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THE INFLUENCE OF WIND-INDUCED ATMOSPHERE-OCEAN EXCHANGE ON SUMMERTIME EAST PACIFIC INTRASEASONAL OSCILLATIONS IN THE MODIFIED NCAR CAM2.0.1

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1. INTRODUCTION

The northeast Pacific warm pool is associated with significant variations in wind and precipitation associated with the summertime intraseasonal oscillation (ISO). These variations are accompanied by a significant modulation of tropical cyclone activity (e.g. Maloney and Hartmann 2000). This study examines the sensitivity of intraseasonal variability in this region to wind-induced latent heat flux variability, using a general circulation model with a realistic simulation of the intraseasonal oscillation. Such a sensitivity was suggested in the observational results of Maloney and Esbensen (2003, ME03). Intraseasonal precipitation variability is found to be strongly sensitive to wind-induced variations in surface latent heat flux.

2. MODEL

A modified version of the NCAR Community Atmosphere Model 2.0.1 (CAM2.0.1) is used in this study. Because the standard CAM2.0.1 deep convection parameterization produces intraseasonal variability across the Tropics that is significantly weaker than observed, we have implemented the relaxed Arakawa-Schubert convection scheme of Moorthi and Suarez (1992).

Two 15-year simulations forced by climatological sea surface temperatures are conducted. Oceanic surface latent heat fluxes in the second simulation are set to the climatological seasonal cycle from the first simulation in the domain given by 10^{o}S-30^{o}N, 70^{o}W-120^{o}W. Fluxes over land are allowed to remain fully interactive in both simulations, given the expectation from ME03 that oceanic, rather than land, latent heat flux variations are the primary driver of intraseasonal convection variations near the Americas during summertime. The two simulations will hereafter be referred to as the "control" and "fixed-EVAP" simulations.

3. RESULTS

The control simulation with interactive surface fluxes produces northeast Pacific warm pool intraseasonal wind and precipitation variations that are of similar magnitude and structure to those associated with the observed ISO (Figures 1,2). The control lifecycle shown in Figure 2 is a composite based on global equatorial 30-90 day zonal wind EOFs. Periods of low-level westerly intraseasonal wind anomalies are associated with enhanced surface latent heat fluxes and enhanced precipitation (Figure 3), as in observations. Variations in surface wind speed primarily control the surface flux anomalies (not shown).

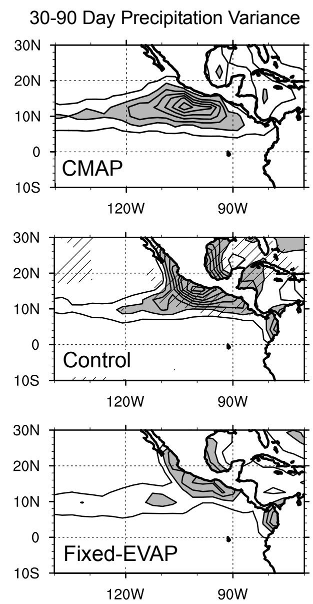

Fig 1. June-October 30-90 day precipitation variance from a) CMAP, b) the control simulation, and c) the fixed-EVAP simulation. The contour interval is 2 mm^2 day^{-2}. Values greater than 4 mm^2 day^{-2} are shaded. Diagonal lines in b) indicate where the fixed-EVAP variance falls below the lower 95% percent confidence limit on the control variance.

A simulation in which eastern north Pacific oceanic latent heat fluxes are fixed produces intraseasonal precipitation variations that are significantly weaker than those in the control simulation and in observations (Figure 1,4). As in the control simulation, a fixed-EVAP composite lifecycle is created based on global zonal wind EOFs that describe eastward-propagating ISO anomalies. These global EOFs are not significantly different than those from the control case, because only eastern north Pacific heat flux anomalies are prescribed.

These results support the observational findings of ME03, who suggested that wind-induced latent heat flux variability is a significant driver of ISO-related convective variability over the northeast Pacific warm pool during Northern Hemisphere summer. East Pacific ISO convec-

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tion in this model thus appears to be forced by an analogous mechanism to that proposed by Maloney and Sobel (2004) to explain forcing of west Pacific ISO convection. The surface exchange mechanism is apparently active within regions of mean westerly low-level flow.

