ATM S 103

Hurricanes and Thunderstorms

Their Science and Impacts

The Final

- 8:30-10:20 AM Thursday June 13th
- Bring a scantron form
- Material covered:
  - 50% Homeworks 7-9; Readings weeks 7-10; associated lecture slides (May 17 to end of class).
  - 50% earlier material
- 45 questions
- Closed book, notes, electronics.

Topics for today

- Hurricane Katrina
- Forecasting hurricanes

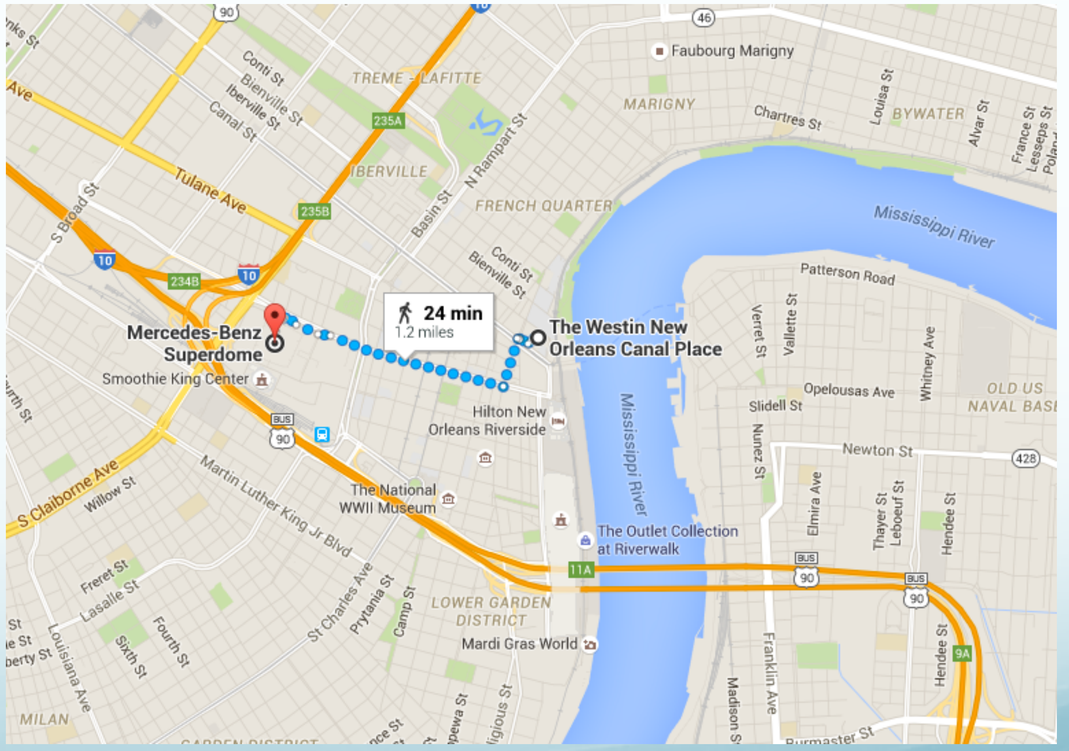
Ernest Morial Convention Center

Ernest Morial Convention Center

- Thousands were directed to the Convention Center as an unofficial evacuation center.
  - By police and word of mouth
- Not a designated refuge.
  - No supplies, food or water
- September 1 (4 days after landfall): Homeland Security Secretary Michael Chertoff on NPR:
  - "I have not heard a report of thousands of people in the Convention Center who don't have food and water."

Civil Government

- 1/6 of the police deserted. 2 months after Katrina 240 of the officers in the 1,450 member force unaccounted for.
- Plenty of looting
- Mayor Nagan remained holed up in on the 27th floor of the Westin Hotel



Media - Gross Exaggeration

- Reports of 200 dead at the Superdome
  - Truth: 6 died
  - (4 of natural causes, 1 over-dose, 1 suicide)
- Four died at the Convention Center
  - (1 homicide)
- Bad journalism, but it was also the Mayor and the Police Chief

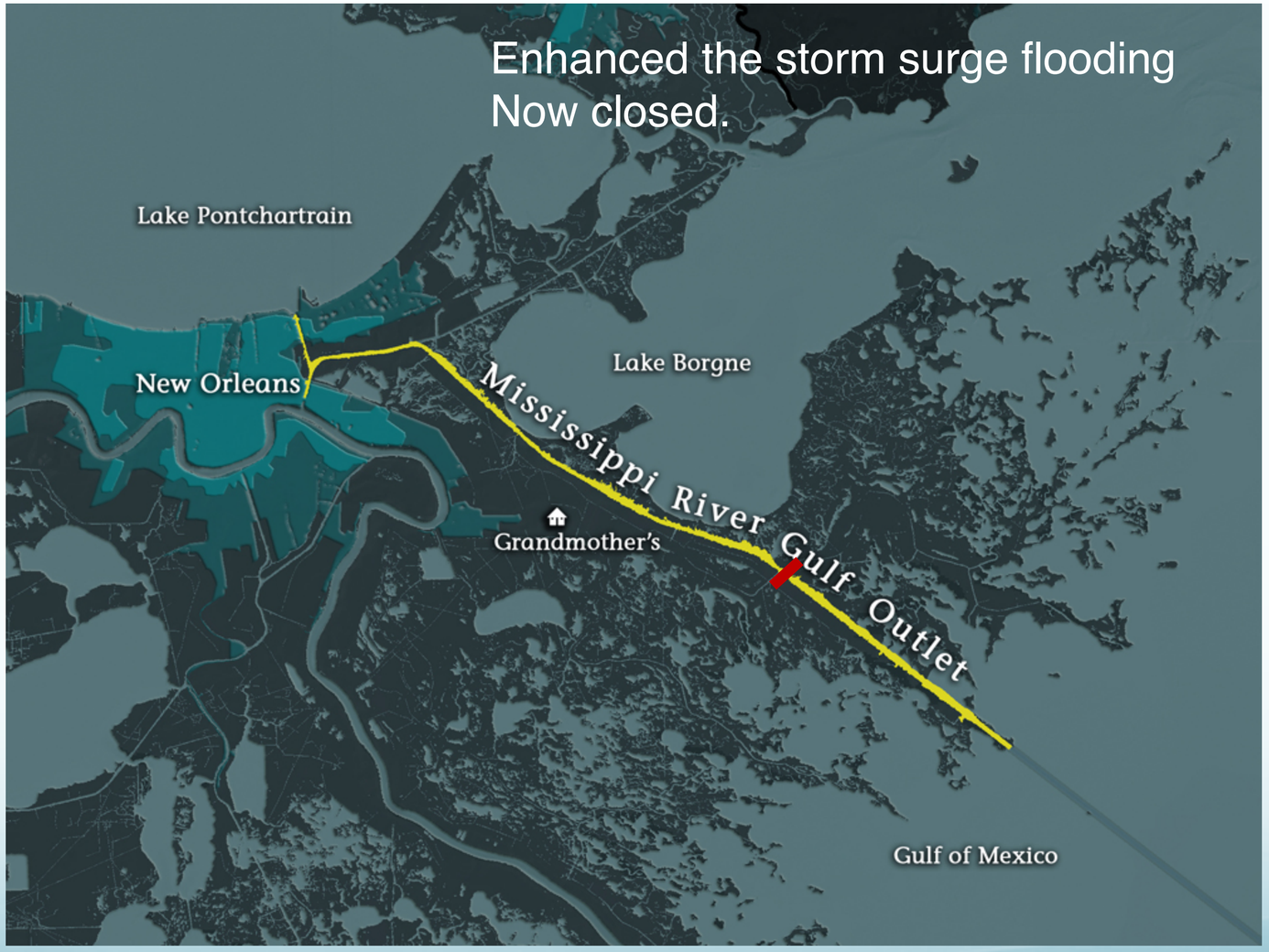
FEMA Response

- Like the city and the state, slow to get resources prepositioned and mobilized.
  - No buses for superdome evacuation.
- “Brownie you’re doing a heckuva job” (Mobile airport, September 2, 2005)
- Michael Brown resigns as head of FEMA (Federal Emergency Management Agency) on September 12, 2005.
- Michael Chertoff (Homeland Security Secretary, Brown’s boss) ultimately assigned principal blame by the Government Accountability Office
  - “GAO faulted Chertoff for not immediately designating Katrina a ‘catastrophic event,’ a technical step that would have permitted federal officials to take the initiative in the emergency. Federal agencies instead had to wait for state and local agencies to request specific kinds of assistance”

