

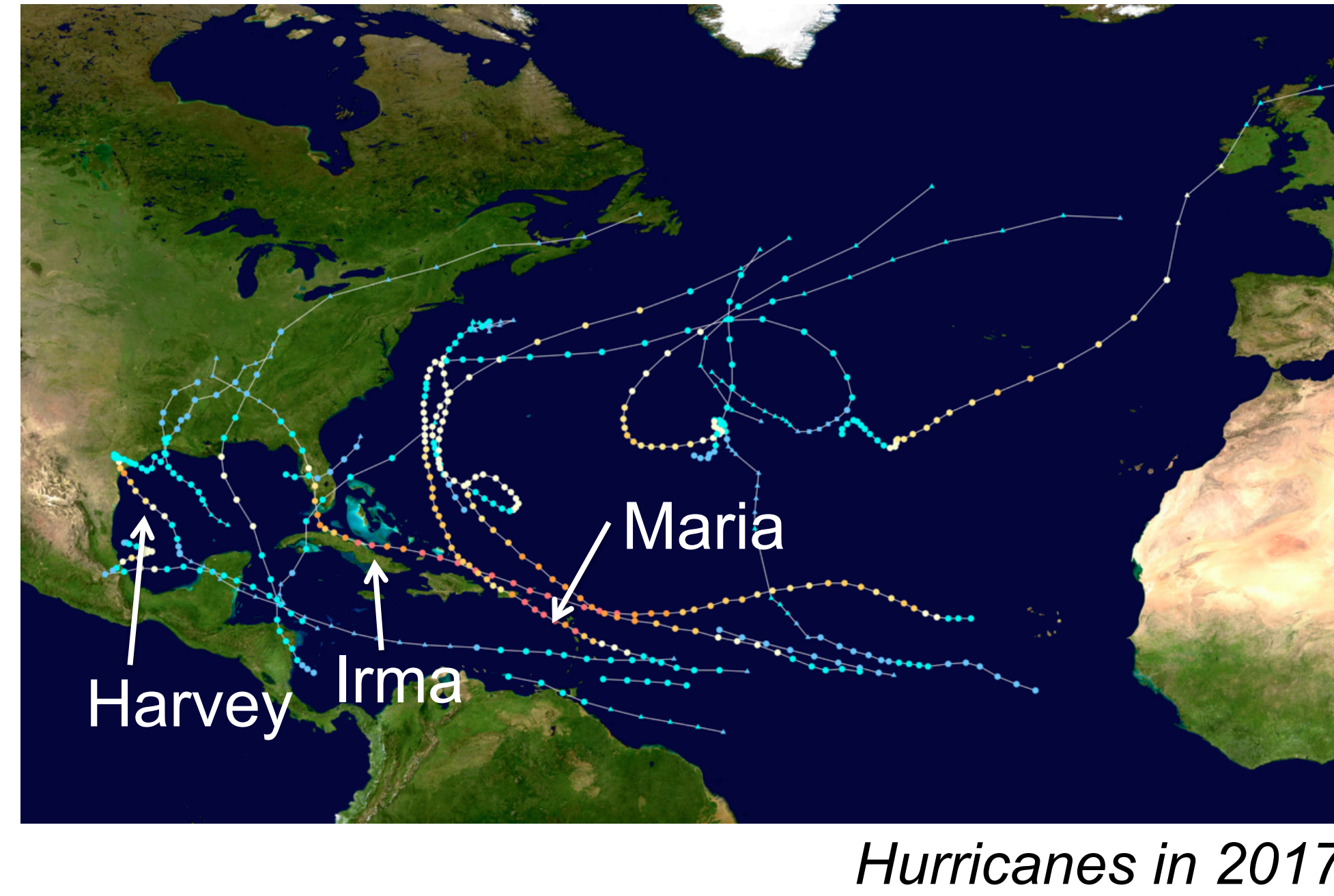
Dominant Effect of Relative Tropical Atlantic Warming on Major Hurricane Occurrence in the North Atlantic: 2017 and the Future

Hiro Murakami^{1,2}, Emma Levin³, Thomas L. Delworth¹, Rich Gudel¹, and Pang-Chi Hsu⁴

¹Geophysical Fluid Dynamics Laboratory/NOAA, ²UCAR, ³Paul D. Schreiber High School, ⁴Nanjing University of Information Science and Technology
 Hiroyuki.Murakami@noaa.gov

1. Introduction

In the 2017 summer North Atlantic hurricane season, there **were 6 major hurricanes** generated, and a few of them made landfall (e.g., Hurricanes Harvey, Irma, and Maria), leading to huge socioeconomic damage around coastal regions.



