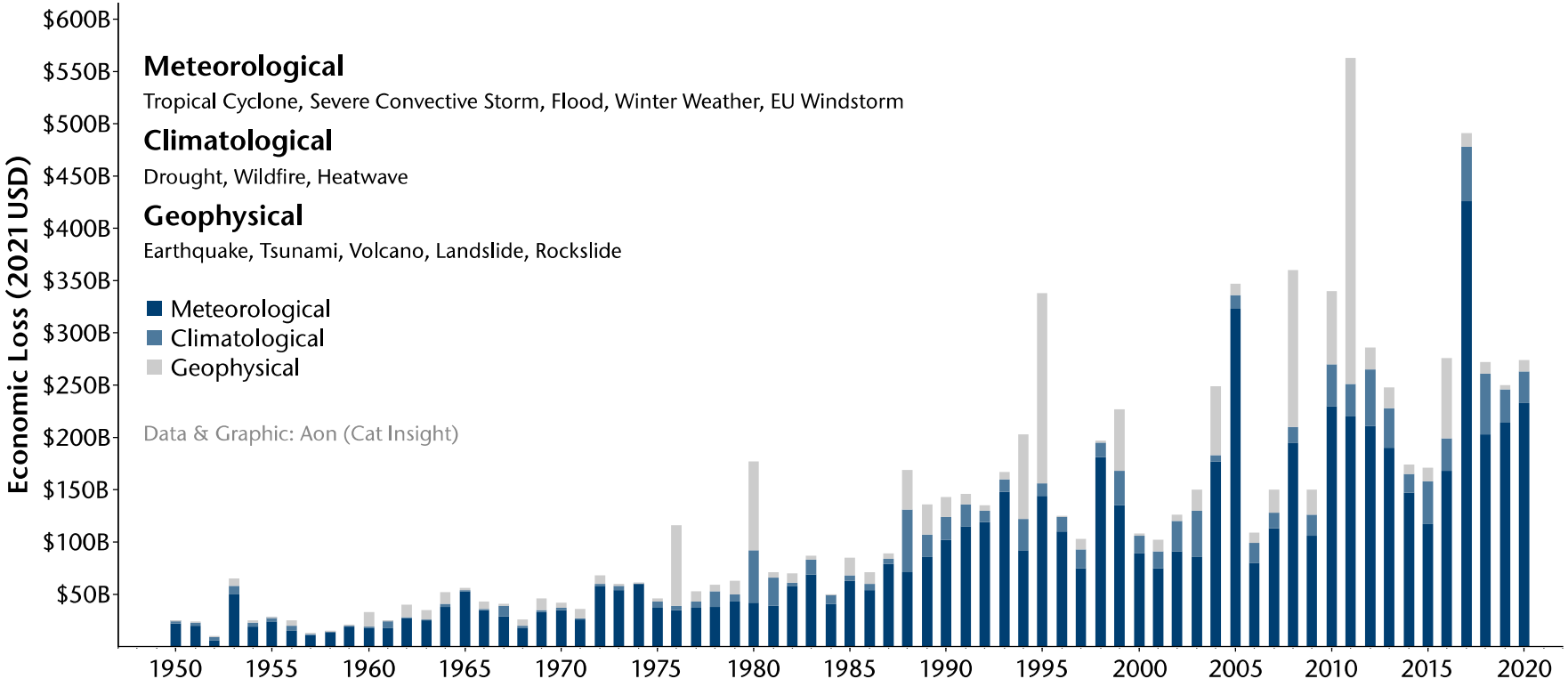
Natural Catastrophe Recap and Outlook for the 2021 Atlantic Hurricane Season

Prepared by Steve Bowen (Aon) & Phil Klotzbach (Colorado State University)

Overview

2020 Recap: Very Active & Costly – It Could Have Been Worse



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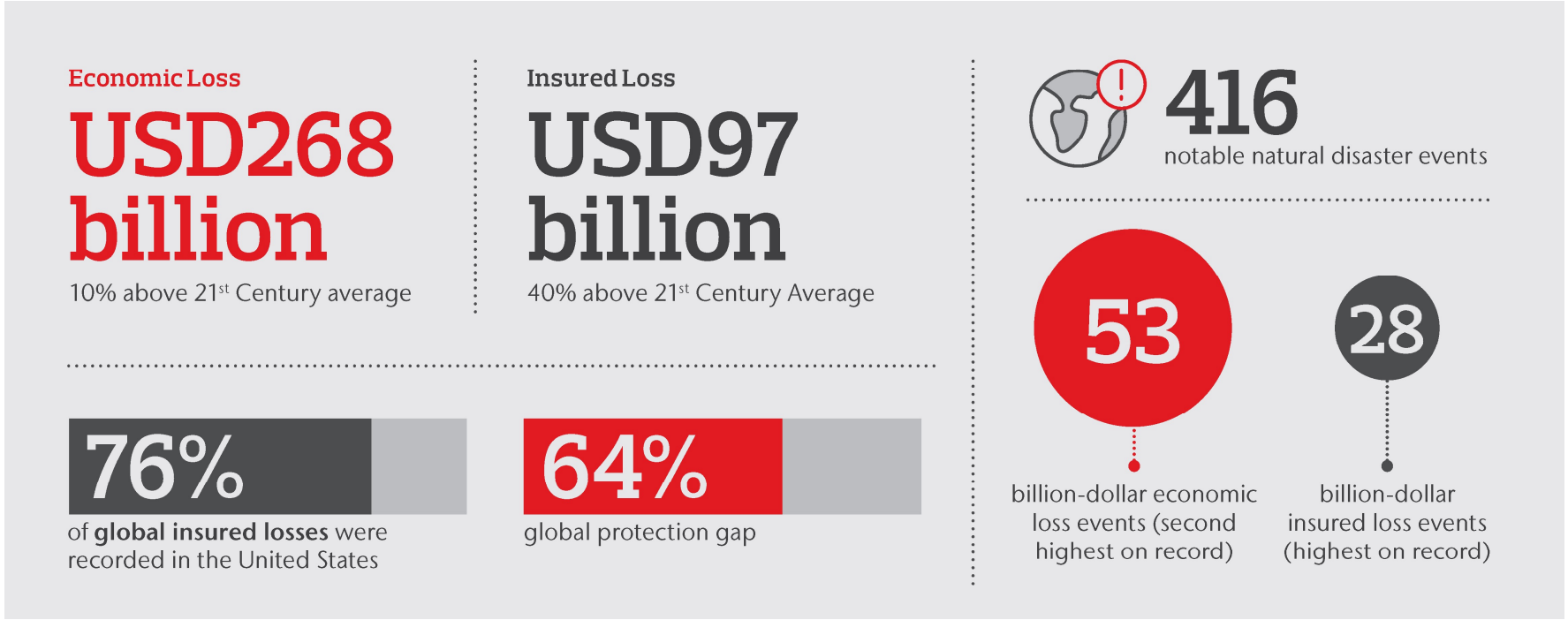

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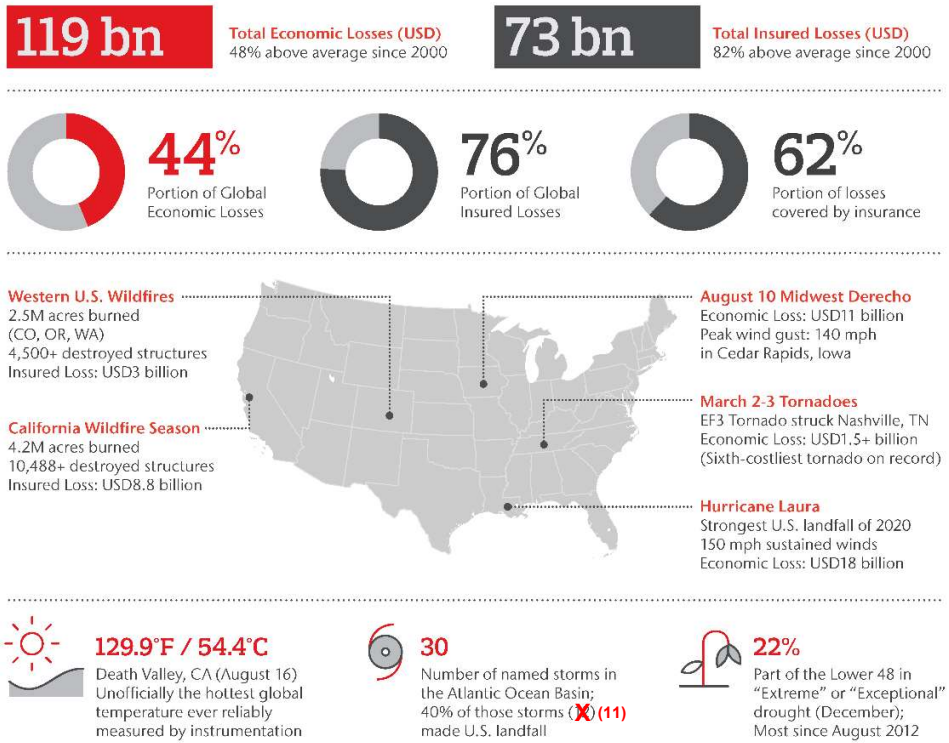
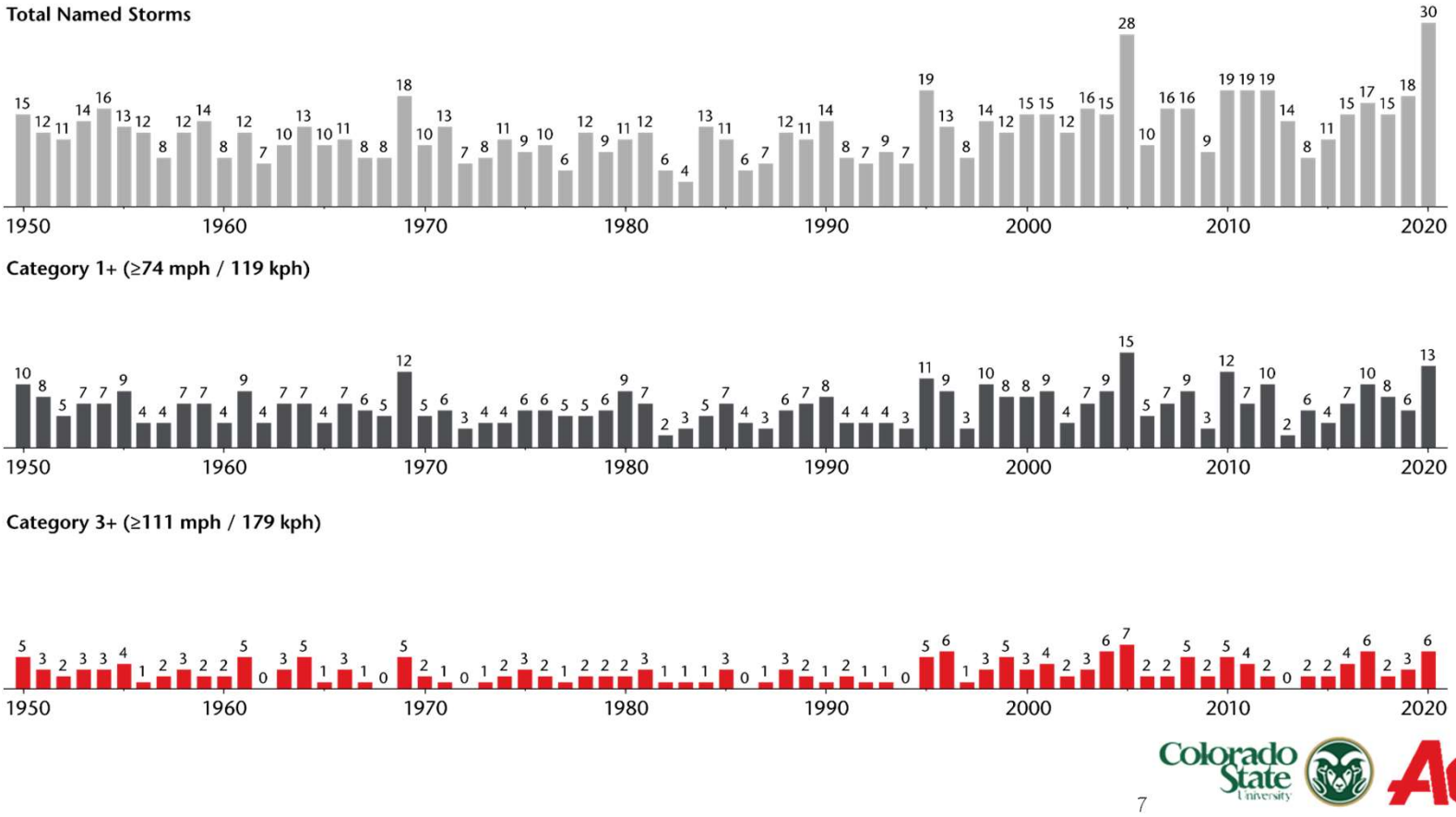
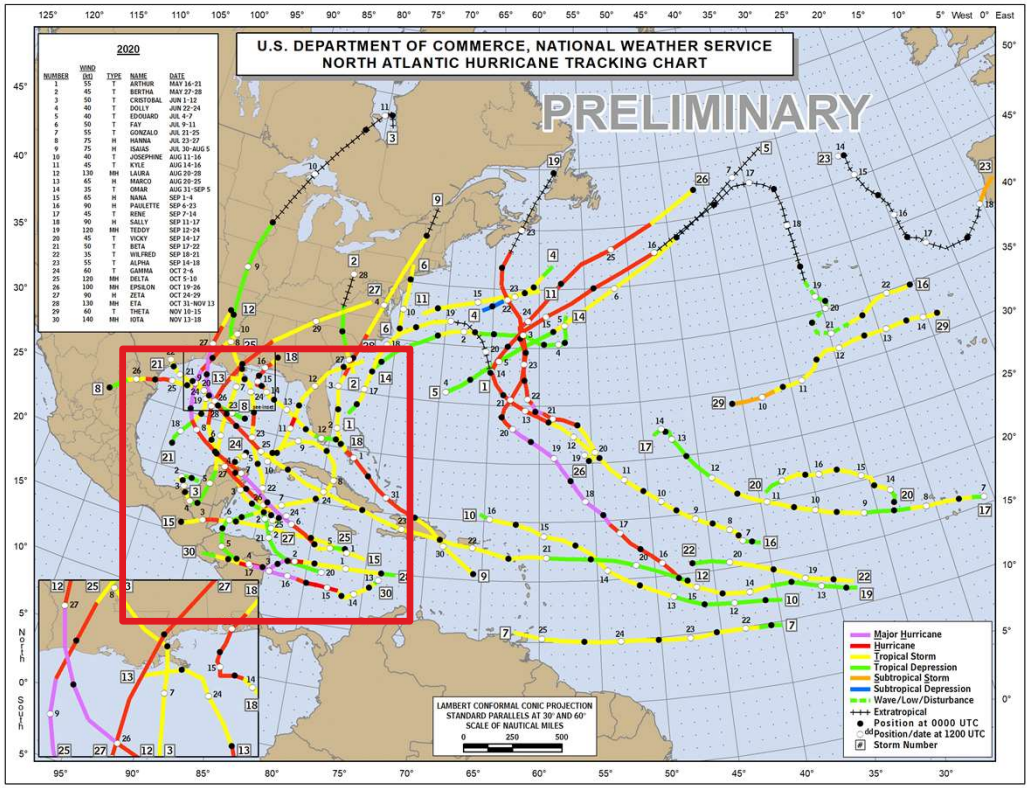