Adaption

Elevated Living Quarters

Mississippi River Gulf Outlet



MRGO Closure

Evacuspot

evacuteer.org

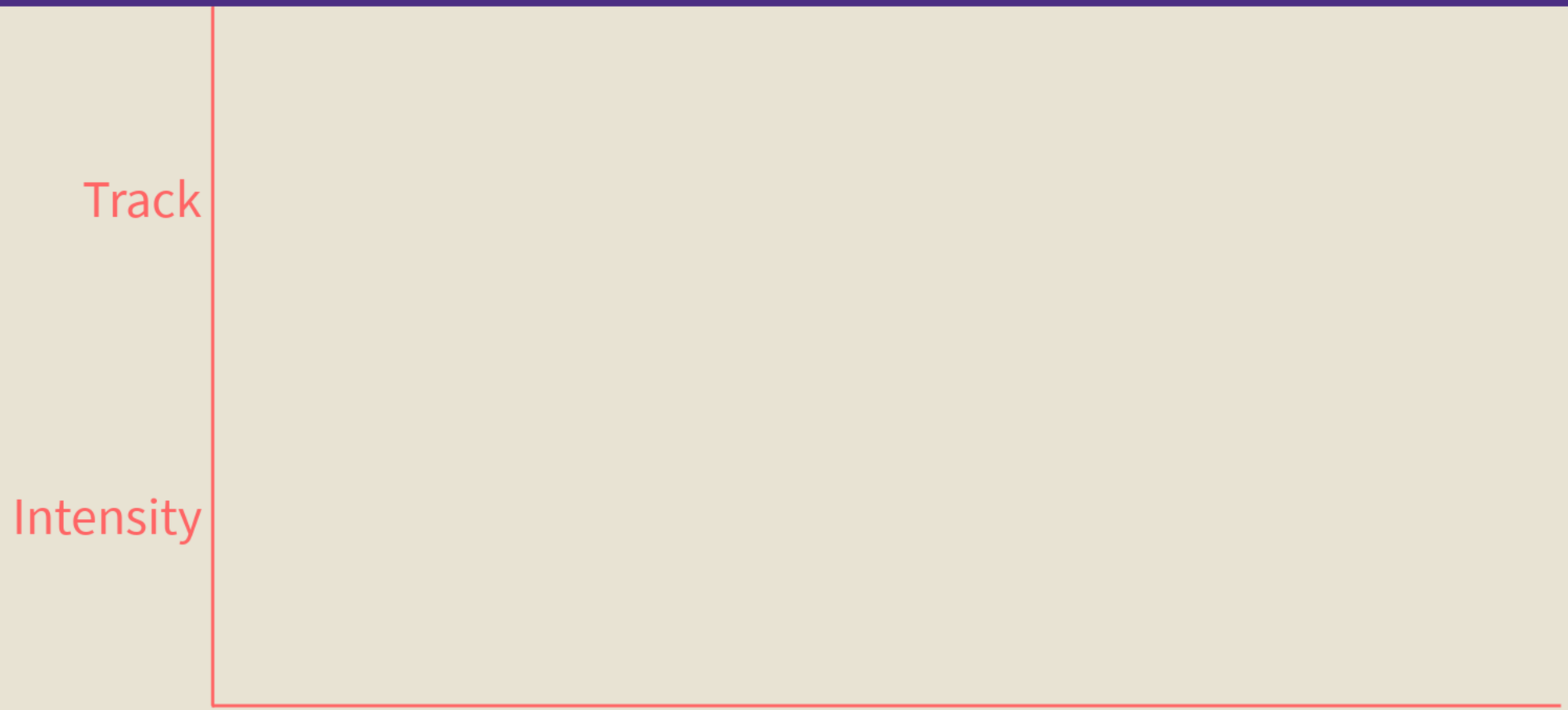
Nonprofit recruits, trains, and manages over 500 volunteers annually.

They will assist with NOLA evacuations.

Forecasting Hurricanes

- Key issue is forecast lead time
- National Hurricane Center Website
- Overview of hurricane forecasting

Which was better forecast for hurricane Katrina?



Answer

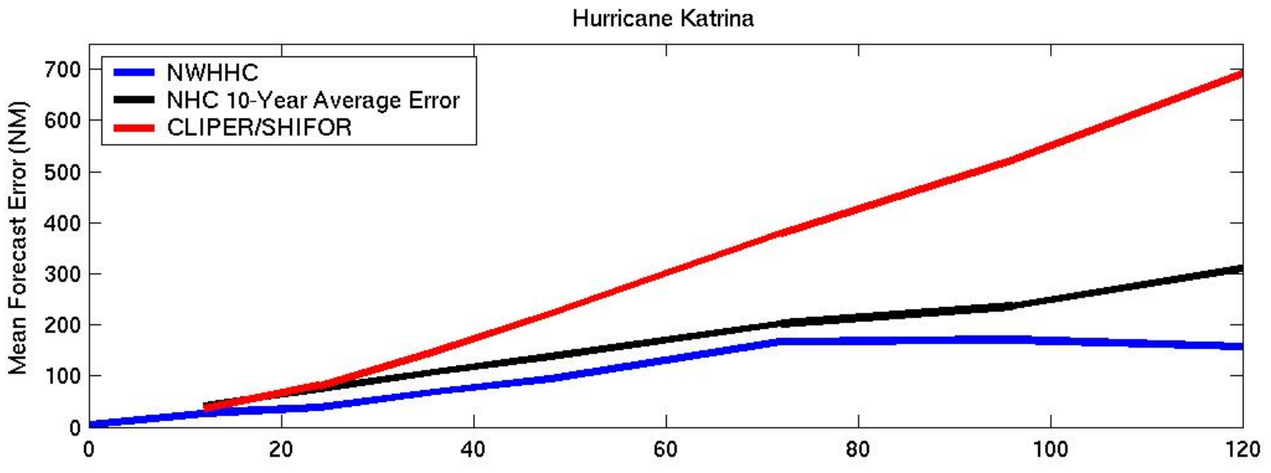
- The track forecast was better than the intensity forecast for Katrina

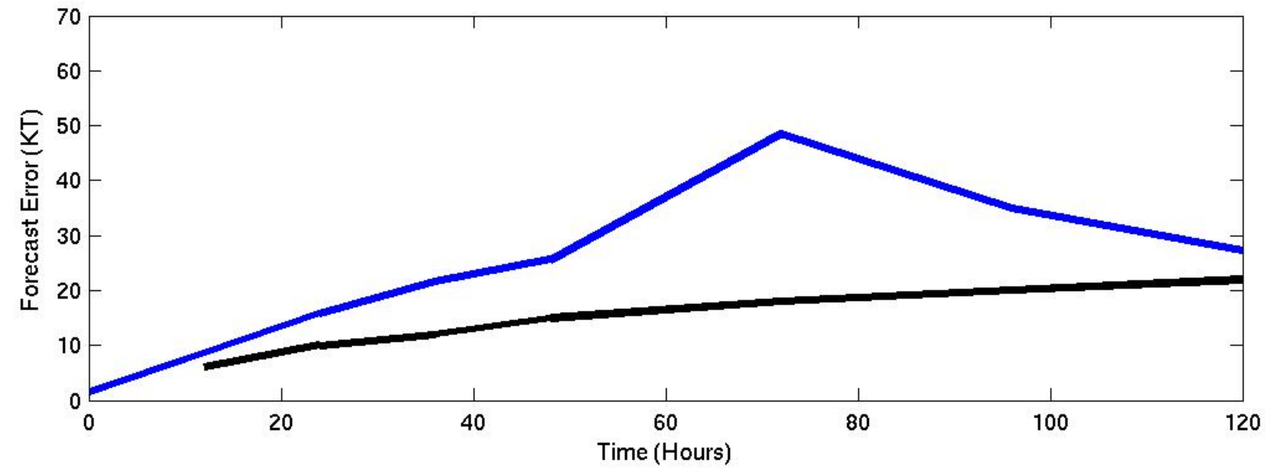
Errors Relative to Average in Katrina Forecasts

