

# Hurricane Heat Trails and Their Impact on Caribbean “Heat Waves”

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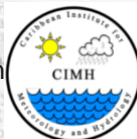
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WESTERN WATER  
ASSESSMENT  
A NOAA RISA TEAM



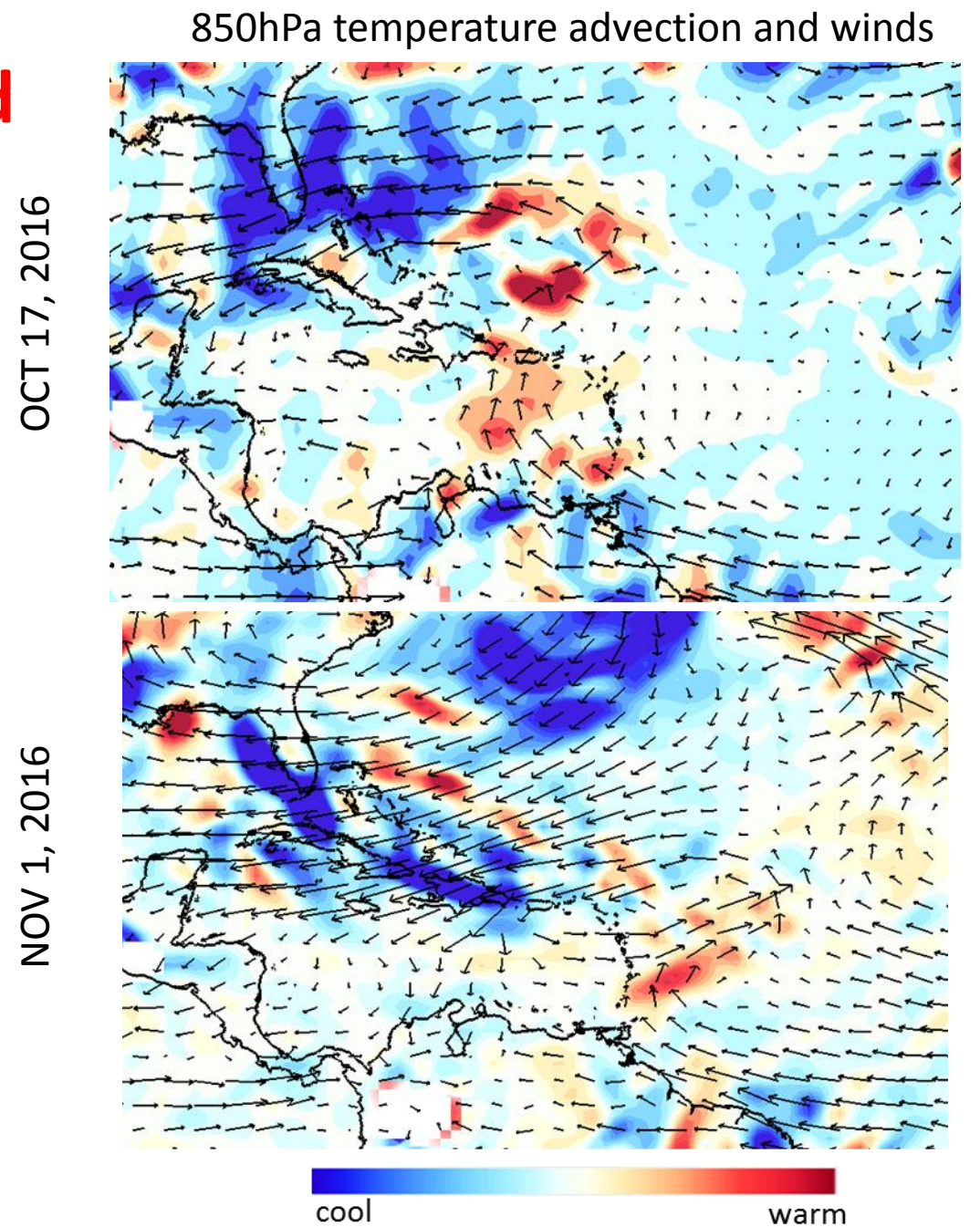
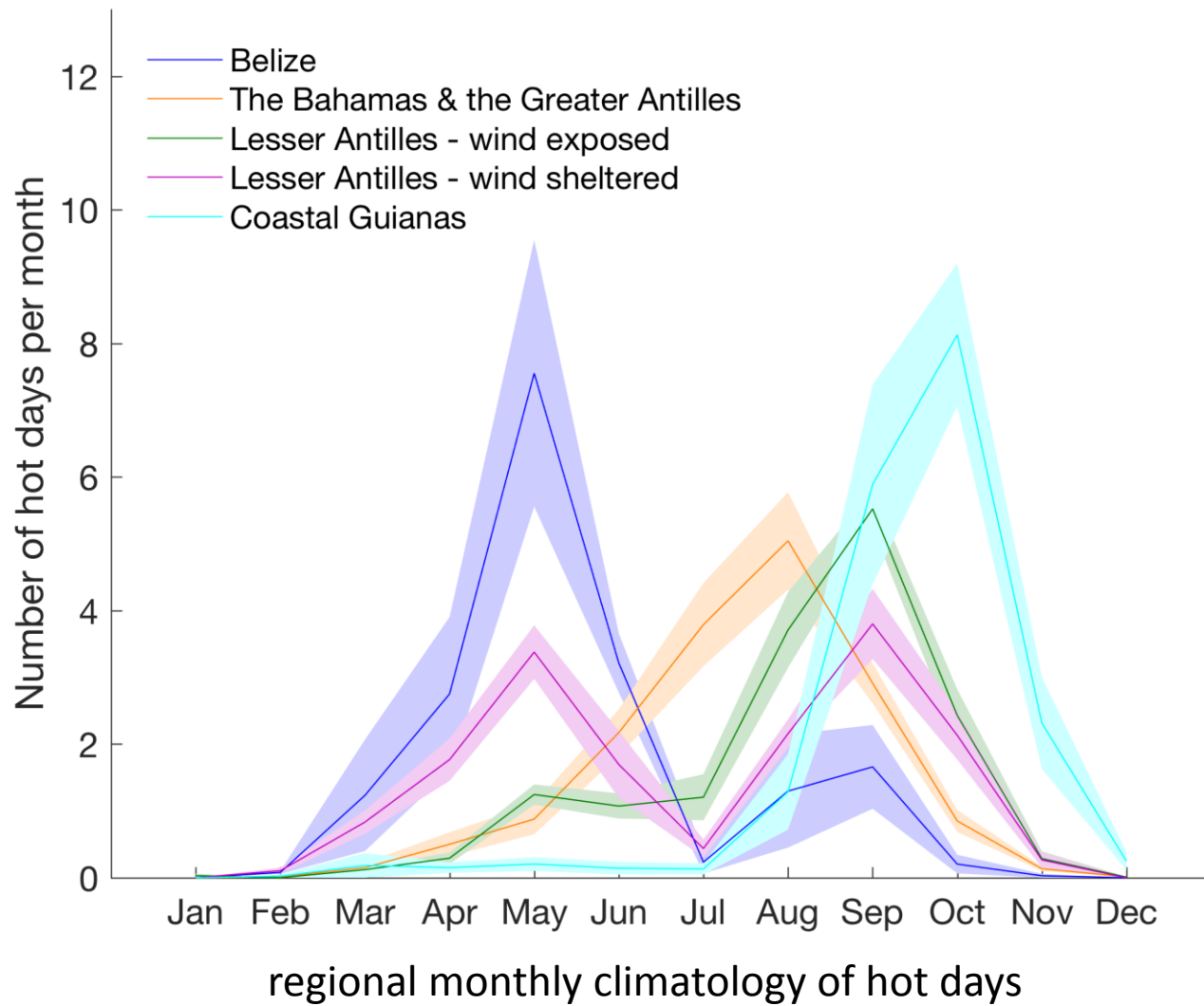
SCHOOL OF PUBLIC HEALTH  
AND TROPICAL MEDICINE



