



Analysis of Intraseasonal and Interannual variability of the Asian summer monsoon using a Hidden Markov Model

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Intraseasonal and interannual variability of Asian summer monsoon rainfall in pentad precipitation data is examined using a Hidden Markov Model (HMM). The spatial patterns of discrete rainfall states derived with the HMM and the associated transition probabilities between the states are shown to represent well the principal Asian summer monsoon intraseasonal oscillation (ISO), propagating eastward and northward with a period of 40–50 days. The transition probabilities between states shows that re-initiation of convection over the equatorial Indian ocean is more variable than other ISO phases. Stochastic simulations made with the HMM reproduce the canonical ISO propagation and its observed level of irregularity reasonably.

The interannual modulation of the ISO associated with ENSO is assessed by employing a nonhomogeneous HMM (NHMM) with summer-mean NINO3.4 index prescribed as an input variable. ENSO influence on the ISO is found to manifest as preferences toward particular ISO phases depending on the ENSO condition, thus adding an asymmetry to the ISO. In the presence of seasonal mean anomalies, it is shown that the El Niño seasonal mean rainfall anomaly pattern is identified by the HMM as a distinct state, in addition to the ISO states, whereas the La Niña seasonal mean rainfall anomaly pattern does not appear distinct from the ISO states.