The unique climate variations of Florida and the Challenges it poses

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The Monsoon-like Florida Rains

• Peninsular Florida displays a very strong seasonal cycle of rainfall with a distinct wet season that delineates the season from the rest of the year

• This robust seasonal cycle also manifests in other variables including oceanic variables
The dramatic onset of the rains in Peninsular Florida.
The dramatic onset of the rains in Peninsular Florida

Onset in 2000

June 8

Demise in 2000

Sep 28
The dramatic onset of the rains in Peninsular Florida—CLIMATOLOGY (58 Years; 1948-2005)

Onset day: May 22

Demise day: October 10
Evolution of Sea Surface Temperature

Onset Demise
Movie loop of ocean heat content and ocean heat transport vector pre and post onset
Movie loop of ocean heat content and ocean heat transport vector pre and post demise
Model simulations

Model simulation with weak currents

Model simulation with strong currents

Heat content and heat transport

Rainfall Difference in the wet (summer) season

Vertical cross section of the meridional flow (ms⁻¹) through the Yucatan Channel from a) SODA ocean reanalysis, b) CTL and c) EXP integrations.

Reduced sill depth of the Yucatan Channel
Feedback loop of the Florida Monsoon hydroclimate with the ocean

1. Length of the wet season through changes to dates of onset and demise
2. Seasonal accumulation of wet season rainfall
3. Distribution of daily rainfall during wet season
The varying seasonal lengths of Peninsular Florida

- The four seasons of the year in Peninsular Florida are not fixed by calendar months
- The four seasons of the year have varying seasonal lengths
The challenge that Florida’s climate poses
The challenges of the global model spatial resolution
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?

RCM@10km: Significantly warm in the West Florida Shelf in the mid-21st century

CCSM4: Mild warming of the upper oceans in the mid-21st century

Fig. 6. The projected annual mean climatological (2041–2060) difference from the mean current climate (1986–2005) for (a, d) SST (°C), (b, e) depth of the 26°C isotherm, and (c, f) depth of the 20°C isotherm (in meters).
How is the future climate changing?

RCM@10km: Significantly dry over Peninsular Florida in the mid-21st century

CCSM4: Insignificant to moderate increase in the mid-21st century

Fig. S. The projected annual mean climatological (2041–2060) difference from the mean current climate (1986–2005) for (a, d) rainfall (mm day$^{-1}$), (b, e) moisture flux convergence (mm day$^{-1}$), and (c, f) surface evaporation (mm day$^{-1}$) from (a, b, c) RCM and (d, e, f) CCSM4 simulations.
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 in Florida?

• The surface temperature is projected to increase by approximately $4^\circ F$ to $8^\circ F$ by 2100

• Vulnerability to heat waves, days with maximum temperatures exceeding $95^\circ F$ 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

From NCA2018
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; 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.

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 including Florida show warming of approximately $7^{\circ}$F/century compared to $5.5^{\circ}$F/century in rural areas.
Conclusions

• Florida displays a robust seasonal cycle that manifests both in the oceanic and atmospheric variables

• The variations of the seasonal length in Florida is an important parameter to monitor in a changing climate

• Most climate models do a very poor job of simulating the ocean circulations around Florida; as a result summer climate is affected and the potential influence on weather extremes (e.g. hurricanes)

• Land cover has subtle but significant impact on surface temperature precipitation trends.