**Tropical Cyclone Severe Wind Risk Analysis for GMMA**

M.A. Cecilia Monteverde1,**Thelma. A. Cinco1**, Flaviana D. Hilario1, Cynthia P. Celebre1, Analiza Tuddao1, Emma Ares1 and W. Craig Arthur2

1Philippine Atmospheric, Geophysical and Astronomical Services Administration, Diliman 1101, Quezon City

2Geoscience Australia

**ABSTRACT**

In this study, a tropical cyclone severe wind hazard modeling and mapping for Greater Metro Manila Area(GMMA) is presented. This study used Tropical Cyclone Risk Model (TCRM) developed by GeoScience Australia as part of the AusAID project on Capacity Enhancement on Risk Analysis in collaboration with GeoScience Australia (GA). Historical tracks of tropical cyclones affecting the Philippine Area of Responsibility (PAR) for the period 1950 to 2011 were used to quantify the hazard due to severe wind. Statistical and probabilistic approaches using the General Extreme Value (GEV) and the Generalized Pareto Distribution (GPD) analyses are used to model the gust wind speeds. The Regional maximum wind hazard maps for various return periods were generated for the whole Philippines using the Powell Method. The model output is combined with the analysis of the return period of the observed maximum wind speed (3-second peak gust) from 51 synoptic that have at least 30 years of record for the period 1951 to 2011 to validate the various return periods (RPs) of maximum wind gust. As expected, the highest wind speeds are in the northern and eastern sections of the country, corresponding to those regions most often impacted by tropical cyclones which initially developed in the Western North Pacific (WNP) area and moved westerly to northwest direction. 1% AEP gust wind speeds exceed 250 km/h over Catanduanes. Gust wind speeds are lowest over southern and western parts of Mindanao, where tropical cyclones are infrequent and less intense.

The impact of severe wind varies considerably between structures at various locations, due to the geographic terrain, the height of the structure concerned, the surrounding structures and topographic factors. In order to accurately estimate damage to buildings from severe winds, an understanding of wind speeds at the site of the building is required. The regional wind speed needs to be modified to reflect the effects of local land cover (e.g. forests, high-rise buildings or water bodies), the shielding effect due to upwind structures and topographic effects. This is done using so-called site‑exposure multipliers. These site-exposure multipliers are developed using the high-resolution digital elevation and digital surface models in conjunction with multispectral aerial photography captured in LIDAR Data set in GMMA.

The wind risk assessment is a function of the interaction of the wind hazard, building exposure and the vulnerability of the building structures that will be impacted by the wind hazard. The wind risk assessment can be used to determine what might be the expected losses in terms of property damage and the corresponding damage cost due to wind hazard. In assessing the risk, the western and the central sections of GMMA are subject to severe wind impact and have a higher risk than the other areas in GMMA. These areas are densely built-up with high proportion of vulnerable building types (makeshift, wood-type), old structures or “high rise” buildings, and that are located in high hazard areas. On the other hand, the expected cost of wind damage depends on the proportion of wind damaged buildings and the cost of the building.

Keywords: TCRM, LIDAR, severe wind hazard modeling, return period, multipliers

The regional severe wind hazard maps were developed using TCRM, and represent a 3 second gust wind speed at 10 meter height above open, flat terrain. As expected, the highest wind speeds are in the northern and eastern sections of the country, corresponding to those regions most often impacted by tropical cyclones which initially developed in the Western North Pacific (WNP) area and moved westerly to northwest direction. 1% AEP gust wind speeds exceed 250 km/h over Catanduanes. Gust wind speeds are lowest over southern and western parts of Mindanao, where tropical cyclones are infrequent and less intense.

The impact of severe wind varies considerably between structures at various locations, due to the geographic terrain, the height of the structure concerned, the surrounding structures and topographic factors. In order to accurately estimate damage to buildings from severe winds, an understanding of wind speeds at the site of the building is required. There are a number of factors that need to be considered to determine the local wind speed within the area. The regional wind speed needs to be modified to reflect the effects of local land cover (e.g. forests, high-rise buildings or water bodies), the shielding effect due to upwind structures and topographic effects. This is done using so-called site‑exposure multipliers[[1]](#footnote-1). These site-exposure multipliers are developed using the high-resolution digital elevation and digital surface models in conjunction with multispectral aerial photography captured in LIDAR imagery.

The wind risk assessment is a function of the interaction of the wind hazard, building exposure and the vulnerability of the building structures that will be impacted by the wind hazard. The wind risk assessment can be used to determine what might be the expected losses in terms of property damage and the corresponding damage cost due to wind hazard. In assessing the risk, the western and the central sections of GMMA are subject to severe wind impact and have a higher risk than the other areas in GMMA. These areas are densely built-up with high proportion of vulnerable building types (makeshift, wood-type), old structures or “high rise” buildings, and that are located in high hazard areas. On the other hand, the expected cost of wind damage depends on the proportion of wind damaged buildings and the cost of the building.

1. Lin, X.G. and Nadimpalli, K. (2005). Natural Hazard Risk in Perth: Chapter 3: Severe Wind Hazard Assessment in Metropolitan Perth, Geoscience Australia Report, GeoCat No. 63527. [↑](#footnote-ref-1)