

Indian Monsoon Intraseasonal Oscillations: From Understanding to Prediction

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The Indian summer monsoon plays a hide and seek game in the form of 'active' and 'break' spells during the monsoon season (June-September). Extended range prediction of these intra-seasonal oscillations (ISOs) is critically important for water resource management and improved agricultural productivity. The journey of the author on understanding the scale selection of these oscillations, their space-time structure, linkages with seasonal mean and synoptic activity and their predictability over the past two decades and how that led to the development of a technique to predict these spells three weeks in advance is described in this talk.

The monsoon intraseasonal variability (ISV) is dominated by two temporal scales, a 30-60 day oscillation and a 10-20 day oscillation. The author's work in the scale section of both the modes will be presented. While the 30-60 day mode is associated with fluctuations of the northward propagating tropical convergence zone (TCZ) due to a convective-radiative-dynamic feedback, the 10-20 day oscillation arises from an equatorial Rossby mode driven unstable by convective feedback. The spatial scale of the 30-60 day mode is about 10,000 km while that of the 10-20 day mode is about 6,000 km. It is shown that the monsoon ISOs makes the seasonal mean more difficult to predict by introducing significant contribution to interannual variability (IAV) of the seasonal mean while it increases the predictability of monsoon weather by clustering the synoptic events.

The most important aspects of the monsoon ISV are its large amplitude and the fact that it has a strong underlying quasi-periodic component. The amplitude of monsoon ISV is much larger than that of the IAV of the seasonal mean and as large as that of the annual cycle. This provides optimism in extended range prediction of the monsoon ISV. What is the potential limit on predictability of the monsoon ISV? A novel method proposed by the author to estimate this potential predictability from observations will be discussed and shown that monsoon breaks have much longer predictability compared to monsoon active conditions. Using daily rainfall data for 104 years, changes in the potential predictability of monsoon ISV will also be presented. Climatological ISO (CISO) of monsoon represents a predictable component of monsoon ISO. Regime shift of the monsoon CISO and its link to predictability will also be discussed.

The understanding the dominant monsoon ISO is a nonlinear convectively coupled oscillation indicates that for each phase of the precipitation ISO, the large scale circulation parameters must be uniquely related with an unique evolutionary

characteristics. Keeping this in mind, a nonlinear pattern recognition technique, self organized map (SOM) is used to identify different nonlinear phases of precipitation by using only large scale parameters. This technique is then used to find close analogues in the past to make real time forecast of monsoon pentad rainfall over central India three weeks in advance with useful skill. The technique will be described.