

Climatological Influences on Tropical Cyclones Uncertainties and Challenges



FCHLPM Meeting

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Peter Dailey, Ph.D.

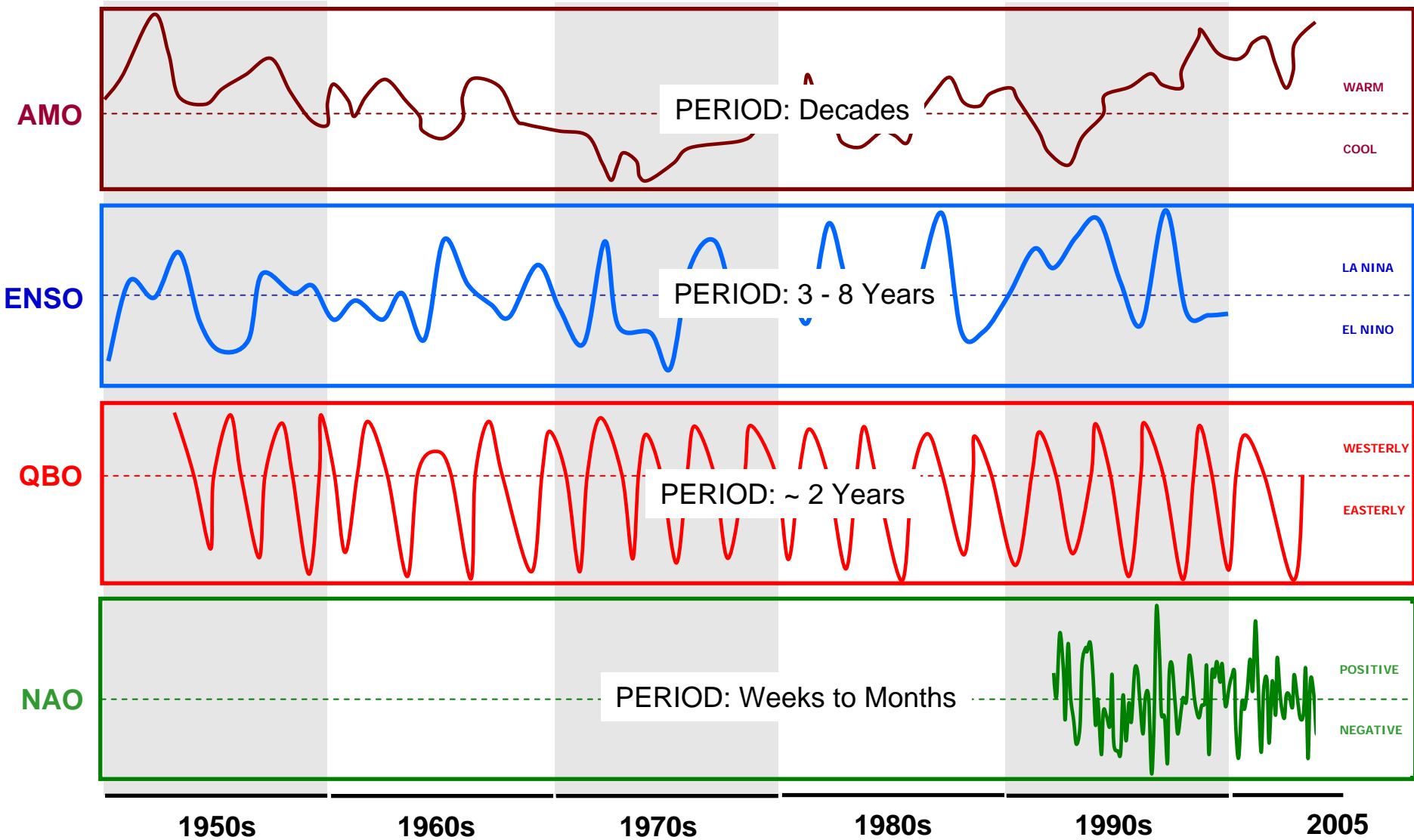
BETTER TECHNOLOGY
BETTER DATA
BETTER DECISIONS

