A satellite image of the Earth, showing the North Atlantic Ocean and surrounding landmasses. The image is centered on the North Atlantic, with the eastern coast of North America on the left and the western coast of Europe on the right. The ocean is a deep blue, and the land is a mix of green and brown. There are some white clouds visible in the sky.

Seasonal Prediction of North Atlantic Accumulated Cyclone Energy and Major Hurricane Activity

Kyle Davis and Xubin Zeng

University of Arizona

Presented at the AMS 99th Annual Meeting

Session - Tropical Cyclones: Subseasonal to Interannual Variability and Prediction

Many Ways to Measure a Hurricane Season

(Davis and Zeng 2018, Weather and Forecasting)

For the North Atlantic basin:

	Named Storms	Hurricanes	Major Hurricanes*	ACE**
2015:	11	4	2	63
2013:	14	2	0	36
2005:	28	15	7	250
2004:	15	9	6	227
1981–2010 Avg:	11.9	6.4	2.7	106

**Hereafter MH*

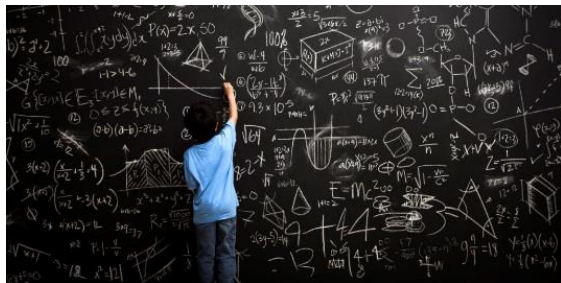
***Accumulated cyclone energy*



New Statistical Models to Predict MH & ACE

Model Basics

- Extension of previous work
- Statistical models
- Three variables
- Forecasts issued early June (data through May)
- Data from 1968-2017



