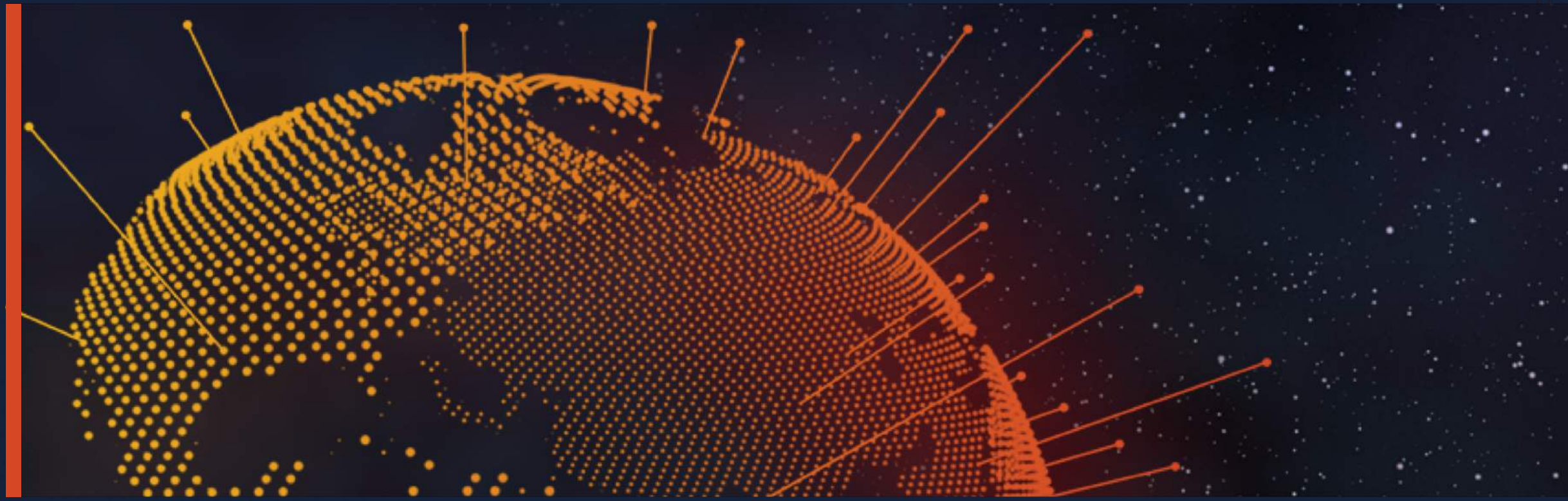
EARTH NETWORKS



2019 ATLANTIC HURRICANE OUTLOOK

PRESENTED BY: ANTHONY SAGLIANI - MAY 16, 2019

HURRICANE MICHAEL UPGRADED TO CATEGORY FIVE

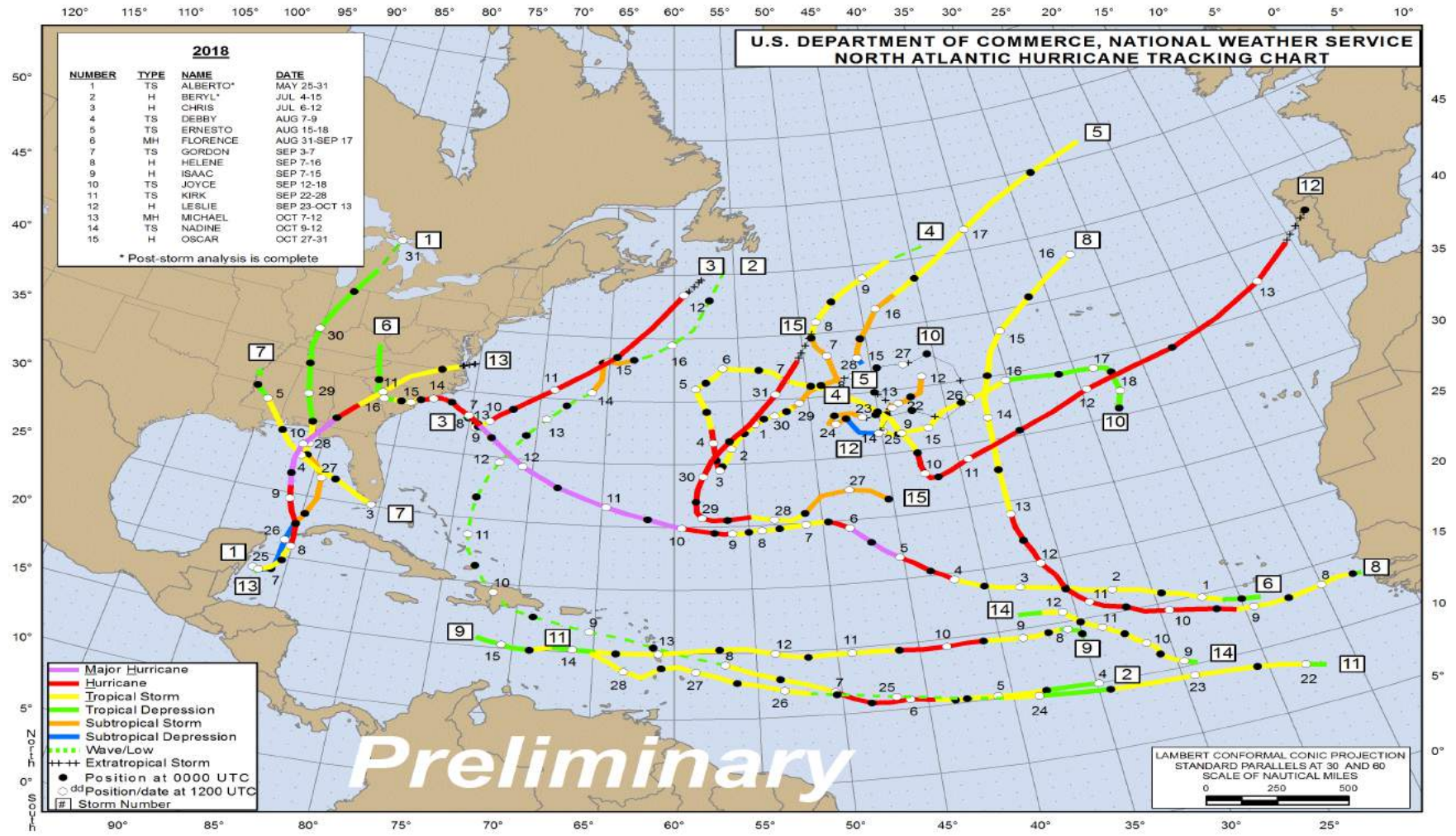
Upgraded to category five after post-storm analysis.

First category five landfall in U.S. since Andrew in 1992.

Only 4th category five landfall in known hurricane record (1851).

Total damage in U.S. about $25 billion.