# IRAP

Climate Science for Public Health Risks  
a NOAA research project

# HEAT IN THE CARIBBEAN - background



# HEAT IN THE CARIBBEAN

**BRCCC**  
PROGRAMME  
Programme for Building Regional Climate Capacity in the Caribbean

USAID FROM THE AMERICAN PEOPLE

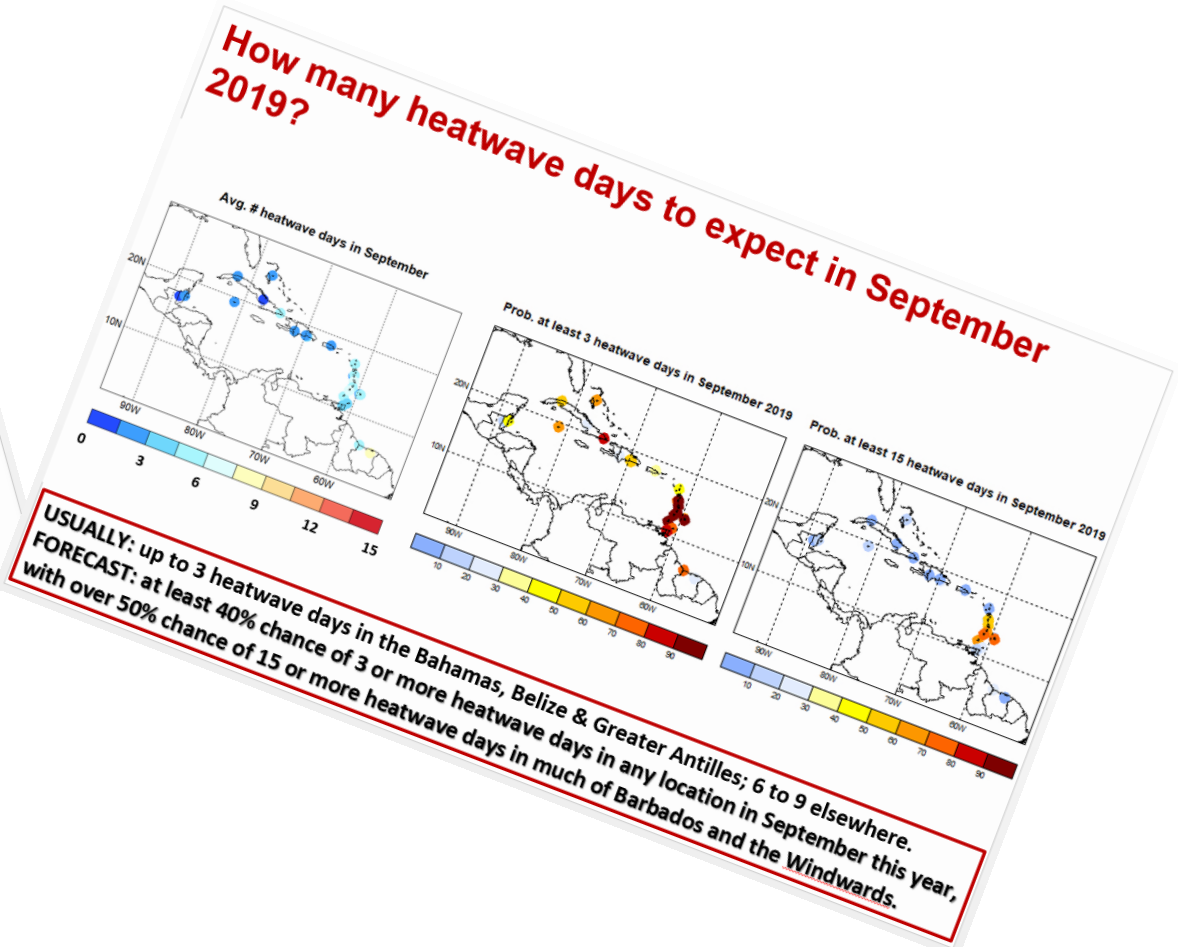

GFCS GLOBAL FUND FOR CLIMATE SERVICES

**Heat Outlook for September 2019 to February 2020**  
**Excessive heat between September and November**

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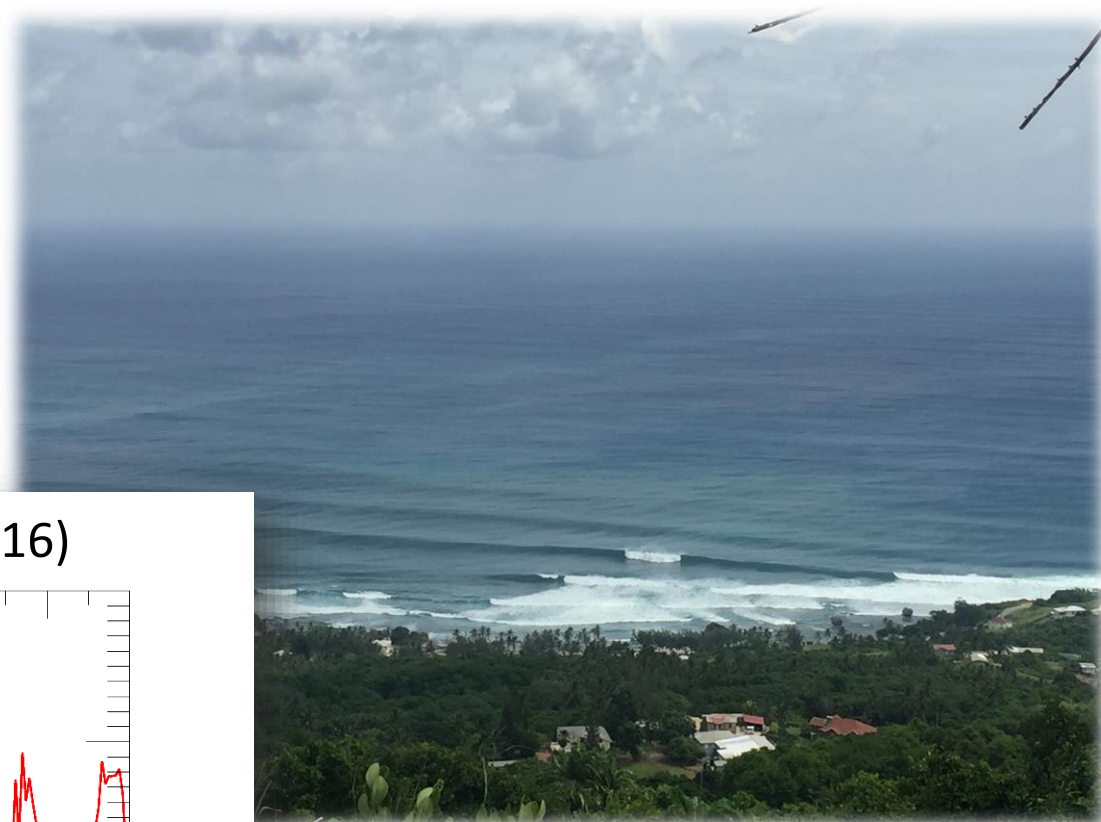
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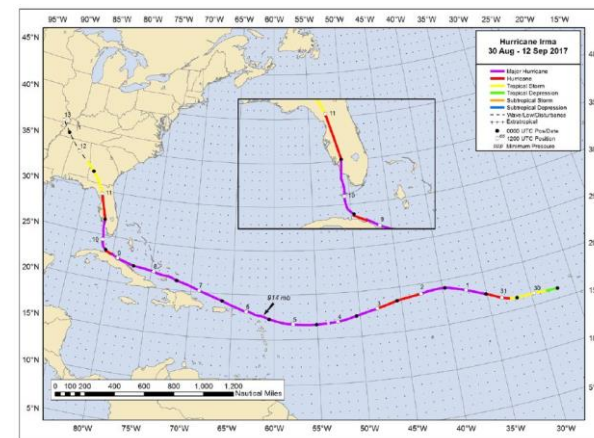
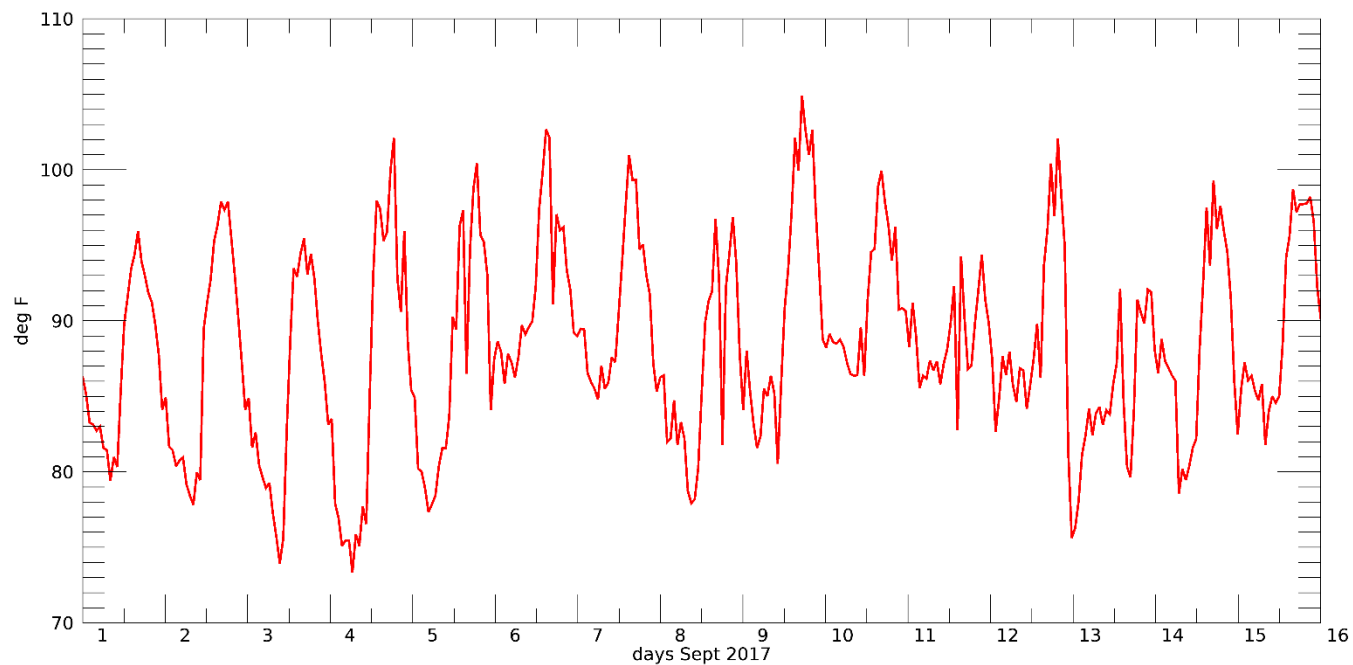
monthly heat products from the CIMH

# HURRICANE IRMA - 2017

Category 5 – 185mph winds as it approached the eastern Caribbean

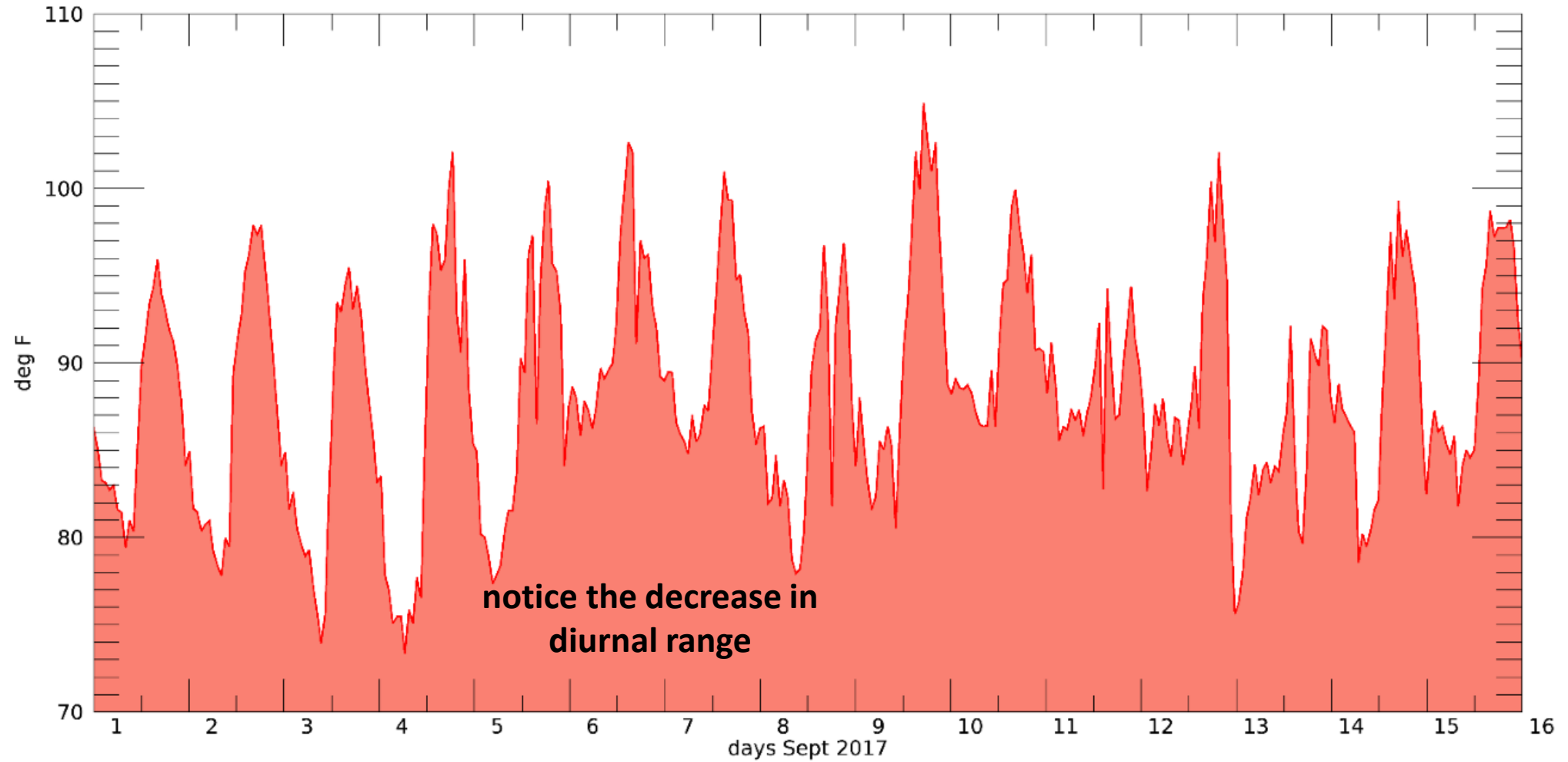


hourly heat index – Barbados airport (Sept. 1-16)



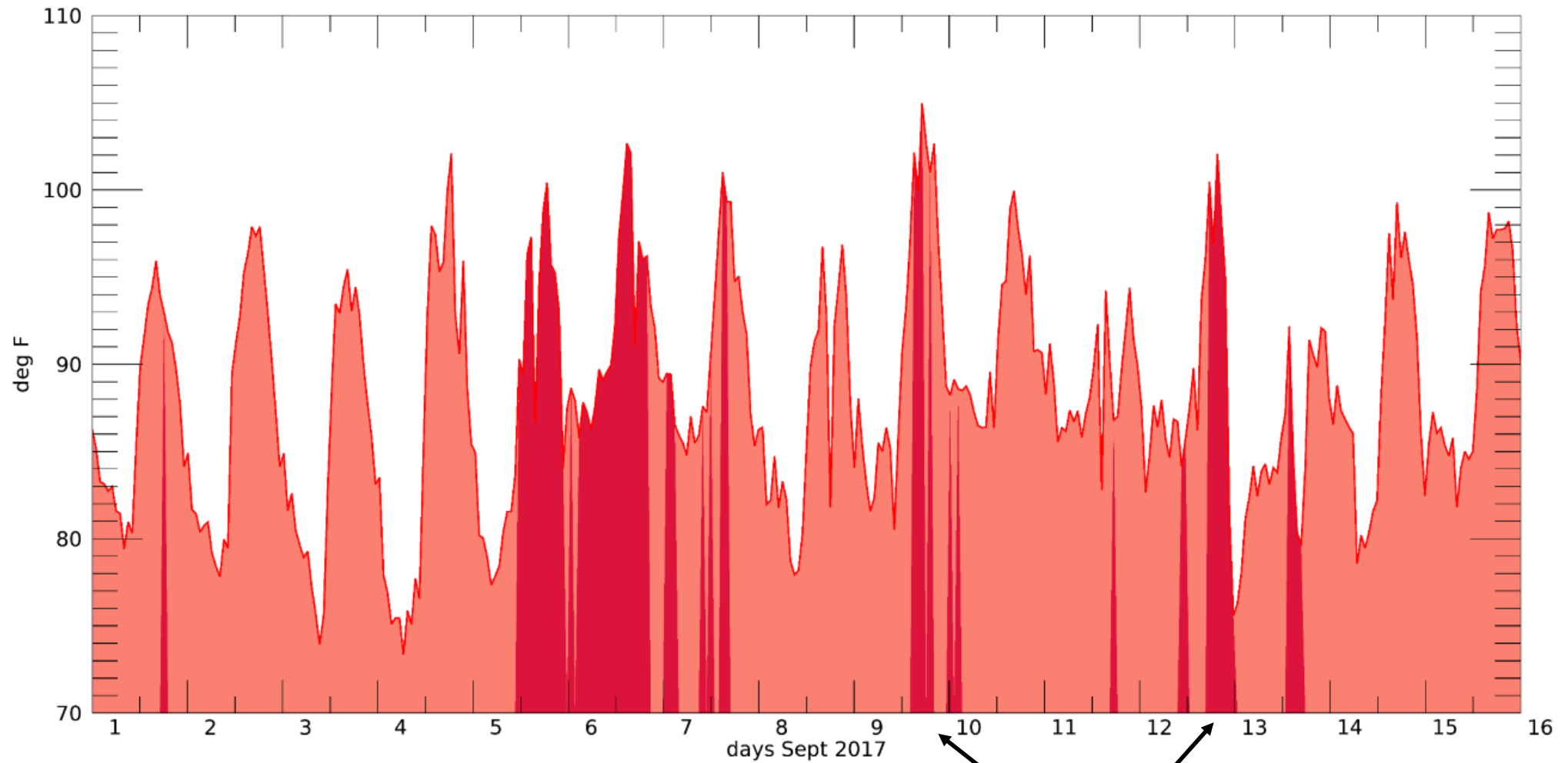
# HURRICANE IRMA - 2017

hourly heat index – Barbados airport (Sept. 1-16)



# HURRICANE IRMA - 2017

hourly heat index – Barbados airport (Sept. 1-16)