2020 Atlantic Hurricane Season

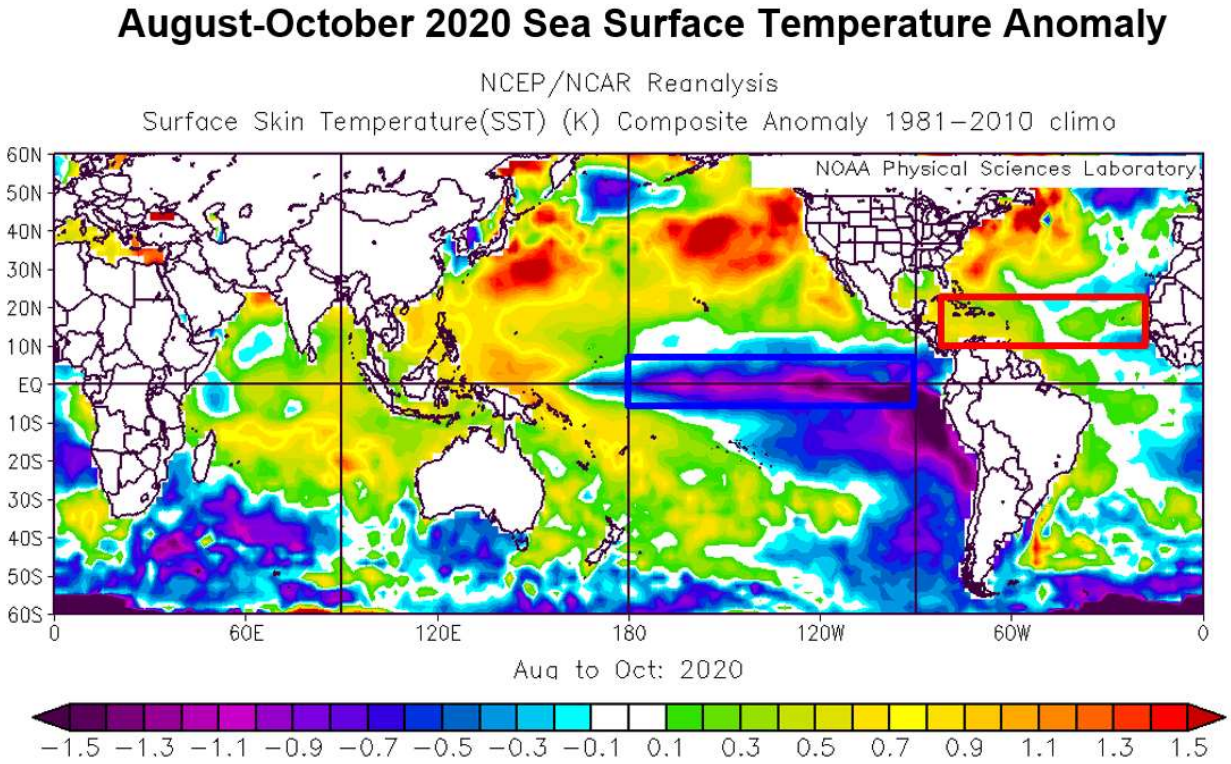
2020 Atlantic Hurricane Season: Record Number of Storms



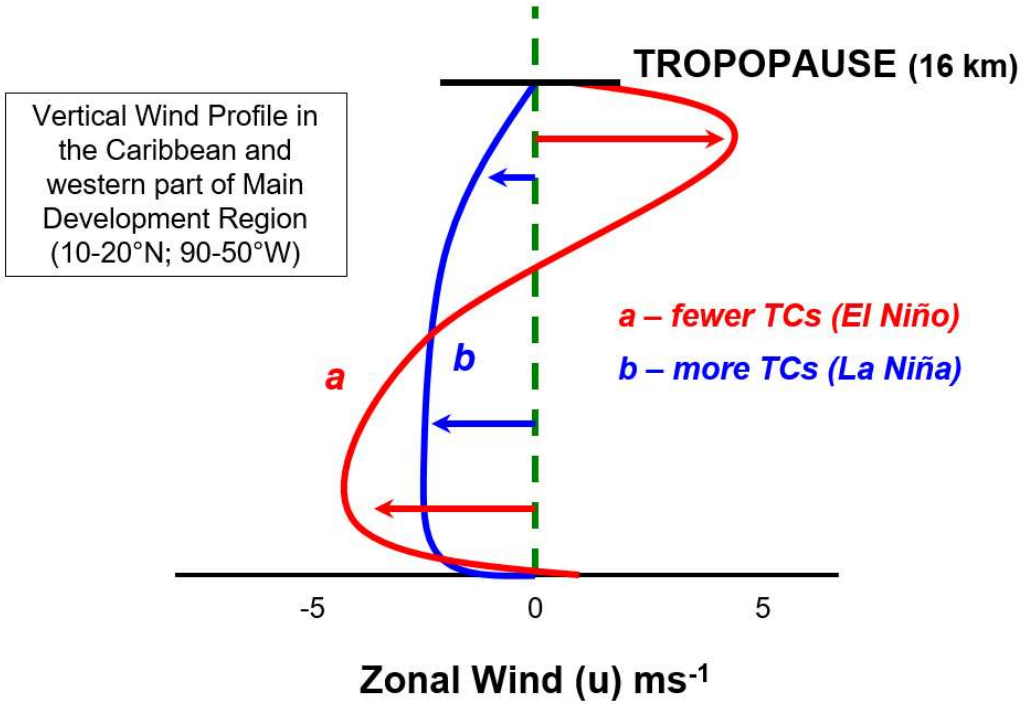
High Concentration of Storms in Western Atlantic



Why So Active?



El Niño-La Niña Vertical Wind Shear Impacts



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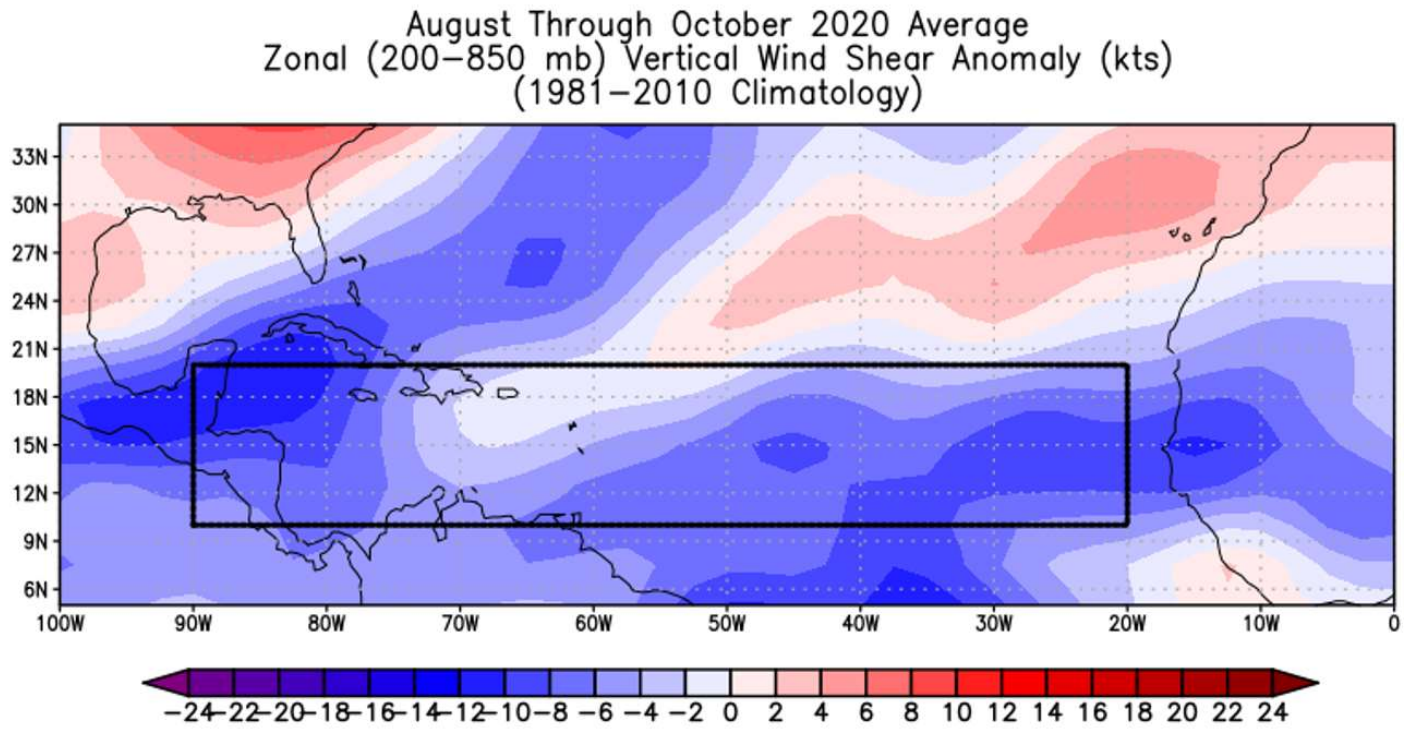
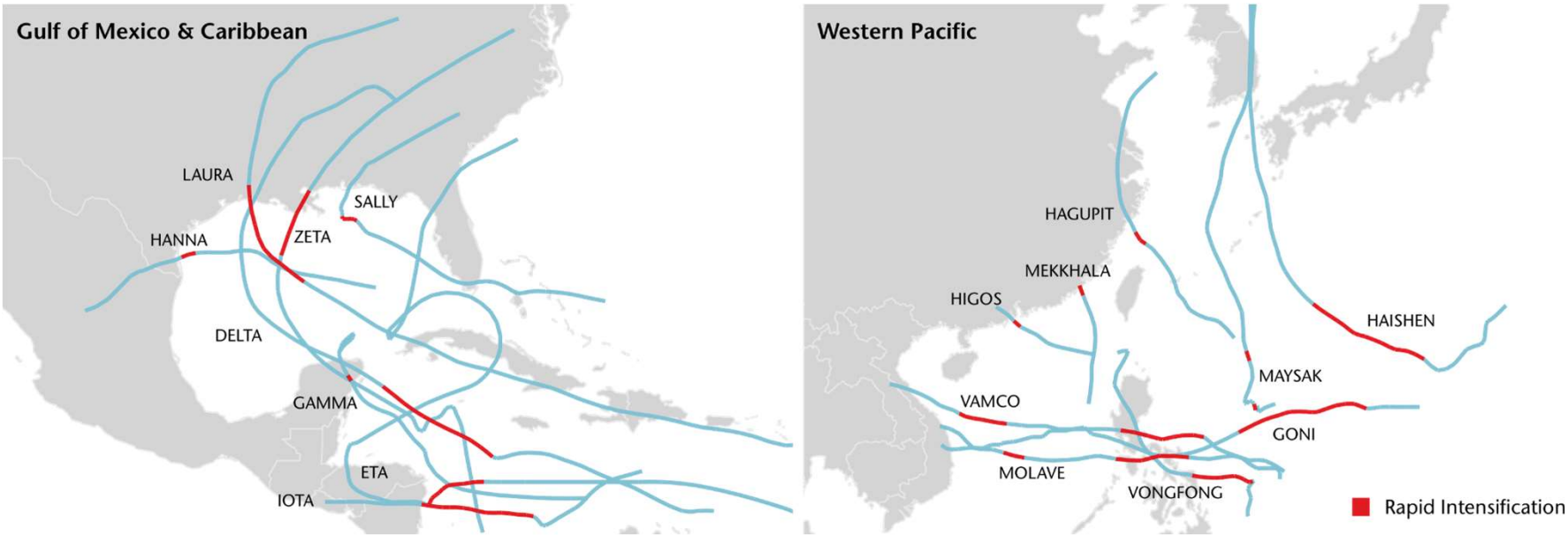
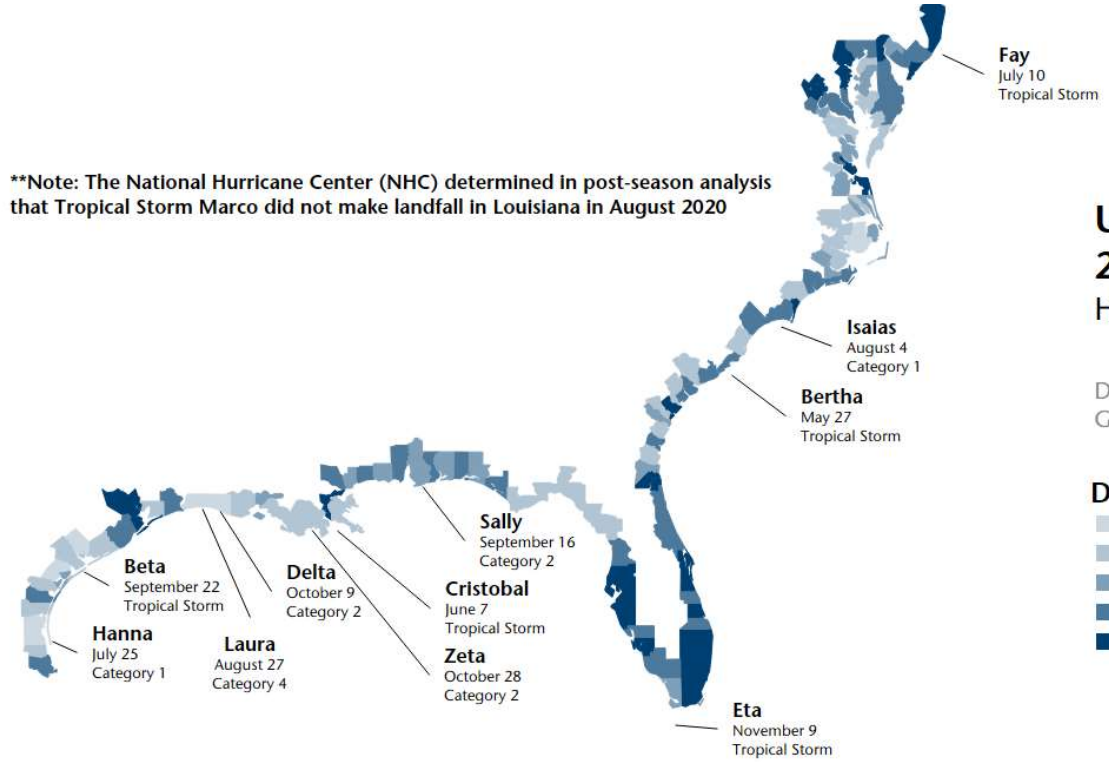


