

Seasonal Hurricane Forecasting

Florida Governor's Hurricane Conference

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National Hurricane Center

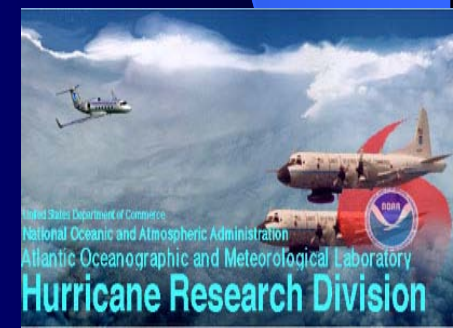
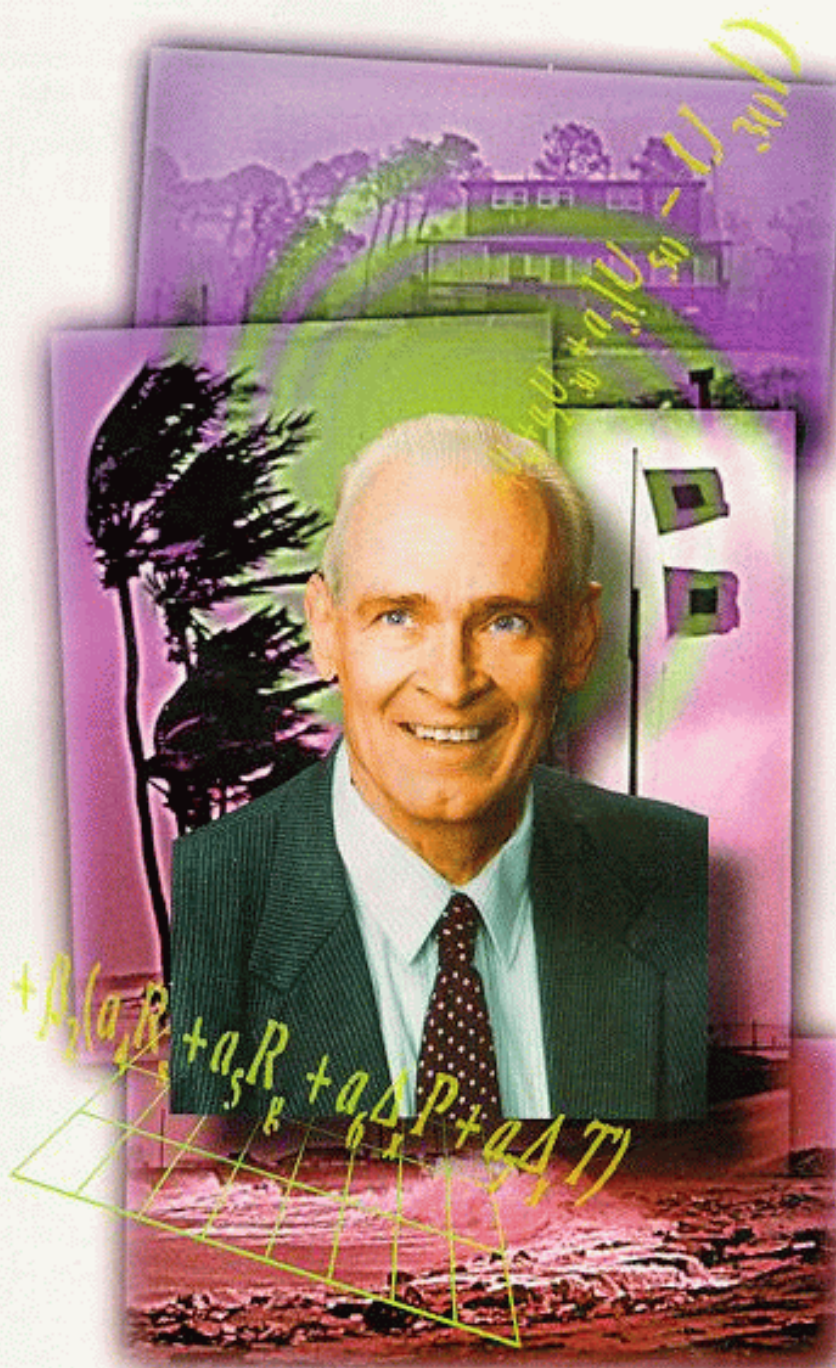
5/25/2010

Outline

- Seasonal forecast predictors
- Current forecast methodology
- Verification of 2009 seasonal forecast
- Conclusions

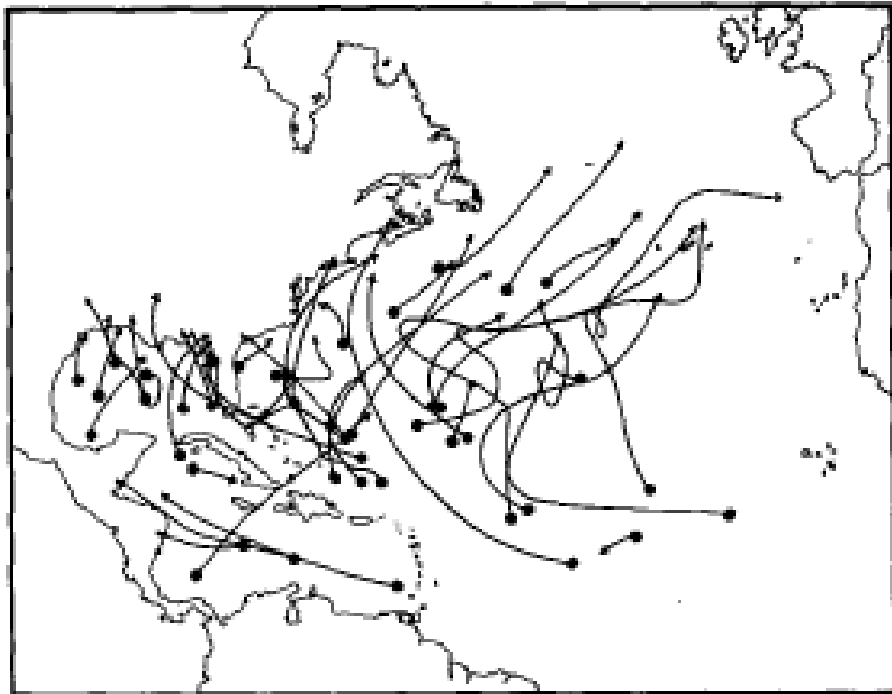
Dr. Bill Gray Colorado State University

Father of seasonal
hurricane prediction

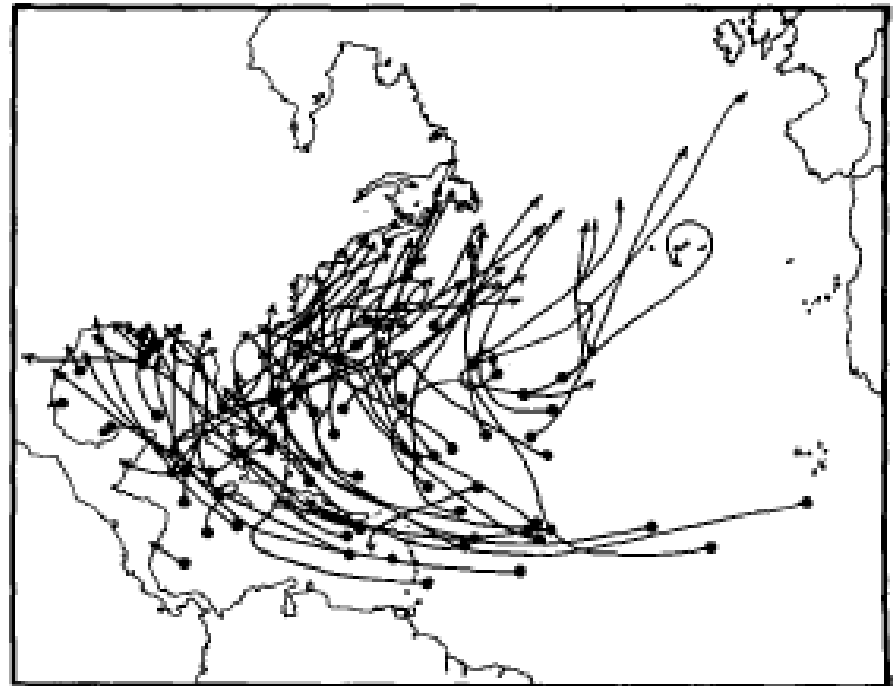


Origin of seasonal forecasting

El Niño Years



Years after El Niño
(like 2010)

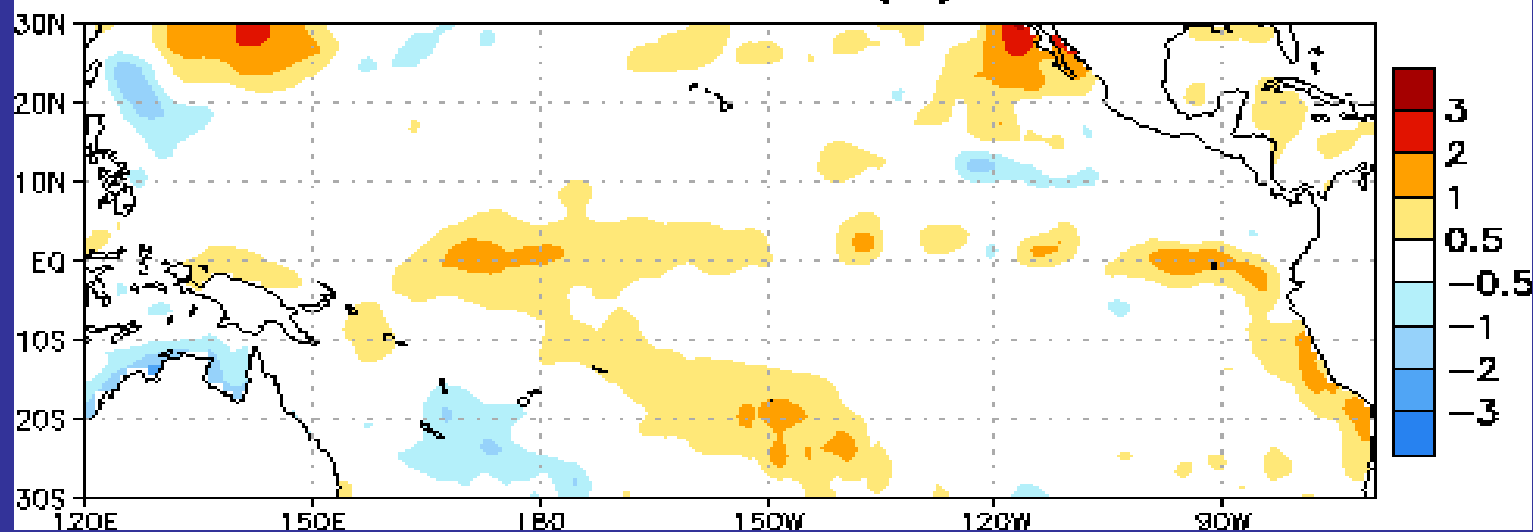


From Gray 1984

El Niño

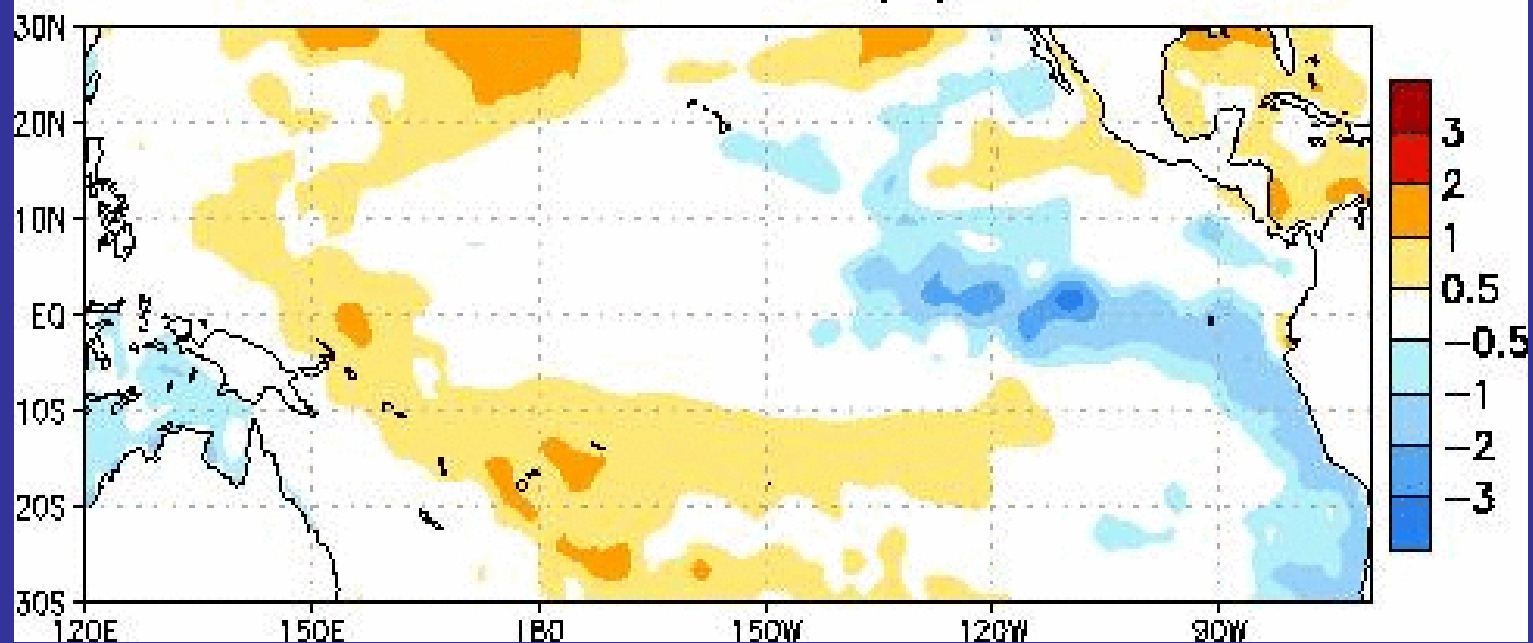
- Occurs every 3 to 5 years
- Affects weather patterns by changing thunderstorm development
- Generally reduces Atlantic hurricane activity

