Heat related illness in a changing climate and demography of Florida

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Impact of Hurricane Irma 2017

Florida's elderly struggle in Irma's sweltering aftermath

By ASSOCIATED PRESS / SEPTEMBER 14, 2017

Mary Della Ratta, 94, sits by a battery powered lantern in her home three days after Hurricane Irma knocked out power in Naples, Fla.

DAVID GOLDMAN/AP

- Disruptions caused by weather can be fatal!
- Hurricane is a wet weather event.
- And yet casualties from heat related illness becomes somewhat obvious and ominous

13th and 14th Residents Die From Florida Nursing Home That Lost A/C After Hurricane Irma

by Associated Press / Oct.09.2017 / 4:42 PM EDT

Impact of Hurricane Maria 2017 in Puerto Rico

Causes of death	Sept./ Oct. 2015	Sept./ Oct. 2016	Sept./ Oct. 2017	Pct. change
Essential hypertension and hypertensive renal disease	88	84	134	+56
Sepsis	138	117	197	+55
Suicide	31	35	49	+48
Alzheimer's and Parkinson's Diseases	370	343	524	+47
Diabetes	441	473	666	+46
Chronic Lower Respiratory Diseases	143	175	225	+42

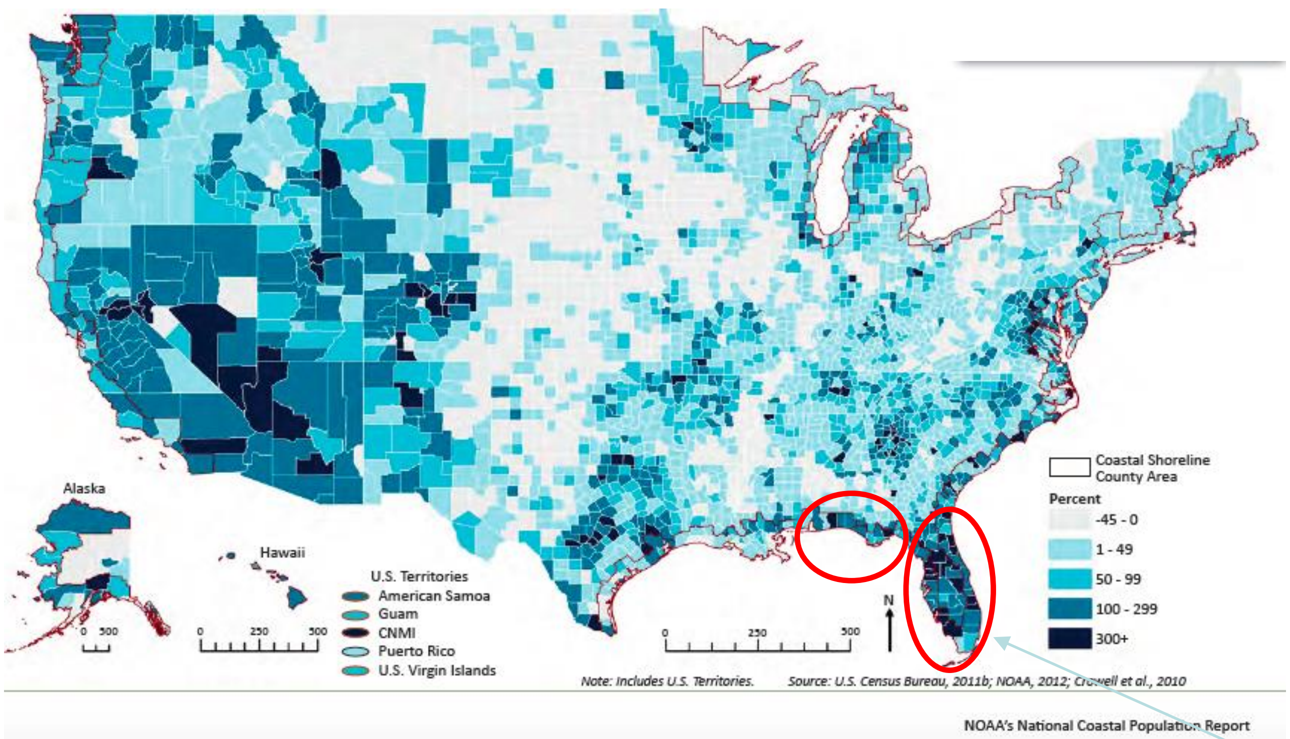
The New York Times | Source: Demographic Registry of Puerto Rico, Health Department of Puerto Rico (causes of death as of May 31) | Note: Percentage change is the number of deaths in September and October 2017 compared with the average of the number of deaths in the same months in 2015 and 2016.

Outline

- Why Florida?
- How is the future climate changing?
- How is current climate changing?
- Conclusions

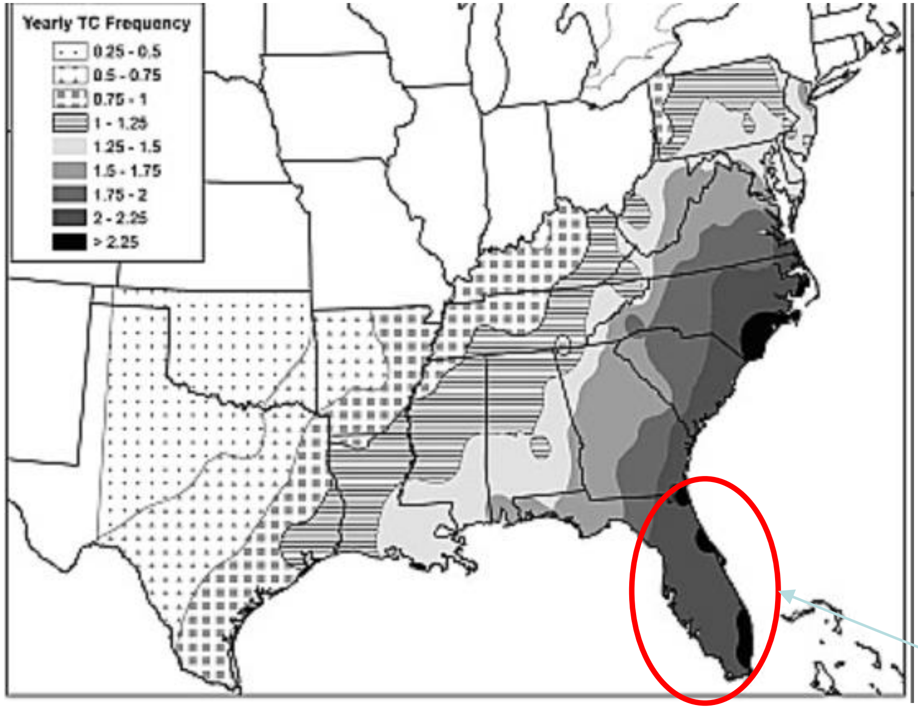
Why Florida?

Percent population change in U. S. Counties (1970-2000)



One of the largest increases in population of coastal shoreline counties in the nation

Why Florida?



Yearly tropical cyclone frequency
(Knight and Davis 2009)

Some of the highest frequencies of landfalling tropical cyclones in the nation

Why Florida?

The population density change in coastal shoreline counties has increased by 45% across the nation over the last 40 years

The senior population is increasing by over 80% (and by 208% in Florida)

Figure 5 | Population Density Change in Coastal Shoreline Counties and Inland Counties from 1970 to 2020

