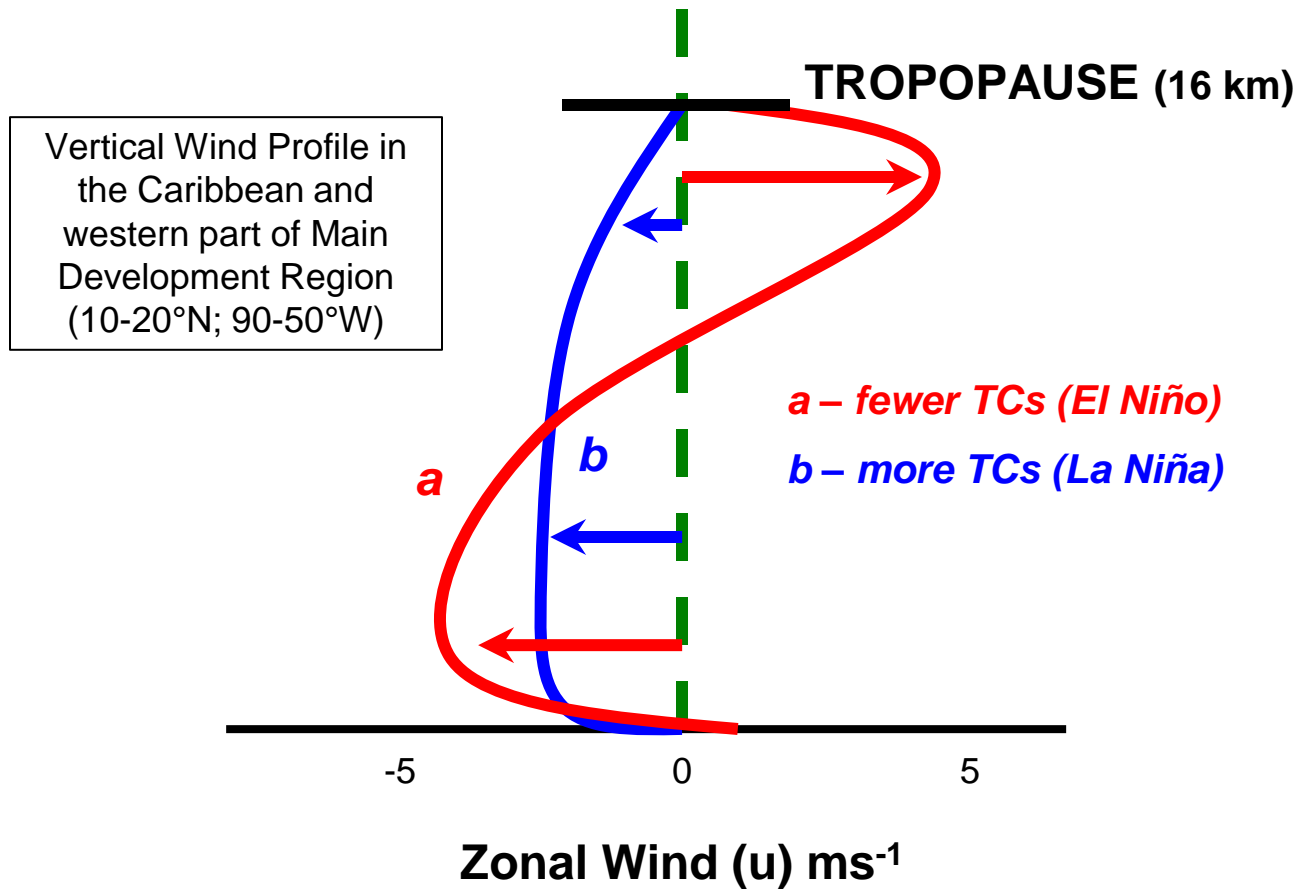
HOWEVER...

“You can see a lot by looking”

Yogi Berra

August – October SSTs: Ten Most Active minus Ten Least Active Atlantic Hurricane Seasons since 1950







**2020 Atlantic Hurricane Season: A
Look Back**

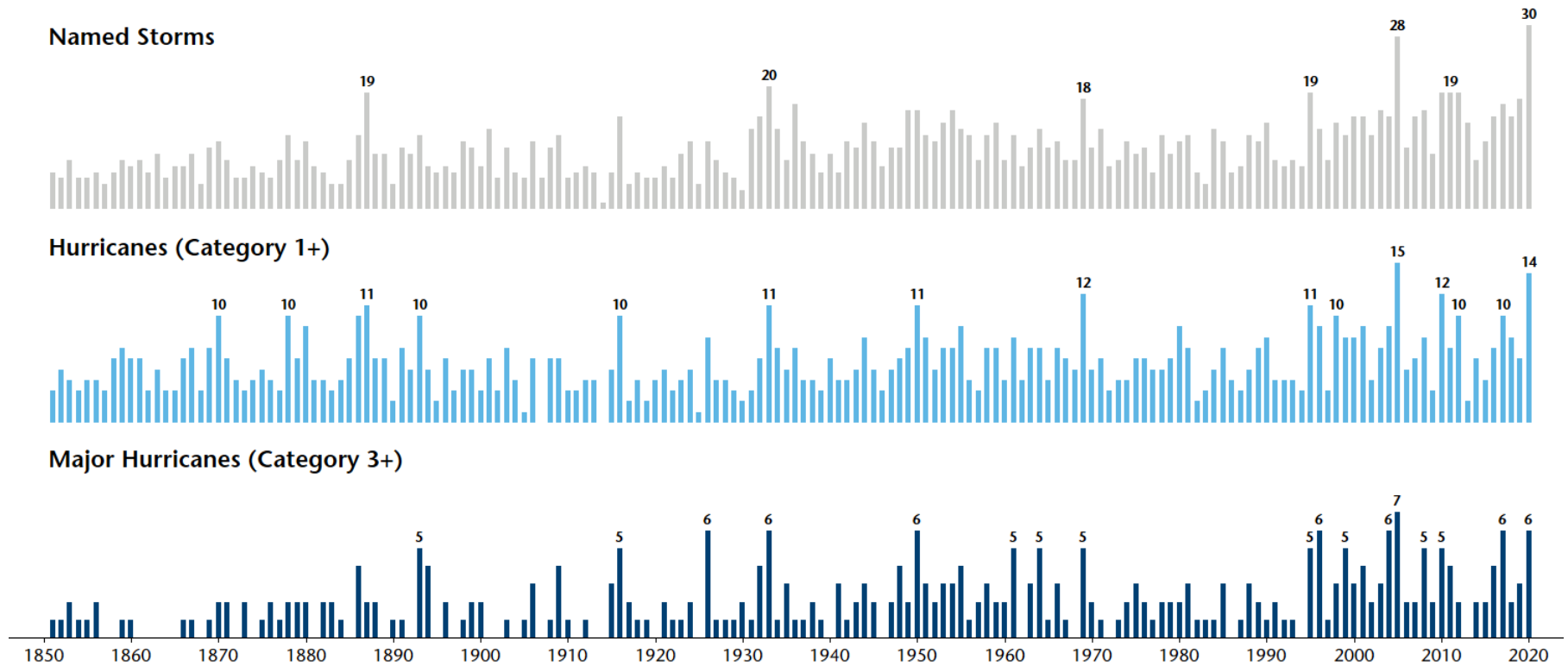
2020 Atlantic Hurricane Activity vs. Historical Records

| Forecast Parameter | 2020 Observed | 1981-2010 Average | 2020 % of 1981-2010 Average | 2020 Full Season Rank Since 1966 (Satellite Era) |
|-------------------------------------|------------------|----------------------|-----------------------------------|--|
| Named Storms (NS) | 30 | 12.1 | 248% | 1 |
| Named Storm Days (NSD) | 118 | 59.4 | 199% | 3 |
| Hurricanes (H) | 14* | 6.4 | 219% | 2 |
| Hurricane Days (HD) | 34.75 | 24.2 | 144% | 13 |
| Major Hurricanes (MH) | 6 | 2.7 | 222% | T-2 |
| Major Hurricane Days (MHD) | 8.75 | 6.2 | 141% | 14 |
| Accumulated Cyclone Energy (ACE) | 180 | 106 | 170% | 6 |

*Gamma was upgraded to a hurricane in post-season analysis

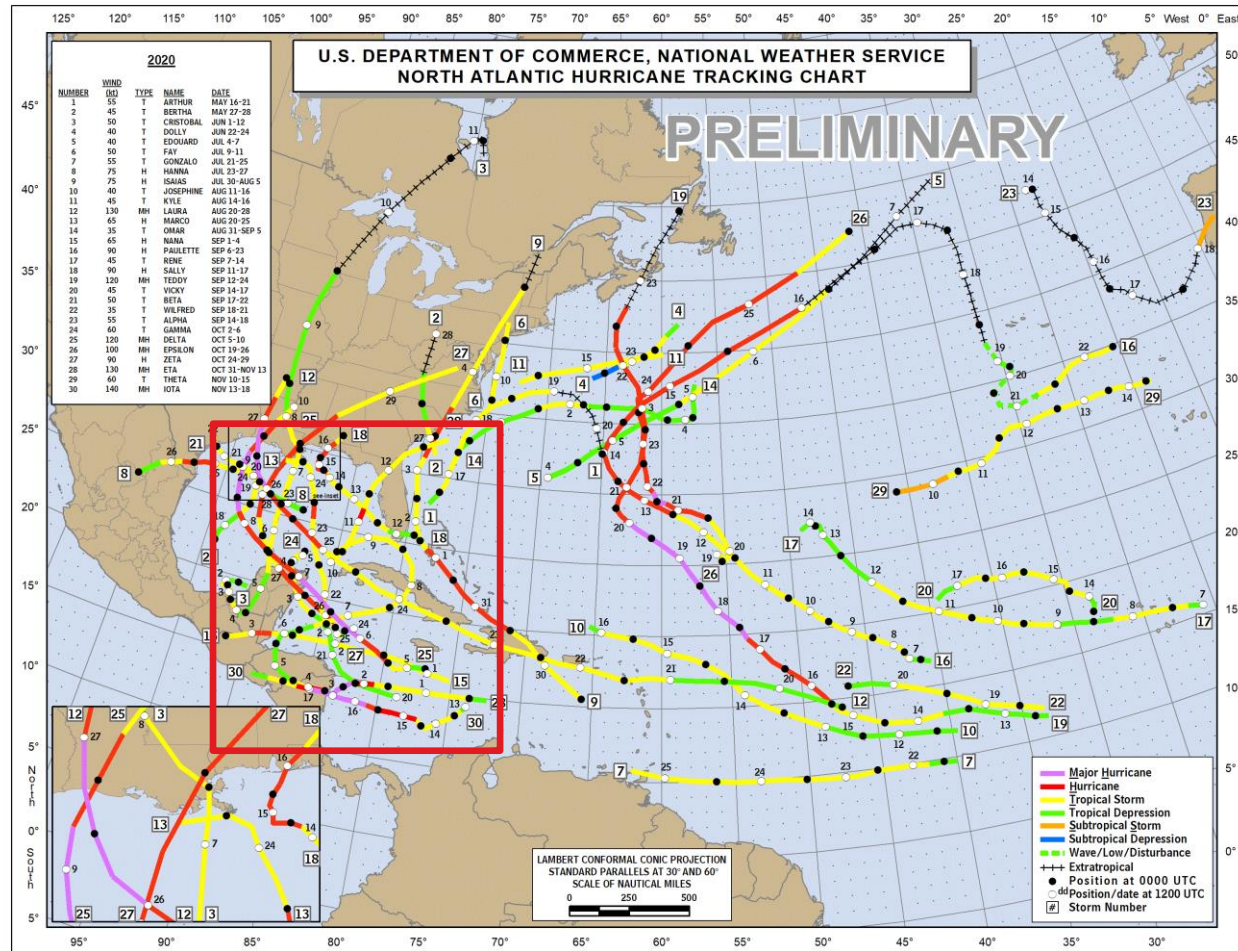
T – Denotes tie with other years

Atlantic Named Storms, Hurricanes and Major Hurricanes since 1950



Steve Bowen (Aon)

High Concentration of Storms in the Western Atlantic

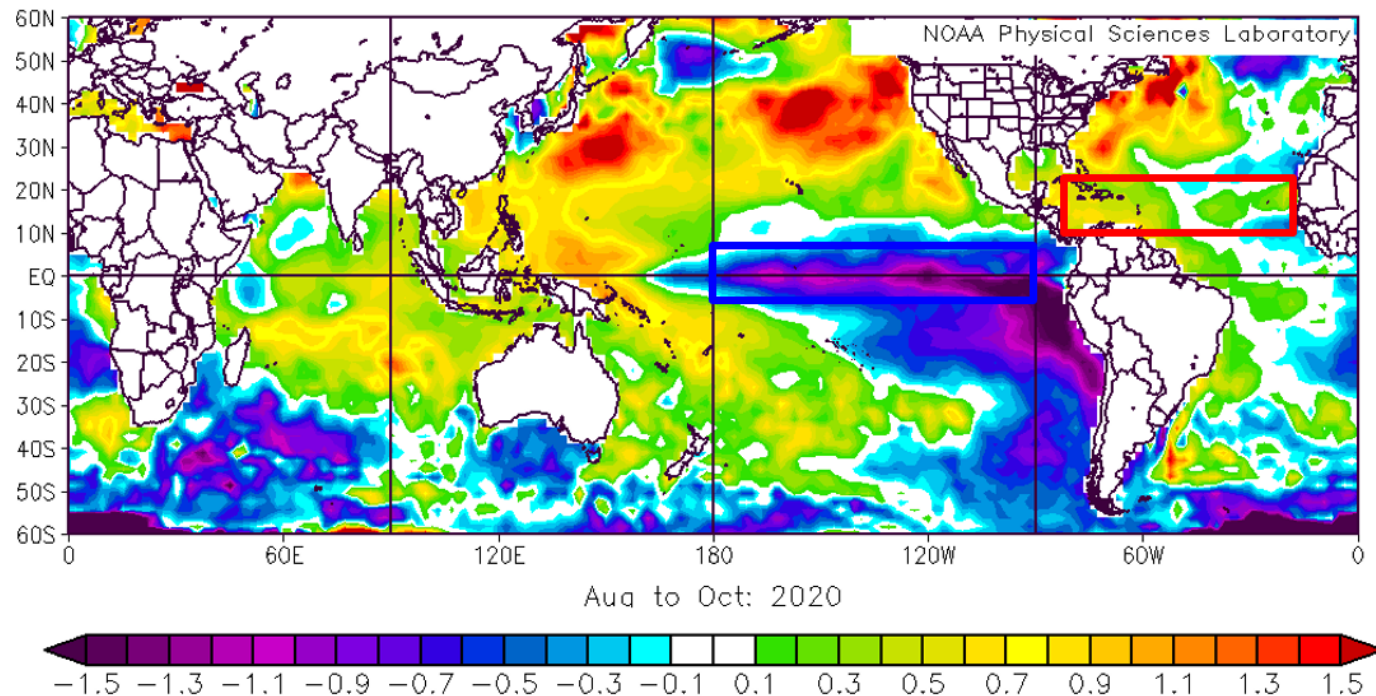


Why was 2020 so active?