Set of track forecasts

better than average

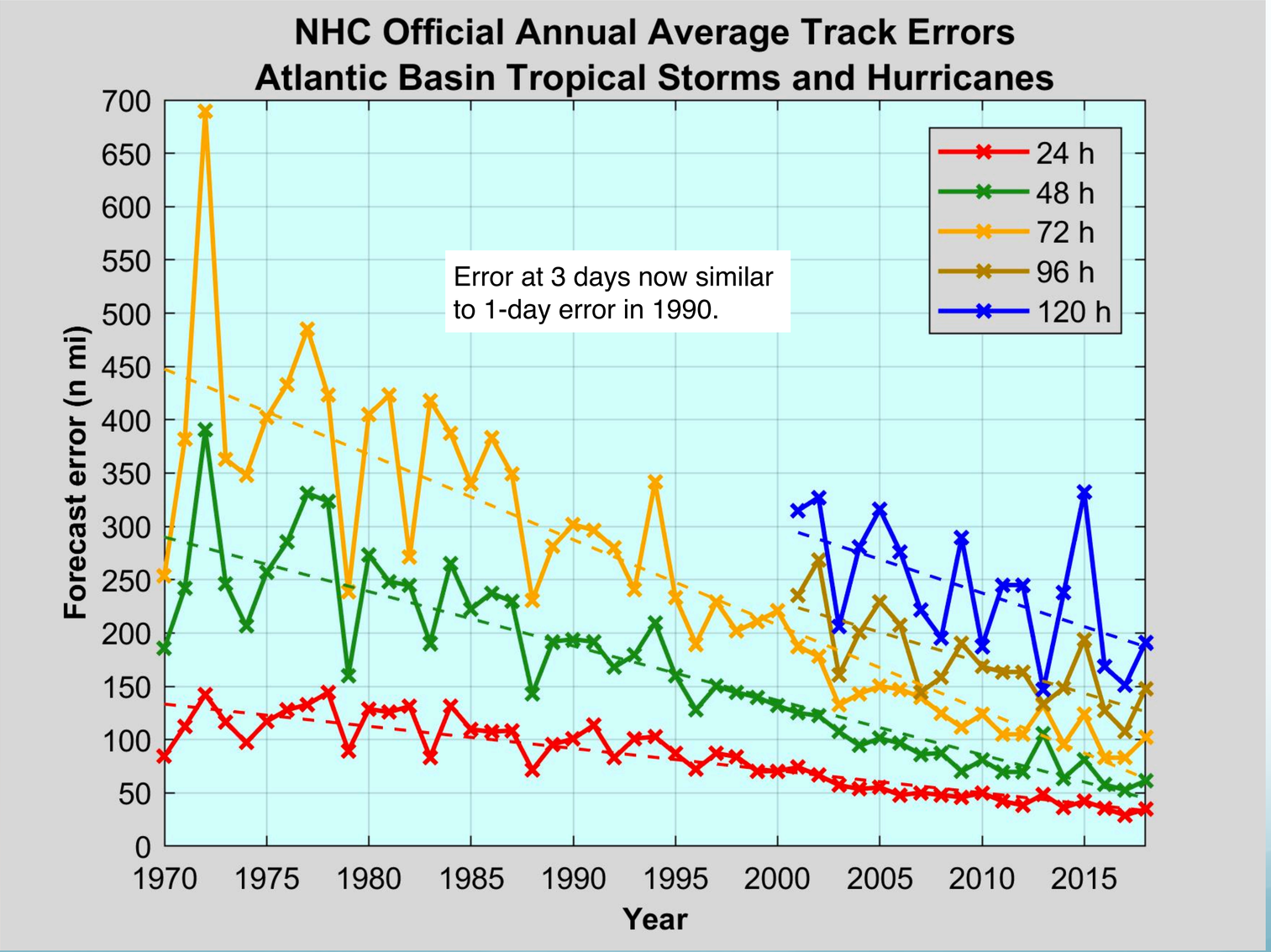
Wind speed forecast:
worse than average



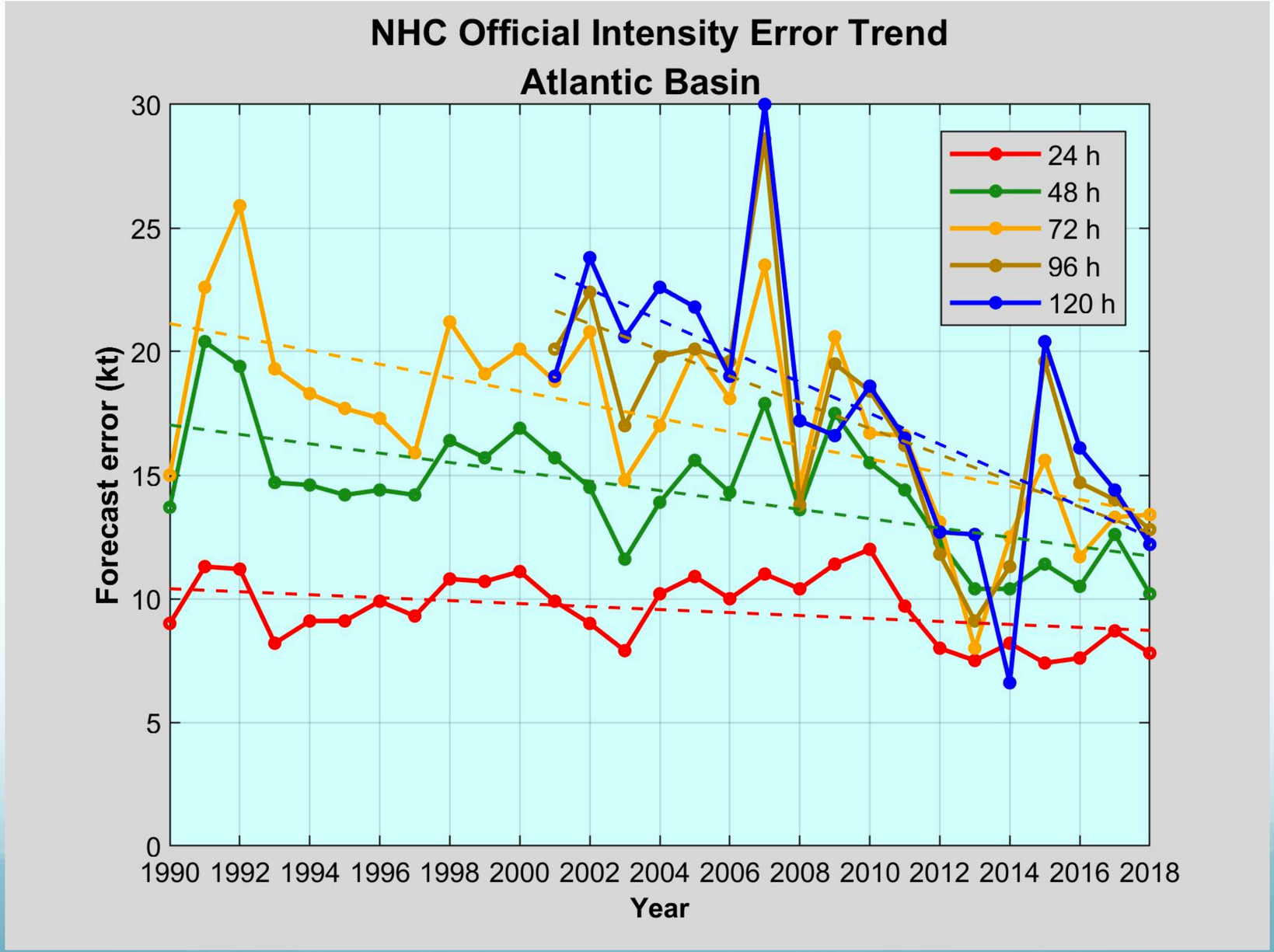


Are Hurricane Forecasts Getting Better?

