



## **Vulnerability Assessment of Housing Damage in the Philippines Due to an Increase in Typhoon Intensity**

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It is currently feared that the increase in surface sea temperature resulting from increasing level of greenhouse gases in the atmosphere could result in higher tropical cyclone intensity in the future. Although the vulnerability of infrastructure and economic systems have been studied for a number of developed countries, very little work has been done on developing countries. The present work first attempts to evaluate the vulnerability of different regions in the Philippines to the passage of tropical cyclones. To this effect a total of 22 typhoons and tropical storms that affected the Philippines were analysed for the period 2003-2008. The data used was collected by the National Disaster Coordinating Council of the Philippines, who issue "SitRep" NDCC Reports after each major storm. This agency provides damage data for each region, including number of casualties, affected people, damaged and destroyed houses, and losses in the infrastructure and agriculture.

The likely economic effects of increased typhoon intensity by using a Monte Carlo Simulation that magnifies the intensity of historical tropical cyclones between the years 1978 and 2008 to simulate the economic damage by 2085. The methodology used is based on the work of Esteban et al. (2009), which in turn uses the results of Knutson and Tuleya (2004) for the estimation of the increase in tropical cyclone intensity in 2085.

The results show that downtime could increase from a national 1% to 1.3% by 2050 if economic and population growth are taken into account (29 to 36bn USD, from a total GDP of 2,757bn USD by 2050). If these are ignored the time lost each year can be estimated to cost around 630m USD (PPP) for the control scenario, which could increase to between 766m or 945mm USD by the year 2085 for the two different scenarios considered. This indirect damage depends on the geographical location and is for example higher in some areas of the northern island of Luzon, while the island of Mindanao in the south is almost unaffected due to its proximity to the equator.

The estimation of the damage shows that the number of houses partially or totally destroyed could increase by up to 58% in certain regions by 2085. The historical damage data shows how the adaptive capacity values of each region given by Yusuf and Herminia (2009) are crucial to the amount of damage recorded. These authors defined this parameter as the degree to which adjustments in practices, processes or structures can moderate or offset potential damage or take advantage of opportunities from climate change. This clearly highlights the importance of mitigation measures to increase the resilience of communities in the future. This is a significant conclusion of the present paper, independent of whether tropical cyclones increase in intensity or not.