Week centered on 26 JUL 2006
SST Anomalies (°C)



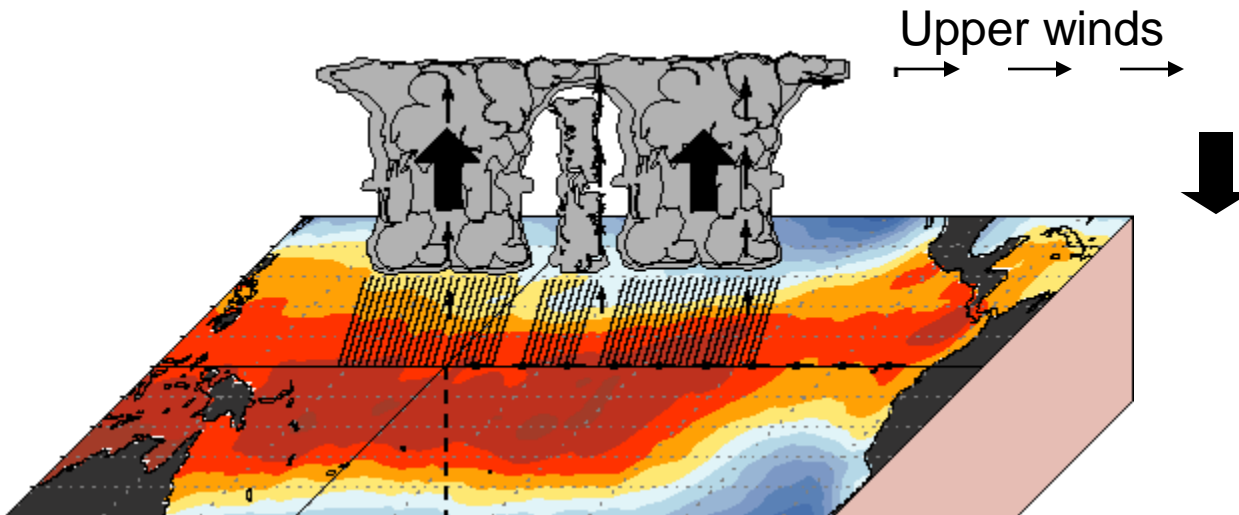
El Niño

Week centered on 15 AUG 2007
SST Anomalies (°C)

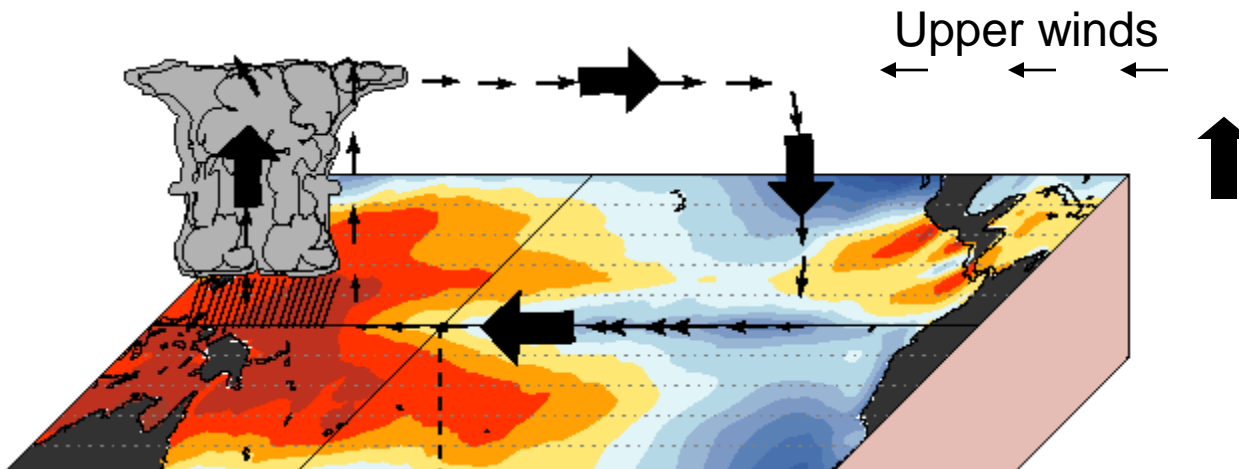


La Niña

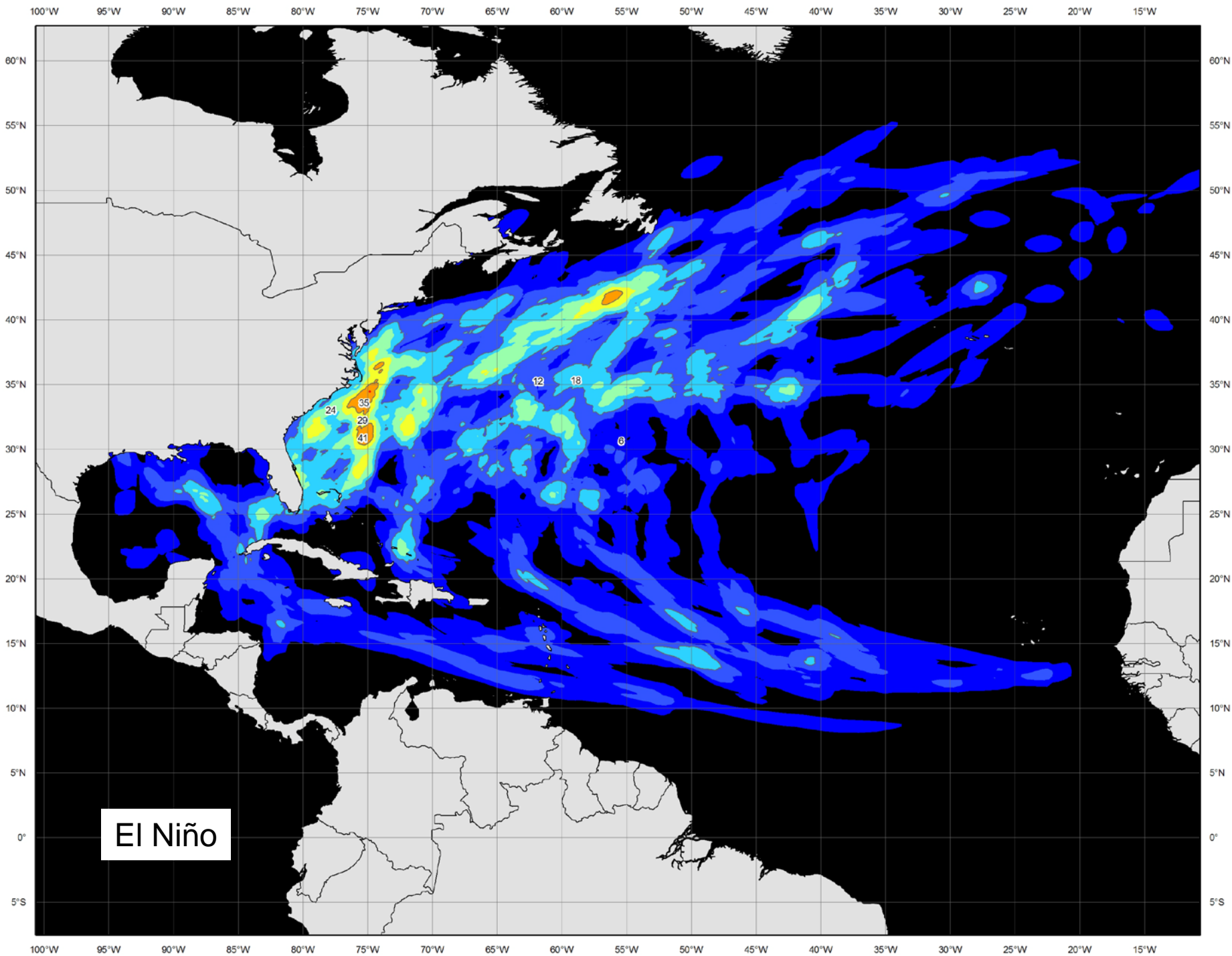
El Niño versus La Niña

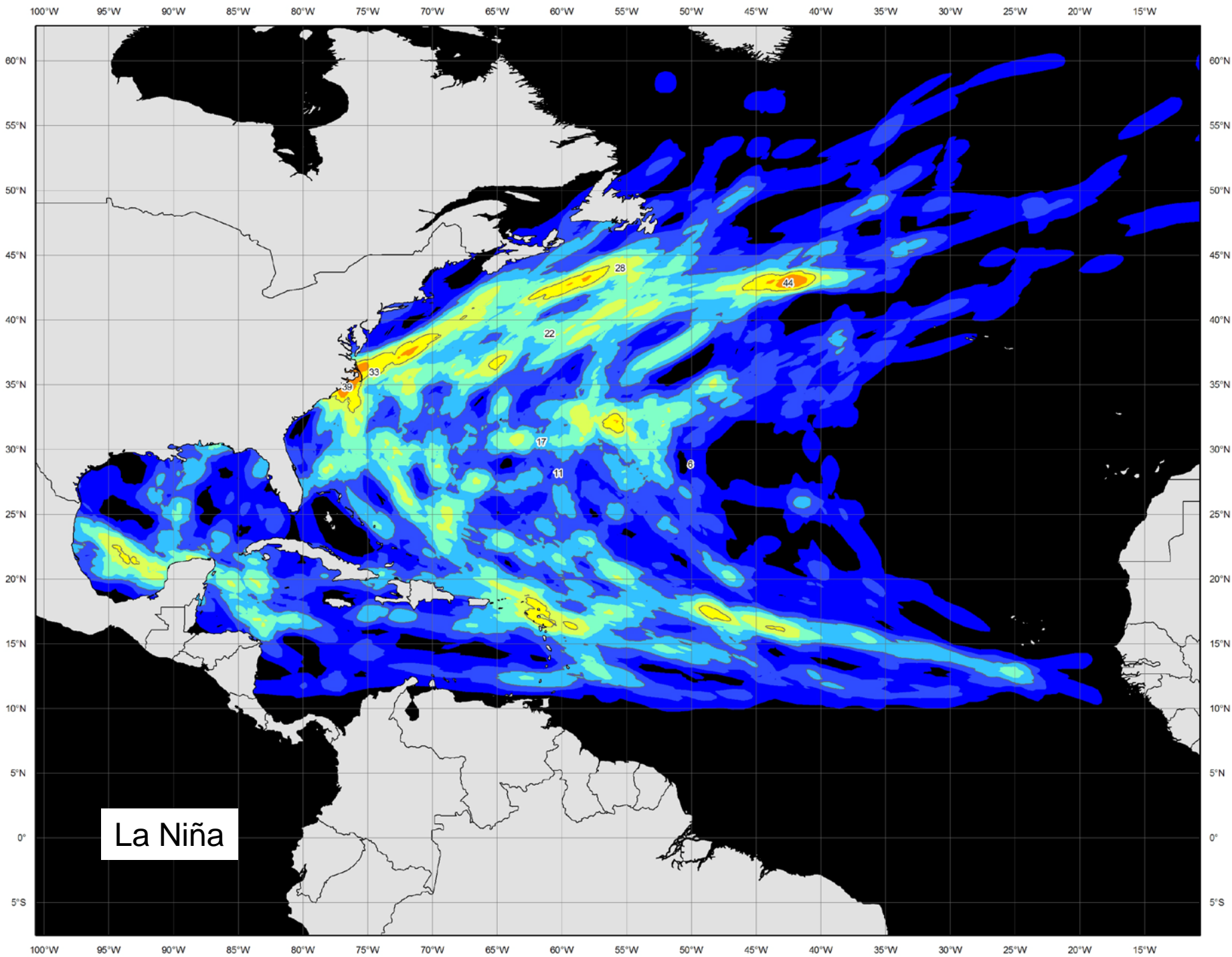


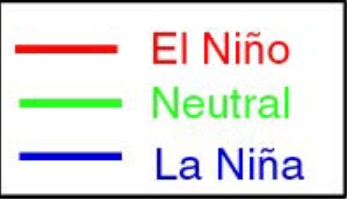
Extra shear and dry sinking air over the Atlantic basin.