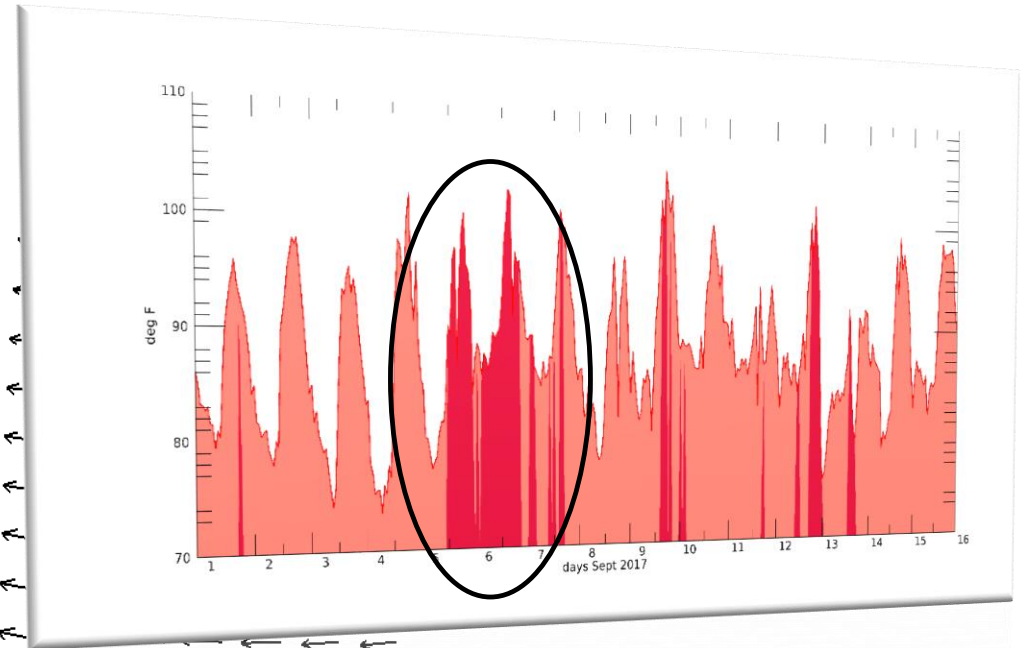
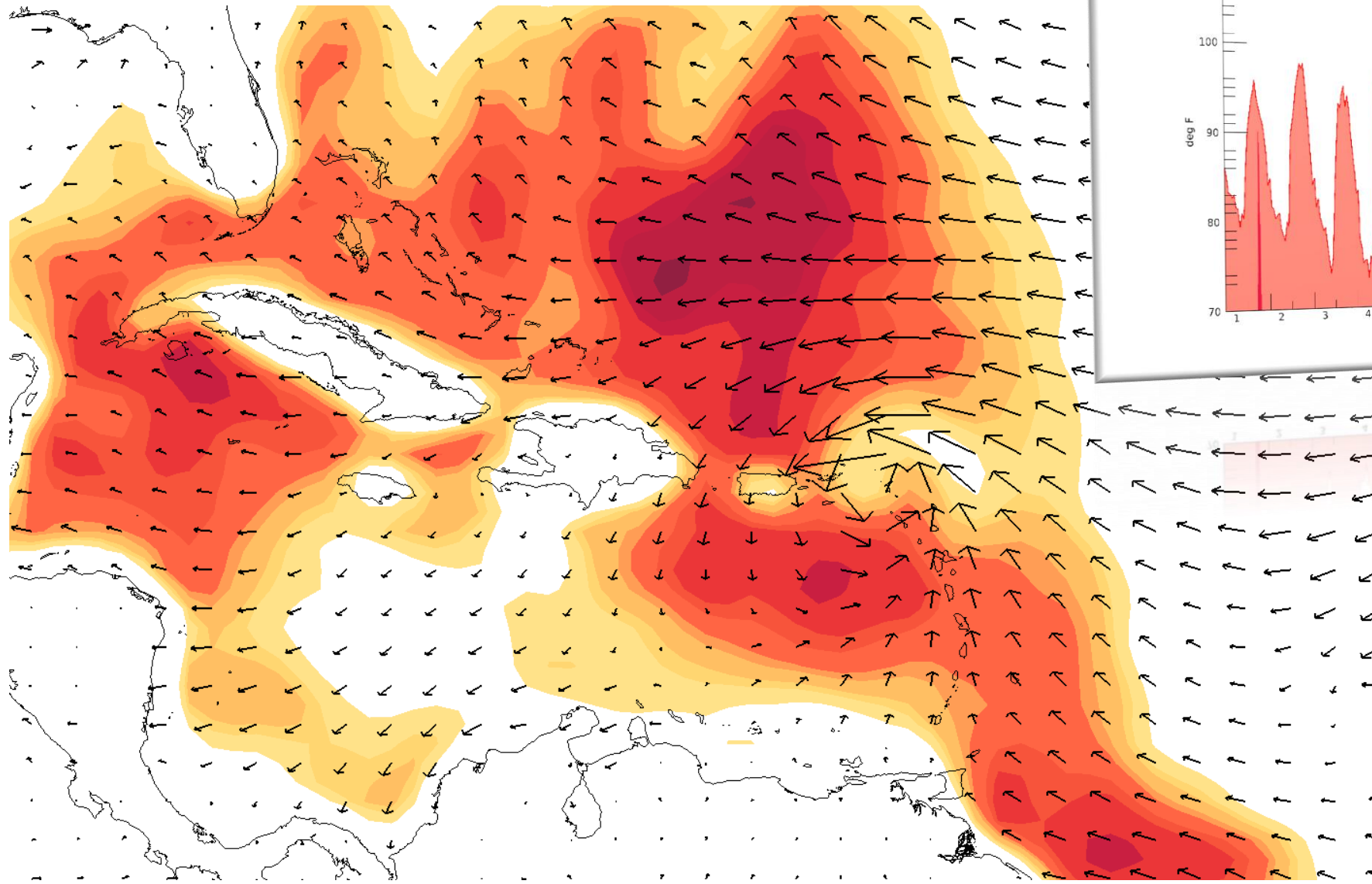