Our Goal

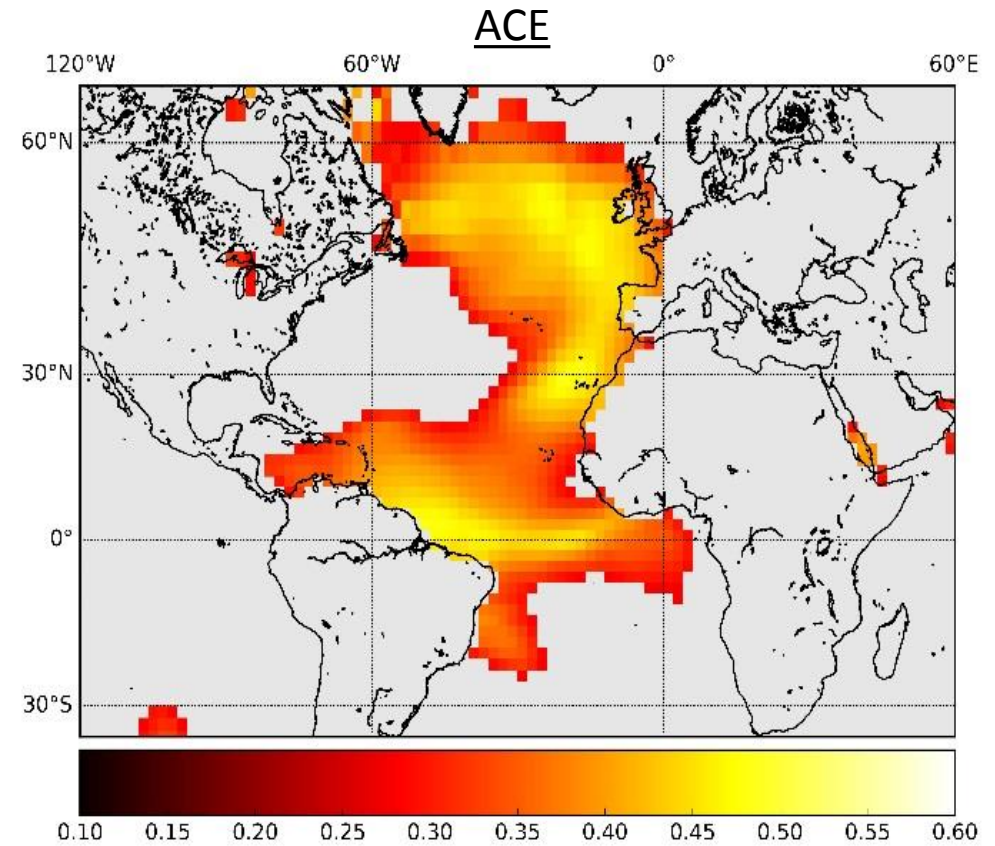
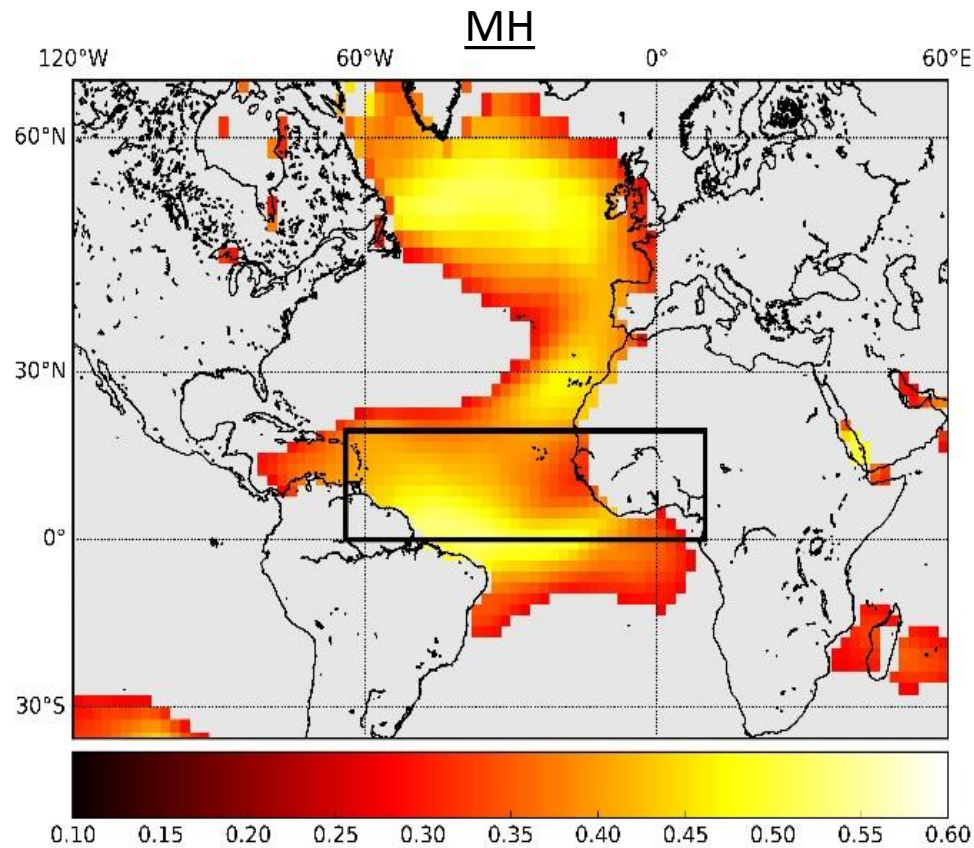
To produce models:

- Better than climatology
- Comparable/better than other centers

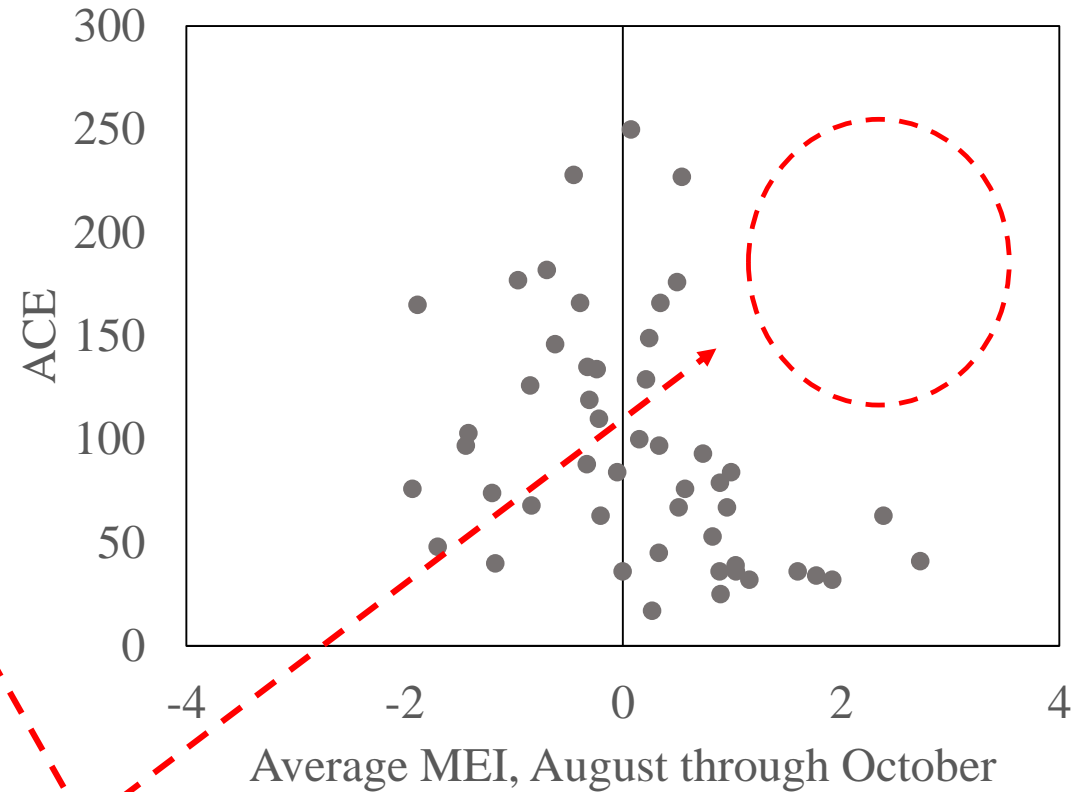
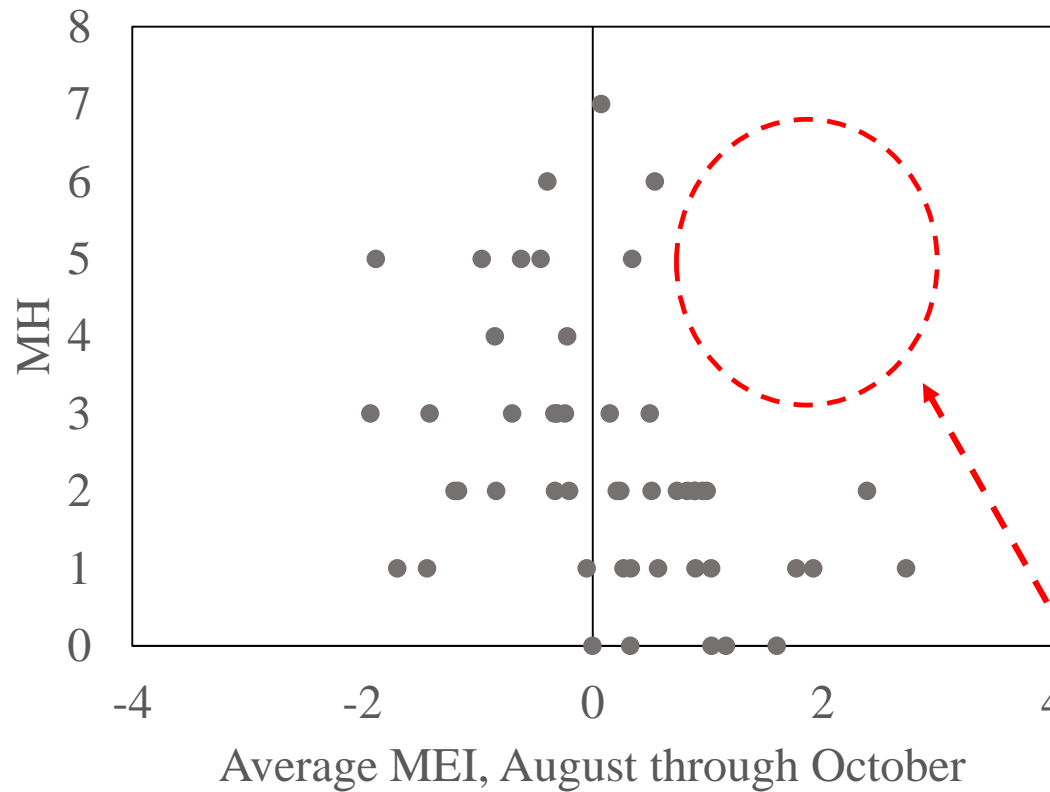