REVIEW OF 2018 HURRICANE SEASON



2018 TOTALS

15 Tropical Storms

8 Hurricanes

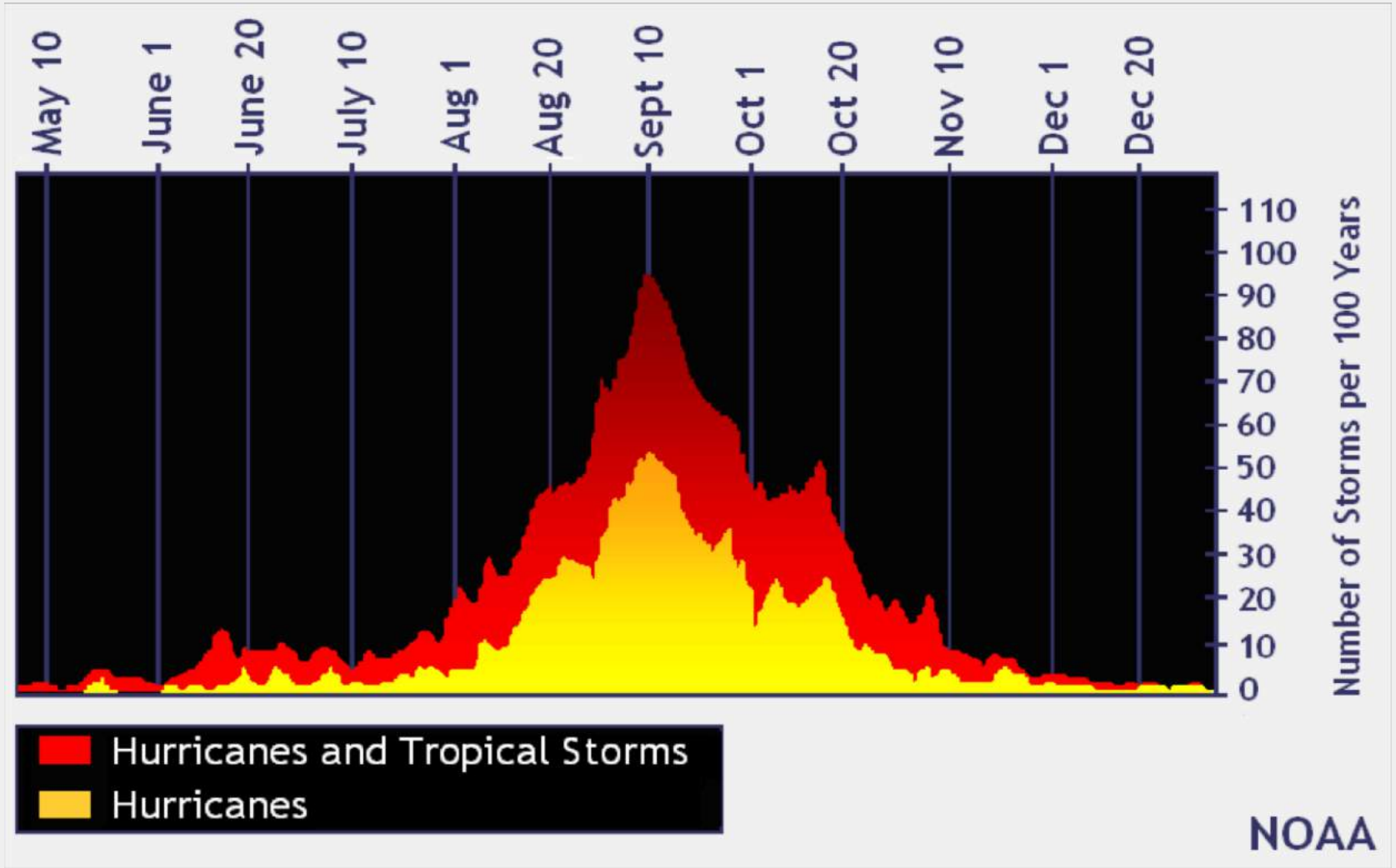
2 Major Hurricanes

VERIFICATION OF 2018 HURRICANE OUTLOOK

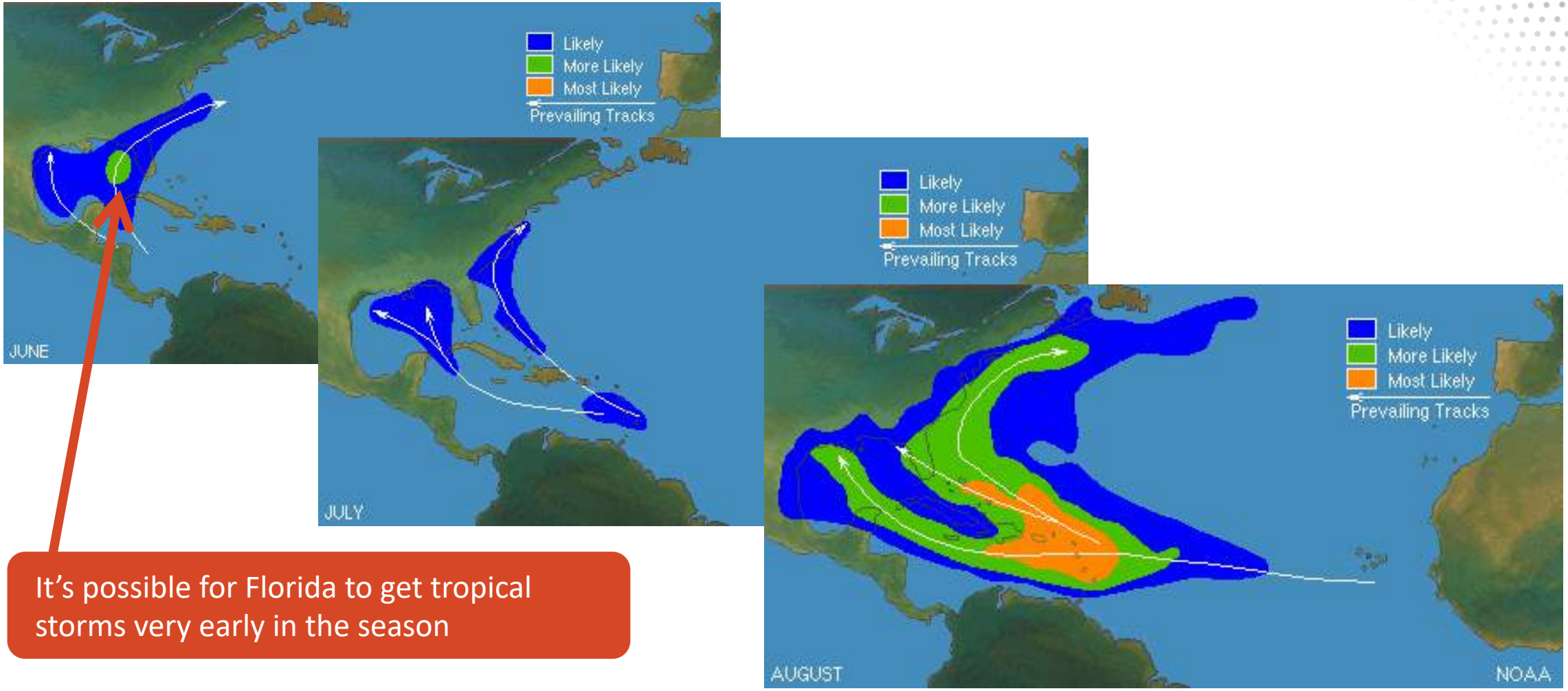
	Our Forecast	2018 Actual	1981–2010 Normal
Named Storms	10 – 15	15	12
Hurricanes	5 – 8	8	6
Major Hurricanes	2 – 4	2	3

CLIMATOLOGY OF ATLANTIC TROPICAL CYCLONES

- Occasional storms develop early (before June 1)
- Peak activity in early September
- Occasional late year storms (after November 30)

