The seasonal predictability of the anomalous rainy seasons of Florida

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BACKGROUND

- Peninsular Florida (**Fig. 1**) experiences a distinct wet season during boreal summer (**Fig. 2**). Daily rain totals increase abruptly at the onset of the wet season in May or June and decrease abruptly at its demise in October or November (Misra et al. 2018).

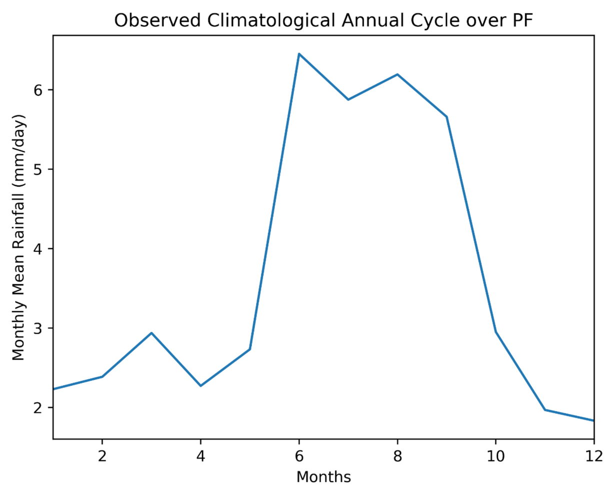

Fig. 2. The observed climatological annual cycle of rainfall area-averaged over Peninsular Florida 1982–2015 (CPC Global Unified Precipitation Dataset).

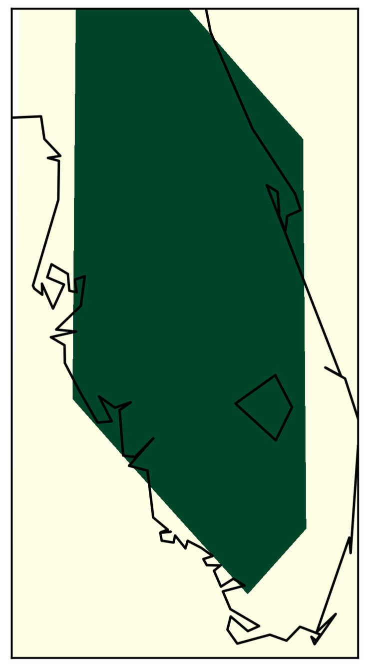

Fig. 1. A map of Peninsular Florida. The area shaded green is the area over which rainfall is averaged.

Impact of Florida Summer Rainfall

- The summer rains of Peninsular Florida replenish the Floridan aquifer, a source of drinking water for the region's growing population (Lindsey et al. 2009). They also support Florida's agriculture industry which contributes over $120 billion in economic impact to the state annually (Putnam 2016).

Mechanisms

- Much of the summer rainfall is attributed to low-level convergence associated with afternoon sea-breezes (Byers and Rodebush 1948; Schwartz and Bosart 1979). Tropical cyclones also contribute to Peninsular Florida's summer rainfall (Misra et al. 2018).
- The onset of Peninsular Florida's wet season coincides with the seasonal warming of the surrounding oceans and the strengthening of the Loop Current in addition to a reversal of the prevailing 850 hPa wind direction (Misra et al. 2018).
- Interannual variations in Peninsular Florida's wet season have been found to be driven by interannual variability of the North Atlantic Subtropical High (Li et al. 2011) and the size of the Atlantic Warm Pool (Misra and DiNapoli 2013).

Seasonal Prediction Using a Multimodel Ensemble

- A multimodel ensemble approach is superior to using an individual model for seasonal forecasting because it enables the quantification of prediction uncertainty due to model formulation (Kirtman et al. 2014).
- An early version of the North American Multimodel Ensemble (Kirtman et al. 2014) was found to have limited-to-no skill predicting summer precipitation in the southeast United States (Tian et al. 2014).

Objective:

Examine the prediction skill of the onset and demise dates of the Florida Peninsula summer wet season by models in the North American Multimodel Ensemble (Kirtman et al. 2014).