Rapid Intensification



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

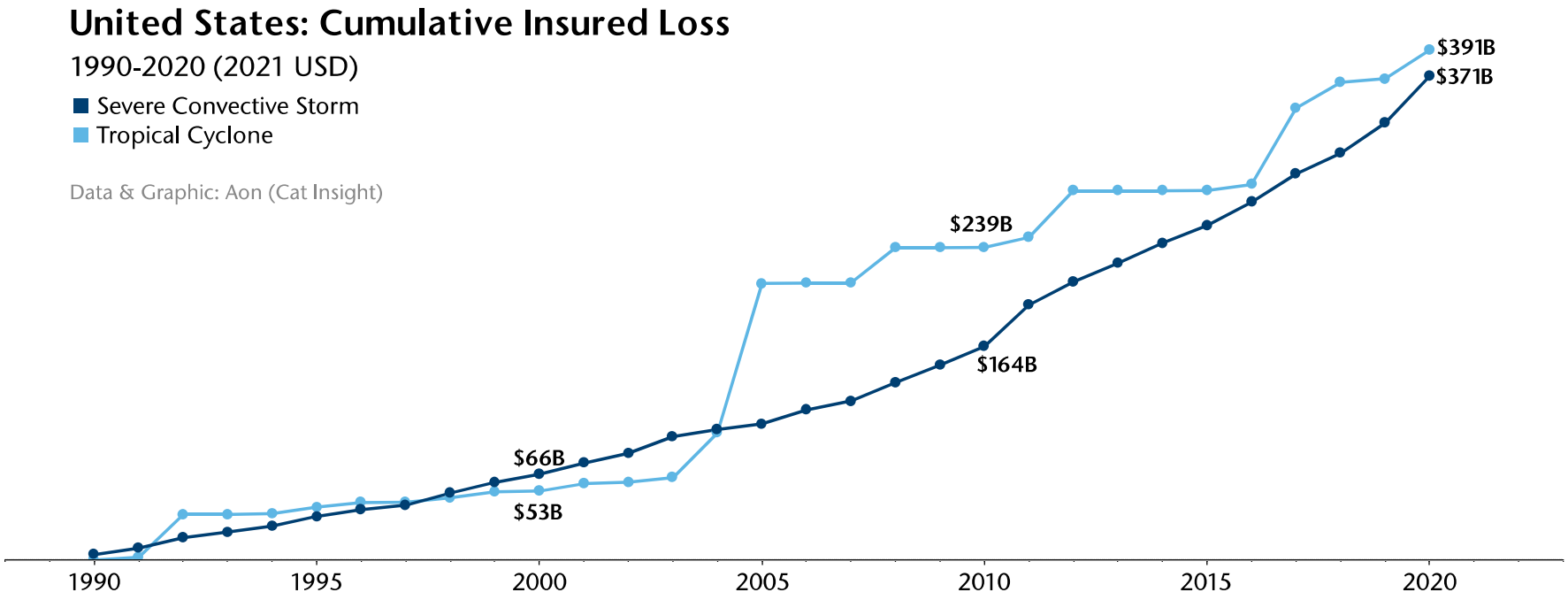
U.S. Mainland Landfalls
2020 Atlantic Season
Housing Density by Coastal County

Data: NOAA
Graphic: Aon (Cat Insight)

Density Homes / Sq Mile
- <10
- 10-50
- 50-100
- 100-250
- >250

Severe Convective Storms (SCS)

Severe Convective Storm – Costlier Than You Realize



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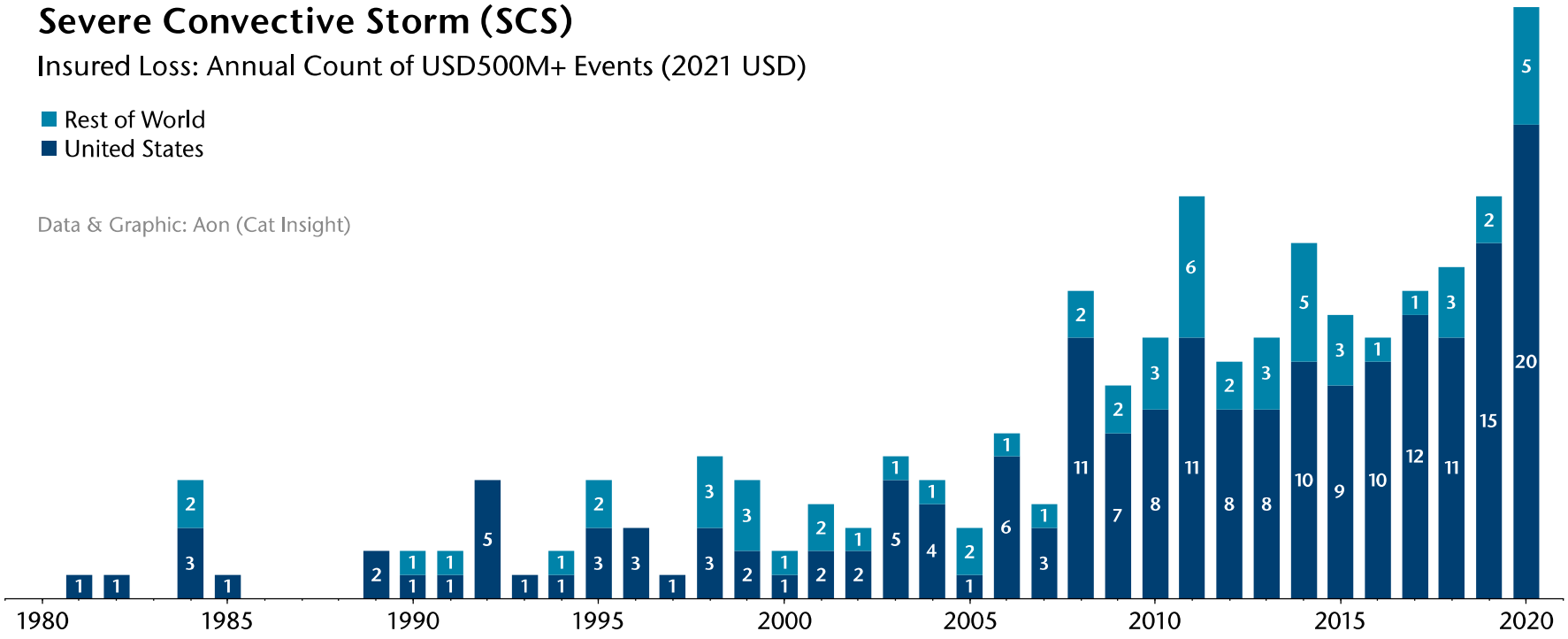
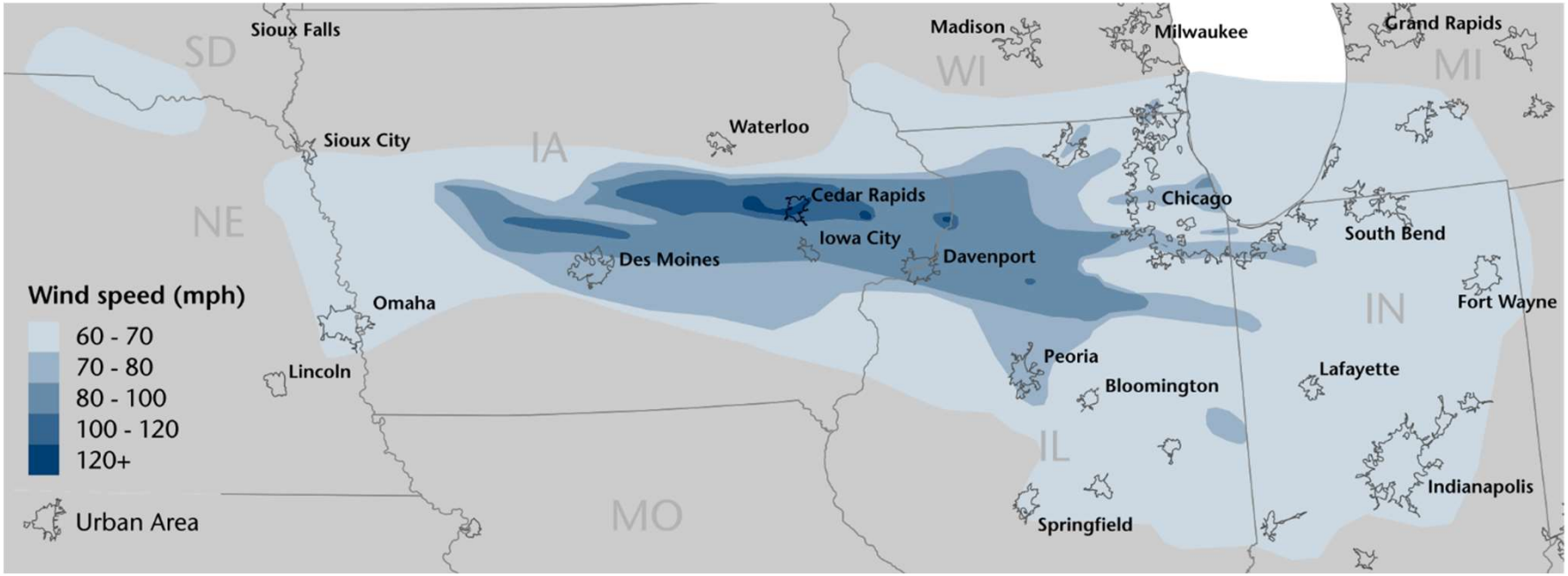


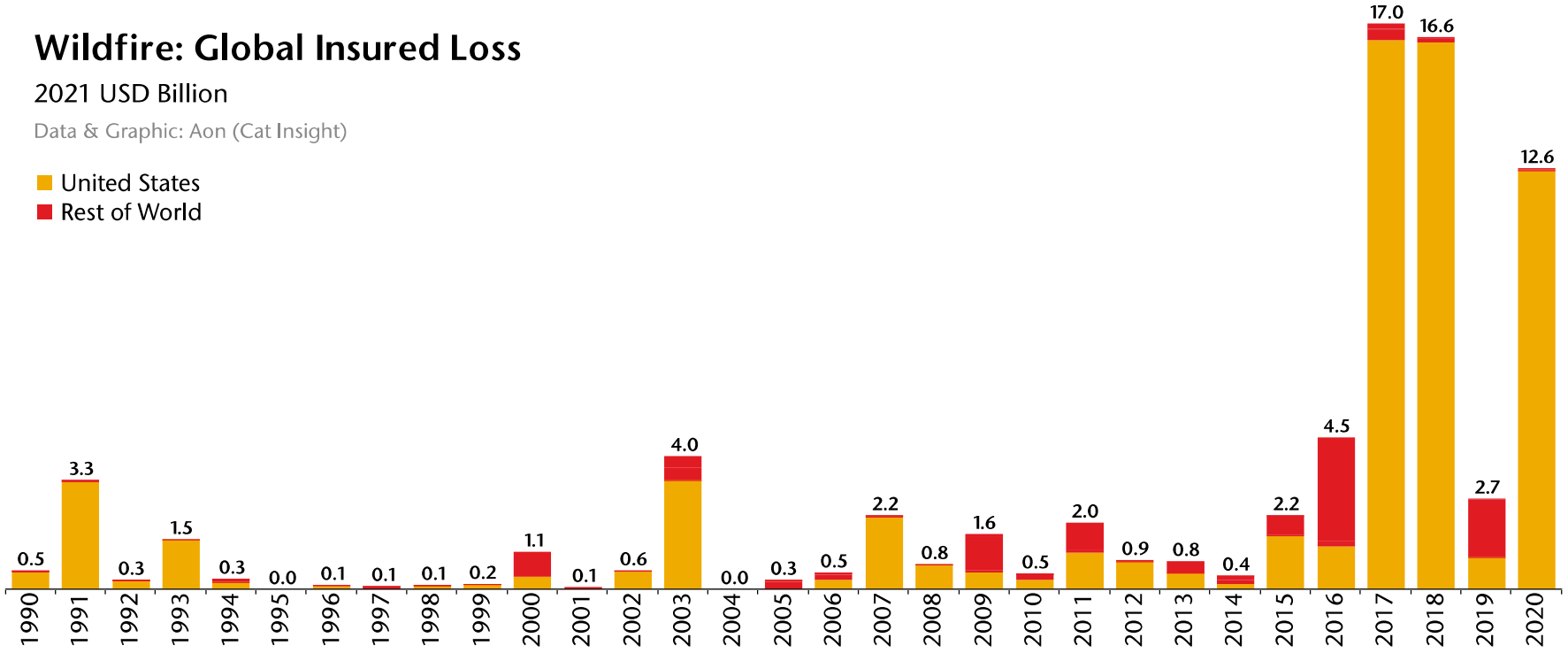
August 10, 2020 Midwest Derecho



[1] *Includes tornado swaths in Illinois, Wisconsin and Indiana. Data: NOAA*

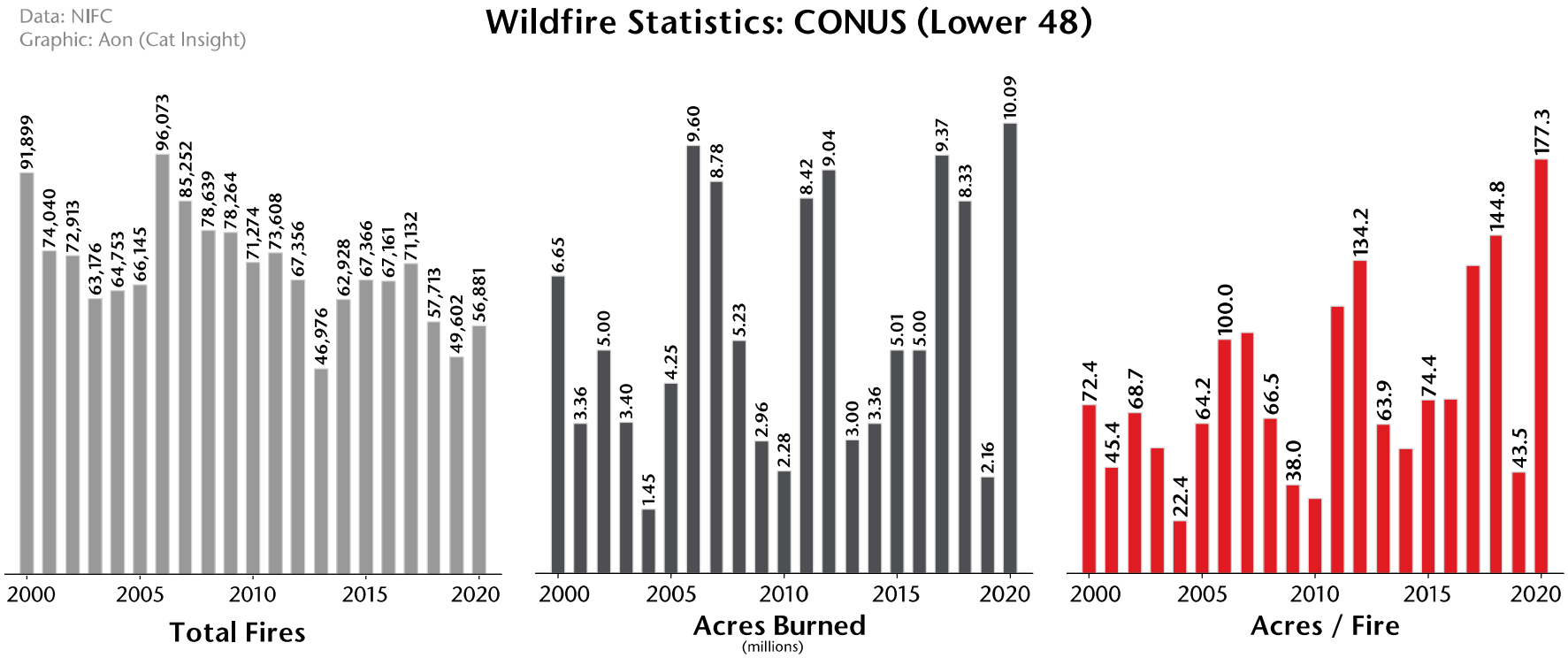

Wildfires

Wildfires – A Growing Risk



Changing Wildfire Behavior

Data: NIFC
Graphic: Aon (Cat Insight)