Hurricanes in 2017

At Geophysical Fluid Dynamics Laboratory (GFDL), we utilize a high-resolution global coupled model (HiFLOR) for real-time seasonal prediction.

In this presentation, we will show following preliminary results.

1. Successful seasonal predictions of 2017 major Hurricanes
2. Factor responsible for the active major hurricane using idealized SST forcing experiments

2. Real-time Seasonal Prediction for 2017 Hurricane Season

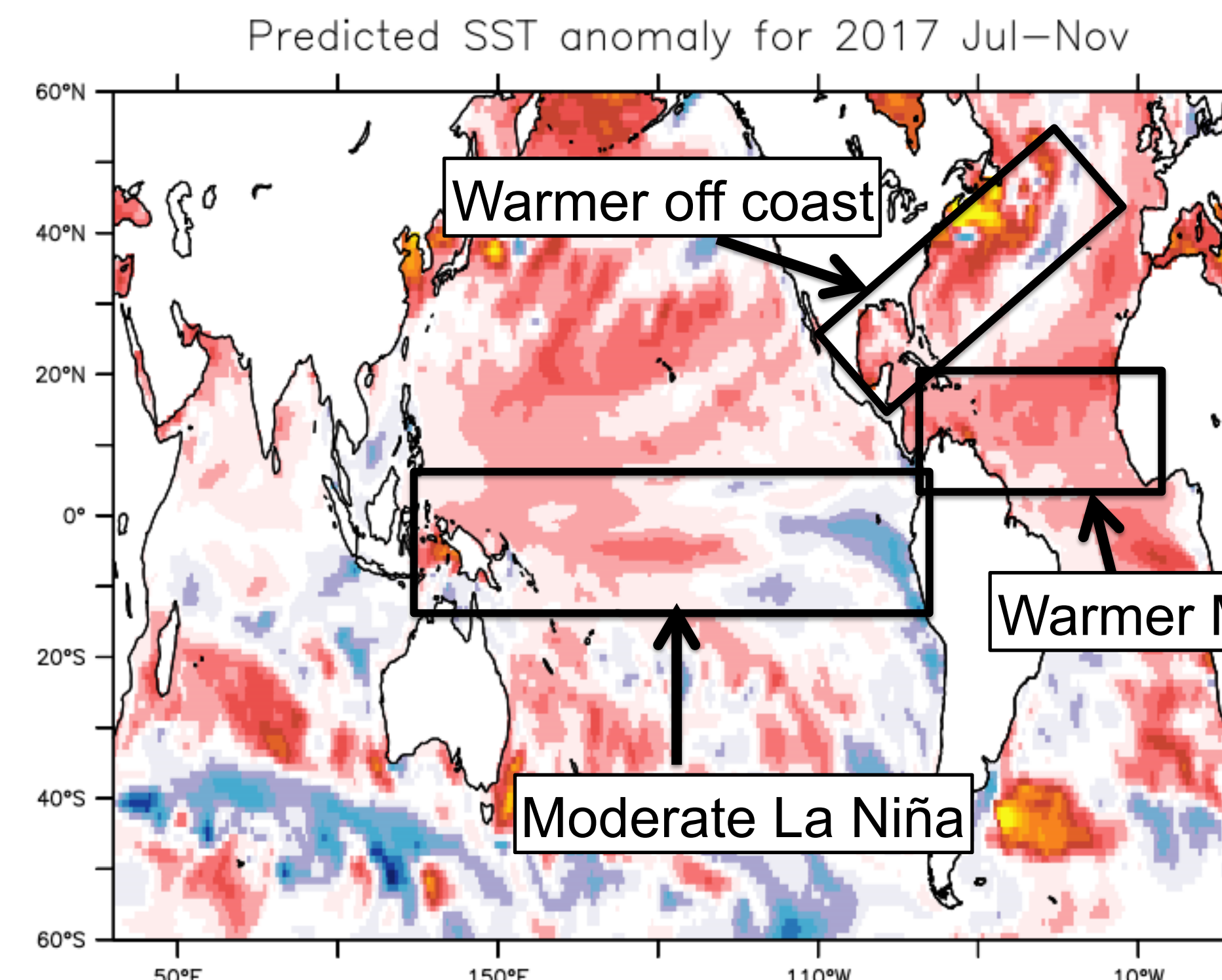


Fig 1. Predicted SST anomaly relative to climatological mean of 1982-2012.

Which region of SST anomaly contributed to active 2017 MH in the North Atlantic?

