Climatology and Trends of Heatwaves in the Southeast United States

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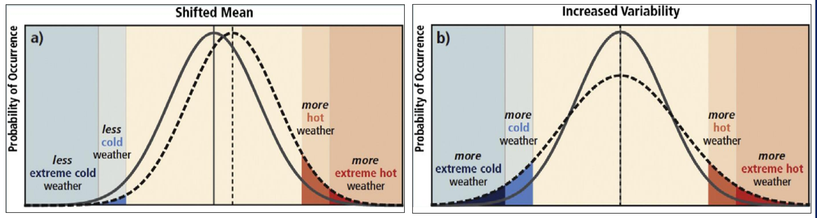
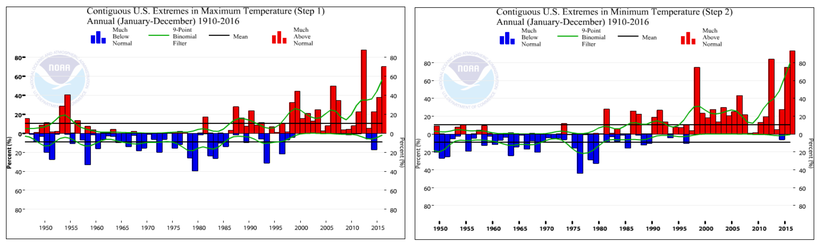
1. Motivation

- There exists broad scientific consensus that heatwaves are increasing in frequency, duration, and intensity in a warming world.
- Heatwaves are generally the most strongly linked extreme weather event to anthropogenic climate change.
- Observed trends (1950–2015) in frequency, intensity, and duration of heatwaves are presented for four cities across the Southeast U.S.
- The characteristics of the synoptic-scale flow pattern and sea surface temperatures (SSTs) were also investigated.



These figures from the 2013 IPCC report show how the temperature distribution can shift under a warming climate, leading to more frequent and intense heat.



U.S. Climate Extremes Index (NOAA NCEI 2017) showing trends in maximum temperatures (left) and minimum temperatures (right) for 1910–2016. Minimum temperatures have generally increased at a faster rate in response to increasing concentrations of greenhouse gases.

2. Data and Method

DATA

- Daily temperature data (MAX | AVG | MIN) were obtained for 10 major airports across the southeast U.S. via the Applied Climate Information System (ACIS, *http://scacis.rcc-acis.org/*). Here, we present results for 4 representative stations.
- For SSTs and synoptic-scale characteristics, composites were constructed using the ERA-Interim Reanalysis (Dee et al. 2011, *QJRMS*)

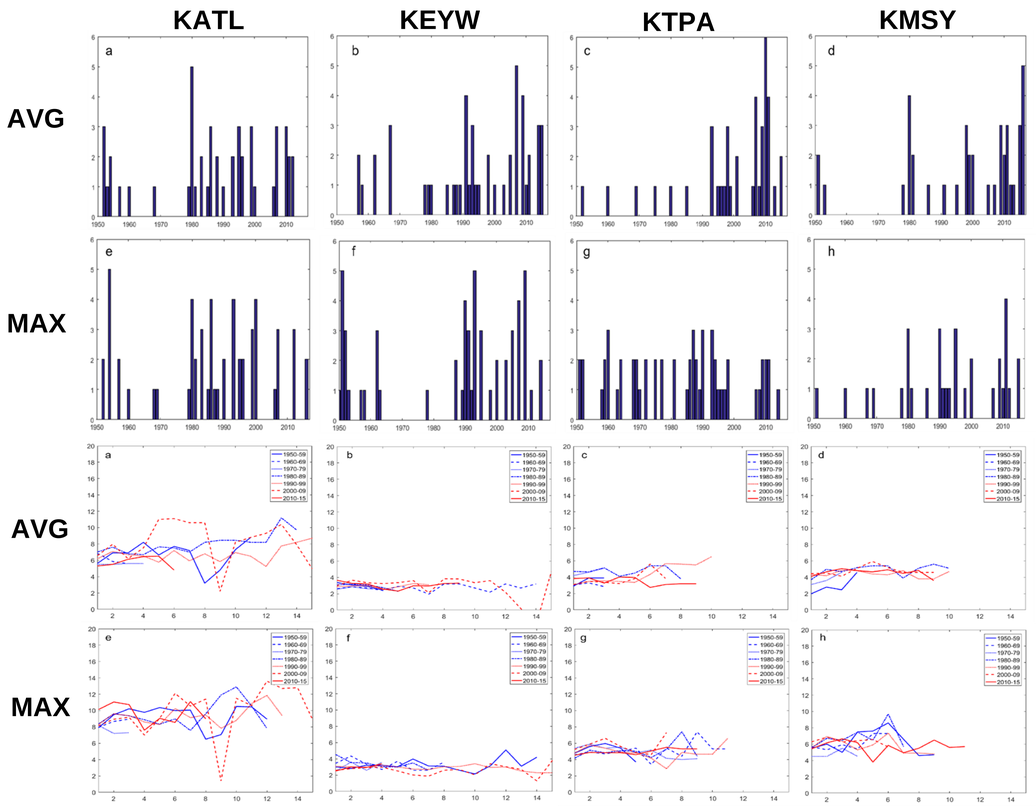
METHOD

- Heatwaves at each station were identified for Summer (Jun–Aug) months.
- An individual heatwave event was defined using the following metric – ***The temperature had to exceed the 95th percentile for three consecutive days with a gap of at least four consecutive days between events.***
- Heatwave events were identified separately for daily MAX, AVG, and MIN temperatures.