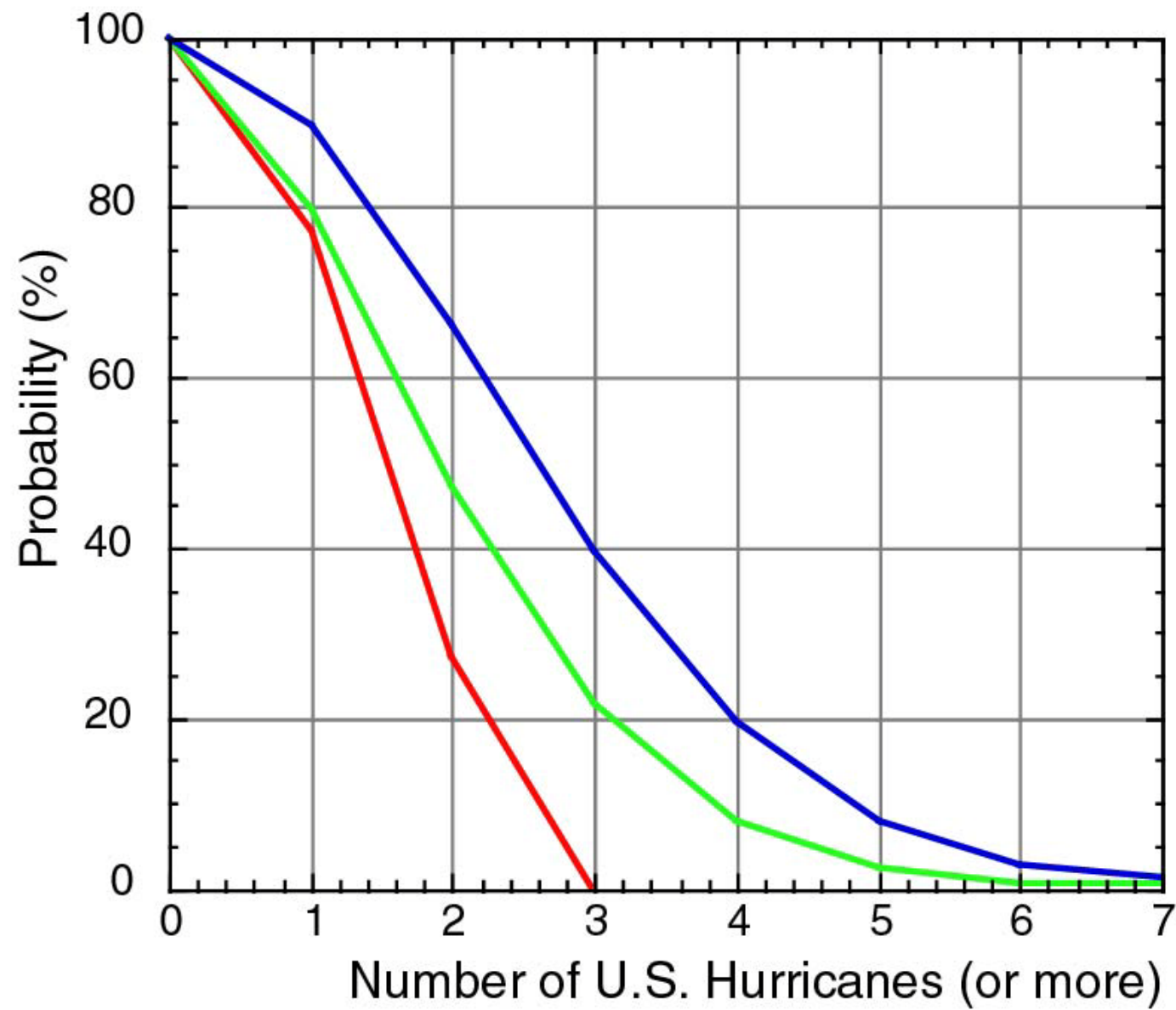
Less shear and sinking air over the Atlantic basin in La Niña.





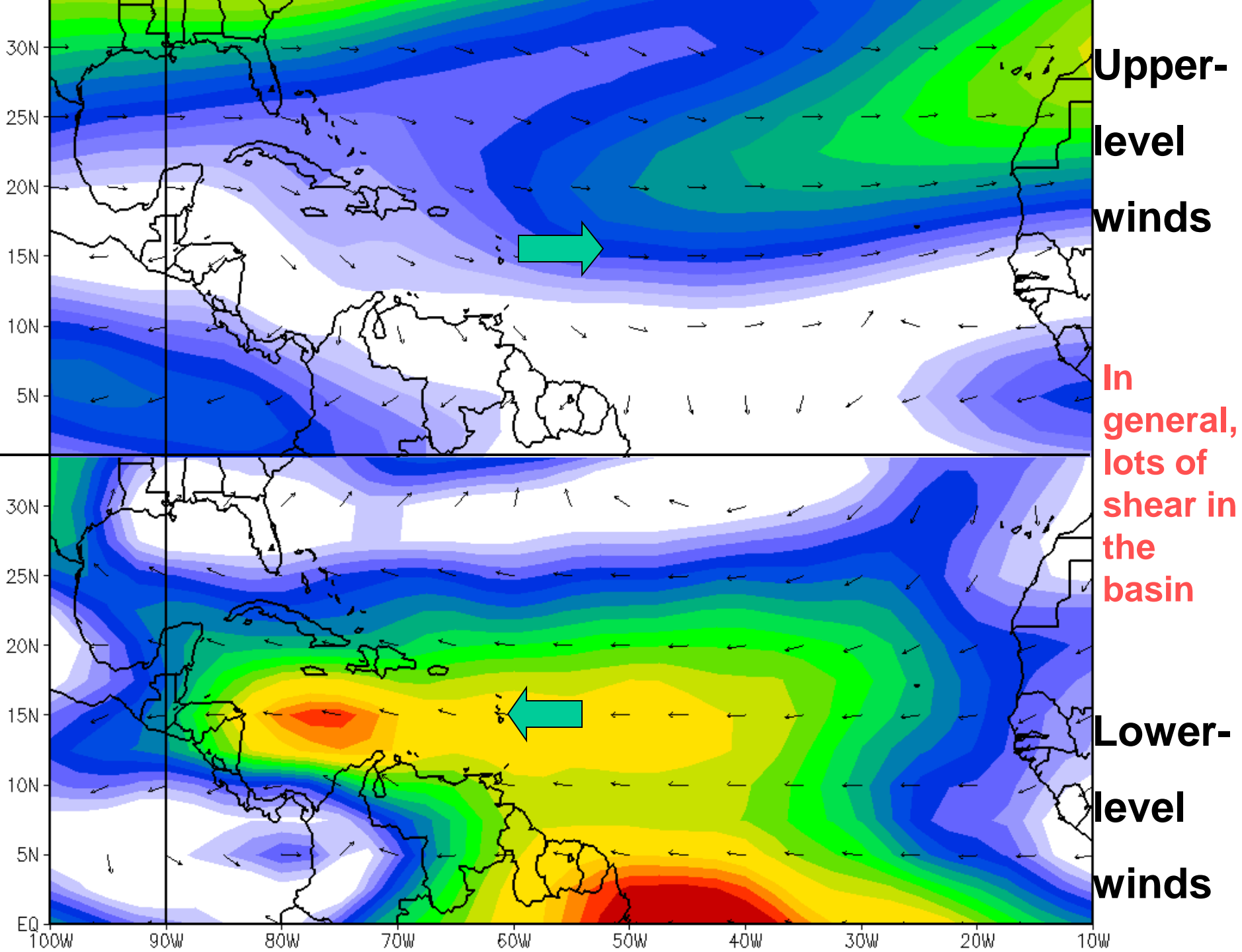


U.S. Landfalling Hurricane Probabilities

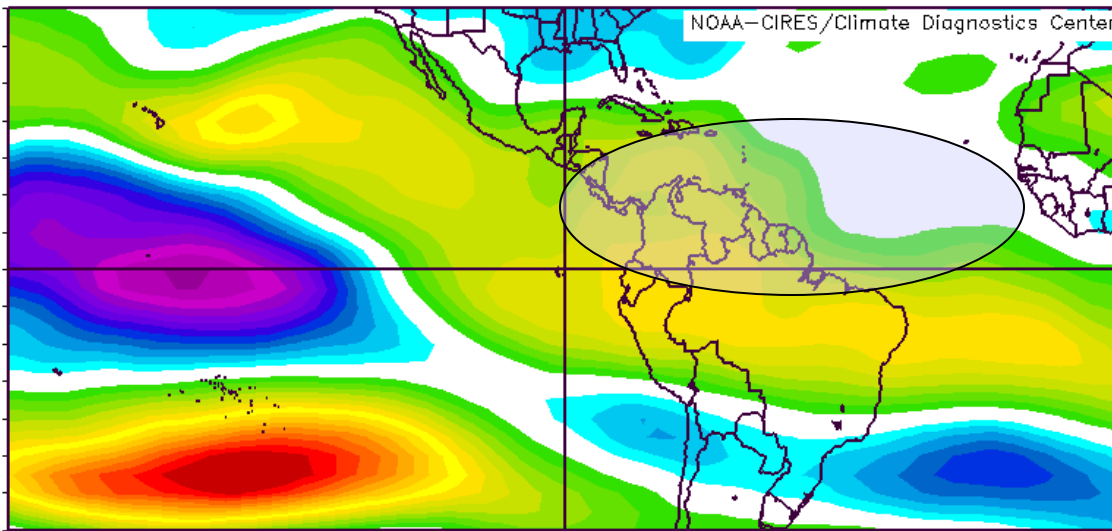


Vertical Wind Shear

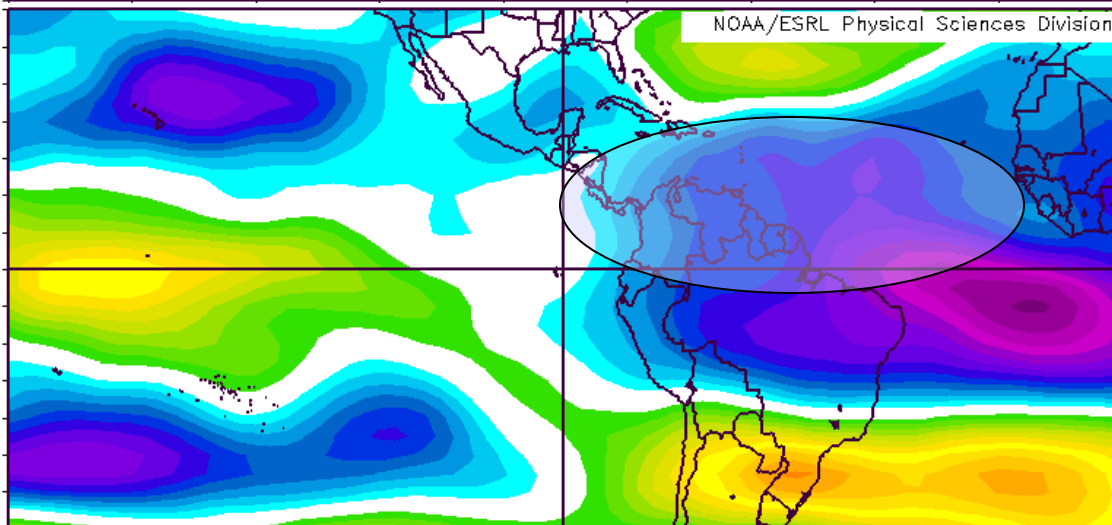
- Tropical cyclones develop in low shear environments, less than about 10-15 mph.
- June-July shear foreshadows later season shear.
- Important because about 90% of all major hurricanes strike after 1 August.



200mb zonal wind anomalies (m/s) during June-July of 10 ENSO events.



El Niño



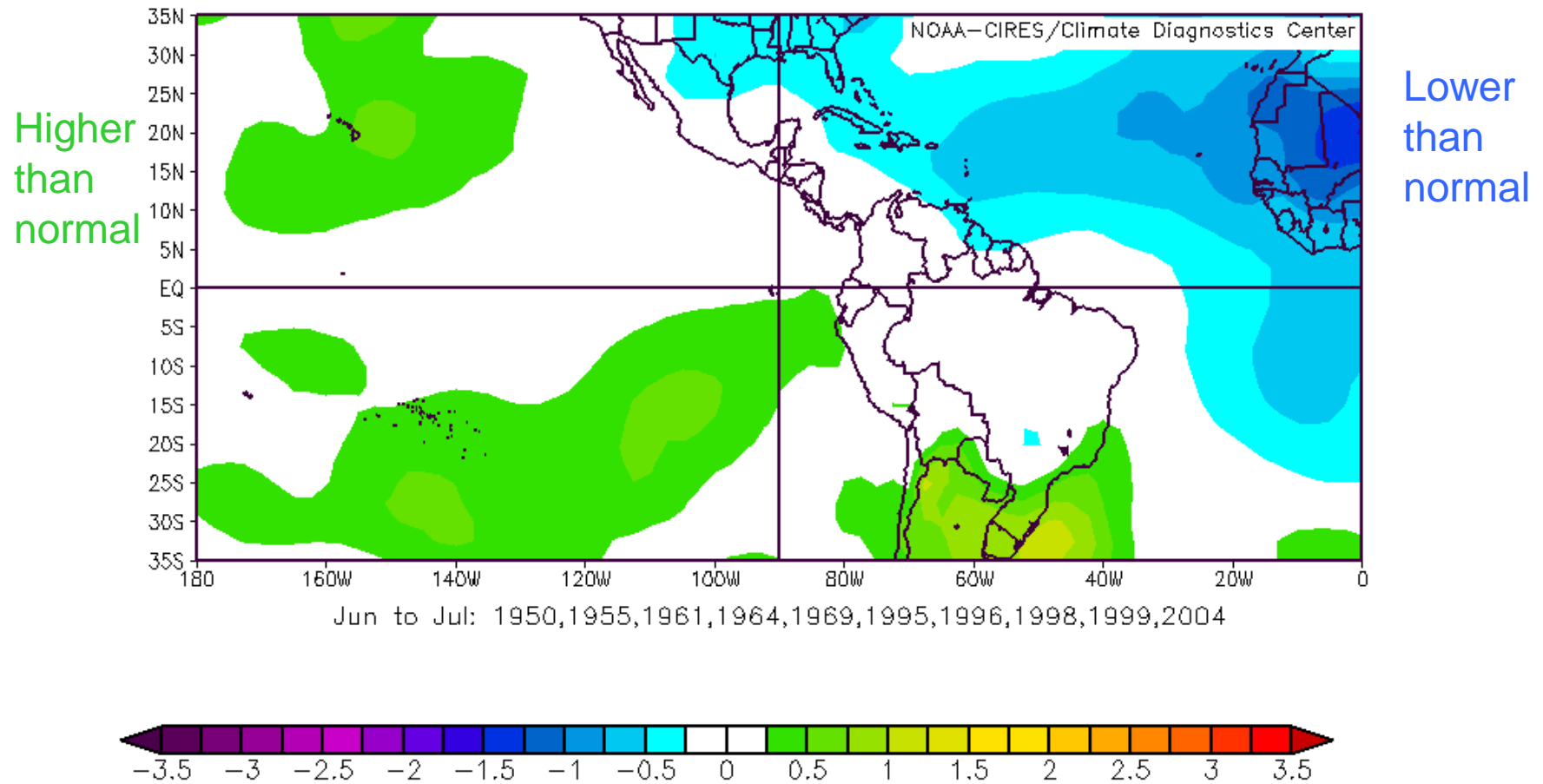
La Niña



Sea-Level Pressure

- Known to be a seasonal predictor for a century.
- Pressure is an indicator for multiple qualities in the atmosphere.
- Low early season pressures often linked to active hurricane seasons