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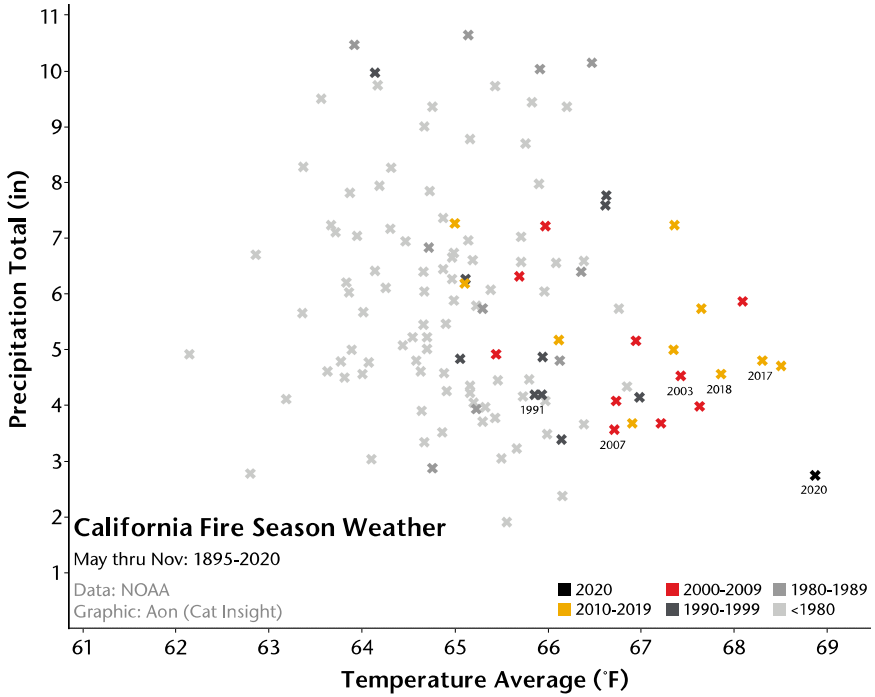
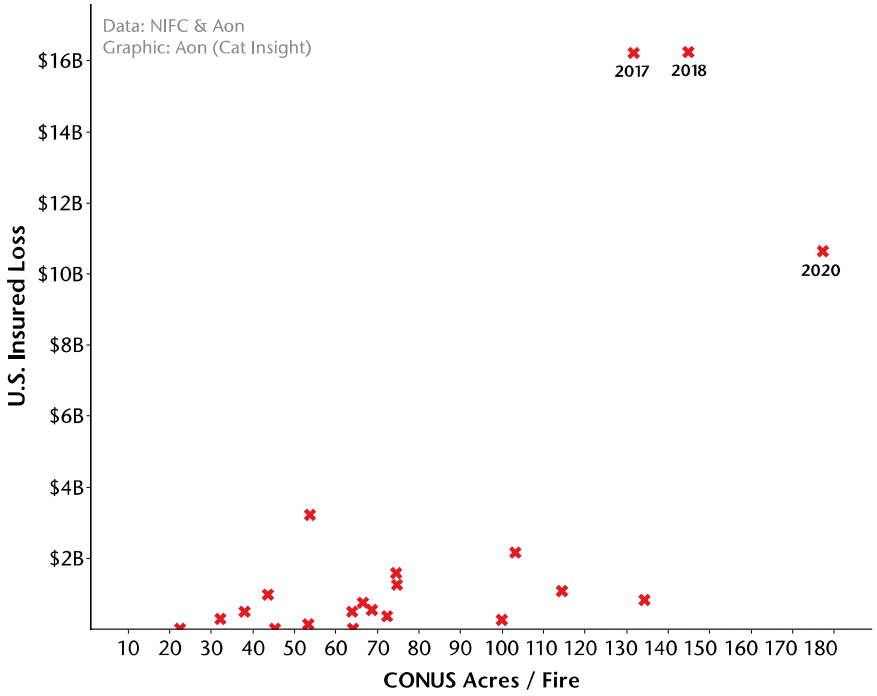
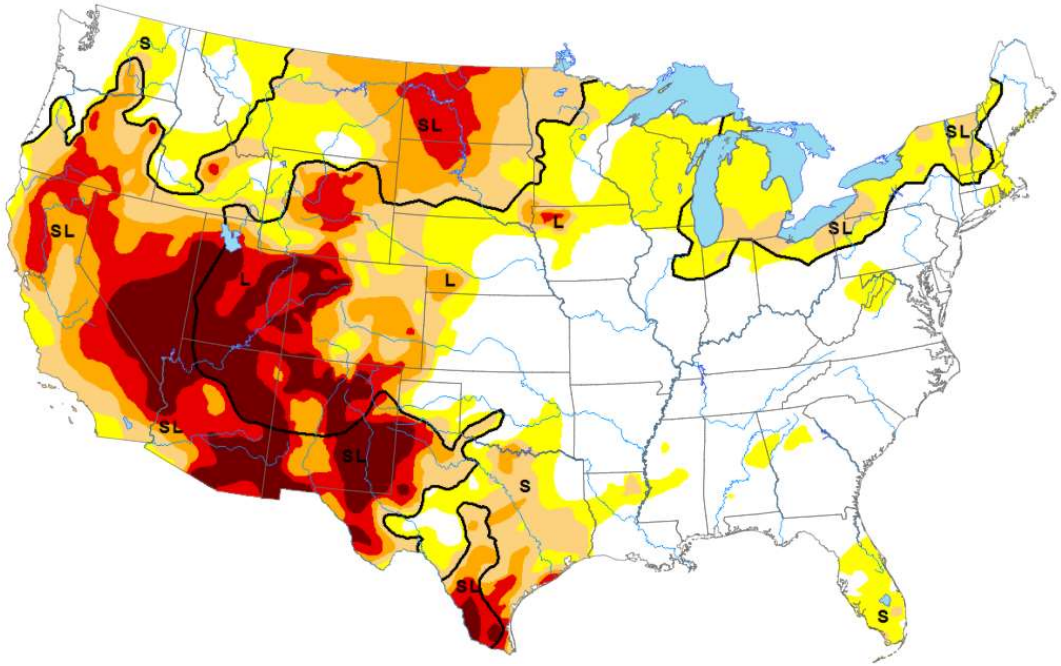




2021 Fire Outlook

Map released: April 1, 2021

Data valid: March 30, 2021



Drought Conditions (Percent Area)

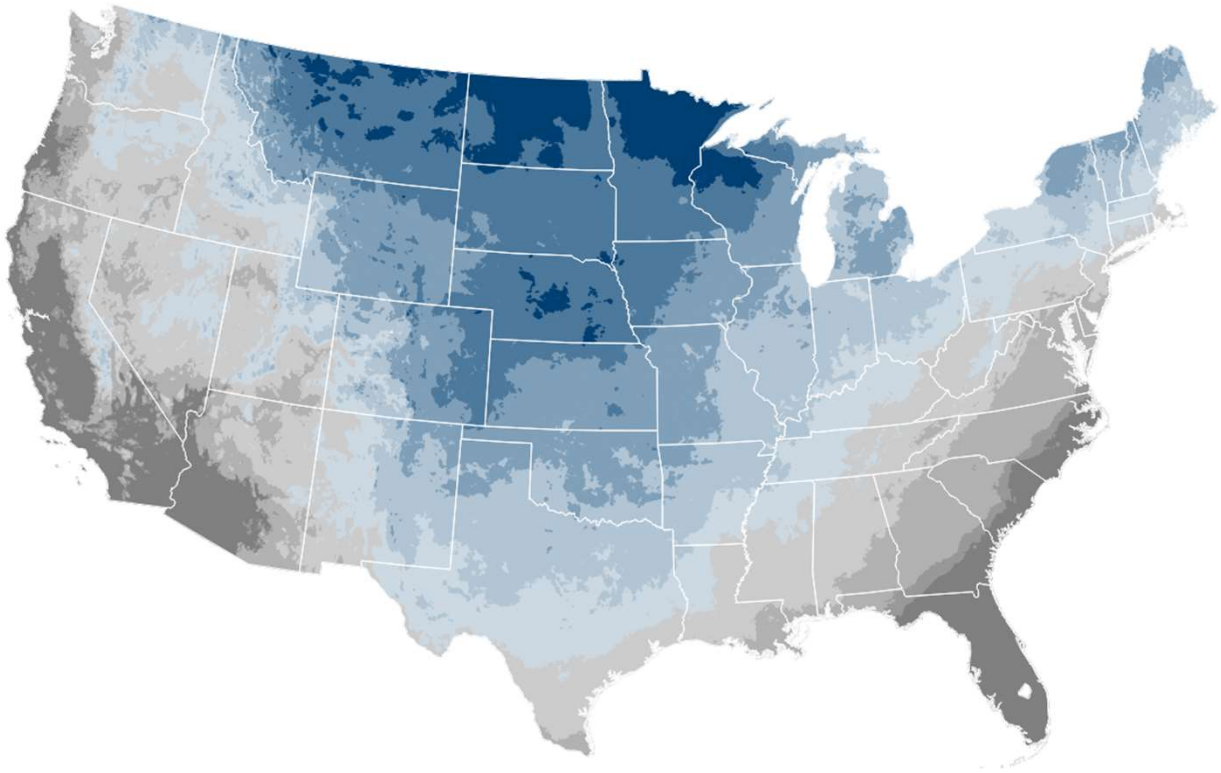
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	36.59	63.41	43.92	29.61	18.69	8.71
Last Week *03-23-2021*	35.79	64.21	43.55	29.83	18.06	8.74
3 Months Ago *12-29-2020*	33.59	66.41	48.99	34.22	22.21	9.89
Start of Calendar Year *12-29-2020*	33.59	66.41	48.99	34.22	22.21	9.89
Start of Water Year *09-29-2020*	38.05	61.95	42.59	27.37	14.63	1.20
One Year Ago *03-31-2020*	74.79	25.21	14.54	3.04	0.48	0.03

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

February 2021:
U.S. Winter Weather

Winter Weather: The Record February 2021 U.S. Event



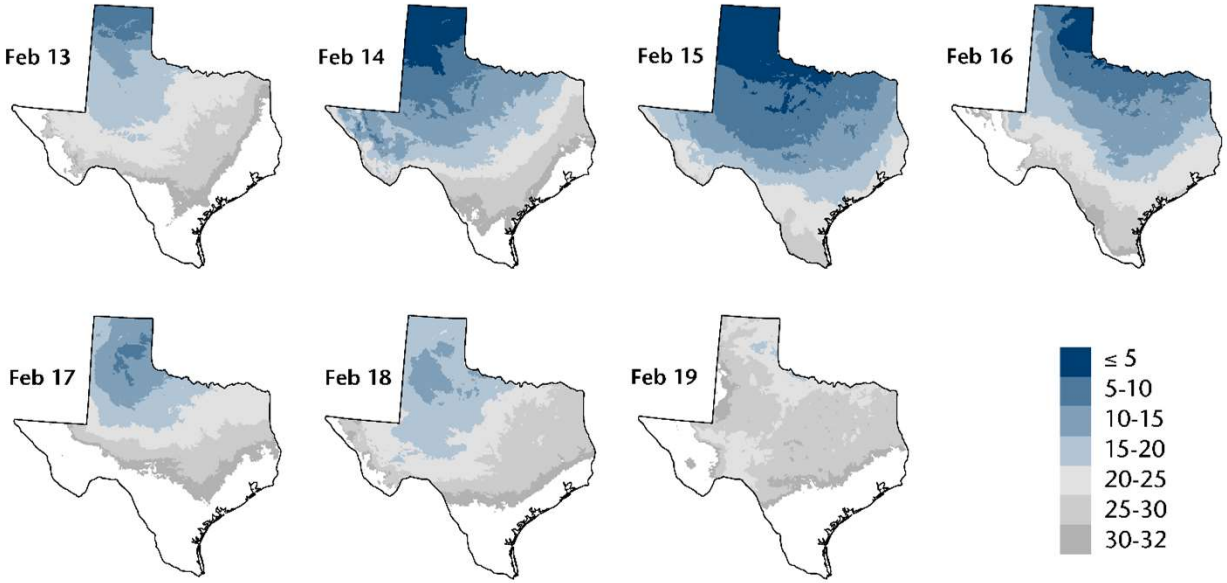
Minimum Temperature (°F)
February 12-19

- ≤-30
- -29 to -20
- -19 to -10
- -9 to 0
- 1 to 10
- 11 to 20
- 21 to 30
- 31 to 32
- ≥33

Data: NOAA
Graphic: Impact Forecasting
(Cat Insight)

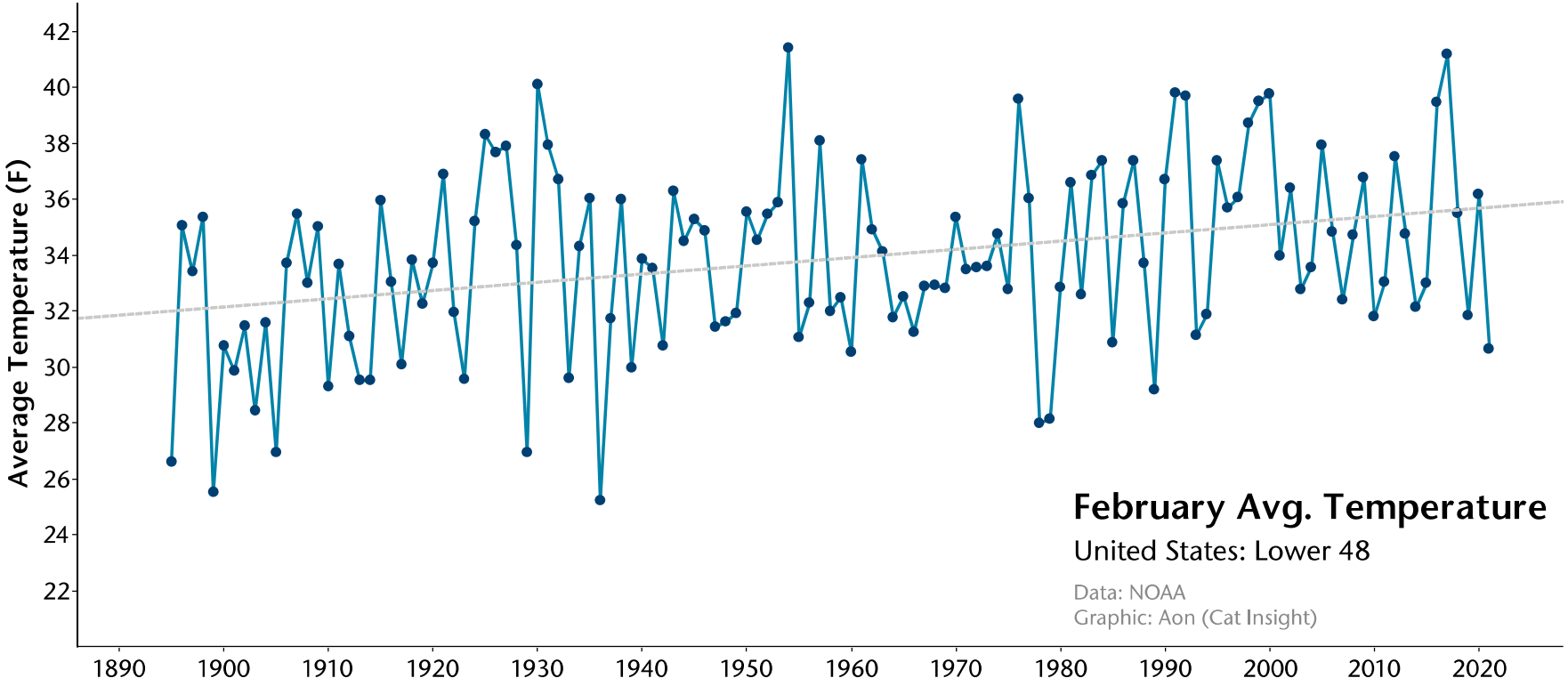
Winter Weather: The Record February 2021 U.S. Event