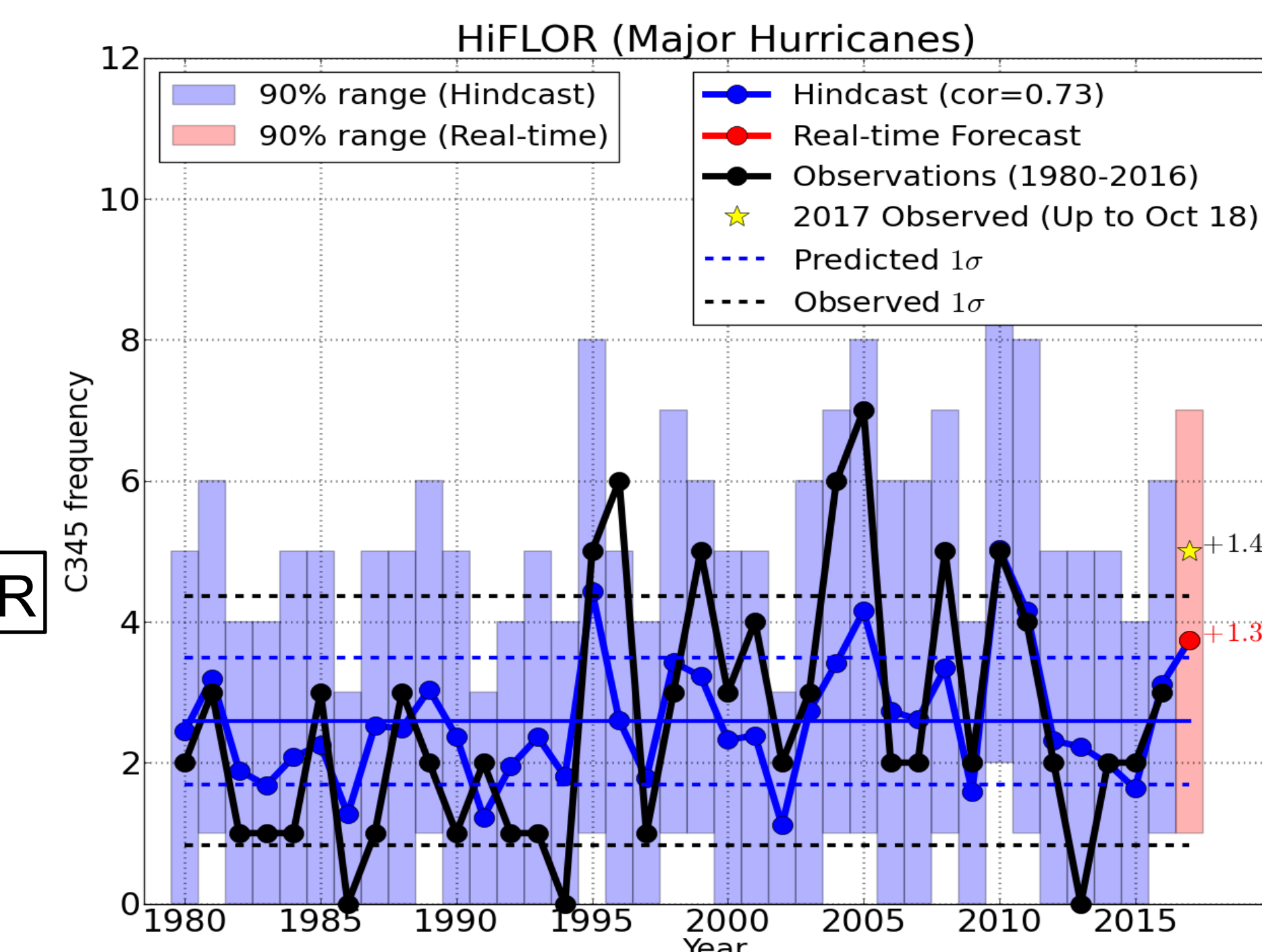


Fig 2. Real-time (red) and retrospective (blue) seasonal forecast (red) by HiFLOR (25km Atm & 100 km Ocean Global Coupled Model)

HiFLOR predicted active 2017 major hurricanes a few months in advance.