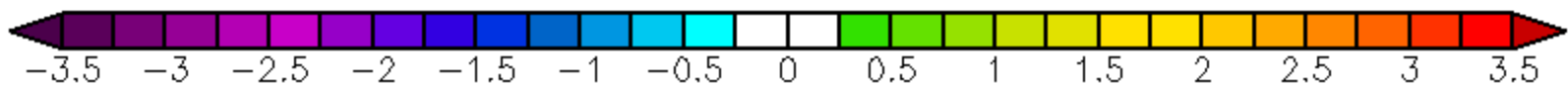
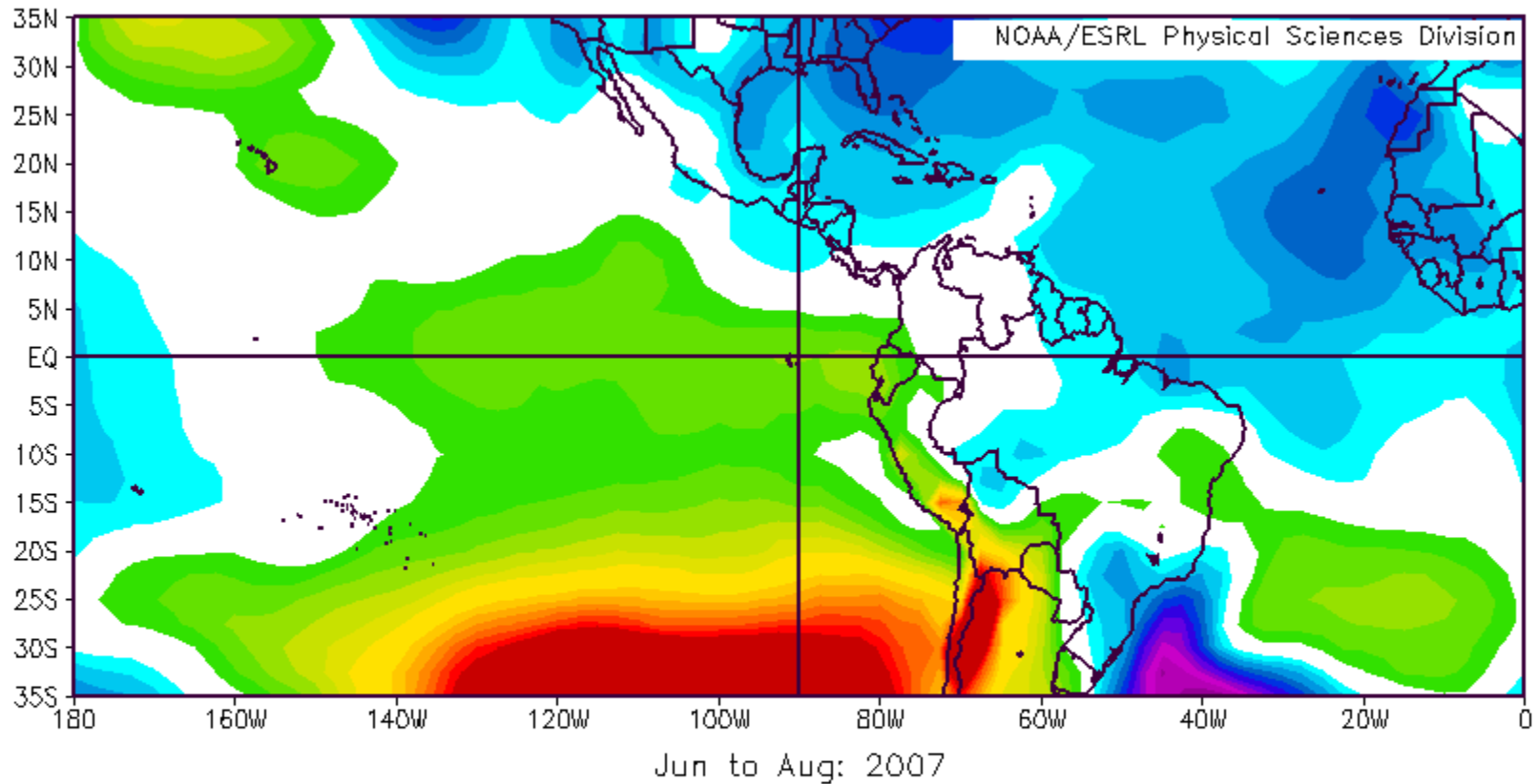
Composite map of June-July surface pressures during 10 active hurricane seasons



Pressure isn't everything!

NCEP/NCAR Reanalysis

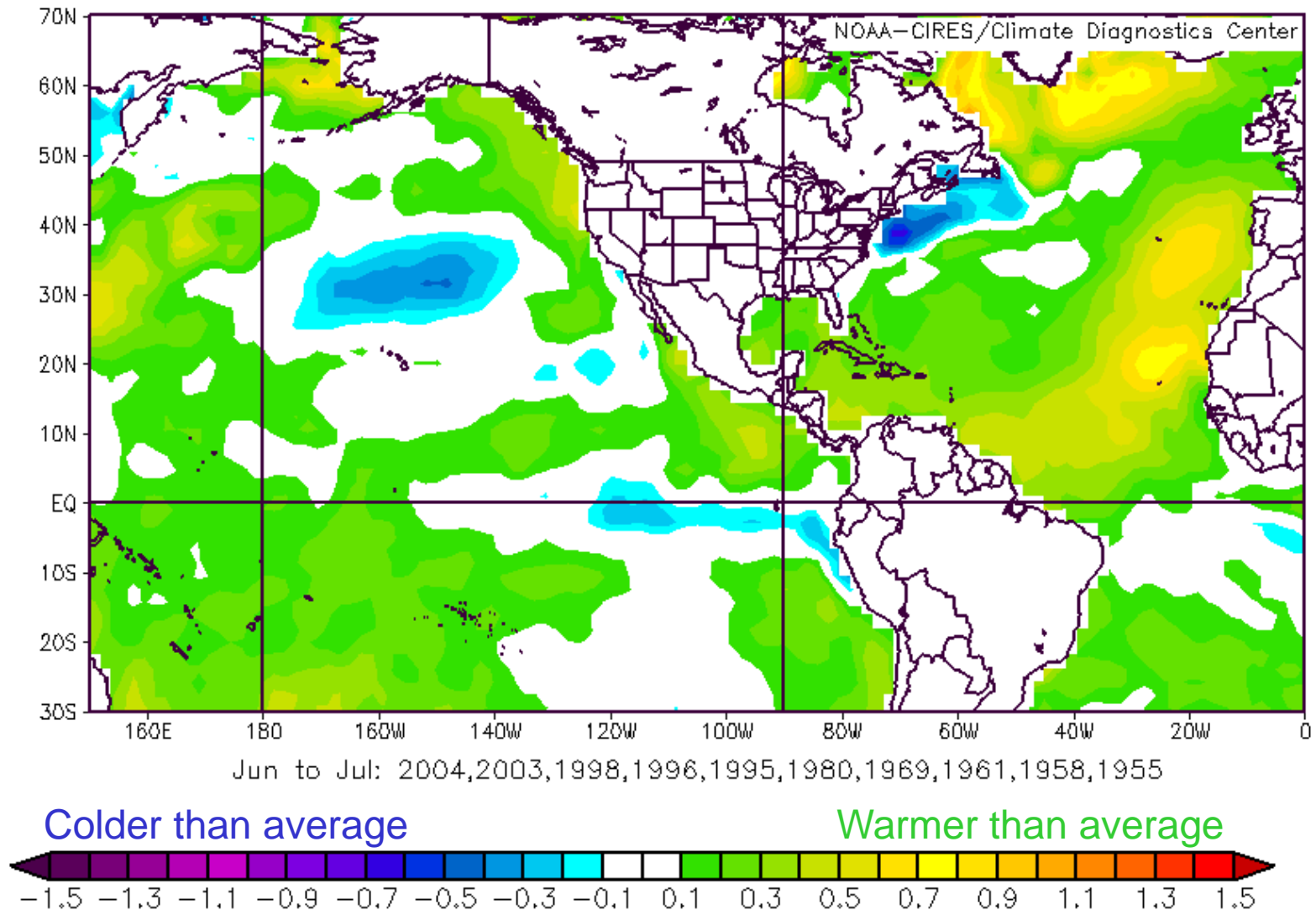
Sea Level Pressure (mb) Composite Anomaly 1968–1996 climo



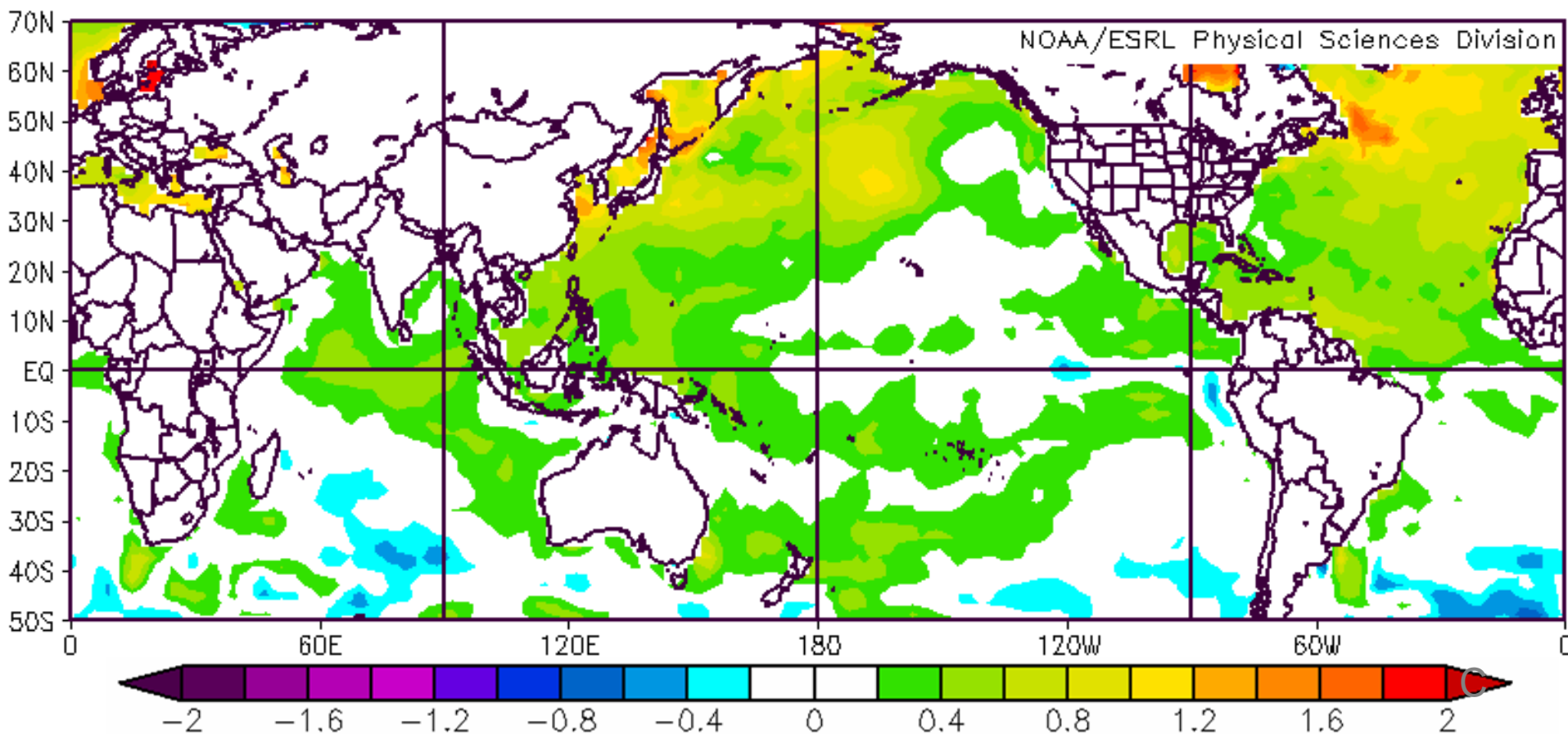
Sea-Surface Temperatures (SSTs)

- Warmer waters generally mean a more active hurricane season.
- Higher SSTs lead to more instability in the lowest layer of the atmosphere.
- Positioning of SST anomalies can change local weather patterns.
- Long-term cycle also important.

