Inhomogeneous Influence of Atlantic Warm Pool on United States Precipitation

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Summary

Using observational and reanalysis data from 1900 to 2000, this study examines the Atlantic Warm Pool (AWP) summer variability on interannual and longer time scales and their corresponding influences on US precipitation. At interannual time scales, the warming of the AWP is associated with a tripole SST pattern in the North Atlantic (**Fig.1**). This tripole pattern leads to an anomalous low pressure system over the northeastern North American continent and results in more (less) rainfall in the central and eastern (western) US (**Fig.2**) through the pressure-induced changes of moisture transport. On the decadal-to-multidecadal time scales, the AWP warming corresponds to the basin-wide warming pattern known as the Atlantic Multidecadal Oscillation (**Fig.1**). This SST warming pattern leads to less precipitation in the central and eastern US (**Fig.2**), in agreement with previous studies. It is shown here that the inhomogeneous relationship between the AWP and US rainfall on different time scales is largely due to the sign of mid-latitude SST anomaly associated with the AWP warming. The negative mid-latitude SST anomaly associated with the tripole pattern may enhance the local low sea level pressure (SLP) over the northeastern North American continent and also enhance the barotropic response of the barotropic Rossby wave which is excited by the AWP warming (**Fig.3**). This strengthened low pressure system over northeastern North America, which is not exhibited when the mid-latitude SST anomaly is positive associated with the AWP warming, results in a different moisture transport variation (**Fig.4**) and thus the rainfall pattern over the US.

Atlantic Warm Pool Variability

1

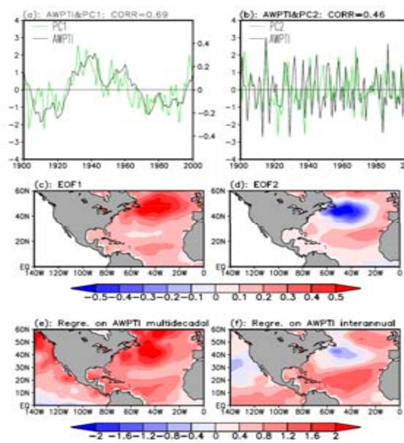

Figure 1. (a) Time series of ASO AWPTI at decdal to multidecadal time scales and principal component of the first EOF mode of the North Atlantic in ASO. (b) Time series of ASO AWPTI at decadal to interannual time scales and principal component of the second EOF mode of the North Atlantic in ASO. (c) The first mode and (d) second mode of the EOF analysis of North Atlantic SST in ASO. Regression of North Atlantic SST on AWPTI (e) at decadal to multidecadal time scales and (f) at interannual time scales.

Precipitation

2

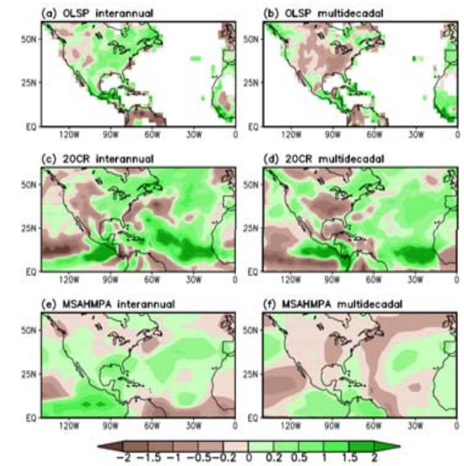

Figure 2. (left) Regression of the precipitation data from (a) OLSP, (c) 20CR and (e) MSAHMPA onto interannual band AWPTI. (right) Regression of the precipitation data from (b) OLSP, (d) 20CR and (f) MSAHMPA onto AWPTI of decadal-to-multidecadal band

Pressure Structure

3

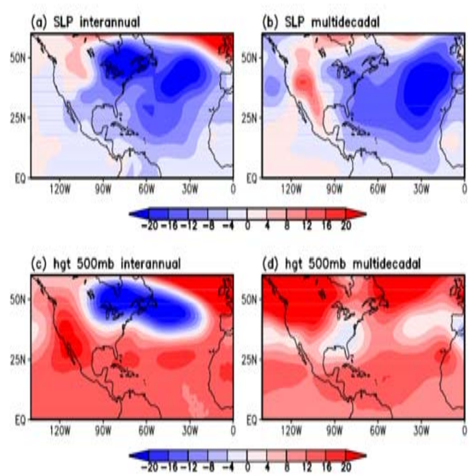

Figure 3. Regression of ASO SLP (Pa) onto (a) interannual band AWPTI and (b) decadal-to-multidecadal band AWPTI. Regression of ASO geopotential height (m) at 500mb onto (c) interannual band AWPTI and (d) decadal-to-multidecadal band AWPTI.

Moisture Transport

4

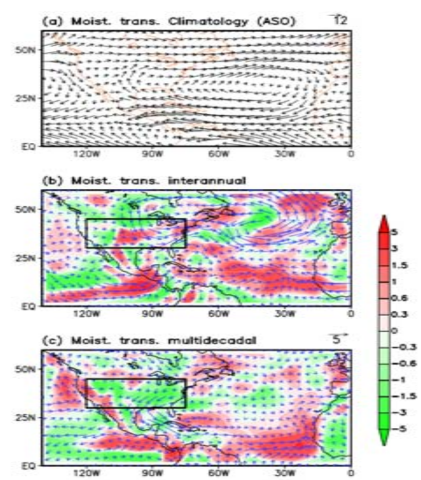

Figure 4. (a) The climatology of moisture transport in ASO. Regression of moisture transport (vector) and moisture convergence (shading) onto (c) the interannual band AWPTI and (d) the decadal-to-multidecadal band AWPTI. Moisture transport (g kg-1 m s-1) is calculated at each vertical level and integrated from sea surface to 300mb.

References

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