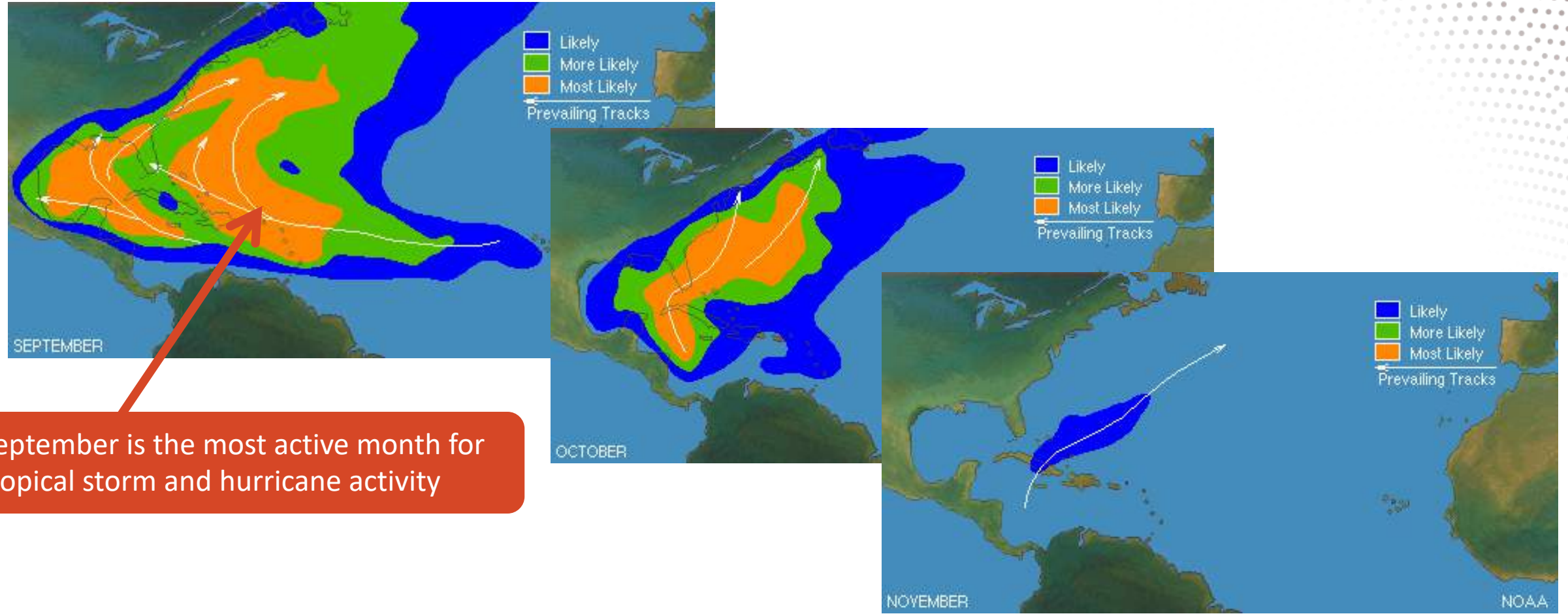


TYPICAL TROPICAL CYCLONE TRACKS, JUNE – AUGUST



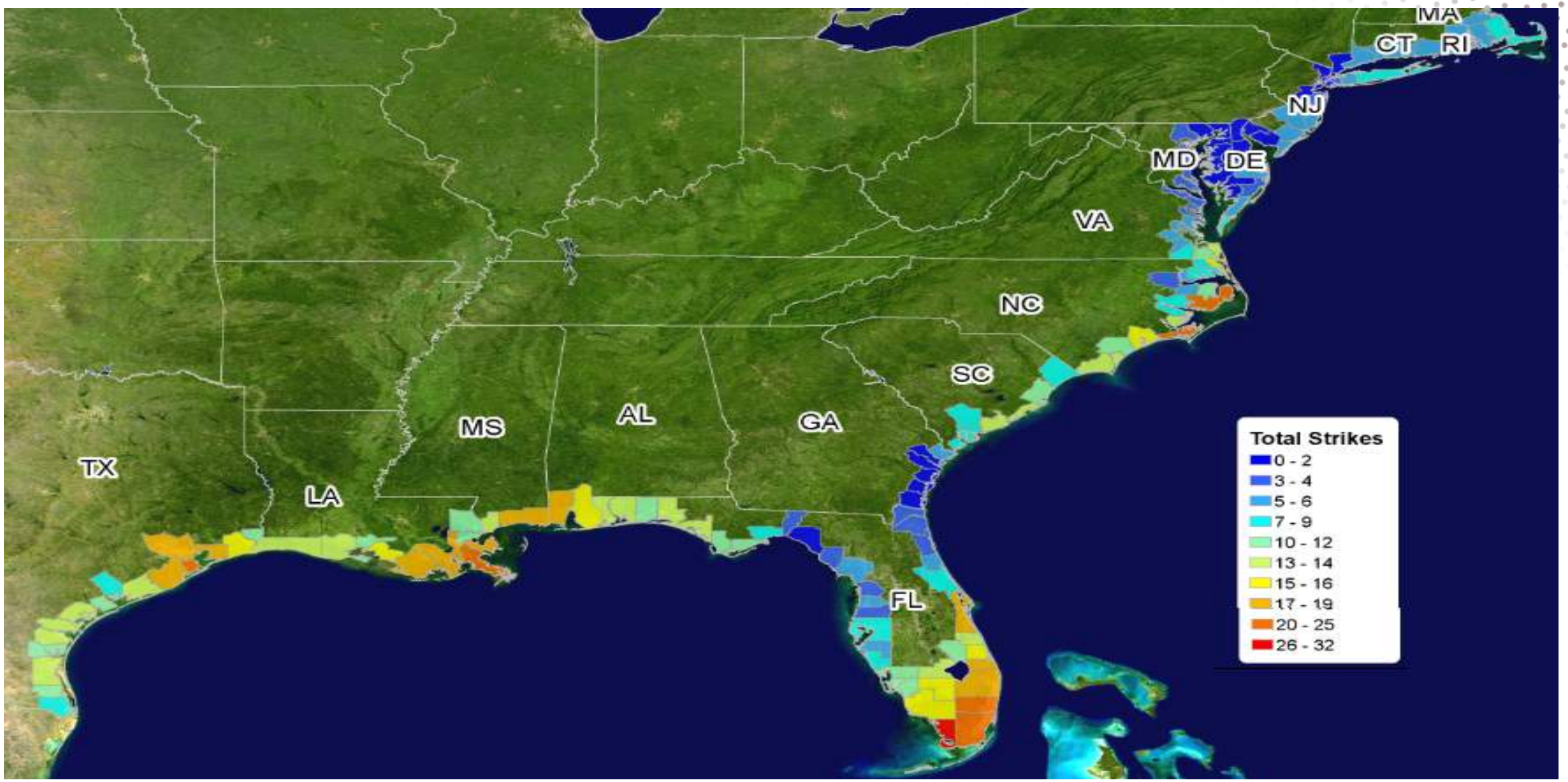
It's possible for Florida to get tropical storms very early in the season

TYPICAL TROPICAL CYCLONE TRACKS, SEPTEMBER – NOVEMBER



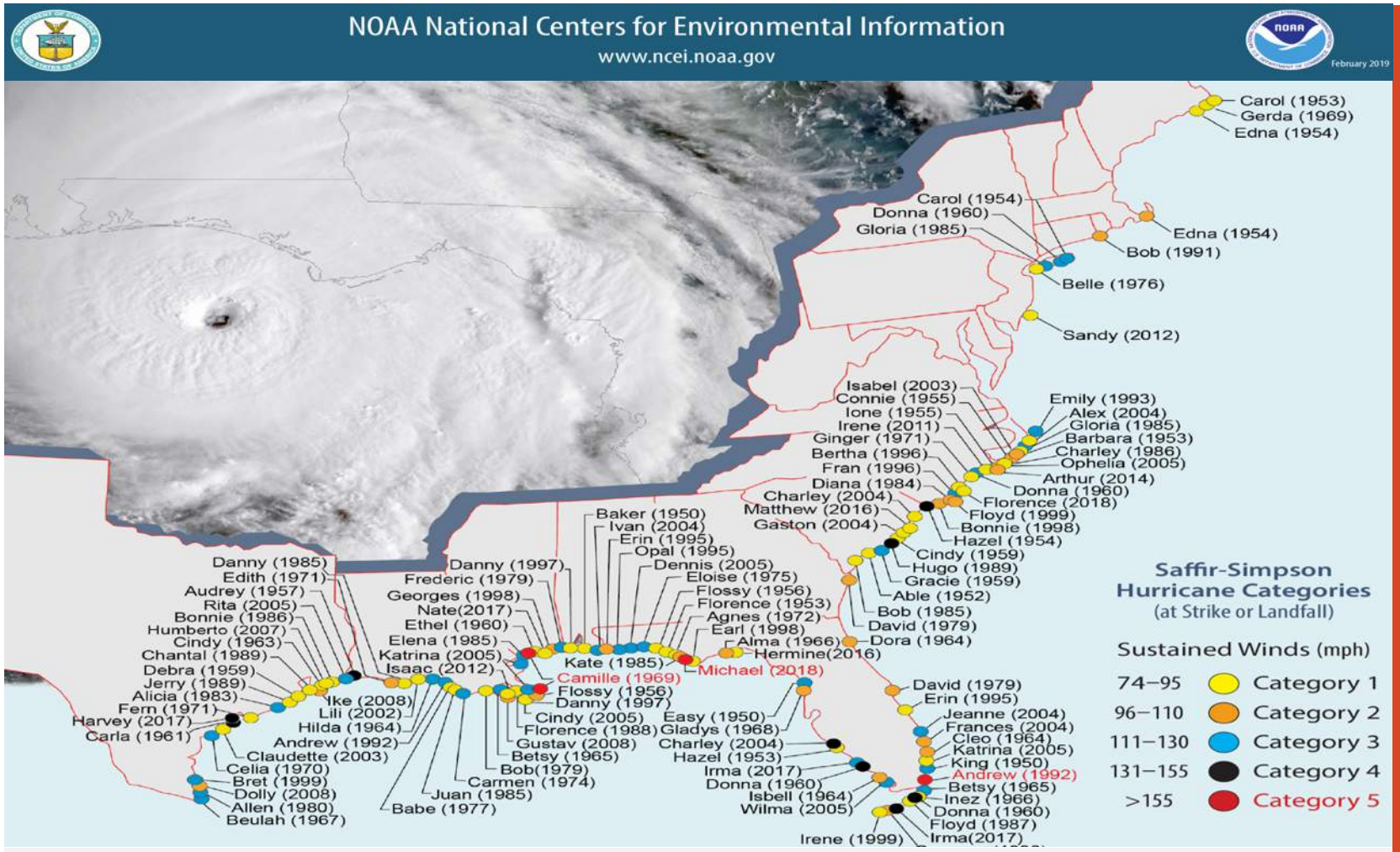
September is the most active month for tropical storm and hurricane activity

TOTAL U.S. HURRICANE LANDFALLS (1900 – 2010)



EARTH NETWORKS

CONTINENTAL U.S. HURRICANE STRIKES (1950 – 2018)



No hurricanes struck the U.S. in 1951, 1962, 1973, 1978, 1981, 1982, 1990, 1994, 2000, 2001, 2006, 2009, 2010, 2013, 2015

Most Recent Hurricane Landfall

- Texas – Harvey 2017
- Louisiana – Gustav 2008
- Mississippi – Nate 2017
- Alabama – Ivan 2004
- Florida – Michael 2018
- Georgia – David 1979
- South Carolina – Matthew 2016
- North Carolina – Florence 2018
- Virginia – None since 1950
- Maryland – None since 1950
- Delaware – None since 1950
- New Jersey – Sandy* 2012
- New York – Gloria 1985
- New England – Bob 1991

ELEMENTS OF THE 2019 ATLANTIC HURRICANE OUTLOOK

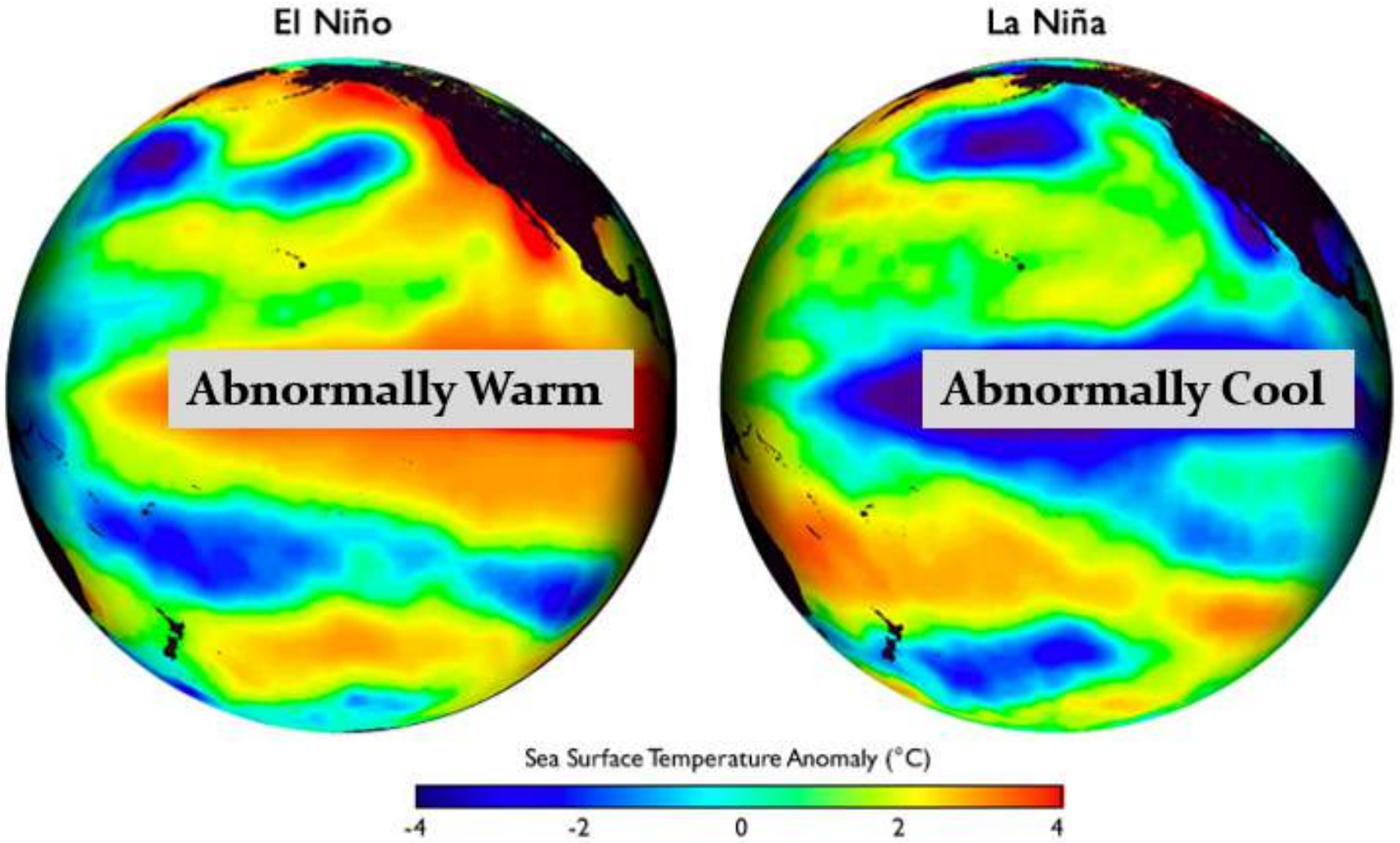
KEY FACTORS

- El Niño / La Niña (ENSO)
- Atlantic Multi-decadal Oscillation (AMO)
- Ocean Water Temperature (Atlantic, Gulf-Mex, Caribbean)

