

## Driven by Sea Surface Temperatures

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### Introduction

- Humid heat extreme (HHE) is a type of compound extreme event in which high temperature coincide with high humidity.
- Summertime HHE poses severe risks to human health.
- The occurrence of HHE has increased in recent decades and is projected to continue increasing according to climate simulations.
- There is a need for skillful prediction of HHE and for identifying the sources of predictability.

### Definition of Heat Index and HHE

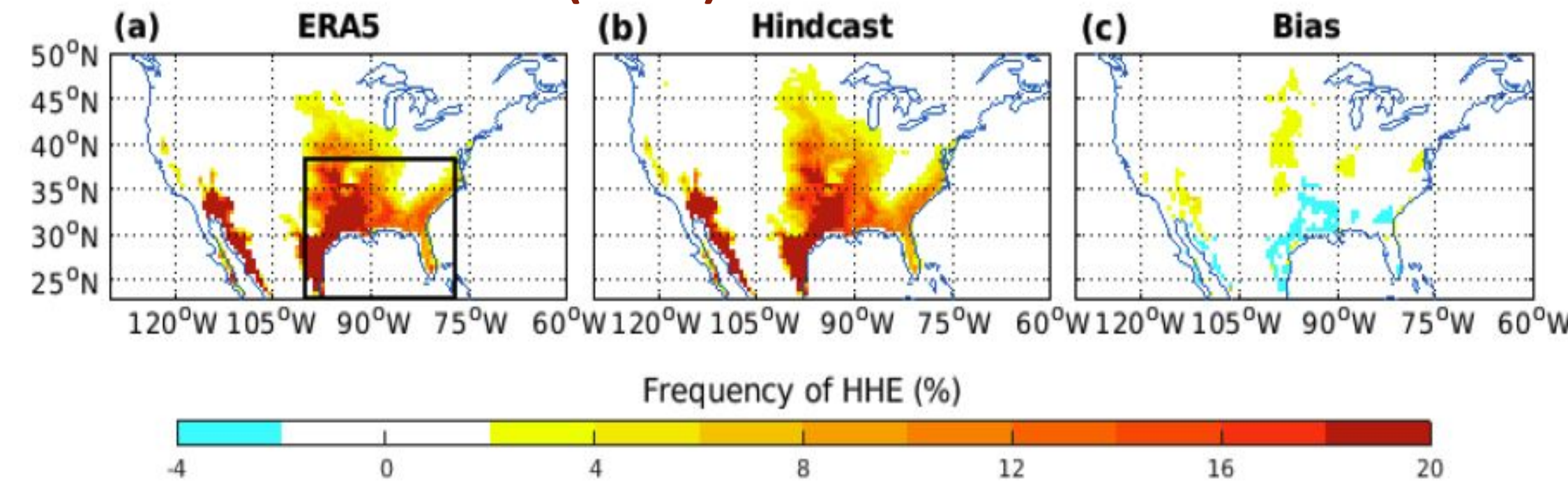
- $HI = -42.379 + 2.04901523 \cdot T + 10.14333127 \cdot RH - .22475541 \cdot T \cdot RH - .00683783 \cdot T \cdot T - .05481717 \cdot RH \cdot RH + .00122874 \cdot T \cdot T \cdot RH + .00085282 \cdot T \cdot RH \cdot RH - .00000199 \cdot T \cdot T \cdot RH \cdot RH$  where T is temperature, RH is relative humidity.
- A day with  $HI > 105$  °F is called an HHE.
- The frequency of HHE in Jun.-Aug. is then calculated.