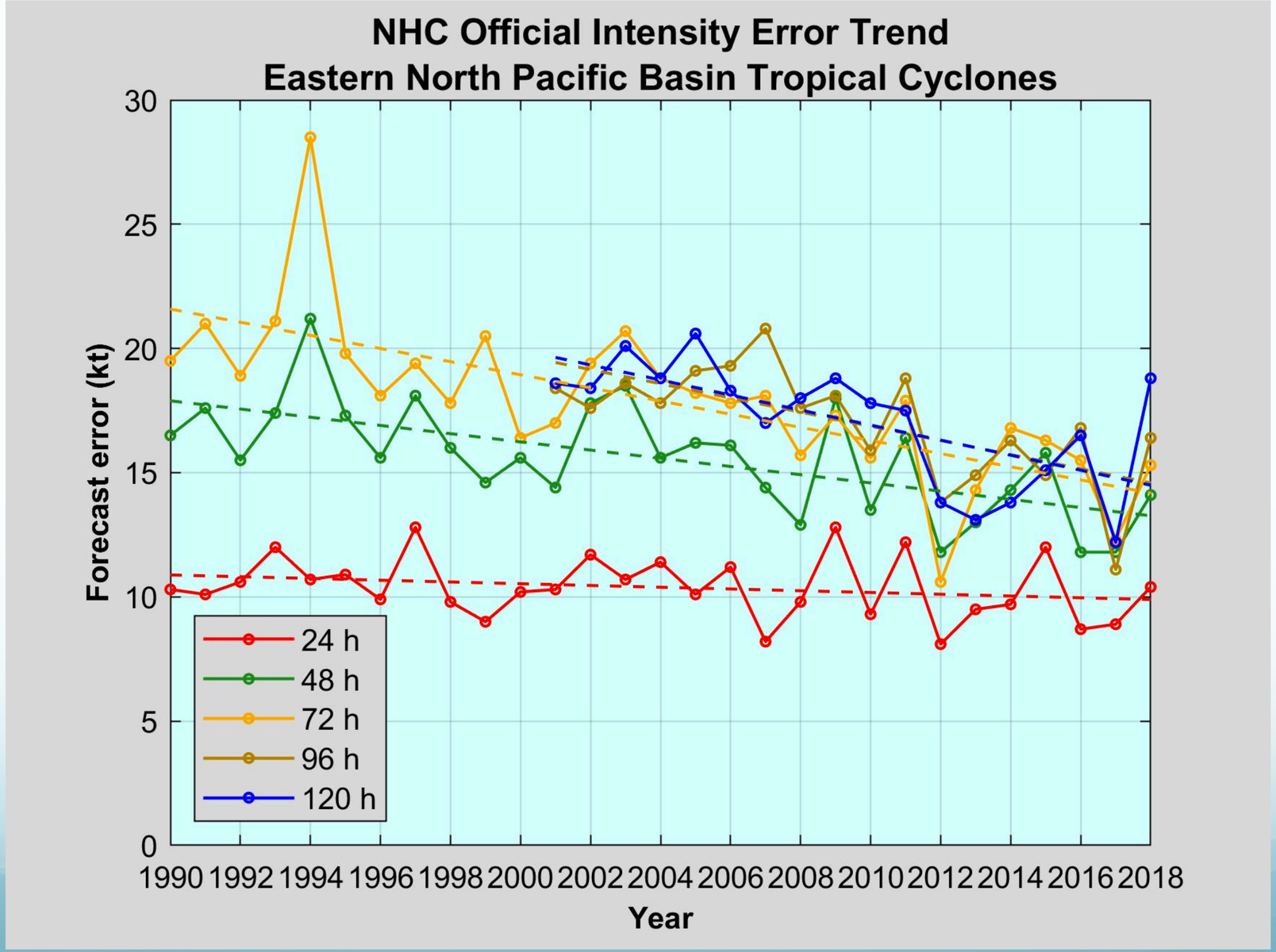
Track Forecasts are Getting Better



One-Day Intensity Forecasts Are Not Improving



One-Day Intensity Forecasts Are Not Improving



Forecasting Challenges

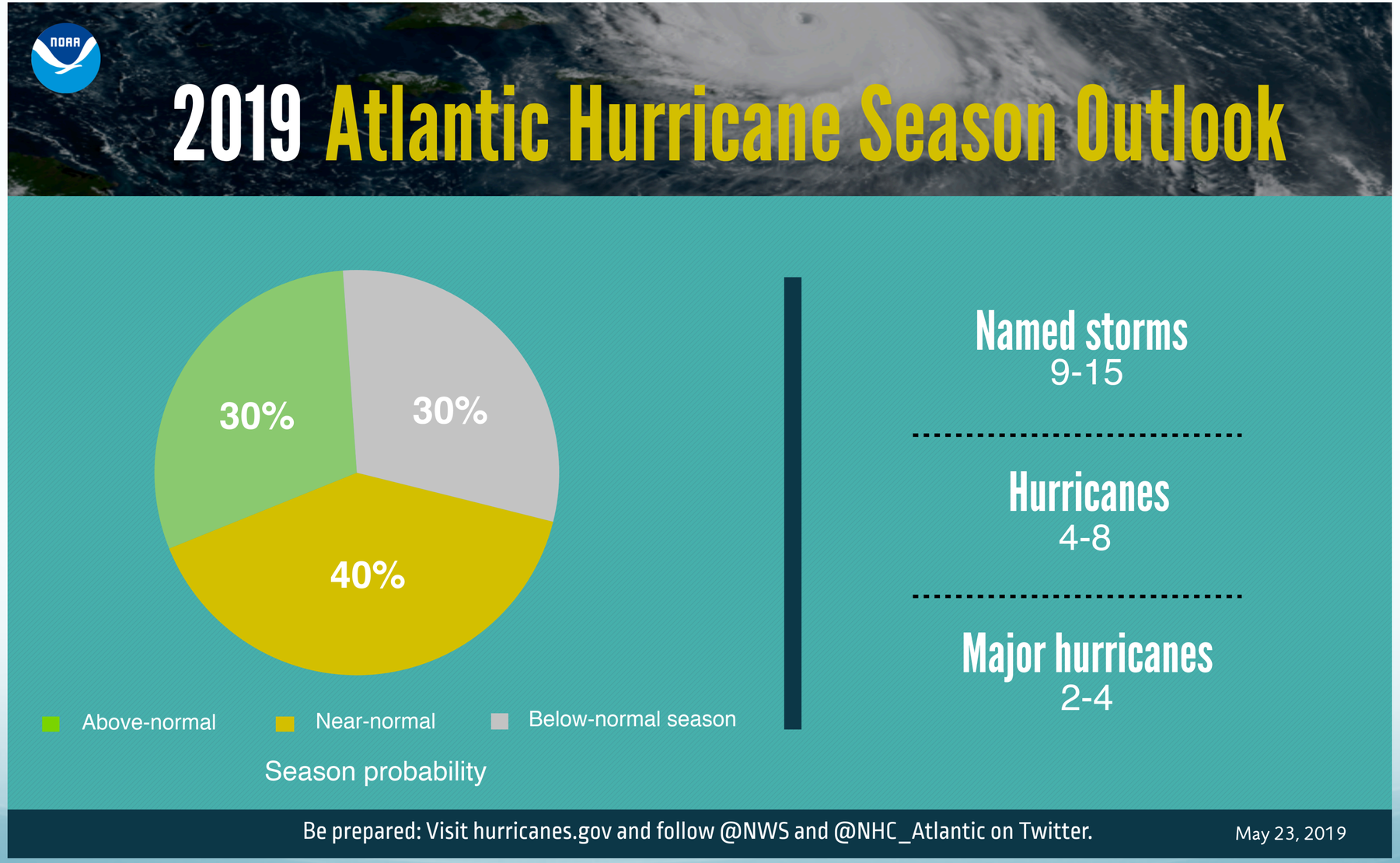
- Knowing the current state of the atmosphere
- Modeling how the atmosphere will evolve from its current state
  - Computer models solve complex partial differential equations
  - Statistical models based on similar past events
- Improvements in track forecasts have come from improvements in both determining the current state and improving models.
- Lack of improvement in 24-hour intensity forecasts may be limited by sensitivity of hurricane development of small, hard to observe properties of the current state

Seasonal Hurricane Forecasts

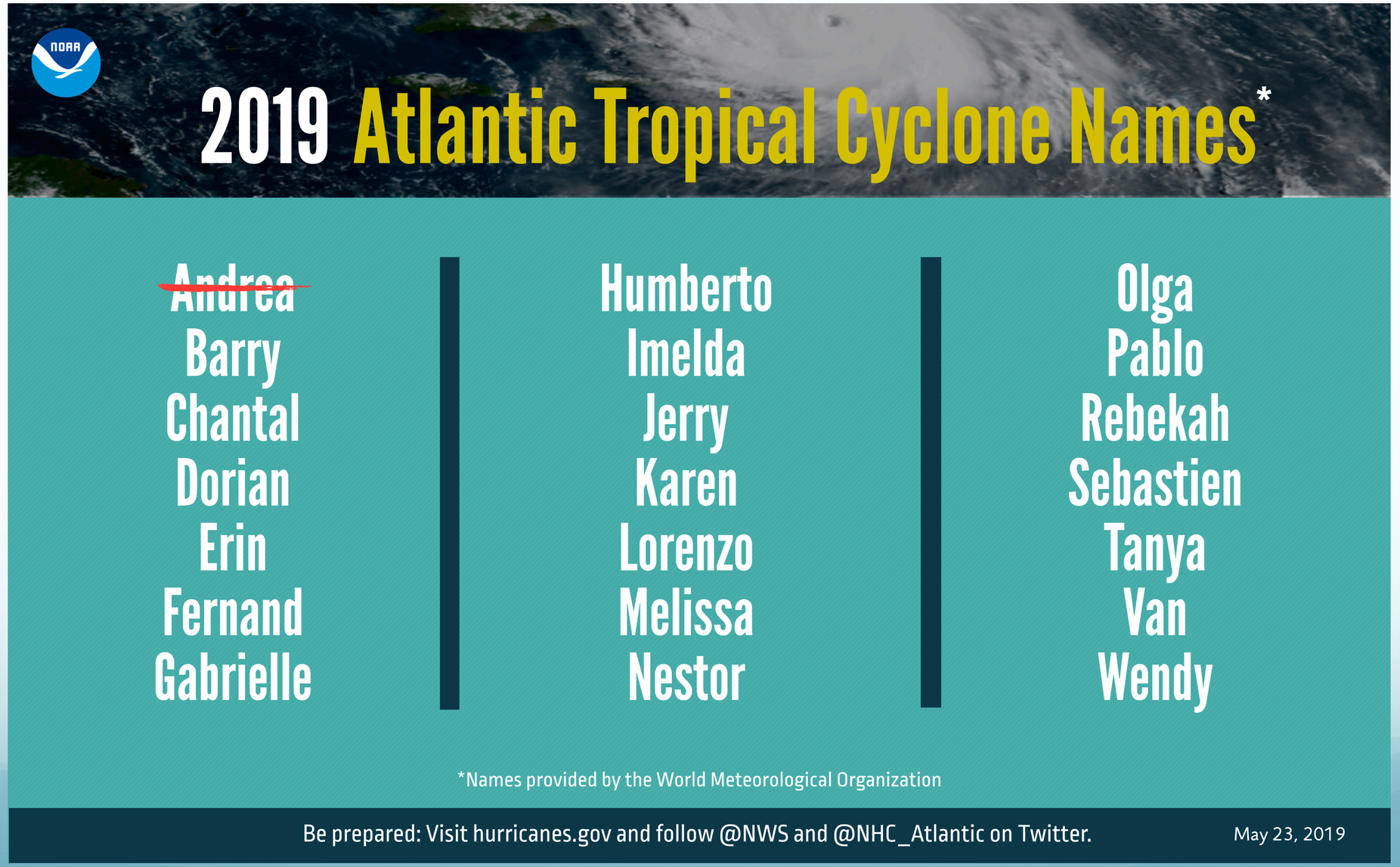
- What goes into them?
- How do they perform?