August-October 2020 Sea Surface Temperature Anomaly

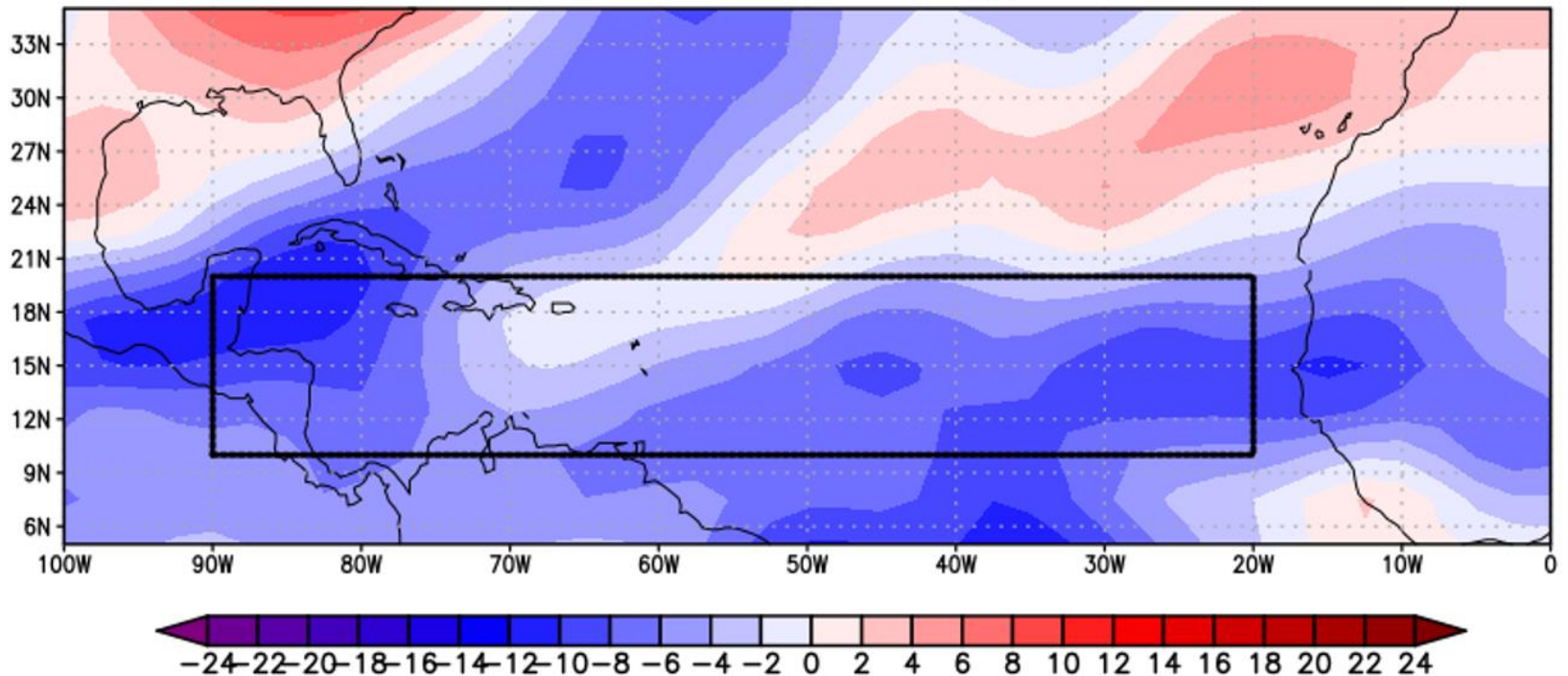
NCEP/NCAR Reanalysis

Surface Skin Temperature(SST) (K) Composite Anomaly 1981–2010 clima

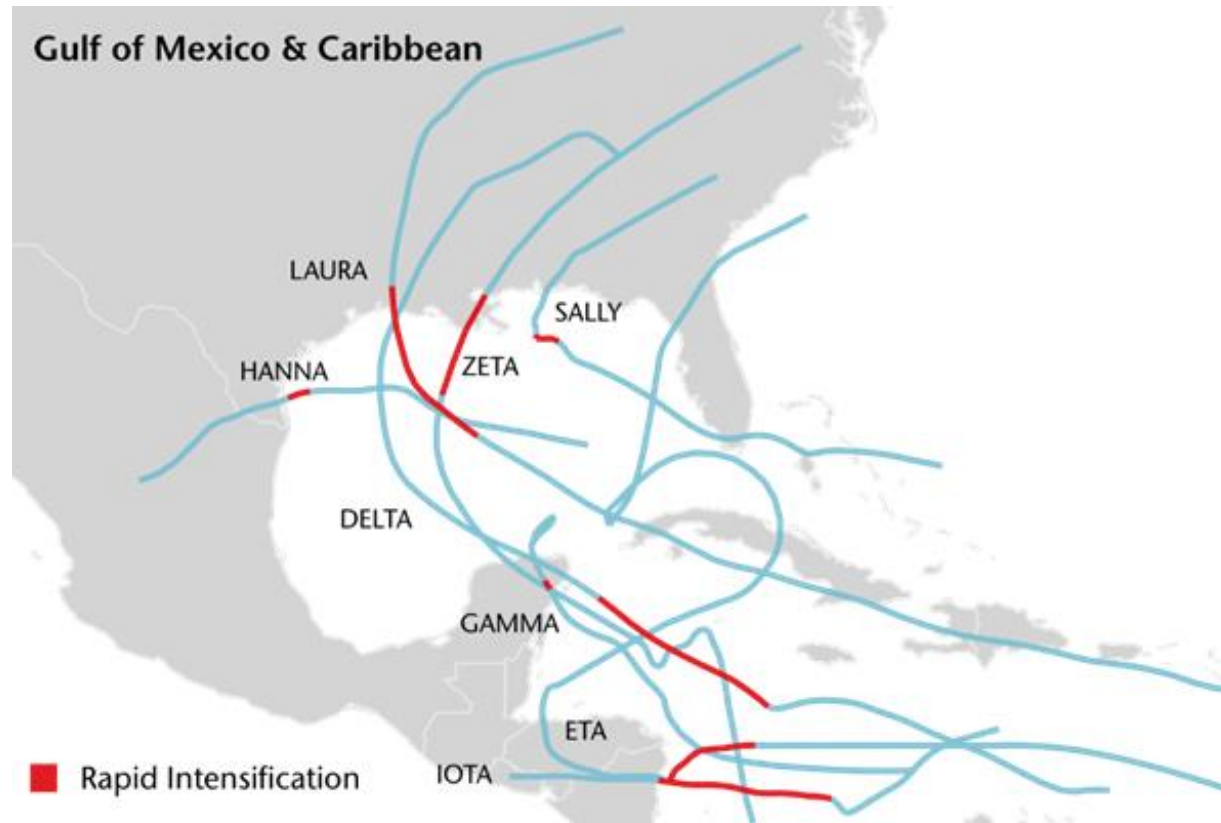


Why was 2020 so active?

August Through October 2020 Average
Zonal (200–850 mb) Vertical Wind Shear Anomaly (kts)
(1981–2010 Climatology)



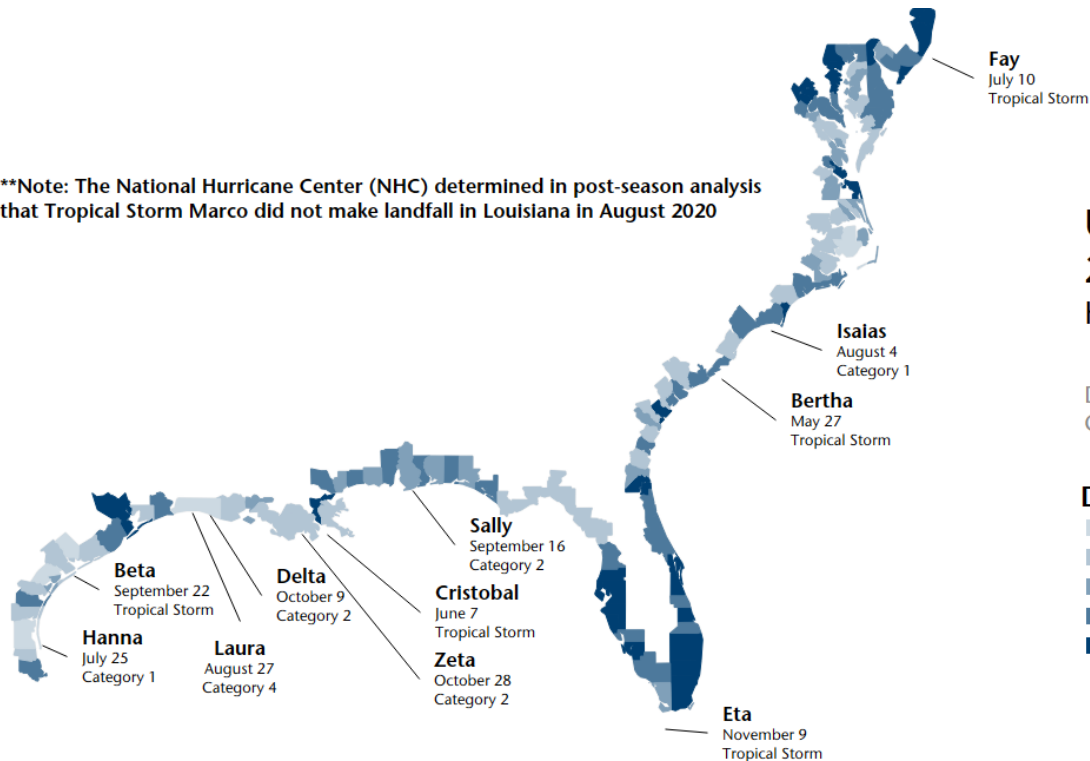
Rapidly Intensifying Hurricanes: ≥ 35 mph in 24 hr



Steve Bowen (Aon)

2020 Atlantic Hurricane Season: It Could Have Been Way Worse

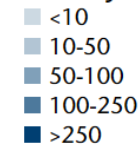
****Note:** The National Hurricane Center (NHC) determined in post-season analysis that Tropical Storm Marco did not make landfall in Louisiana in August 2020



U.S. Mainland Landfalls 2020 Atlantic Season Housing Density by Coastal County

Data: NOAA
Graphic: Aon (Cat Insight)

Density Homes / Sq Mile



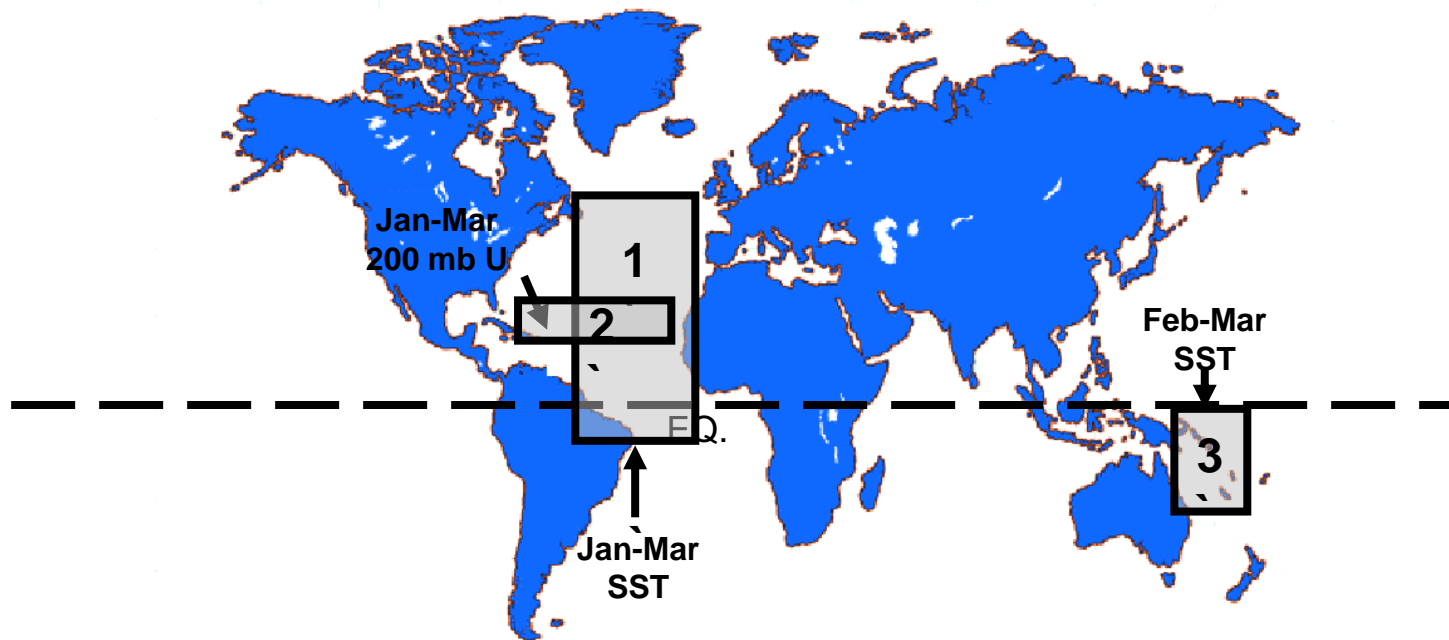


2021 Atlantic Seasonal Hurricane Outlook

2021 FORECAST AS OF 8 APRIL 2021

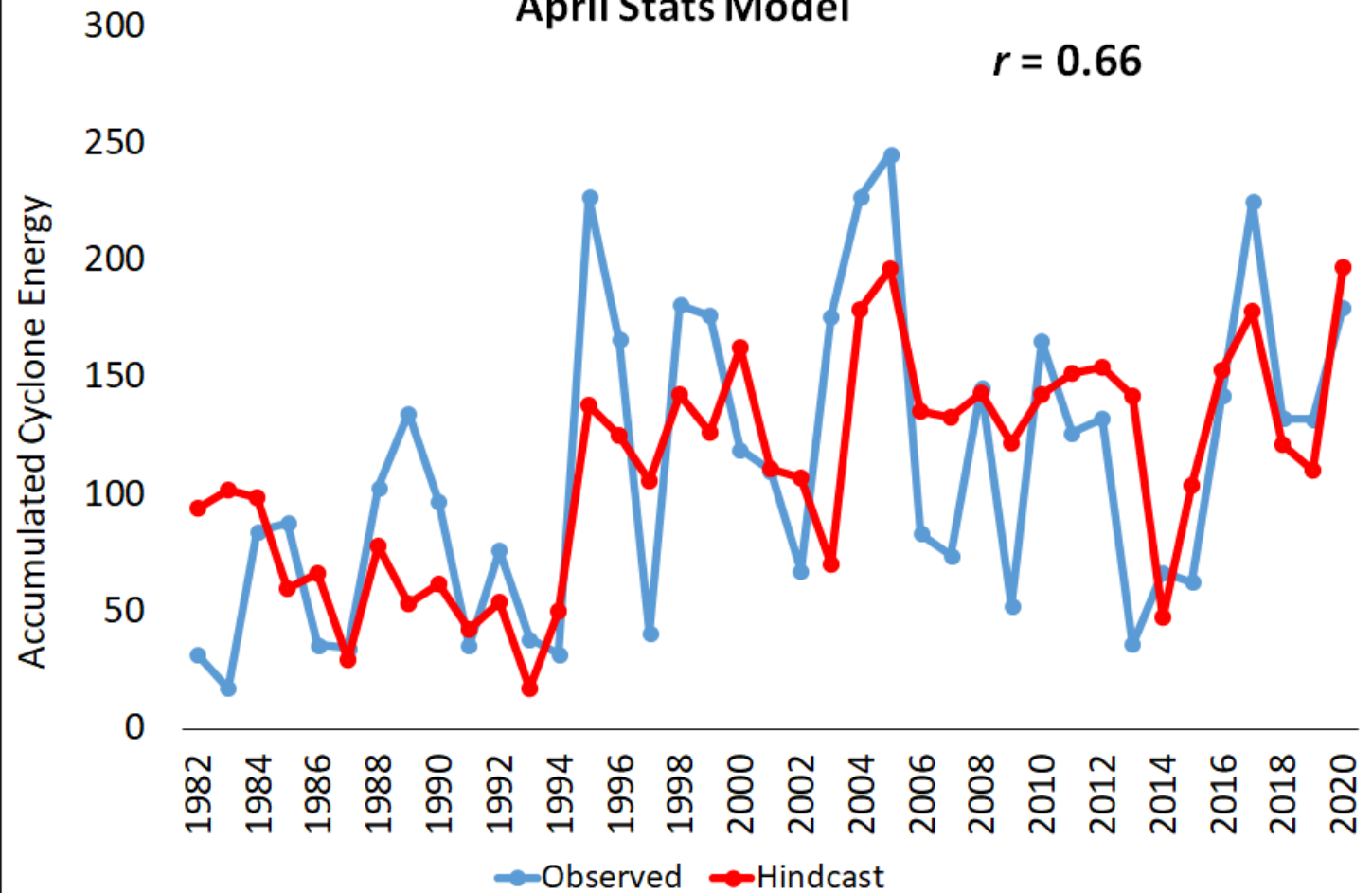
| Forecast Parameter | CSU Forecast | 1991-2020 Average |
|-------------------------------------|-----------------|----------------------|
| Named Storms (NS) | 17 | 14.4 |
| Named Storm Days (NSD) | 80 | 69.4 |
| Hurricanes (H) | 8 | 7.2 |
| Hurricane Days (HD) | 35 | 27.0 |
| Major Hurricanes (MH) | 4 | 3.2 |
| Major Hurricane Days (MHD) | 9 | 7.4 |
| Accumulated Cyclone Energy (ACE) | 150 | 123 |
| Net Tropical Cyclone Activity (NTC) | 160 | 135 |