Sea Surface Temperatures

Showing statistically significant ($p < 0.05$) correlations



MEI and Tropical Cyclone Activity

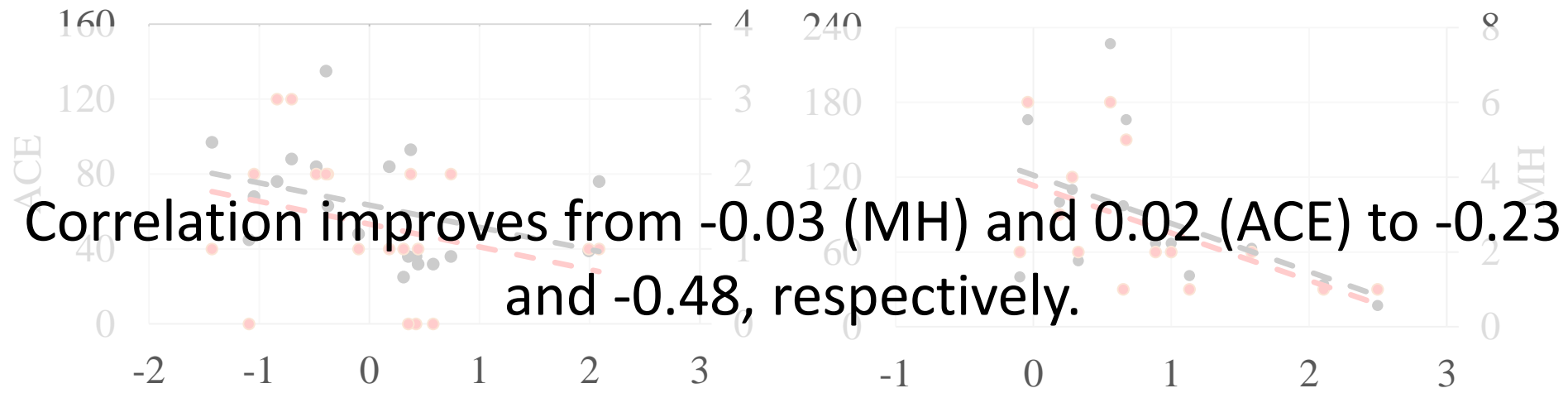


Suppressed activity MEI > 1



