Northwest Pacific Climate Predictability During Summer and Possible Role of the Tropical Indian Ocean and Interaction: Analysis of Eleven Coupled Model Hindcasts

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The skills of 11 coupled ocean-atmosphere General Circulation Models (CGCMs) are investigated in the prediction of seasonal rainfall and circulation anomalies over the Northwest (NW) Pacific particularly in the summer following the mature phase of El Niño [hereafter JJA(1)]. Analysis of coupled model predictions and their multi-model ensemble (MME) for the period 1980-2001 reveals exciting prospects for NW Pacific rainfall and circulation forecast at one-month (May initial condition) and four-month (February initial condition) lead. It is shown that the first empirical orthogonal function (EOF) mode of sea level pressure (SLP) is closely link to the second EOF mode for rainfall variability of NW Pacific in summer associated with mature phase of ENSO in preceding winter. The correlation coefficient between the first principal component (PC) of SLP and the second PC of rainfall over the NW Pacific is 0.8 for observations and 0.95 for MME prediction. Most coupled models and their MME well predict these EOF modes and their relationship with high fidelity. It is interesting to note that coupled models which have a higher correlation coefficient between the two PCs tend to have better skill for predicting the second EOF mode of rainfall.

Our analysis shows that the NW Pacific rainfall prediction in JJA(1) is strongly related to Tropical Indian Ocean (TIO) SST on interannual time-scale, supporting previous studies that NW Pacific/East Asian summer rainfall variability is not directly linked to El Niño at its decay phase. An experiment (NoTIO run) performed using a SINTEX-F coupled GCM by prescribing the SST climatology over the TIO supports our results. SINTEX-F retrospective forecast for 1983-2006 captures major

modes of atmospheric variability over the NW Pacific during JJA(1) well in the control run. By decoupling the ocean and atmosphere in the TIO, we aim to isolate its effect on climate elsewhere. In NoTIO, the NW Pacific anticyclone during JJA(1) weakens considerably and reduces its westward extension. Without an interactive TIO, the anomaly correlation coefficient for rainfall PC prediction drops significantly. To diagnose the TIO effect on the circulation, the differences between the two runs (Control minus NoTIO) are analyzed. The warm TIO induce changes in lower and upper level circulation and there by modulates the NW Pacific JJA(1) atmospheric anomalies. Possible interactions between TIO and NW Pacific summer climate are further discussed.