April Forecast Predictors

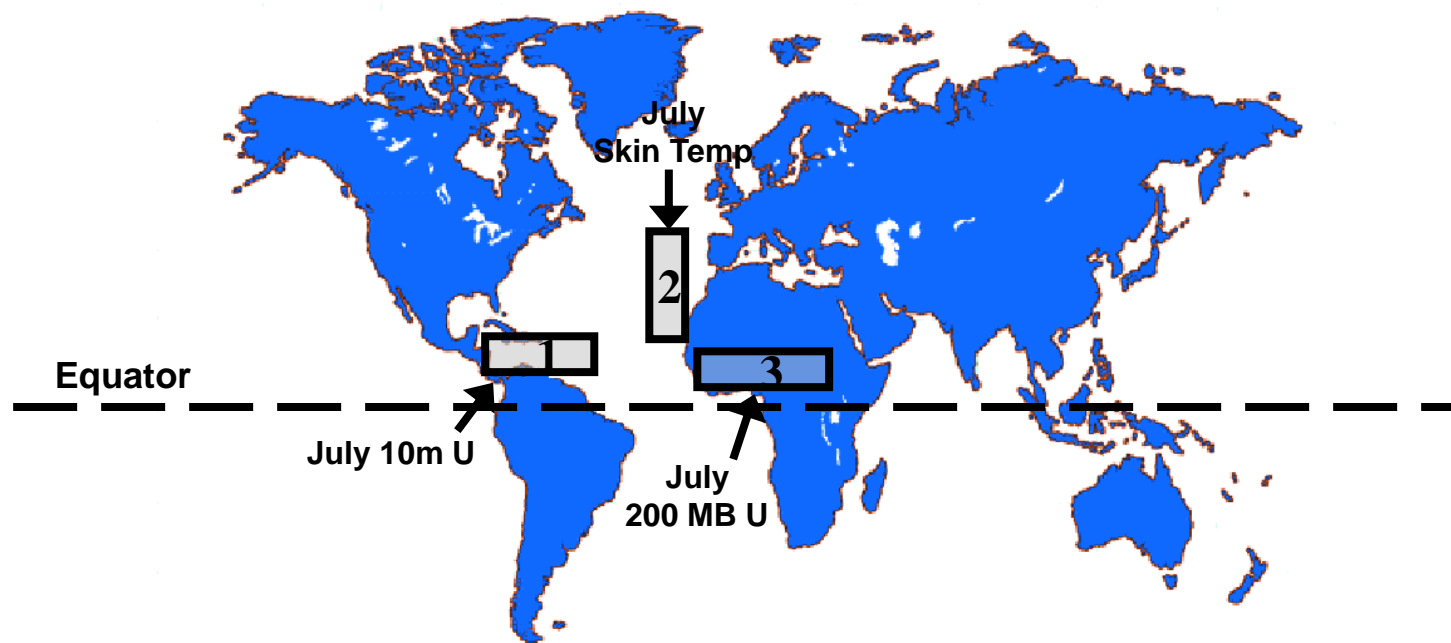


**Atlantic ACE Hindcast (1982-2020) - Cross-Validated
April Stats Model**

$r = 0.66$

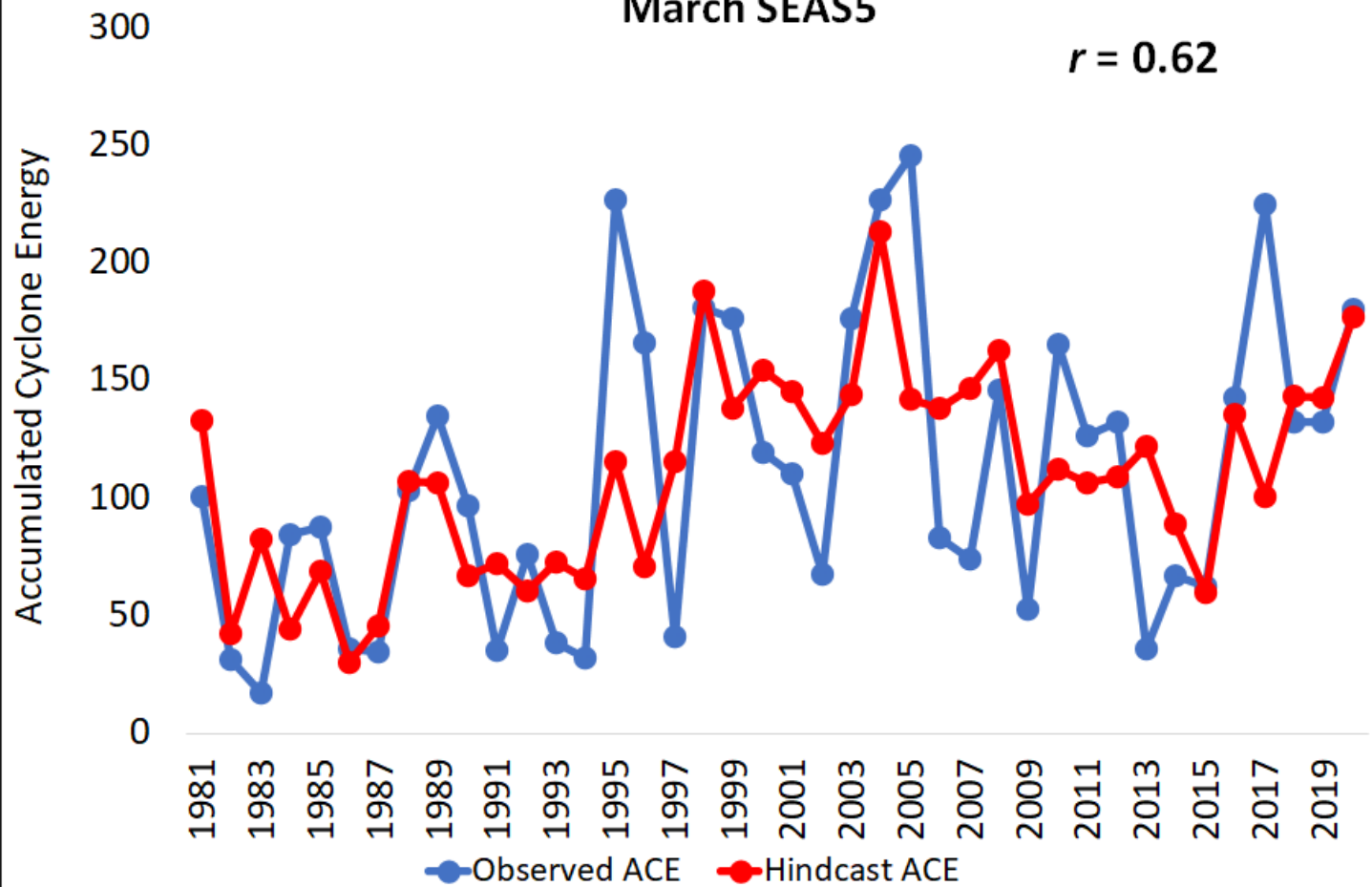


Post-31 July Seasonal Forecast Predictors

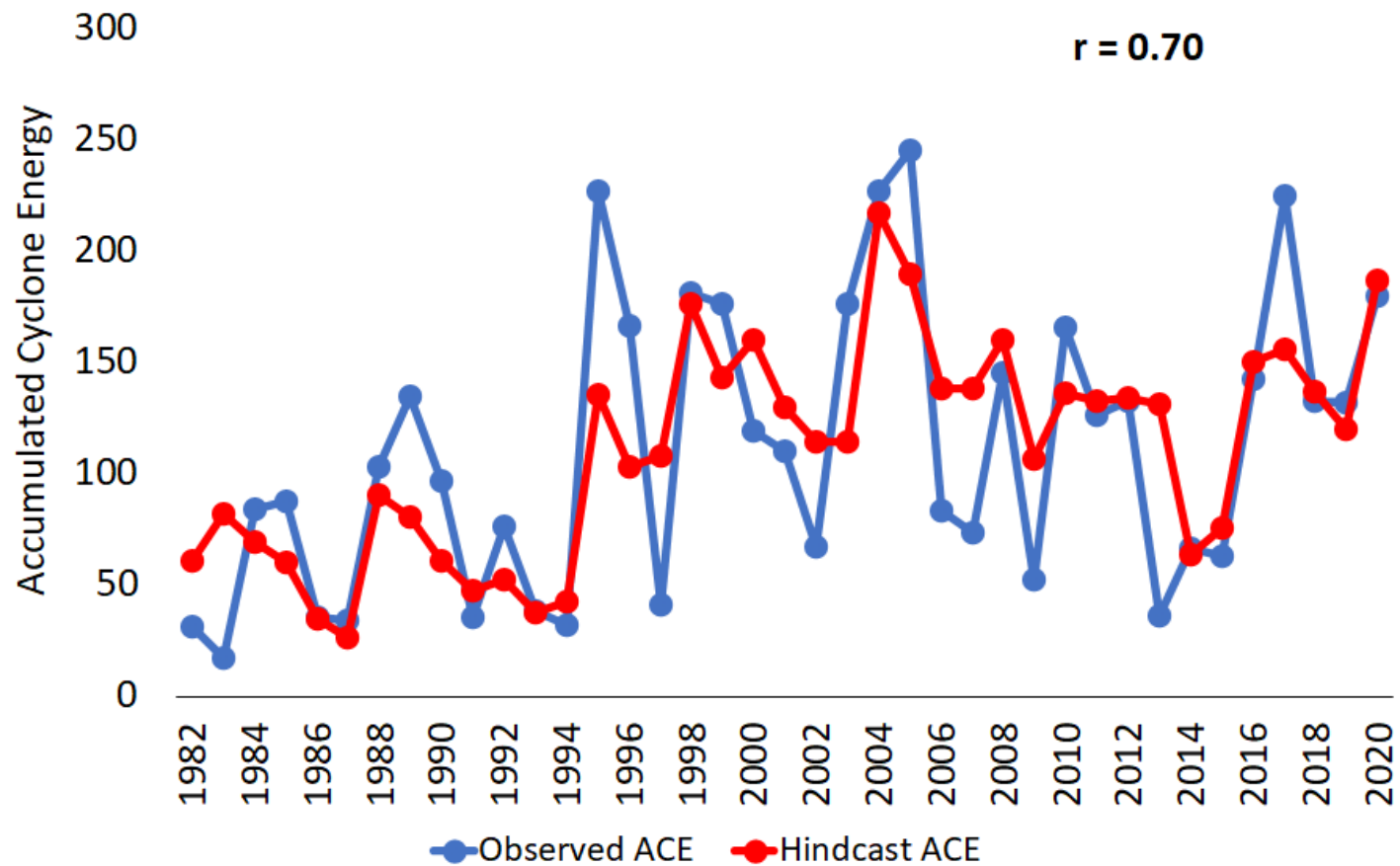


**Atlantic ACE Cross-Validated Hindcast (1981-2020) -
March SEAS5**

$r = 0.62$



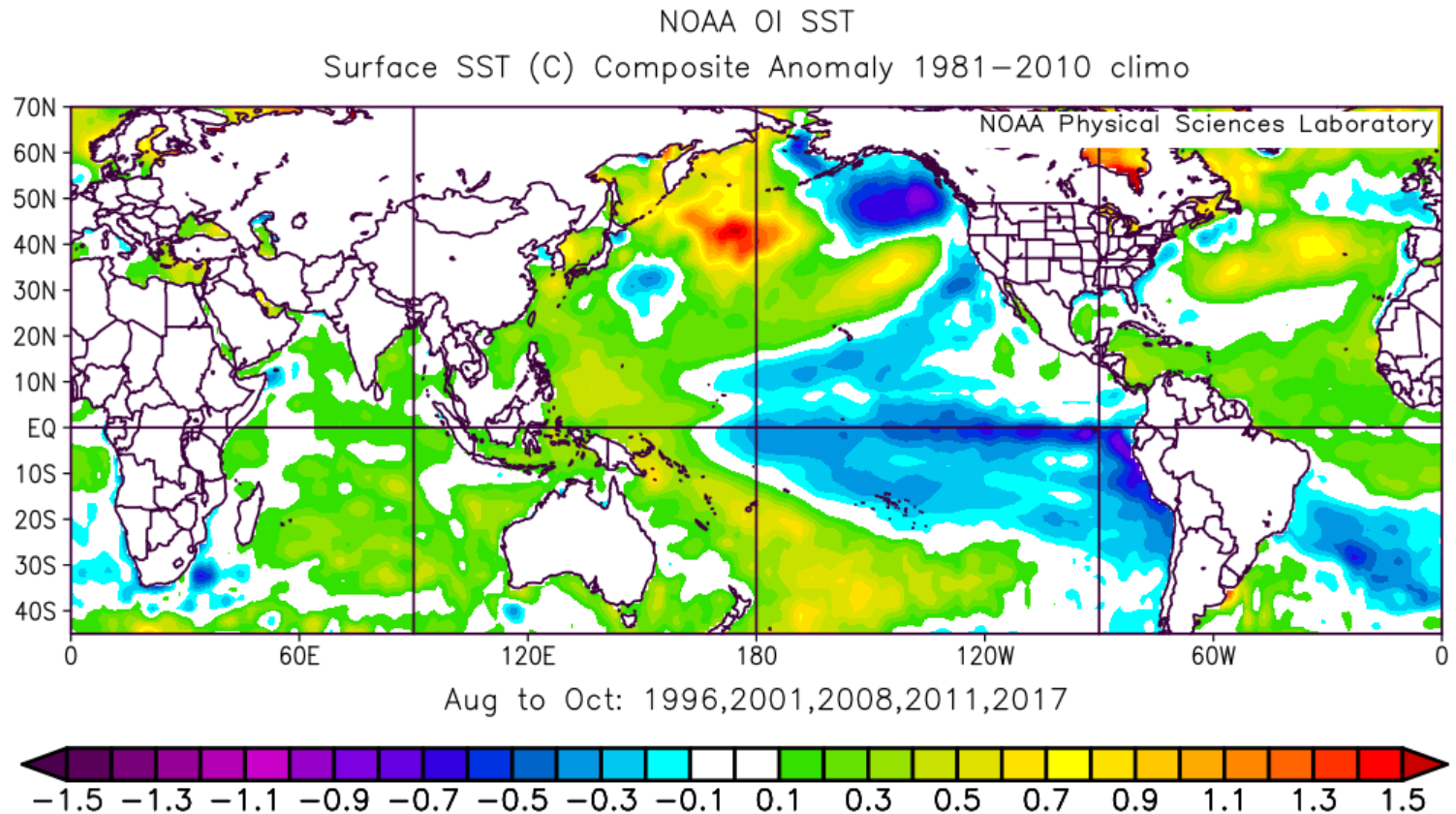
Atlantic ACE Hindcast (1982-2020) - Cross-Validated Blended Forecast Model - 1 April



