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Comparison of Warm Season North American Precipitation Variability Observations to CFSv2

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1. Introduction

Warm season precipitation, defined as April/May/June (AMJ), in the central and eastern US is driven by the northward transport of heat and moisture by the low-level atmospheric circulation (the North American low-level Jet; NALLJ). The NALLJ's main role in the climate system is to communicate the large scale climate influences (*i.e.* sea surface temperature; SST) to regional scales. Thus understanding SST influences on NALLJ variability is fundamental to understanding how the large scale remote climate influences are manifest in the context of regional climate variability and change.

Previous studies have shown significant correlations between NALLJ variability and modes of SST are present from 1950-2010. However, the extent of influence SSTs have on NALLJ and regional precipitation variability is difficult to obtain from observations alone. To further characterize SST influence on NALLJ and precipitation variability, the observational analyses are repeated using the National Center for Environmental Prediction Climate Forecast System Version 2 (CFSv2) Atmospheric Model Intercomparison Project (AMIP) simulations.

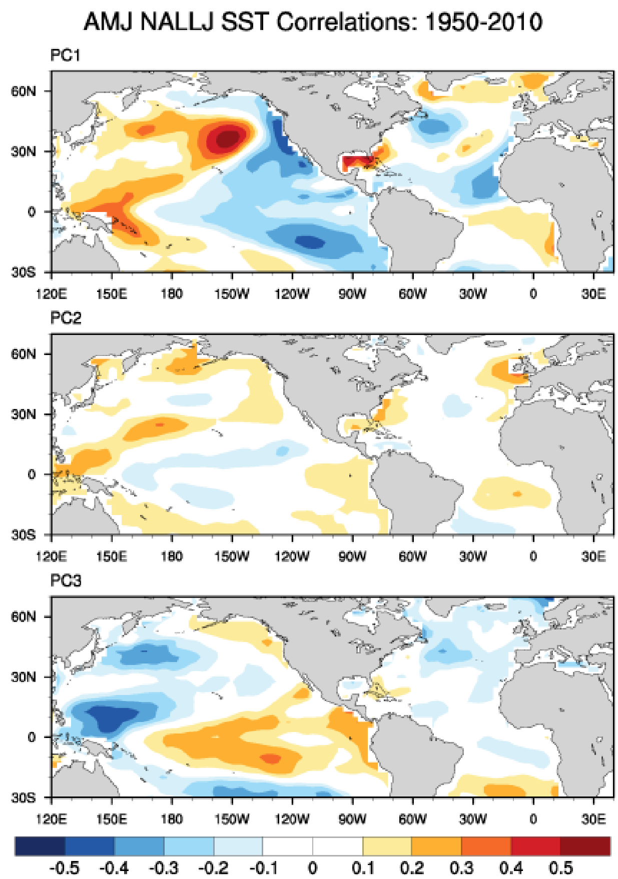

Fig. 1 Correlations between the first 3 modes of the NALLJ and the SST observations.

2. Data

This study utilizes multiple datasets due to its focus on comparing observations to simulations. Rainfall observations are from the Precipitation Reconstruction updated by the NOAA Climate Prediction Center (CPC) and are available from the CPC website. The NALLJ observations are identified from the 850hpa V-wind from the NCAR/NCEP reanalysis. With the main goal of determining SST influence on precipitation variability, the ERSSTv3 SST dataset is chosen to determine the correlation between SSTs and the NALLJ observations. The simulated dataset is from the CFSv2 AMIP dataset. The simulations consist of 12 ensemble members with monthly output from 1950-2010. Isolating the SST influence from the CFSv2 AMIP simulations is accomplished by comparing the ensemble mean value to the observations.

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3. Summary of results

(a) NALLJ and SST

The first three modes of the EOF analysis performed on the NALLJ region bounded by 105° – 80°W 20° – 50°N are correlated to the SST observations for 1950-2010 (Figure 1). Mode 1 accounts for approximately 41% of the variance. It also shows the strongest correlations with the largest values in the North Pacific. Correlation patterns in the Pacific are similar to spatial pattern of the Pacific Decadal Oscillation. Atlantic correlations are weaker than the Pacific with a spatial pattern similar to the Atlantic Multidecadal Oscillation. Mode 2 accounts for approximately 20% of the variance with the weakest correlations of the three modes. Mode 3 accounts for approximately 11 % of the variance with correlations focused in the tropical pacific region.

(b) Precipitation & 850hpa V-wind climatology

The observations of the AMJ NALLJ stretches from the western Gulf of Mexico into the central plains with the NALLJ maximum centered over Texas. Precipitation observations are focused east of NALLJ position in the Southern Plains and Southeastern regions. CFSv2 AMIP NALLJ is centered over same region as observations. AMIP NALLJ is stronger than observations with tighter gradient along topography in western Texas. AMIP precipitation is focused further north in Great Plains region.