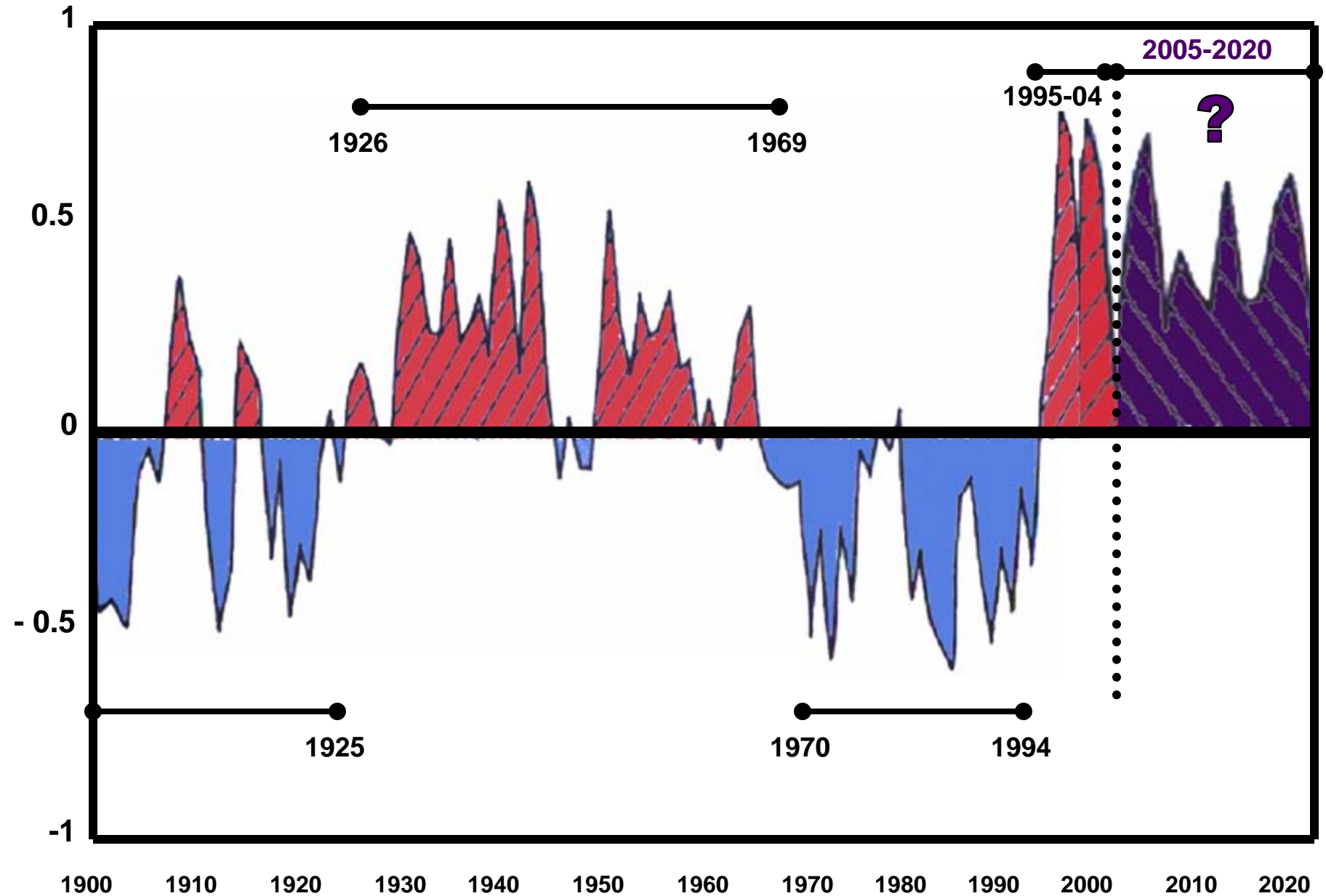
June-July SST anomalies during 10 active hurricane seasons



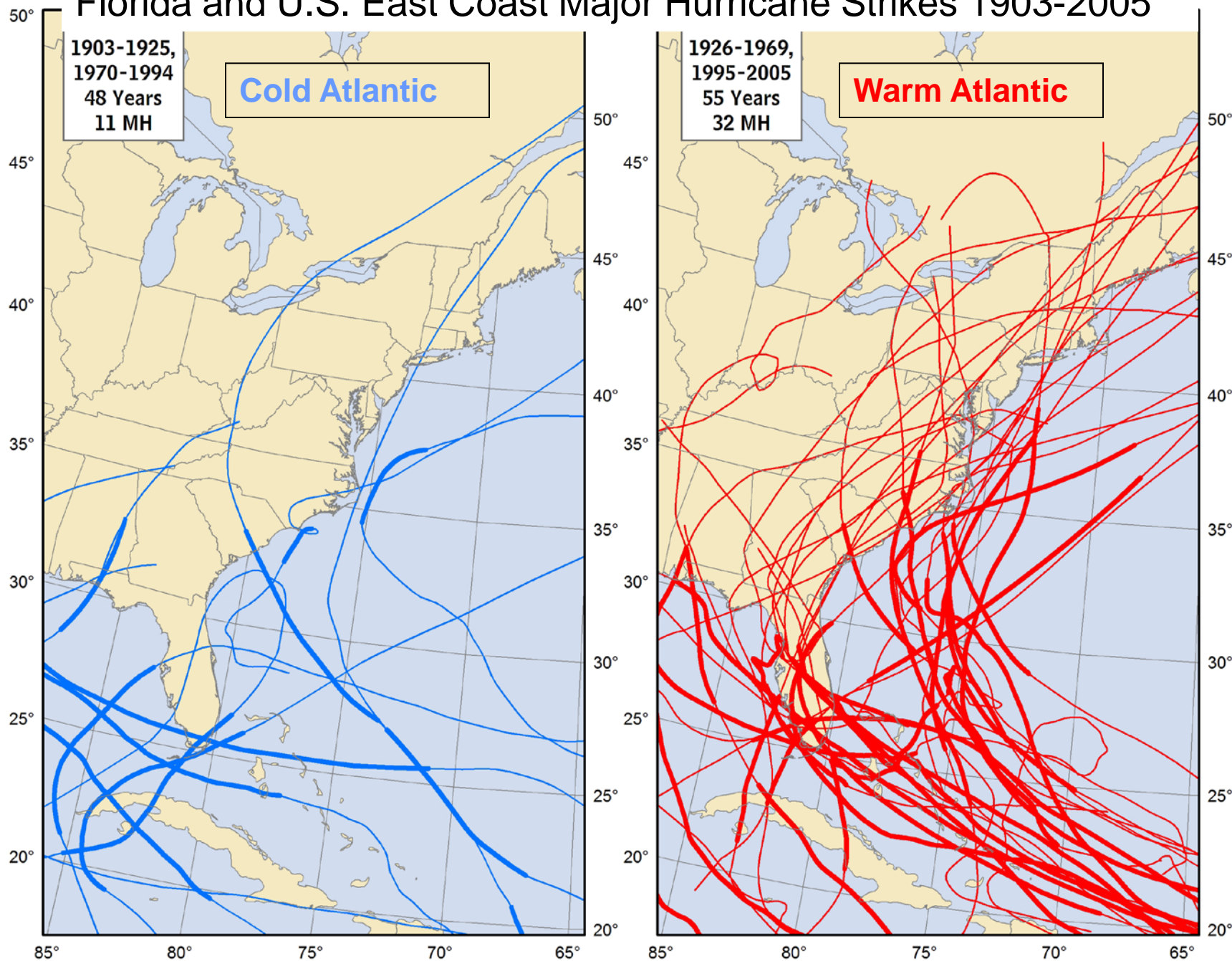
August-October SSTs 1995-2007 minus 1970-1994



North Atlantic SST Annual Anomaly (50°N-60°N; 50°W-10°W)



Florida and U.S. East Coast Major Hurricane Strikes 1903-2005



Global Climate Model Forecasts

- Global Climate Models (GCMs) are now able to simulate the number and strength of a given storm season.
- Skill is derived from the model forecasts of El Niño and Atlantic SSTs, which primarily control the large-scale Atlantic conditions.
- Hindcast skill is comparable to statistical techniques and appears to be new independent information for the forecaster.

Storm Counts and ACE Index

2009 Atlantic Basin

ATL – Below Average Year

CFS T382 ATL							% of Normal ACE Index
2009	Aug	Sept	Oct	Nov	Total		
704	1	2		1	4		33.04
705	1	1	1		3		36.44
706	3	2			5		51.22
707	3	1	1		5		25.74
708	3	1		1	5		51.62
709	3	2			5		53.89
710	1	3	1		5		86.55
711	2		2		4		26.10
712	3	2		2	7		67.75
713	4	4	1		9	Clim	147.18
Ensemble	2.4	1.8	0.6	0.4	5.2	7.8	57.95

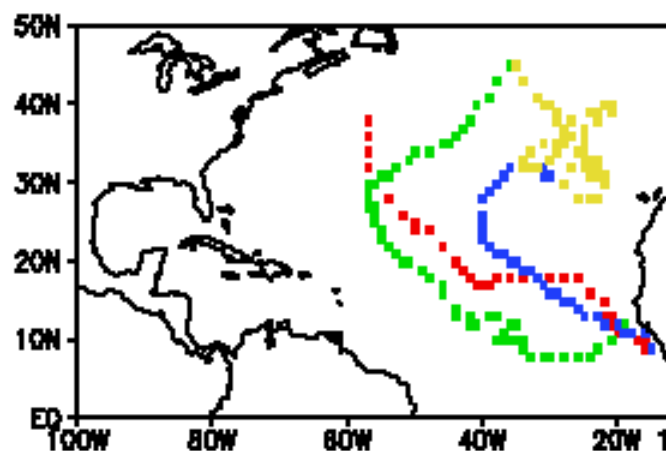
Standard Deviation: 2009 = 1.8 , Clim = 2.1

CFS is predicting **5.2** storms versus a **7.8** storm climatology.
 ACE Index is only **58% of Normal**

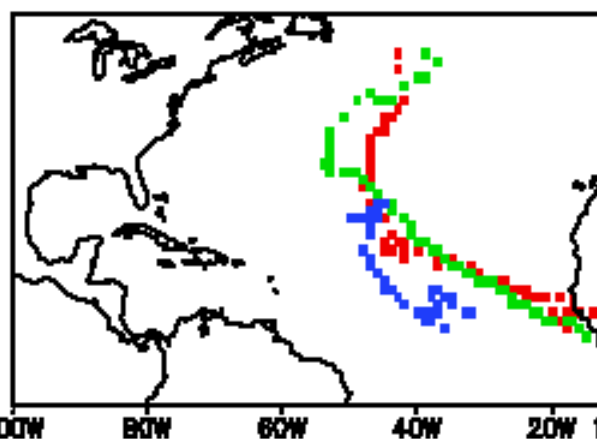
Tropical Cyclone Storm Tracks in the Atlantic Region

CFS_07 T382, 2009

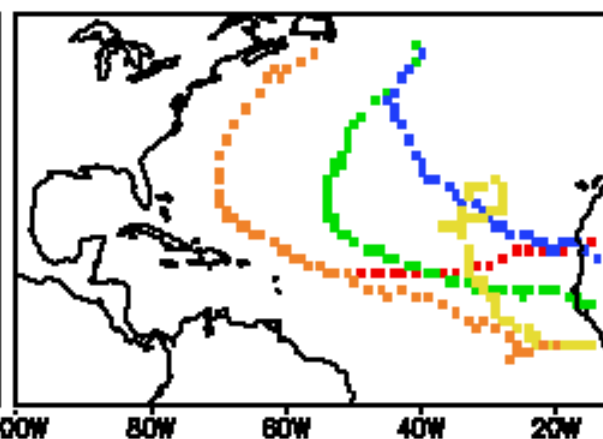
IC=0704 (4 Storms)



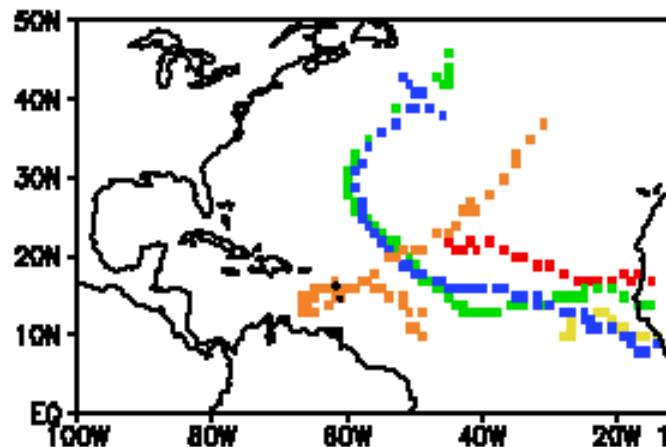
IC=0705 (3 Storms)



