UNDERSTANDING TROPICAL CYCLONE PRECIPITATION IN THE NORTHERN PHILIPPINES

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ABSTRACT

The Philippines is exposed to Tropical Cyclones (TCs) throughout the year due to its location in the western North Pacific. While these TCs provide much-needed precipitation for the country's hydrological cycle, extreme precipitation from TCs may also cause damaging hazards such as floods and landslides. In this study we will examine environmental and topographic factors affecting TC precipitation and characteristics for westward-moving TCs crossing Luzon, northern Philippines. This study will be conducted in two parts: observational analysis of extreme precipitation of TCs and modeling of TCs making landfall across mountain ranges with modified altitudes.

For the first part of this study, using gridded precipitation data from the Asian Precipitation - Highly-Resolved Observational Data Integration Towards Evaluation of the Water Resources V1101 and V1101_EX datasets (hereafter simply referred to as APHRODITE) we will measure extreme precipitation of TCs through the Weighted Precipitation Exceedance (WPE). WPE calculated by taking the overland precipitation 24 hours after TC landfall and then subtracted from a 95th percentile precipitation threshold. Calculating the precipitation of TCs against this threshold considers both the magnitude and spatial extent of TC-related extreme precipitation. This also allows to directly compare the WPE between different TCs using a consistent standard. TC making landfall in Luzon between 1978 to 2015 will then be categorised according to intensity, movement speed, and season. This will allow us to identify which categories or classifications are associated with extreme TC precipitation.

We will then examine the effect of the Cordillera Mountain Range (CMR) in Luzon, Philippines on Tropical Cyclone (TC) precipitation and characteristics through Numerical Weather Prediction modeling. Using the Weather Research and Forecasting (WRF) model, we will simulate selected TC events with three different terrain profiles: Control, Reduced (0.5x CMR), and Enhanced (2.0x CMR). To further understand the interaction between TC precipitation and different altitudes of the mountain range, we will examine the relationships of precipitation and relevant dynamical fields, including but not limited to mountain slope, the speed of incoming winds perpendicular to CMR, and the moist Froude Number (F_w). Understanding the interactions between TCs and the terrain of Luzon may help in regional quantitative and qualitative precipitation forecasting efforts in the mountainous regions of the Philippines.

Keywords: Tropical Cyclones, Philippines, Extreme Precipitation, Topography, Mountain Ranges, Numerical Weather Prediction