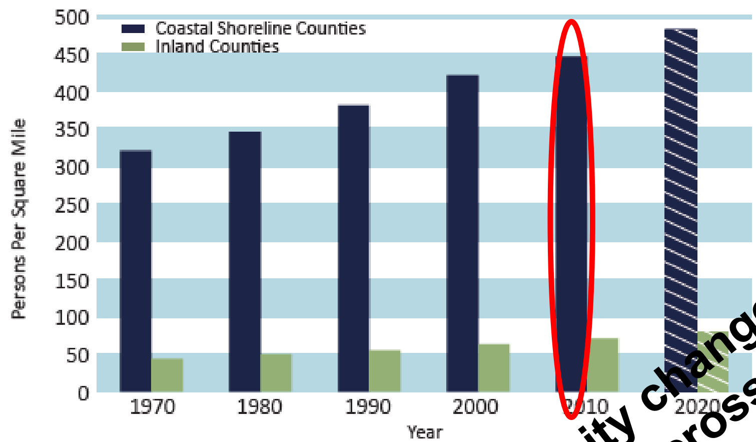
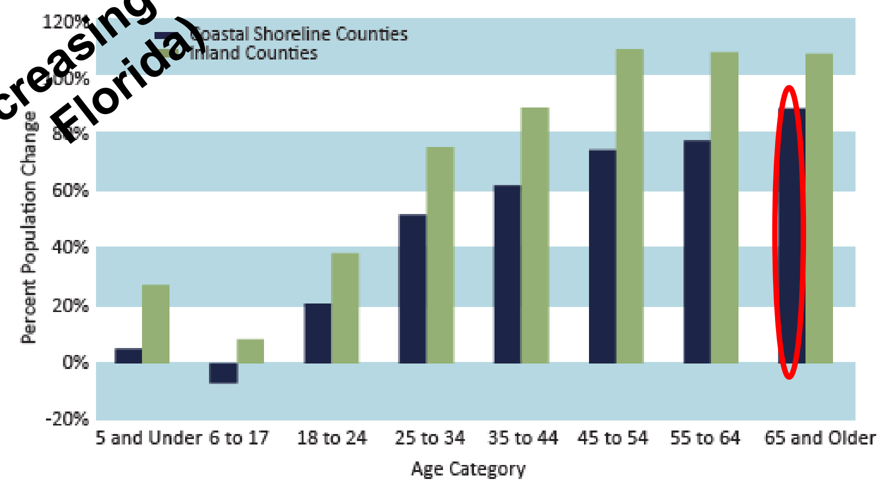
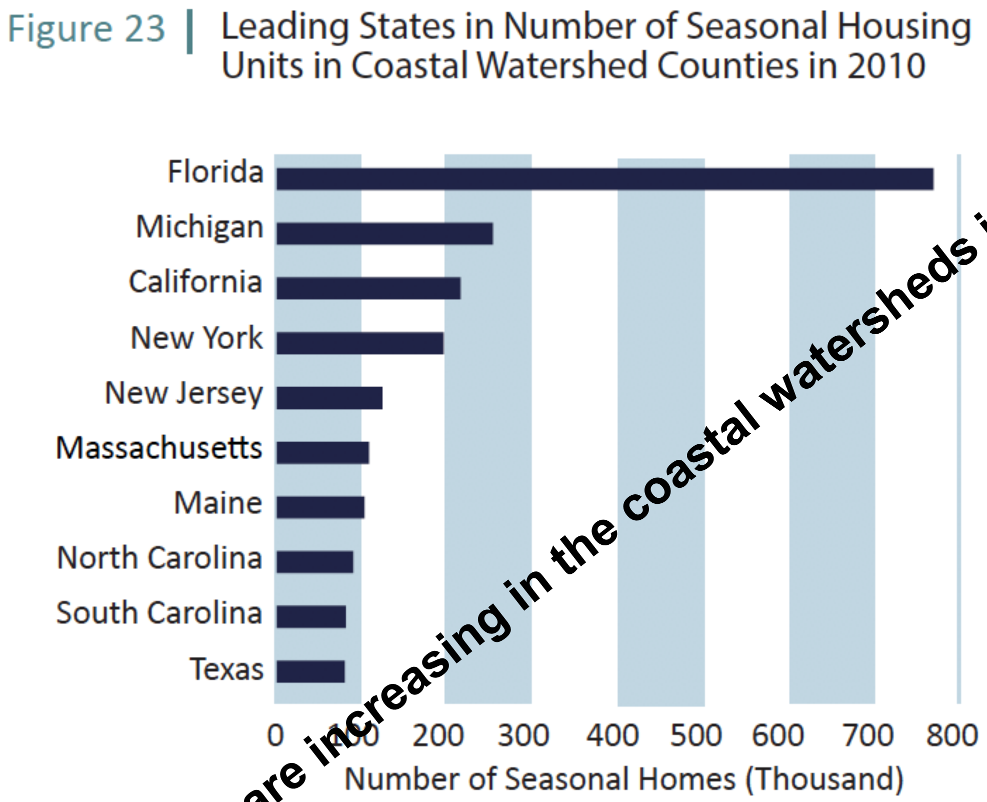


Figure 6 | Percent Population Change of Coastal Shoreline Counties and Inland Counties by Age from 1970 to 2010



From NOAA coastal population report (2013)

Why Florida?



Dwelling units are increasing in the coastal watersheds in Florida

From NOAA coastal population report (2013)

Why Florida?

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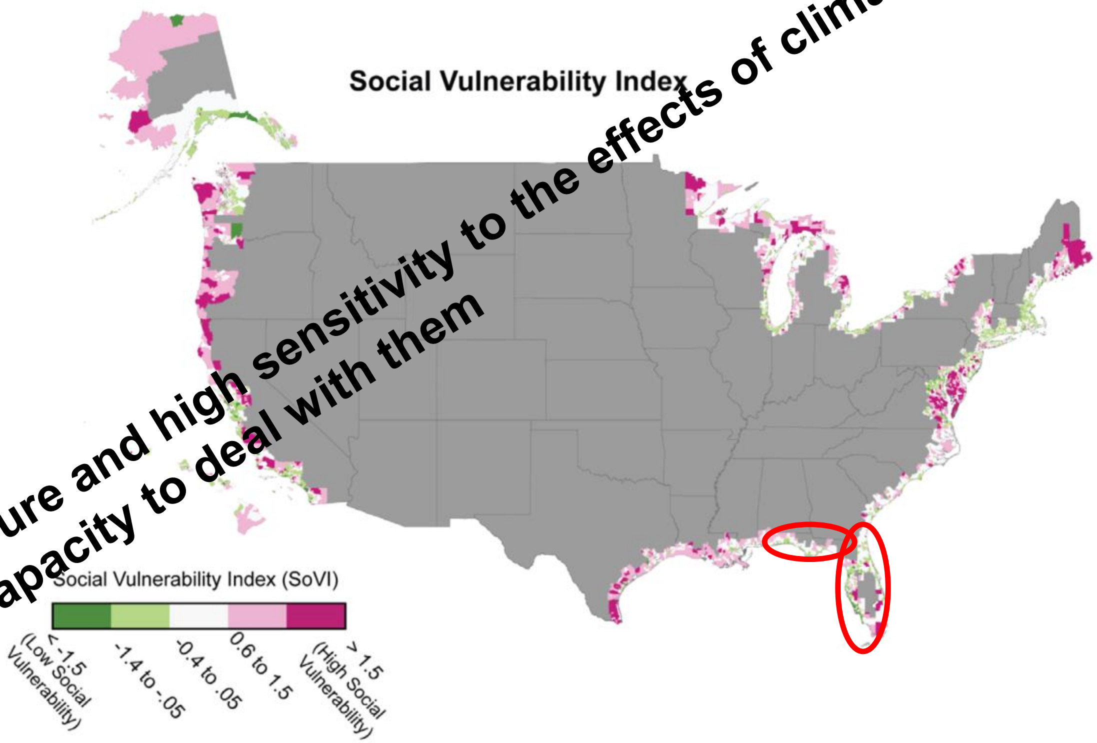


High exposure and high sensitivity to the effects of climate change and low capacity to deal with them

The Social Vulnerability Index (SoVI) provides a quantitative, integrative measure for comparing the degree of vulnerability of human populations across the nation. A high SoVI (dark pink) typically indicates some combination of **high exposure and high sensitivity to the effects of climate change and low capacity to deal with them**. From Moser et al. (2014)-NCA2014

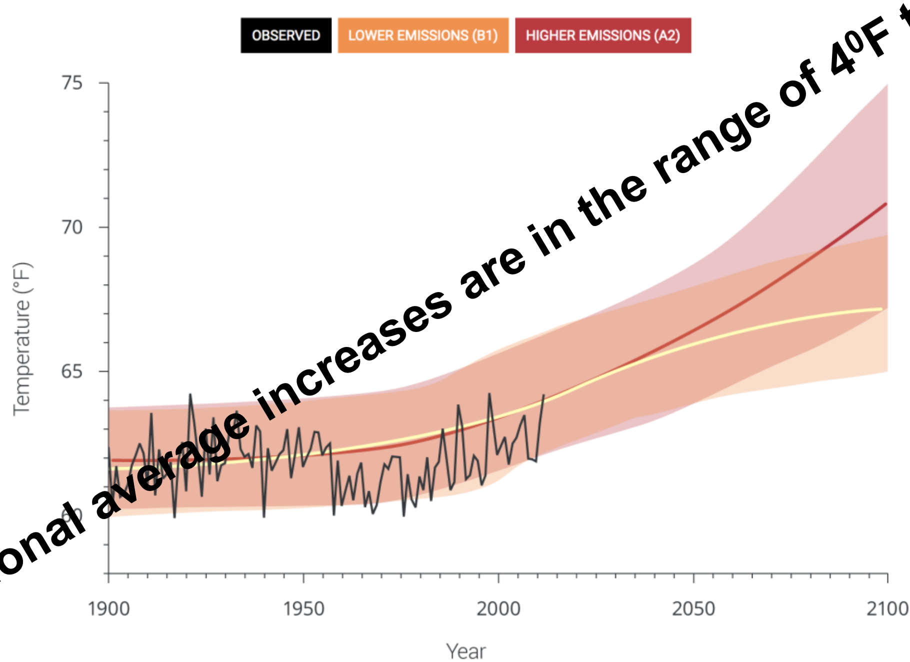
Why Florida?

- The population has increased by over 300% in the last 40 years
- The senior population along the coastal watershed counties in Florida has increased by over 208% in the last 40 years
- As of 2010 Florida has the highest number of dwelling units in the coastal watershed counties in the Nation
- Florida is home to many extreme weather events: tropical cyclones, droughts, heat waves, deep freeze events

How is the future climate changing?

How is the future climate changing?

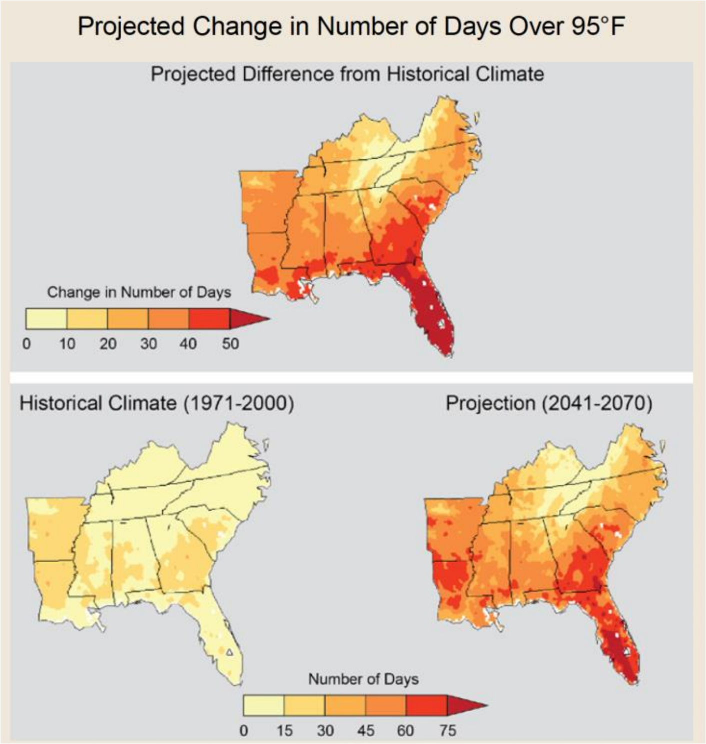
Regional average increases are in the range of 4^0F to 8^0F



Observed annual average temperature for the Southeast US and projected temperature changes for two different emission scenarios

From Carter et al. (2014)-CH17; NCA2014

How is the future climate changing?