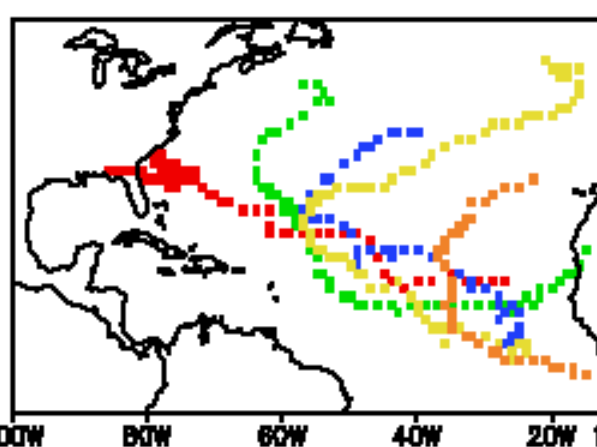
IC=0706 (5 Storms)



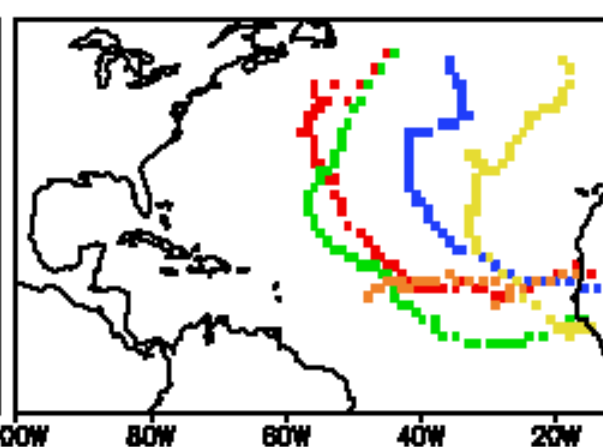
IC=0707 (5 Storms)



IC=0708 (5 Storms)



IC=0709 (5 Storms)



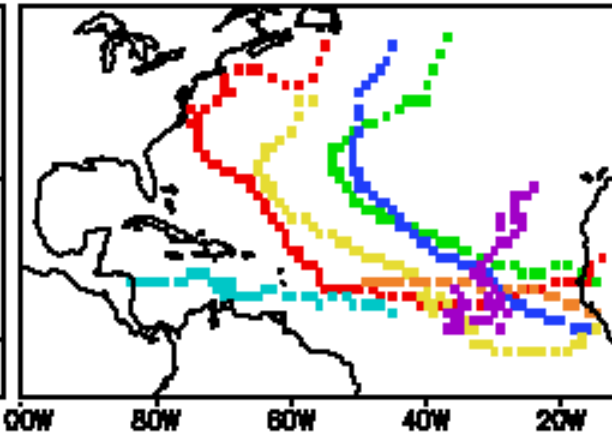
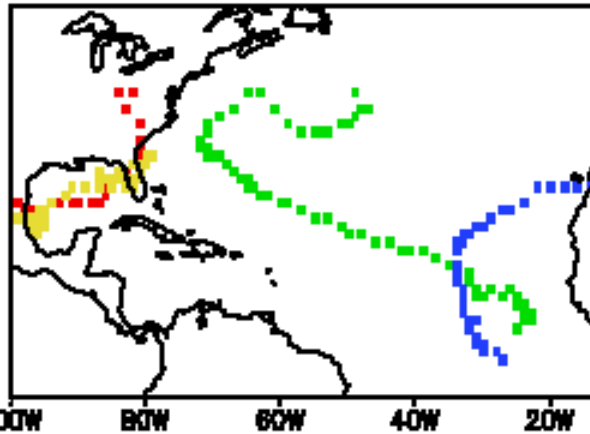
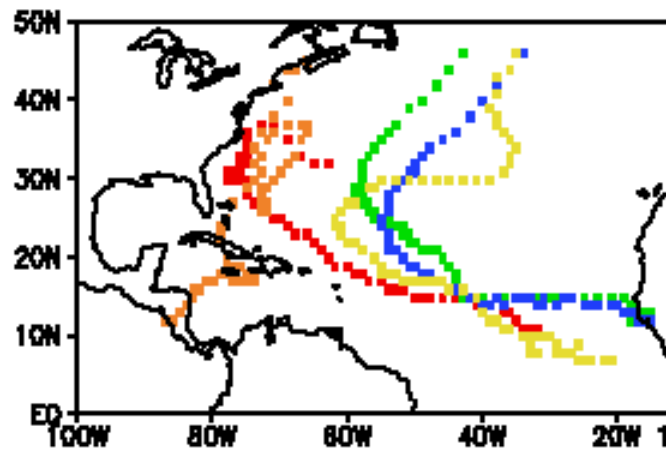
Tropical Cyclone Storm Tracks in the Atlantic Region

CFS_07 T382, 2009

IC-0710 (5 Storms)

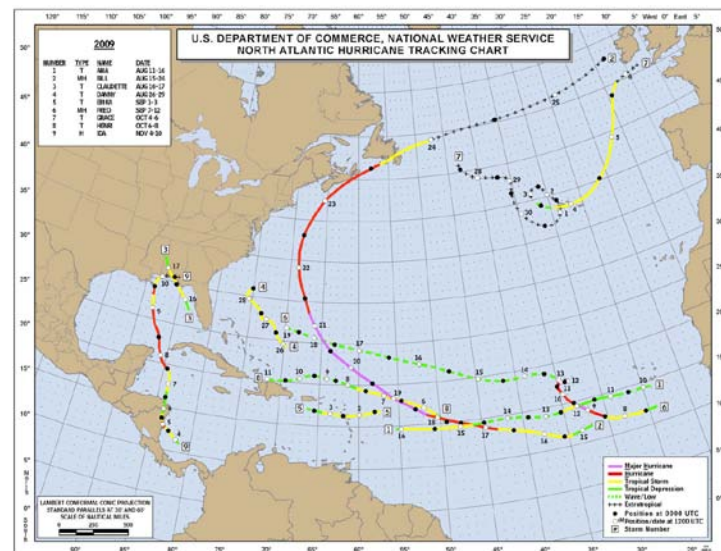
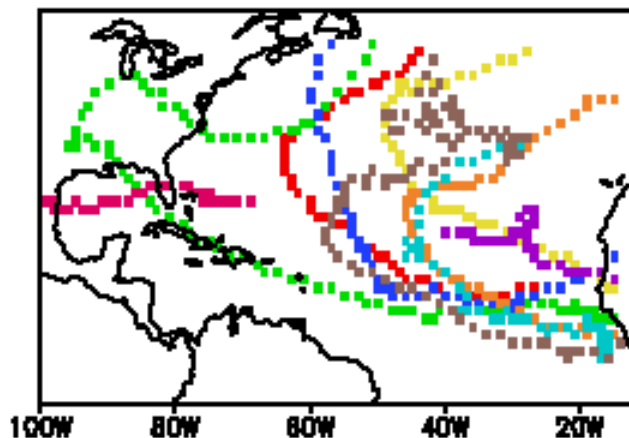
IC-0711 (4 Storms)

IC-0712 (7 Storms)



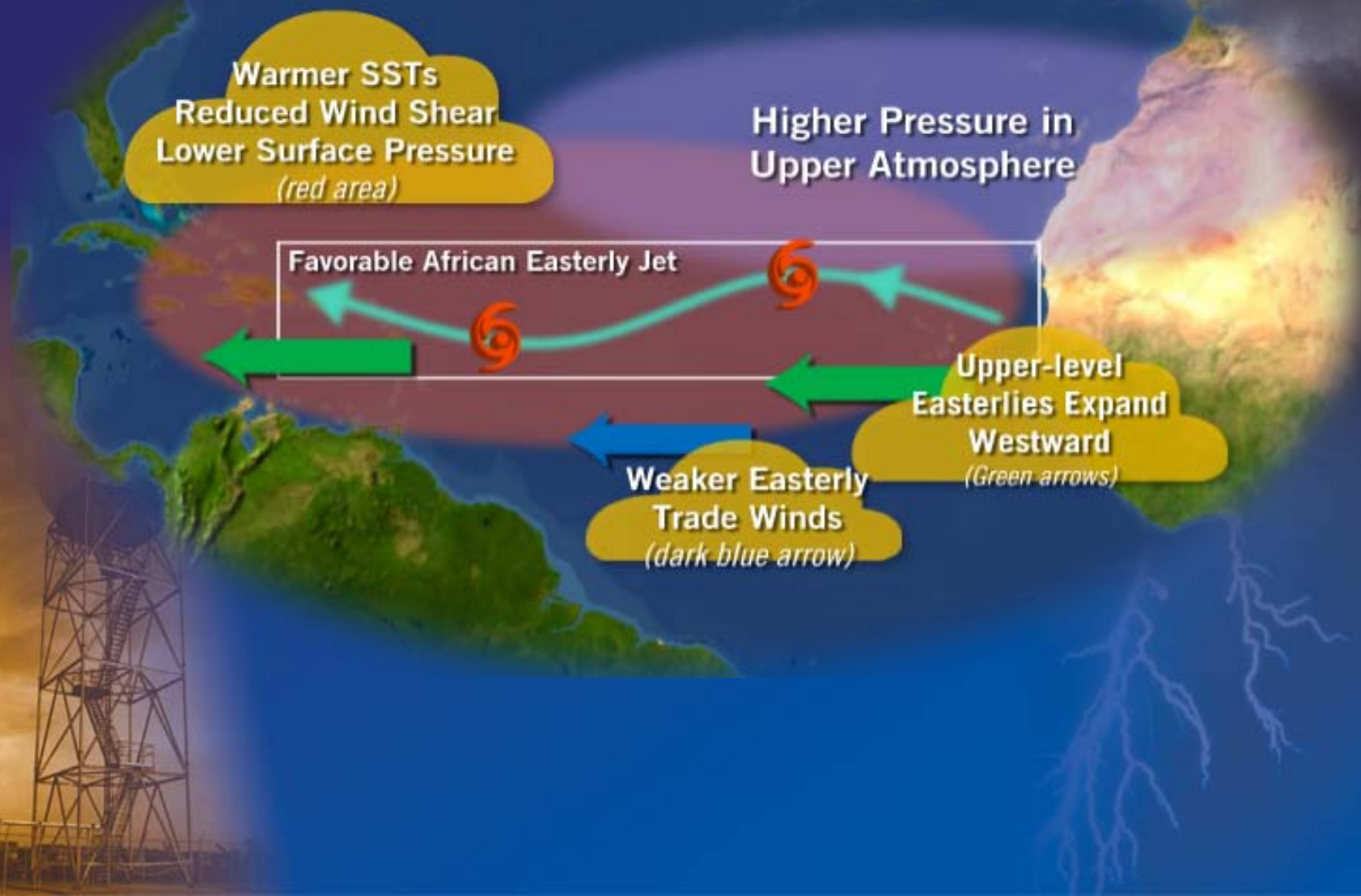
2009 Actual

IC-0713 (9 Storms)





Conditions During Active Atlantic Hurricane Seasons



NOAA Forecast Methodology

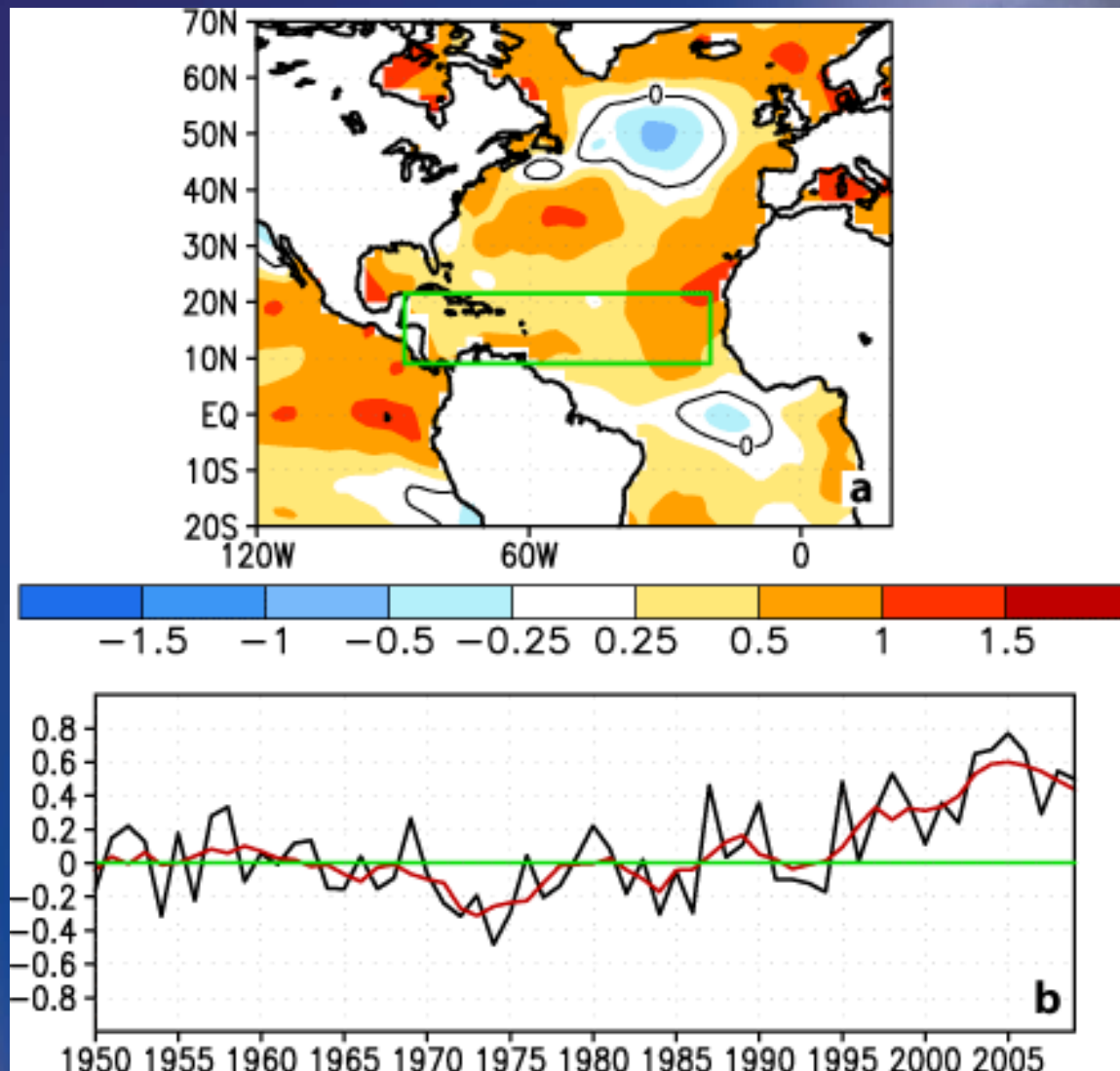
- 1) Assess states of the ocean and atmosphere.
- 2) Use model forecasts for El Niño/Atlantic SSTs and incorporate any analog techniques and dynamical model forecasts.
- 3) Predict range of overall activity and probabilities of above-, near-, and below-average seasons.
- 4) Qualitative/Quantitative process.
- 5) **No forecast of hurricane landfalls, just the total seasonal activity for the entire basin.**

NOAA's 2009 Atlantic Hurricane Outlook

<u>Season and Activity Type</u>	<u>May 2009 Outlook</u>	<u>Aug 2009 Outlook</u>	<u>Observed Activity</u>	<u>Climatology</u>
Chance Above Average	25%	10%		33%
Chance Near Average	50%	50%		33%
Chance Below Average	25%	40%	Below Average	33%
Named Storms	9-14	7-11	9	11
Hurricanes	4-7	3-6	3	6
Major Hurricanes	1-3	1-2	2	2
ACE % of Median	65-130	60-110	60	~100



Sea-surface temperatures in the tropical Atlantic were slightly warmer than average.