Texas Average Daily Temperatures (°F)
February 13-19 (12AM-11PM CST)



Data: NOAA/URMA
Graphic: Impact Forecasting (Cat Insight)

Winter Weather: The Record February 2021 U.S. Event

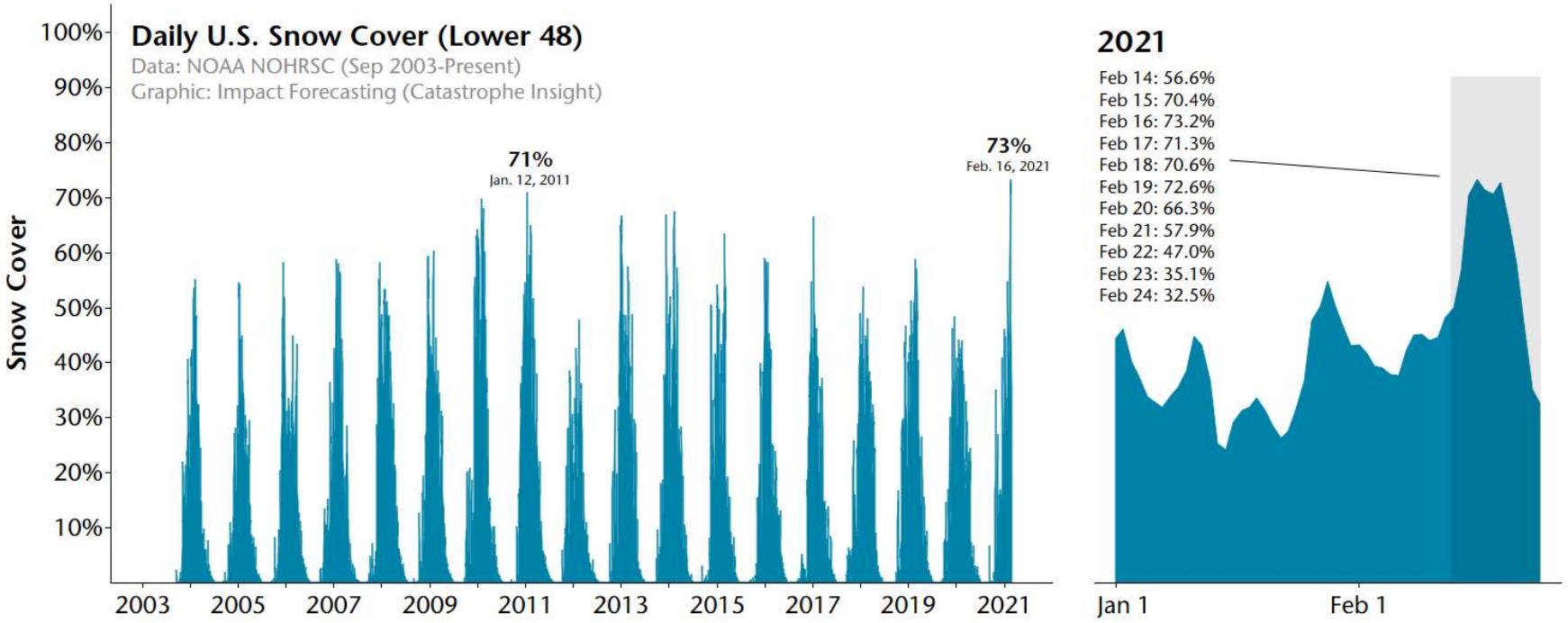


Not the Coldest Event in Texas; More People Felt Cold Impacts in 2021

City (Data Start)	Min High	Min Low	Min Daily Avg	1899 Pop	1989 Pop	2011 Pop	2020 Pop
Abilene (1885)	7°F Jan 15, 1888	-9°F Jan 4, 1947	1°F Jan 15, 1888	3,389	105,820	117,566	124,710
Amarillo (1892)	-2°F Feb 12, 1905	-16°F Feb 12, 1899	-6°F Feb 11, 1899	1,346	156,737	189,132	199,747
Austin (1897)	20°F Feb 12, 1899	-2°F Jan 31, 1949	10°F Feb 12, 1899	21,490	453,649	782,149	1,011,790
Corpus Christi (1887)	26°F Jan 16, 1888	11°F Feb 12, 1899	19°F Feb 12, 1899	4,671	254,737	302,113	327,144
Dallas / Fort Worth (1898)	12°F Feb 12, 1899	-8°F Feb 12, 1899	2°F Feb 12, 1899	68,508	3,794,354	6,426,214	7,573,136
Houston (1888)	20°F Feb 13, 1899	5°F Jan 18, 1930	13°F Feb 13, 1899	42,925	1,627,012	2,089,000	2,320,268
San Antonio (1885)	23°F Jan 30, 1951	0°F Jan 31, 1949	15°F Feb 12, 1899	51,756	920,934	1,313,000	1,547,253

Data: NOAA & U.S. Census Bureau | Graphic: Impact Forecasting (Cat Insight)

Highest U.S. (Lower 48) Snow Cover in Decades



2021 Atlantic Hurricane Season Forecast

In Memory of Bill Gray (1929-2016)

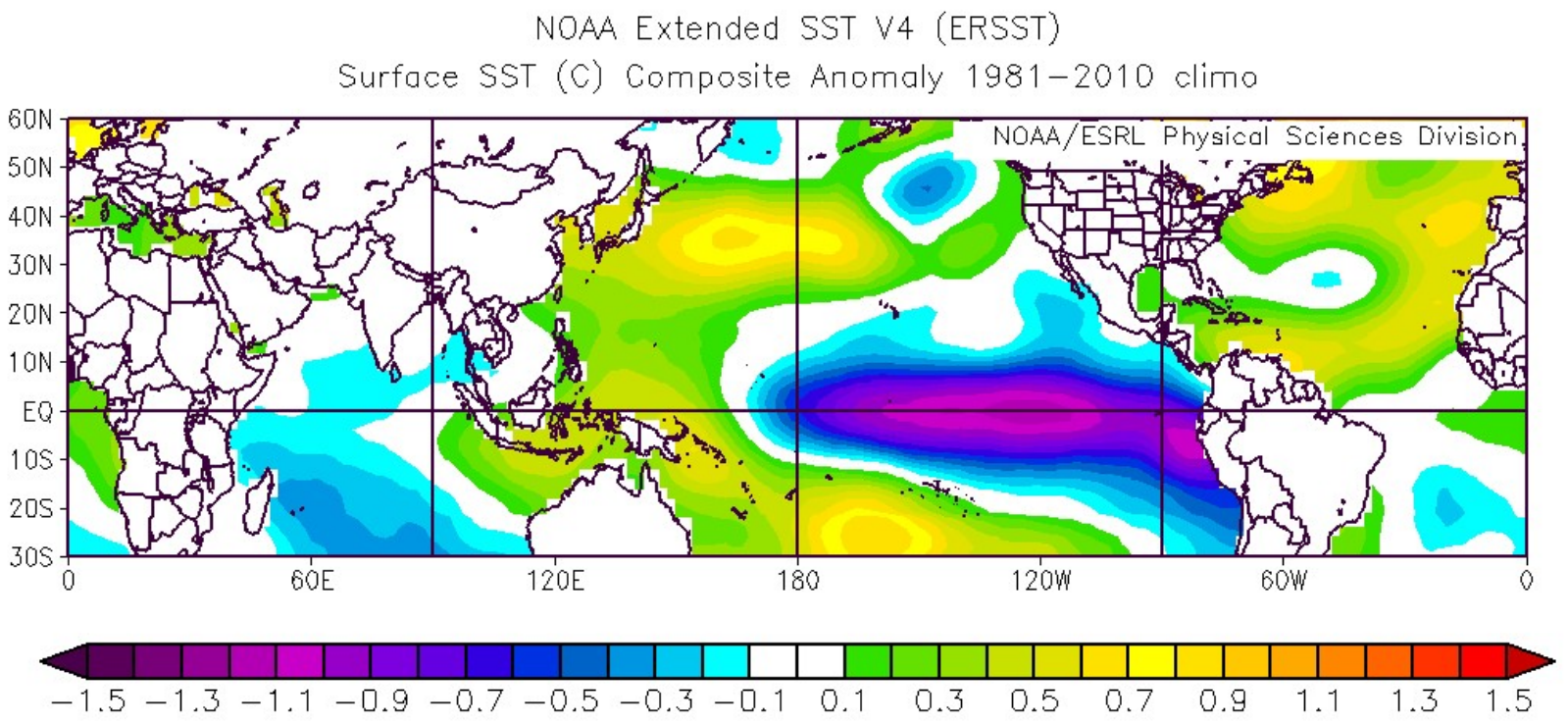
Relevant Quotes from the Legendary Yogi Berra

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

HOWEVER…

“You can see a lot by looking”

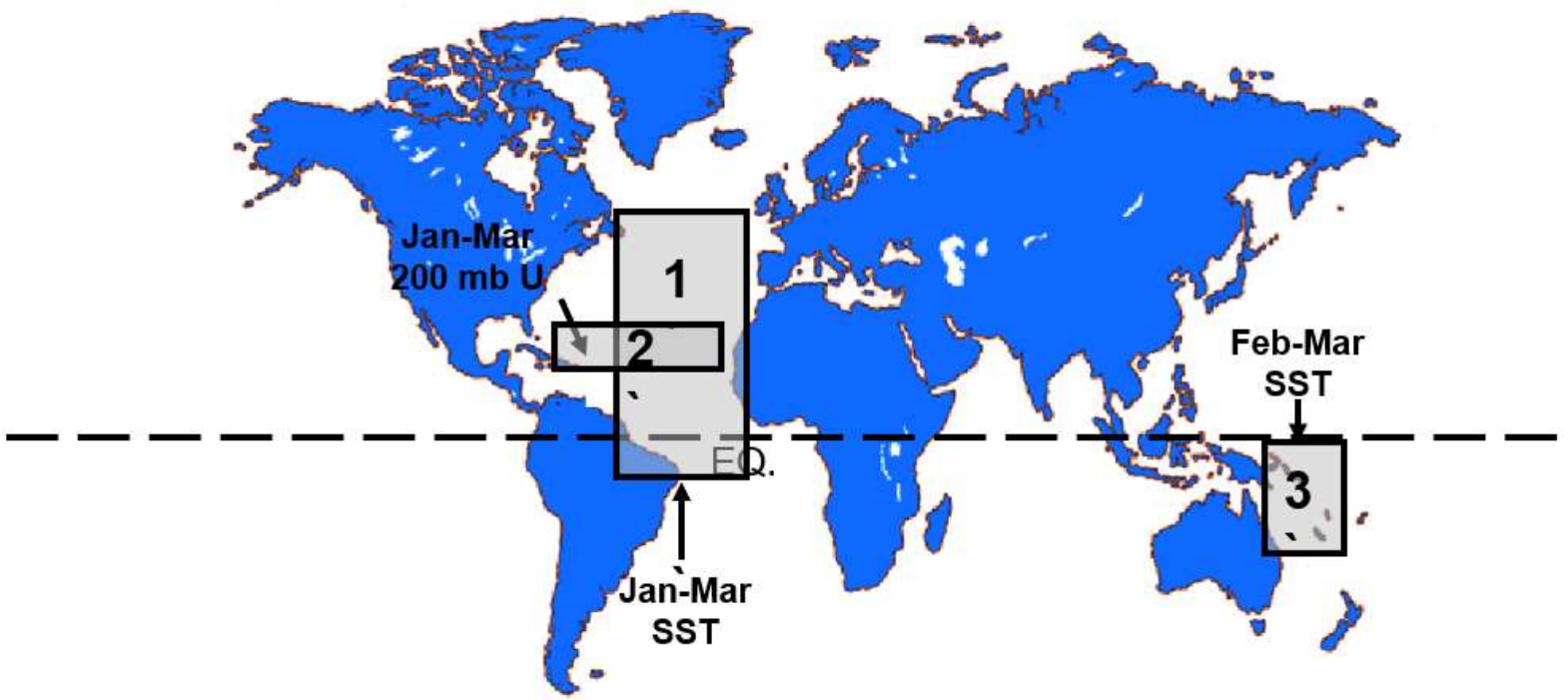
Active vs. Inactive Atlantic Hurricane Seasons (August-October SSTs)



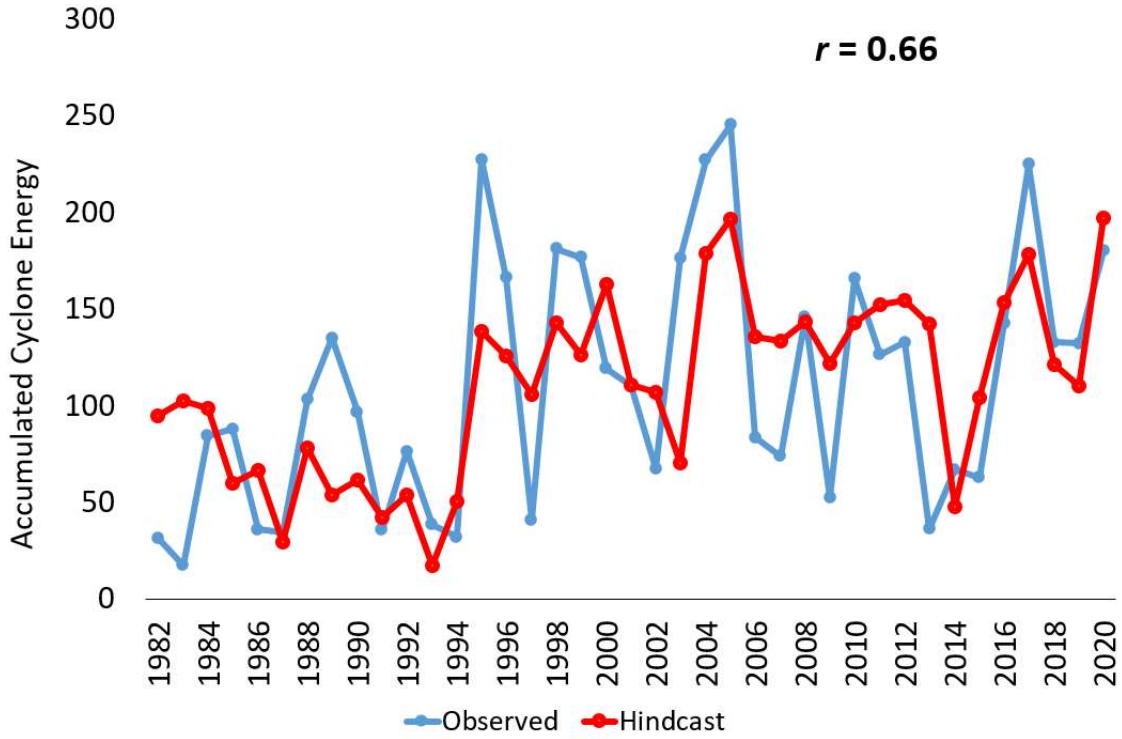
2021 Atlantic Basin Seasonal Hurricane Forecast