Projected average number of days per year with maximum temperatures above 95^0F for 2041-2070 compared to 1971-2000 for A2 emissions scenario

From Carter et al. (2014)-CH17; NCA2014

How is the future climate changing?

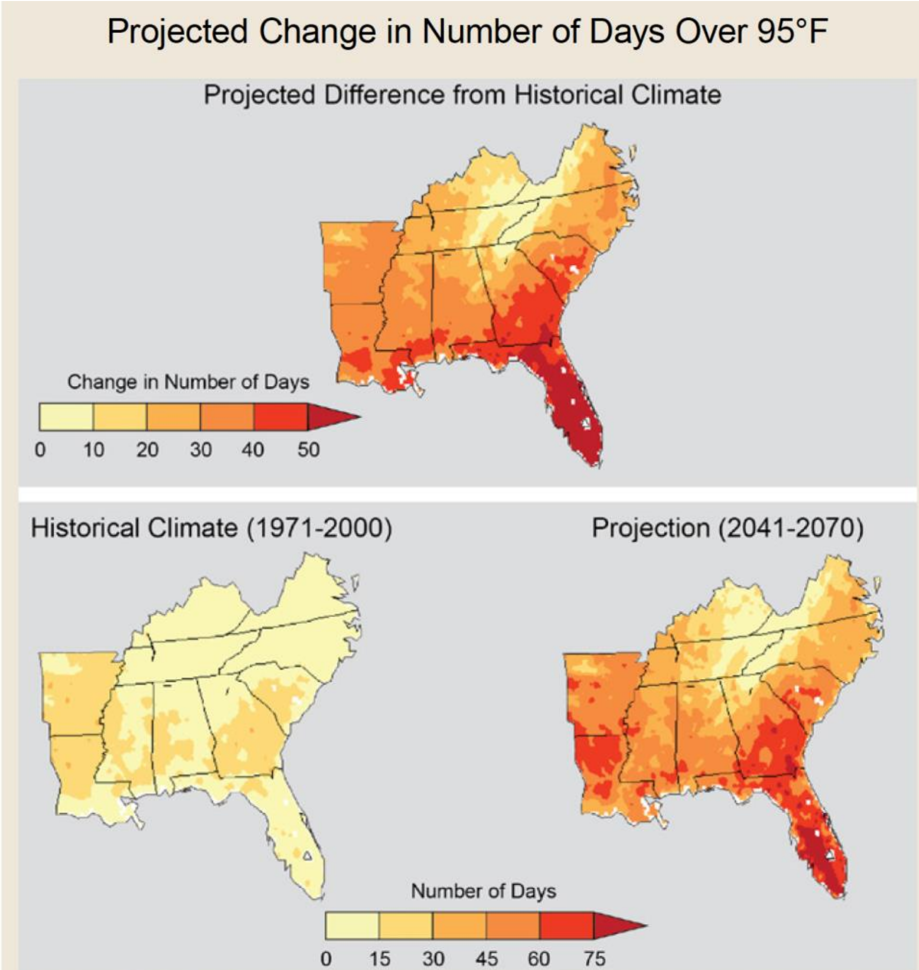
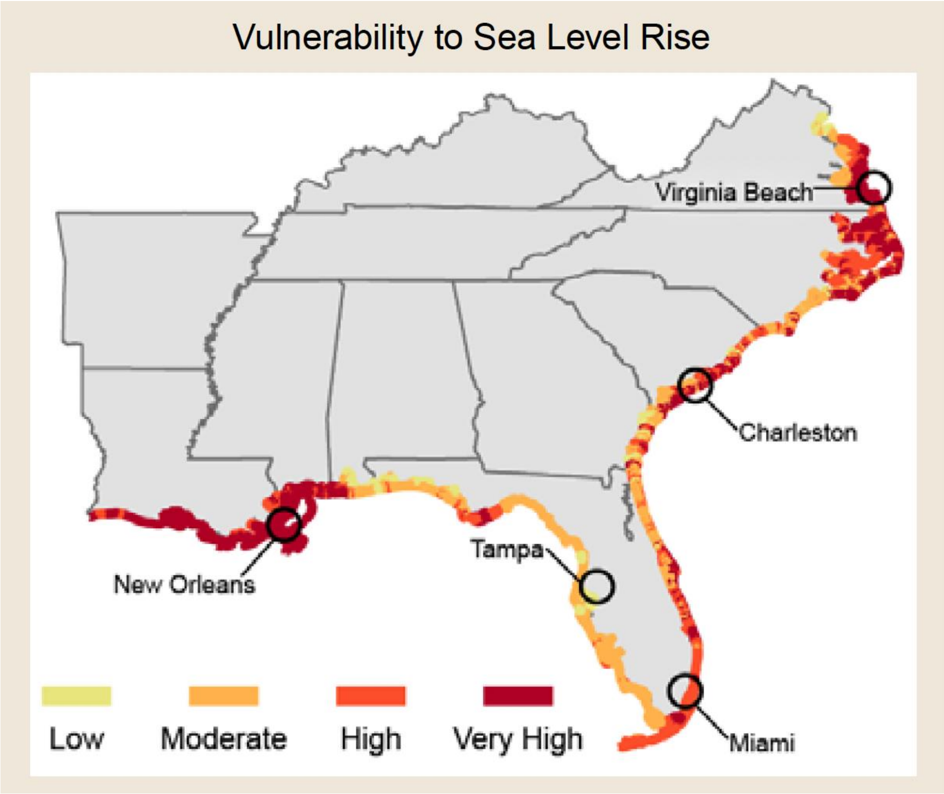


Figure 17.4. Projected average number of days per year with maximum temperatures above 95°F for 2041-2070 compared to 1971-2000, assuming emissions continue to grow (A2 scenario). Patterns are similar, but less pronounced, assuming a reduced emissions scenario (B1). (Figure source: NOAA NCDC / CICS-NC).

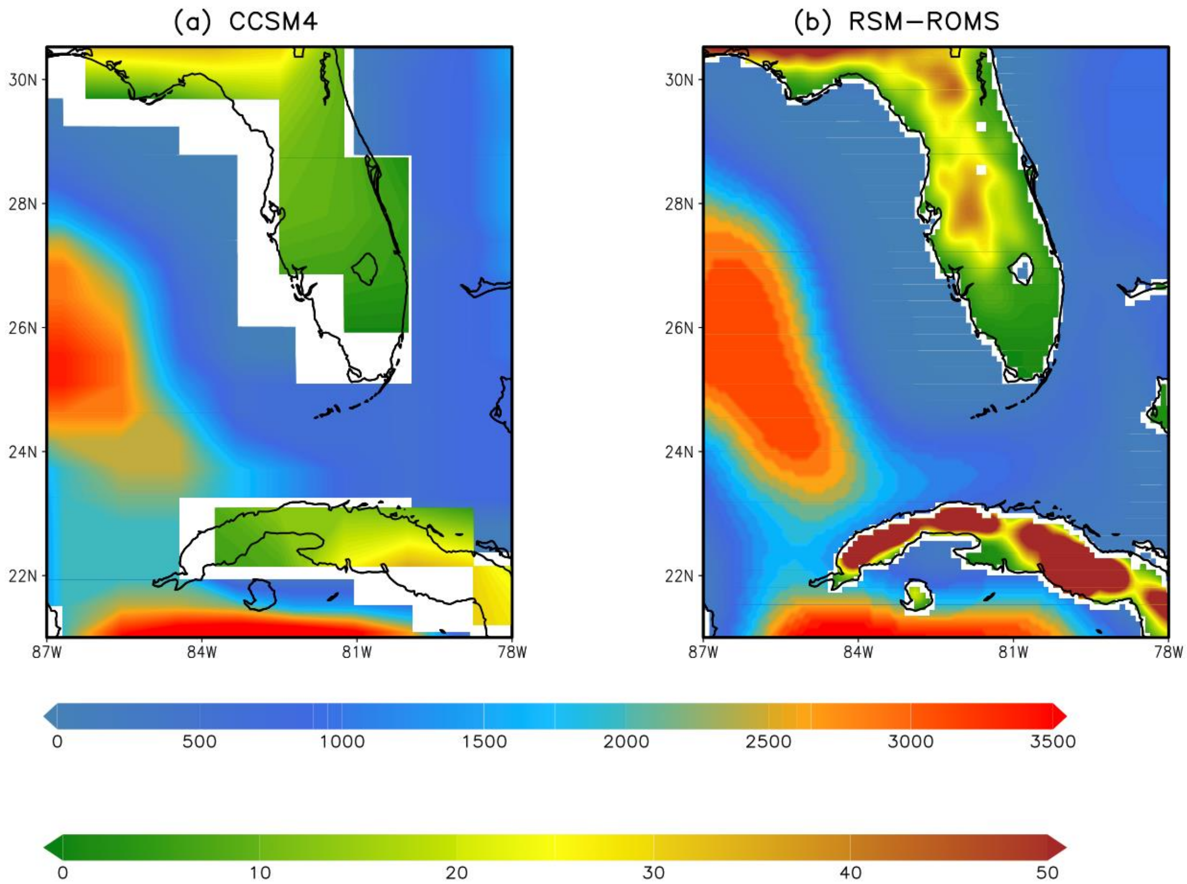
From Carter et al. (2014)-CH17; NCA2014

How is the future climate changing?