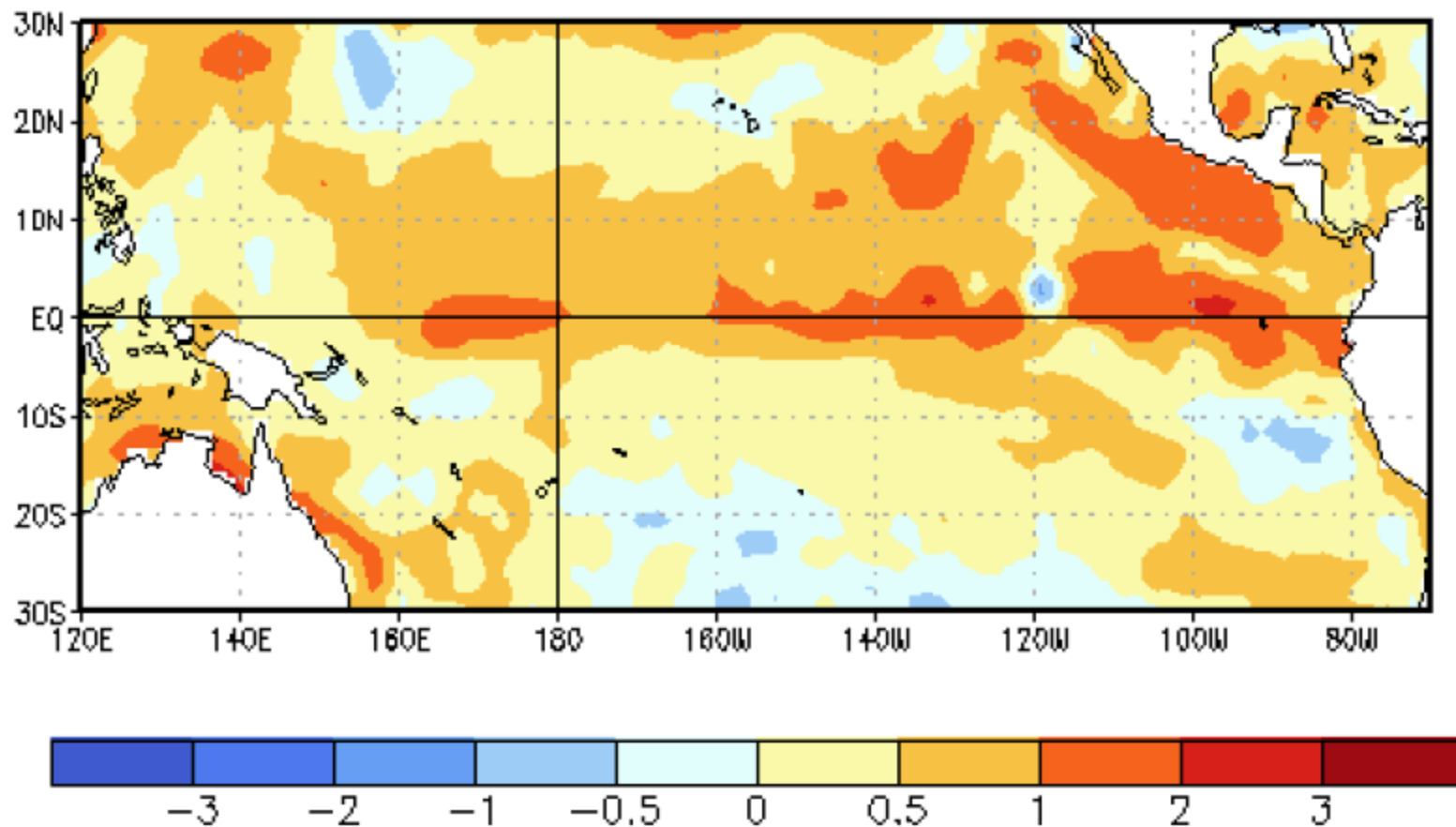




El Niño developed during the summer

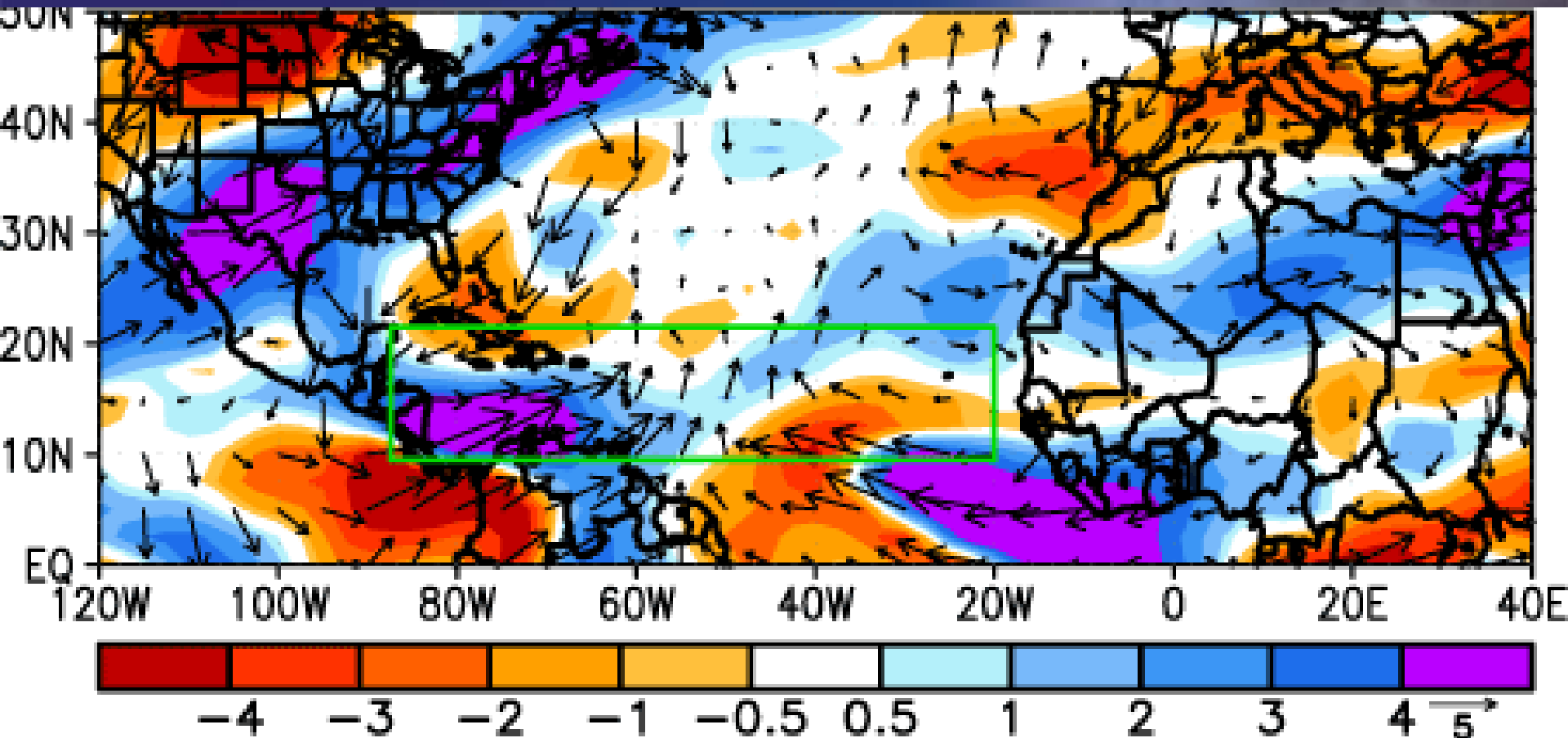
SST Anomalies ($^{\circ}\text{C}$)

02 SEP 2009



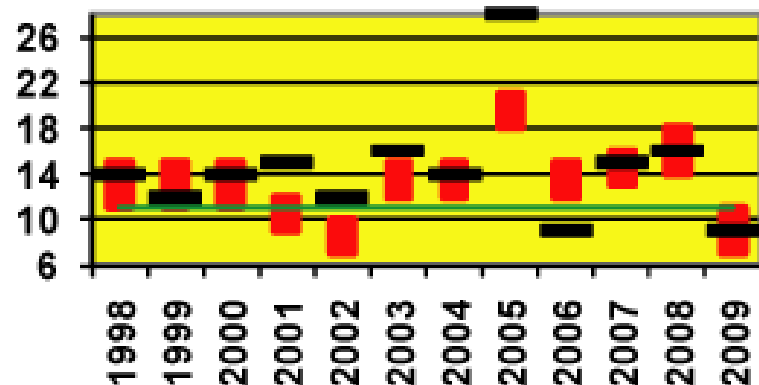


Anomalous vertical wind shear August-October 2009

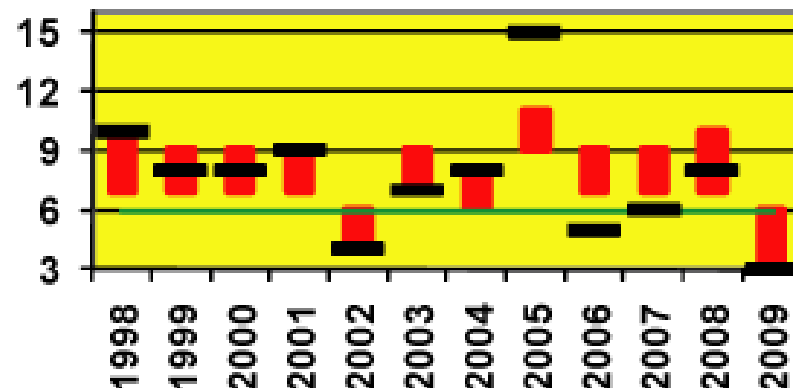


NOAA's Atlantic Hurricane Season Forecast Verification For Outlooks Issued in August