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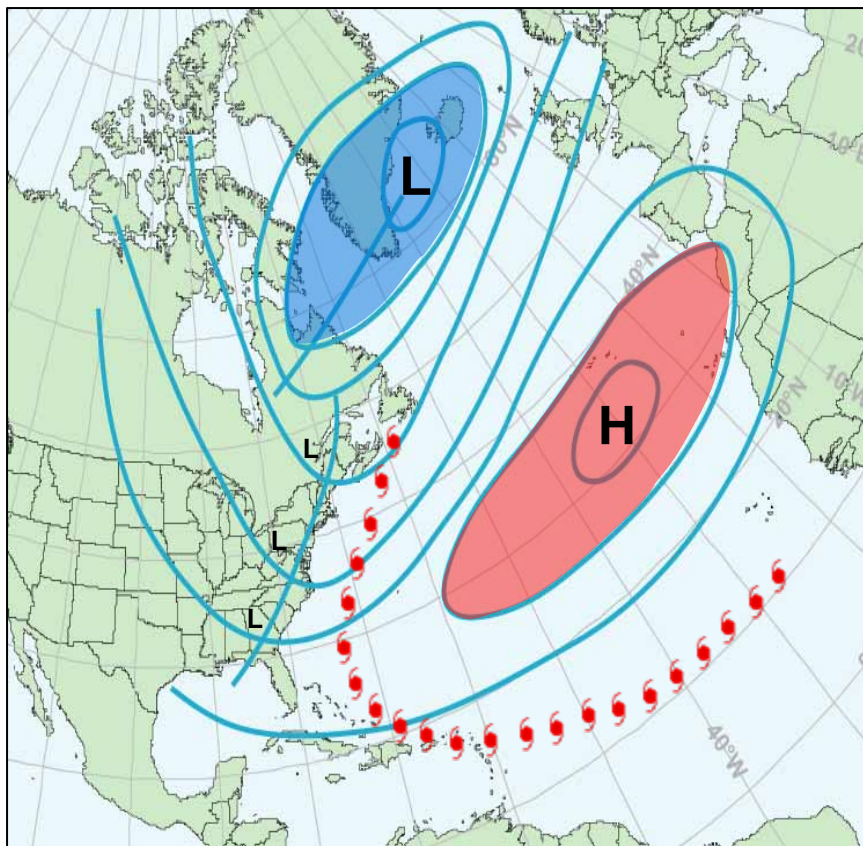
With the Exception of QBO, Periodicity is Irregular