From Carter et al. (2014)-CH17; NCA2014

How is the future climate changing?



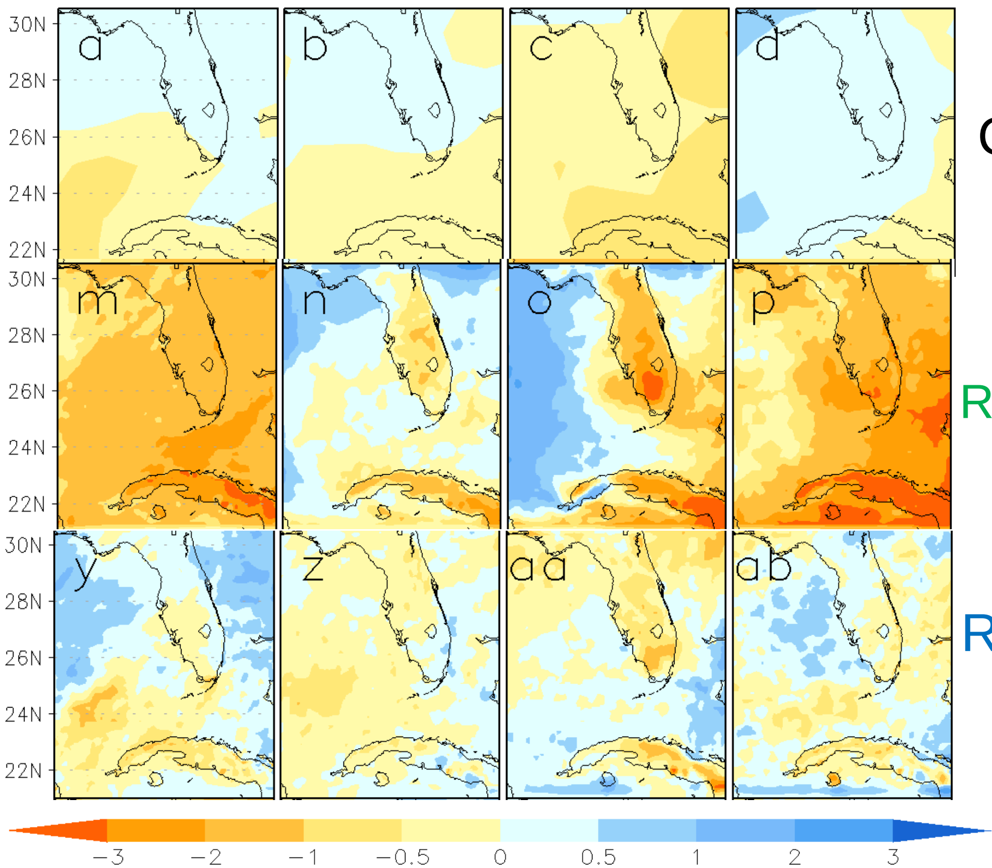
Grid spacing: 139km x 100km for land
123km x 45km for ocean

Grid spacing: 10km x 10km

How is the future climate changing?

21st century change (2041-2060) of precipitation with respect to 20th century (1986-2005) simulation

DJF MAM JJA SON



CCSM4

Insignificant to moderate increase in rainfall

RSM-ROMS

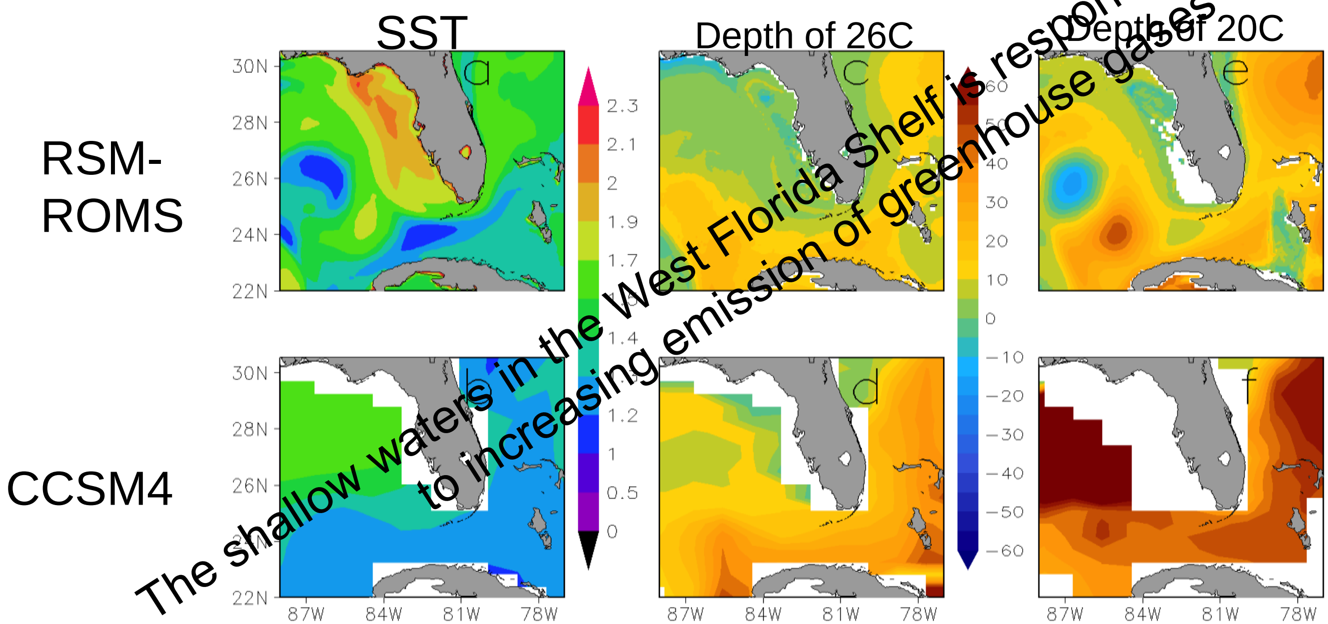
Much drier climate throughout the year in a future climate

RSM

Insignificant to moderate decrease in rainfall

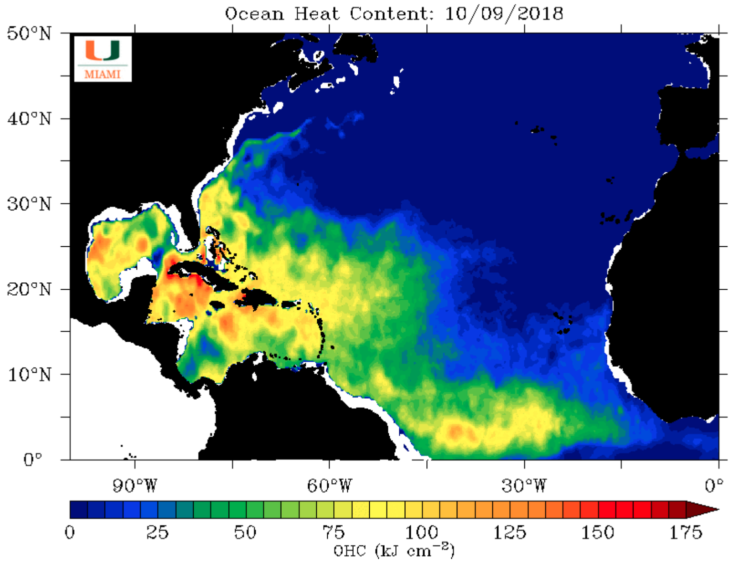
How is the future climate changing?

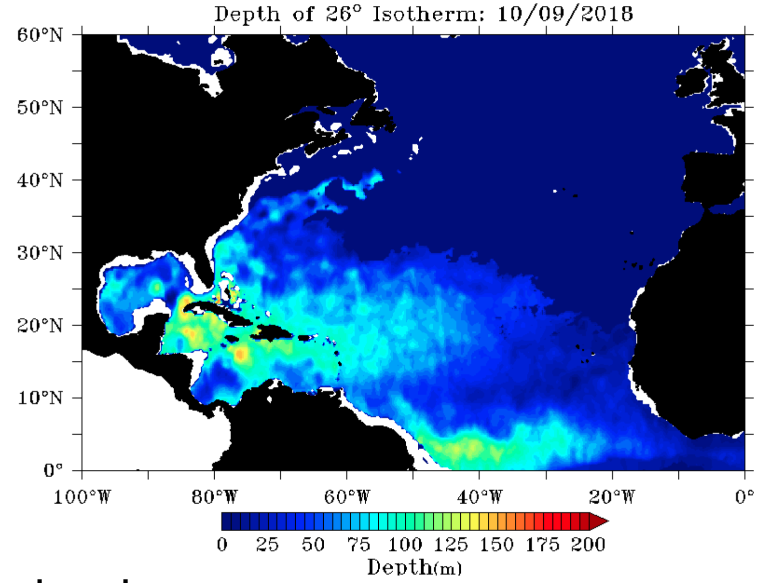
21st century change (2041-2060) of SST with respect to 20th century (1986-2005) simulation

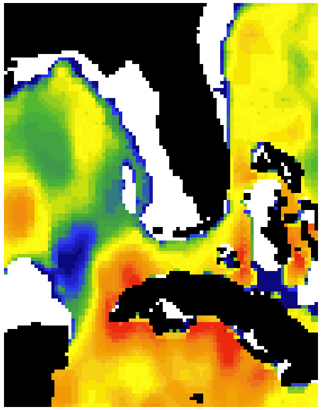


The shallow waters in the West Florida Shelf is responding aggressively to increasing emission of greenhouse gases

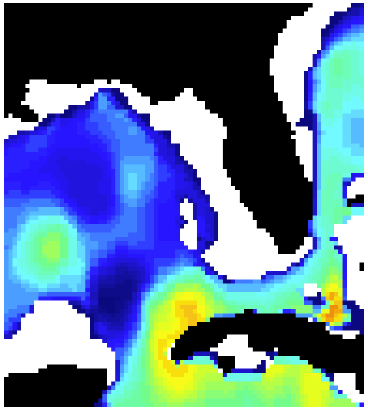
Hurricane Michael, 10/10/2018







The warming in the West Florida Shelf is reminiscent of the warming expected from increased radiative forcing from increased greenhouse gas emissions by 2060.



