

ABSTRACT

The Indian Summer Monsoon (ISM) represents a complex coupled system, and its dynamics have undergone significant transformations following the climate shift of 1998. This thesis seeks to investigate the post-1998 period by analyzing changes in the structure of the ISM and assessing the variability of the characteristics of the Tropical Easterly Jet (TEJ), Somali Jet (SJ), and Monsoon Trough (MT), all of which are integral semi-permanent features of the ISM. The methodology consists of splitting the dataset into two epochs, divided by the climate shift, and analyzing the epochal changes. The study reveals a signature of strengthening of TEJ, which is attributed to increased upper-level meridional temperature gradients and increased diabatic heating over the TP region. The intensification is further associated with increased convection and a stronger correlation between TEJ parameters and OLR, indicating greater influence of the upper troposphere on ISM variability. Additionally, SJ shows a signature of weakening in May and strengthening in September in the aftermath of the climate shift, leading to altered progression dynamics of ISM and increased season length. Furthermore, the weakening of MT is also observed as indicated by increased MSLP and 850 hPa geopotential heights in the region. This has led to a reduction in land-ocean thermal contrast and modifies the shear dynamics, particularly through weaker easterlies at 850 hPa. This leads to reduced active spell duration and increased break spell durations in the recent epoch. Collectively, thermodynamic modulators like diabatic heating anomalies, PV anomaly shifts, and decreasing land-ocean thermal contrast have altered the jet dynamics and reduced MT strength, thereby causing restructuring of ISM onset and withdrawal and intra-seasonal variability. The ISM in the aftermath of the 1998 climate shift is characterized by delayed but faster onset, late withdrawal, weakening MT, and strengthening TEJ. This has culminated in increased variability and reduced predictability of ISM with altered rainfall distribution, which has critical consequences for agriculture, hydrology, and climate policy making in the Indian context.

Keywords: Climate shift, TEJ, SJ, MT, ISM, Monsoon Dynamics