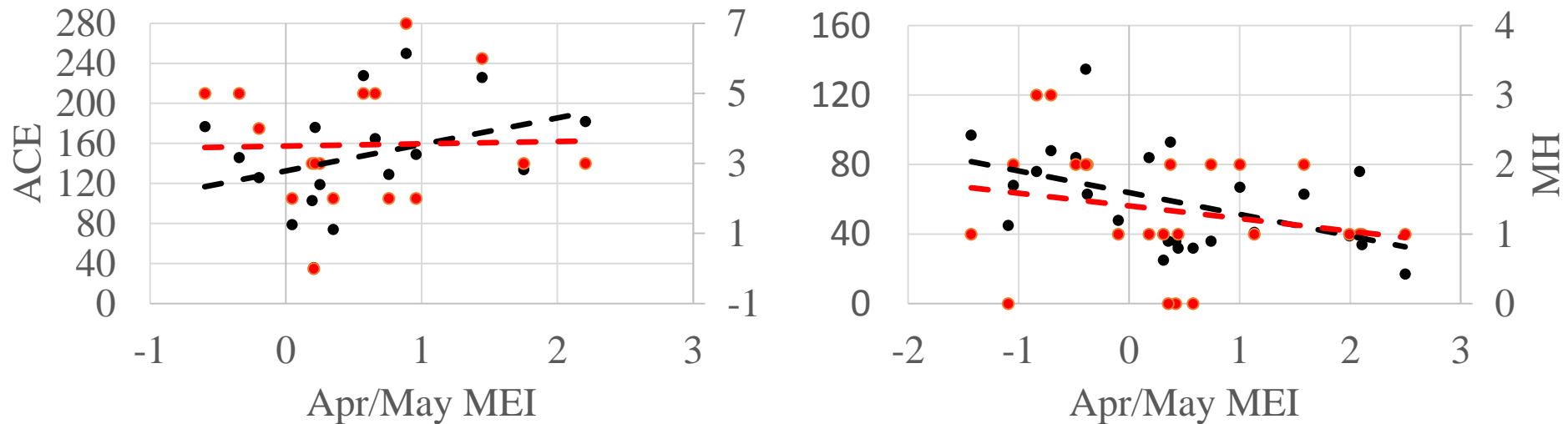
a) AMO < -0.1

b) -0.1 <= AMO <= 0.1



c) 0.1 < AMO

d) MEI | AMO

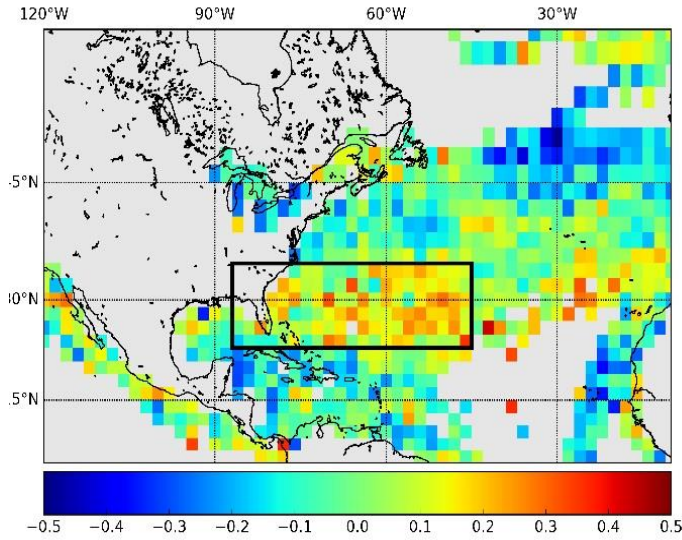


● ACE ● MH - - - Linear (ACE) - - - Linear (MH)