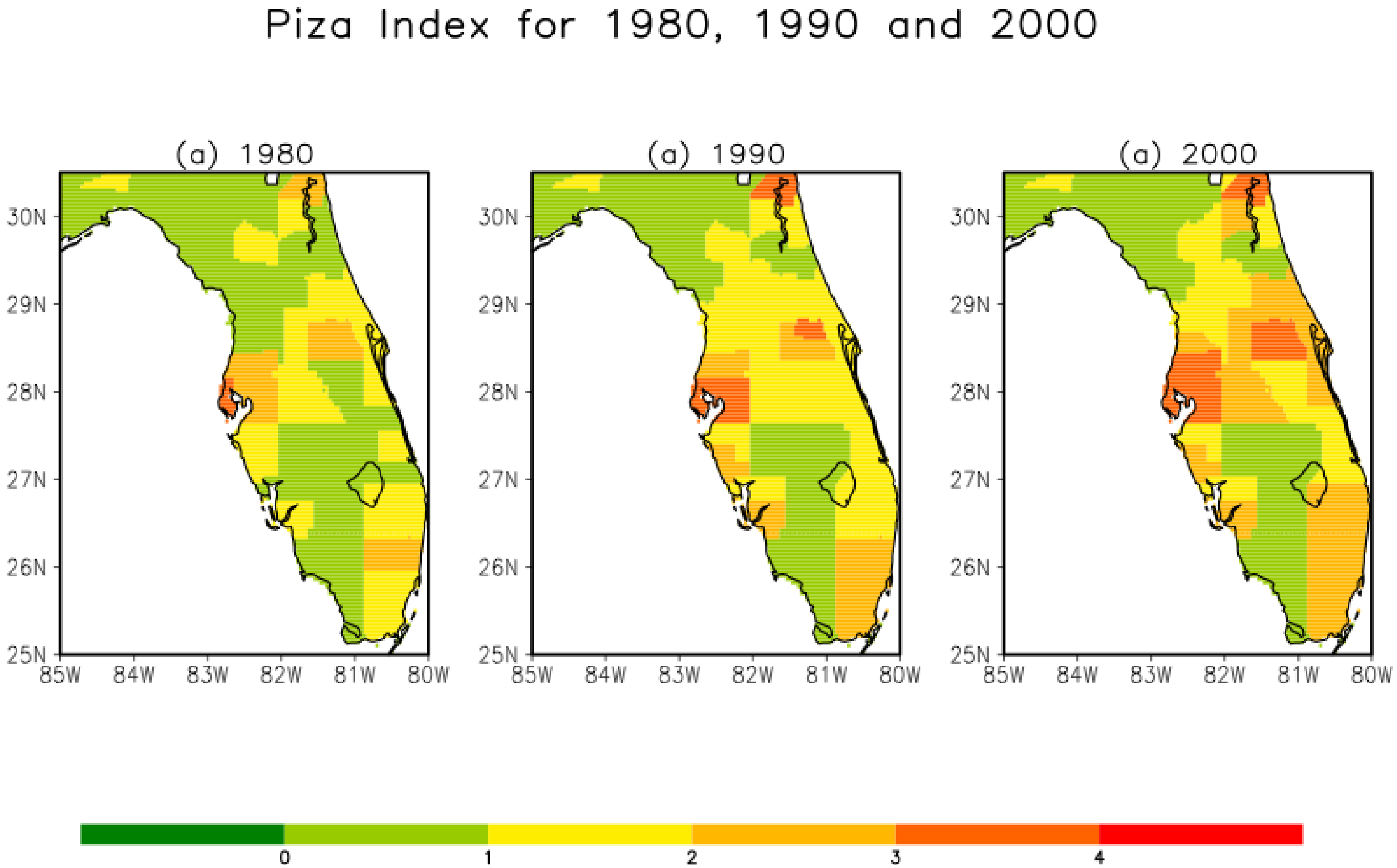
How is the future climate changing?

- The surface temperature is projected to increase by approximately 4^0F to 8^0F by 2100
- Vulnerability to heat waves, days with maximum temperatures exceeding 95^0F is projected to increase
- Disruptions to essential services on account of the projected increase in frequency of severe weather impacts are going to raise the vulnerability of the population

How is the current climate changing?

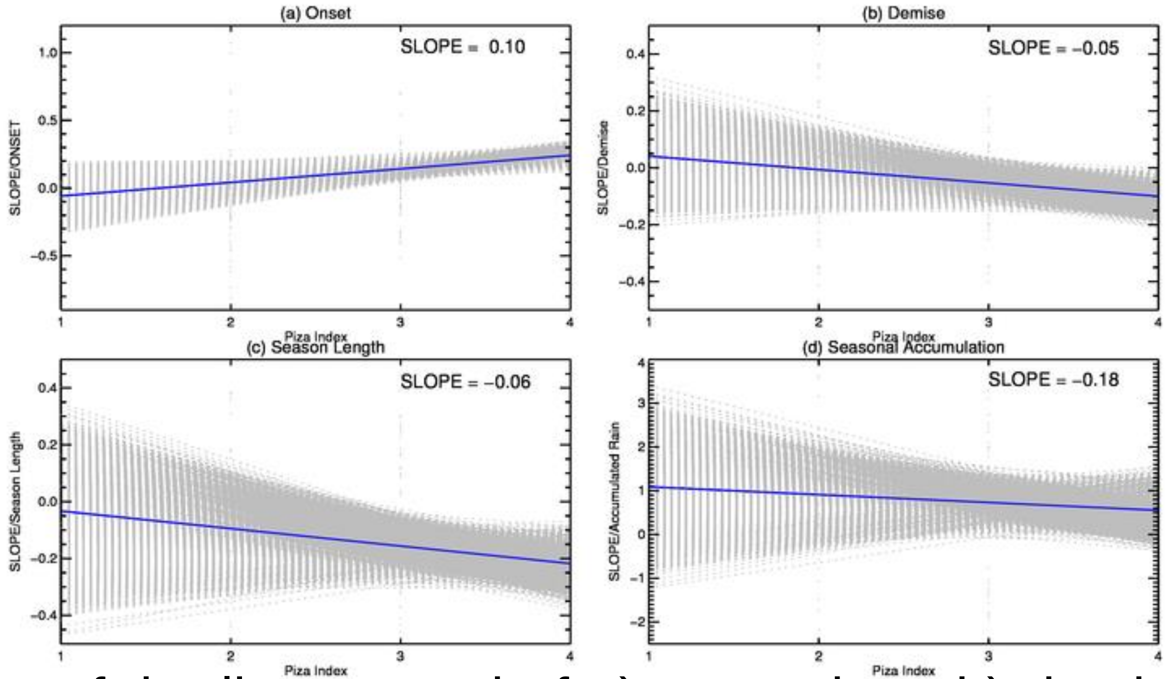
Impact of urbanization

1. Urban areas throughout Florida Peninsula are experiencing shorter, increasingly intense wet seasons relative to rural areas
2. We find that wet season length has decreased by about three and half hours per year in Florida's most urban areas compared to its most rural areas in the last 40-60 years.
3. The linear trends of T_{min} in urban areas of the SE united States approximately 7°F/century compared to 5.5°F/century in rural areas



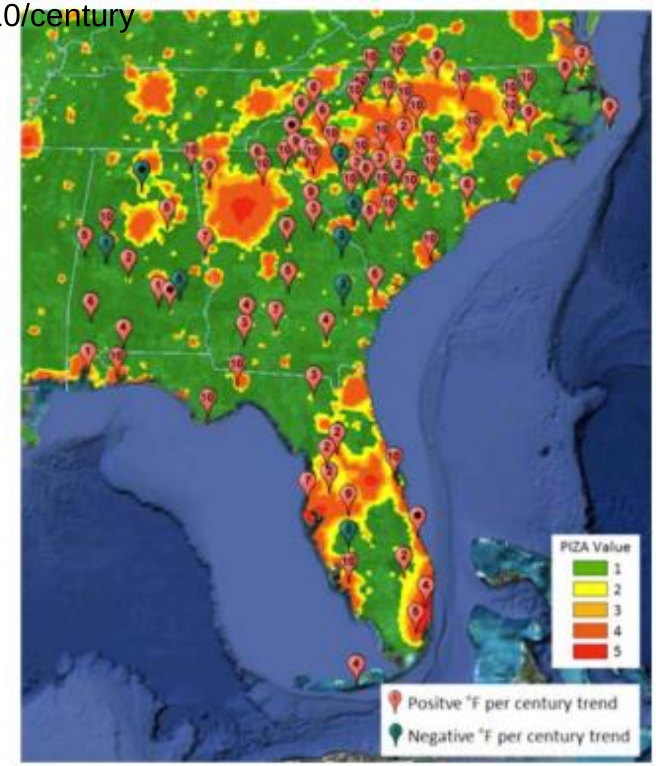
The distribution of the land cover (PIZA index, ERS 2005) spanning over three decades a) 1980, b) 1990, and c) 2000.