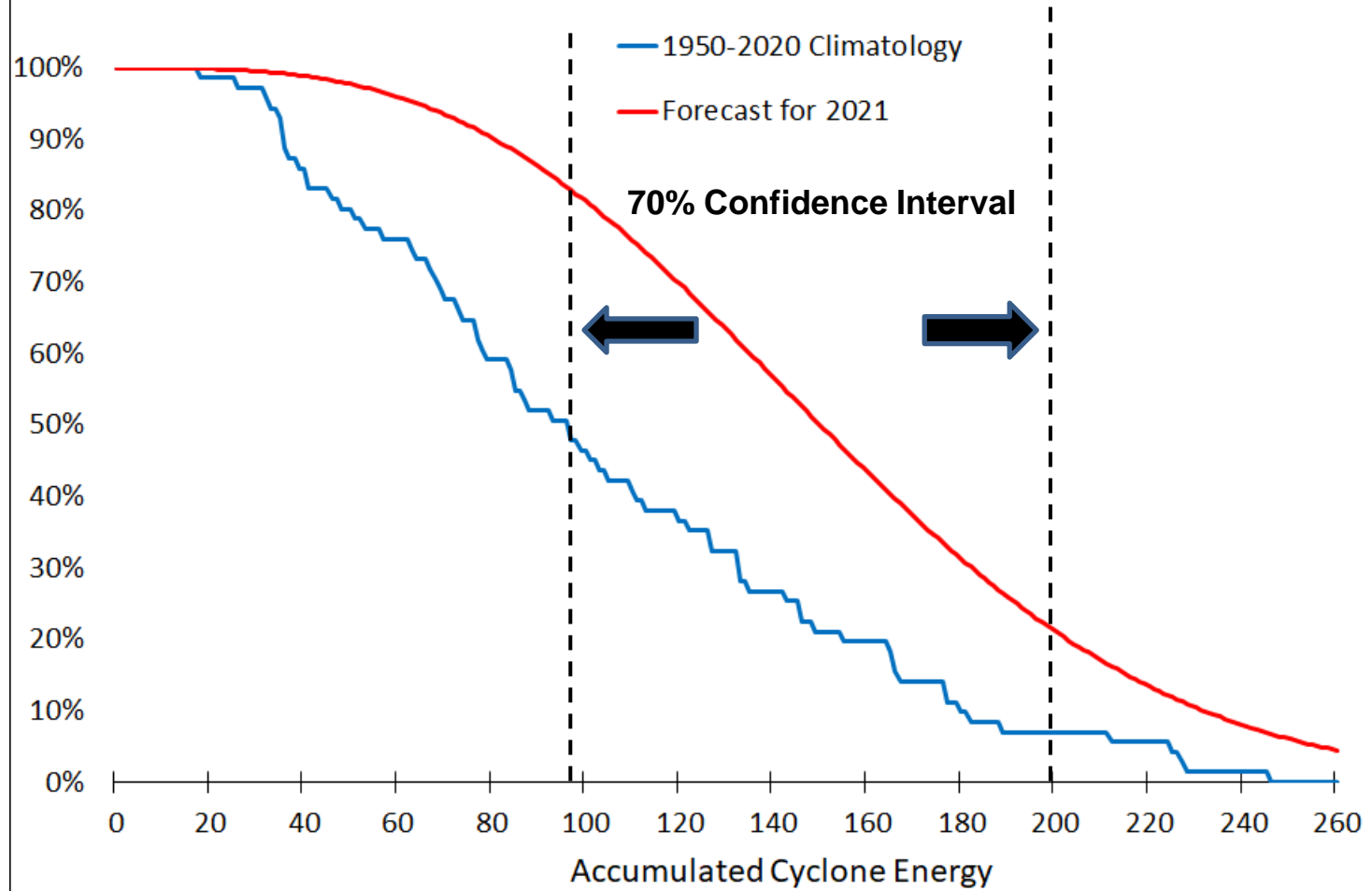
BEST ANALOG YEARS FOR 2021 (APRIL FORECAST)

| | NS | NSD | H | HD | MH | MHD | ACE | NTC |
|--------------------------|------------------|-------------|------------|-------------|------------|------------|------------|------------|
| 1996 | 13 | 79.00 | 9 | 45.00 | 6 | 13.00 | 166 | 192 |
| 2001 | 15 | 68.75 | 9 | 25.50 | 4 | 4.25 | 110 | 135 |
| 2008 | 16 | 88.25 | 8 | 30.50 | 5 | 7.50 | 146 | 162 |
| 2011 | 19 | 89.75 | 7 | 26.00 | 4 | 4.50 | 126 | 145 |
| 2017 | 17 | 93.00 | 10 | 51.75 | 6 | 19.25 | 225 | 232 |
| <i>MEAN</i> | <i>16. 0</i> | <i>83.8</i> | <i>8.6</i> | <i>35.8</i> | <i>5.0</i> | <i>9.7</i> | <i>155</i> | <i>173</i> |
| 2021 Forecast | 17 | 80 | 8 | 35 | 4 | 9 | 150 | 160 |

August-October Sea Surface Temperature Anomalies in Analog Years



ACE Probability of Exceedance (2021 vs. 1950-2020 Climatology)

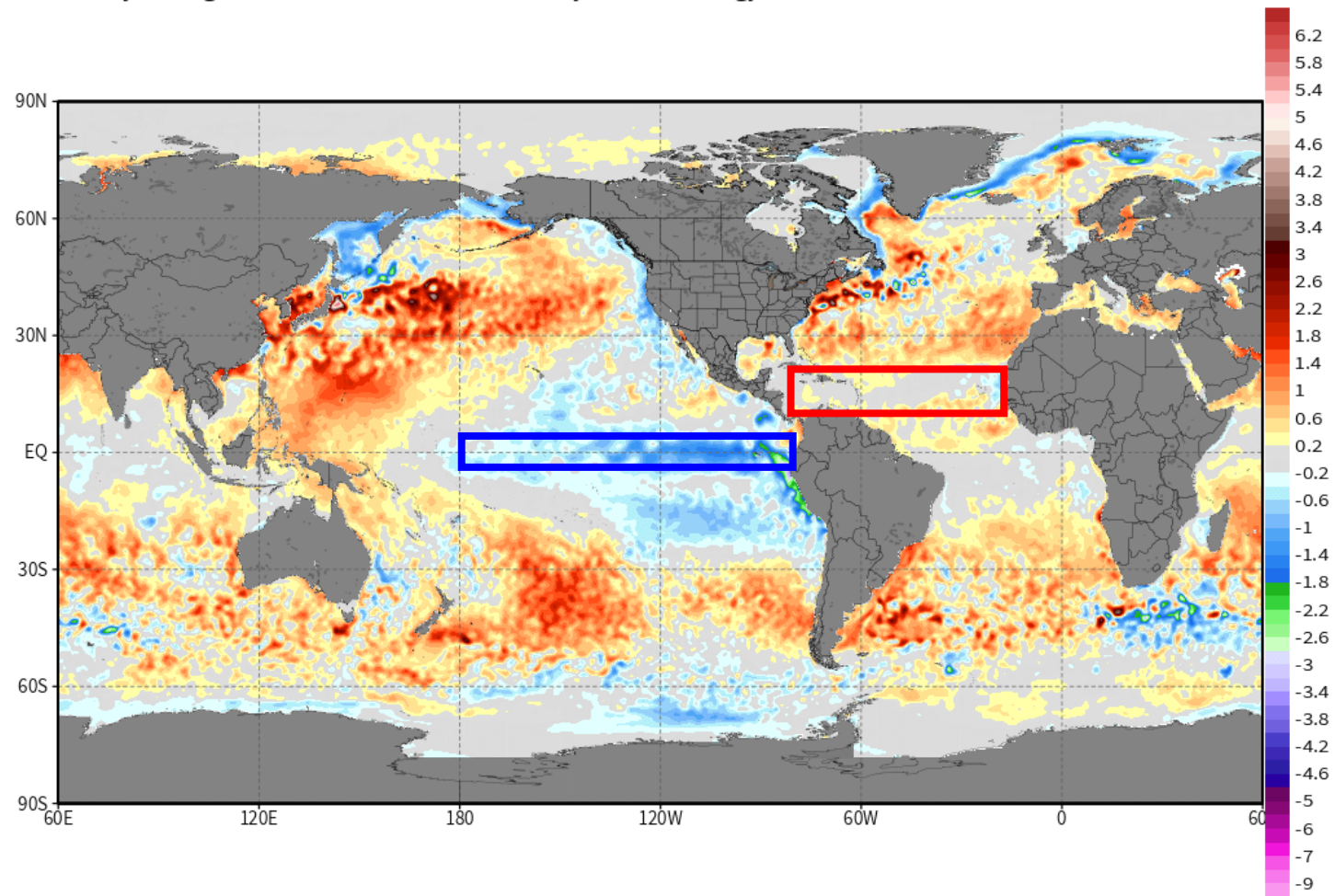


2021 Seasonal Hurricane Forecast Model Uncertainty

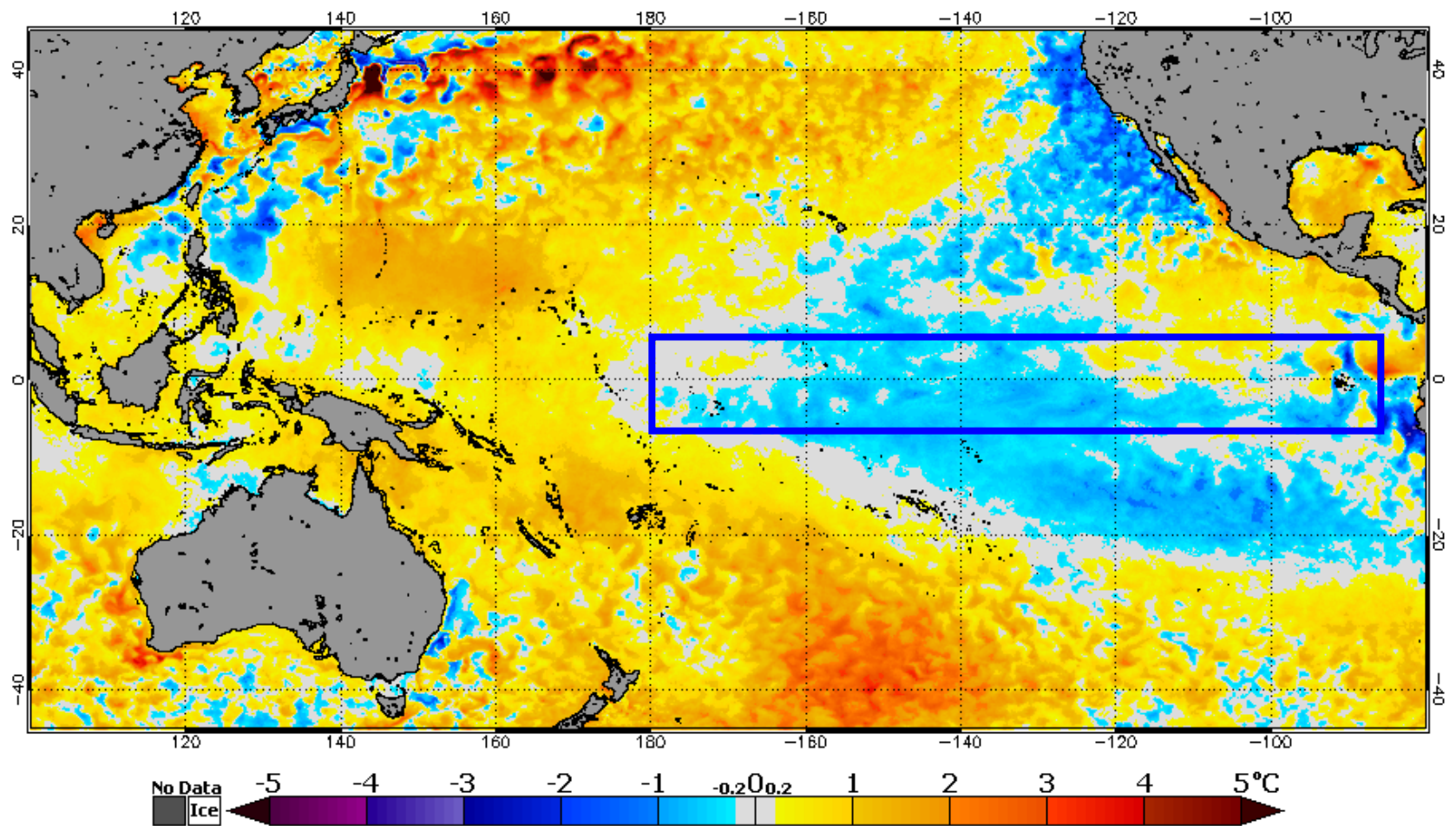
| Forecast Parameter | 2021 Forecast | Uncertainty Range (~70% of Forecasts Fall within Range) |
|-------------------------------------|---------------|---|
| Named Storms (NS) | 17 | 14–20 |
| Named Storm Days (NSD) | 80 | 57–104 |
| Hurricanes (H) | 8 | 6–10 |
| Hurricane Days (HD) | 35 | 22–50 |
| Major Hurricanes (MH) | 4 | 2–6 |
| Major Hurricane Days (MHD) | 9 | 6–14 |
| Accumulated Cyclone Energy (ACE) | 150 | 97–200 |
| Net Tropical Cyclone Activity (NTC) | 160 | 108–217 |

0.25° NCEP OISST Sea Surface Temperature Anomaly [SST, °C]
28-Day Average 23MAR2021 --> 19APR2021 30-year Climatology 1990-2019

[weathermodels.com](https://www.weathermodels.com)



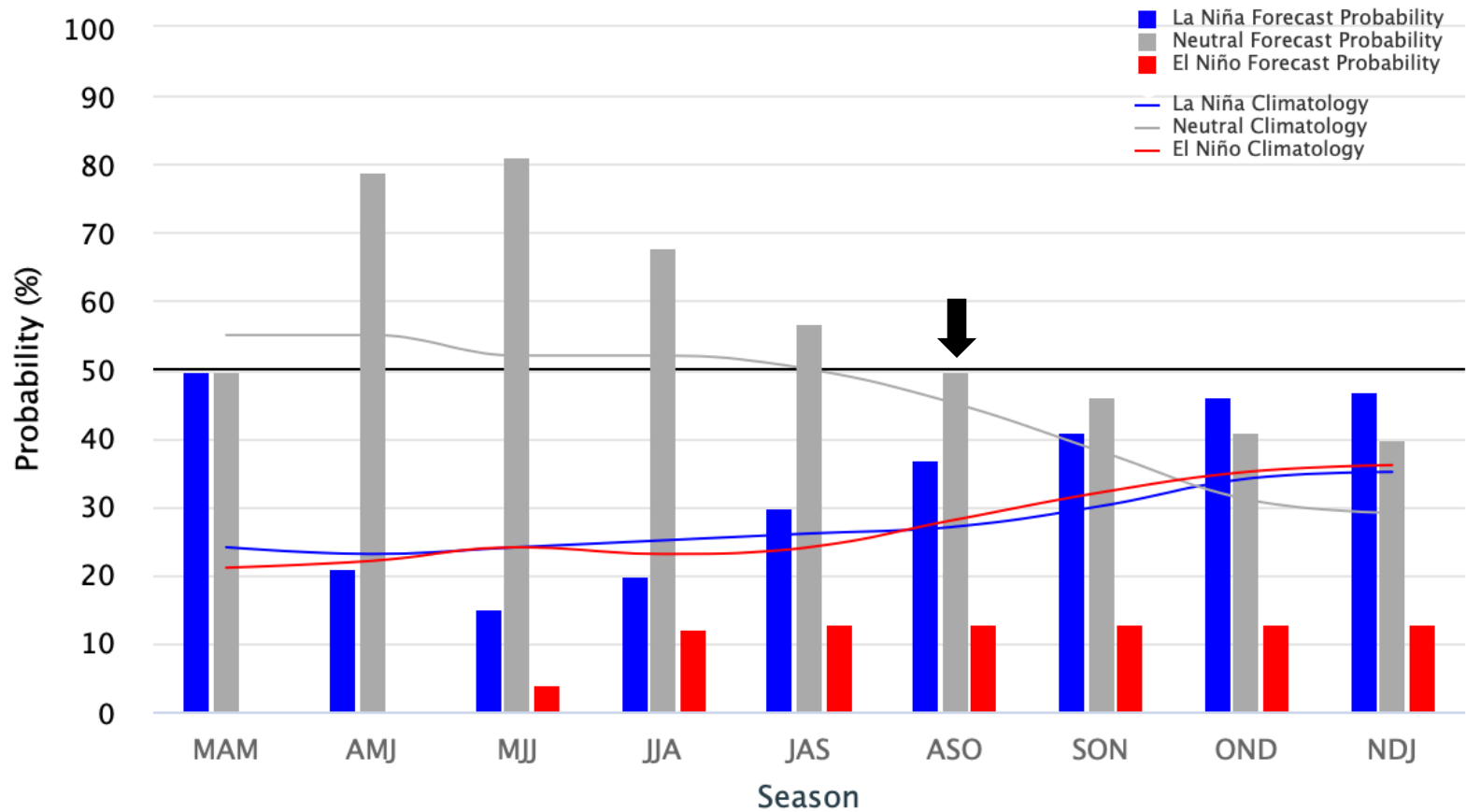
NOAA Coral Reef Watch Daily 5km SST Anomalies (Version 3.1) 19 Apr 2021