Making Forecasts Uncertain

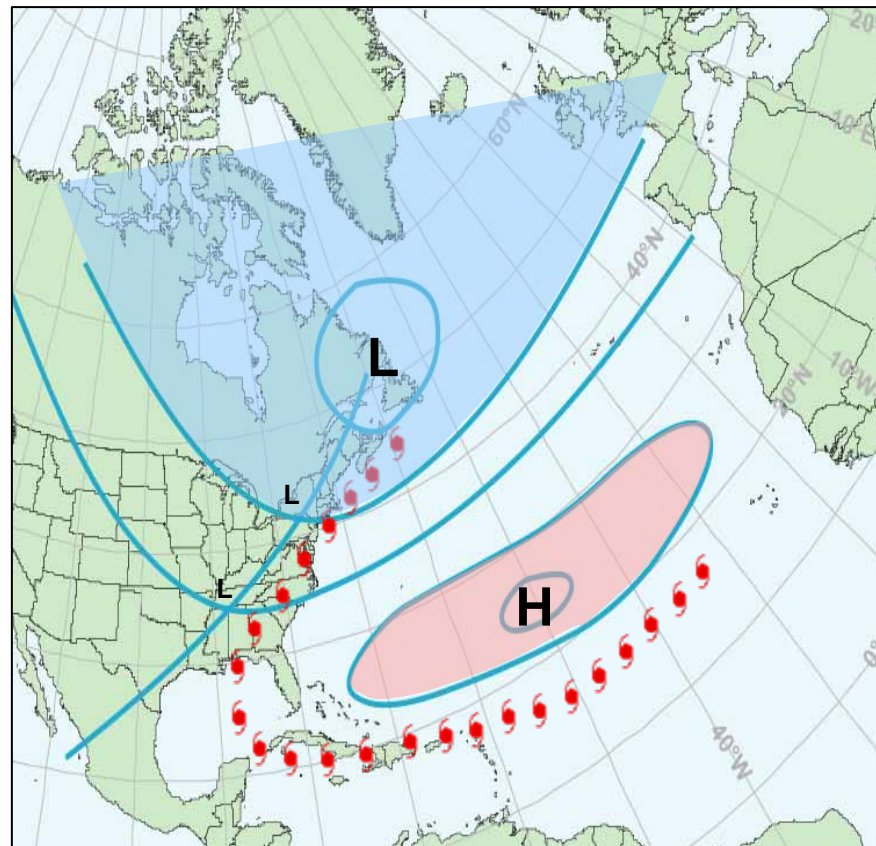


The Atlantic Pressure Distribution Impacts Hurricane Tracking and Landfall Frequency