How is the current climate changing?

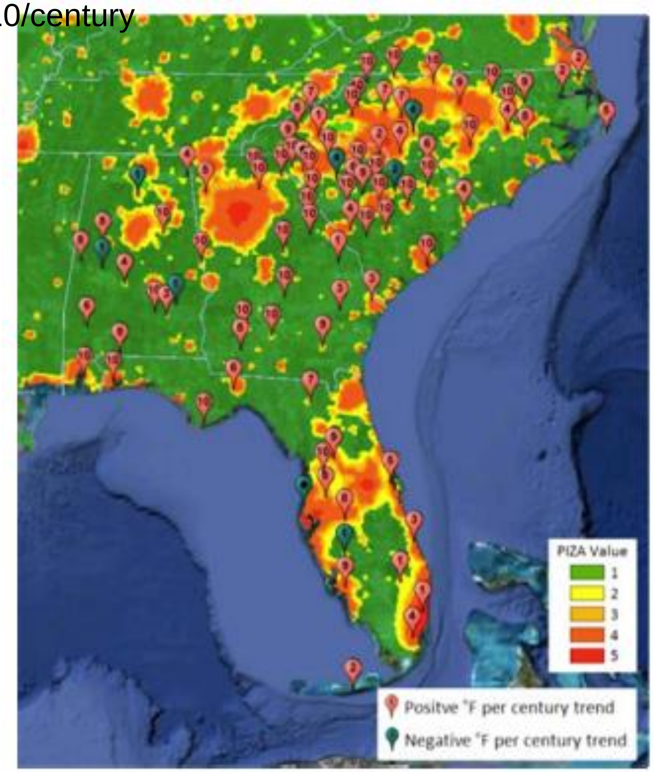


The scatter of the linear trend of a) onset date, b) demise date c) length, and d) seasonal accumulation of wet season rainfall over peninsular Florida with PIZA index is plotted. The units of the slope of the linear fit to the scatter (blue line with median slope) in the 3 panels (a, b, and c) is days/year/PIZAindex and for seasonal rainfall accumulation (bottom left) is mm/season/year/PIZAindex. The gray shaded lines represent the 95% confidence interval of the linear fit.

The annual mean linear trends of T_{max} in $^0F \times 10$/century



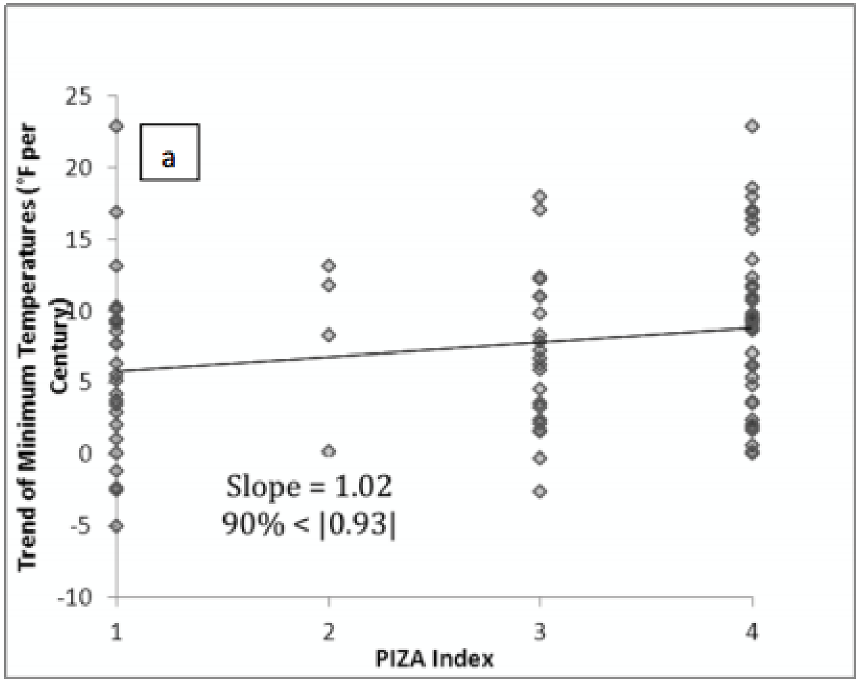
The annual mean linear trends of T_{min} in $^0F \times 10$/century



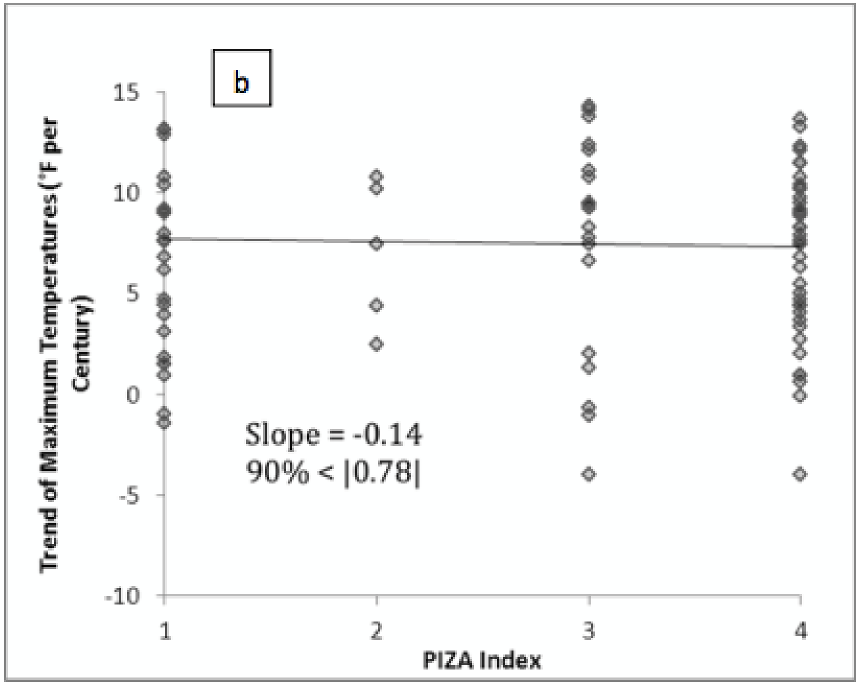
The Population Interaction Zone for Agriculture (PIZA) developed by USDA-ERS (2005) indexes the interaction between urban population and agricultural productivity at 5km grid cell resolution.

How is the current climate changing?

The annual mean linear trends of T_{max} in ^{0}F x 10 /century



The annual mean linear trends of T_{min} in ^{0}F x 10 /century

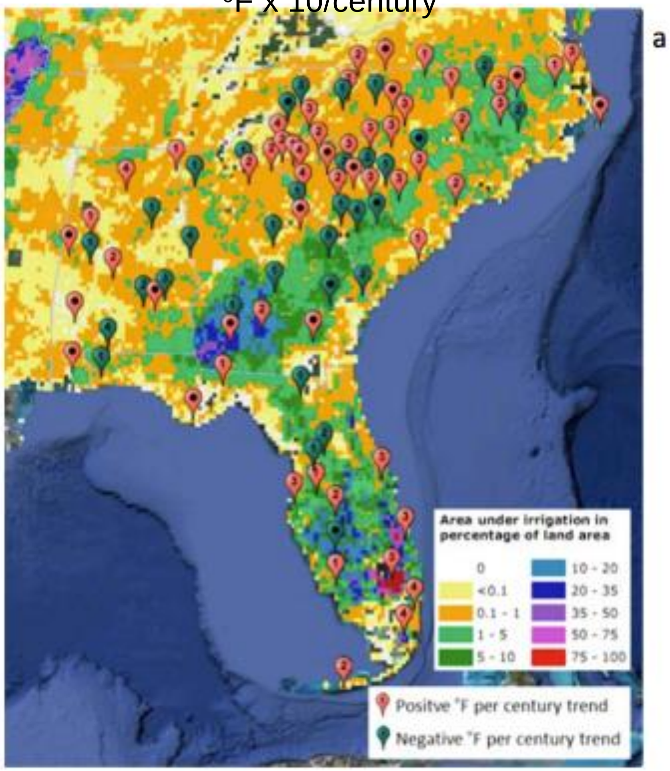


Greater urbanization is leading to higher T_{max} trends

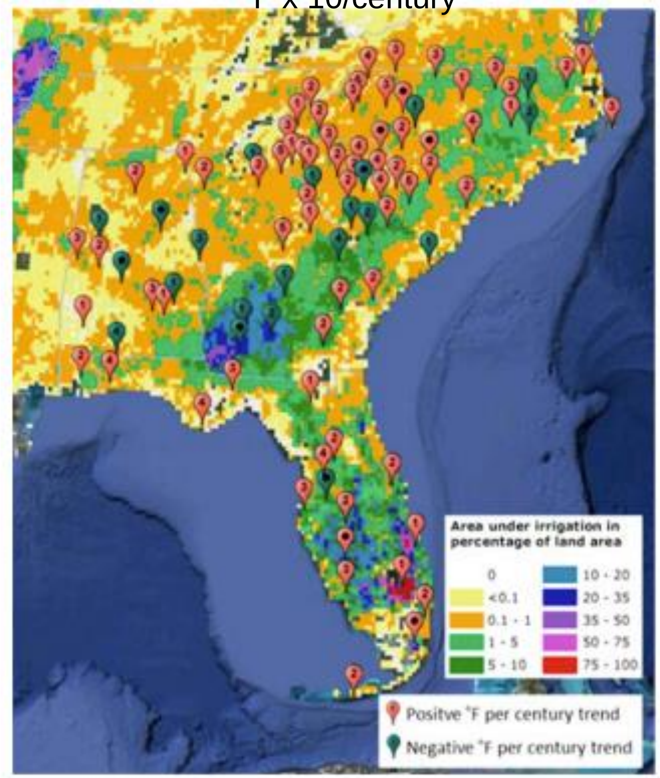
Urban areas display on average a warming of about 0.7^{0}F/century while rural areas on average are showing 0.55^{0}F/century