southerly winds > 12knts

IRMA

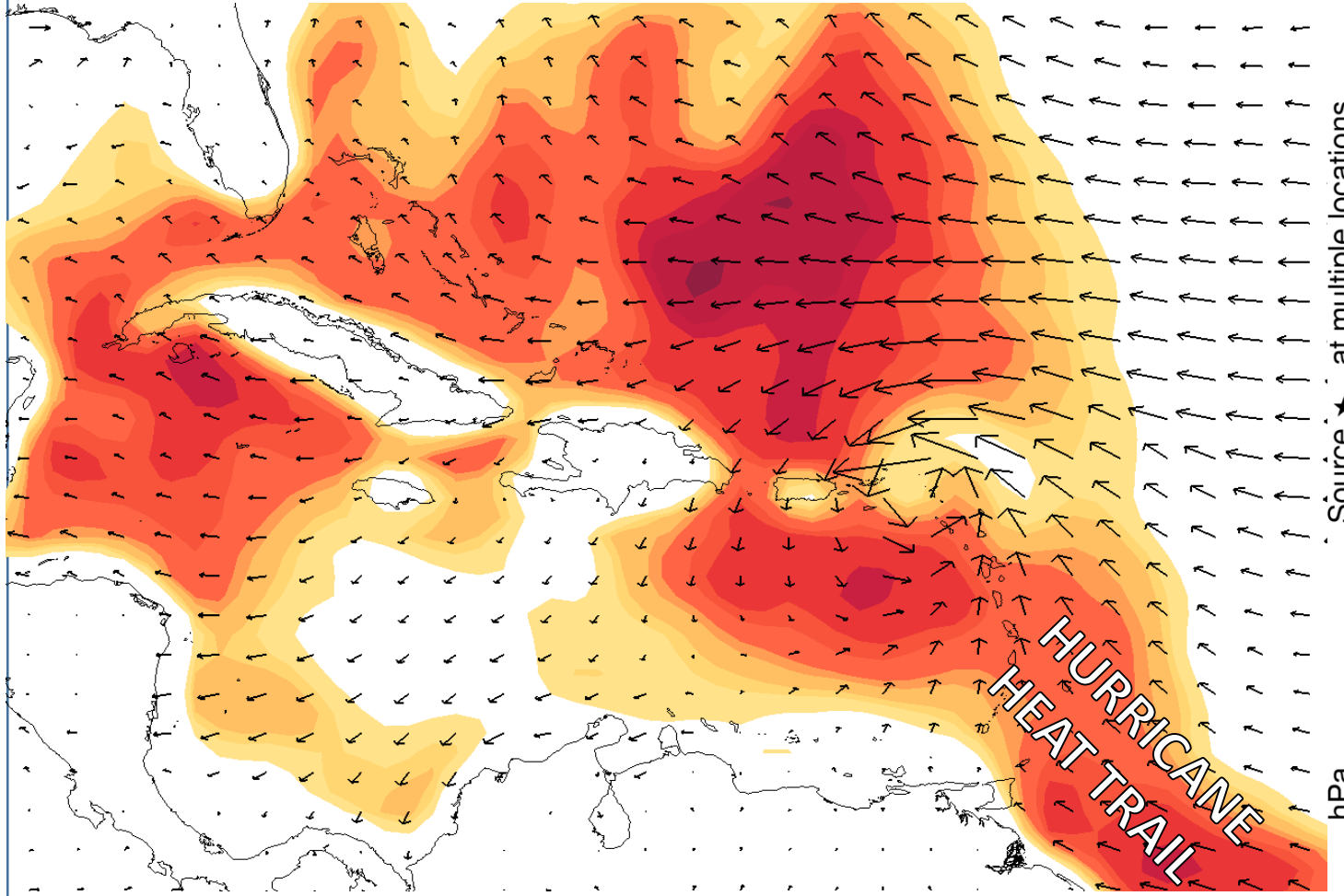
JOSE

# HURRICANE IRMA – Sept. 6. 20Z 2017

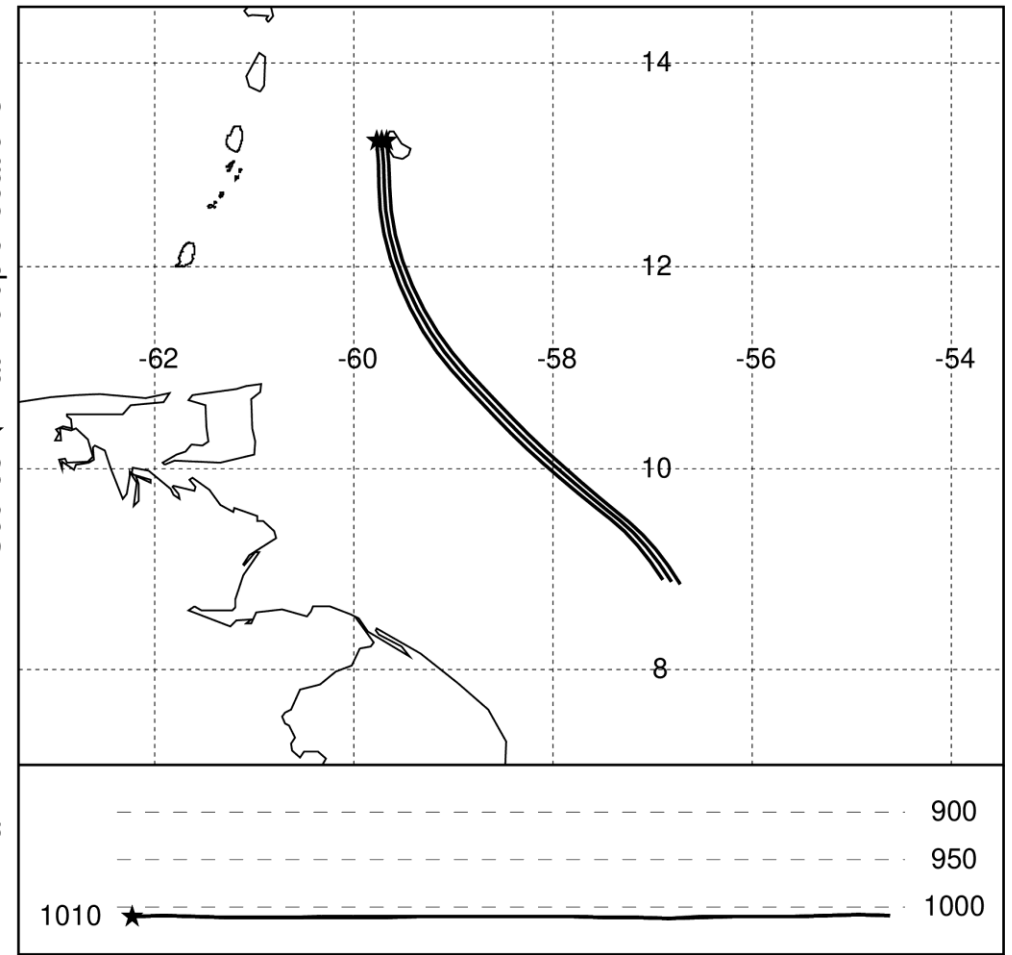


2m temperature and 10m winds  
ERA-5 Reanalysis

# HURRICANE IRMA – Sept. 6. 20Z 2017



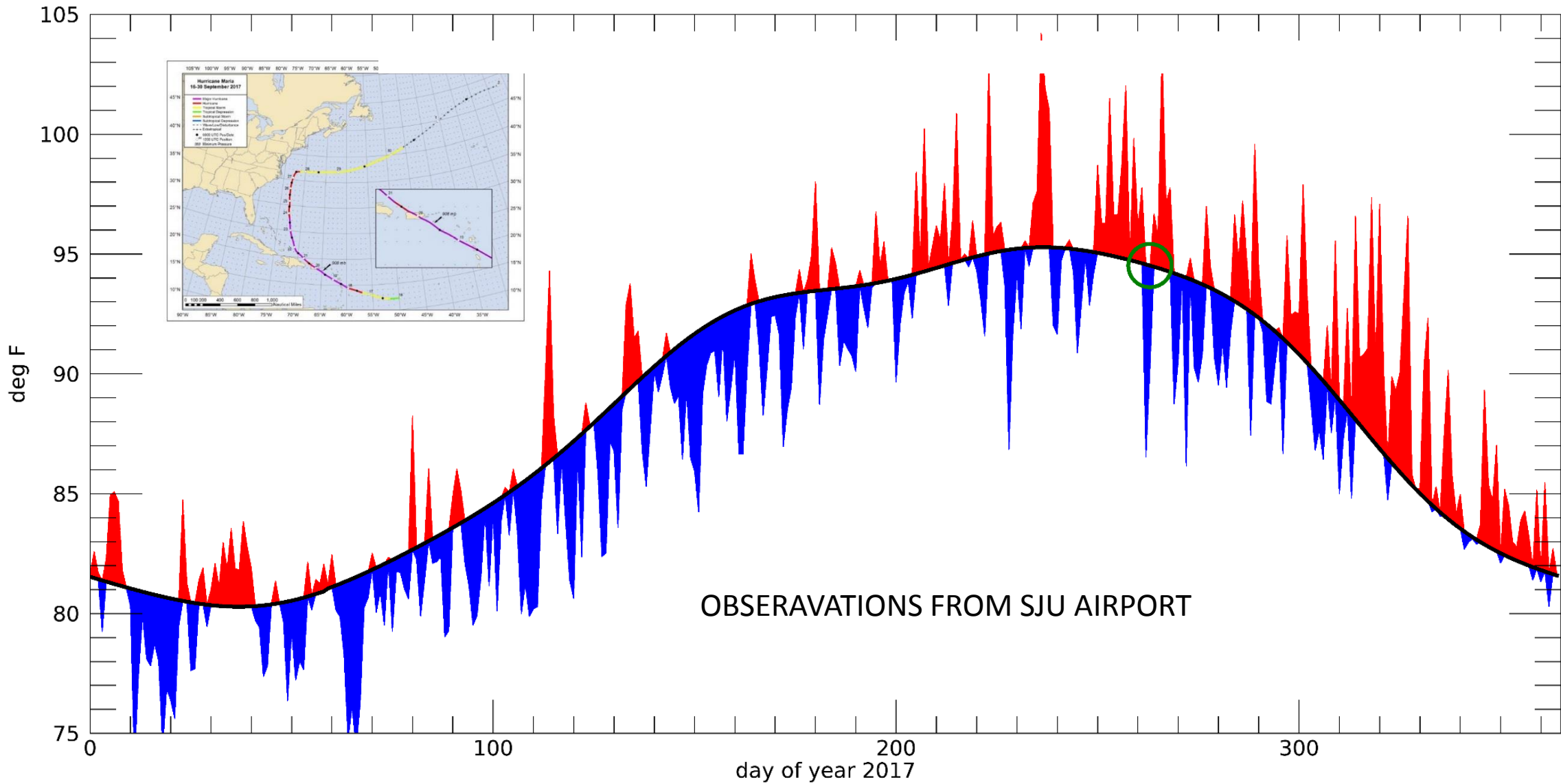
NOAA HYSPLIT MODEL  
Backward trajectories ending at 2000 UTC 06 Sep 17  
GFSG Meteorological Data



