ALL NEPAL SUMMER MONSOON RAINFALL VARIABILITY, ITS DYNAMICS AND ASSOCIATED TELECONNECTION WITH TROPICAL PACIFIC AND INDIAN OCEAN OSCILLATION

Ujjwal TIWARI[1]*, Lochan Prasad DEVKOTA[2] and Sunil Kumar PARIYAR[3]

[1]*Department of Environmental Science, Tri-Chandra College, Ghantaghar, Kathmandu, Nepal*
[2] *Central Department of Hydrology and Meteorology, Tribhuvan University, Kathmandu, Nepal*
[3] *Geophysical Institute, University of Bergen, Norway*
*Corresponding Author: ujjwal.atmos@gmail.com

ABSTRACT

The inter-annual variability of Nepalese monsoon is largely affected by tropical Pacific and Indian Ocean oscillations because these large scale oceanic dynamics have pronounced impact on regional circulation over South Asia. In this research we have tried to establish statistical relationship among Pacific and Indian Ocean Oscillations and All Nepal Summer Monsoon Rainfall (ANSMR), and finally unravel the dynamics of ANSMR. Appropriate indices for El Niño Southern Oscillation (ENSO), Indian Ocean dipole (IOD), Walker and Hadley circulations have been applied and their connection with ANSMR was investigated. Furthermore, to understand the moisture transportation mechanism during monsoon season, moisture budget analysis was carried out using the Moisture Flux Divergence Equation.

Analysis of ANSMR using APHRODITE data for the period 1979-2007 suggested the great spatial and temporal variation with 9 to 11 years cyclic oscillation, however, no clear trend was observed over the study period. Strong negative correlation was observed between ANSMR and Nino3.4 index ($r=-0.50$, $p<0.01$). IOD events have significant impact on Nepalese monsoon with countering effect over ENSO. The impact of El Niño (La Niña) on ANSMP is largely reduced by PIOD (NIOD) when composite of co-occurring El Nino-PIOD and La-Niña-NIOD was considered.

There was a negative association ($r=-0.589$, $p<0.01$) between zonal Walker and meridional Hadley circulation. Both of those of tropical circulation were found to be tightly coupled with ANSMR. In particular ANSMR was positively correlated with Walker circulation ($r=0.69$, $p<0.01$) and negatively correlated with Hadley circulation ($r=-0.632$, $p<0.01$). Interestingly, the correlation between western Nepal rainfall and these two tropical circulations was significantly low compared to eastern and central region rainfall, indicating the limited influence of the tropical circulation on western region precipitation.

The inter-annual variability of ANSMR was consistent with north-south shift in the position of monsoon trough. Particularly, northward shift in the position of trough was associated with high rainfall in Nepal and southward shift in the position of trough was associated with less rainfall in Nepal. Analysis of moisture flux divergence revealed that there was dipolar nature of moisture convergence during the high and low ANSMR years. Moreover, moisture convergence occurred around Arabian Sea and western coast of India in high ANSMR years, while moisture convergence occurred around eastern coast of India in low ANSMR years. Similar pattern was observed in the case of La Niña and El Niño years. In summary, the dynamic behavior and inter-annual variability of ANSMP is largely affected by tropical Pacific and Indian Ocean oscillation and associated atmospheric teleconnections.

KEYWORDS: *ANSMR, El Niño, La Niña, IOD, trough*