Urbanization has insignificant impact on T_{min} trends

The summer season mean linear trends of T_{max} in $^{0}F \times 10$/century



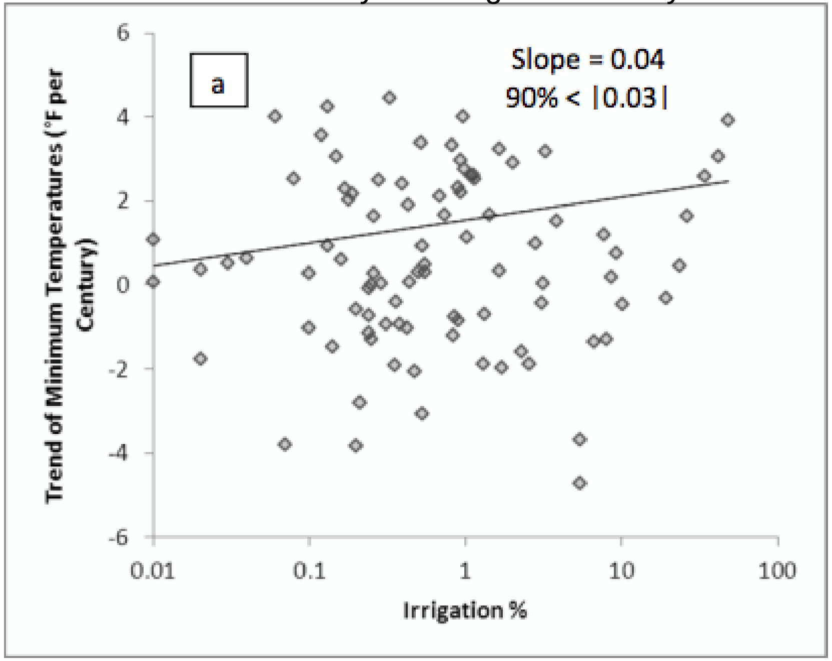
The summer season mean linear trends of T_{min} in $^{0}F \times 10$/century



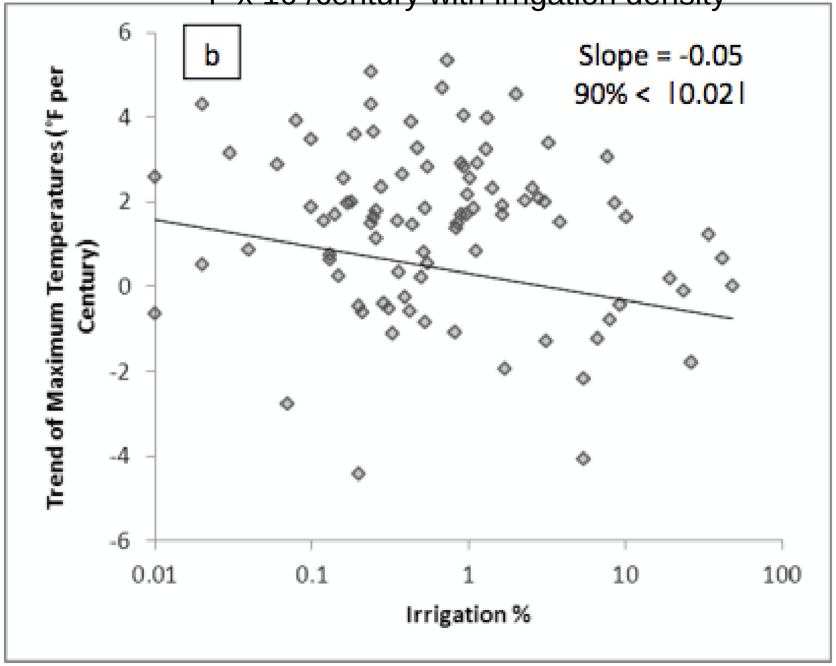
The global maps of irrigation density at 5-minutue resolution that conveys the area equipped for irrigation is from UN FAO AQUASTAT global water and agriculture information system.

How is the current climate changing?

The summer season mean linear trends of T_{min} in ^{0}F x 10 /century with irrigation density



The summer season mean linear trends of T_{max} in ^{0}F x 10 /century with irrigation density



Greater irrigation is leading to warmer T_{min} trends

The difference in the trends of T_{min} between heavy and light irrigation areas is about $0.035^{0}F$/century

Greater irrigation is leading to cooling T_{max} trends

The difference in the trends of T_{max} between heavy and light irrigation areas is about $0.05^{0}F$/century

How is the current climate changing?

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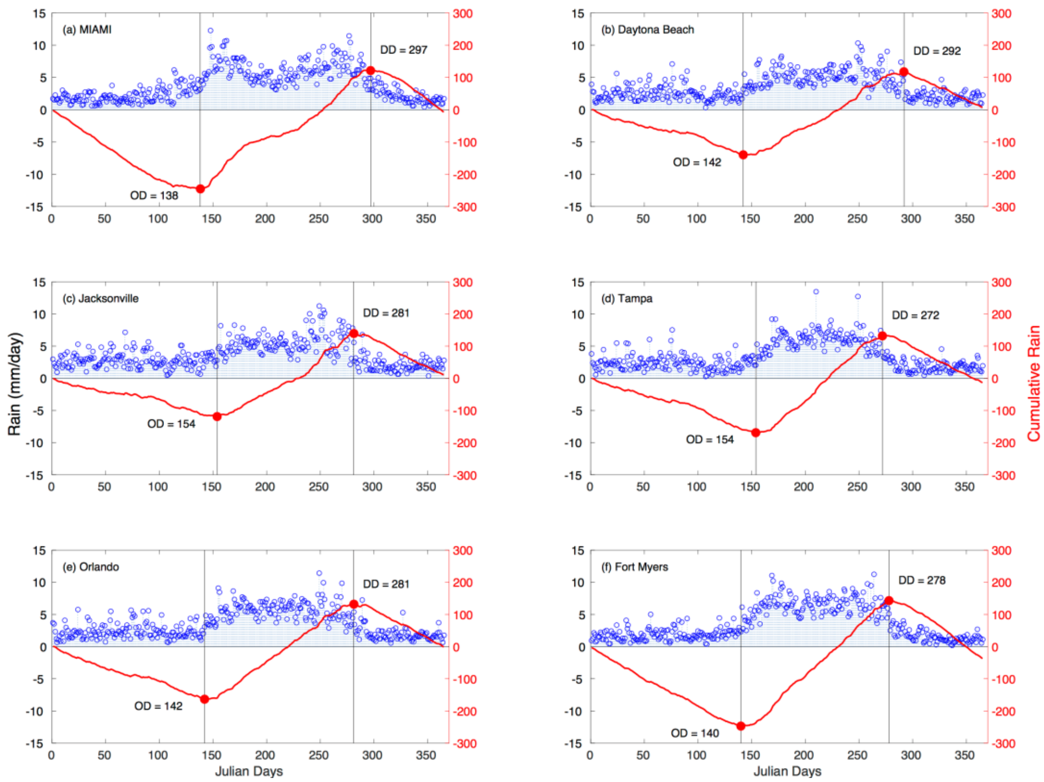
Conclusions

