

Tropical cyclone hazards and their impacts on disaster risk reduction infrastructure and population in the Philippines

Mark Joseph William D. Ducusin

Adviser: Bernard Alan B. Racoma

*Institute of Environmental Science and Meteorology, College of Science,
University of the Philippines Diliman*

ABSTRACT

The Philippines is ranked first with the highest risk index globally by the WorldRiskReport 2026 due to the country's high exposure to natural hazards and limited capacity in managing disasters. Tropical cyclones (TCs) can contribute to disaster risk through torrential rainfall and severe winds, which may cause flooding, landslides, and storm surges. These hazards can result in fatalities, population displacement, and damage to infrastructure such as evacuation centers, hospitals, and transportation networks. Although these facilities provide people with access to services essential to disaster risk reduction (DRR), there is limited understanding of how TCs impact DRR infrastructure. Thus, this study aims to examine how TCs and their associated hazards disrupt the services of DRR infrastructure and affect the population. Specifically, it seeks to (1) analyze the spatial and temporal evolution of TC wind and rain-induced hazards retrospectively across forecast lead times, and (2) assess the extent of service disruption of DRR infrastructure and determine the affected population. TC ensemble forecasts from modeling centers such as the European Centre for Medium-Range Weather Forecasts (ECMWF) will be utilized in deriving the hazard footprints (i.e., wind field and rainfall-driven flooding) of damaging storms that affected the Philippines. Georeferenced DRR infrastructure (i.e., evacuation centers, health facilities, and roads) and gridded population data will be procured from open sources such as OpenStreetMap and WorldPop. The CLIMADA risk platform will be leveraged in spatially integrating TC hazard footprints across different lead times, DRR infrastructure location, and population to calculate TC impacts, determine the services that may potentially be disrupted, and quantify the extent to which this inaccessibility affects people. The results of the study may help support impact-based forecasting and anticipatory action by highlighting the infrastructure and populations that may be affected by incoming tropical cyclones.

Keywords: tropical cyclone, disaster risk reduction, service disruption, impact-based forecast