Backward trajectory

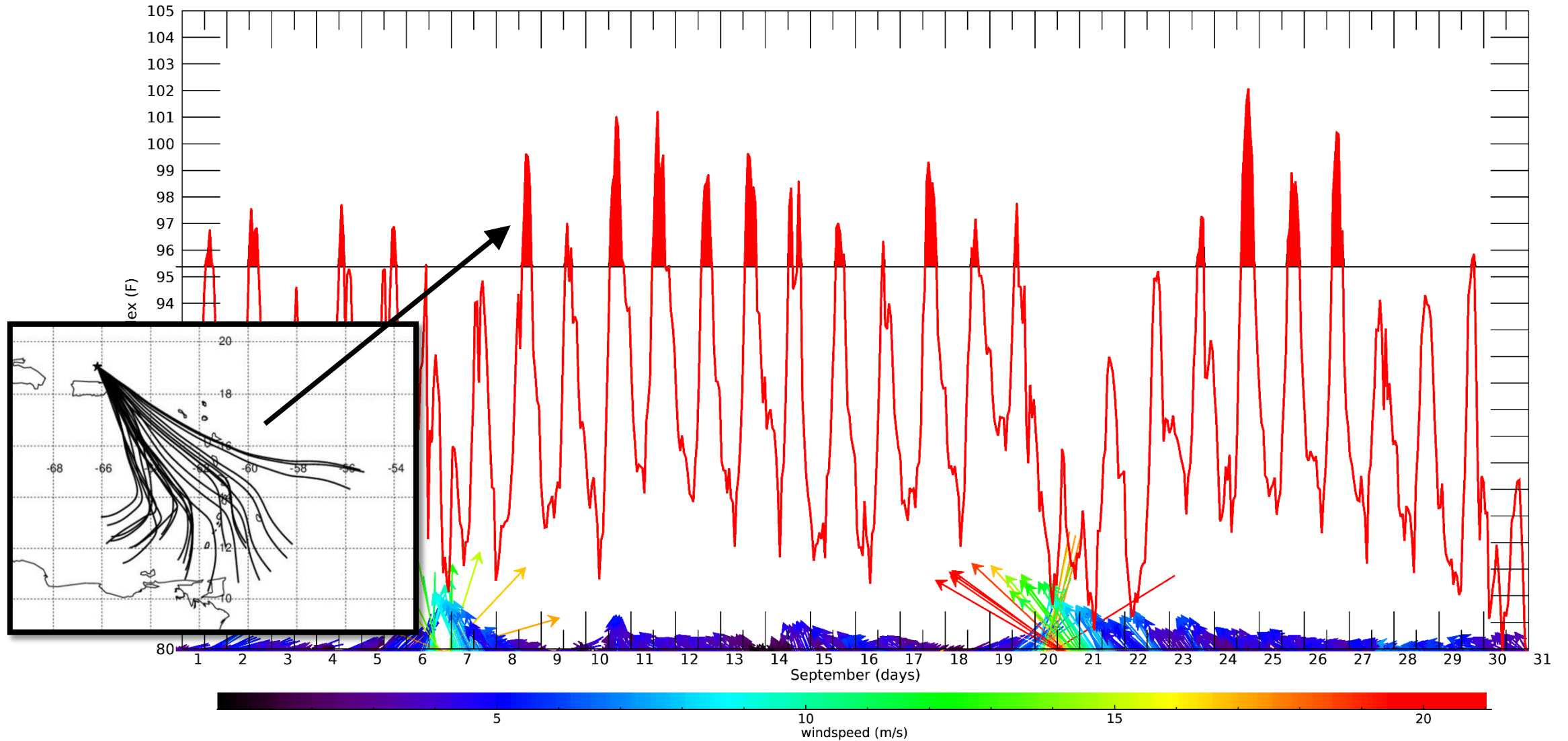


# Daily max HEAT INDEX 2017 and climatology (1980-2009) – San Juan



# Hourly Heat Index Time Series – San Juan, Puerto Rico

September 2017, 18.45, 66W

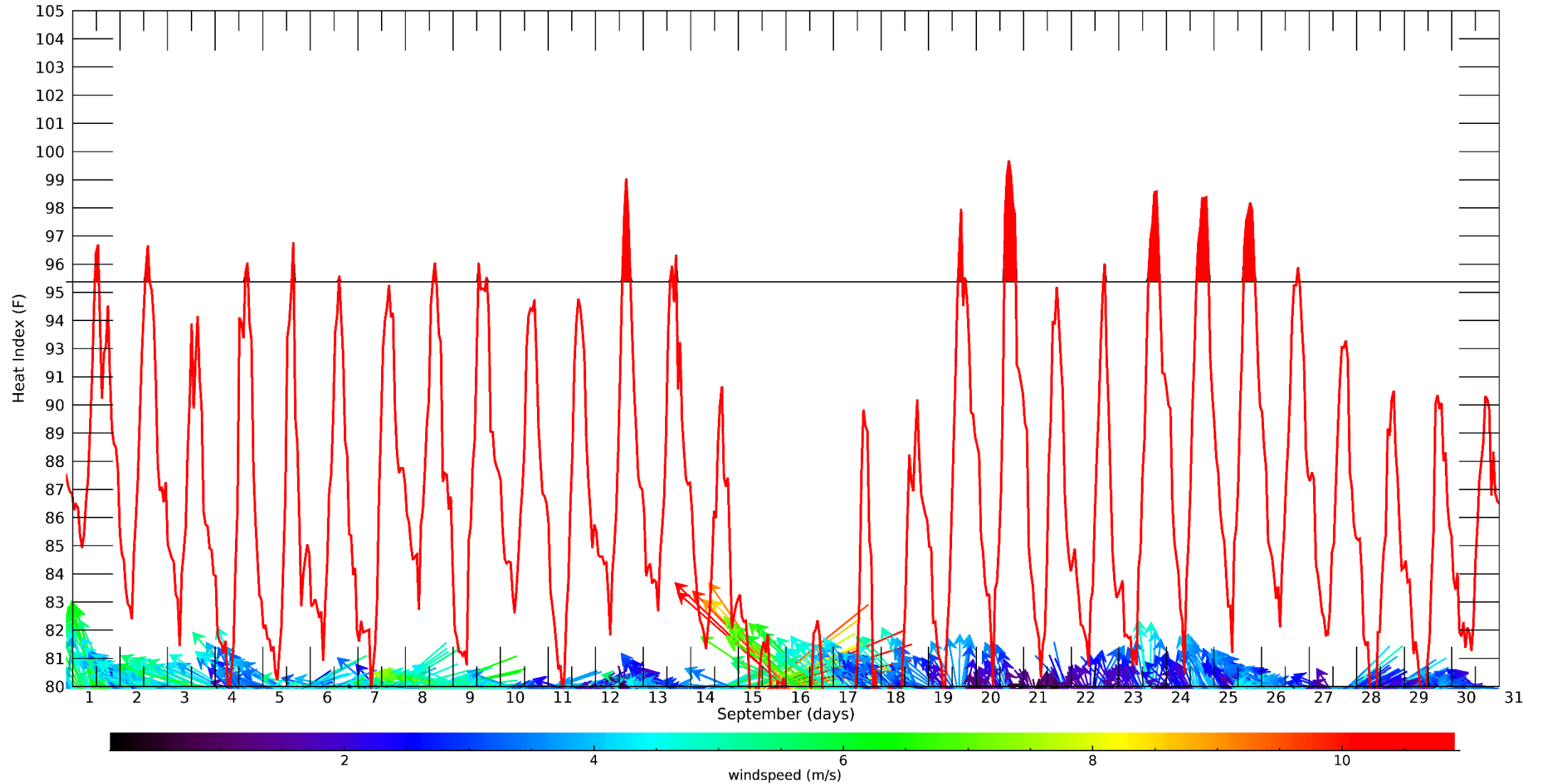


## Hurricane Maria

derived 2m heat index  
ERA-5 Reanalysis

# Hourly Heat Index Time Series – San Juan, Puerto Rico

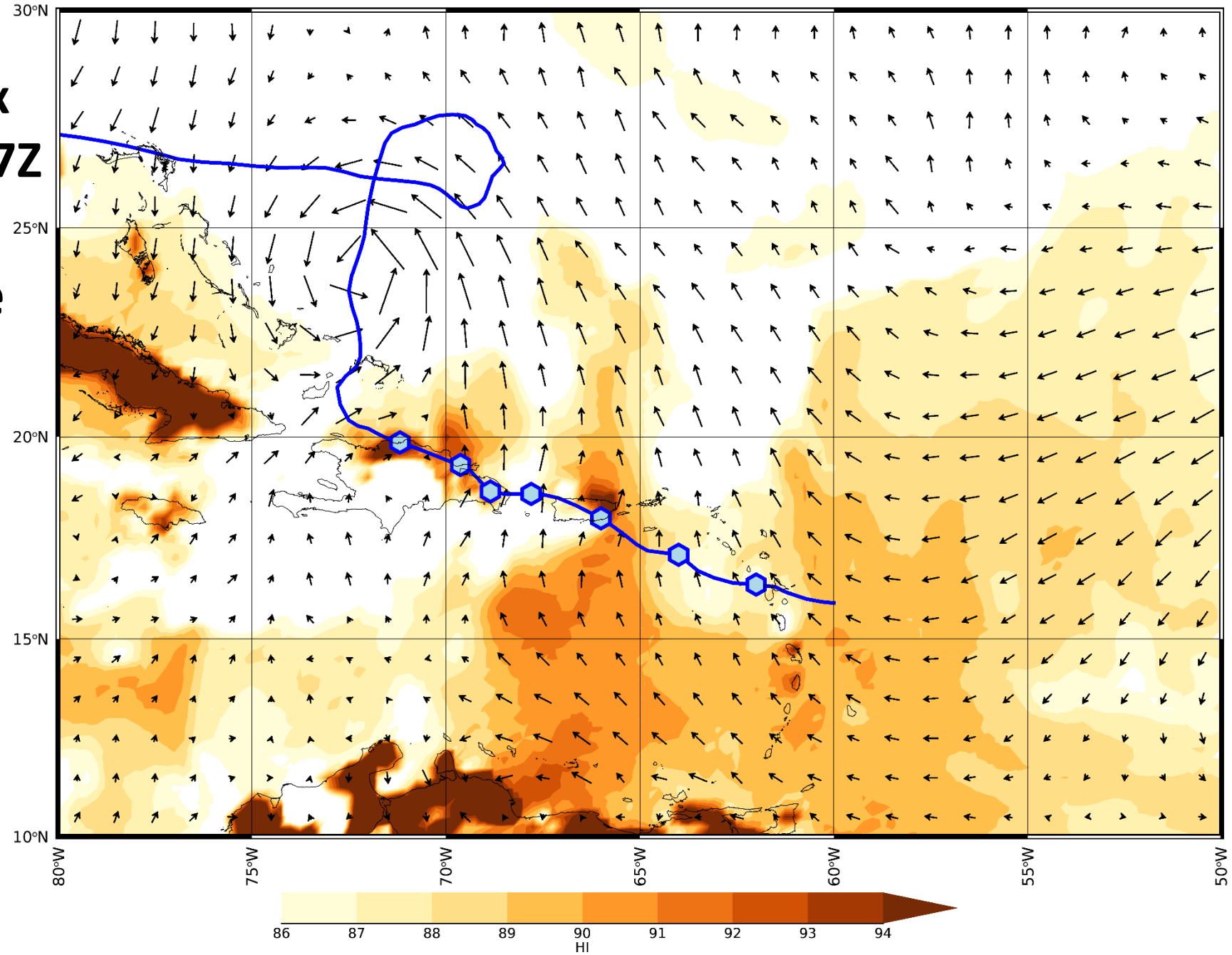
September 2004, 18.45, 66W



## Hurricane Jeanne

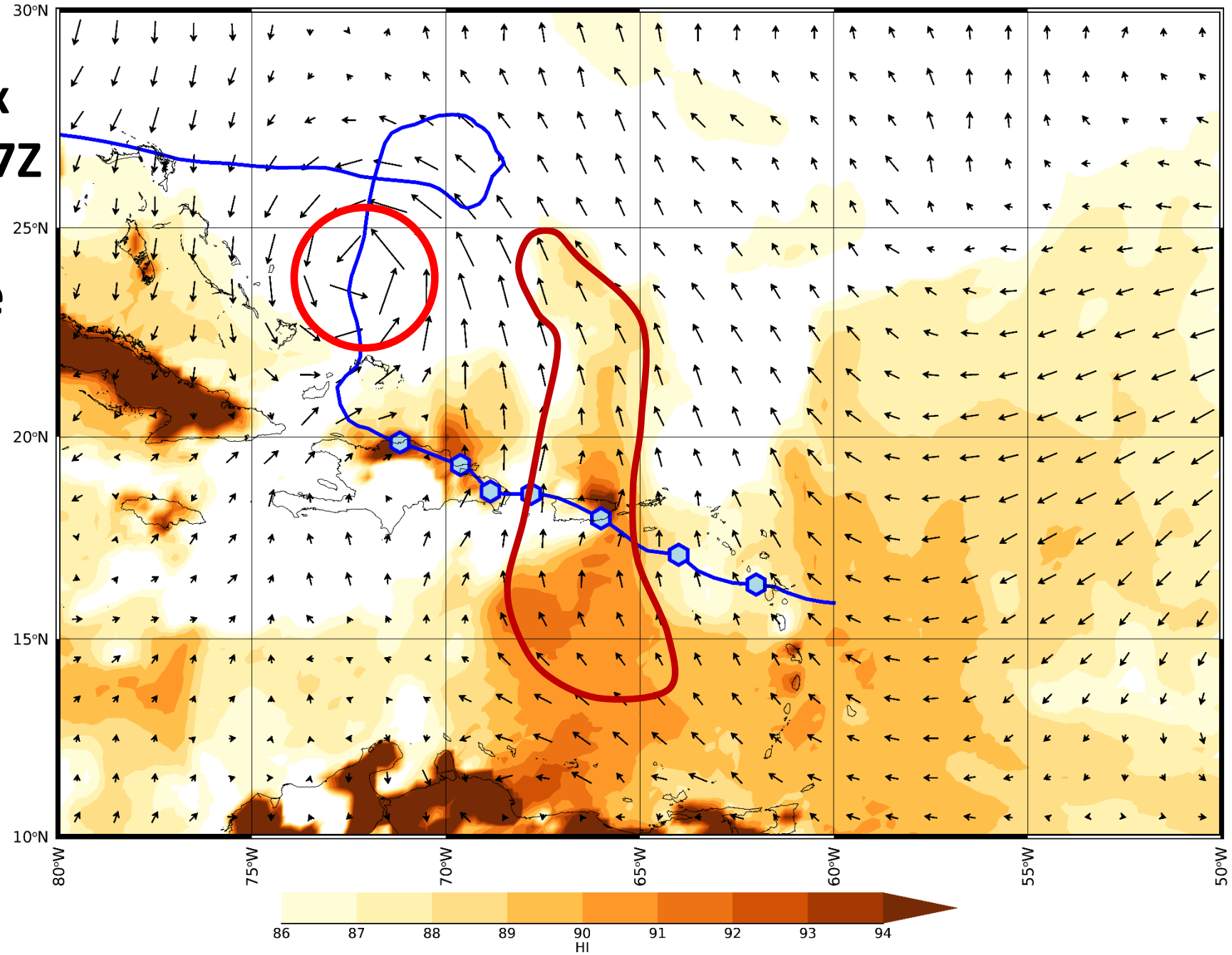
**Heat Index  
Sept 19, 17Z**

**Hurricane  
Jeanne  
2004**



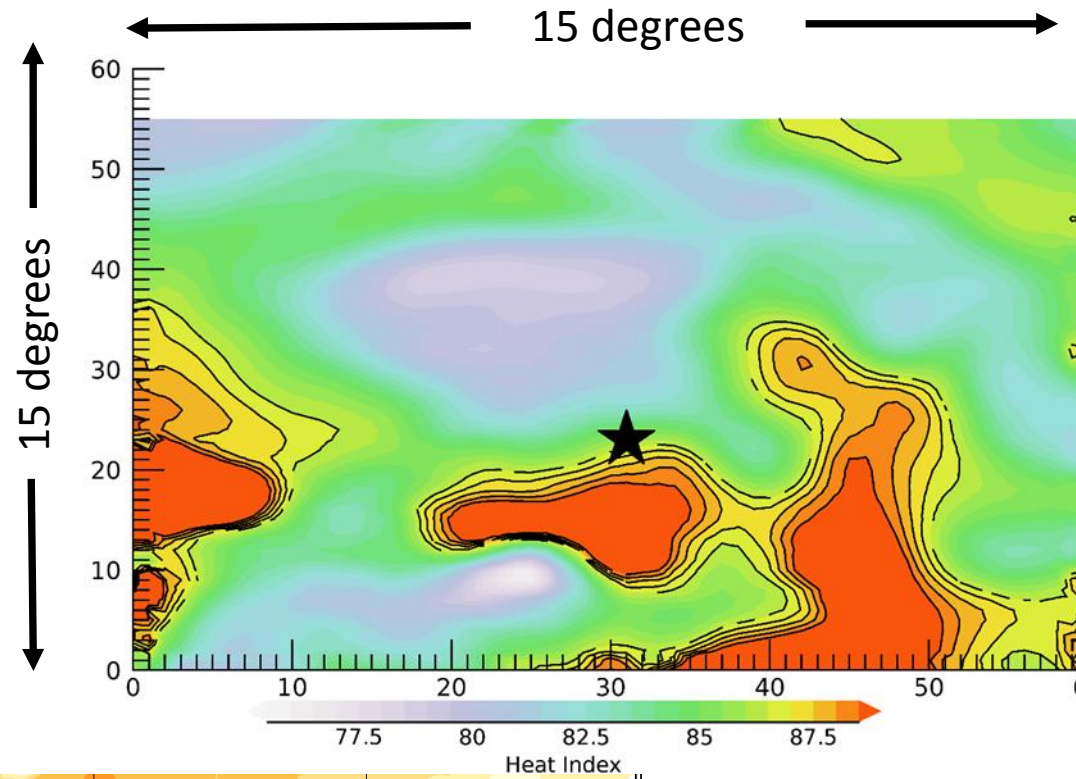
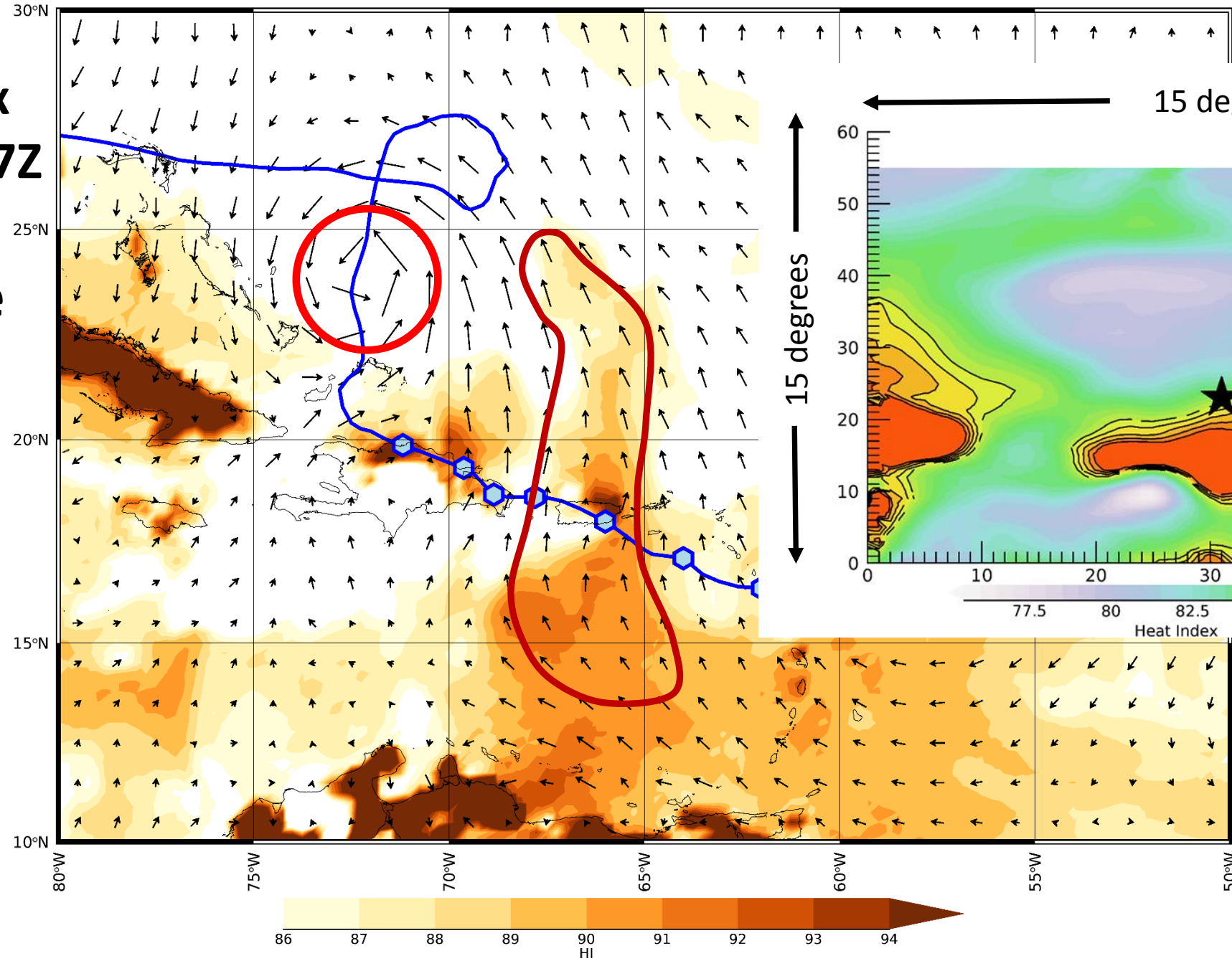
**Heat Index  
Sept 19, 17Z**