Forecast Parameter	CSU Forecast	1981-2010 Average
Named Storms (NS)	17	12.1
Named Storm Days (NSD)	80	59.4
Hurricanes (H)	8	6.4
Hurricane Days (HD)	35	24.2
Major Hurricanes (MH)	4	2.7
Major Hurricane Days (MHD)	9	6.2
Accumulated Cyclone Energy (ACE)	150	106
Net Tropical Cyclone Activity (NTC)	160	116

April Statistical Model Predictors



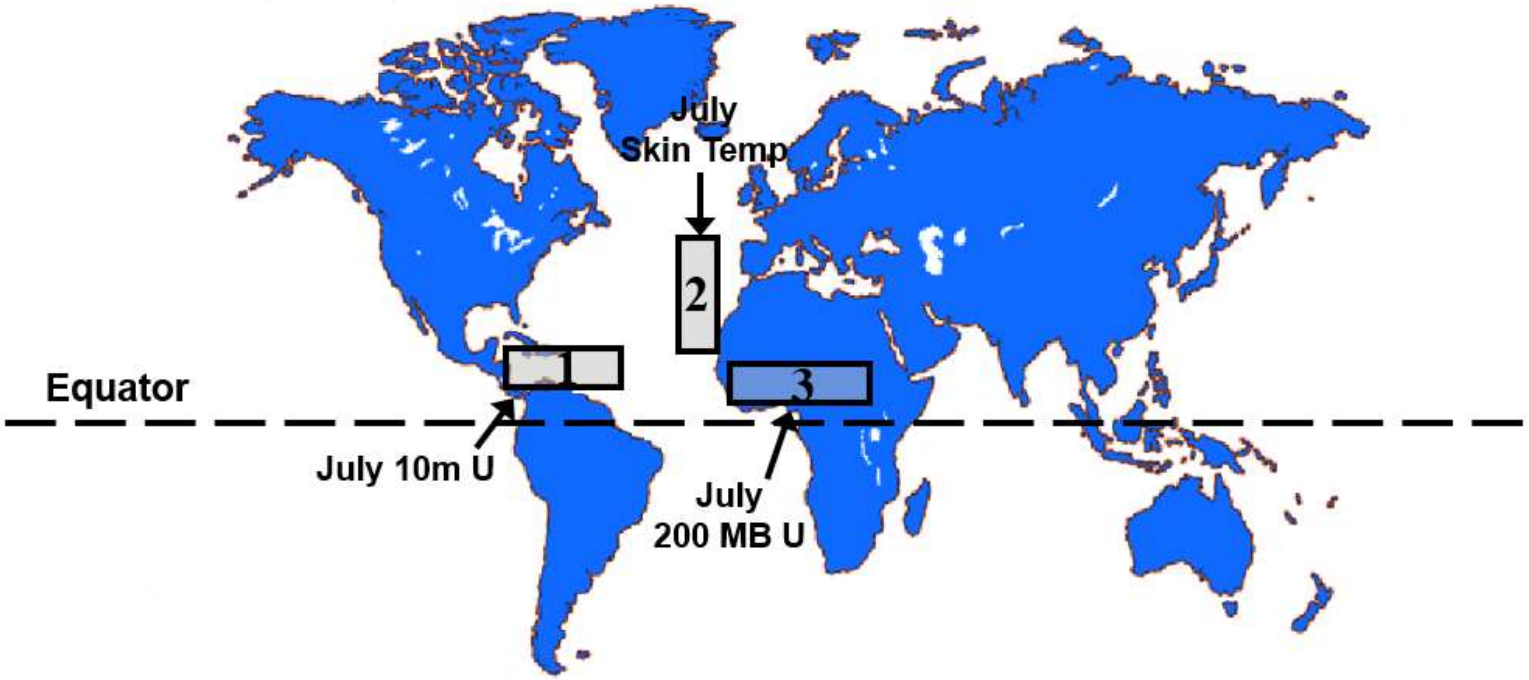
April Statistical Model Cross-Validated Hindcast Skill (1982-2020)



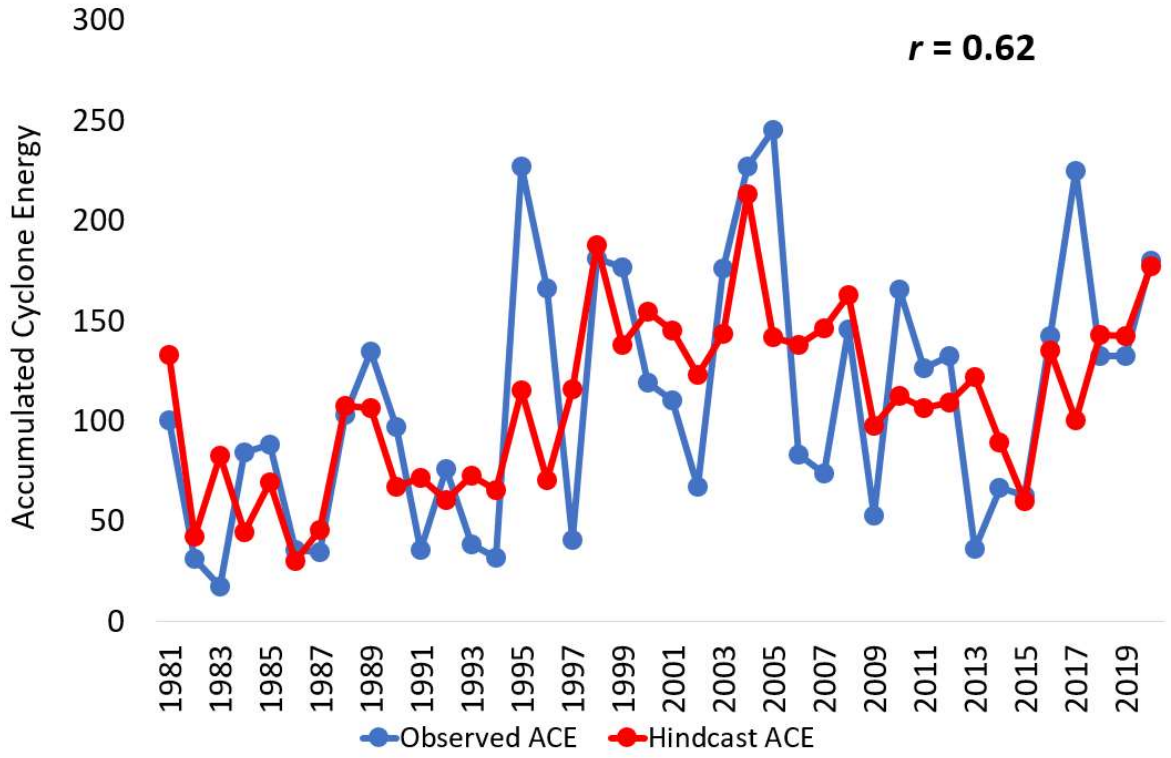
April Statistical Model Output for 2021 Atlantic Hurricane Season

Forecast Parameter	Statistical Model Forecast	1981-2010 Average
Named Storms (NS)	15.5	12.1
Named Storm Days (NSD)	77.1	59.4
Hurricanes (H)	8.0	6.4
Hurricane Days (HD)	31.1	24.2
Major Hurricanes (MH)	3.7	2.7
Major Hurricane Days (MHD)	8.9	6.2
Accumulated Cyclone Energy (ACE)	141	106
Net Tropical Cyclone Activity (NTC)	153	116

Statistical/Dynamical Hybrid Model Forecast Predictors



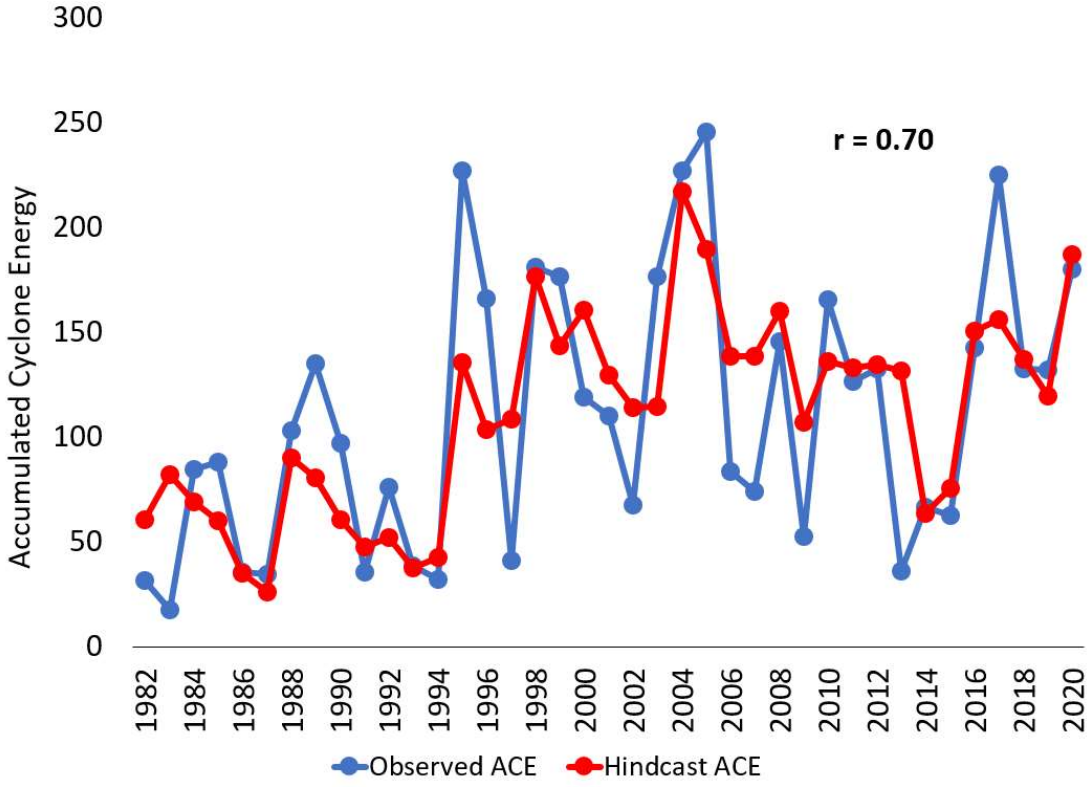
April Forecast Model Cross-Validated Hindcast Skill (1982-2020)



ECMWF-Based SEAS5 Statistical-Dynamical Model Forecast

Forecast Parameter	SEAS5 Model Forecast	1981-2010 Average
Named Storms (NS)	16.9	12.1
Named Storm Days (NSD)	92.0	59.4
Hurricanes (H)	9.6	6.4
Hurricane Days (HD)	41.0	24.2
Major Hurricanes (MH)	4.6	2.7
Major Hurricane Days (MHD)	12.2	6.2
Accumulated Cyclone Energy (ACE)	180	106

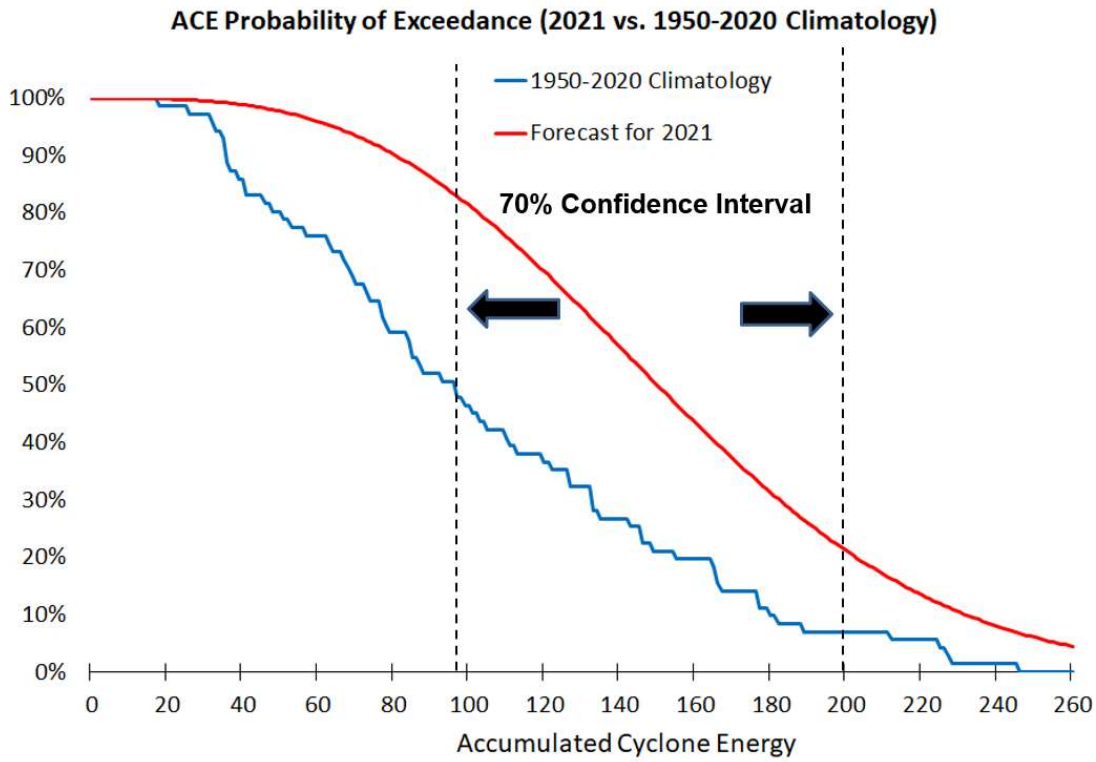
Combined Statistical and Statistical/Dynamical Model Skill



Analog Years for 2021 Atlantic Hurricane Season

	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
MEAN	*16.0*	*83.8*	*8.6*	*35.8*	*5.0*	*9.7*	*155*	*173*
2021 Forecast	**17**	**80**	**8**	**35**	**4**	**9**	**150**	**160**

