ABSTRACT

SPATIOTEMPORAL EVALUATION OF HISTORICAL DROUGHT IN THE PHILIPPINES USING STANDARDIZED PRECIPITATION INDEX

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Drought is a slow-onset natural phenomenon caused by the reduction of precipitation. In the Philippines, previous drought events have severely impacted different sectors such as agriculture, water resources, and society. Despite the recurrence of drought, there is a lack of research investigating the phenomenon in the country.

In this study, a satellite-based drought index derived from the precipitation product of the Tropical Rainfall Measuring Mission (TRMM) was used to characterize several historical drought events from the period 1998 to 2019. The Standardized Precipitation Index (SPI) was used to capture drought at various timescales (SPI-1, SPI-3, SPI-6, and SPI-12), where shorter timescales are linked to soil moisture while longer timescales are related to groundwater and reservoir storage.

The SPI values from TRMM and synoptic measurements were compared through correlation, RMSE, and MBIAS. Some stations had mismatches with TRMM especially in the coastal and smaller islands, but overall agreement ($r=0.843$ to $r=0.868$) between TRMM and synoptic-based SPI suggests the applicability of the satellite for drought monitoring.

The countrywide analysis of SPI shows that the Philippines was frequently hit by different drought types, as identified by different SPI timescales. Onset of these drought events were observed prior, during, and after the El Nino events, suggesting that El Nino poses a strong influence in the occurrence of drought. On the pixelwise analysis, intense drought events usually occurred in the southern region of the Philippines. On the other hand, drought events occurred frequently in the northern Philippines, but with less intensity and with shorter duration.

Investigation of the SPI timescales under different climate types derived from the Modified Corona's Classification (MCC) revealed varying SPI values. Further analysis using Ward's hierarchical clustering method was performed to determine areas with homogenous drought characteristics. Differences between the number of drought event, onset, severity, and intensity were observed in the drought clusters across SPI timescales. In the correlation and lag-correlation analysis with large-scale ocean-atmospheric systems such as El Nino Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), and the Western Pacific Subtropical High (WPSH), the drought clusters were more sensitive to the effect of ENSO. This further validates the driving force of El Nino in the occurrence of drought in the country.

The results of this study provided detailed information on the spatial and temporal distribution of drought in the country. This study also demonstrates the potential use of readily available satellite data for drought monitoring, which can be important in drought preparedness and mitigation.