OTHER FACTORS CONSIDERRED

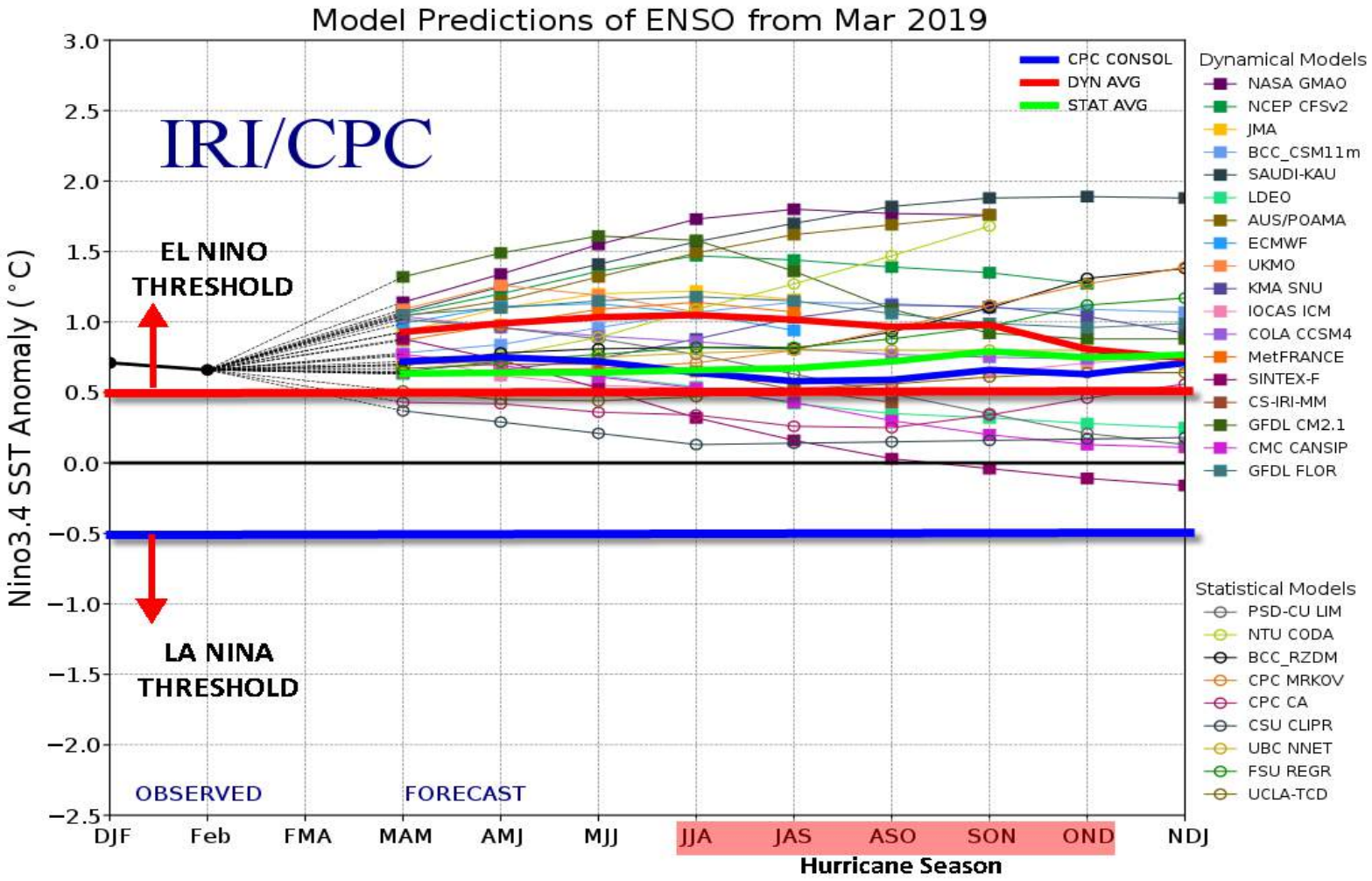
- West African Rainfall
- Analog Years

ENSO – A PERIODIC CYCLICAL WARMING AND COOLING OF THE EQUATORIAL PACIFIC OCEAN



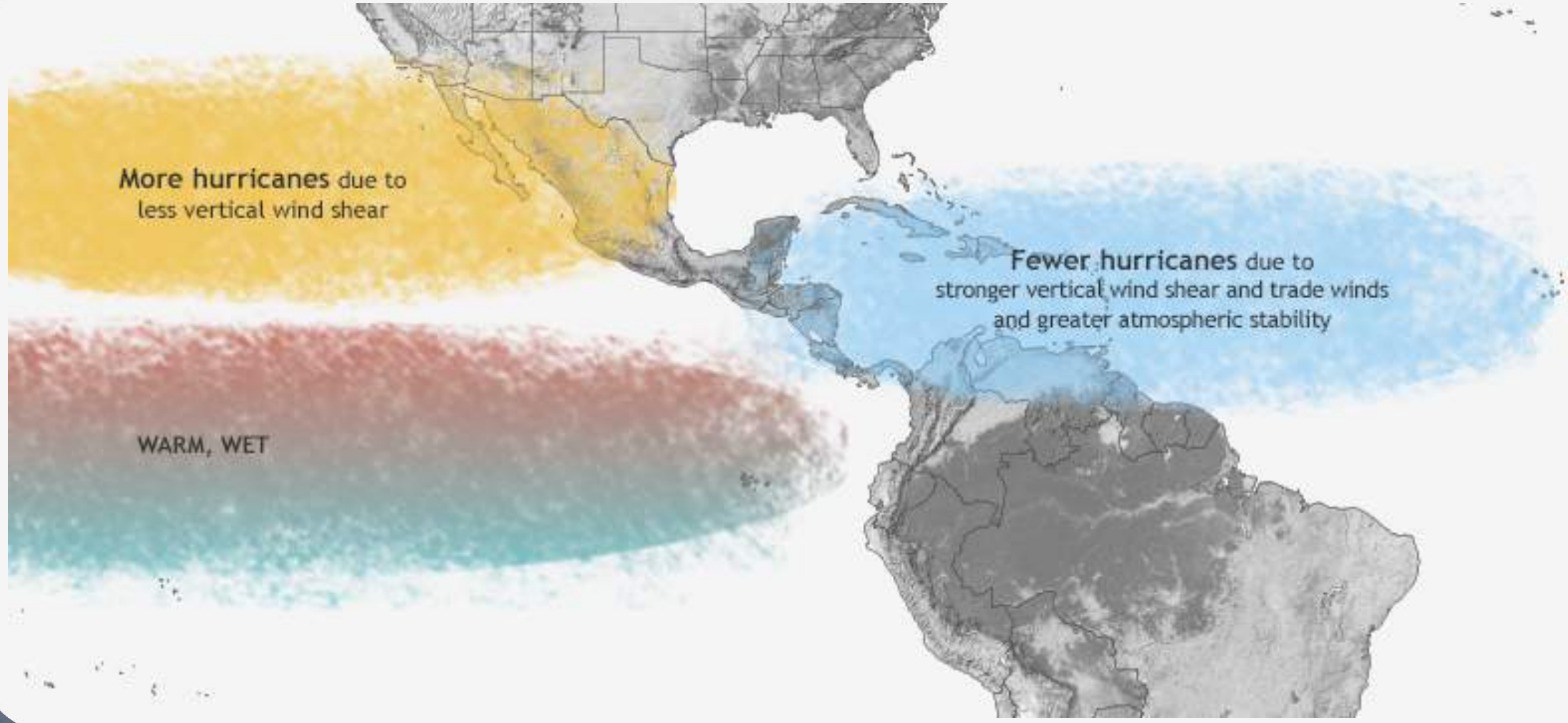
EARTH NETWORKS

LATEST MODEL ENSO FORECASTS



Most models forecast El Niño conditions persisting through this summer and Fall

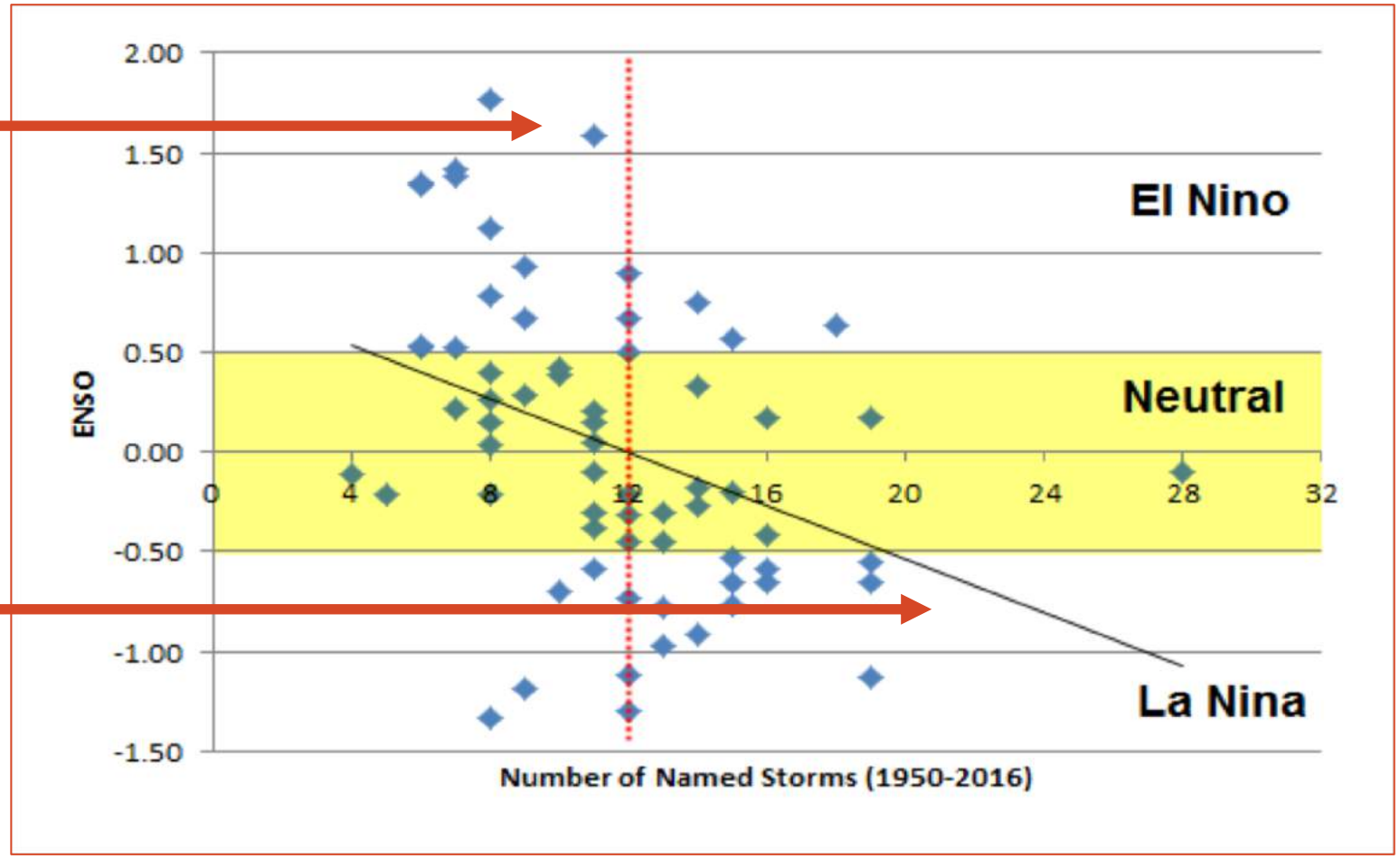