NAO Positive Phase

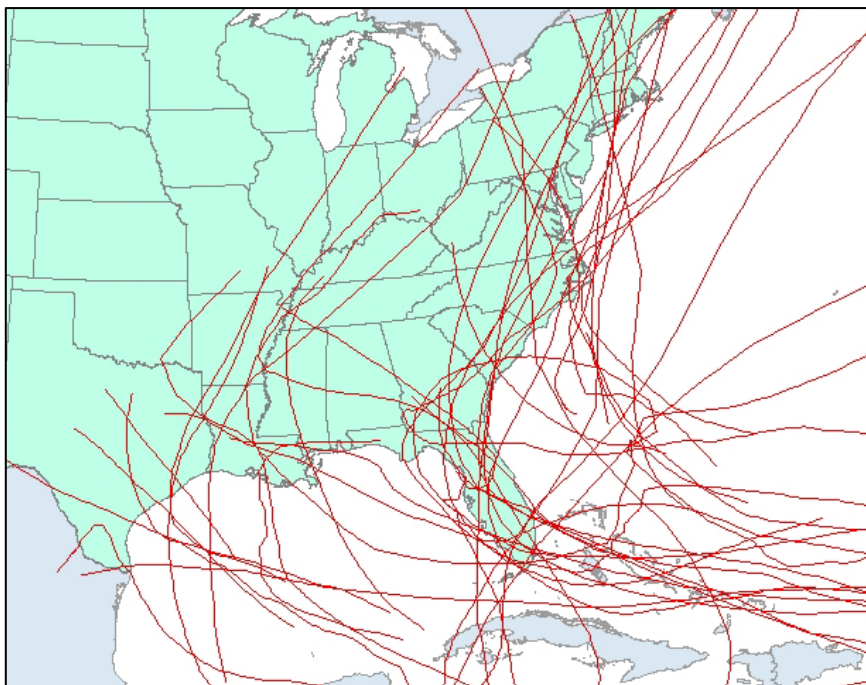


NAO Negative Phase

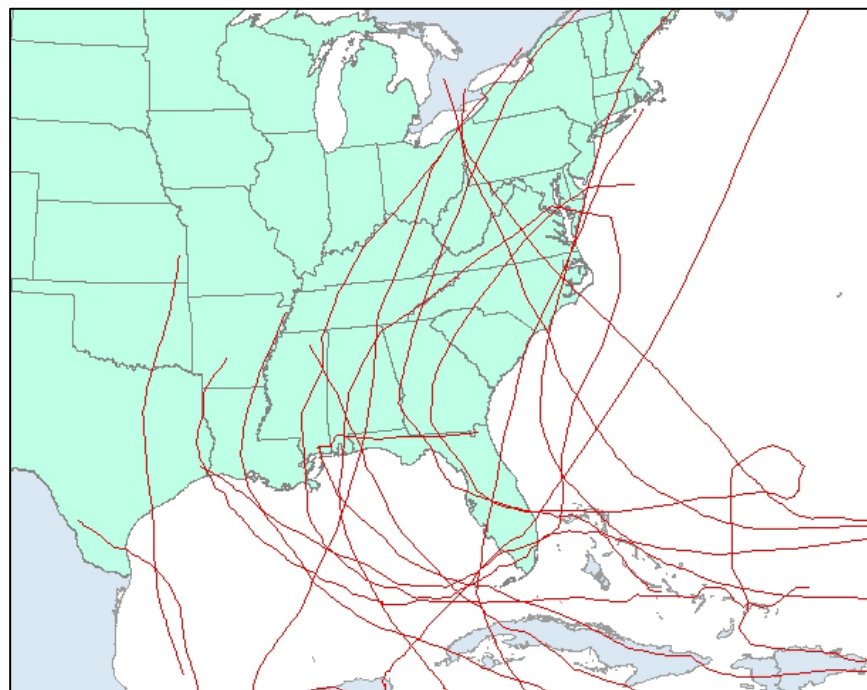


Frequency of Major U.S. Landfalling Hurricanes by AMO Warm Phase