NOAA 2019 Seasonal Forecast: Near Normal

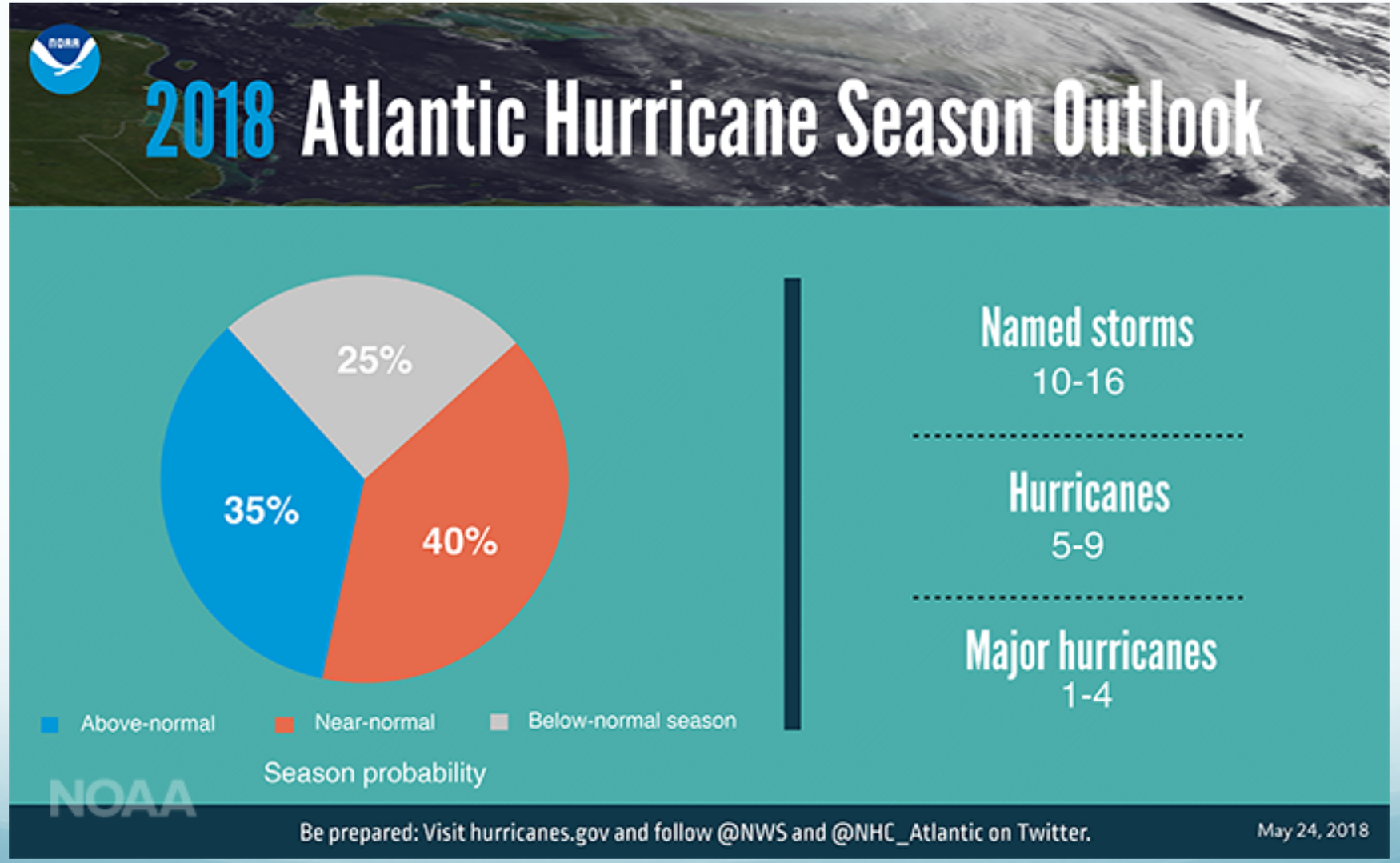
Video



2019 Atlantic Tropical Cyclone Names



NOAA 2018 Seasonal Forecast: Near Normal



Average 12

Actual 15

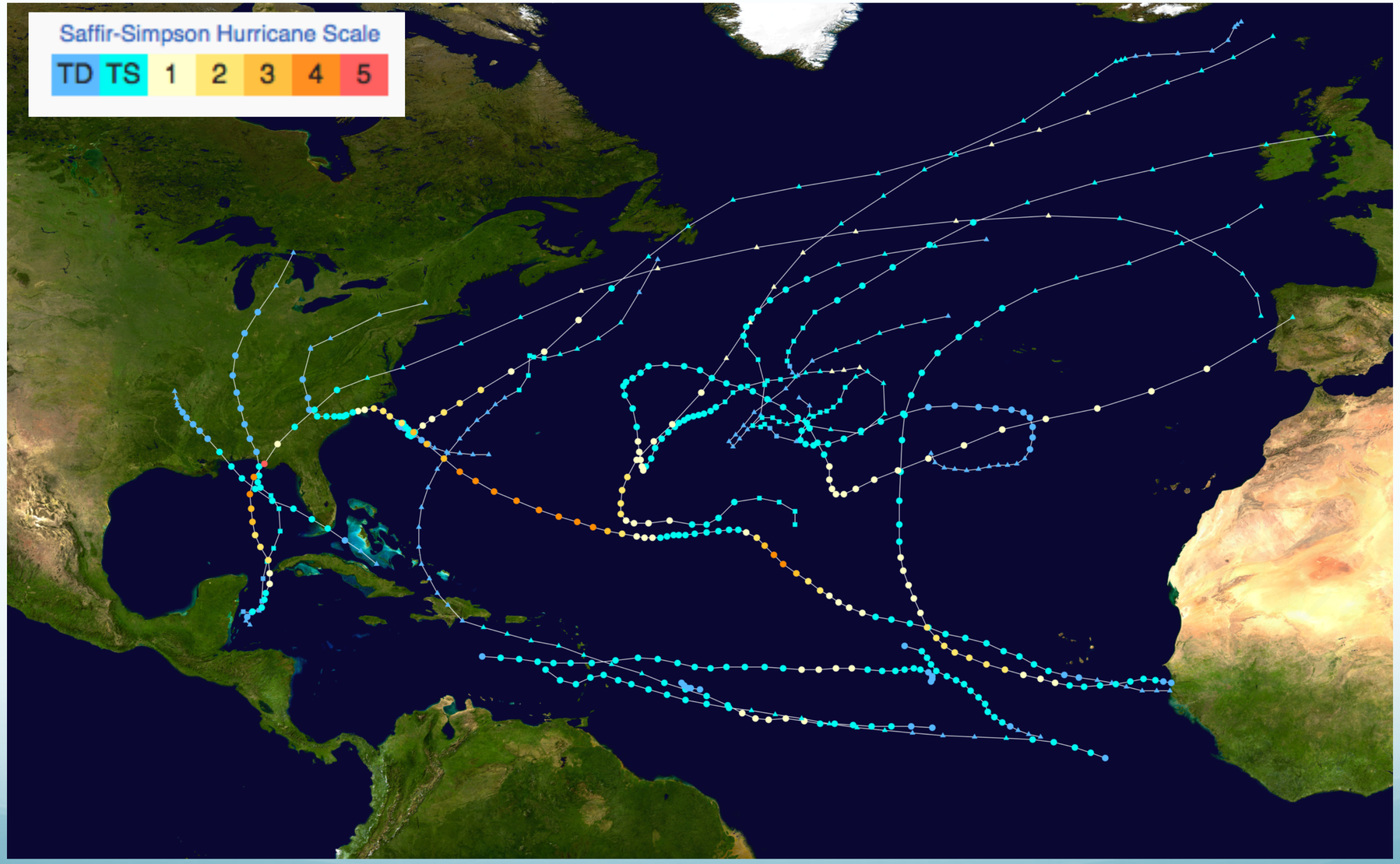
Average 6

Actual 8

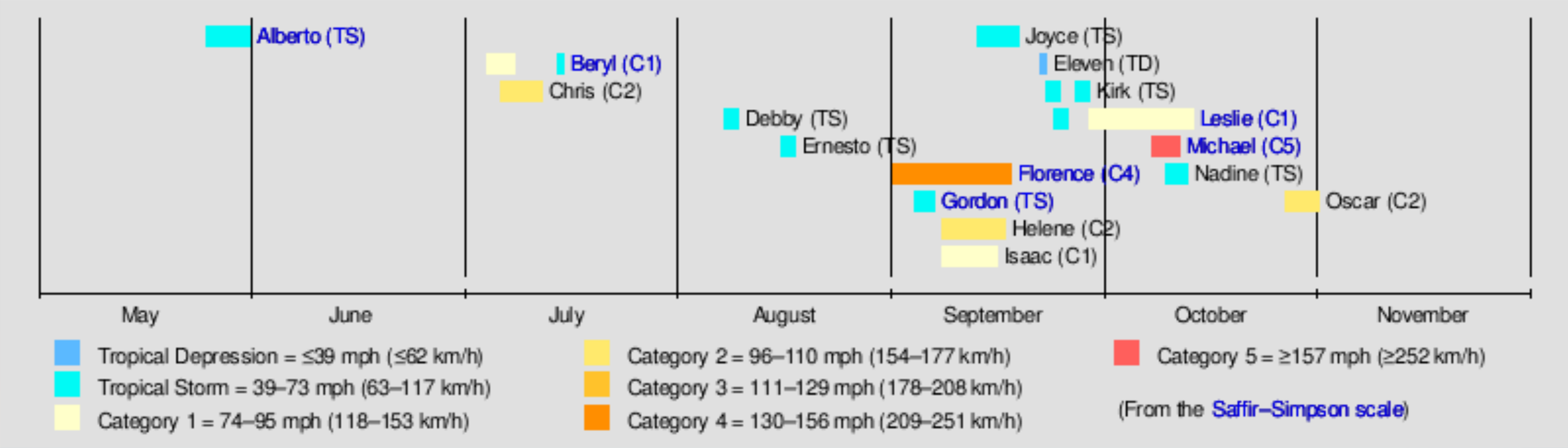
Average 3

Actual 2

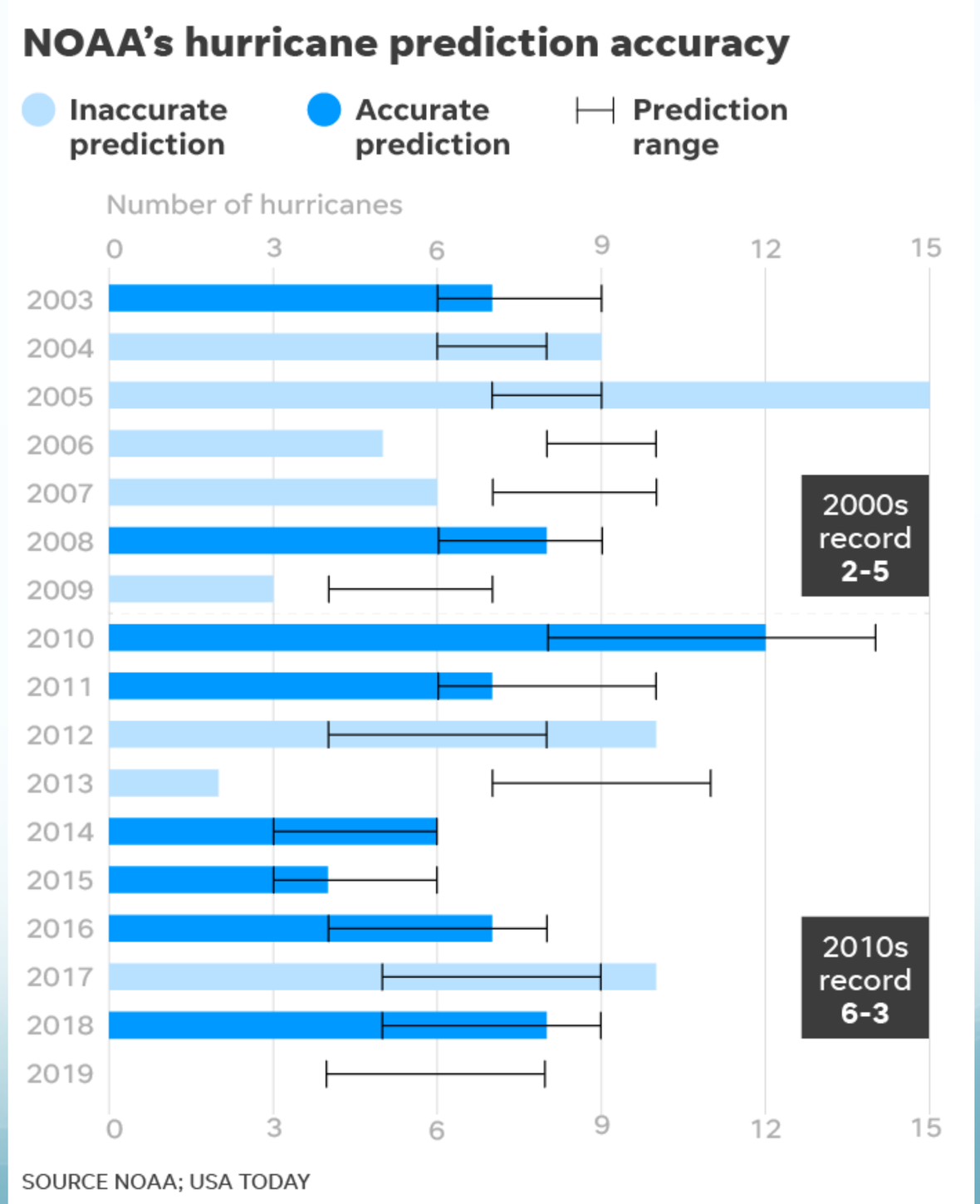
2018 Hurricane Tracks



Timeline


Alberto (TS)
Beryl (C1)
Chris (C2)
Debby (TS)
Ernesto (TS)
Joyce (TS)
Eleven (TD)
Kirk (TS)
Leslie (C1)
Michael (C5)
Florence (C4)
Nadine (TS)
Gordon (TS)
Oscar (C2)
Helene (C2)
Isaac (C1)
May
June
July
August
September
October
November
Tropical Depression = ≤39 mph (≤62 km/h)
Tropical Storm = 39–73 mph (63–117 km/h)
Category 1 = 74–95 mph (118–153 km/h)
Category 2 = 96–110 mph (154–177 km/h)
Category 3 = 111–129 mph (178–208 km/h)
Category 4 = 130–156 mph (209–251 km/h)
Category 5 = ≥157 mph (≥252 km/h)
(From the Saffir–Simpson scale)

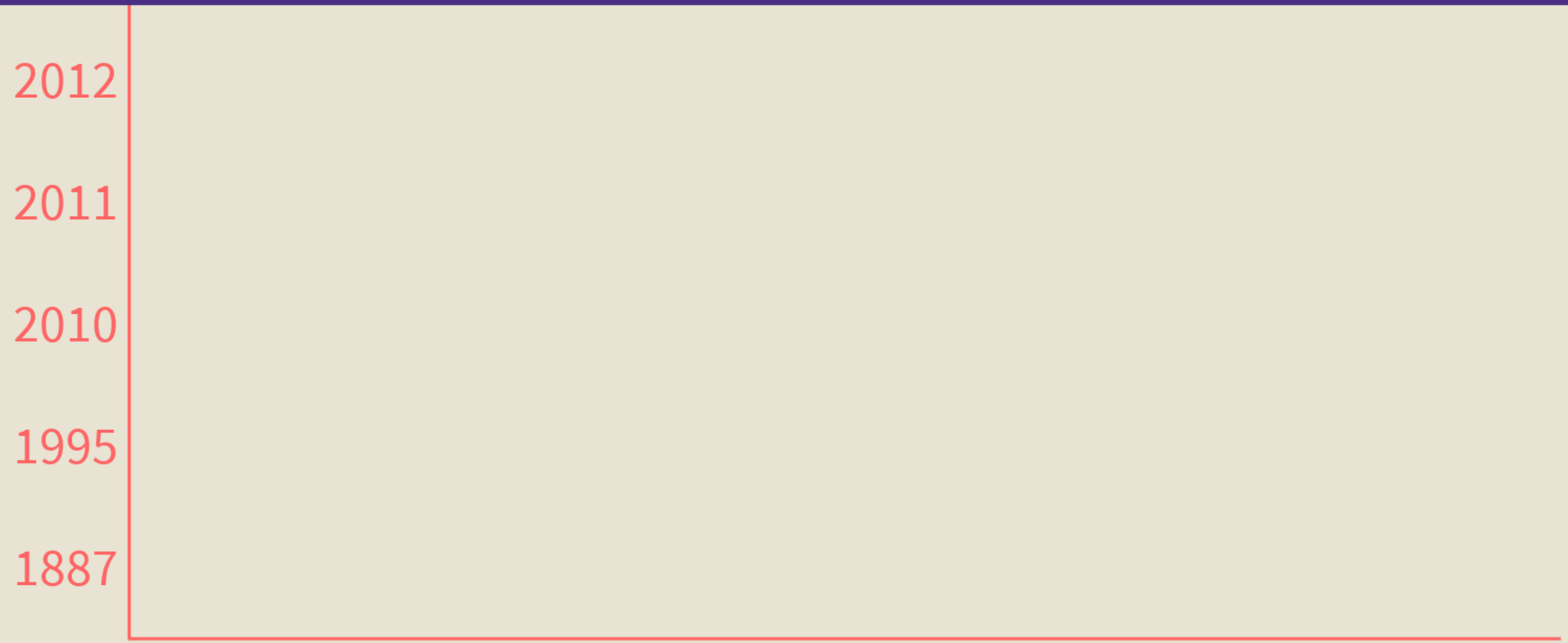
NOAA Atlantic Hurricane Forecasts and Verifications