TYPICAL IMPACT OF EL NIÑO – HIGHER WIND SHEAR IN THE ATLANTIC INHIBITS DEVELOPMENT OF STORMS



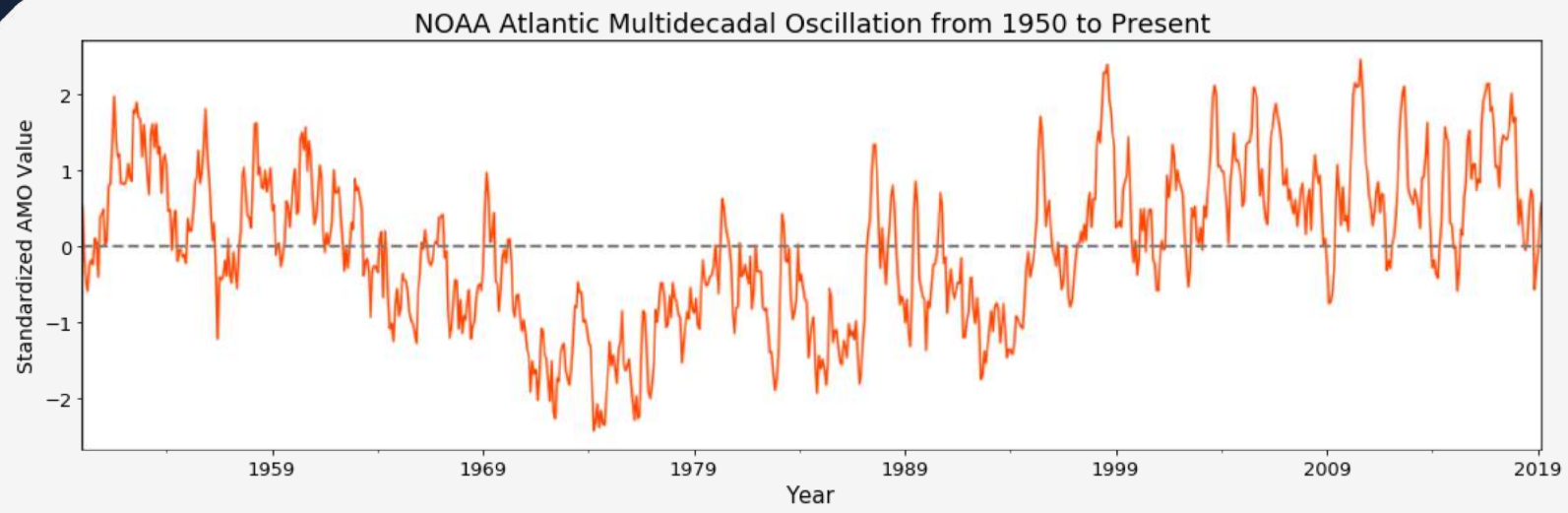
HISTORIC ACTIVITY DURING DIFFERENT ENSO CONDITIONS

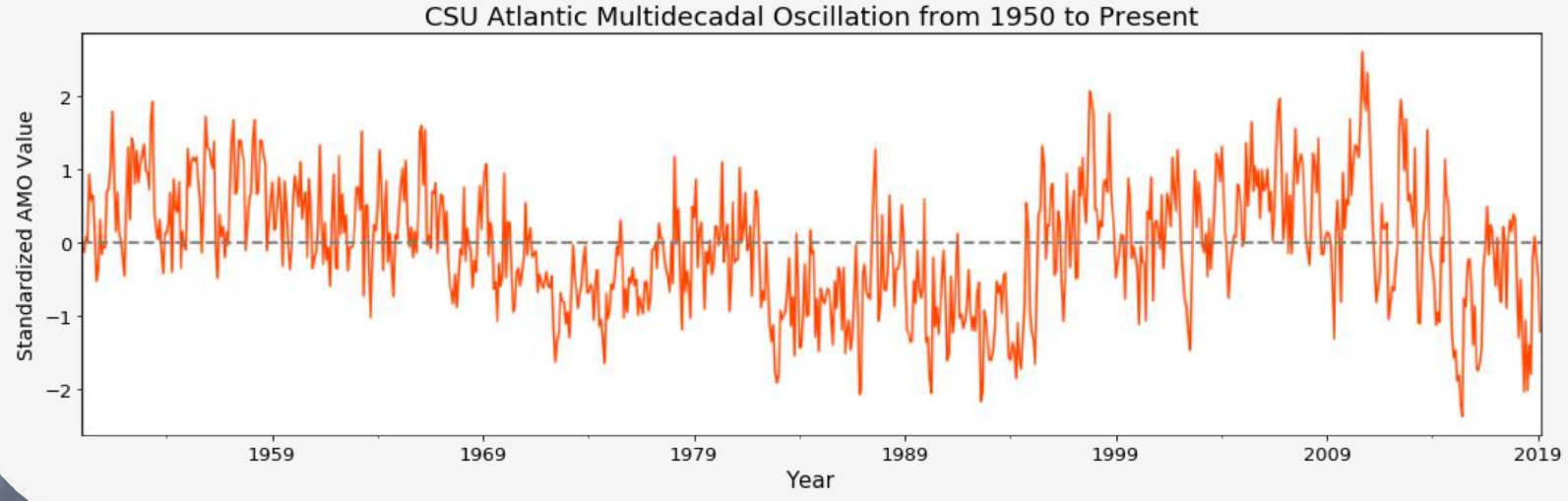
El Niño:
Activity Below Average

La Niña:
Activity Above Average



AMO (ATLANTIC MULTIDECADAL OSCILLATION) SINCE 1950





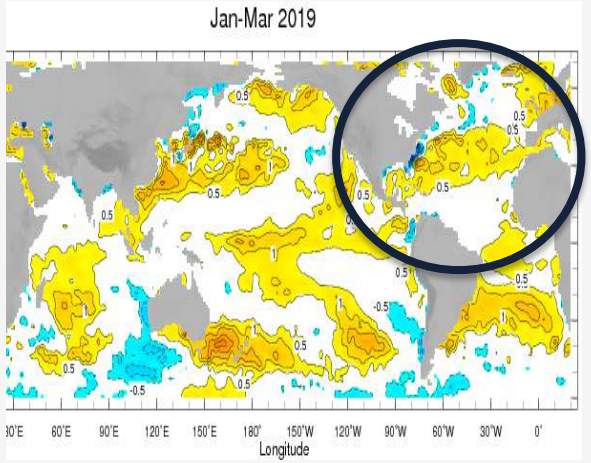
- AMO cycles typically last 20-30 years.
- Since 1995, AMO has been mainly positive (warm SST).