Previous Warm Phase (45 yrs)

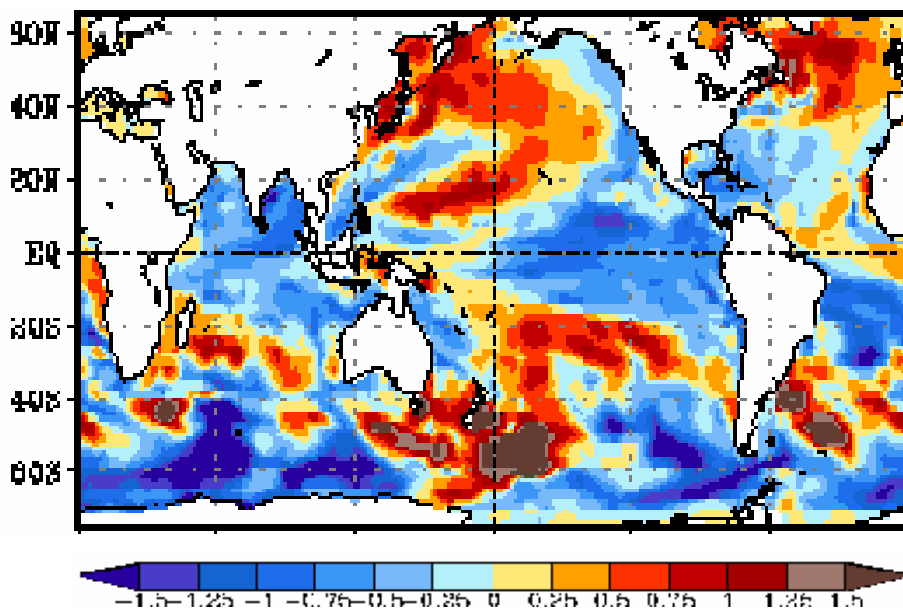


Current Warm Phase (11 years)

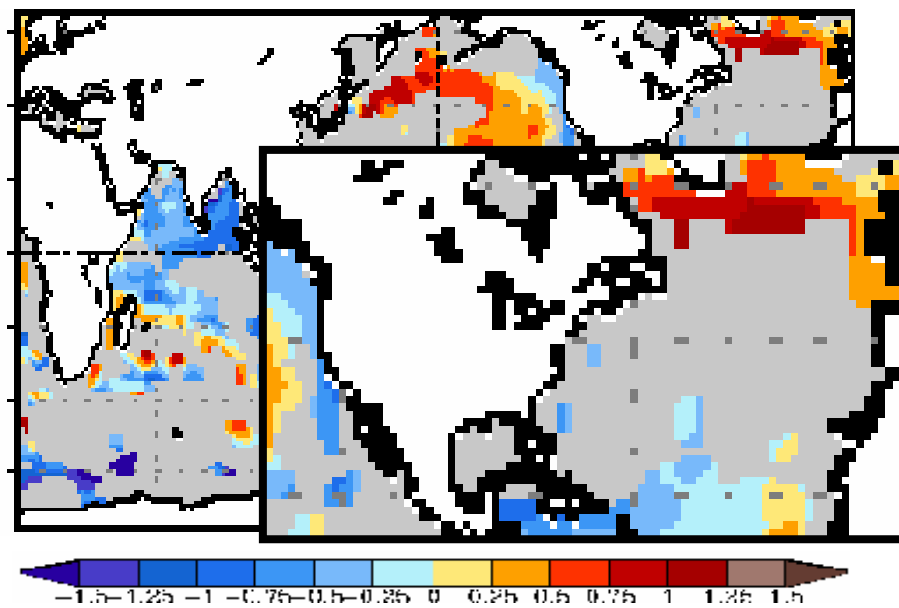


How Can We Approach SST Forecasts in the 5-Year Time Horizon?