Record Seasons for Atlantic Hurricanes

- Most active: 2005 (holds the record in all 3 categories)
  - 28 tropical storms
  - 5 Hurricanes
  - 7 Major hurricanes
- 2nd most active: 1933 (20 tropical storms)
- 3rd most active: 2012, 2011, 2010, 1995, 1887 (19 tropical storms)

All the following seasons nominally had 19 tropical storms in the Atlantic. In reality, which one probably had the most?



Start the presentation to see live content. Still no live content? Install the app or get help at **PollEv.com/app**

Total Results

Answer: 1887

- No satellites in 1887, several storms probably went undetected.
- 2nd place for most active Atlantic Season, 1933, likely also had undetected storms

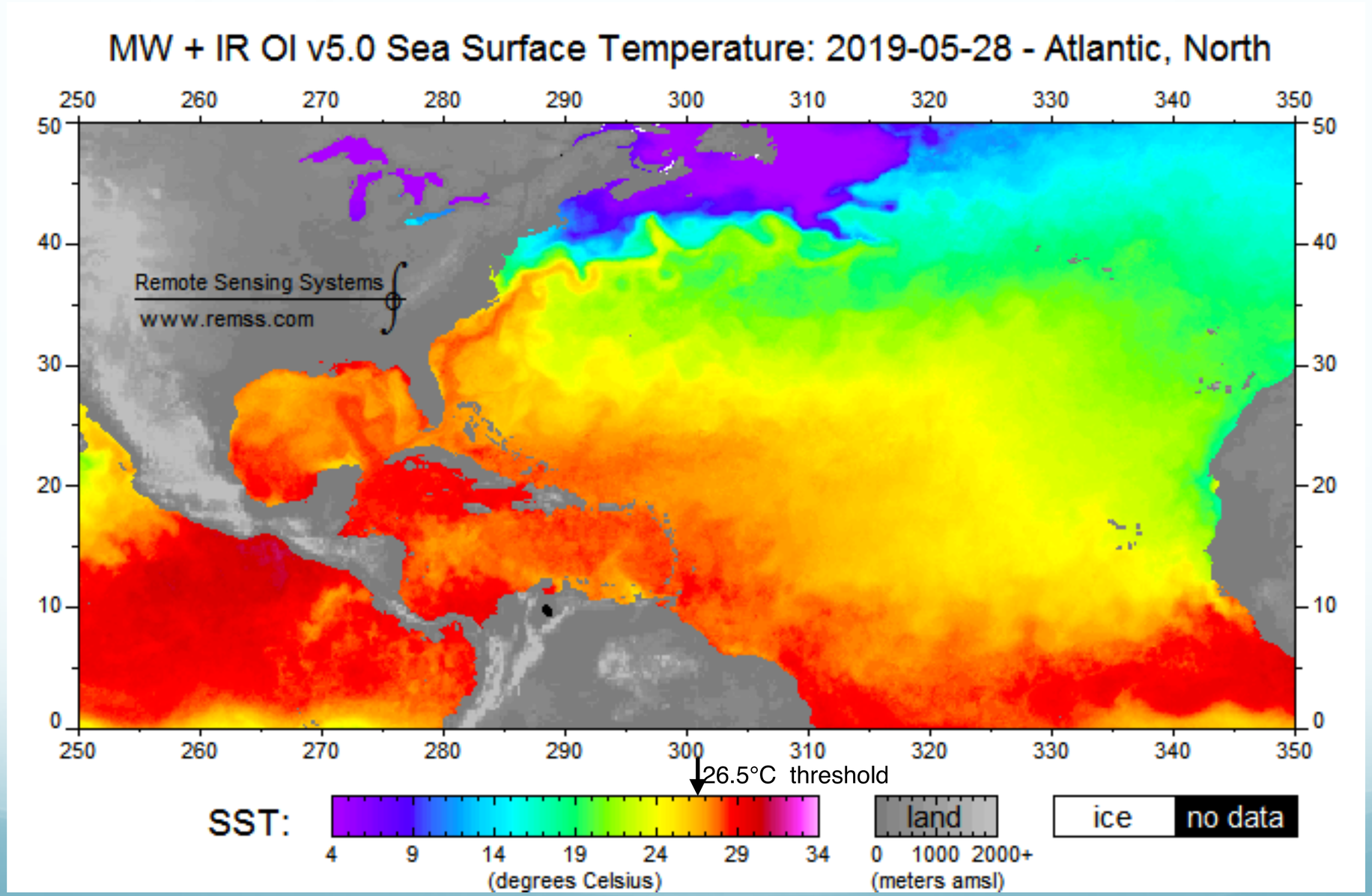
Hurricane Season Forecast Ingredients

Largely based on forecasts of

- Sea surface temperatures (SST) in the tropical north Atlantic
  - Local effect of SST beneath the hurricanes
- Presence of El Niño or La Niña
  - Remote influence of SST in the equatorial Pacific Ocean

