

Long-term trends of Asian summer monsoon onset and precipitation during the recent several decades

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Long-term trends of the Asian summer monsoon rainfall and circulation field during the recent several decades (1979-2008) have been examined on a monthly mean basis by using the multiple rainfall datasets (CMAP, GPCP, APRODITE), multiple reanalysis data (NCEP/NCAR, NCEP-DOI, ERA40, and JRA25), HadiSST, and NOAA interpolated OLR. A significant increasing trend of monsoonal rainfall is found over the Arabian Sea, the Bay of Bengal and the South China Sea in May. In contrast, the rainfall over these area shows significant decreasing trend in June. The increasing trend over the Southern China is also remarkable in June. These rainfall trends are consistent with the monsoon circulation and watervapor flux trends in the lower troposphere. The monsoon onset date over the south eastern Asia and the eastern Asia has been shifted approximately 10-15 days earlier in recent decades, which reflects the rainfall trends in May and June. Of interest is that the Asian monsoonal rainfall in July and August does not have clear significant trend. Thus, the Asian monsoon has significant trend only during the transient phase. It is suggested that these trends of the earlier monsoon onset date is closely related to the increasing trends of the SST over the tropical Pacific and Indian Ocean as well as trends in land surface temperature in Asian continent. Further investigations are needed for (1) exploring the possible mechanism to produce the seasonality in the long term variation and (2) addressing whether the remarkable SST increase and land-surface warming are due to anthropogenic or natural forcings. We are also examining these features using a coupled ocean-atmosphere climate model.