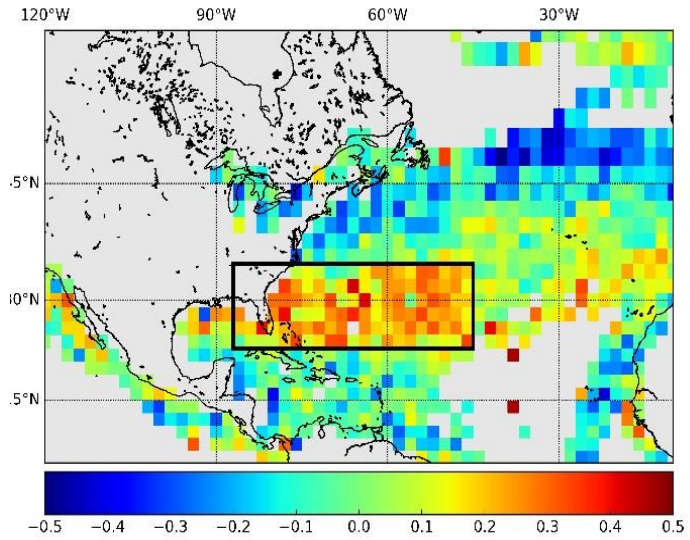


ZPWS = Zonal Pseudo-Wind Stress = magnitude of wind * x component of wind

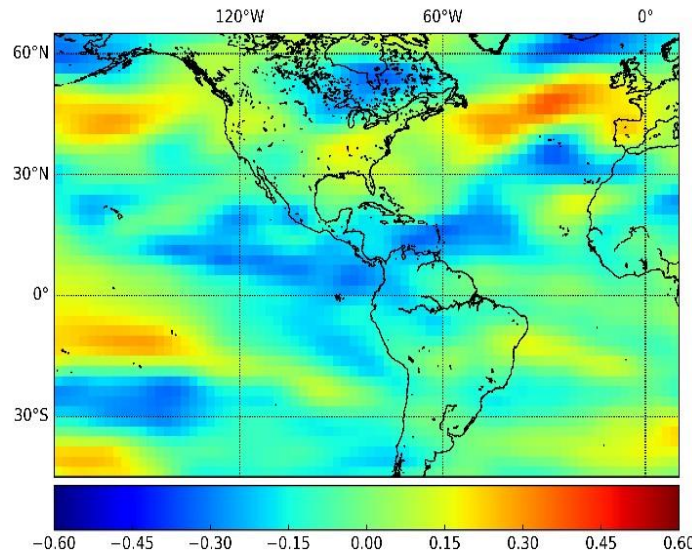
ZPWS with MH



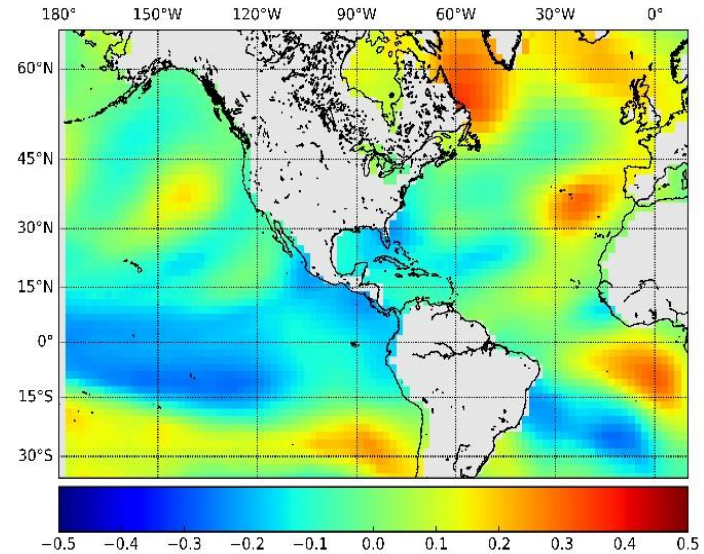
ZPWS with ACE



May ZPWS Correlated with Aug-Oct Wind Shear