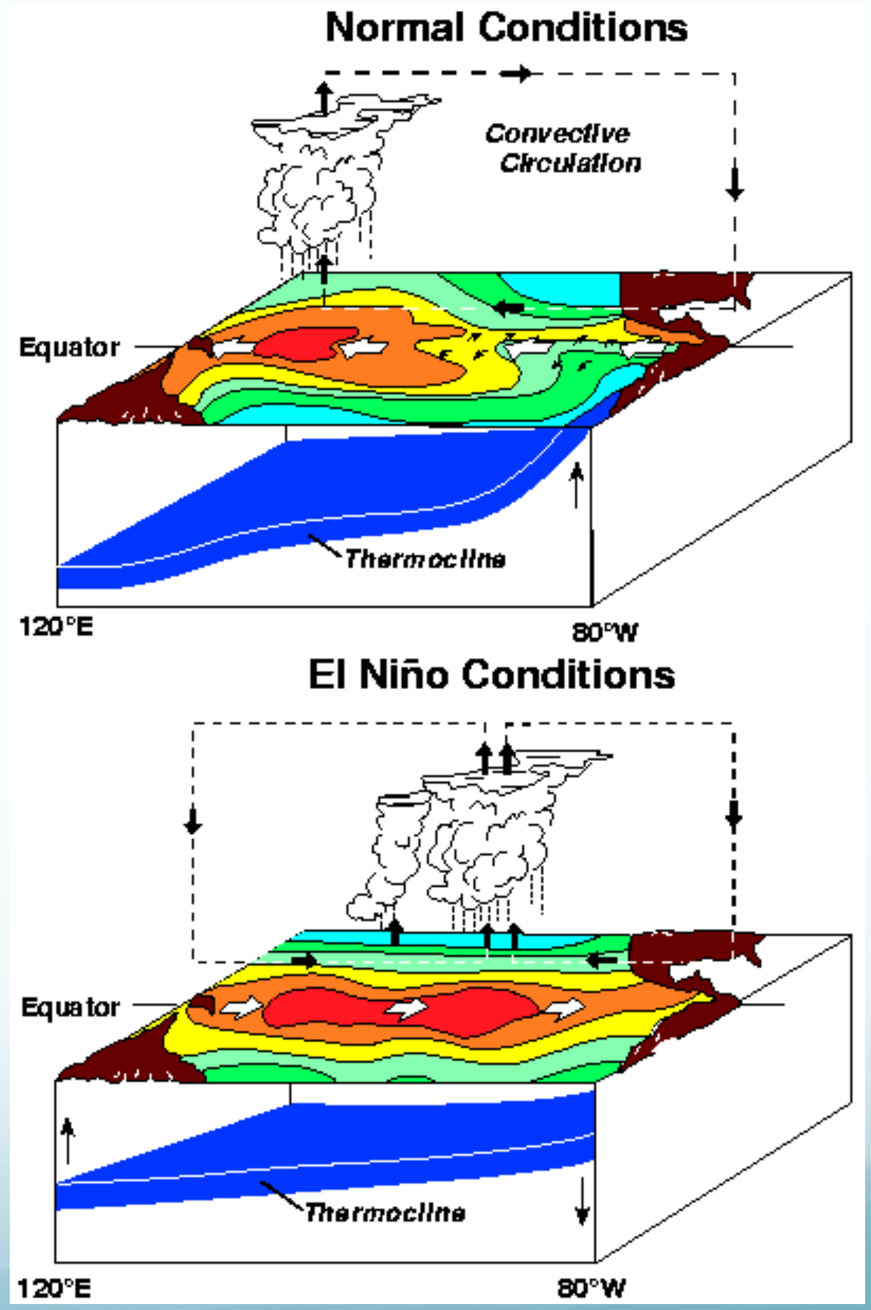
Video

Current Sea Surface Temperatures (SST)

