

INVESTIGATING THE VARIABILITY OF PRECIPITATION AND ITS RELATIONSHIP WITH CLIMATE MODES IN DIFFERENT REGIONS OF SRI LANKA

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Understanding precipitation variability is vital for water resource management, agriculture, and disaster preparedness in Sri Lanka, a country highly sensitive to climate fluctuations. Sri Lanka, situated in a region influenced by complex atmospheric circulation patterns, is particularly susceptible to the impacts of various large-scale climate modes. These atmospheric phenomena, including the El Nino-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) exert significant influence on the country's weather and climate systems. Understanding how ENSO and IOD affect rainfall patterns in Sri Lanka is critical for sustainable water resource management and agricultural planning, making this research essential for the nation's economic and environmental sustainability.

This study explores the influence of two major climate drivers, ENSO and IOD on Sri Lanka's rainfall patterns from 1999 to 2015, addressing a critical gap in understanding the simultaneous impacts of these phenomena on precipitation variability. ENSO events were identified using the Oceanic Nino Index (ONI), while IOD events were determined using the Dipole Mode Index (DMI) based on established meteorological thresholds. Both indices were normalised using the min-max method to ensure statistical comparability and robust analysis. Precipitation data from representative meteorological stations strategically distributed across the wet, intermediate, and dry zones were analysed using advanced statistical techniques to evaluate correlations with these climate indices.

Warm sea surface temperatures in the equatorial eastern Pacific are referred to as the El Nino phase, while its cooler counterpart is considered as the La Nina phase. El Nino events generally suppressed rainfall in the wet and intermediate zones, creating drought-like conditions, while La Nina events enhanced precipitation in these regions, often leading to above-normal rainfall. Positive IOD events were typically associated with increased rainfall across most regions, whereas negative IOD events corresponded to drier conditions, though notable regional variations were observed throughout the study period. The findings underscore the complex yet significant influence of ENSO and IOD on Sri Lanka's regional rainfall patterns, demonstrating that these climate oscillations play crucial roles in determining seasonal and annual precipitation variability. This research fills a critical knowledge gap by examining the simultaneous impacts of ENSO and IOD on precipitation patterns and evaluating the ability of statistical models to forecast rainfall anomalies under varying climate conditions. Understanding their combined effects is essential for improving climate predictions and informing evidence-based decision-making in key economic sectors. Future research should incorporate more recent data and employ machine learning approaches to explore complex interactions among multiple climate drivers.

Keywords: Climate variability, El Nino Southern Oscillation, Indian Ocean Dipole, Precipitation

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Study Area



Data & Methodology

APHRODITE
precipitation
data



ENSO



IOD (DMI)



Correlation +
Combined Index



ML models

Key Findings



Correlation increases
with longer time scales
(30 months)



Eastern & Northern
regions are most
sensitive



Random Forest
showed best
performance

Implications



Improved rainfall
prediction



Supports water
resource planning
and climate resilience