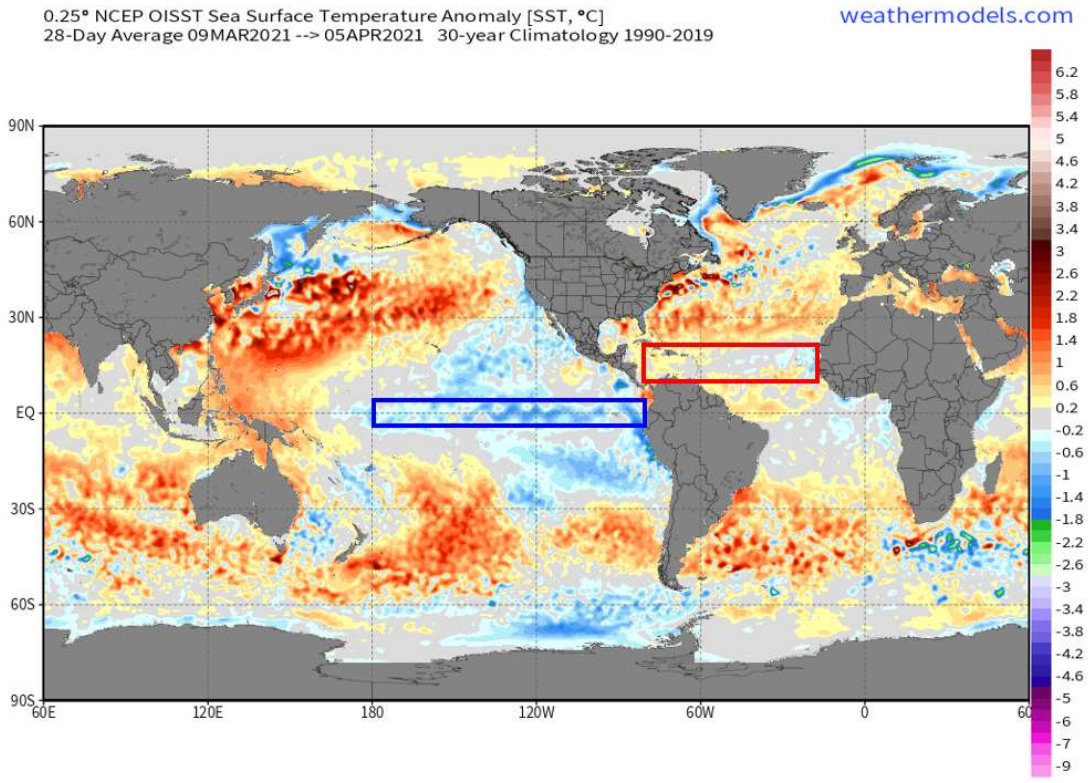
Probability of Exceedance Curve for Accumulated Cyclone Energy



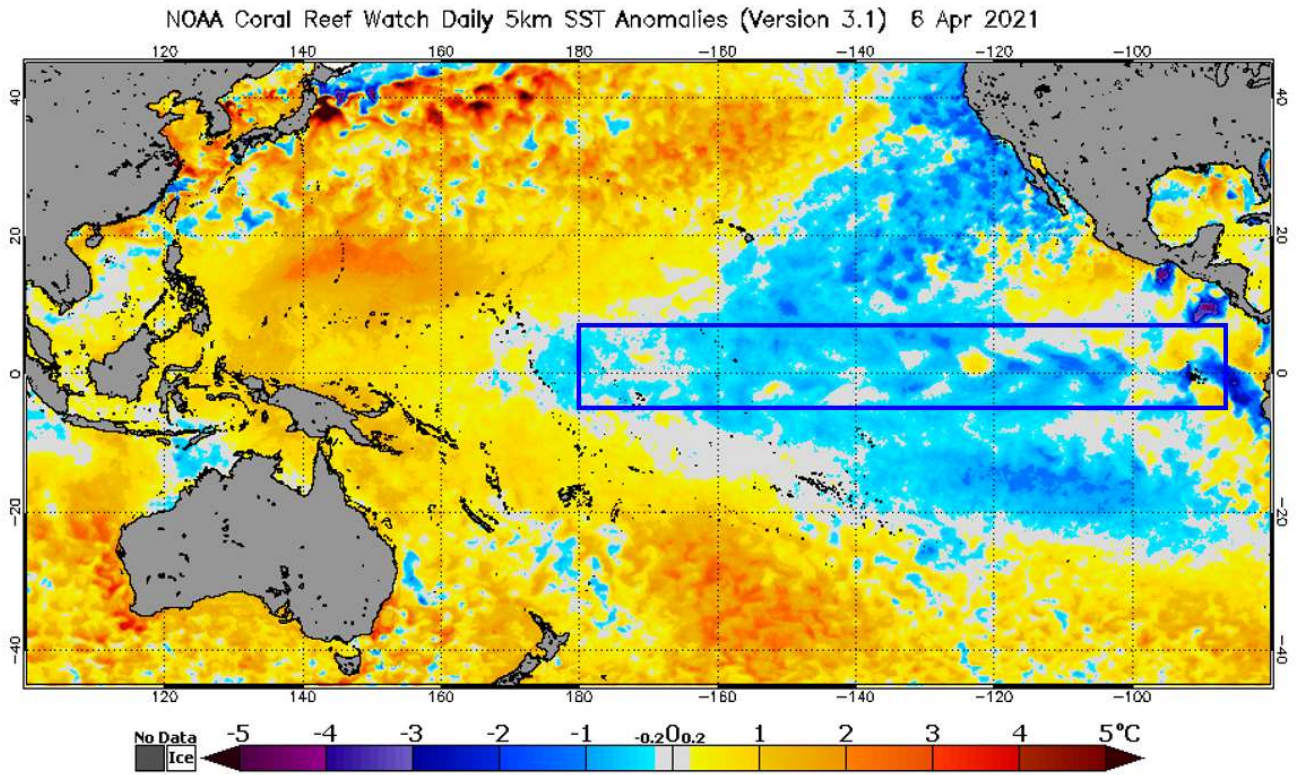
CSU Atlantic Seasonal Hurricane Forecast Uncertainty

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

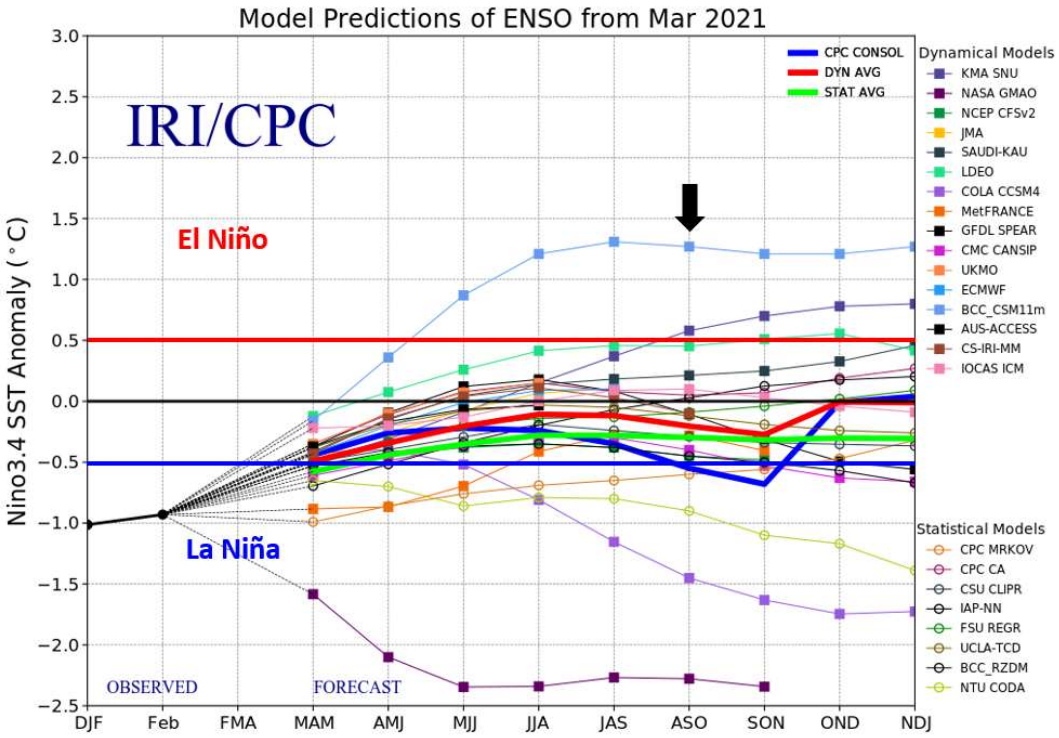
Current Global Sea Surface Temperature Anomalies



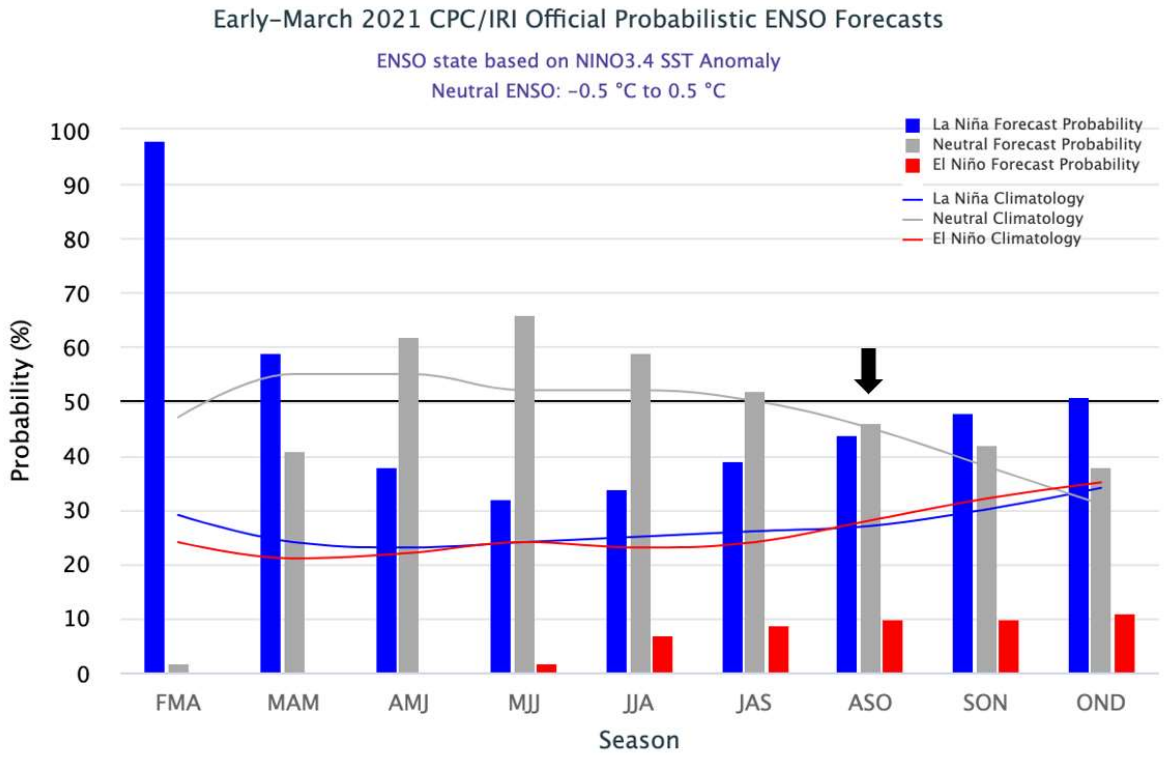
Pacific Ocean Sea Surface Temperature Anomalies



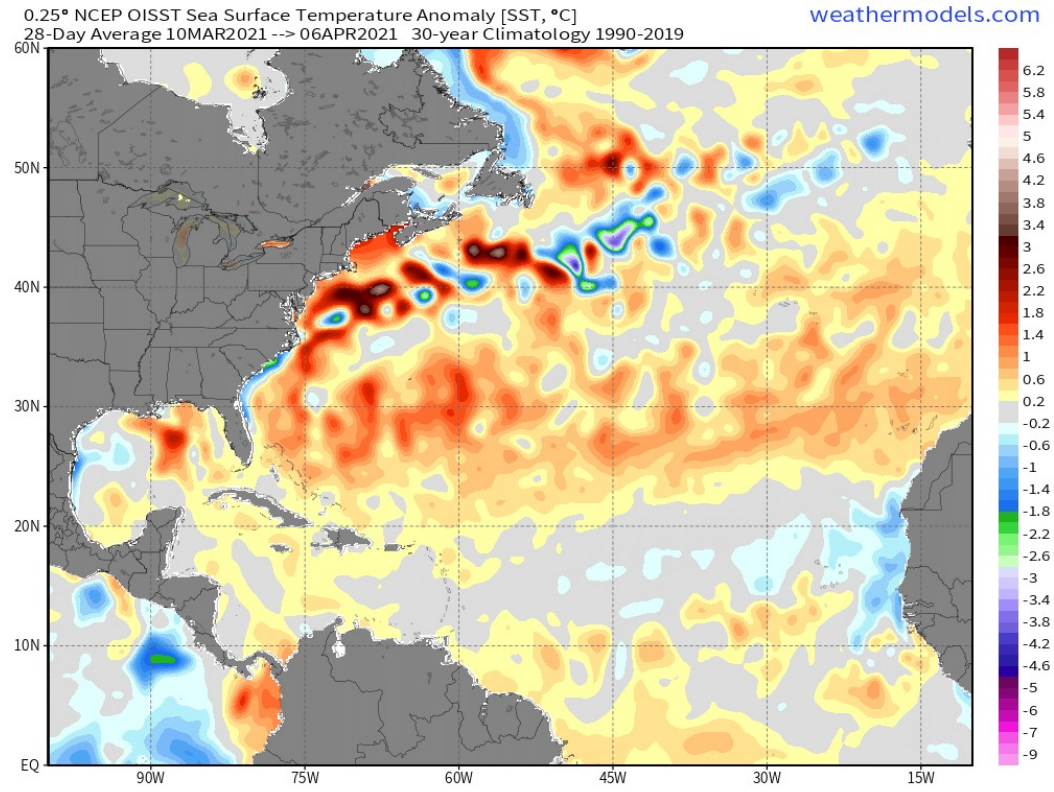
What do Models Say about the Future of El Niño?