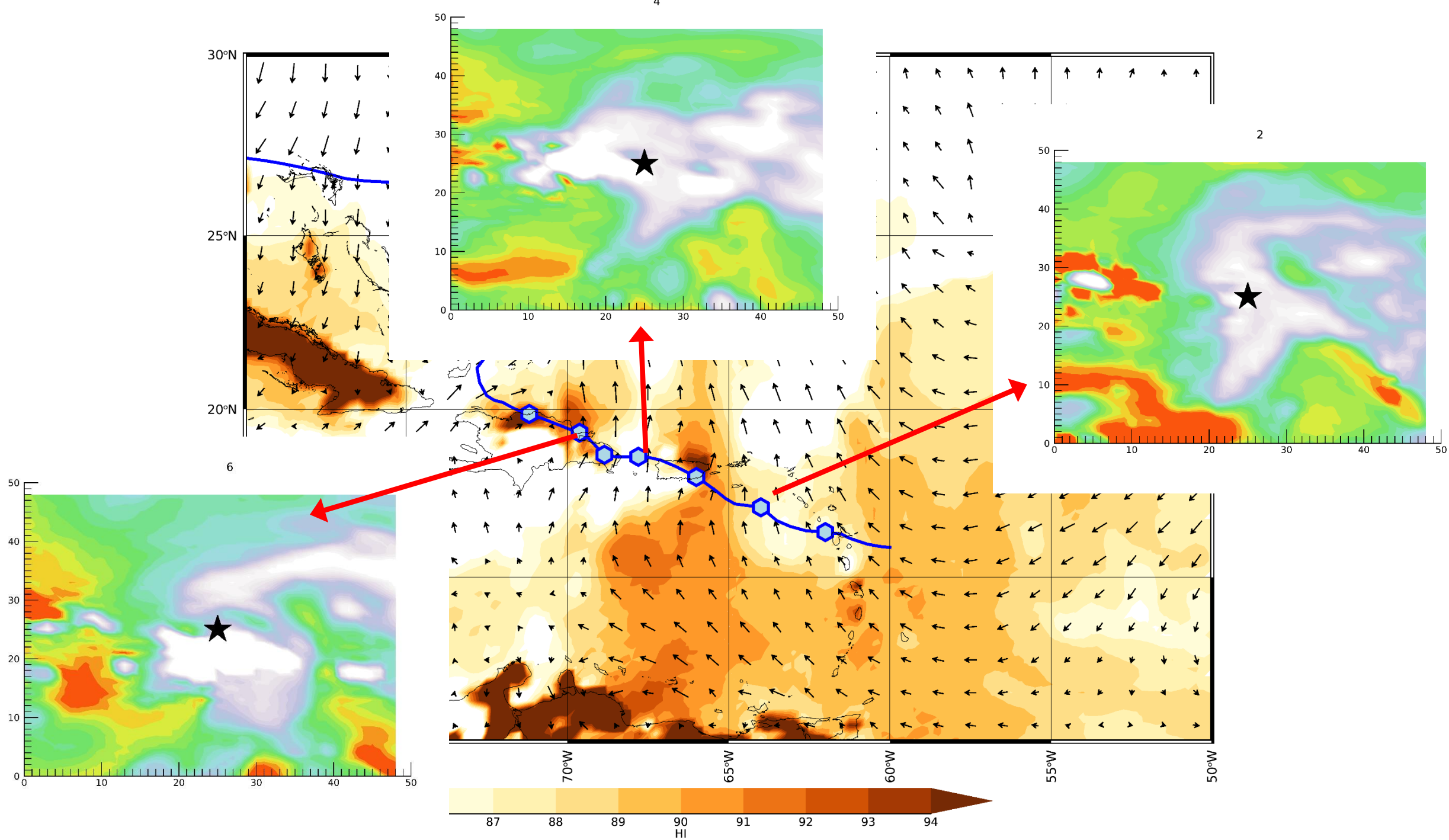
**Hurricane  
Jeanne  
2004**

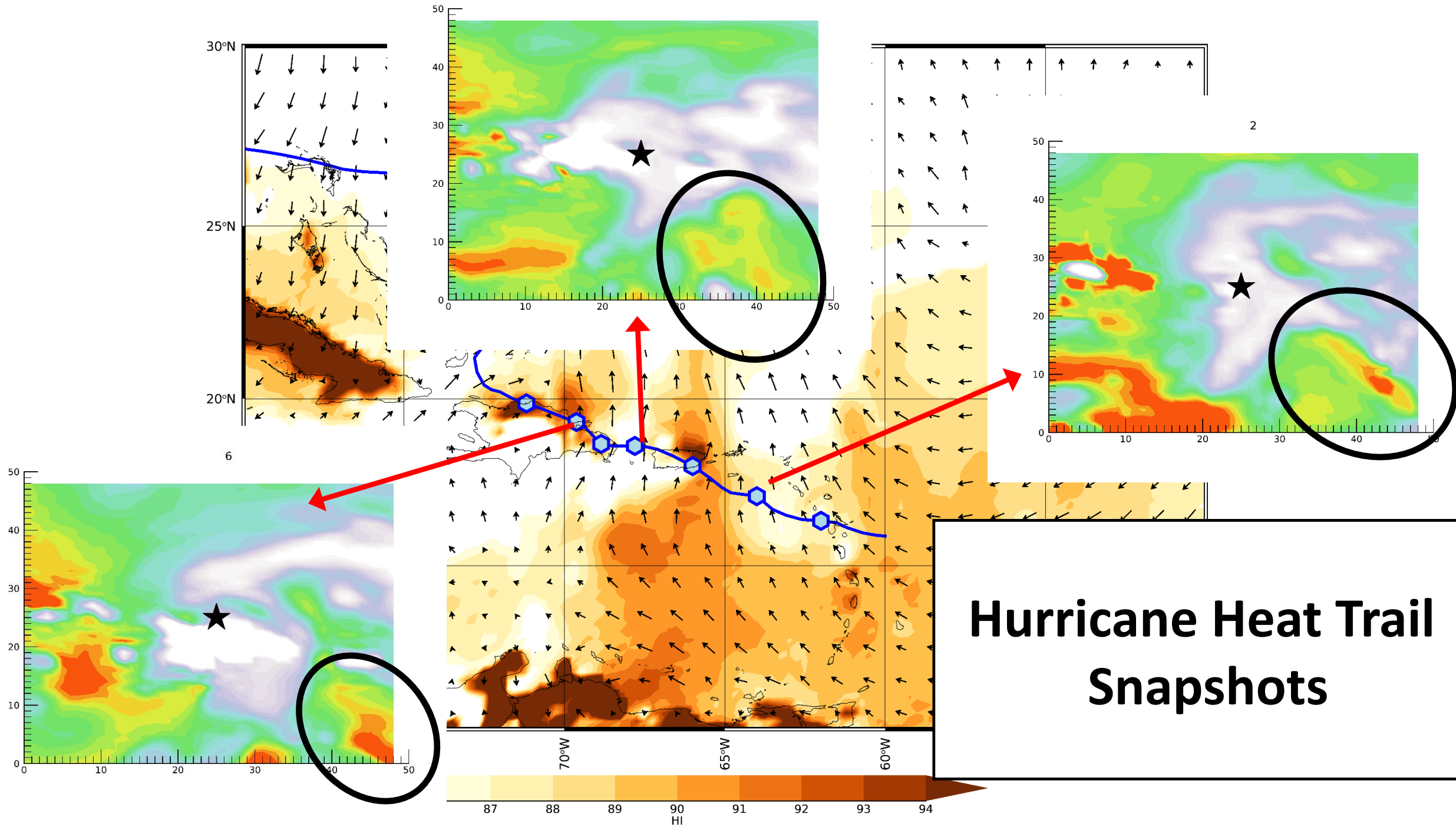


**Heat Index  
Sept 19, 17Z**

**Hurricane  
Jeanne  
2004**





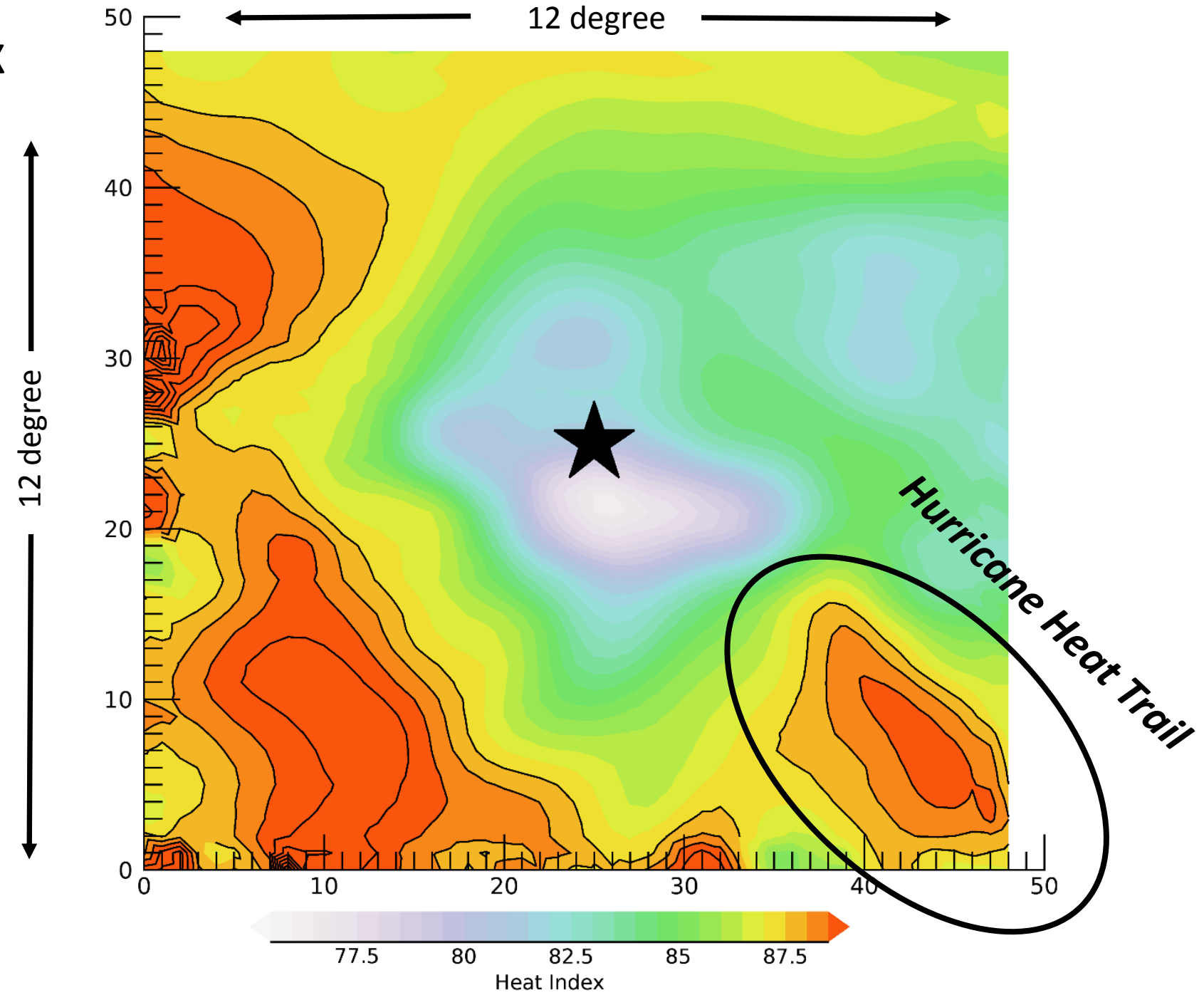


**Hurricane Heat Trail  
Snapshots**



# Composite Heat Index Snapshots

*Composite winds?, temperature?, humidity?, wind speed?*



# HUMAN HEALTH APPLICATIONS



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*Am J Trop Med Hyg.* 2019 Jun;100(6):1413-1420. doi: 10.4269/ajtmh.19-0015.

## Impacts of Hurricanes Irma and Maria on *Aedes aegypti* Populations, Aquatic Habitats, and Mosquito Infections with Dengue, Chikungunya, and Zika Viruses in Puerto Rico.

Barrera R<sup>1</sup>, Felix G<sup>1</sup>, Acevedo V<sup>1</sup>, Amador M<sup>1</sup>, Rodriguez D<sup>1</sup>, Rivera L<sup>1</sup>, Gonzalez O<sup>1</sup>, Nazario N<sup>2</sup>, Ortiz M<sup>2</sup>, Muñoz-Jordan JL<sup>3</sup>, Waterman SH<sup>1</sup>, Hemme RR<sup>1</sup>.

### ⊕ Author information

#### Abstract

Puerto Rico was severely impacted by Hurricanes Irma and Maria in September 2017. The island has been endemic for dengue viruses (DENV) and recently suffered epidemics of chikungunya (CHIKV 2014) and Zika (ZIKV 2016) viruses. Although severe storms tend to increase the number of vector and nuisance mosquitoes, we do not know how they influence *Aedes aegypti* populations and arboviral transmission. We compared the abundance of female *Ae. aegypti* in autocidal gravid ovitraps (AGO traps), container habitats, and presence of RNA of DENV, CHIKV, and ZIKV in this vector before and after the hurricanes in Caguas city and in four communities in southern Puerto Rico. Two of these communities were under vector control using mass AGO trapping and the other two nearby communities were not. We also investigated mosquito species composition and relative abundance (females/trap) using Biogents traps (BG-2 traps) in 59 sites in metropolitan San Juan city after the hurricanes. Mosquitoes sharply increased 5 weeks after Hurricane Maria. Ensuing abundance of *Ae. aegypti* was higher in Caguas and in one of the southern communities without vector control. *Aedes aegypti* did not significantly change in the two areas with vector control. The most abundant mosquitoes among the 26 species identified in San Juan were *Culex (Melanoconion) spp.*, *Culex quinquefasciatus*, *Culex nigripalpus*, and *Ae. aegypti*. No arboviruses were detected in *Ae. aegypti* following the hurricanes, in contrast with observations from the previous year, so that the potential for *Aedes*-borne arboviral outbreaks following the storms in 2017 was low.

PMID: 30963992 PMCID: [PMC6553919](#) DOI: [10.4269/ajtmh.19-0015](#)

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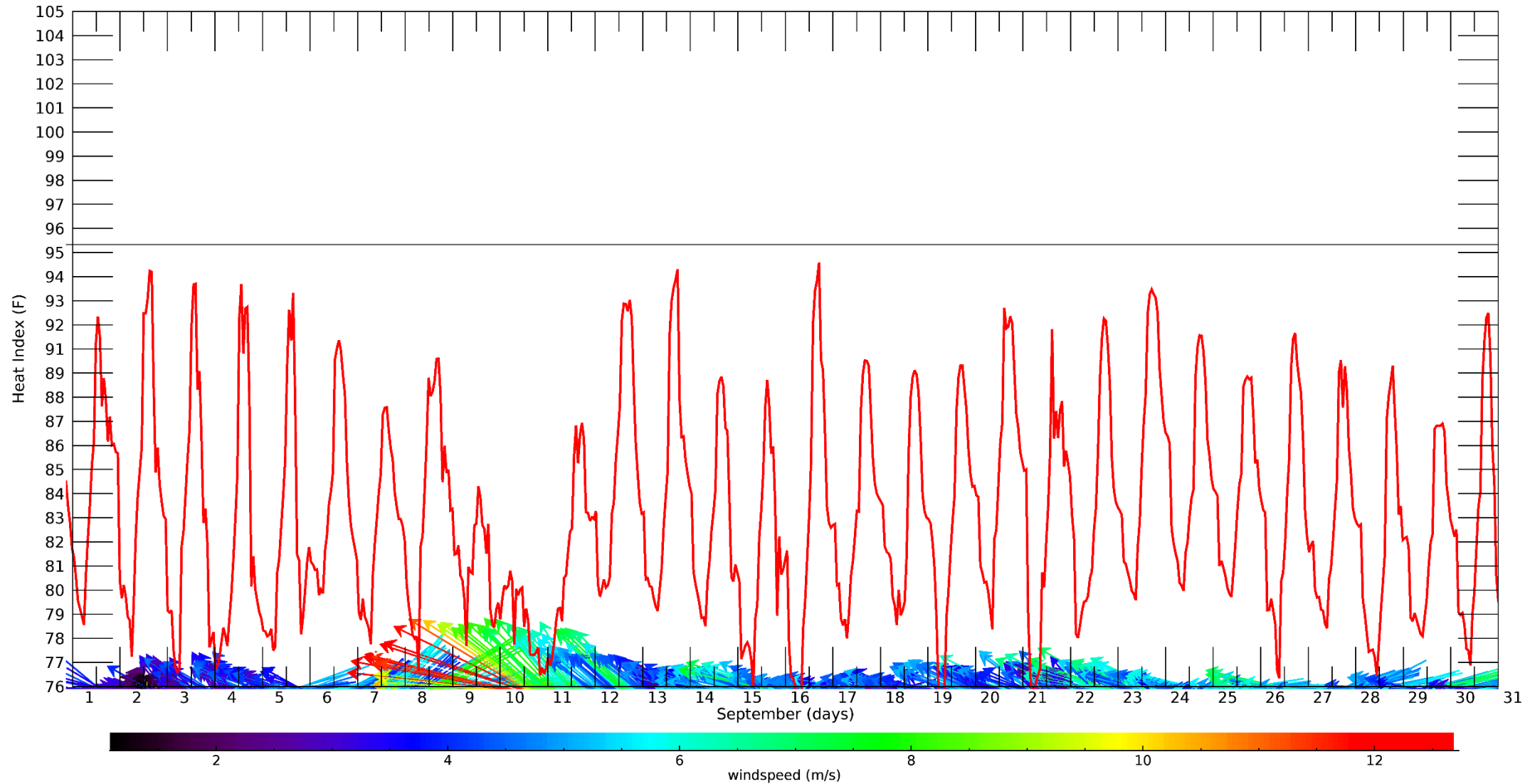
# NEXT