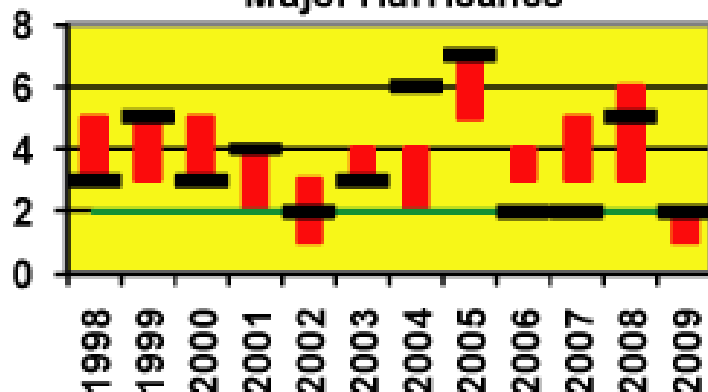
Named Storms



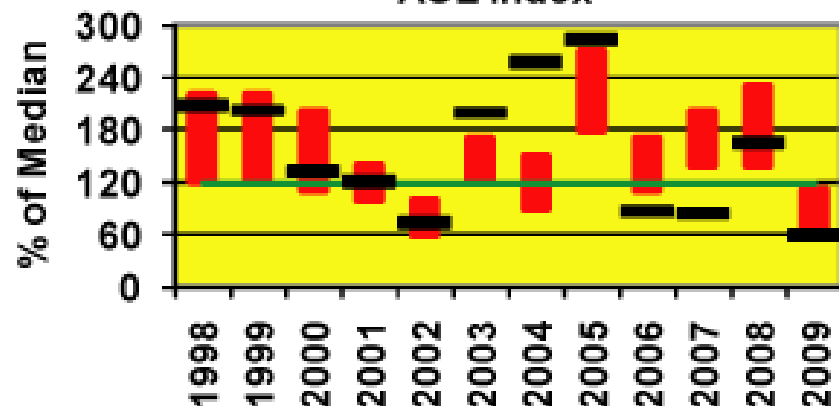
Hurricanes



Major Hurricanes



ACE Index



■ Predicted Range — Observed

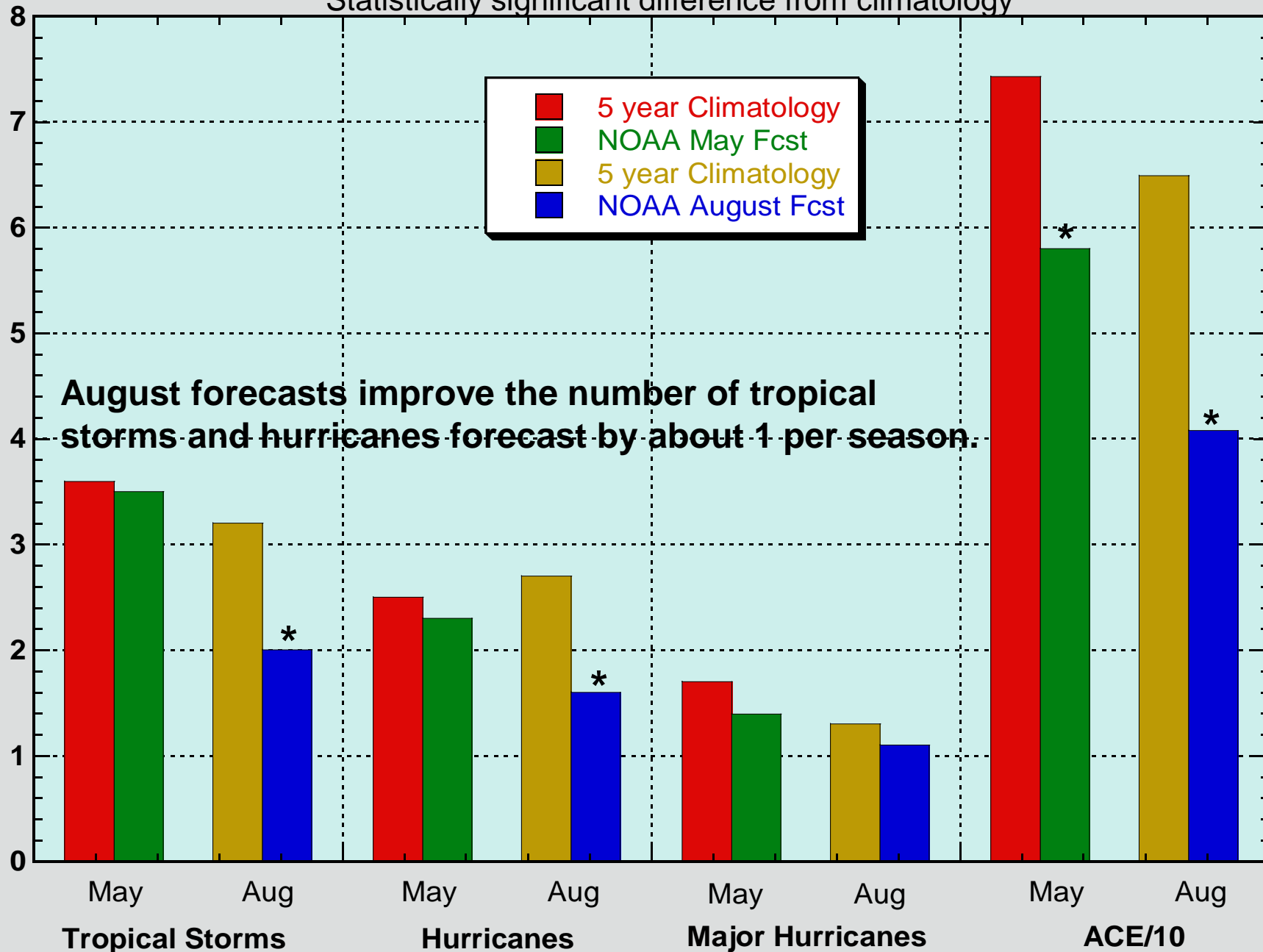
Green Bars for TS, H, MH denote the climatological means

Green bar in ACE plot shows lower boundary for above-normal seasons

Mean Absolute Error for May and August NOAA Forecasts

* Statistically significant difference from climatology

Forecast Error



Issued: 8/18

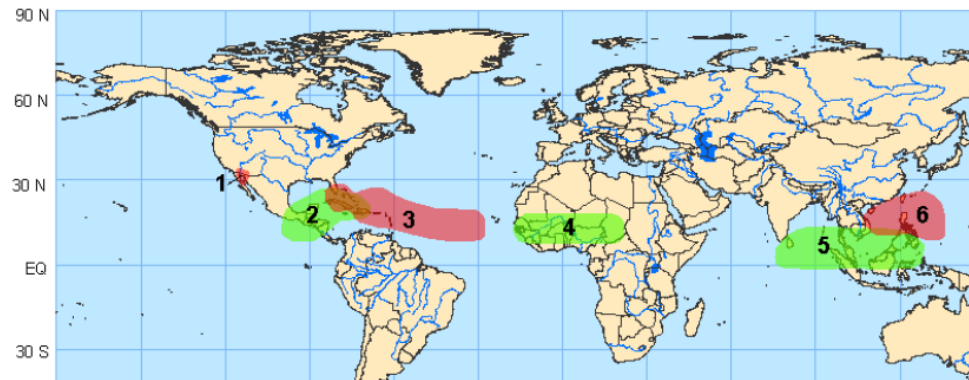
Week 2 Outlook – Valid: Aug 26 – Sep 1, 2008



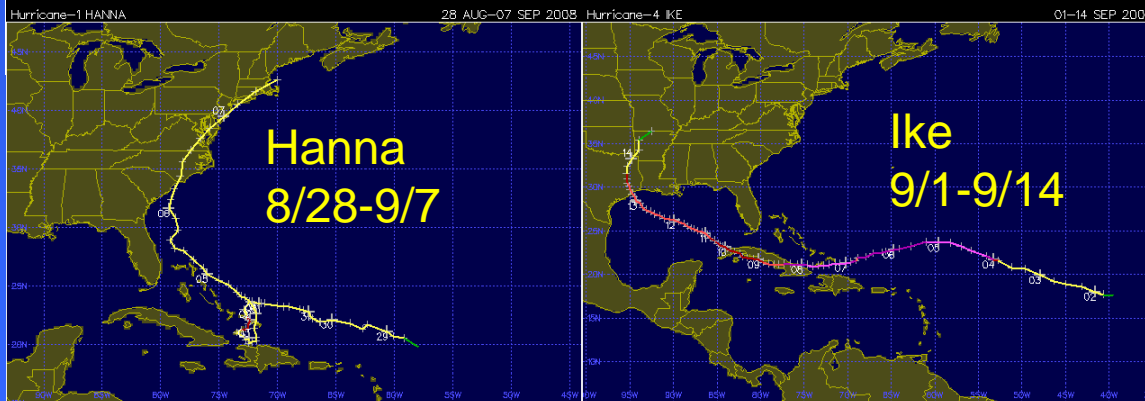
Product Example

Issued: 8/25

Week 1 Outlook – Valid: Aug 26 – Sep 1, 2008



Issued once per week
around 4 pm Mon.



A satellite image of Earth from space, showing a curved horizon and a vast expanse of blue oceans and white clouds. The image is used as a background for the text.

What about 2010?

**2010 NOAA seasonal outlook
is on May 27.**

however...

Putting Seasonal Forecasts in Perspective

If a perfect seasonal forecast predicts:

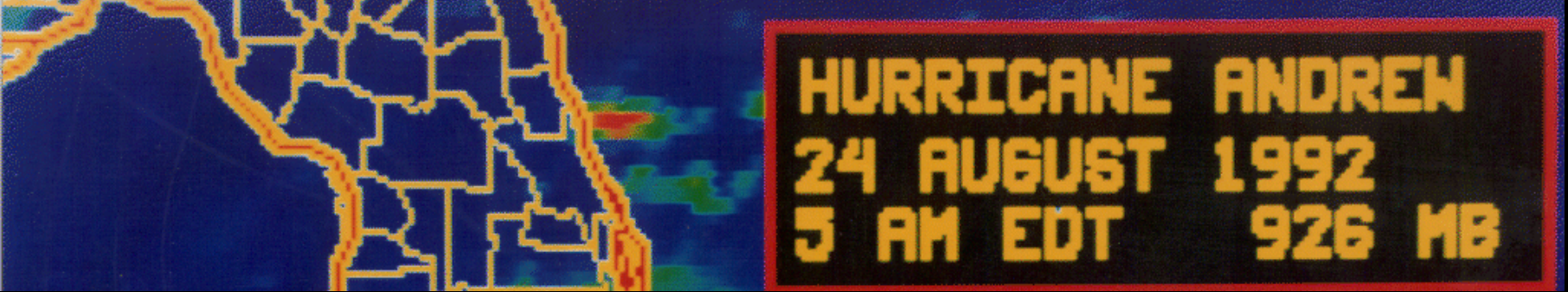
7 Named Storms

4 Hurricanes

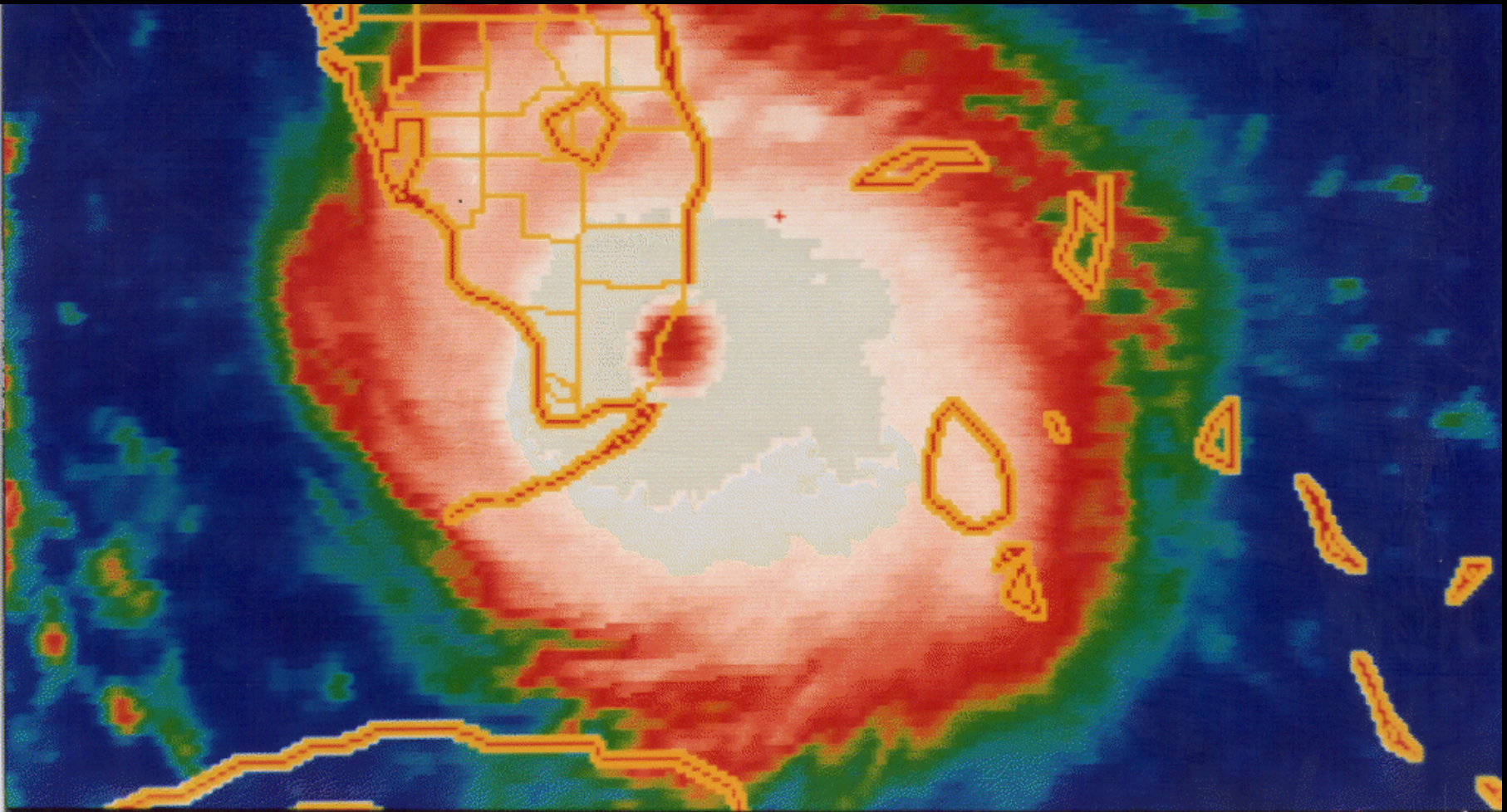
1 Major Hurricane

Long-term Average = 11, 6, and 2

Do you think it is going to be a bad year?



It only takes one in your area for it to be a bad season!



Conclusions

- El Niño/La Niña and Atlantic SSTs are probably the most important factor in a seasonal forecast.
- Early season atmospheric conditions can reveal clues to the rest of the season.
- 2009 was a mostly successful seasonal hurricane forecast.

Seasonal Forecasting is more than this!



Questions?

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