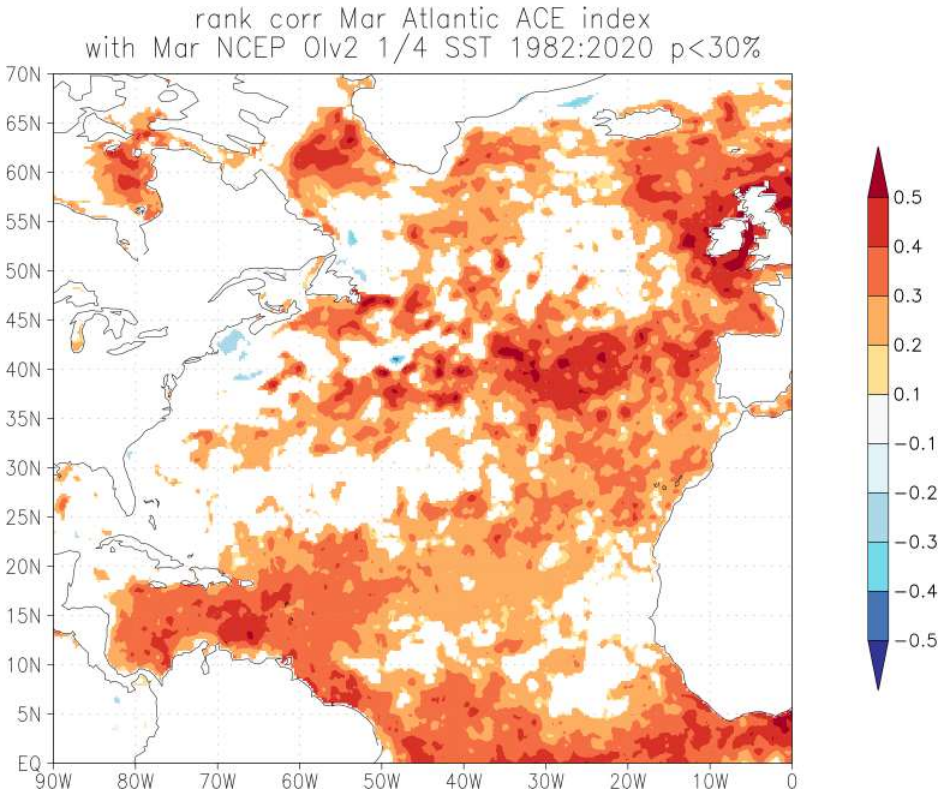
Official Forecast of ENSO from NOAA



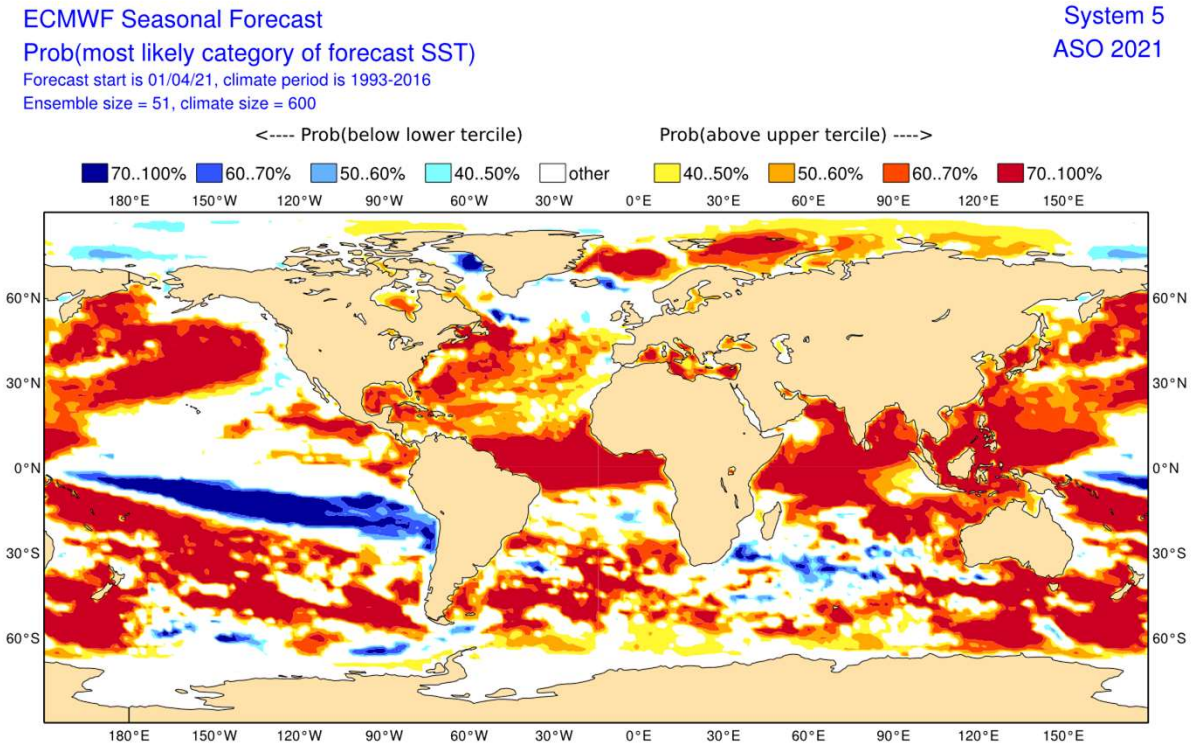
North Atlantic Sea Surface Temperature Anomalies



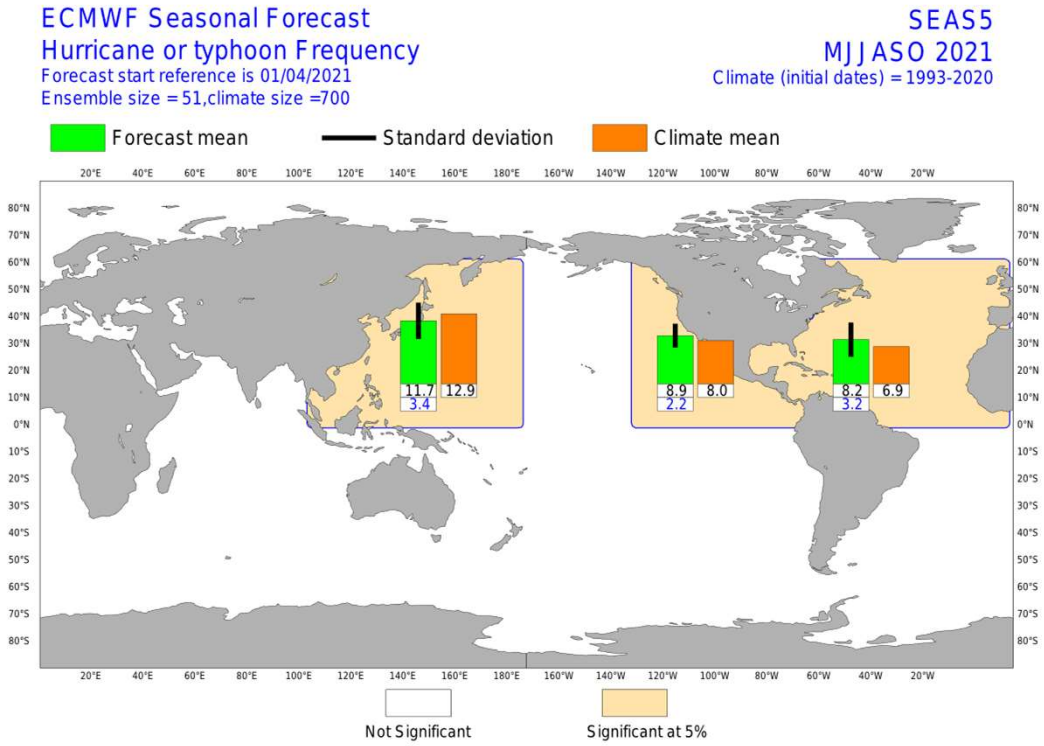
Atlantic Ocean Sea Surface Temperature Correlations with ACE



ECMWF Seasonal Forecast for Sea Surface Temperatures



ECMWF Forecast for Hurricanes (May – October)

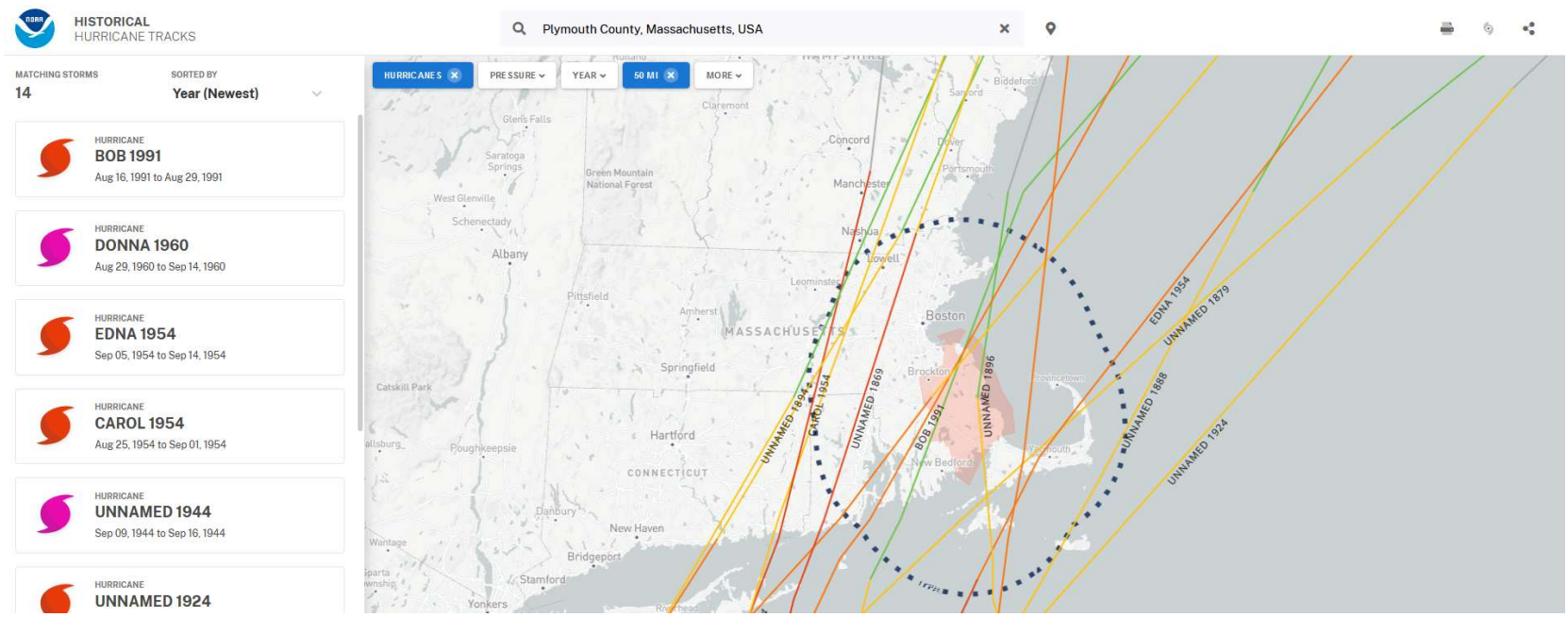


2021 Landfall Probabilities (20th Century Probabilities in Parentheses)

1. Entire U.S. Coastline: 69% (52%)
2. U.S. East Coast including Peninsula FL: 45% (31%)
3. Gulf Coast from FL Panhandle west to Brownsville: 44% (30%)
4. Caribbean Basin: 58% (42%)

Named Storms, Cat. 1+, and Cat. 3+ within 50 miles of Each County

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



https://coast.noaa.gov/hurricanes

2021 Probabilities (1851-2019 Probabilities in Parentheses)

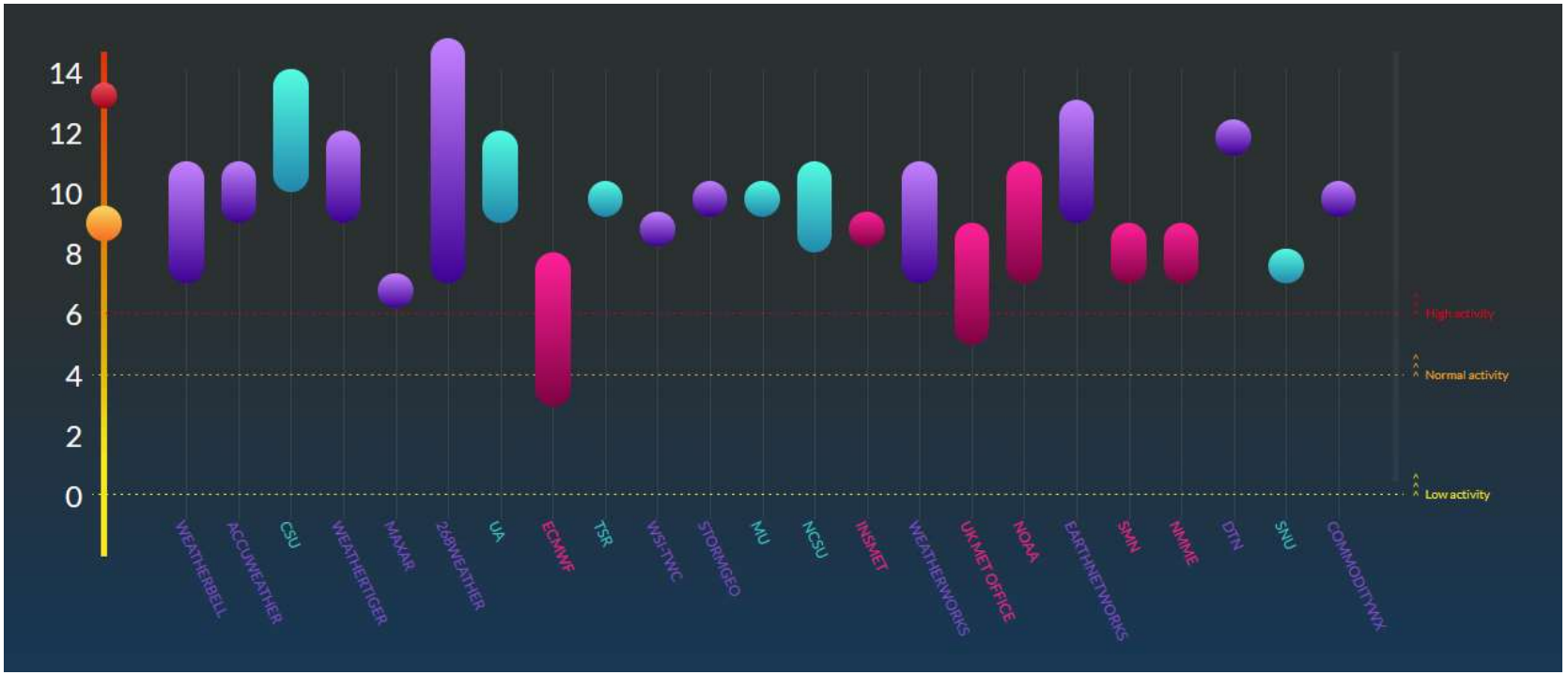
State	>=1 Hurricane Within 50 Miles	>=1 Major Hurricane Within 50 Miles
Florida	75% (58%)	41% (28%)
Louisiana	53% (37%)	23% (15%)
Massachusetts	23% (15%)	6% (3%)
Mississippi	39% (26%)	12% (8%)
New York	15% (10%)	4% (2%)
North Carolina	52% (37%)	11% (7%)
Texas	49% (35%)	21% (14%)

2021 CSU Atlantic Seasonal Hurricane Forecast Schedule

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

Contributing Groups to Atlantic Seasonal Hurricane Forecast Compilation
Website: *https://seasonalhurricanepredictions.org*

Seasonal Hurricane Forecast Compilation Website – Forecasts from August 2020 for 2020 Atlantic Hurricane Season



Arago's Admonition

"Never, no matter what may be the progress of science, will honest scientific men who have regard for their reputations venture to predict the weather."

Final Thoughts

Key Takeaways

1

Tropical Cyclones

- 2020 was one of most active years in the Atlantic Basin dating to 1851
- It could have been much worse!
- 2020 season has no bearing on 2021 Atlantic activity

2

Severe Convective Storms (SCS)

- 2020 was the costliest year on record for SCS events in the U.S.
- Midwest Derecho was the single costliest thunderstorm complex ever recorded
- SCS: Greater annual consistency vs TC risk

3

Western U.S. Wildfires

- 2020 featured five billion-dollar wildfires
- California: Most acres burned in the modern record
- Western U.S. fire seasons getting longer as summer-like conditions persist

4

What to expect in 2021?

- Conditions favorable for above-average Atlantic TC activity
- Focus less on event frequency; more on event intensity & location
- Prepare now!

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