Airports Used

KATL	Atlanta
KMSY	New Orleans
KTPA	Tampa
KEYW	Key West

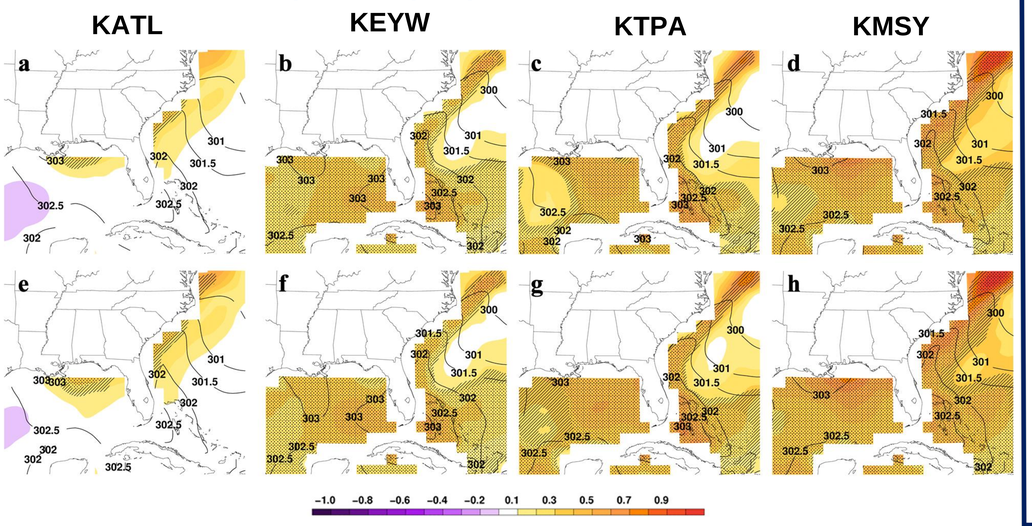
3. Trends in Frequency, Intensity, and Duration



Top two rows: AVG and MAX temperature heatwave event frequency for each year from 1950–2015 at: Atlanta (a, e), Key West (b, f), Tampa (c, g), and New Orleans (d, h).

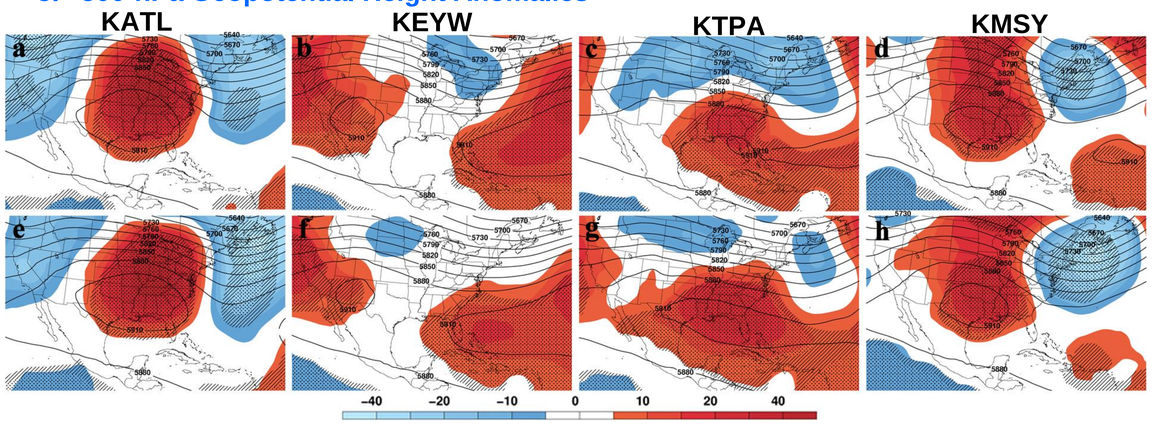
Bottom two rows: for each decade (1950–2015), mean departures (°C) and duration of AVG and MAX heatwave events at: Atlanta (a, e), Key West (b, f), Tampa (c, g), and New Orleans (d, h).

4. Sea Surface Temperature (SST) Anomalies



ERA-Interim monthly-weighted composite SST anomalies (K, shaded), means (K, contours), and statistical significance at the 95th (hatched) and 99th (dotted) percent confidence interval for: Atlanta (a, e), Key West (b, f), Tampa (c, g), and New Orleans (d, h). Shown are the composite first (top) and second (bottom) day of AVG heatwave events, 1979–2015.

5. 500-hPa Geopotential Height Anomalies



ERA-Interim monthly-weighted composite 500-hPa geopotential height anomalies (m, shaded), means (m, contours) and statistical significance at the 95th (hatched) and 99th (dotted) percent confidence interval for: Atlanta (a, e), Key West (b, f), Tampa (c, g), and New Orleans (d, h). Shown are the composite first (top) and second (bottom) day of AVG heatwave events, 1979–2015.

6. Conclusions

- Positive trends in heatwave frequency and duration are observed, especially for AVG and MIN (not shown) events. However, substantial trends in intensity are not seen.
- Anomalously warm SSTs are observed during heatwaves, particularly at coastal stations (e.g., KTPA); the largest anomalies are found over adjacent waters.
- Statistically significant anomalous 500-hPa ridges are observed at all four stations. The ridges at KATL and KMSY are centered over each station and are of continental origin, while the ridge for KEYW cases is located to the east, related to the Bermuda-Azores High.

7. For More Information

- Raghavendra, A., A. Dai, S. M. Milrad, and S. R. Cloutier-Bisbee, 2018: Floridian Heatwaves and Extreme Precipitation: Future Climate Projections, *Clim. Dyn.*, revised.
- **Poster Number 1016** (31st CCVC | Exhibit Hall 3 on Wed 10 Jan 2018, 3:45 PM–5:30 PM
- **Oral presentation Session 15B** (Rm #408 Hilton ACC on Thu 11 Jan 2018 1:30–1:45 PM