METHODOLOGY

Diagnosis of Onset and Demise Dates

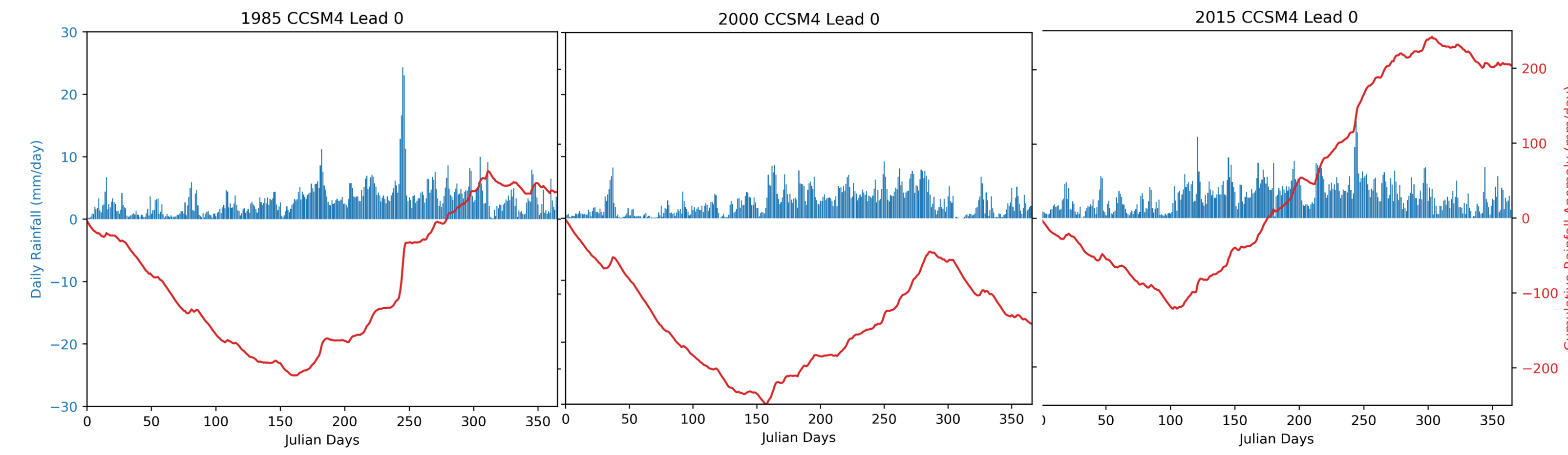

Fig. 3. Cumulative anomaly plots generated by model CCSM4 at lead 0 for 1985, 2000, and 2015. Ensemble-mean hindcast daily rainfall is plotted by the blue bars**.** The ensemble-mean cumulative anomaly curves are shown as red lines.

- Daily rainfalls anomalies are cumulatively summed from January 1st to December 31st , generating a cumulative anomaly curve. The date corresponding to the minimum (maximum) value of the cumulative anomaly curve is the onset (demise) date of the wet season, with the condition that the demise date must occur after the onset date.

Metrics of Deterministic Skill

Comparing Model Hindcasts to Observations

- Anomaly Correlation: The correlation coefficient between the observed and predicted onset dates or demise dates.
- Root-mean-square Error: $RMSErrors = \sqrt{\frac{\sum_{i=1}^{n}(\hat{y}_i - y_i)^2}{n}}$

Ensemble Spread

- Signal-to-noise Ratio: procedure found in Shukla et al. (2000)

