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Decadal Shift of the South China Sea Monsoon System in Mid-1990s and Its Possible Mechanism

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The South China Sea (SCS) monsoon system was found existing a decadal shift in mid-1990s by multi-variables season-reliant empirical orthogonal function (MV-SEOF) analysis. The SCS summer monsoon outbreaks late before 1993 and early after 1994. Seasonal cycle of the SCS monsoon mainly manifests two out-of-phase modes between the winter-summer monsoon and the spring-autumn monsoon. In the early onset years of the SCS summer monsoon after the decadal shift, the winter monsoon also set up quite early. For the climatologically intraseasonal oscillation, before the decadal shift, monsoon activities was controlled by bi-weekly oscillation, and convection signal comes from the northwest to the SCS; After the interdecadal shift, monsoon activities is dominant by 30-60-days oscillation, and convection signal propagates from the southeast to the SCS. The SCS monsoon system decadal shift in 1990s possess regioselectivity, with the north-central region of the SCS (5 ° N-25 ° N, 105 ° E-125 ° E) being the most significant areas of decadal shift. This decadal shift signal more reflects the change in the annual cycle of the ”monsoon year ", indicating the unique characteristics of the SCS monsoon. For the variables in SCS monsoon system in major modes, changes in rainfall in the monsoon system is not the most obvious manifestation form, and sea surface temperature (SST) changes in the share of contribution is more important. This may suggest that the local monsoon-SST coupling plays important role in the decadal changes in mid-1990s, while monsoon rainfall changes may be of the response to the SCS local sea-atmosphere coupled system decadal changes. Changes in the frequency and property of El Nino/Southern Oscillation (ENSO) events may cause relations of the SCS summer monsoon and ENSO significant change occurred in the mid-1990s. The SCS summer monsoon always occurs at the decay phase of El Nino and developing phase of La Nina events before 1993, and shift to has stronger ties with the central Pacific warm of El Nino Modoki events after 1994. These results reveal a possible mechanism of decadal shift in the SCS monsoon system in mid-1990s, which has important scientific significance for long-term forecasting of monsoon climate.