2019 AMO VALUES (NOAA, CSU):

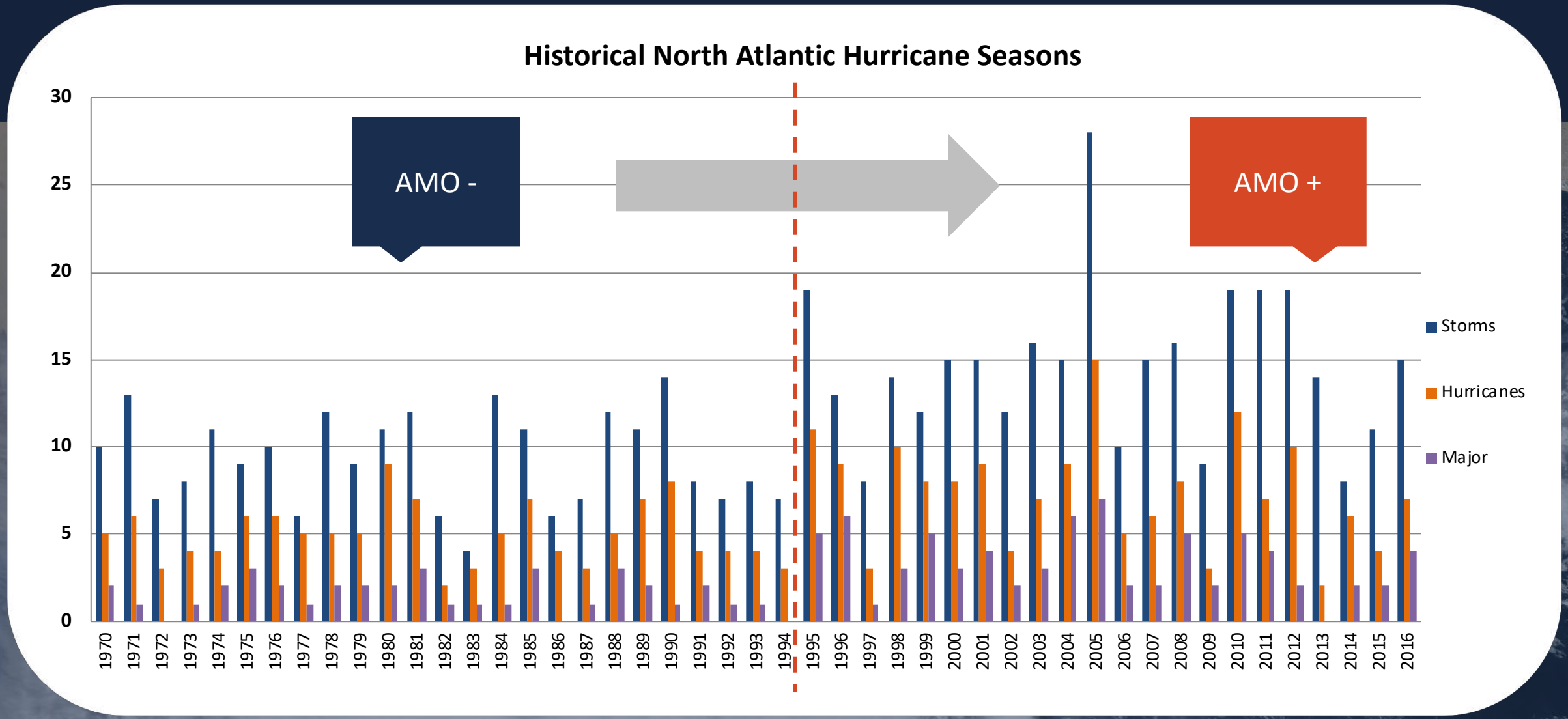
Jan. = -0.015, -0.48

Feb. = 0.080, -1.21

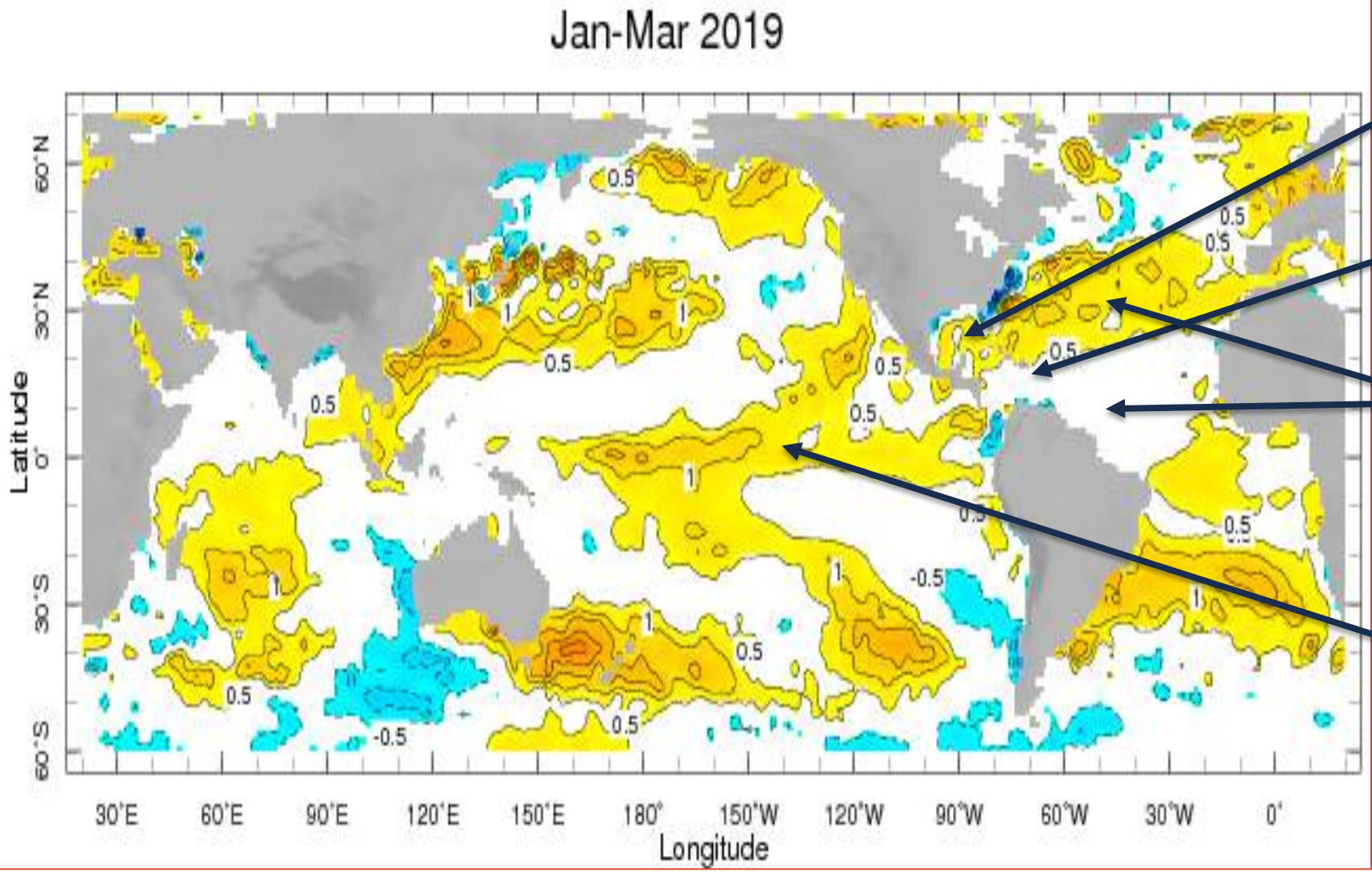
Mar. = 0.121, -1.87



INCREASED ACTIVITY SINCE 1995 EVIDENT



LATEST OCEAN WATER TEMPERATURE ANOMALIES



GULF OF MEXICO
Most areas above average

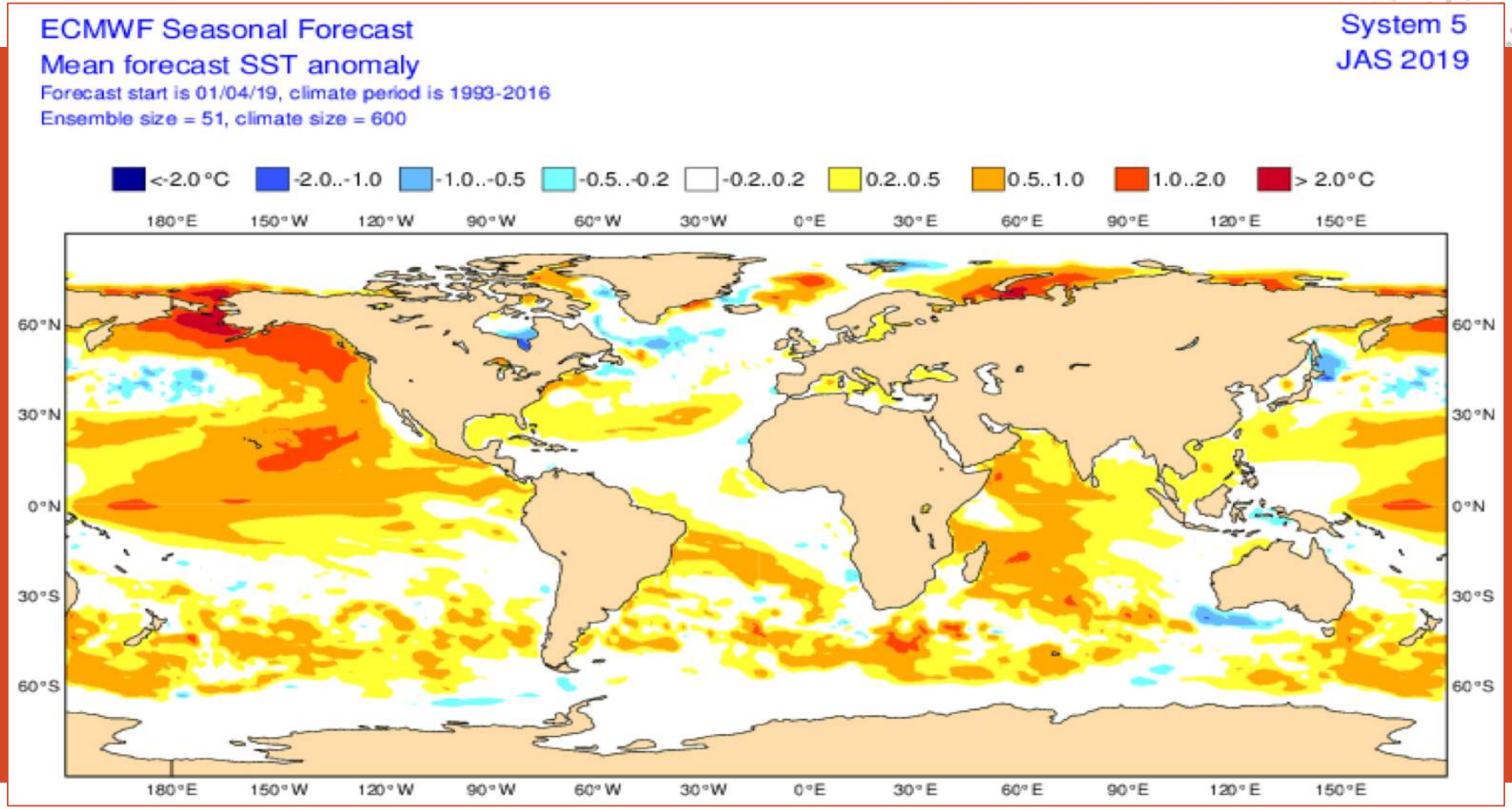
CARIBBEAN
Generally near average

ATLANTIC
Near average most areas, except well above average off SE US coast, Subtropical Atlantic

CENTRAL/ EASTERN PACIFIC