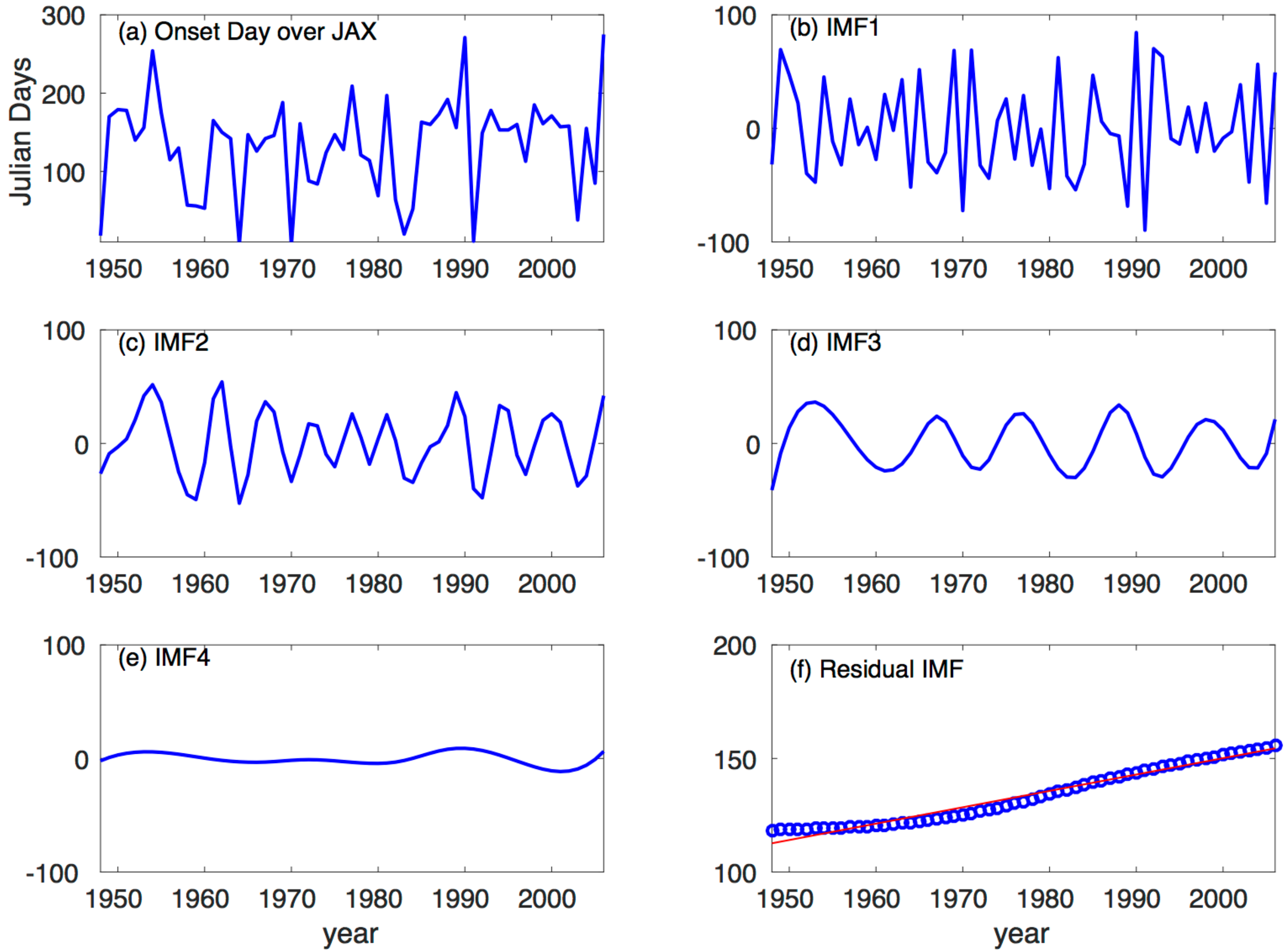
- Florida is heading to be a complex region to combat mitigation of future impacts of climate change, especially related to heat related illness
- The rising development and population of coastal regions in the state is a challenge in itself
- The meteoric rise in the senior population along the coast should raise red flags in terms of health care
- Impacts of future climate change are ominous
- Michael 2018 played out a scene from the future
- Other anthropogenic impacts like urbanization and irrigation show moderate changes to local climate—could we engineer ourselves out from impacts of climate change?

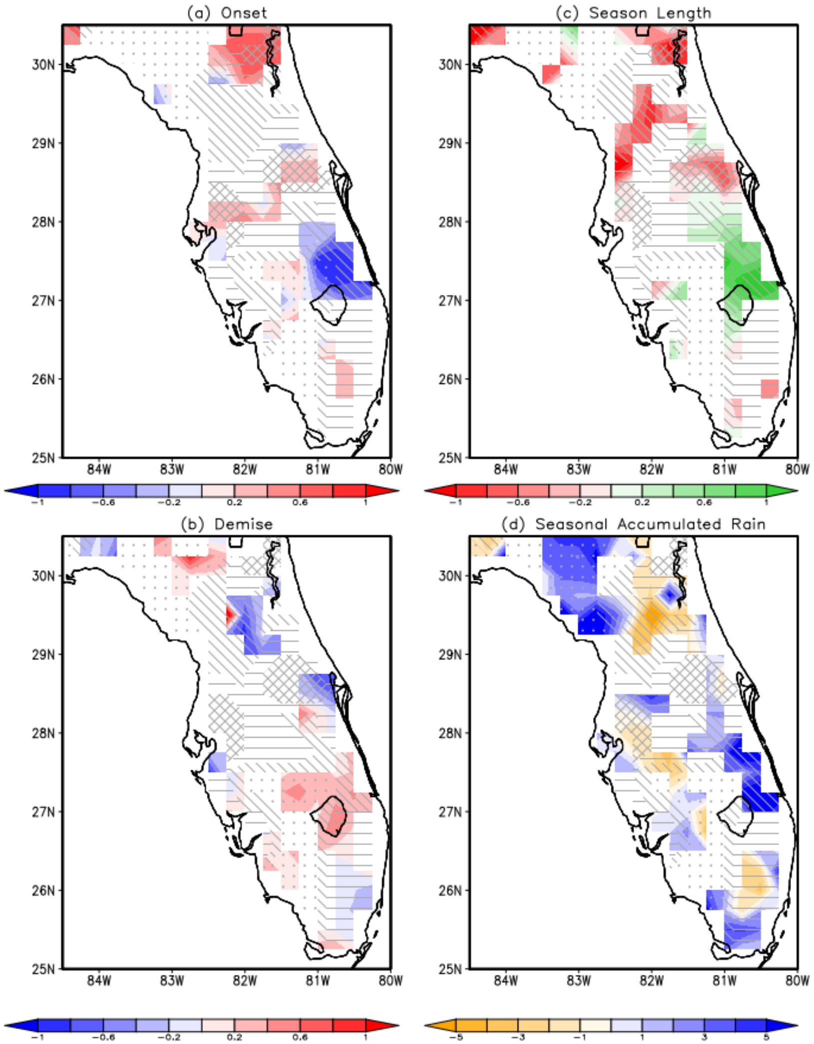
Extra slides



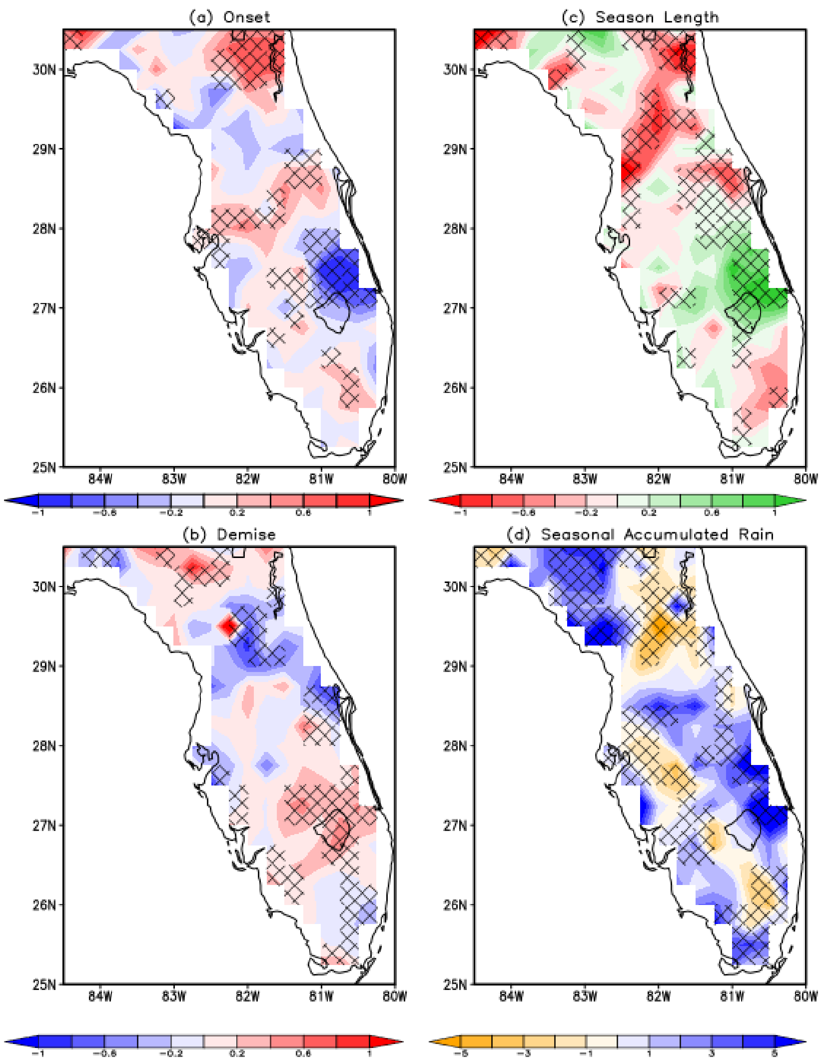
The time series of the climatological daily rainfall (red) and the corresponding accumulated daily rainfall anomaly (blue) with onset (OD) and demise (DD) date indicated (in Julian day) for a) Miami, b) Daytona Beach, c) Jacksonville, d) Tampa, e) Orlando, and f) Fort Myers.

Decomposition of the time series of onset dates for Jacksonville





An overlay of the slope of the observed linear trends (shaded) in a) onset (days/year), b) demise (days/year) dates and c) seasonal length (days/year) and d) accumulated rainfall (mm/year) of the wet season on the PIZA index for the year 2000. The PIZA index of 1, 2, 3, and 4 correspond to dots, slanted lines, horizontal lines and diamond shape in the background.



The observed linear trends (shaded) in a) onset (days/year), b) demise (days/year) dates and c) seasonal length (days/year) and d) accumulated rainfall (mm/year) of the wet season. The hatched regions indicate passing the Mann-Kendall test for significance ($p \leq 0.05$).