UNIVERSITY OF THE PHILIPPINES

Master of Science in Meteorology

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Spatiotemporal evaluation of historical drought in the Philippines using standardized precipitation index

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ABSTRACT

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.

Satellite-based Standardized Precipitation Index (SPI) at various timescales (SPI-1, SPI-3, SPI-6, and SPI-12) derived from the product of Tropical Rainfall Measuring Mission (TRMM) were used to characterize drought events for the period 1998 to 2019. The SPI timescales (SPI-1, SPI-3, SPI-6, and SPI-12) uses different accumulation of precipitation (1-month, 3-month, 6-month, and 12-month) reflecting impacts of drought on different water resources. Shorter timescales (SPI-1 and SPI-3) are link to soil moisture while longer timescales (SPI-6 and SPI-12) are related to groundwater and reservoir storage.

The SPI values from TRMM and synoptic measurements were compared through correlation, RMSE, and MBIAS. Forty out of forty-five stations showed a good agreement (r=0.739 to r=0.971) between TRMM- and synoptic-based SPI suggesting the applicability of the satellite for drought monitoring.

The countrywide analysis of SPI showed that the Philippines frequently experiences different drought types, as identified by different SPI timescales. Most of the drought coincided with El Niño, suggesting that El Niño poses a strong influence on the occurrence of drought. Regional analysis reveals that 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.

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 Niño Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), and the Western Pacific Subtropical High (WPSH), the drought clusters were found to be more sensitive to the effect of ENSO. This further validates the driving force of El Niño in the occurrence of drought in the country.

The results of this study provide detailed information on the spatial and temporal distribution of drought in the country using satellite data. This study demonstrates that satellite data can be used effectively for the drought monitoring needed in drought preparedness and mitigation.