Equatorial warmth due to ongoing El Niño

EARTH NETWORKS

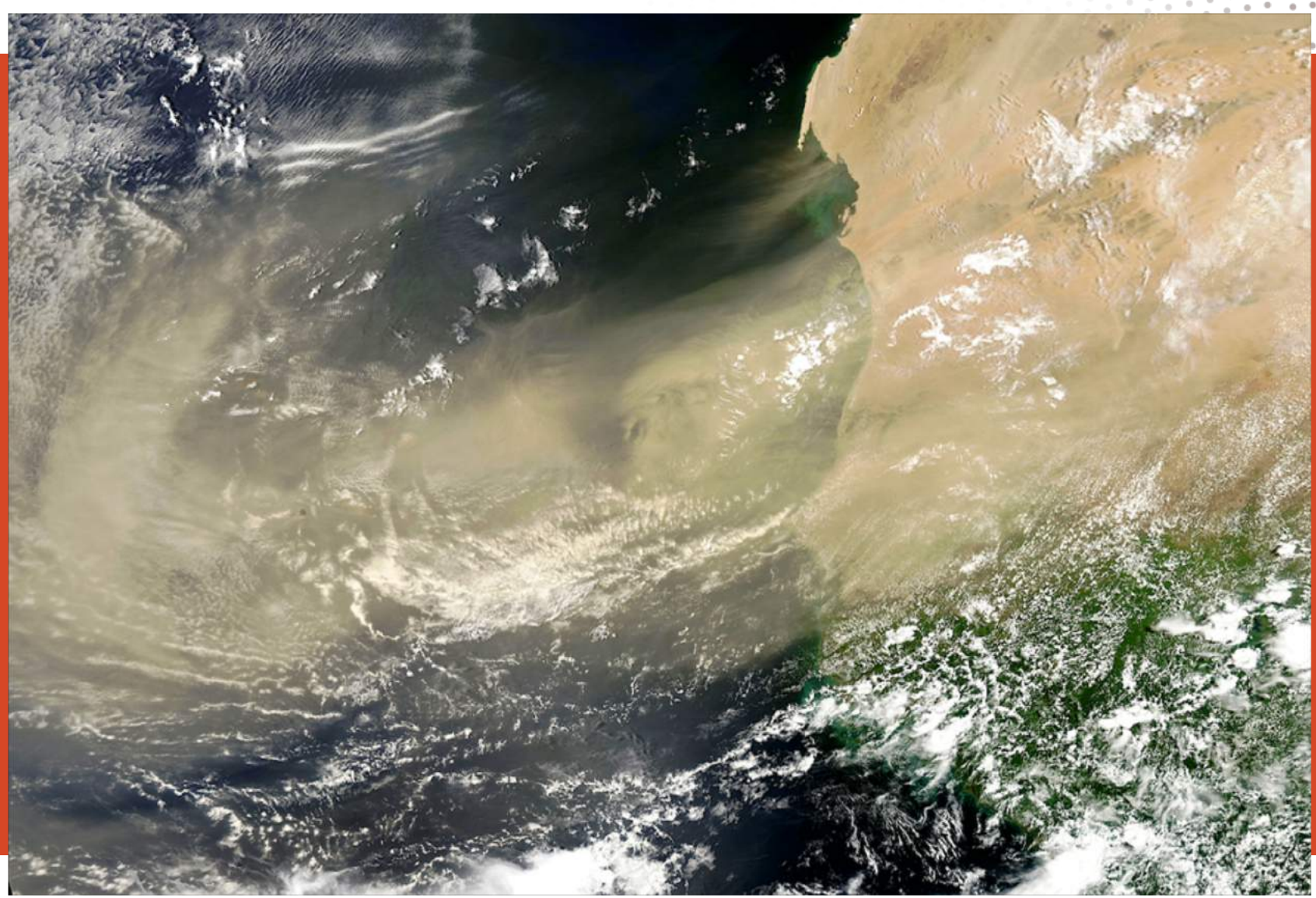
FORECAST OCEAN WATER TEMPERATURE ANOMALIES



SAHARAN DUST TRANSPORT

THE TRANSPORT OF SAND PARTICULATES

- Stabilizes atmosphere
- Reduces incoming solar radiation
- Inhibits thunderstorm growth



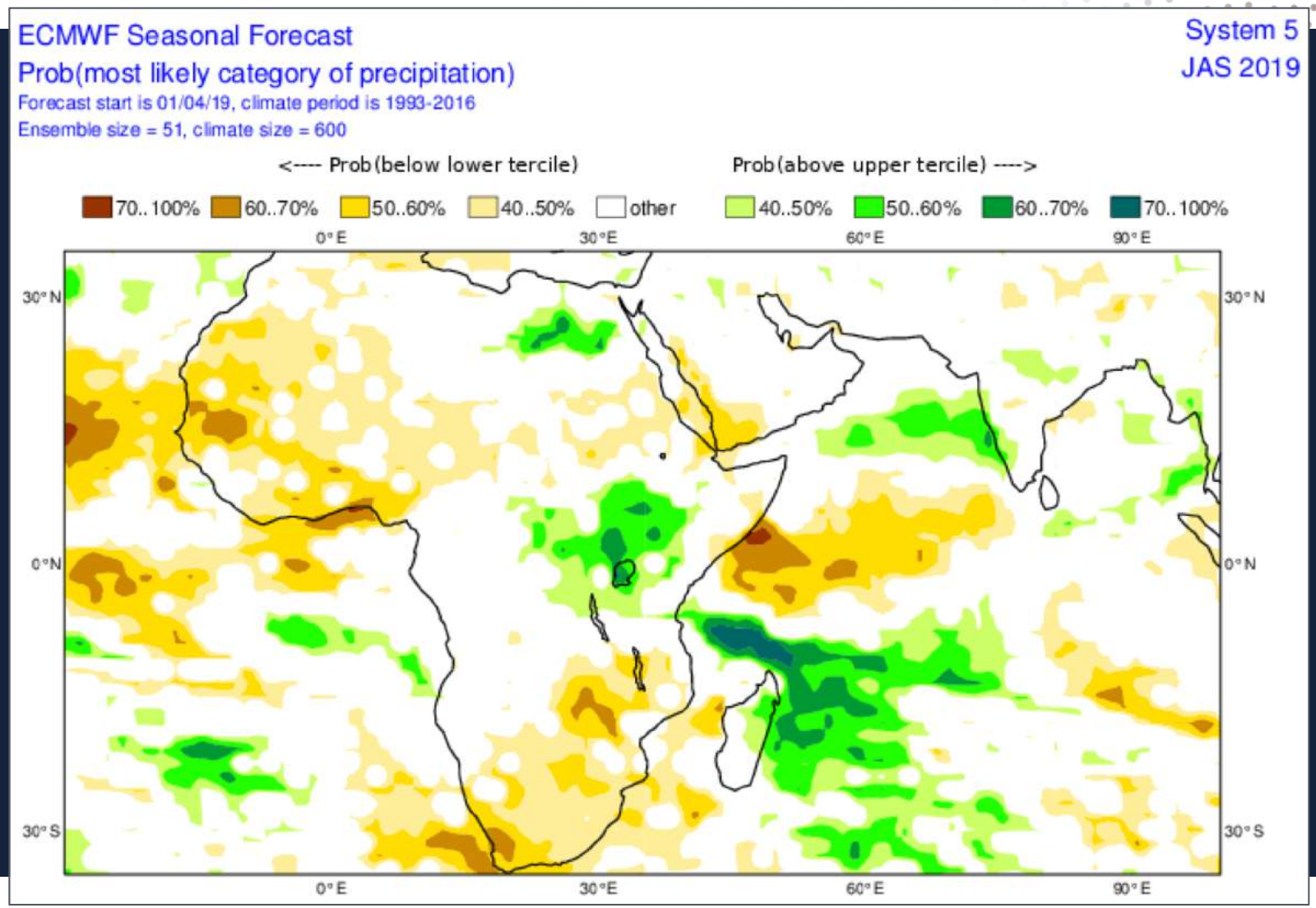
EARTH NETWORKS

WEST AFRICAN RAINFALL

The risk posed by Saharan dust appears to be above average

Soil moisture in Niger to Algeria could be lower than normal, enhancing dust transport from those areas.