RESULTS

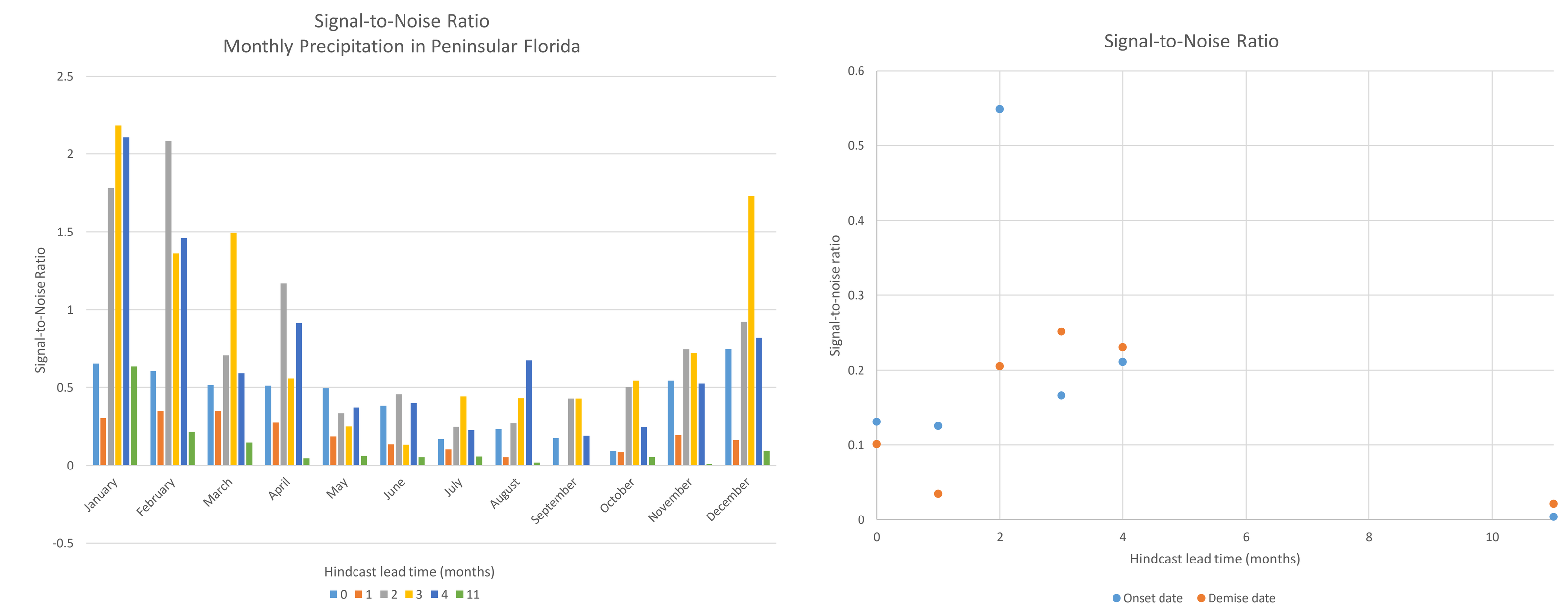

Fig. 4. Signal-to-noise ratios of **(left)** the monthly rainfall in Peninsular Florida and **(right)** the onset and demise dates of the wet season at hindcast lead times of 0–4 and 11 months by CCSM4.

RESULTS (continued)