May ZPWS Correlated with Aug-Oct SST



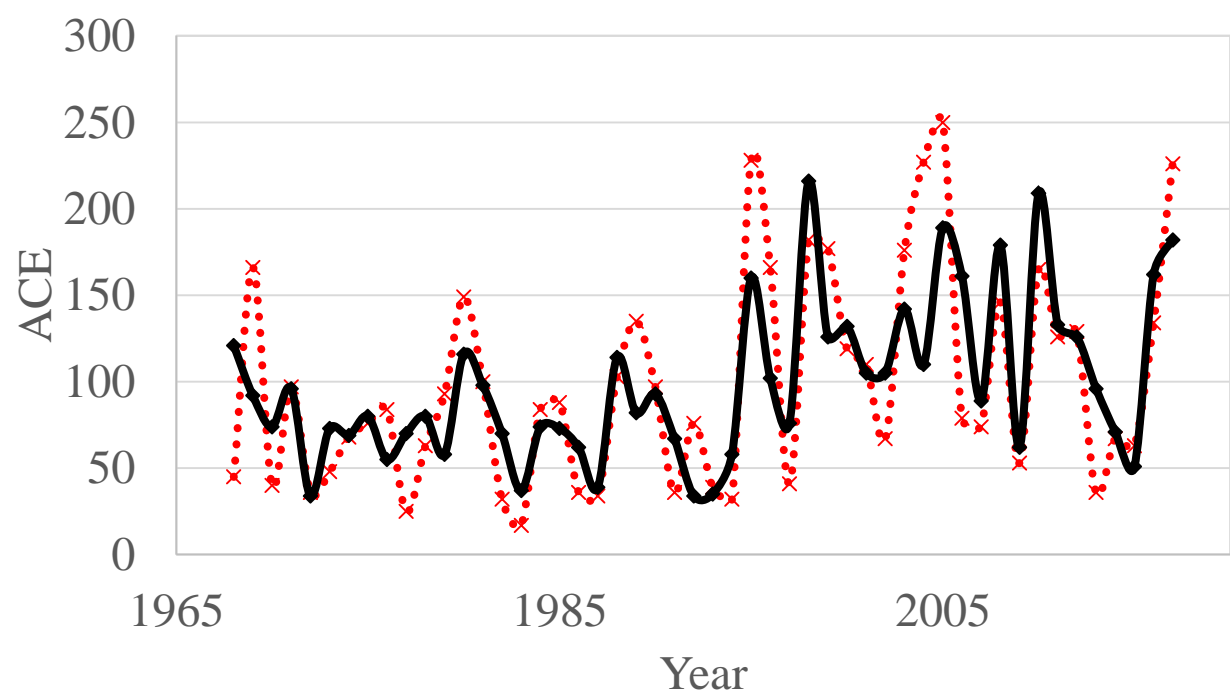
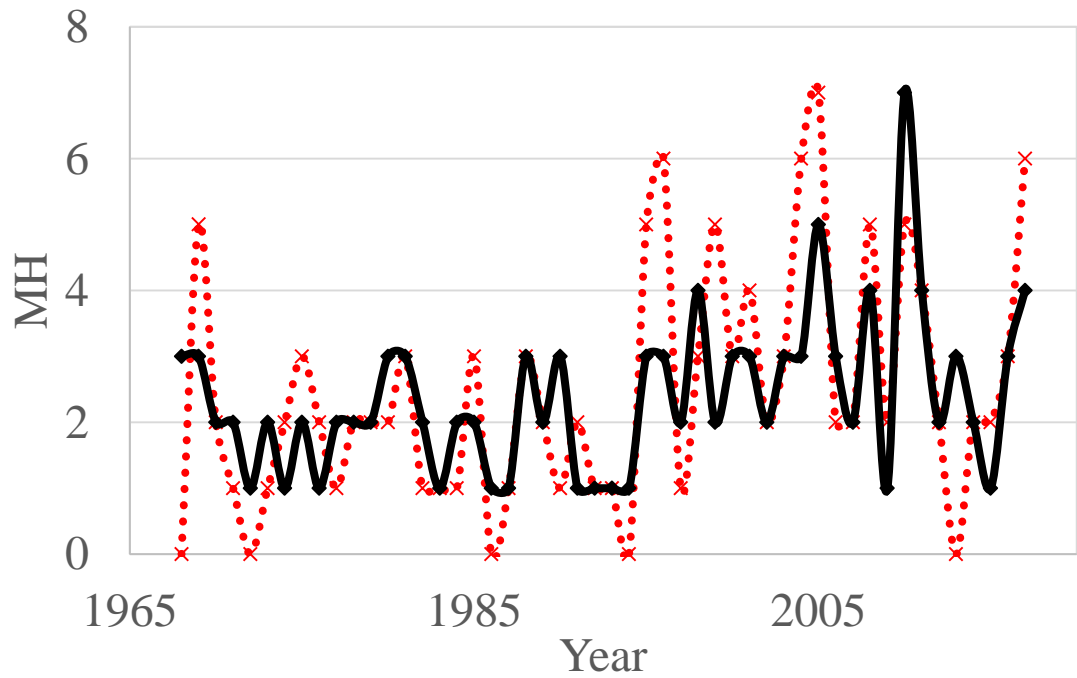
Results

Metric	R	MAE*	MAE 5-Year
MH	0.65	0.96	1.4
ACE	0.75	30	51

*Mean absolute error

$$E(MH|\mathbf{x}) = \exp \left[-23.60 + 0.94 * SST_{MAM} + 0.004 * ZPWS^3 - 0.28 * MEI | AMO \right]$$