Dry conditions favored near Senegal may be due to fewer African waves, the precursor to tropical systems during the late summer.



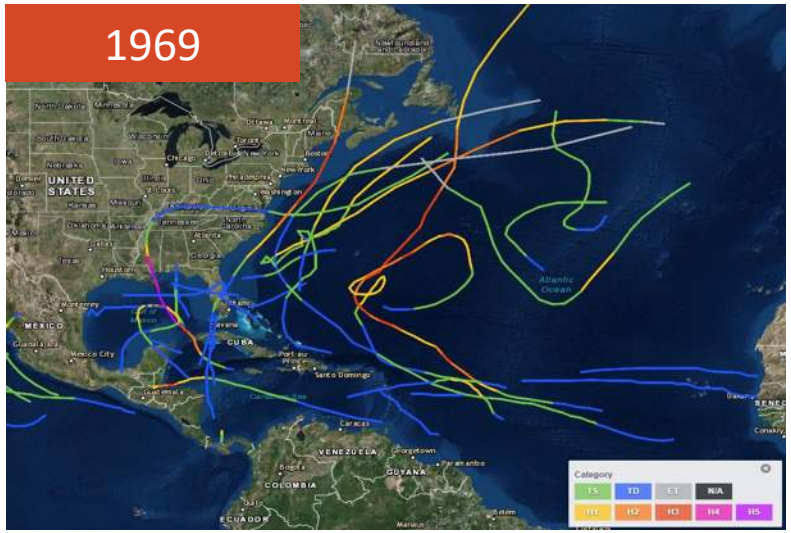
ANALOG YEARS – YEARS WITH SIMILAR WEATHER PATTERNS

Year	Named Storms	Hurricanes	Major Hurricanes
1969	18	12	5
1979	9	5	2
2002	12	4	2
2009	9	3	2
2014	8	6	2
Mean of Analog years	11.2	6	2.6
Normal tropical season	12	6	3

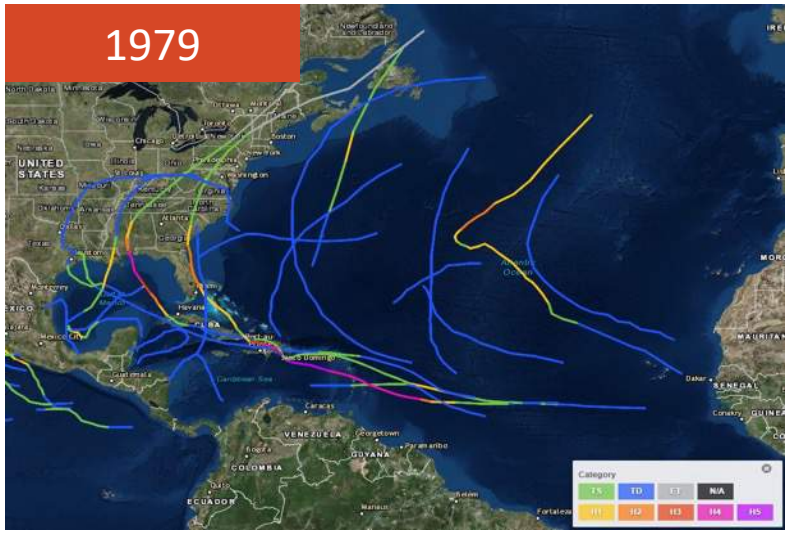
- Years where El Nino persisted through the Summer and Fall
- Near neutral AMO
- **Analog years point to near-normal tropical activity** for the upcoming season.

STORM TRACKS FOR TOP ANALOG YEARS

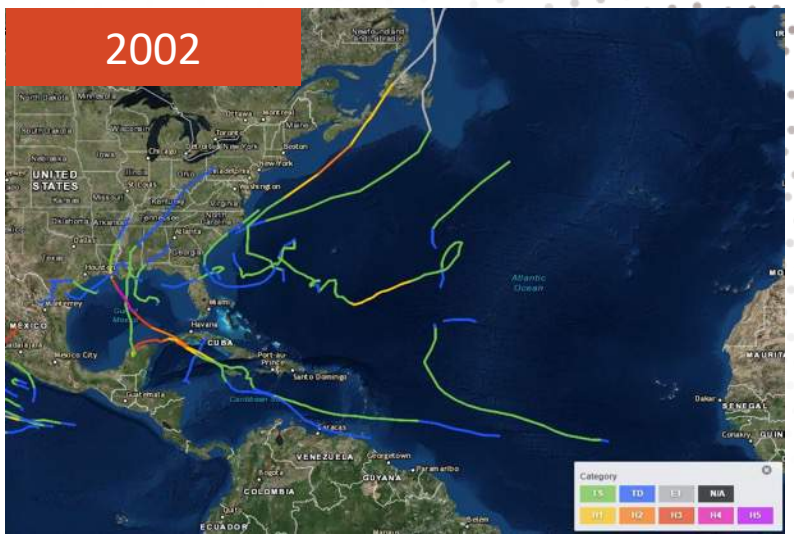
1969



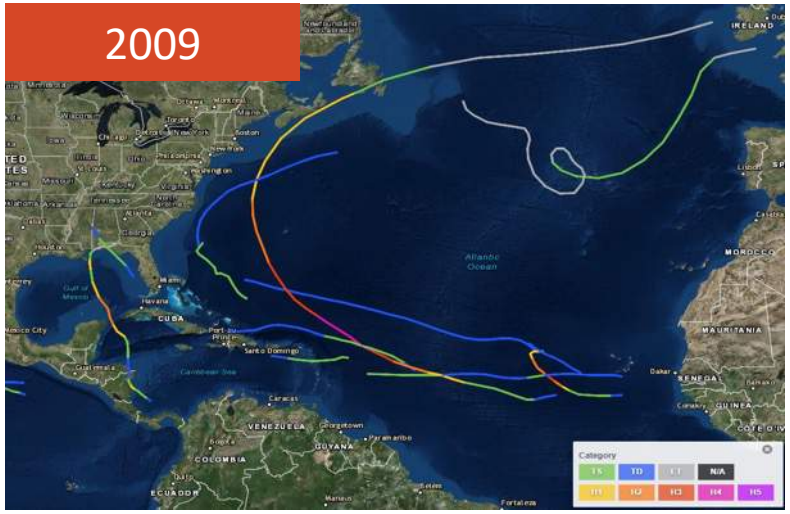
1979



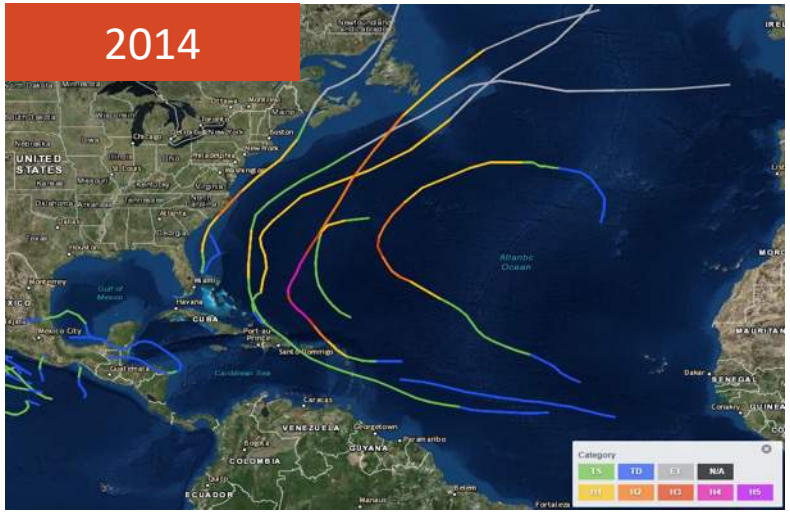
2002



2009



2014



- Every analog year had at least one landfalling Tropical Storm.
- All but one analog year had a landfalling Hurricane.
- 1969 – Hurricane Camille, retired storm name.
- 1979 – Hurricane Frederic, retired storm name.

EARTH NETWORKS

SUMMARY OF FACTORS FOR 2019 ATLANTIC ACTIVITY

Factor	Quiet	Neutral	Active
ENSO	●●●	●	
AMO	●	●●	
Water Temps		● (SE US Coast)	●● (Gulf of Mexico, Subtropical Atlantic)
African Rainfall	●		
Analog Years		●	

EL NINO CONDITIONS WILL PERSIST THROUGH SUMMER

- **RISK** – If El Nino weakens during summer or early Fall, abnormally strong shear and trade winds could weaken, allowing for an uptick in activity.

AMO MOST LIKELY TO BE NEUTRAL

- **RISK** – May become negative, resulting in below-normal activity.
- **RISK** Above normal SSTs off the SE US Coast and Gulf of Mexico could result in threats close to coast.

EARTH NETWORKS – 2019 ATLANTIC HURRICANE OUTLOOK:

NEAR NORMAL

	Normal Season	Our Forecast
Named Storms	**12**	**10 – 14**
Hurricanes	**6**	**4 – 7**
Major Hurricanes	**3**	**2 – 3**

UPCOMING EVENTS – JOIN US!

THANK YOU

QUESTIONS AND COMMENTS?