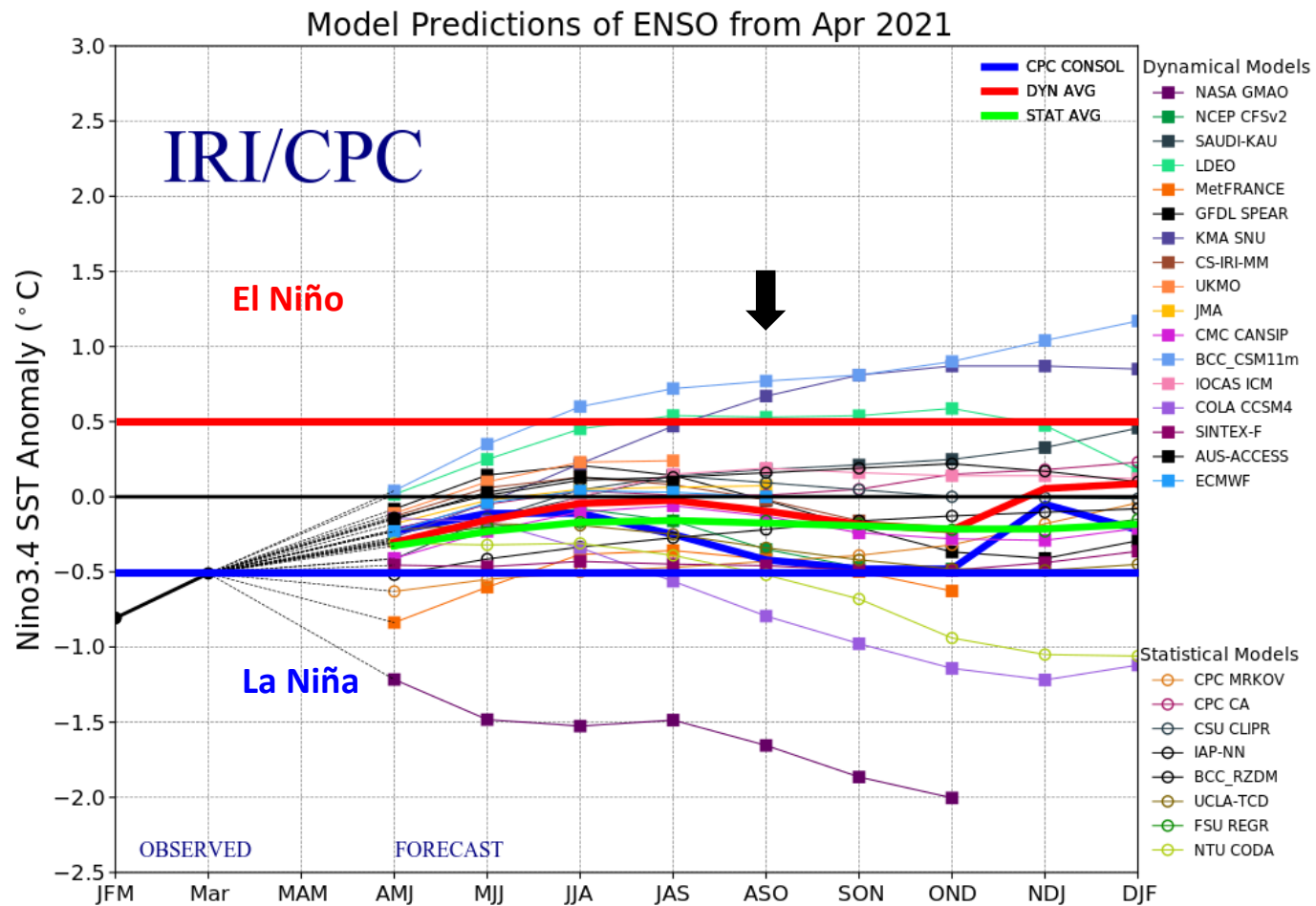


Early-April 2021 CPC/IRI Official Probabilistic ENSO Forecasts

ENSO state based on NINO3.4 SST Anomaly

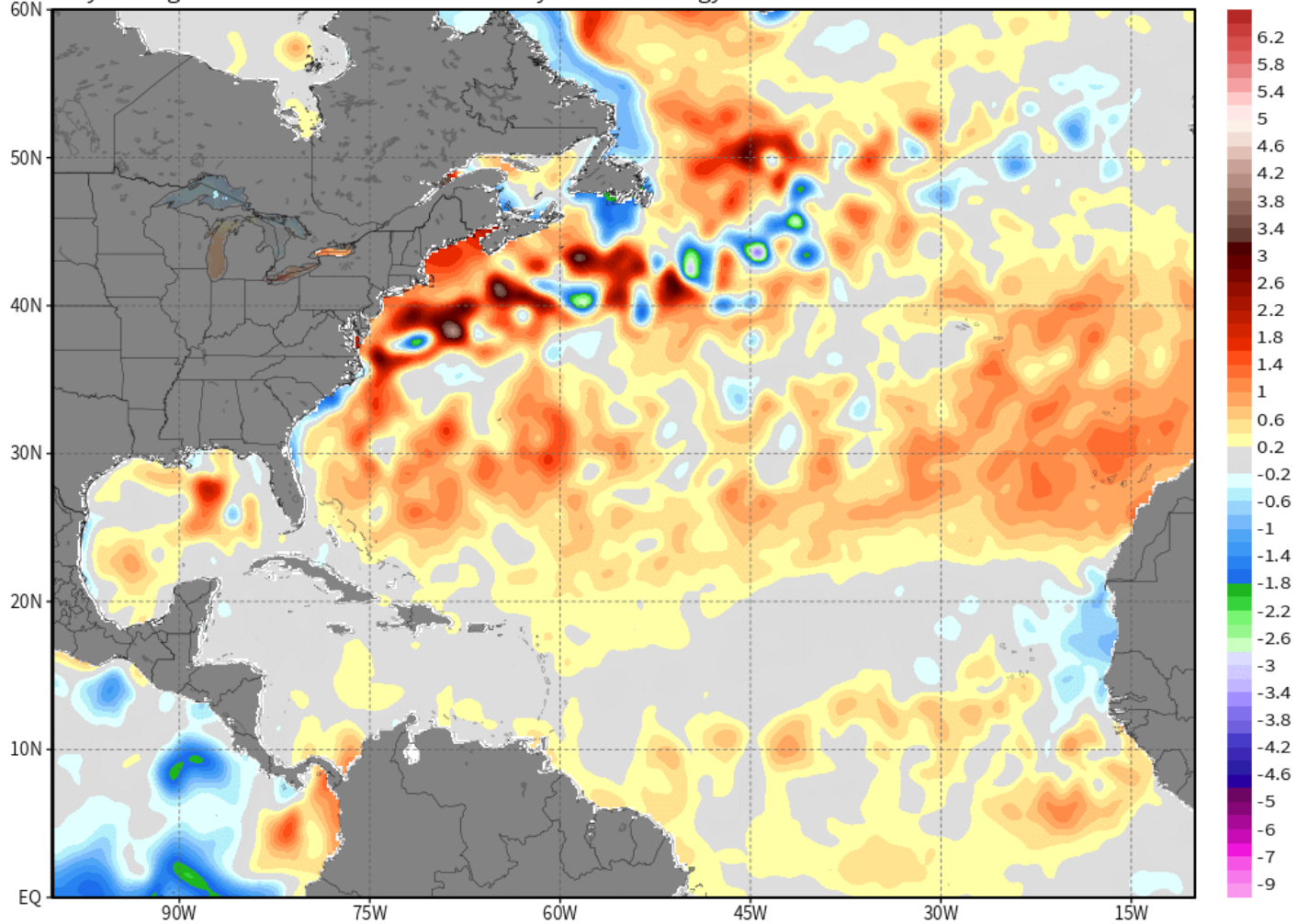
Neutral ENSO: -0.5°C to 0.5°C



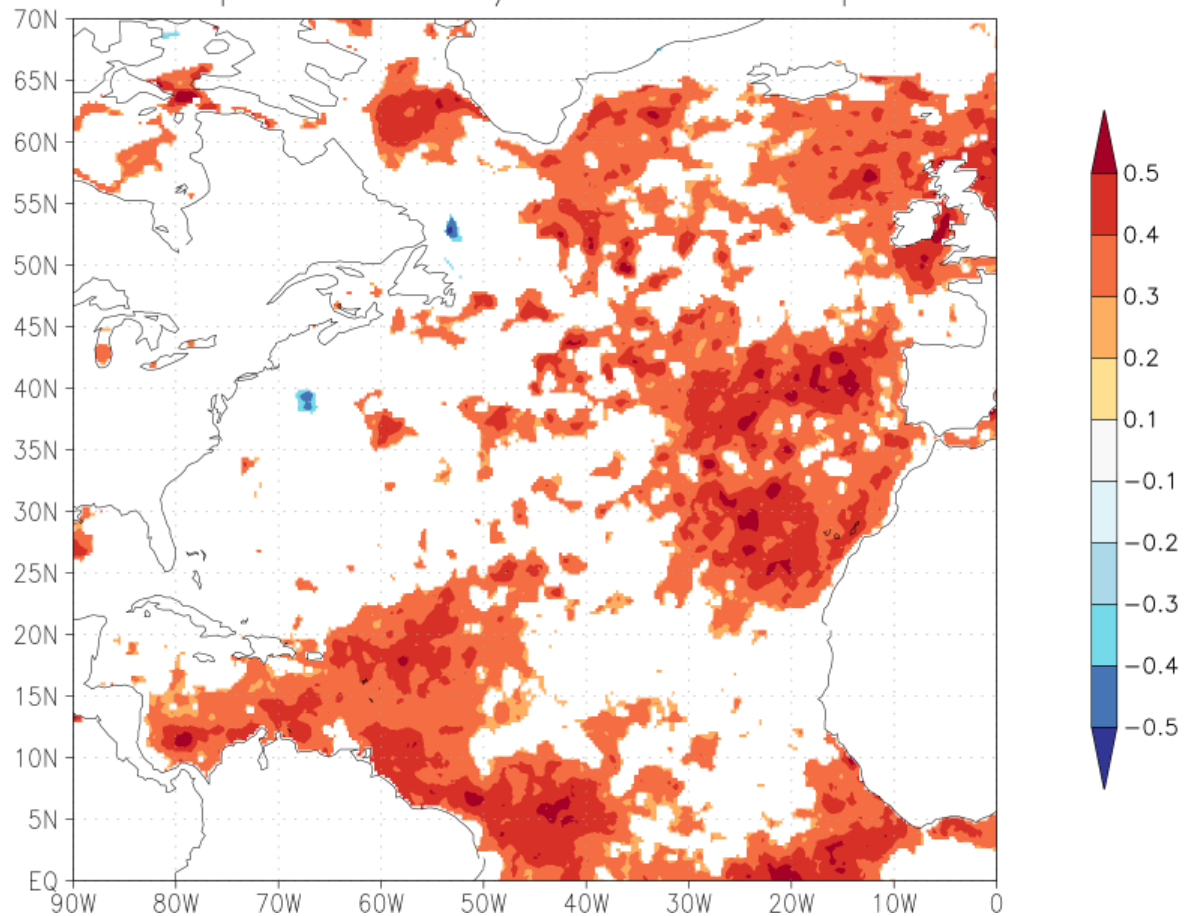


0.25° NCEP OISST Sea Surface Temperature Anomaly [SST, °C]
28-Day Average 23MAR2021 --> 19APR2021 30-year Climatology 1990-2019

weathermodels.com



rank corr Apr Atlantic ACE
with Apr NCEP Olv2 1/4 SST 1982:2020 $p < 10\%$

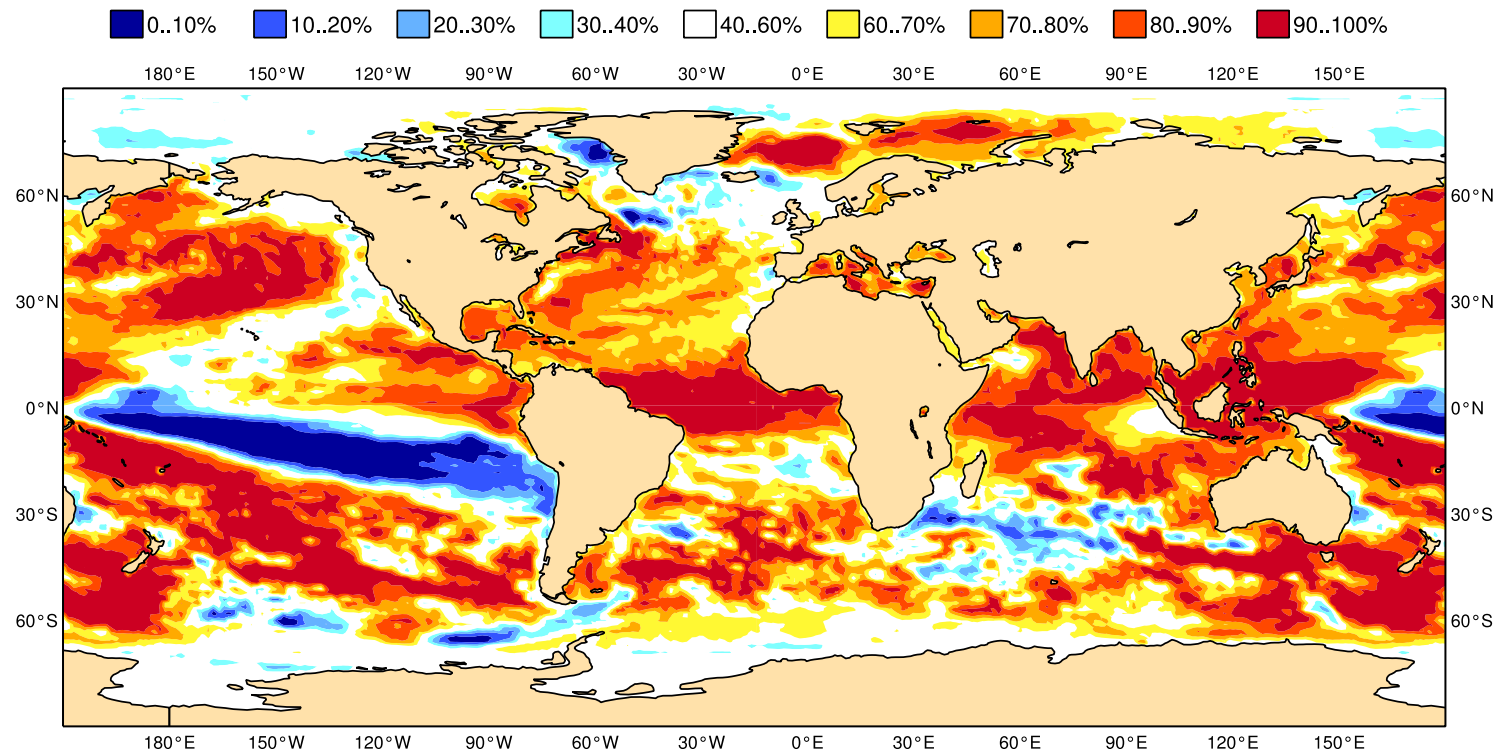


ECMWF Seasonal Forecast
Prob(forecast SST > median)