- DIAGNOSE each land-falling case– why some had strong or weak signals
- INVESTIGATE land falling versus non-land-falling events within 100nm / 200nm distance from shore
- COMPOSITES?
- Heat Index THRESHOLD VALUES? Are there better options?
- INTEGRATE station data into the analysis
- REGIONAL investigation vs island specific



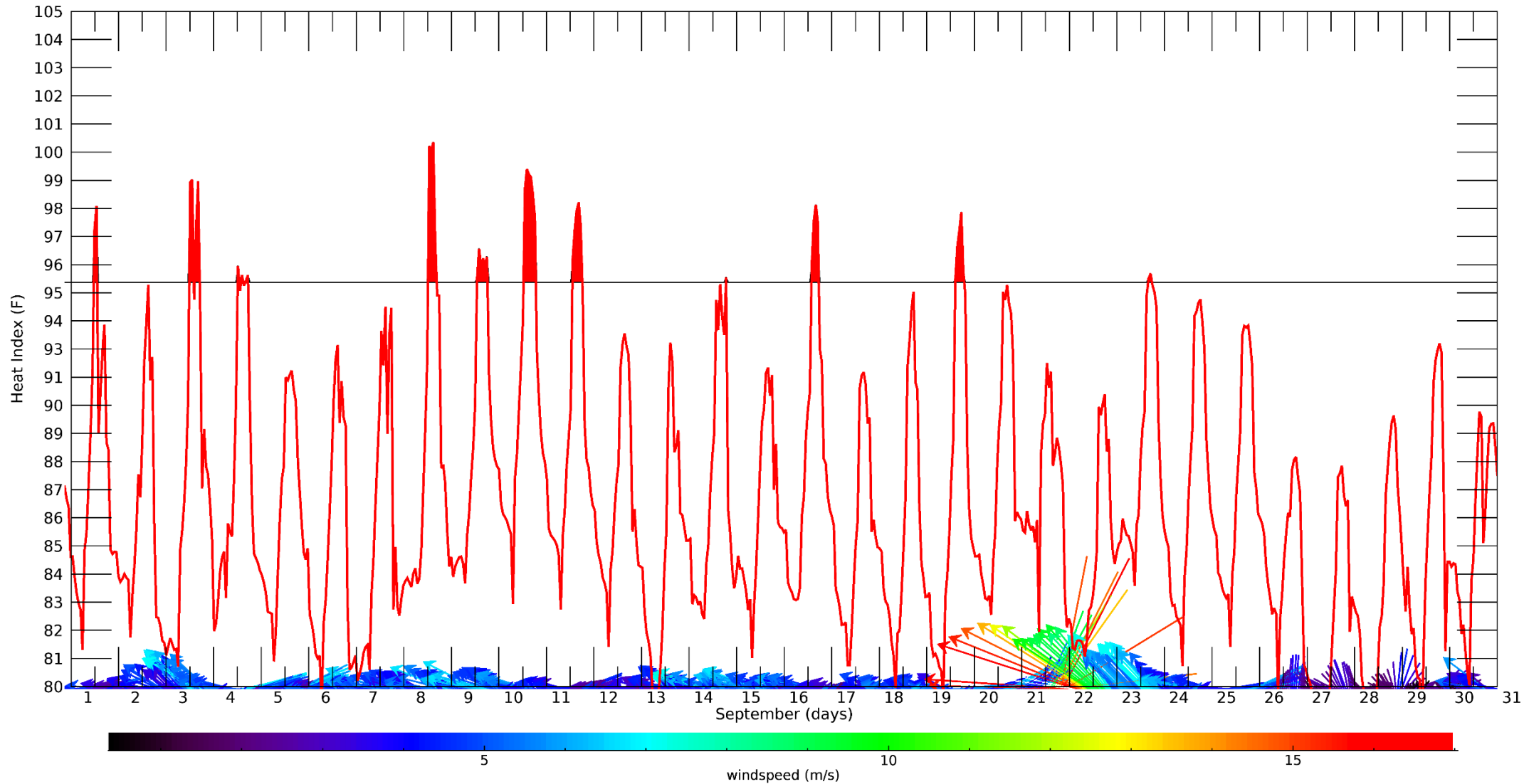
# Hourly Heat Index Time Series

September 1996, 18.45, 66W



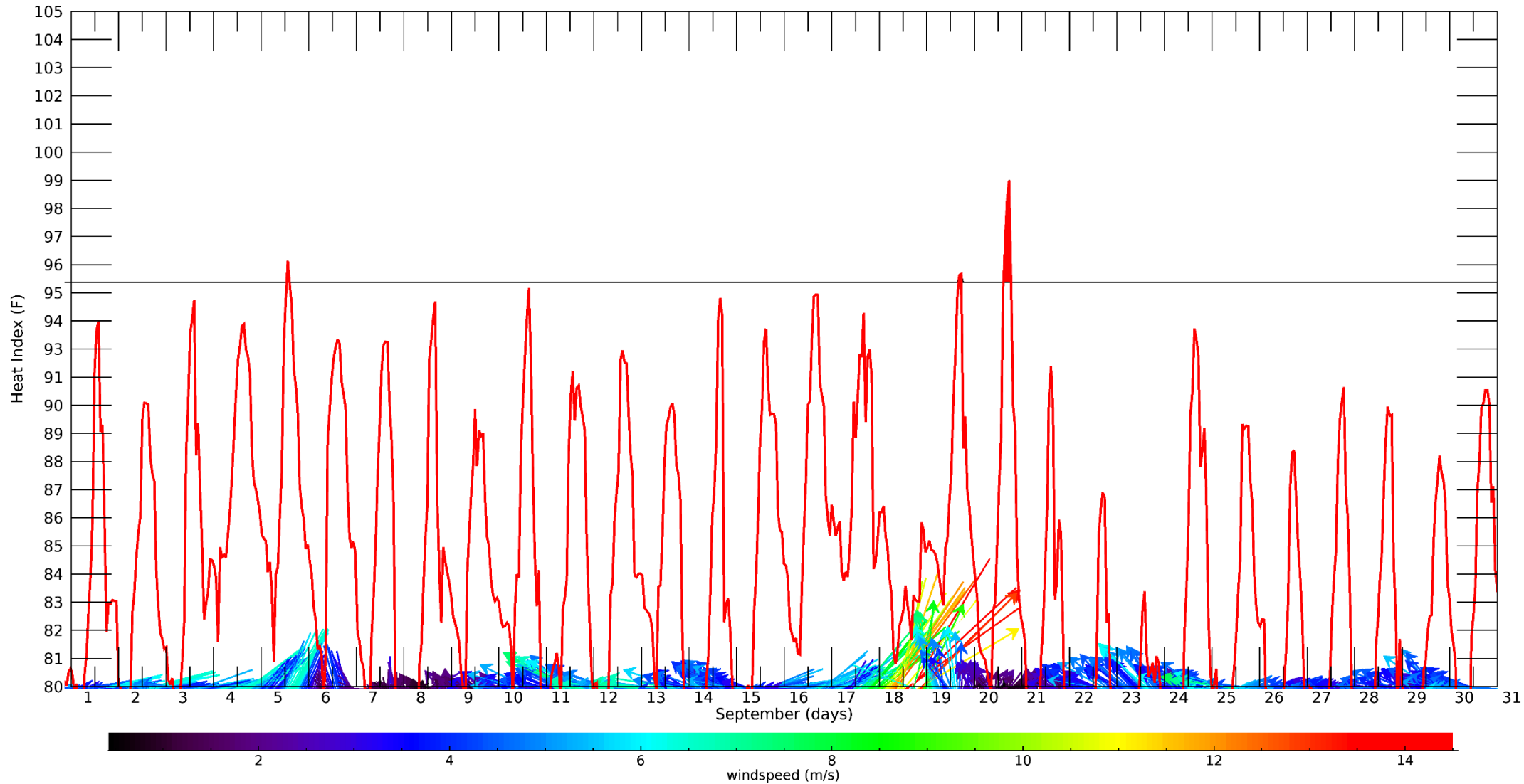
## Hurricane Hortense

September 1998, 18.45, 66W