### Model and Data

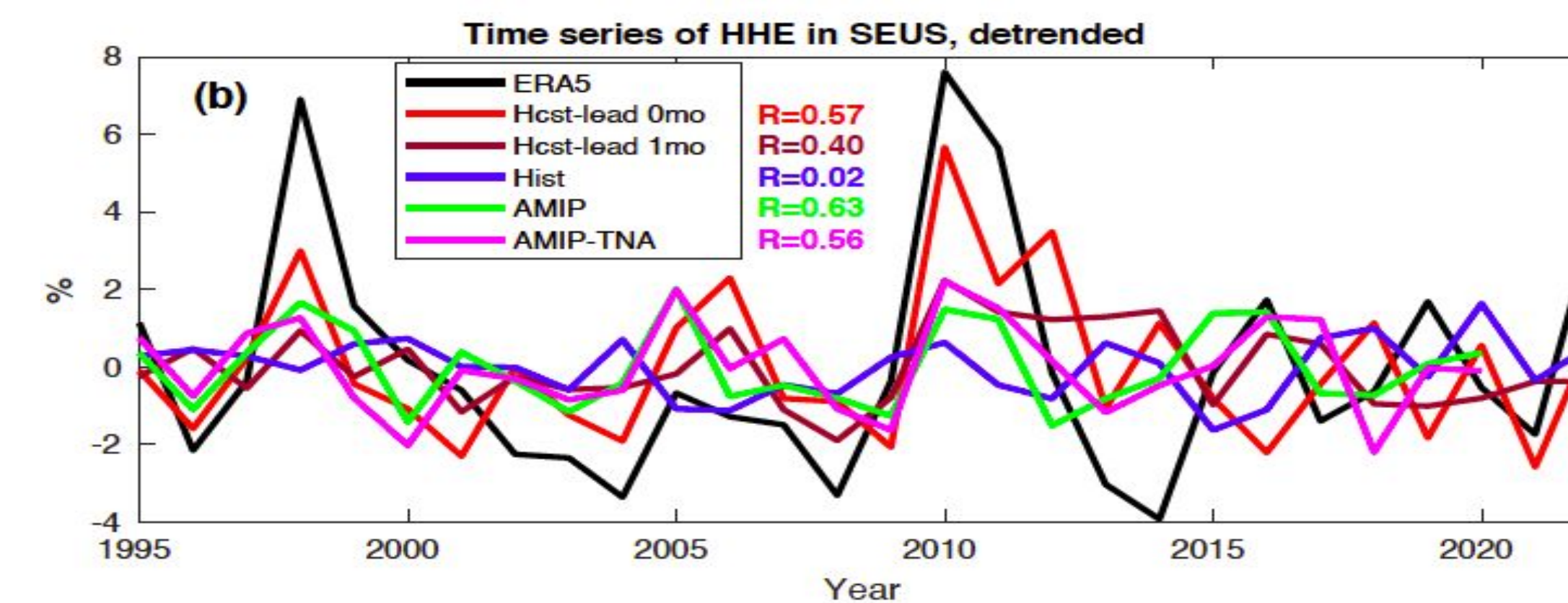
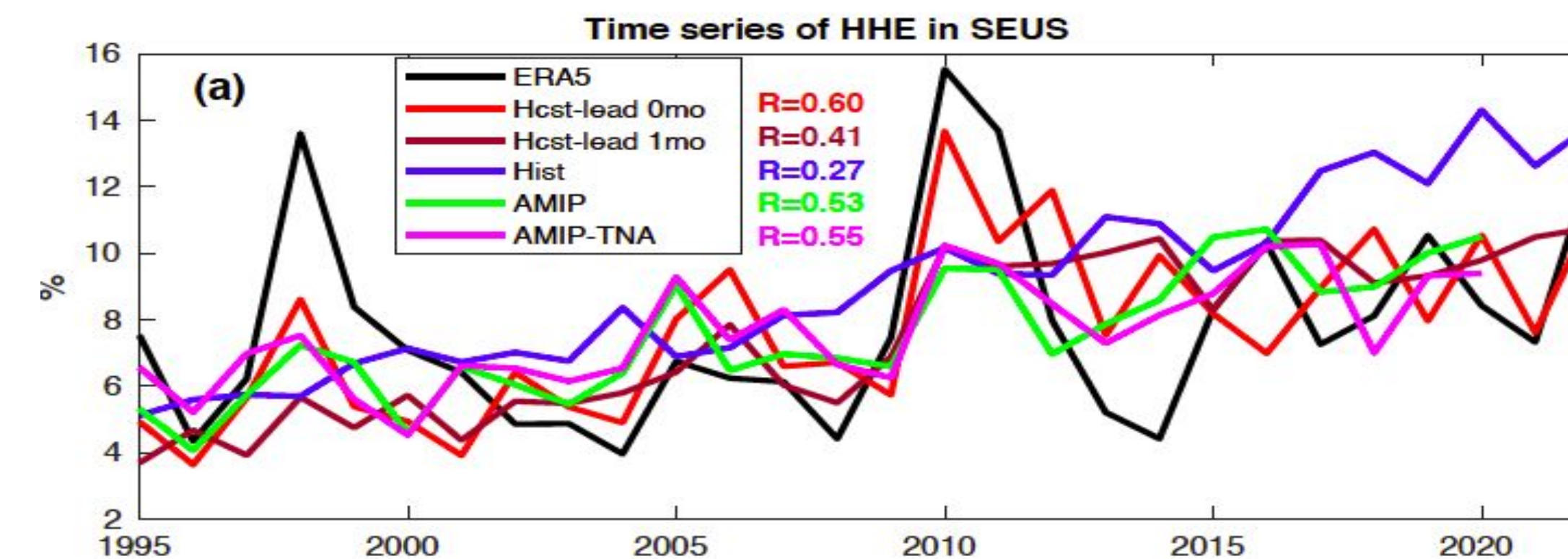
- GFDL's SPEAR hindcasts during the period of 1995-2022 (15 members)
- SPEAR historical simulations (15 members)
- SPEAR AMIP-style simulations (15 members each)
  - a) forced with prescribed sea surface temperature (SST) and sea ice over global ocean basin.
  - b) as a), but forced with a repeating cycle of climatological SST/sea ice outsided of tropical North Atlantic (TNA, 0-23°N, 80-35°W)
- ERA5 data for verification