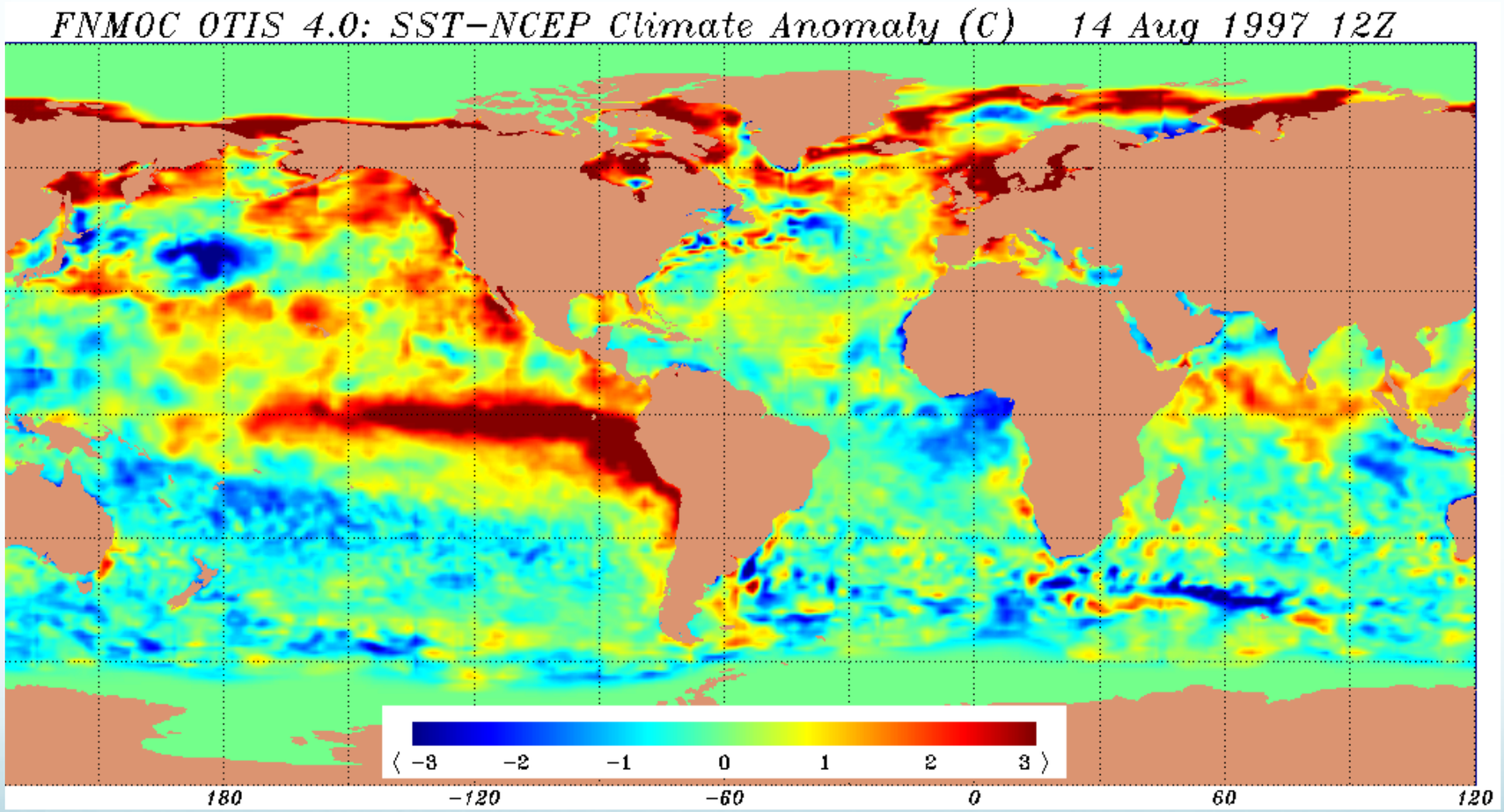


El Niño

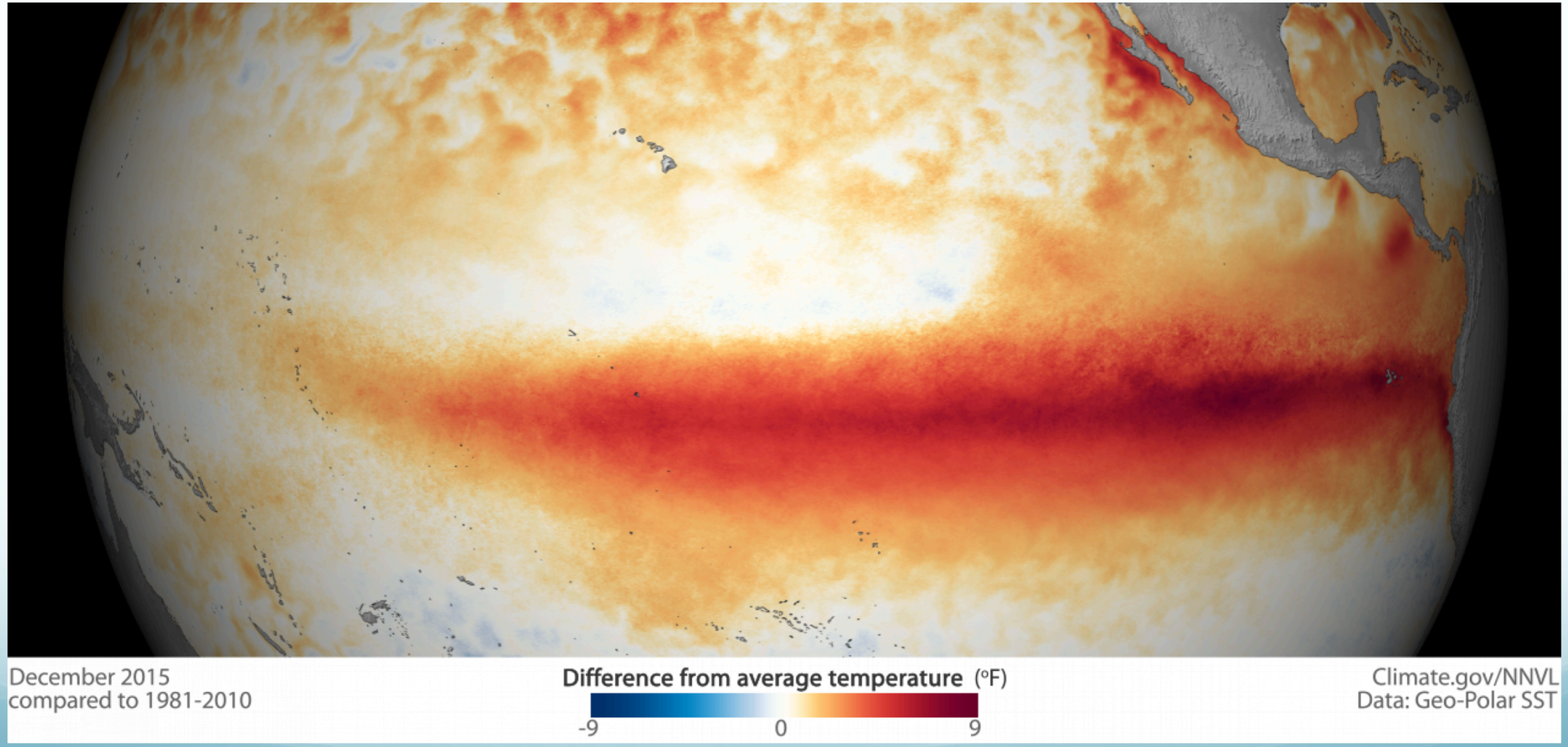
- Is the absence of typical cold conditions in the eastern equatorial Pacific
- Warm anomaly (difference from average conditions)
- Influences the atmosphere by shifting thunderstorm activity eastward along the equator



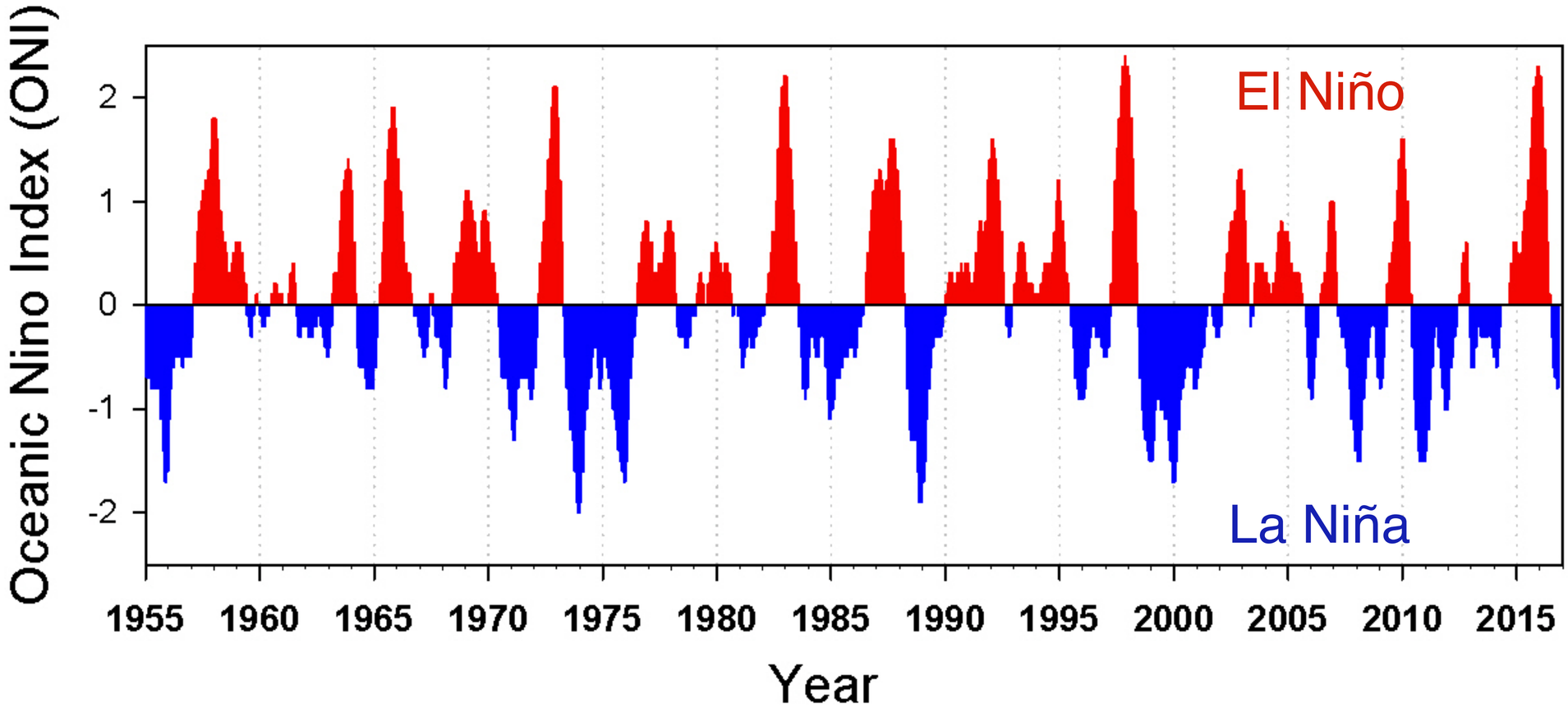
1997-1998 El Niño SST Anomaly



2015-2016 El Niño Sea-Surface-Tempearture Anomaly



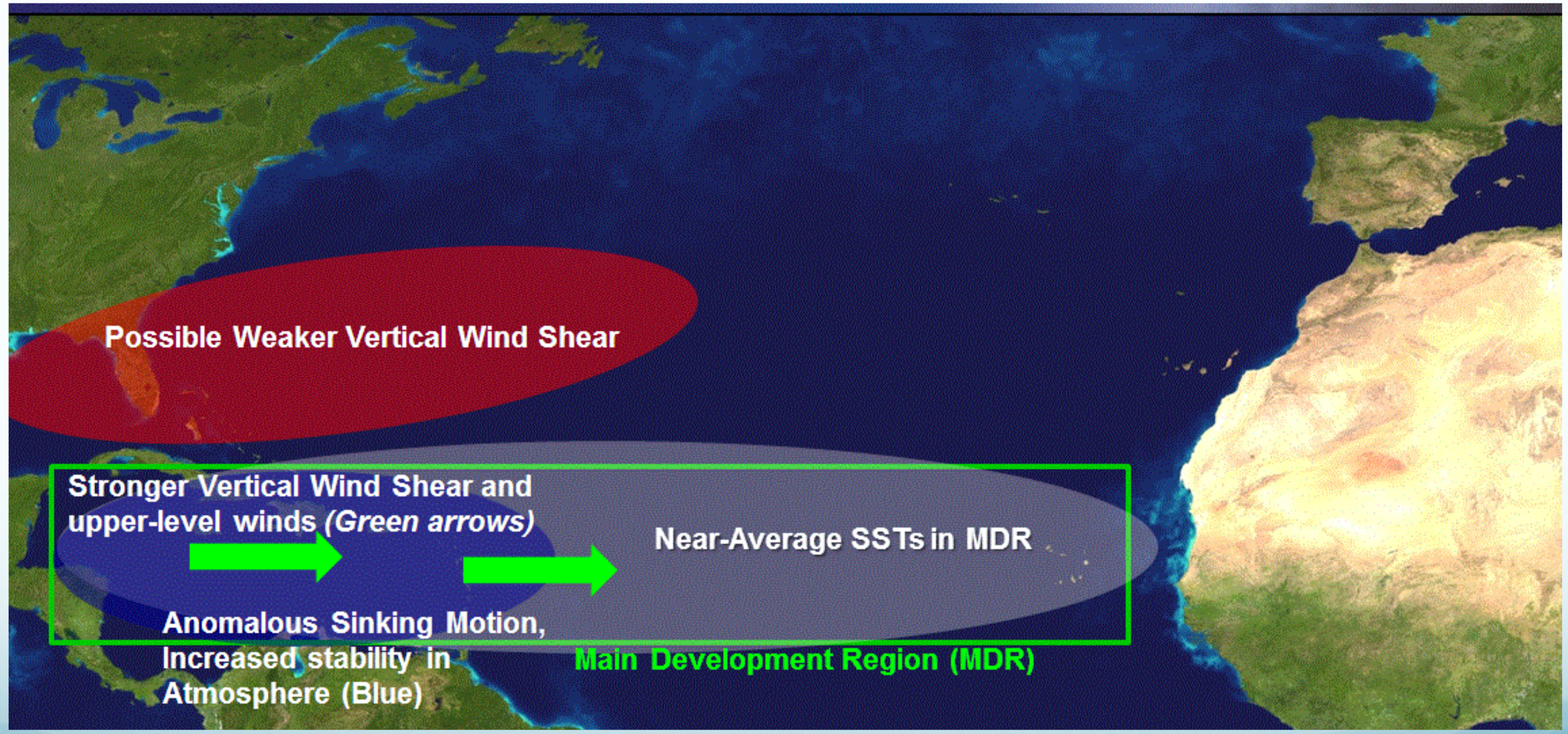
East Pacific Sea-Surface Temperature Anomaly by Year



Some El Niño Impacts

- Increases the environmental vertical wind shear in the Tropical Atlantic
- Decreases the environmental vertical wind shear in the Eastern Pacific
- Tends to make the winters warmer and drier in the Pacific Northwest

El Niño Impacts in Atlantic



Vertical wind shear and hurricanes