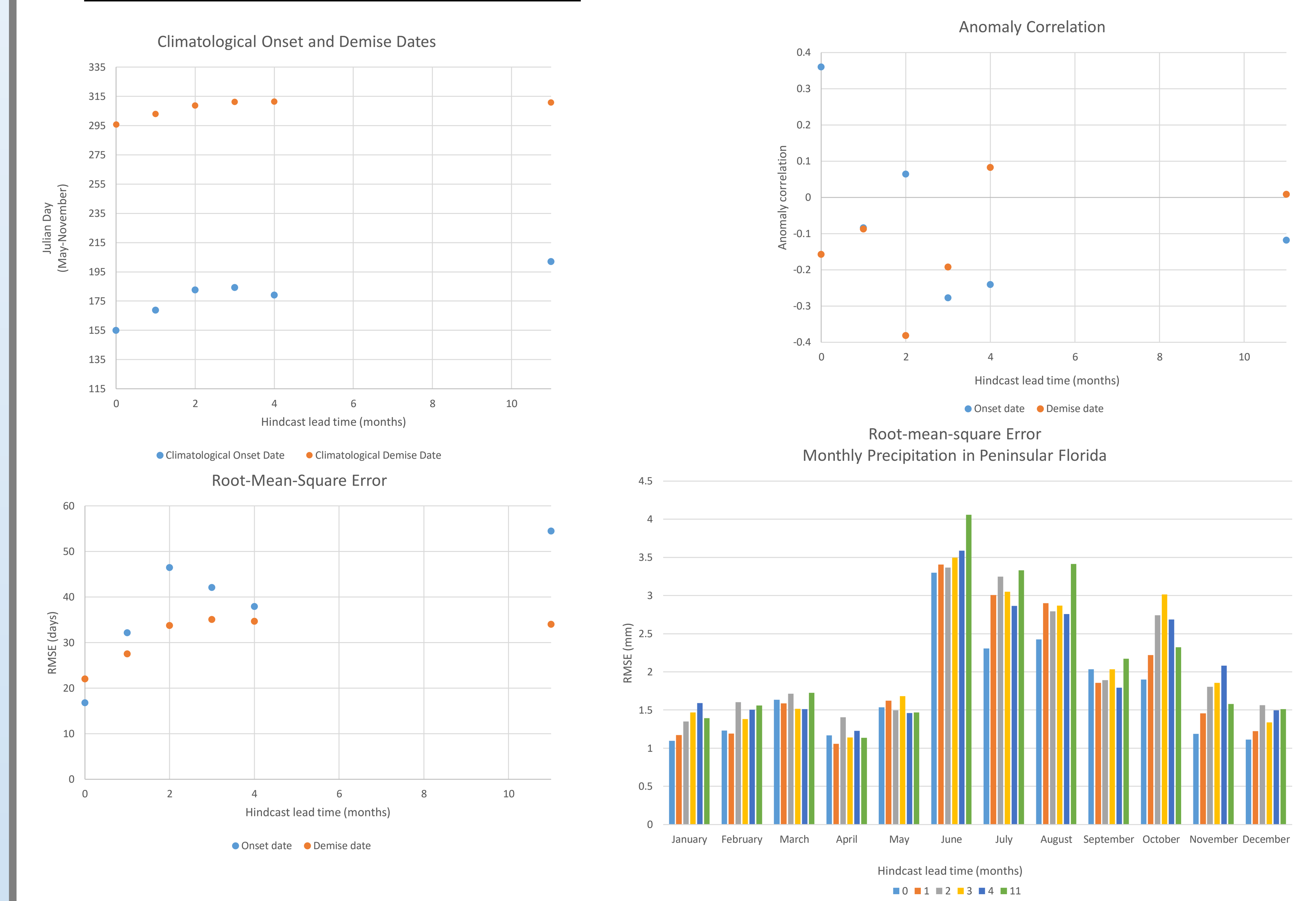

Fig. 5. (Top left) The climatological onset and demise dates of the Peninsular Florida wet season 1982–2015 hindcast by CCSM4 at lead times of 0–4 and 11 months. **(Top right)** Anomaly correlations and **(Bottom left)** Root-mean-square Error for the onset and demise dates hindcast by CCSM4 at lead times of 0–4 and 11 months. **(Bottom right)** Root-mean-square Error of the monthly rainfall in Peninsular Florida at hindcast lead times of 0–4 and 11.

- Signal-to-noise ratios are high for hindcasts of precipitation that initiate in the winter months and at lead times near 3 months **(Fig. 4).** The CCSM4 hindcasts show high ensemble spread in the prediction of onset and demise of the summer precipitation over Peninsular Florida.
- The observed climatological onset (demise) date for 1982–2015 is 151.6 (279.0) Julian Day. Onset and demise dates hindcast by CCSM4 generally have a later bias as lead times increase **(Fig. 5)**.
- Anomaly correlations show no skill in hindcasting either onset or demise of the summer precipitation in CCSM4 hindcasts **(Fig. 5)**.
- RMSEs are highest in summer and at longer lead times **(Fig. 5)**.

FUTURE WORK

- The deterministic skill metrics presented here will be examined at lead times of 0–11 months for the remaining models in the North American Multimodel Ensemble: CanCM3, CanCM4, GEOS5, and FLORB-01.
- Additionally, probabilistic skill of the models will be examined by implementing relative operating characteristic curves.

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CPC Global Unified Precipitation data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at https://www.esrl.noaa.gov/psd/.