### Results

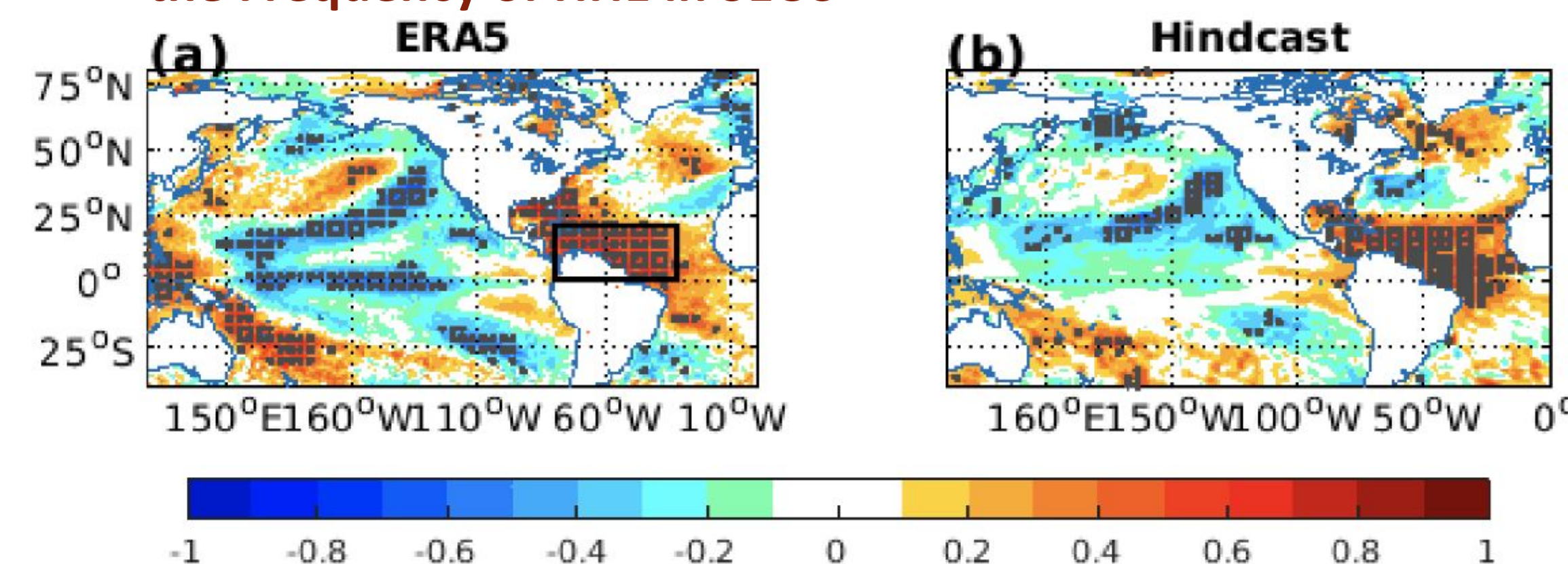
#### Highest Climatological Frequency of Summer HHE in Southeastern US (SEUS)



