
Abstract

In this study, we first investigate the relationship between Tropical Cyclone (TC) extreme precipitation and TC characteristics by introducing the Weighted Mean Precipitation Exceedance (WPE), a measure of extreme precipitation. We find that stronger or slower TCs that make landfall in Luzon have higher chances of causing higher WPE. However, the relationship between TC intensity and WPE is more pronounced during June to September. These results suggest that it is important to consider the pre-landfall cyclone movement speed, intensity, and season to anticipate extreme precipitation of incoming TCs.

To explain the underlying processes that link TC winds, precipitation, and orography, we then conduct Numerical Weather Prediction experiments for eight different TCs for different heights of the Cordillera Mountain Range (CMR): Control, Reduced, and Enhanced. We find that precipitation along the mountain range increases for increasing CMR height on average, while there are no significant changes for TC movement speeds and TC position for different terrain profiles. TCs weaken for higher CMR elevation when comparing the Enhanced and Control experiments, while the TC strength is similar the Reduced and Control experiments. It is possible that TC intensity is less sensitive to mountain ranges at or below the height of the actual CMR. We also find that mechanical uplift caused by stronger winds blowing up steeper slopes result in higher amounts of precipitation along the CMR.

These results highlight the complexity of the relationship between TCs, mountains, wind, and rainfall, and there are further nuances to consider in terms of anticipating the amount of TC precipitation and TC weakening due to mountain ranges. The findings of this study can be used to fill gaps in current forecasting limitations and may help improve our response to potential hazards associated with TCs.