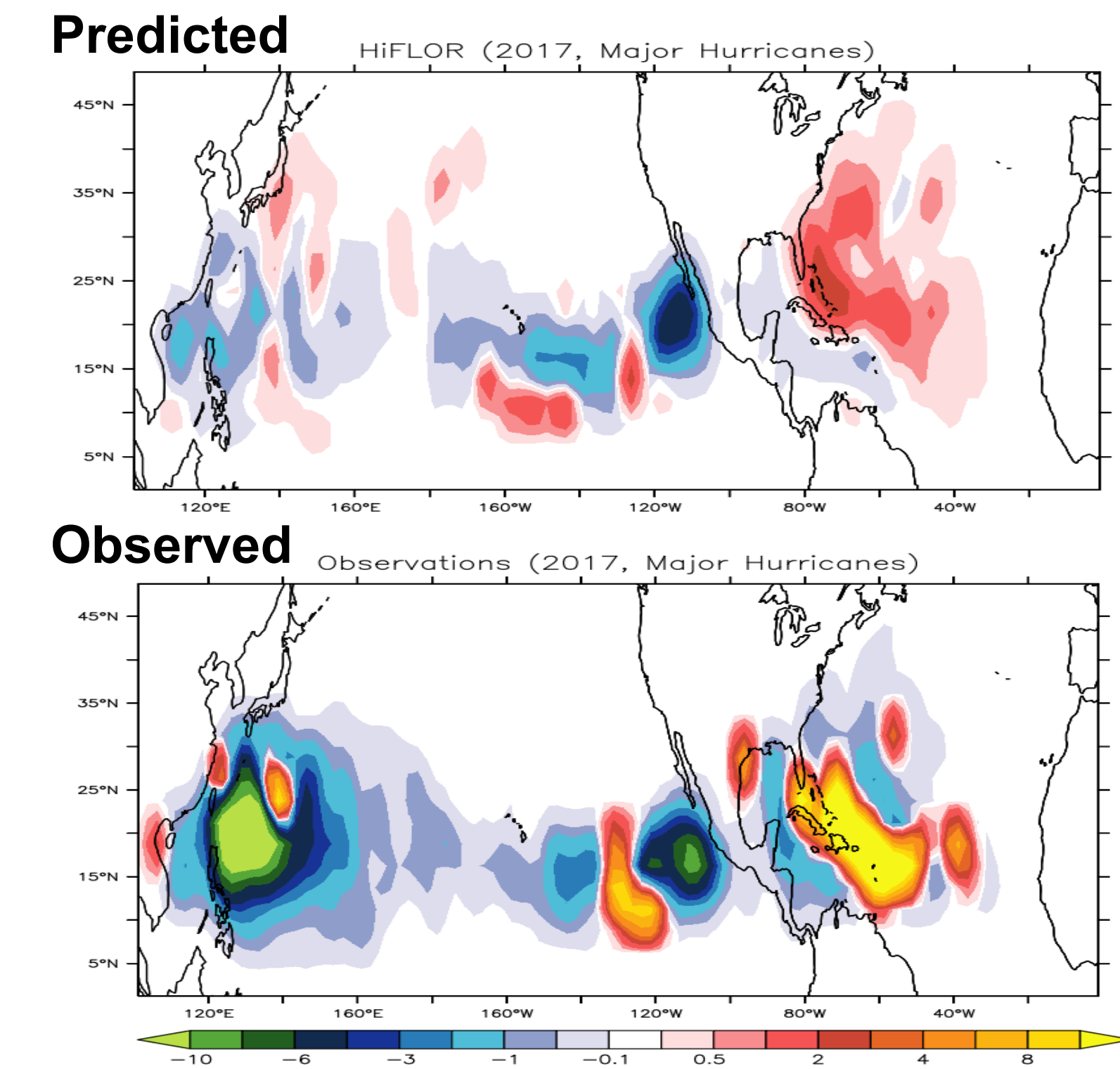
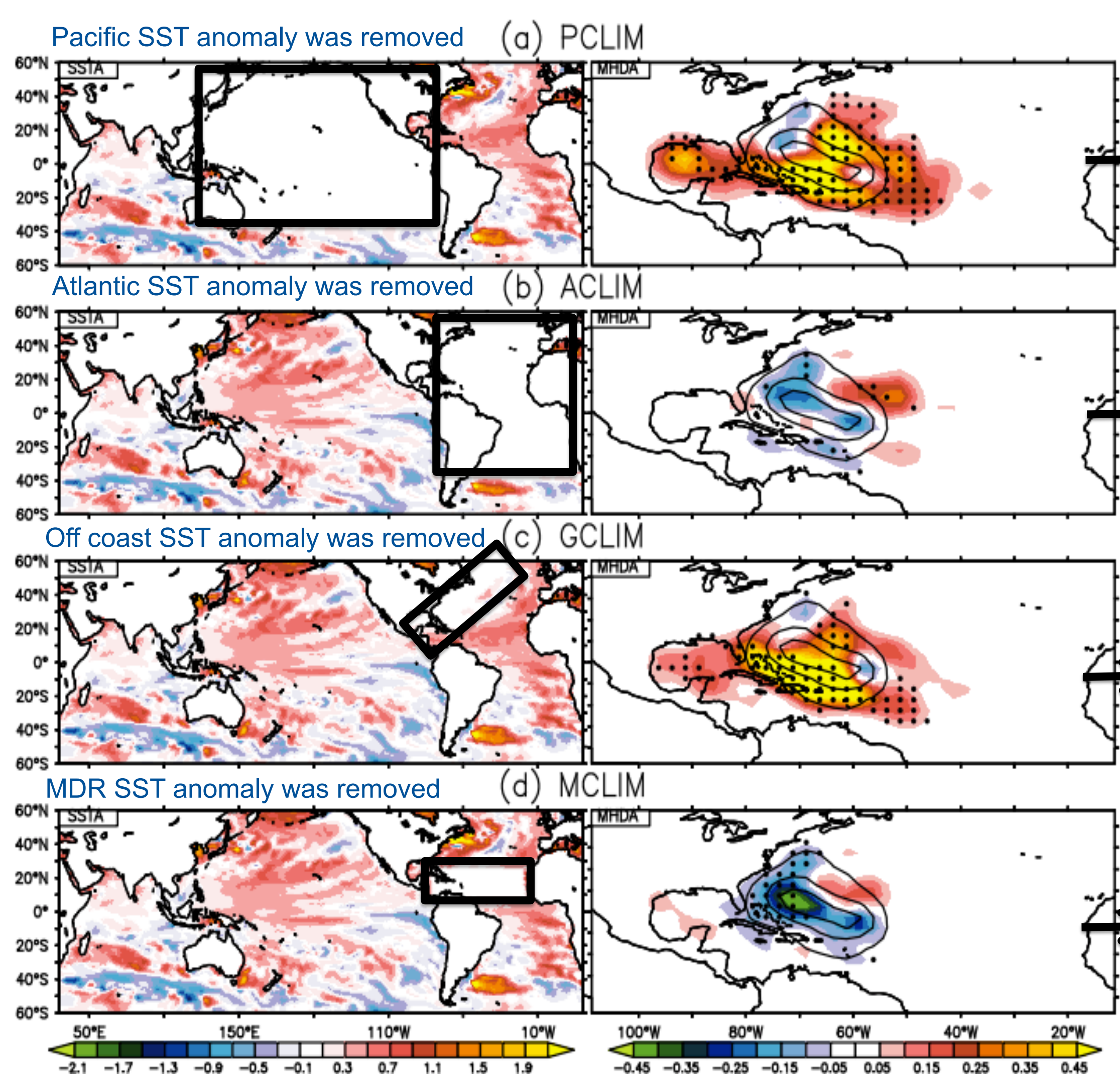


Fig 3. Predicted (top) and observed (bottom) major hurricane density anomaly for 2017.