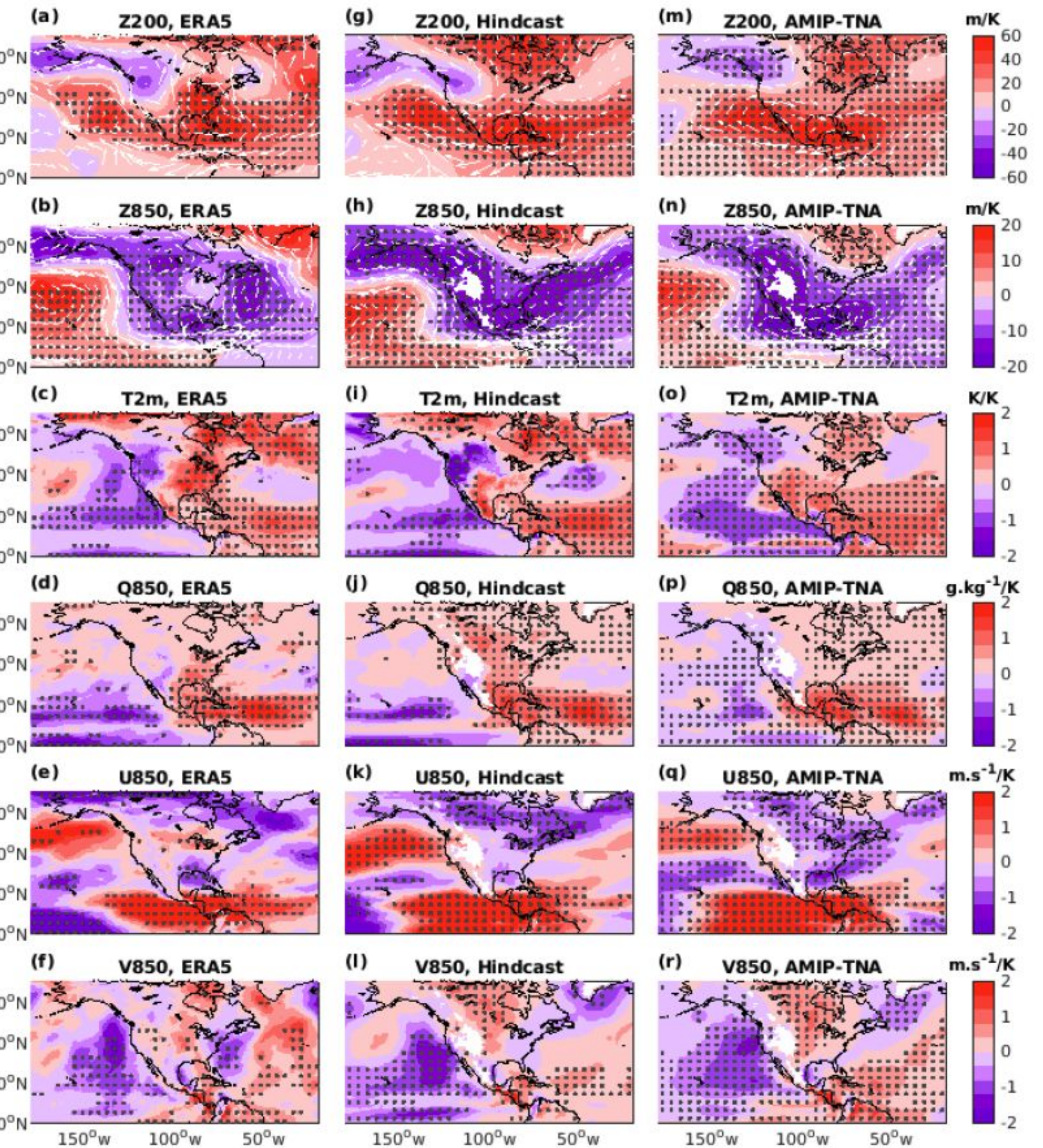
The Frequency of HHE averaged in SEUS is Skillfully predictable 0-1 months ahead



Tropical North Atlantic SSTs Show High Correlations with the Frequency of HHE in SEUS



#### Mechanisms linking SSTs in the Tropical North Atlantic to the frequency of HHE in SEUS



### Summary

- The frequency of summer HHE in SEUS is skillfully predicted 0-1 months ahead.
- The SSTs in the tropical North Atlantic (TNA) is the primary source of predictability.
- The responses of large-scale atmospheric circulation and winds to anomalous warm SSTs in the TNA favor the transport of heat and moisture from Gulf of Mexico to the SEUS.

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