

# **An Objective Definition of the Indian Summer Monsoon Season and a New Perspective on Enso-Monsoon Relationship**

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The concept of interannually varying Indian summer monsoon season is introduced here, as the duration of the primary driving of the Indian monsoon namely the large-scale meridional gradient of deep tropospheric heat source may vary from one year to another. Onset (withdrawal) is defined as the day when the tropospheric heat source shifts from south to north (north to south). This physical principle has led to a new thermodynamic index of the seasonal mean monsoon. While the traditional seasonal rainfall averaged from 1 June to 30 September indicates a breakdown of ENSO-monsoon relationship in the recent decades, it is argued that this breakdown is partly due to the inappropriate definition (fixed) of the monsoon season and shown that ENSO-monsoon relationship has remained steady over the decades with a physically based definition of the seasonal mean. El Nino (La Nina) contracts (expands) the season and thus decrease (increase) the seasonal mean monsoon by setting up persistent negative (positive) tropospheric temperature (TT) anomalies over the southern Eurasian region. Thus, a teleconnection pathway, not recognized so far, has been discovered through which Indian summer monsoon could be influenced by remote climatic phenomena via modification of TT over Eurasia. Diagnostics of the onset and withdrawal processes suggest that the delay of onset is due to the enhanced adiabatic subsidence that inhibits vertical mixing of sensible heating from warm landmass during the pre-monsoon months. On the other hand, the major factor that determines whether the withdrawal is early or late is the horizontal advective cooling. Most of the late (early) onsets and early (late) withdrawals are associated with El Nino (La Nina). This link between ENSO and monsoon is realized through vertical and horizontal advections associated with the stationary waves in the upper troposphere set up by the tropical ENSO heating.