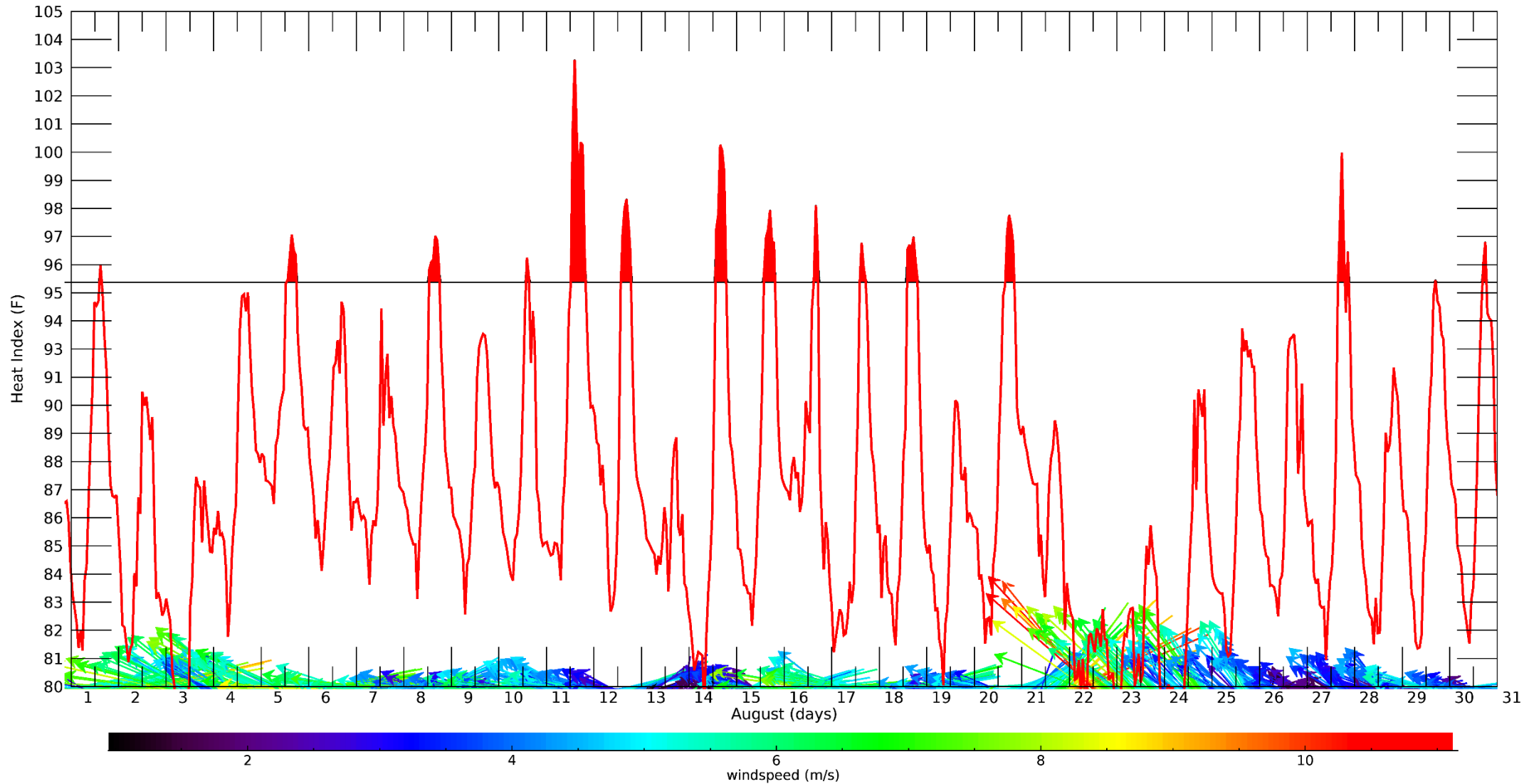
# Hurricane Georges

September 1989, 18.45, 66W



# Hurricane Hugo

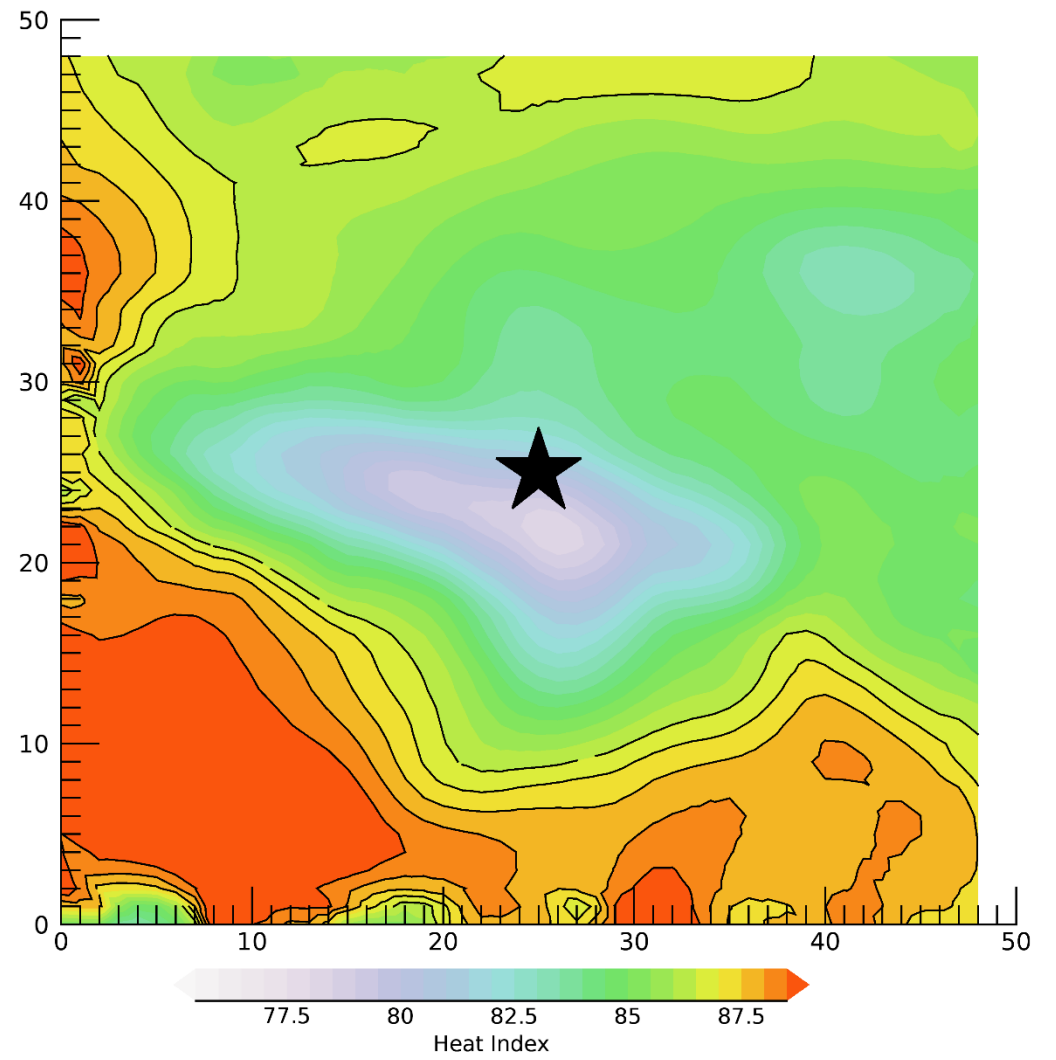
August 2011, 18.45, 66W

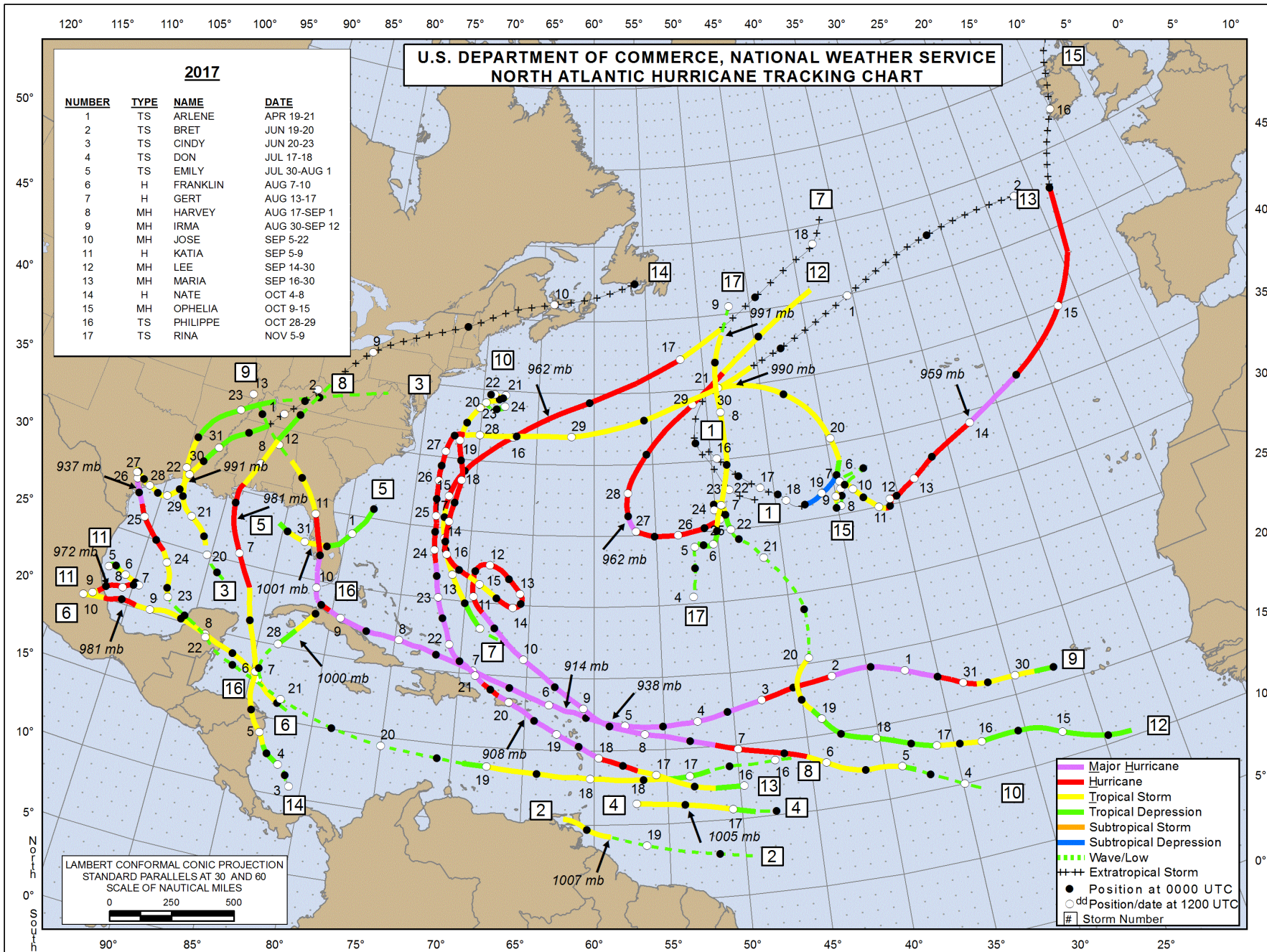


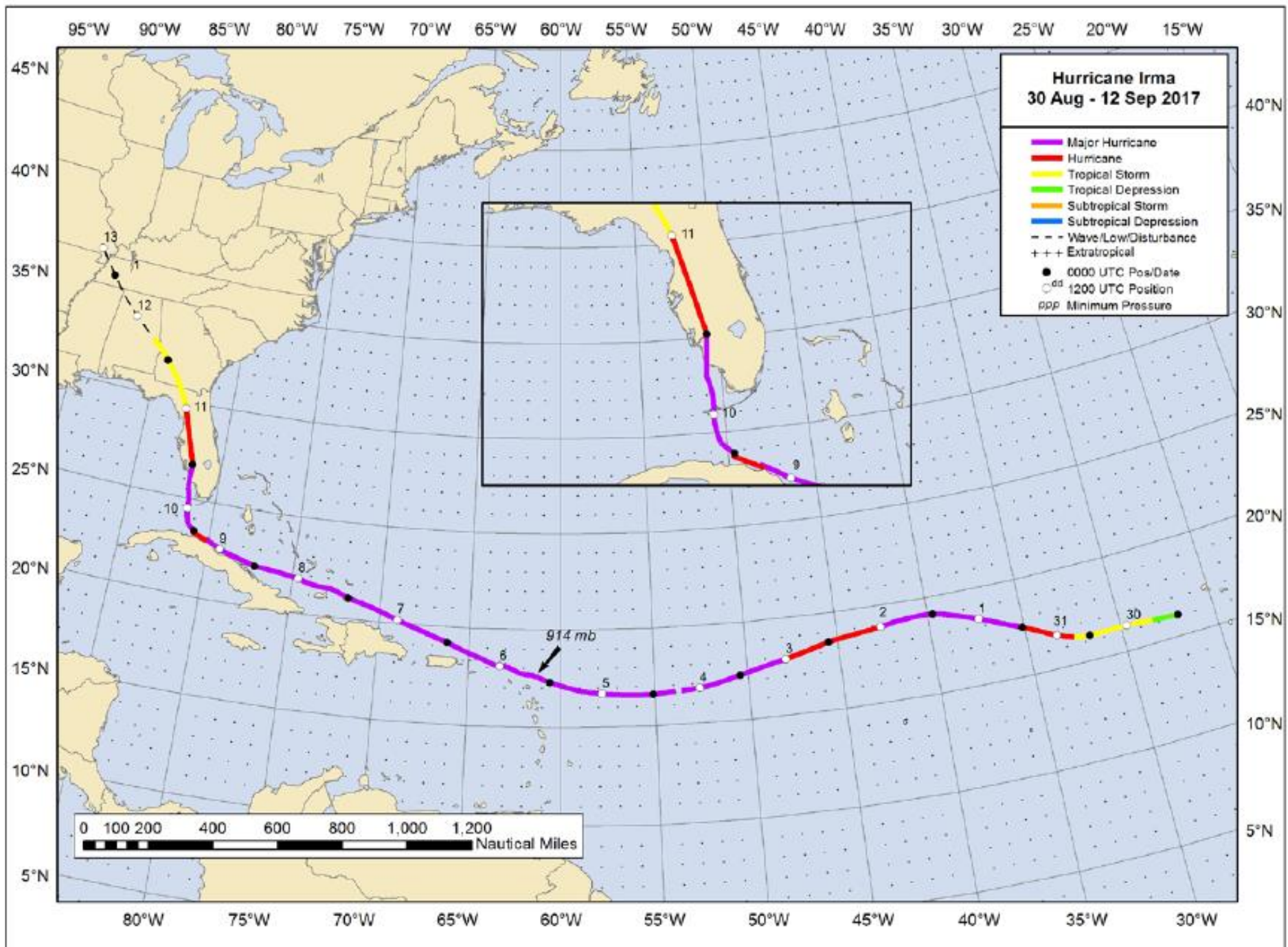
# Hurricane Irene

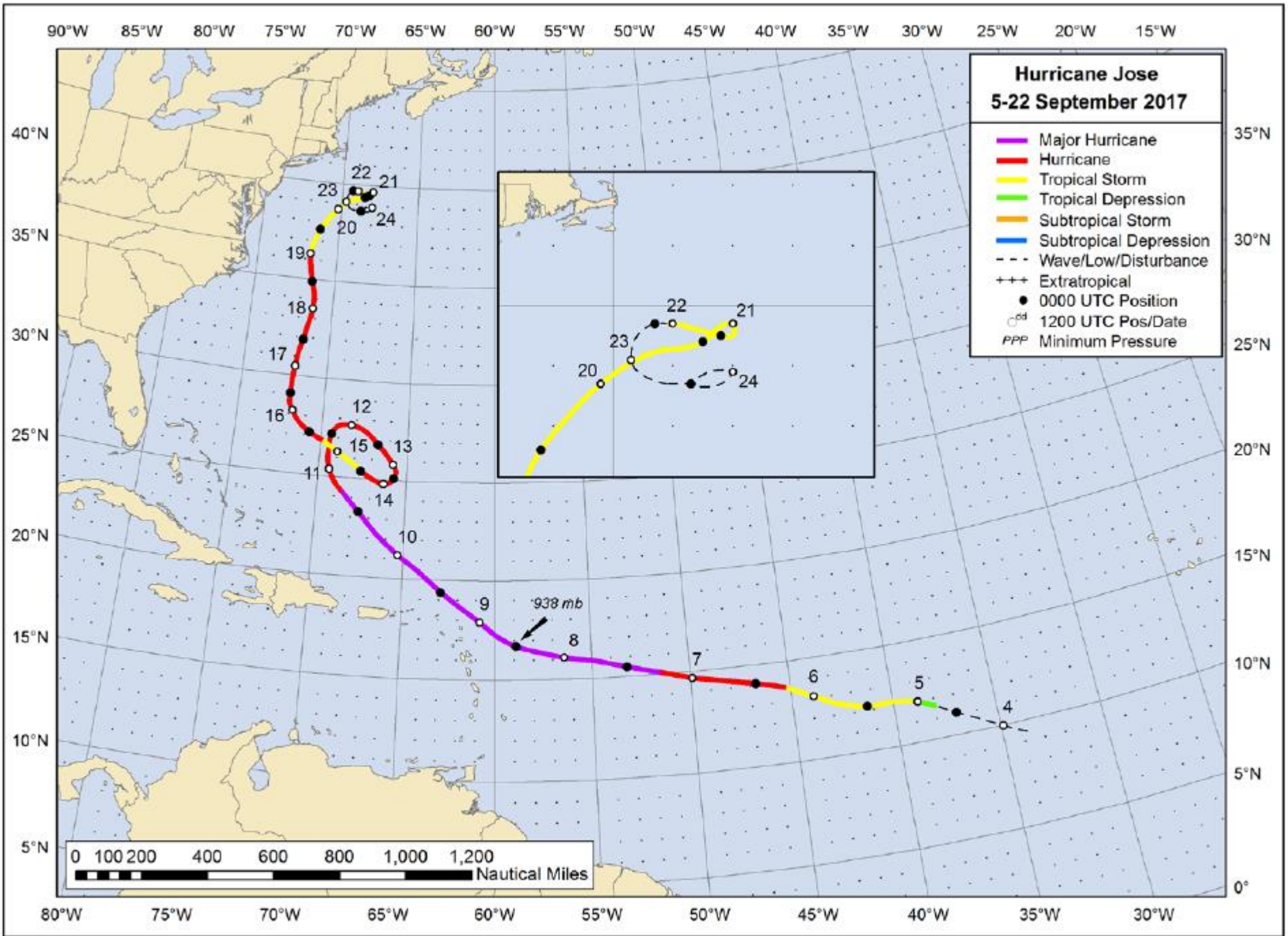


avg from all circles









0 100 200 400 600 800 1,000 1,200 Nautical Miles

80°W 75°W 70°W 65°W 60°W 55°W 50°W 45°W 40°W 35°W 30°W

40°N  
35°N  
30°N  
25°N  
20°N  
15°N  
10°N  
5°N

35°N  
30°N  
25°N  
20°N  
15°N  
10°N  
5°N  
0°