HiFLOR predicted location of major hurricanes very well.

3. Idealized SST forced Reforecasts

In order to identify which of SST anomaly shown in Fig. 1 has a greater impact on major hurricane activity, idealized SST forced forecasts were conducted.



Pacific SST anomaly in 2017 has less impact on major hurricane activity in the North Atlantic.

Atlantic SST anomaly has a big impact on major hurricanes.

Off-coast SST anomaly has less impact on major hurricanes.

MDR SST anomaly has a significant impact on major hurricanes.

MDR SST anomaly is a key factor for this active 2017 major hurricanes.

Fig 4. Prescribed idealized SST anomaly (left) and predicted major hurricane density anomaly (right).

4. Similar Year of 2018 in the Future

To mimic the impact of 2017 SSTA pattern if it were to occur in the future, we superimposed the 2017 SSTA onto the SSTs from the RCP8.5 predicted by CMIP5 models.

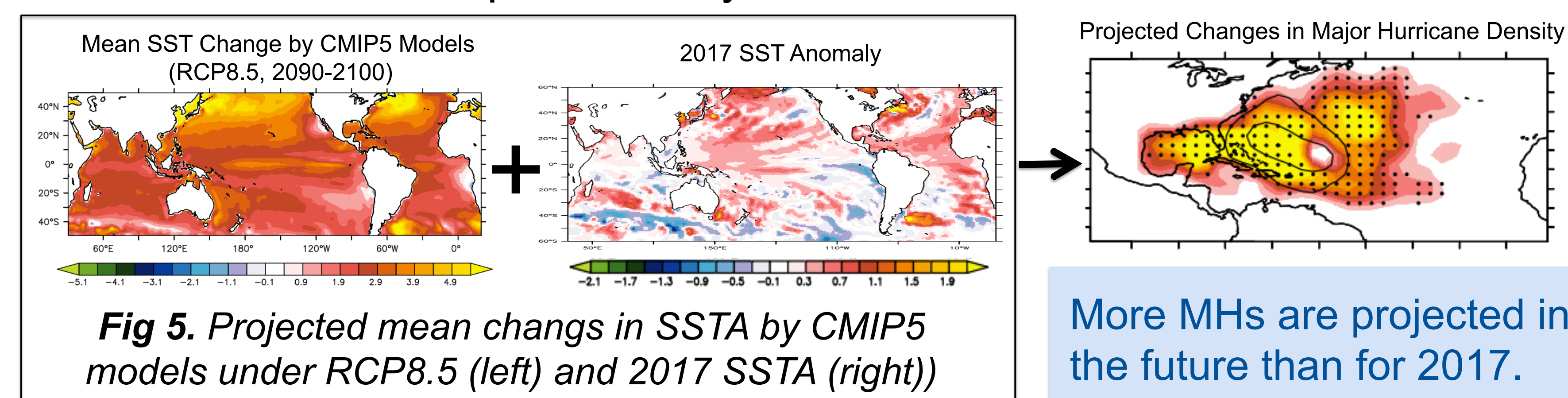


Fig 5. Projected mean changes in SSTA by CMIP5 models under RCP8.5 (left) and 2017 SSTA (right)

More MHs are projected in the future than for 2017.

Which of local or relative SSTA is important for major hurricanes?