Forecast start is 01/04/21, climate period is 1993-2016

Ensemble size = 51, climate size = 600

System 5
ASO 2021



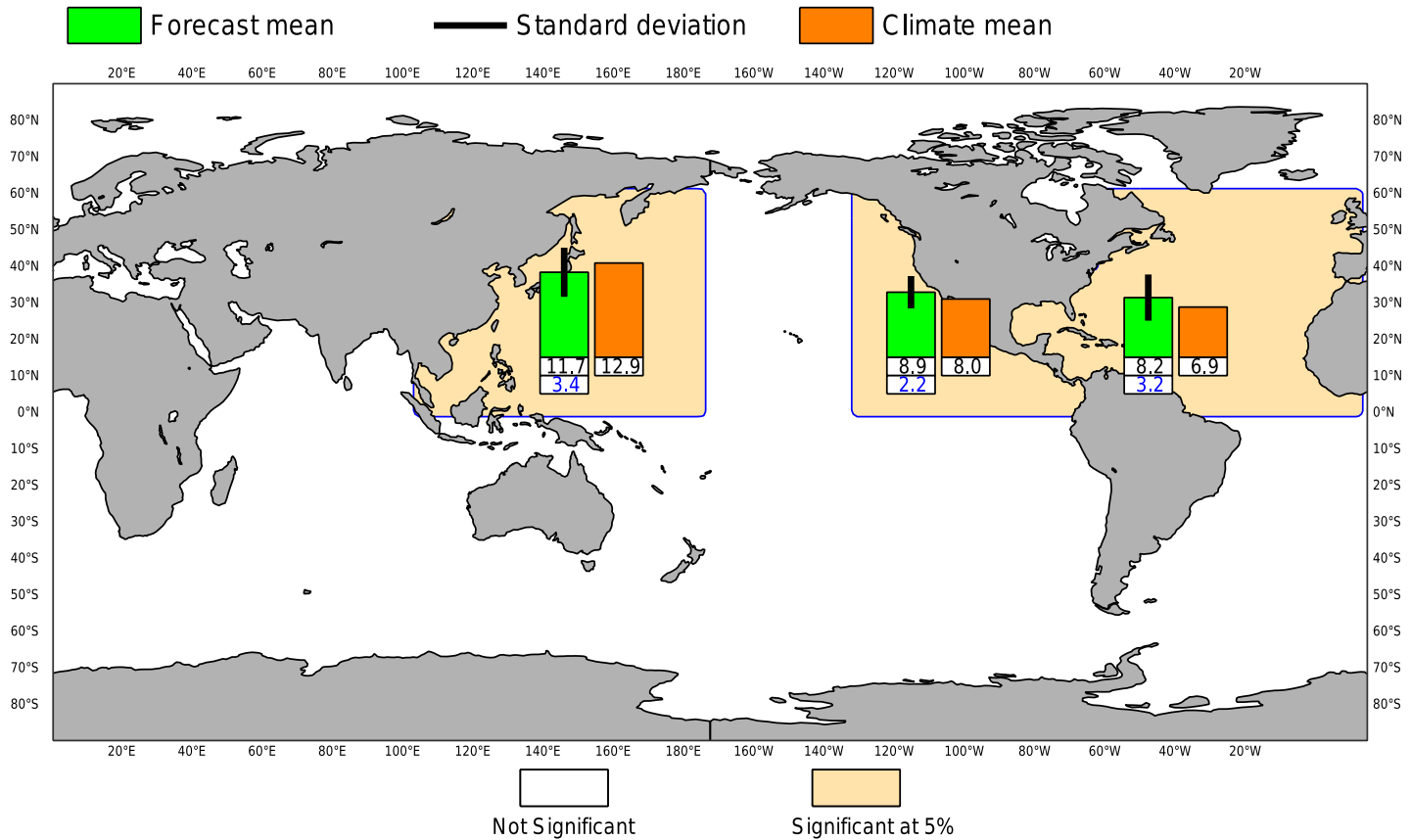
ECMWF Seasonal Forecast Hurricane or typhoon Frequency

Forecast start reference is 01/04/2021

Ensemble size = 51, climate size = 700

SEAS5
MJJASO 2021

Climate (initial dates) = 1993-2020

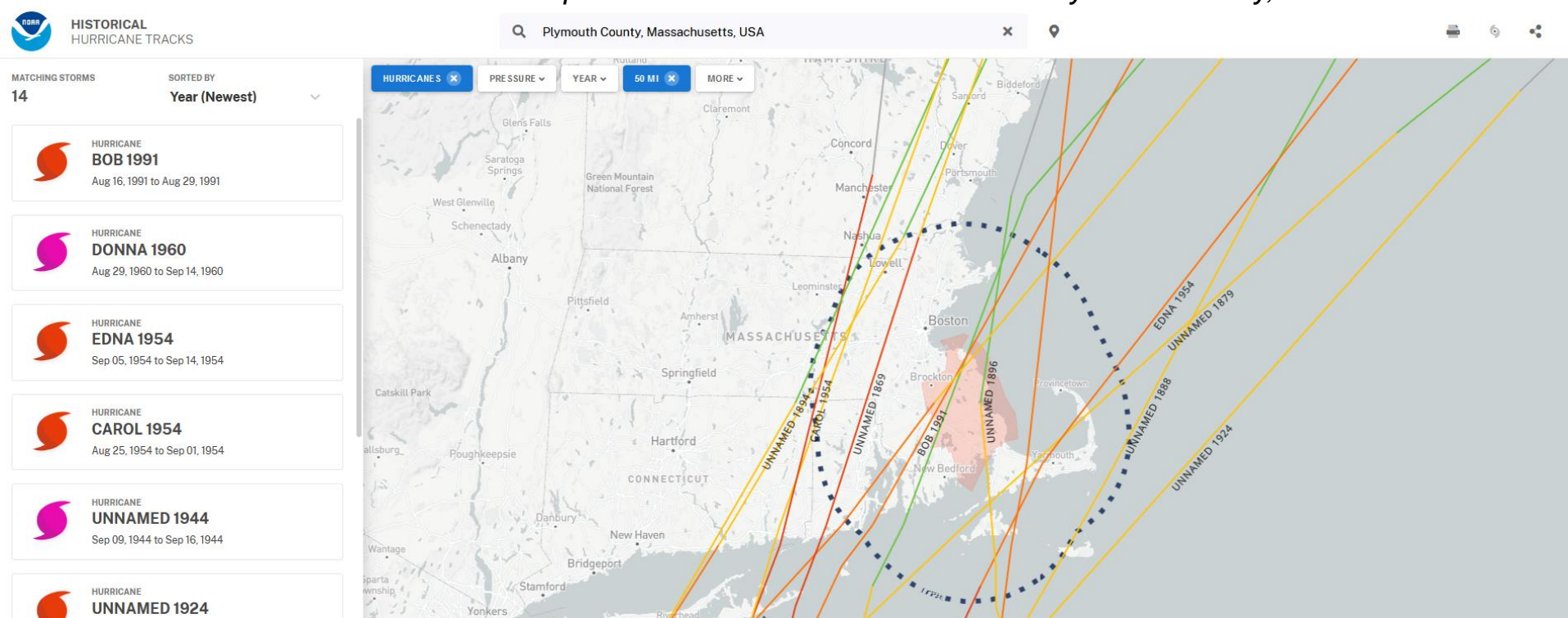


**2021 PROBABILITIES FOR AT LEAST ONE MAJOR
(CATEGORY 3-4-5) HURRICANE LANDFALL IN
EACH OF THE FOLLOWING AREAS (20th
CENTURY PROBABILITIES IN PARENTHESES)**

- 1) Entire U.S. coastline – **69% (52%)**
- 2) U.S. East Coast including Peninsula Florida – **45% (31%)**
- 3) Gulf Coast from the Florida Panhandle westward to Brownsville – **44% (30%)**
- 4) Caribbean (10-20°N, 60-88°W) – **58% (42%)**

Count all named storms, hurricanes and major hurricanes within 50 miles of each county/parish

Example: All Hurricanes within 50 miles of Plymouth County, MA



<https://coast.noaa.gov/hurricanes/>

2021 Probabilities (1851-2019 Probability in Parentheses)

| State | ≥ 1 Hurricane Within 50 Miles | ≥ 1 Major Hurricane Within 50 Miles |
|----------------|------------------------------------|--|
| Florida | 75% (58%) | 41% (28%) |
| Louisiana | 53% (37%) | 23% (15%) |
| Massachusetts | 23% (15%) | 6% (3%) |
| Mississippi | 39% (26%) | 12% (8%) |
| New York | 15% (10%) | 4% (2%) |
| North Carolina | 52% (37%) | 11% (7%) |
| Texas | 49% (35%) | 21% (14%) |

2021

Forecast Schedule

| Date | 8 April | 3 June | 8 July | 5 Aug |
|------------------------------|--------------------|-------------------|-------------------|------------------|
| Seasonal Forecast | X | X | X | X |



<http://www.seasonalhurricanepredictions.org>

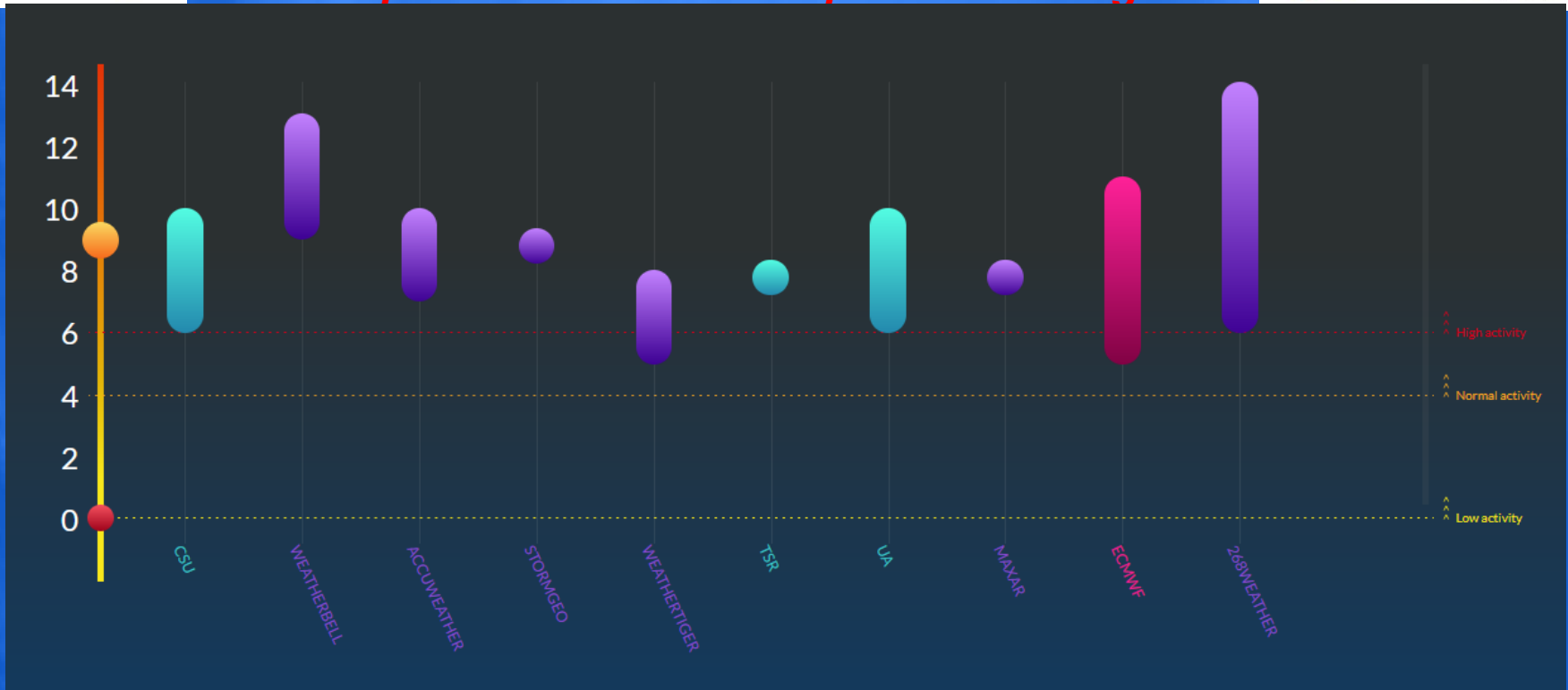
Contributing Forecast Groups





Seasonal Hurricane Forecast Compilation Website

<http://seasonalhurricanepredictions.org>

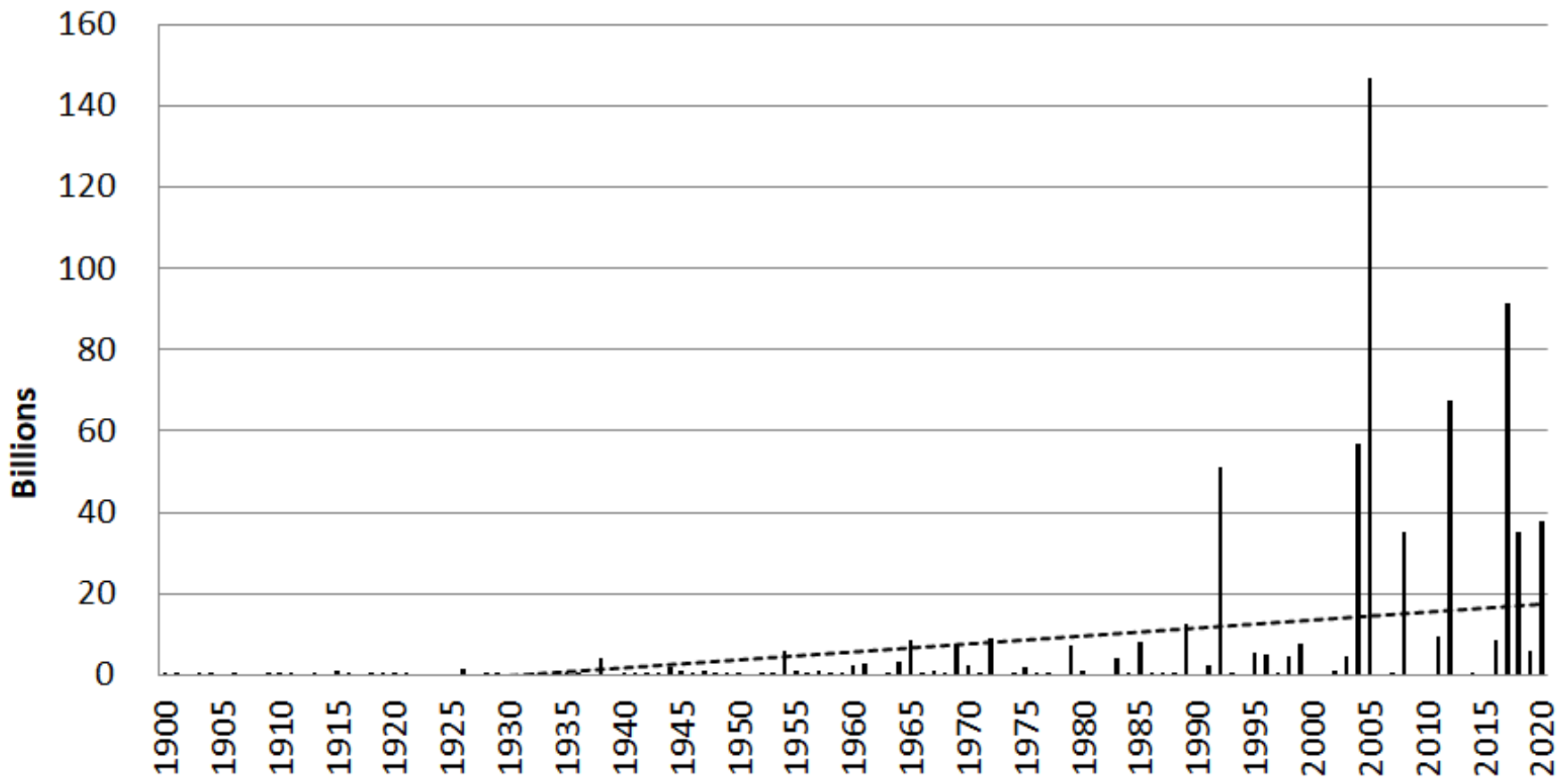


The background of the slide is a satellite image of a hurricane, showing a distinct eye and spiral cloud bands. The image is divided into three horizontal bands: a blue band at the top, a red band in the middle, and a blue band at the bottom. The title text is centered within the red band.