5-Month SST Forecast from
Climate Prediction Center (CPC)



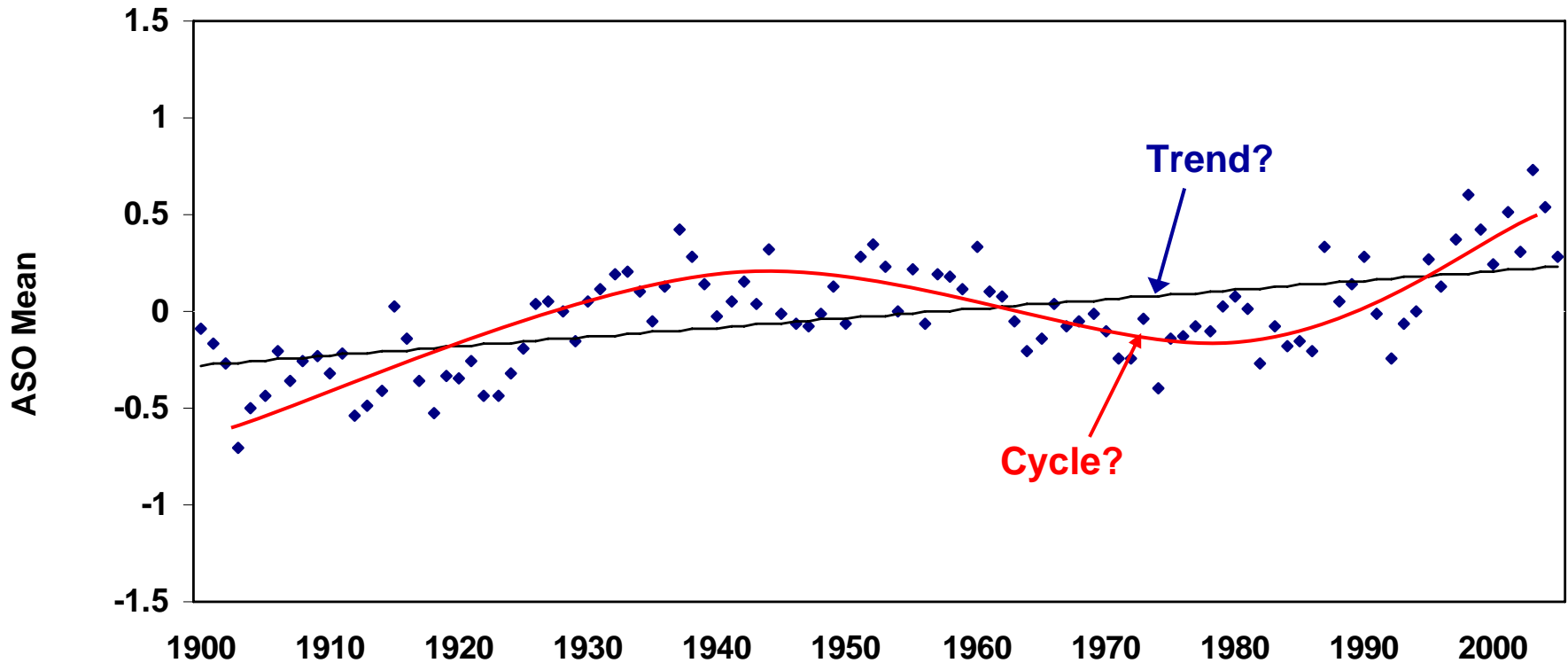
Same Forecast Masked for Uncertainty



Statistical SST Forecasts Begin with Analysis of the SST Anomaly Data

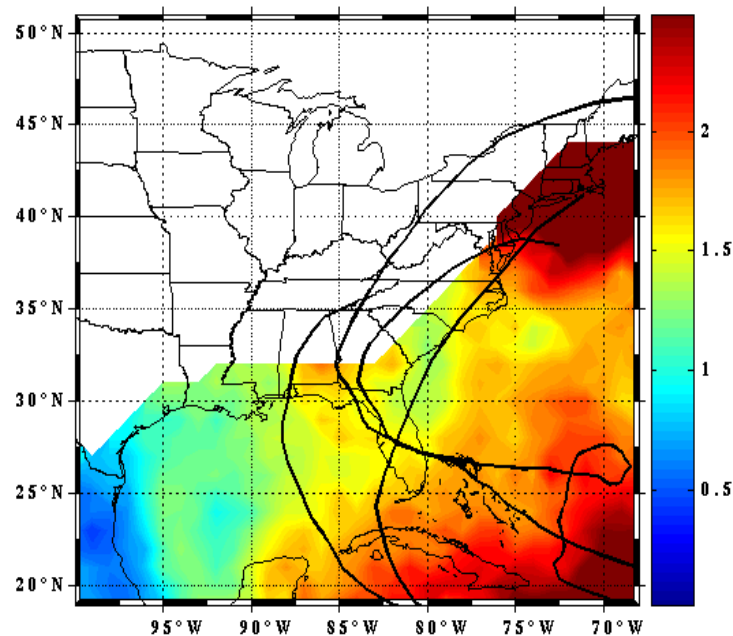


SSTs 1900-2005



Generalized Linear Model Used to Relate SST Anomalies with Hurricane Activity

- ❑ State-of-the-art method for computing regional relationship between climate and hurricane risk. Work is based upon published work by J. Elsner and collaborators
- ❑ Multi-regression model based on the correlation between relevant climate signals (e.g., SST, ENSO, NAO) and hurricane activity
- ❑ Given SST input, the GLM model computes the hurricane Index and associated confidence intervals
 - The index is the ratio between hurricane frequency for a specific climate and hurricane frequency in the average climate
 - An index of **2.0** means storms are twice as likely, and an index of **0.5** means storms are half as likely