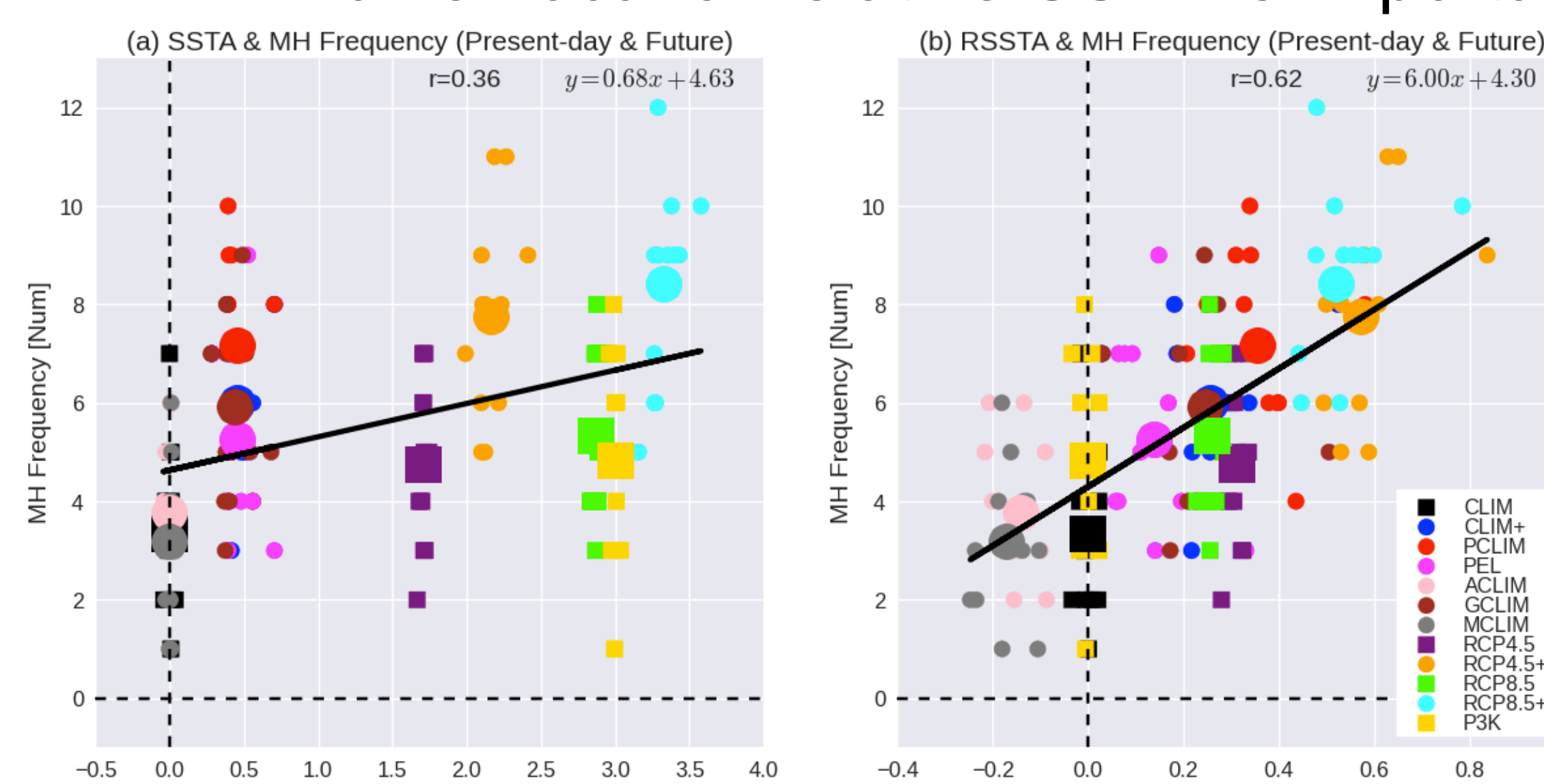


Fig 6. Relationship between (a) the predicted MH frequency and prescribed local MDR SSTA (left), and (b) the predicted MH frequency and prescribed relative MDR SSTA (right)

The relative SST anomaly [i.e., tropical Atlantic SST minus tropical mean (30°S-30°N) SST] shows a higher correlation with major hurricane frequency than the local tropical Atlantic SST anomaly does.

5. Summary

- As observed, HiFLOR could predict active major hurricanes in 2017 a few months in advance.
- HiFLOR could predict not only basin-total frequency of major hurricanes, but also locations of major hurricanes with accuracy.
- **High MDR SST anomaly relative to tropical mean anomaly may be a key factor for this active major hurricanes in 2017.**
- Anthropogenic forcing will increase major hurricanes in the future even with similar 2017 SSTA patterns.