Long-Term Trends in Hurricane Activity

Total Continental US Losses per Year from Atlantic Hurricanes in 2020 USD - Adjusted for Inflation

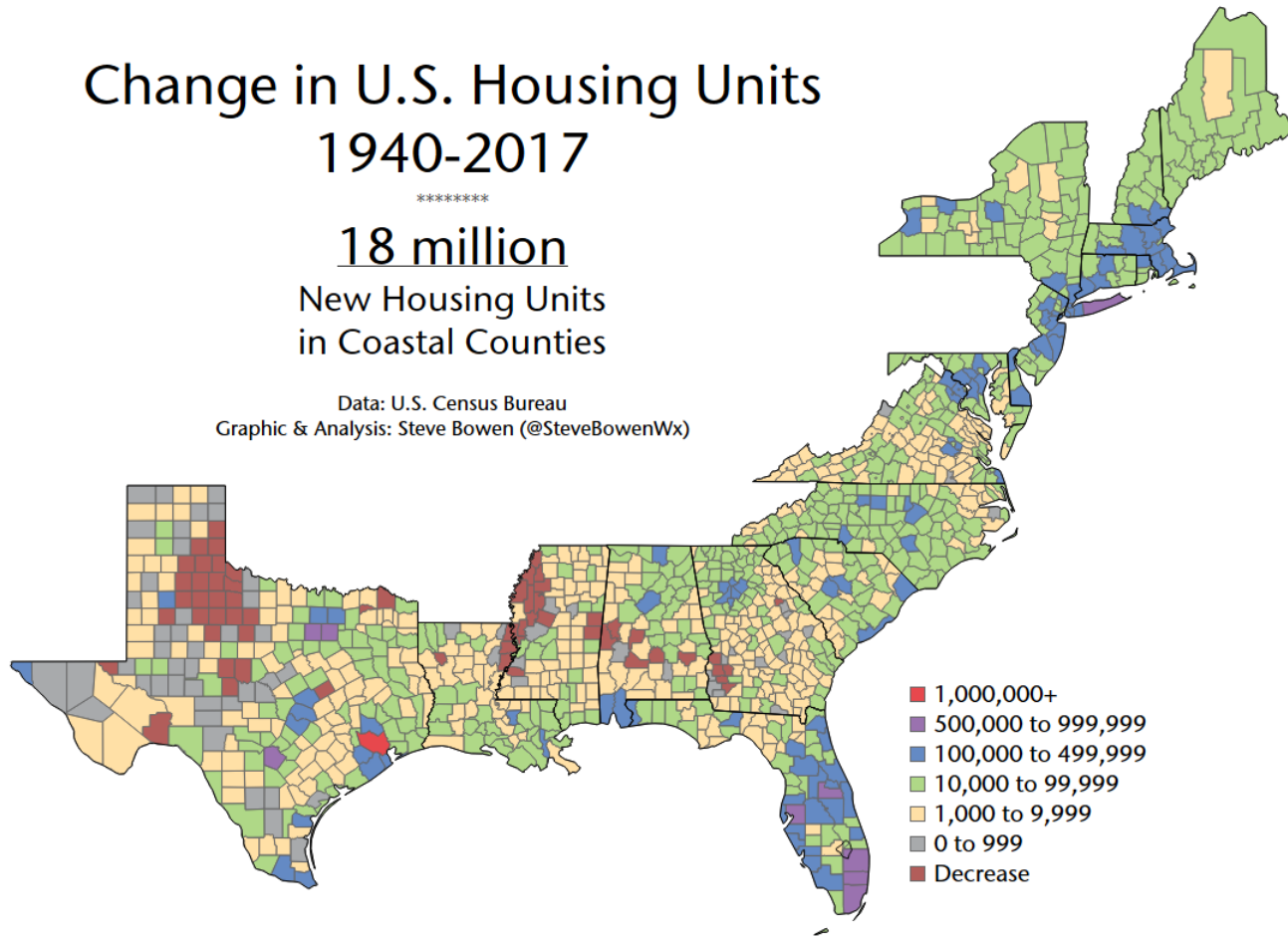
Weinkle et al. (2018)



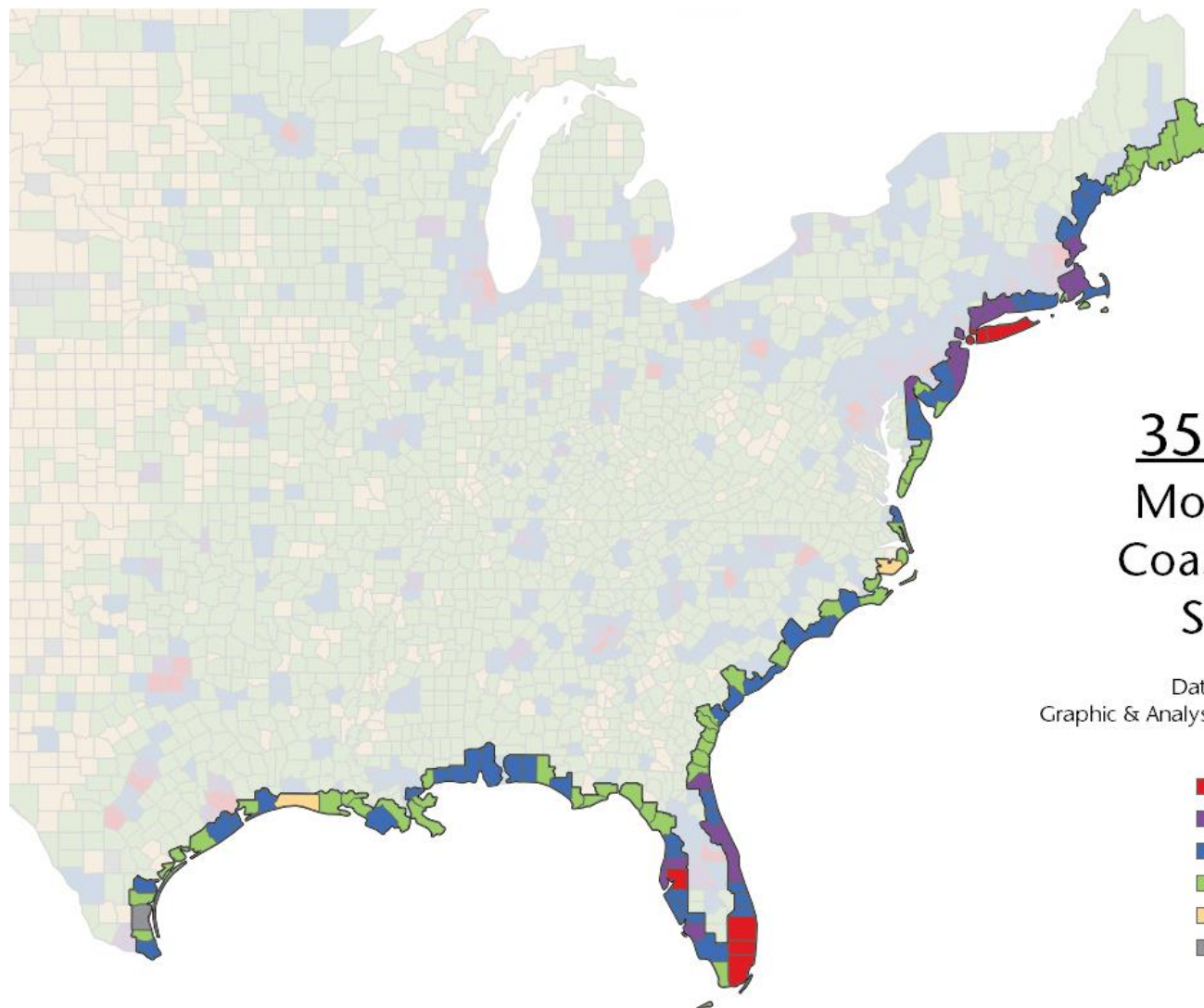
Change in U.S. Housing Units 1940-2017

18 million
New Housing Units
in Coastal Counties

Data: U.S. Census Bureau
Graphic & Analysis: Steve Bowen (@SteveBowenWx)



Klotzbach, P. J., S. G. Bowen, R. Pielke Jr., and M. M. Bell, 2018: Continental United States landfall frequency and associated damage: Observations and future risks. *Bulletin of the AMS*, **99**, 1359-1376.



35.5 Million More People in Coastal Counties Since 1900

Data: U.S. Census Bureau
Graphic & Analysis: Steve Bowen (@SteveBowenWx)

- 1,000,000+
- 500,000 to 999,999
- 100,000 to 499,999
- 10,000 to 99,999
- 1,000 to 9,999
- 0 to 999

Miami-Dade County Population: ~100,000



1926

Miami-Dade County Population: ~2.7 Million



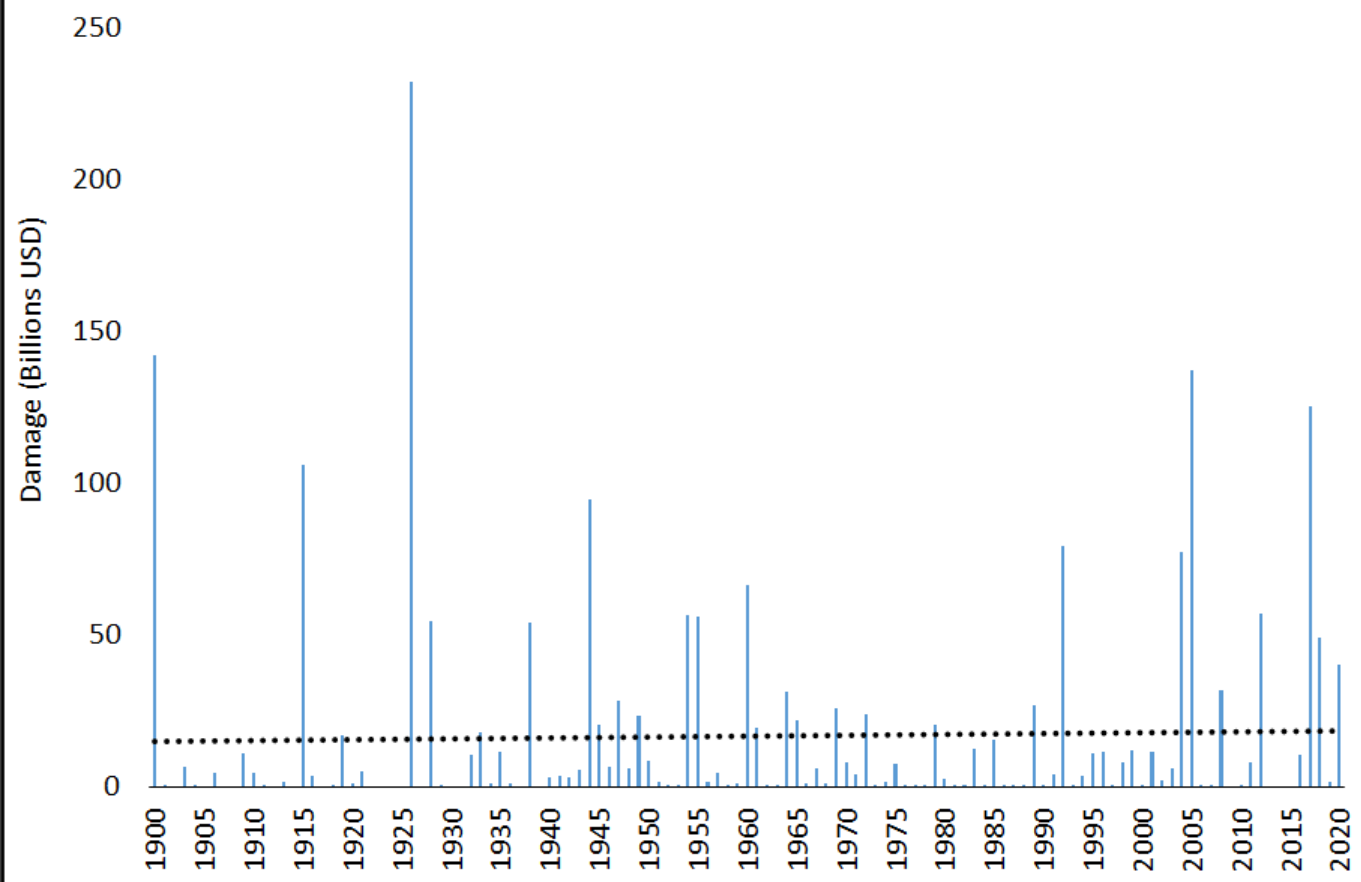
2020

1926 Great Miami Hurricane - >\$222 Billion Economic Damage in 2020

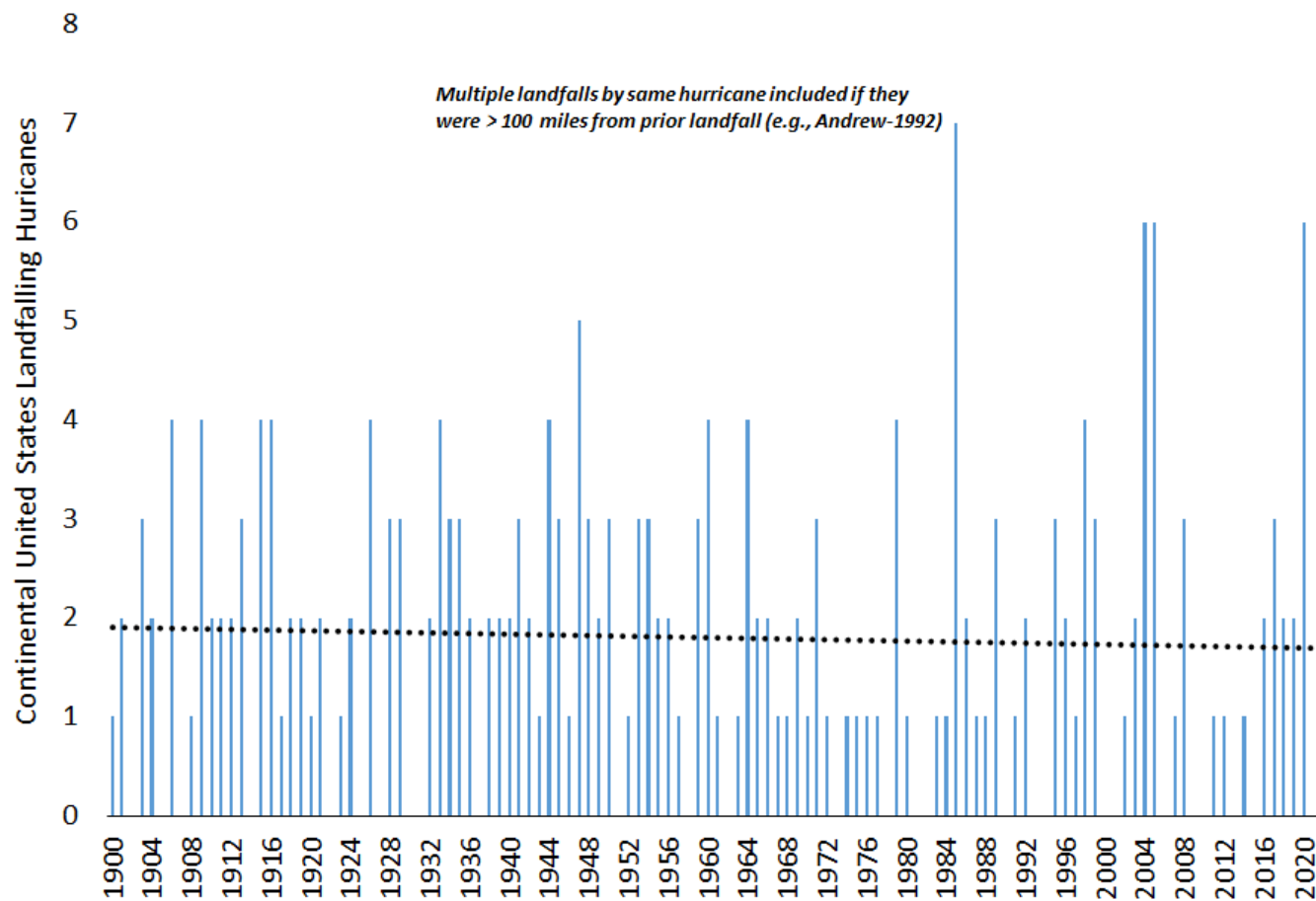
Weinkle, J. et al. (2018). Normalized hurricane damage in the continental United States 1900–2017. *Nature Sustainability* 1(12):808-813.