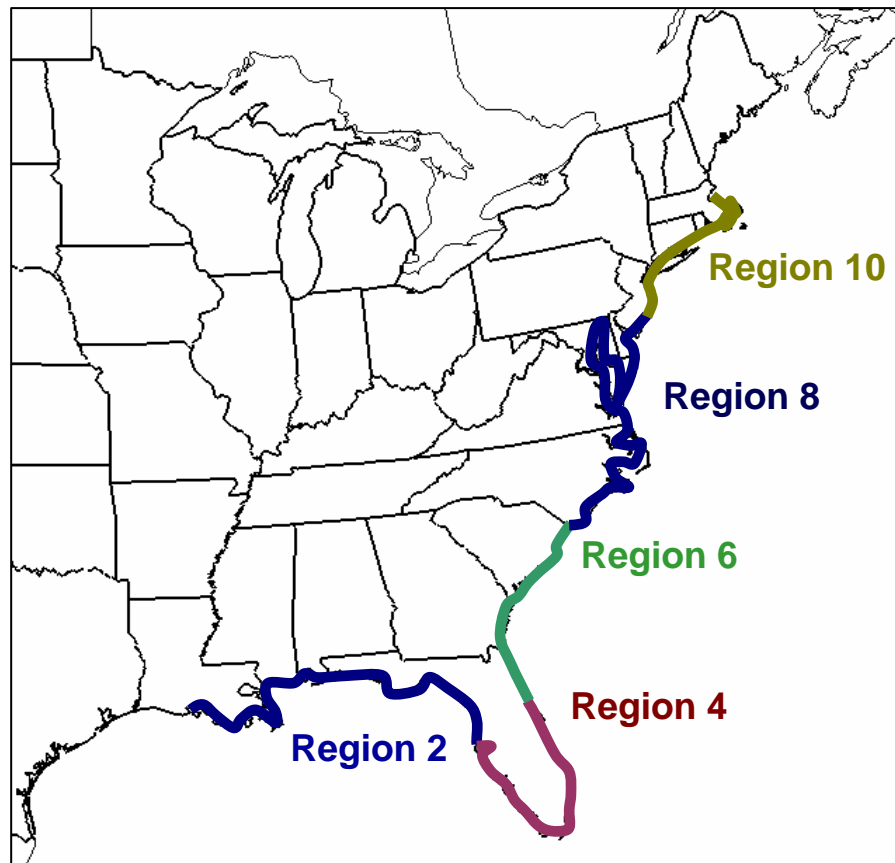


AEF Regional Definition of the Hurricane Index

Base Regions



Overlap Regions



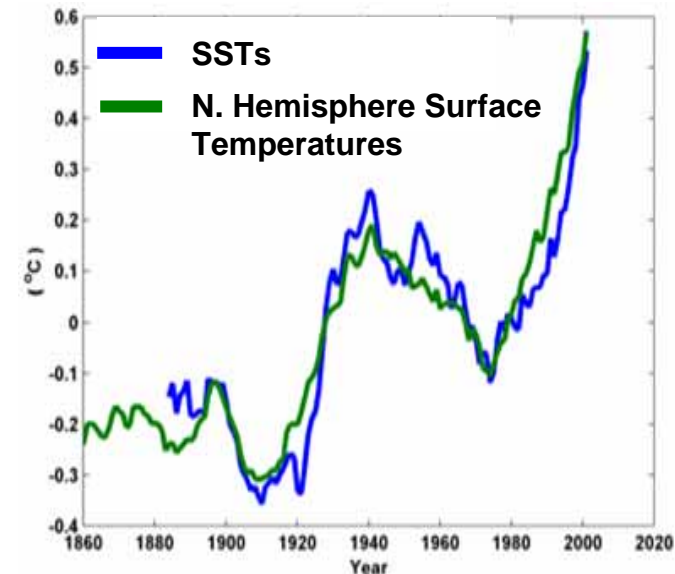
Deviation in Mean Frequency and Associated Confidence Intervals by Region

Region	All Hurricanes		Category 3-5 Hurricanes	
	Mean (%)	95% Confidence Interval (%)	Mean (%)	95% Confidence Interval (%)
1	1	-25 - 31	16	-30 - 83
2	-3	-30 - 30	8	-40 - 78
3	18	-14 - 62	18	-32 - 91
4	25	-10 - 77	36	-20 - 126
5	32	-2 - 88	34	-20 - 117
6	40	2 - 97	78	6 - 225
7	32	2 - 85	82	-6 - 254
8	31	0 - 81	80	4 - 238
9	44	5 - 111	54	-31 - 208
10	32	-6 - 90	40	-40 - 174
11	39	-7 - 114	43	-46 - 206



Some Scientists (e.g., Dr. Kerry Emanuel, MIT) Do Not Believe the AMO Exists

- ❑ Believes *surface* temperatures are driving SSTs
- ❑ Believes the variability in both surface temperatures and SSTs is caused by random episodes of sunspot and volcanic activity, as well as the industrial release and decay of aerosol sulfates
- ❑ Believes there is clear evidence of a warming *trend*, which is caused by the accumulation of greenhouse gases
- ❑ Believes that the frequency of hurricane *landfalls* is dependent on environmental factors unrelated to SSTs, such as NAO
- ❑ All are areas of active research at AIR



Summary of AIR Research on Climatological Influences on Near-term Hurricane Activity

- ❑ The influence of climate factors on hurricane activity has been studied for decades
- ❑ Periodicity of climate signals is irregular, making forecasts uncertain
- ❑ SSTs cannot be forecast using climate models beyond 9 months *at most*
- ❑ There is consensus in the scientific community that there will be a period of elevated basinwide hurricane activity over the next several years
- ❑ The time horizon and magnitude of this elevated risk and, most importantly, its impact on landfalls and regional insured losses, is highly uncertain
- ❑ The science is still evolving and new theories are continually being developed; AIR will continue to collaborate with the scientific community to further the understanding of future hurricane risk