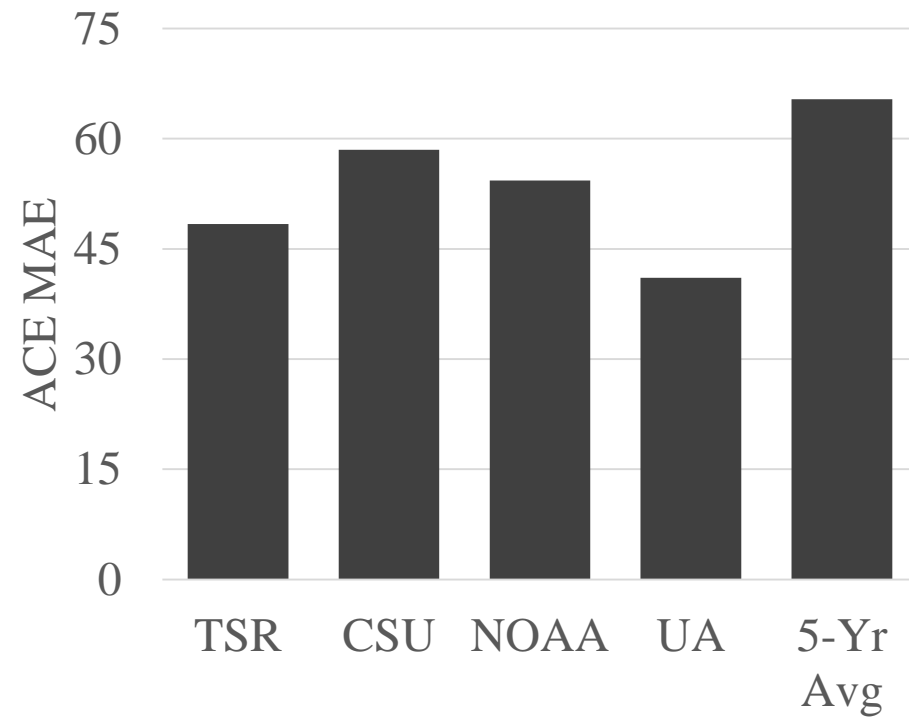
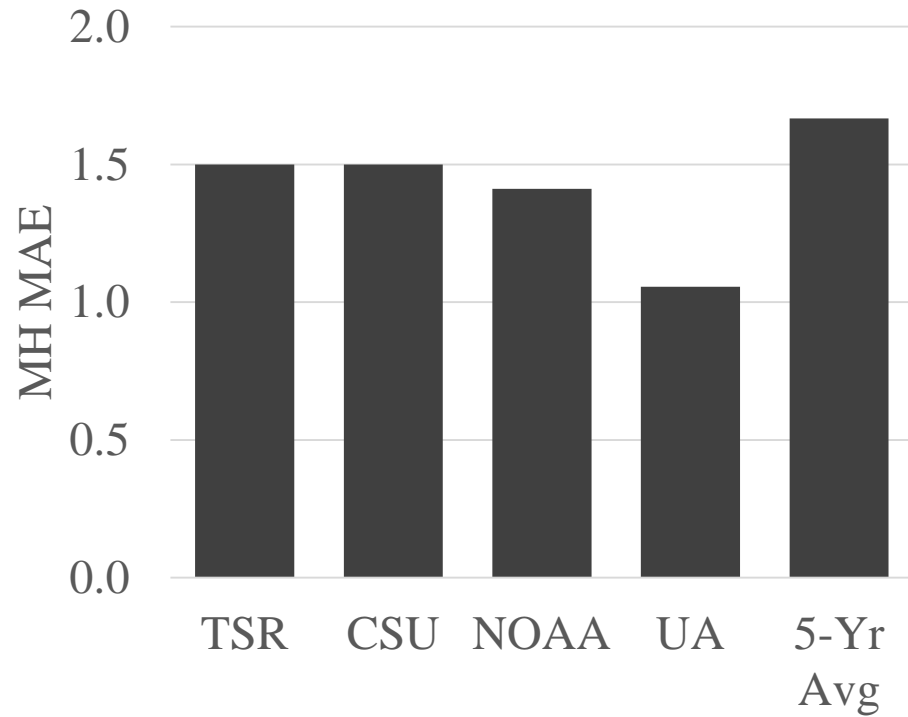
$$E(ACE|\mathbf{x}) = \exp \left[4.73 + 1.81 * AMO_{MAM} + 0.003 * ZPWS^3 - 0.32 * MEI | AMO \right]$$



···x··· Obs —◆— Predicted



How Well Do They Predict?



Three Cases of Real-Time Prediction

1967-1958

Metric	MAE	MAE 5-Year
MH	1.4	1.8
ACE	39	46

2017

Organization	MH	ACE
CSU May	2	100
CSU August	3	135
TSR May	3	98
TSR August	3	116
NOAA May	3	106.5
NOAA August	3.5	-
UA June	6	181
Obs	6	226

2018

Organization	MH	ACE
CSU May	2	90
CSU August	1	64
TSR May	1	43
TSR August	1	58
NOAA May	2.5	96.6
NOAA August	1	69
UA June	2	96
Obs	2	129



Summary and Conclusions

- We developed new statistical models to predict both MH and ACE for the North Atlantic in early June
- Three predictors:
 - SST
 - MEI conditioned on AMO
 - ZPWS
- In hindcast mode, results are comparable and often better than 3 other centers
- Results show skill when predicting real-time