In contrast, summertime eastern north Pacific intraseasonal wind variance and spatial structure does not differ significantly between the control and fixed-evaporation simulations (not shown). A strong coupling between the east Pacific flow and convection over Central America may be responsible for the relatively small changes in wind variability between the simulations. The coarse resolution of Central American orography in the model may contribute to this anomalous coupling.

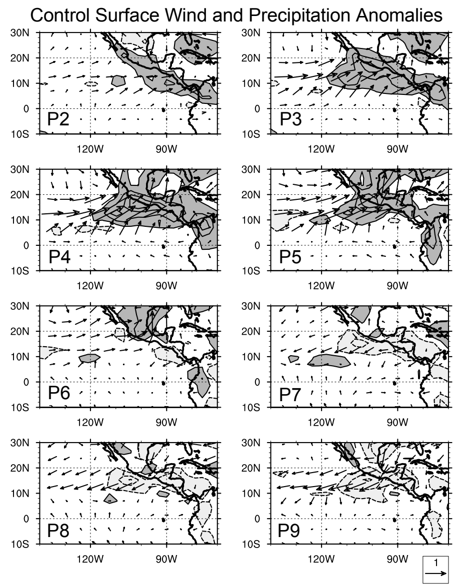

Fig 2. Control simulation composite June-October ISO surface wind and precipitation anomalies as a function of phase. Precipitation contours are plotted every 0.8 mm day^{-1}, starting at 0.4 mm day^{-1}. Values greater (less) than 0.4 mm day^{-1} (-0.4 mm day^{-1}) are dark (light) shaded.

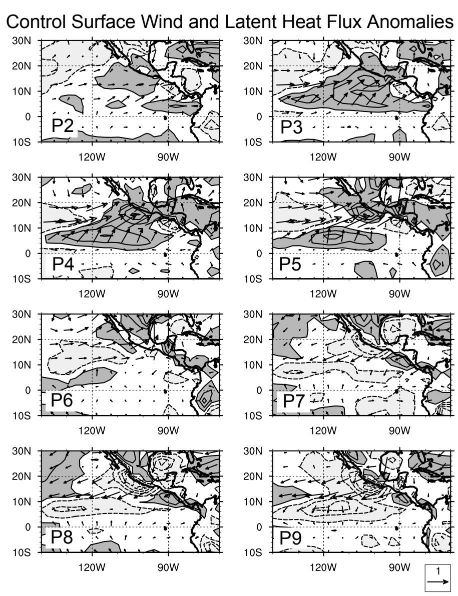

Fig 3. Control simulation composite June-October ISO surface wind and latent heat flux anomalies as a function of phase. Flux contours are plotted every 4.0 W m^{-2}, starting at 2.0 W m^{-2}. Values greater (less) than 2.0 W m^{-2} (-2.0 W m^{-2}) are dark (light) shaded.

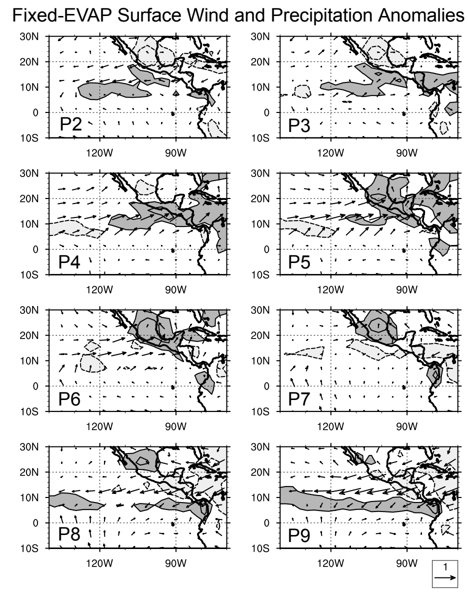

Fig 4. Same as Fig 2, except for the Fixed-EVAP simulation.

Further details of these experiments can be found in a paper submitted to *Journal of Climate* (Maloney and Esbensen 2004).

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4. REFERENCES

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