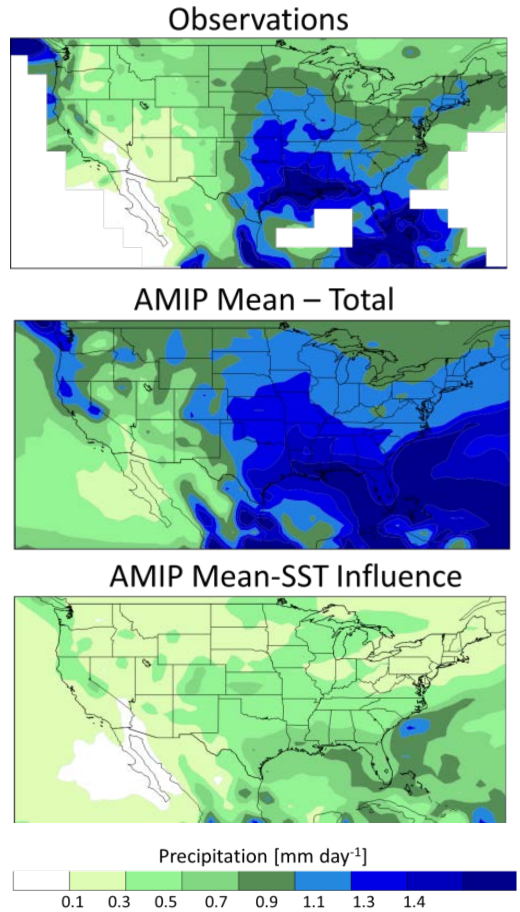

Fig. 2 Comparison of precipitation variability from the observations (top panel) to the total AMIP mean (middle panel) and the AMIP mean isolating SST influence (bottom panel).

(c) Precipitation variability (standard deviation)

Comparisons of the precipitation are shown in Figure 2. The largest variability is focused in Southern Great Plains and Southeastern regions. Observations and total AMIP mean in relative agreement in location and magnitude of variability with total AMIP slightly larger (around .2 mm day^{-1}) in Northern Plains region. The SST influence is greatest over Southern Plains and Southeastern US with values slightly less than half of both the observed and AMIP total.

(d) Regional breakdown

Figure 3 gives the regional breakdown of the precipitation variability. For the Northern Great Plains, the observations fall within envelope of AMIP ensemble spread. The moving standard deviation AMIP mean value (isolating SST influence) is around 0.1 which accounts for around 25% of total variability. For the Southern Great Plains, the observations fall within the AMIP spread. AMIP mean value varies from 0.2 to 0.4 which accounts for around 30% of the total variability. Finally, the Southeast region, the observations fall

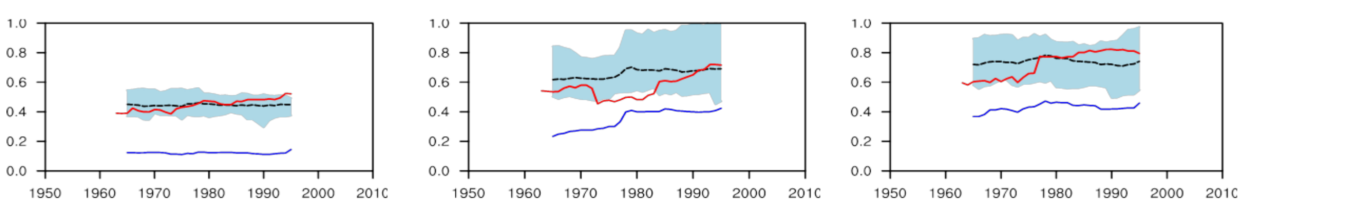

Fig. 3 30-year moving standard deviation of precipitation (mm/day) for the Northern Great Plains (left panel), Southern Great Plains (middle panel), and the Southeast (right panel). Dashed black line is the total AMIP mean with light blue shading indicating the ensemble spread. Red line is the observations. Dark blue line is the AMIP mean isolating the SST influence.

within the spread of the ensemble. The AMIP mean value is around 0.4 which accounts for about 50% of the total variability.

4. Discussion

There are similar spatial patterns between observations and CFSv2 for NALLJ location, with a slightly stronger jet and larger precipitation values in CFSv2 AMIP dataset. Precipitation variability as represented by precipitation standard deviation shows similar spatial patterns when comparing observations and total AMIP variability. AMIP SST influence shows largest variability over Southern Plains and Southeastern US with values slightly less than half of both the observed and AMIP total. Regional comparisons of precipitation anomalies show observations fall within spread of all 12 AMIP ensemble members. Moving standard deviations of regional variability show SST AMIP mean below observations and ensemble spread. SST influence accounts for anywhere from ~25 – 50% of the total variability.

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