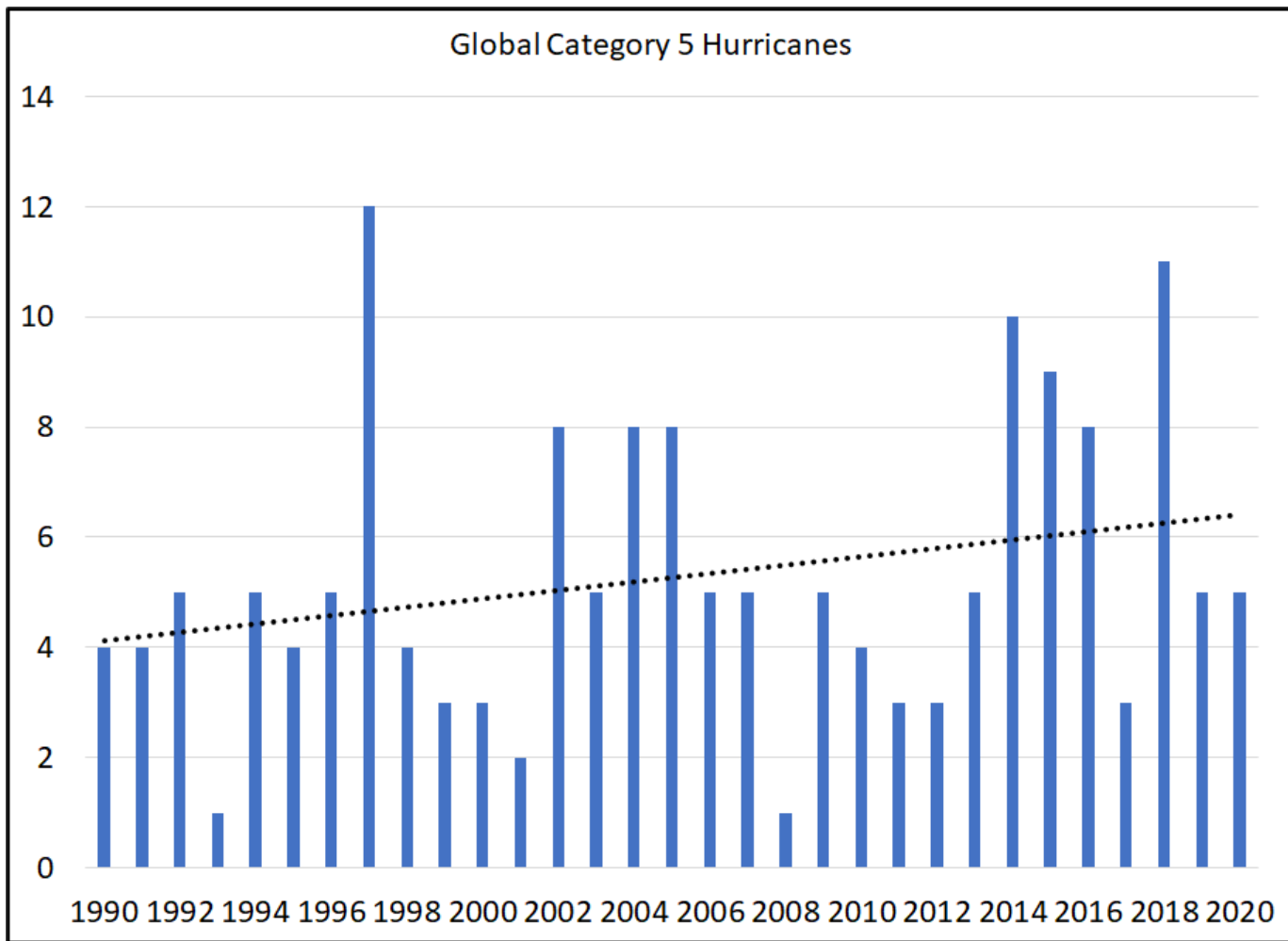
Klotzbach, P. J., Bowen, S. G., Pielke, R., Jr., & Bell, M. M. (2018). Continental U.S. Hurricane Landfall Frequency and Associated Damage: Observations and Future Risks, *Bulletin of the American Meteorological Society*, 99(7), 1359-1376.

**Normalized Continental United States Landfalling Hurricane Damage
(1900-2020)**

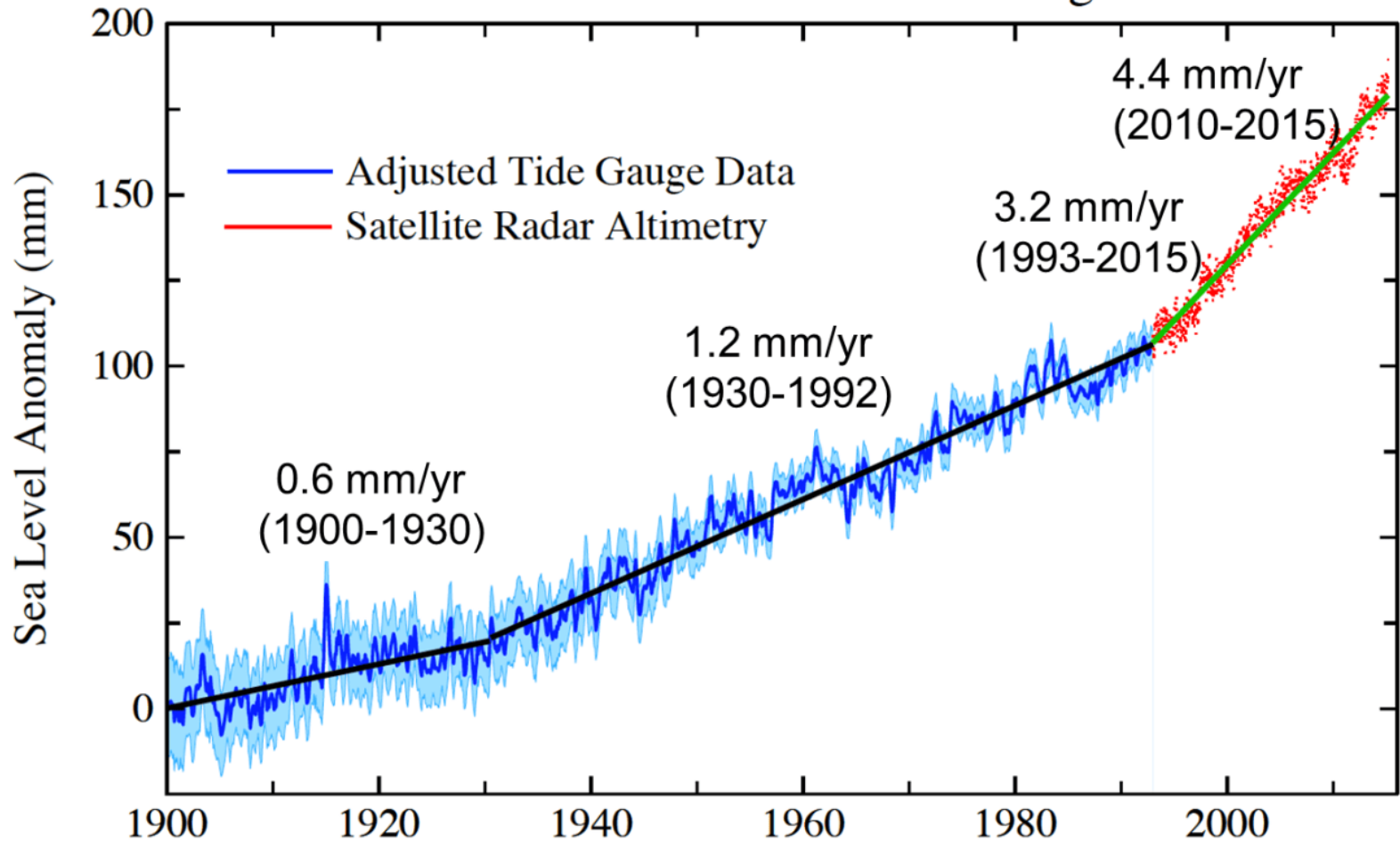


Continental United States Landfalling Hurricanes (1900-2020)

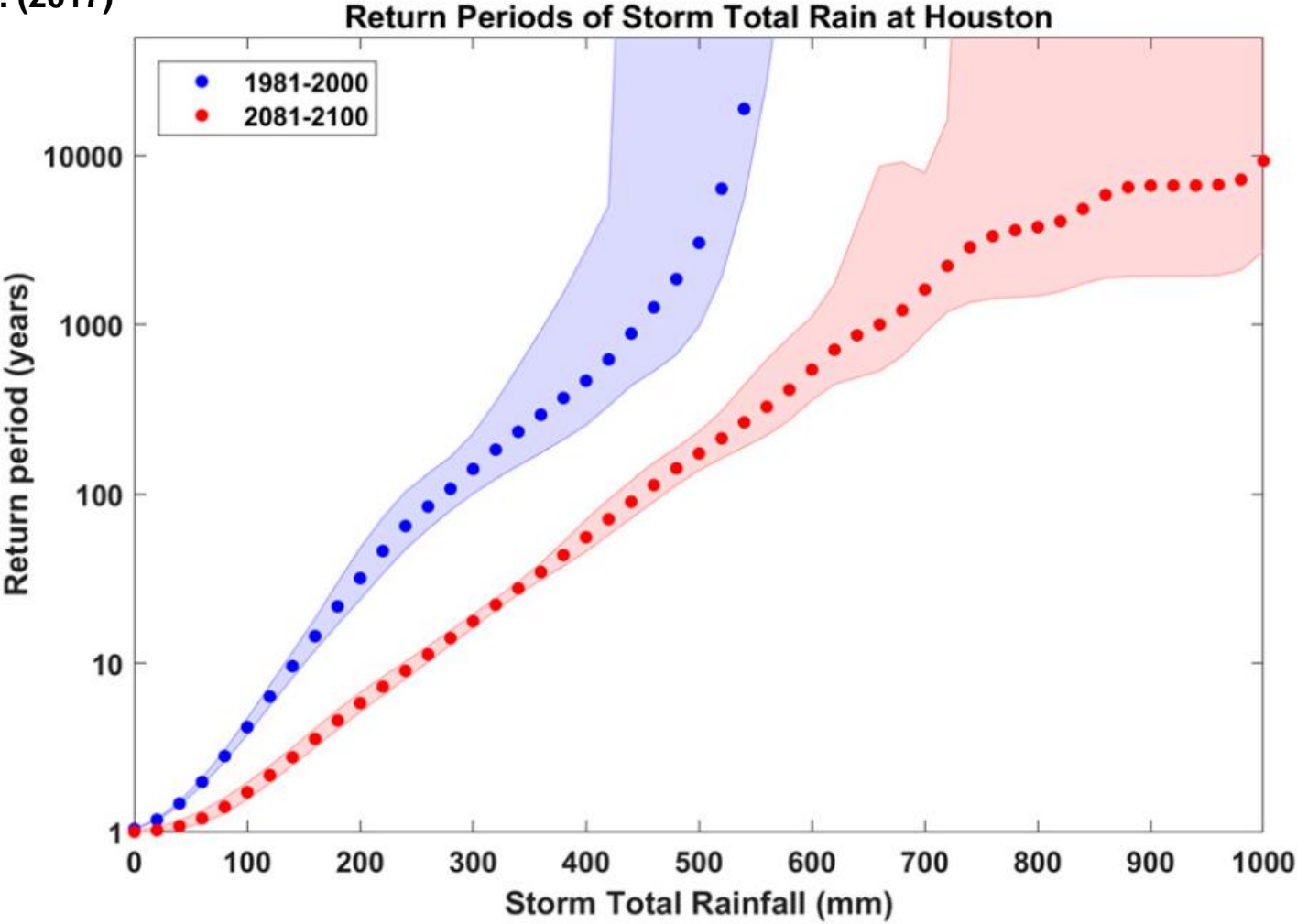




Global Mean Sea Level Change



Emanuel et al. (2017)



Contact Info:

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Twitter: [@philklotzbach](https://twitter.com/philklotzbach)

Upcoming Training

April 30, 2021 1:30 pm

Tasha Carter,

**Florida's Insurance
Consumer Advocate**

“Demolish the Fraud”

[https://attendee.gotowebinar.com/
register/6777785910102894347](https://attendee.gotowebinar.com/register/6777785910102894347)



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Technical Assistance is Available

Available Daily: 1 (800) 677-4548

Options for Further Assistance Include:

Phone and Email consultation

Site Visits

Register at www.flhousing.org for:

Workshops

Webinars

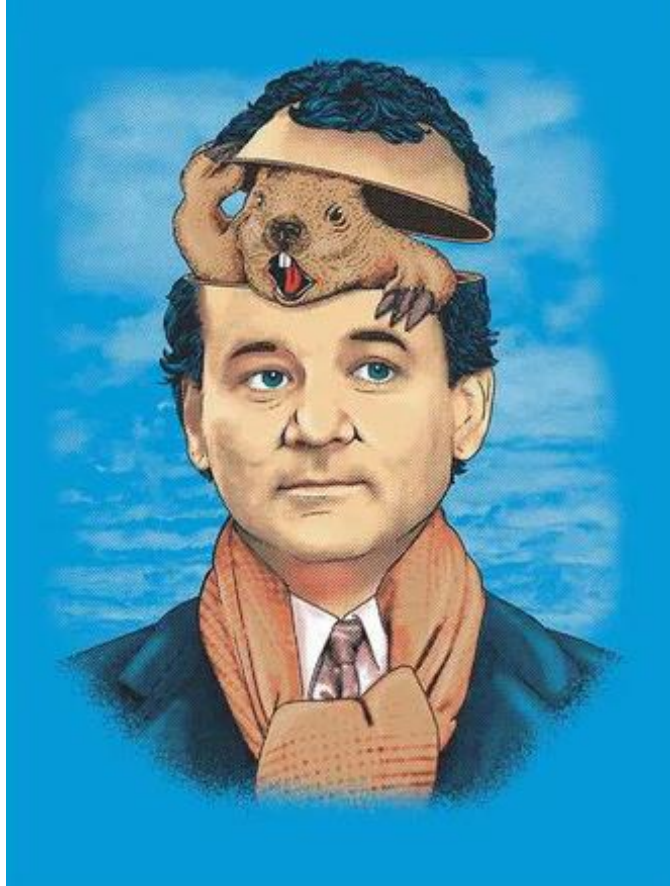


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Thank you!



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Michael Chaney
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