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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Developing an early warning system for storm surge inundation in the Philippines" *by* J. Tablazon et al.

J. Tablazon et al.

jptablazon@noah.dost.gov.ph

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Thank you very much for all your comments. These comments will surely improve our study. The authors really appreciate it.

Referee Comment: On the title - the manuscript describes the development of a hazard map to be used by disaster managers. The impression I got from the title is the development of a model or system that predicts a storm surge from an incoming typhoon. Perhaps the term "early warning system" is not the best choice for the title, something in the line of risk or hazard analysis/planning maybe more appropriate.

Authors' Change in the manuscript: Edited title Probabilistic storm surge inundation maps for Metro Manila based on Philippine Public Storm Warning Signals

Referee Comment: main text - you mentioned more than 6000 people lost their lives in Typhoon Haiyan, was all of that due to storm surge? it would appear so in the manuscript

Authors' Change in the manuscript: Line 17 to 20 Storm surge imposes a major threat to the Philippine coastal areas, as manifested by Typhoon Haiyan (Fig. 1) on 8 November 2013. It is one of the main reasons for the high number of casualties due to the typhoon, with 6300 deaths, 1061 missing, and damages estimated at USD 2 billion (National Disaster Risk Reduction and Management Council, 2014).

Referee Comment: abstract - should be a summary of the whole article, yet no results were mentioned in that section, it appears more like an introduction

Authors' Change in the manuscript: Line 2 to 25 Storm surge is the sudden rise of sea water generated by an approaching storm, over and above the astronomical tides. This event imposes a major threat to the Philippine coastal areas, as manifested by Typhoon Haiyan on 08 November 2013. It is one of the main reasons for the high number of casualties due to the typhoon, with 6300 deaths. It became evident that the need to develop a storm surge inundation map is of utmost importance. To develop these maps, the Nationwide Operational Assessment of Hazards under the Department of Science and Technology (DOST-Project NOAH) simulated historical tropical cyclones that entered the Philippine Area of Responsibility. The Japan Meteorological Agency (JMA) Storm Surge Model was used to simulate storm surge heights. The frequency distribution of the maximum storm surge heights was calculated using simulation results of tropical cyclones under a specific Public Storm Warning Signal (PSWS) that passed through a particular coastal area. This determines the storm surge height corresponding to a given probability of occurrence. The storm surge heights from the model were added to the maximum astronomical tide data from WXTide software. The team then created maps of inundation for a specific PSWS using the probability of exceedance derived from the frequency distribution. Buildings and other structures were assigned to a probability of exceedance depending on their occupancy category, i.e., 1% prob-

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ability of exceedance for critical facilities, 10% probability of exceedance for special occupancy structures, and 25% for standard occupancy and miscellaneous structures. The maps produced show the storm surge-vulnerable areas in Metro Manila, illustrated by the flow depth of up to 4 meters and extent of up to 6.5 kilometers from the coastline. This information can help local government units (LGUs) in developing early warnings systems, disaster mitigation and preparedness plans, vulnerability assessments, risk-sensitive land use plans, shoreline defense efforts, and coastal protection measures. These maps can also determine the areas where to build critical, or at least determine the level of protection of these structures should they be built in hazard areas. Moreover, these will support the local government units' mandate to raise public awareness, disseminate information about storm surge hazards, and implement appropriate counter-measures for a given PSWS.

Referee Comment: are there events where you can compare your simulated results with actual inundation due to storm surge? If yes, it'll be beneficial to include

Authors' Response: Currently, we do not have validation for the simulated results with actual inundation. But, we do have validation for the results of the JMA Storm Surge Model.

Please see Fig. 1. This figure shows the forecast results of the JMA Storm Surge Model coupled with tide data from WXTide for Typhoon Pedring (Nesat) of 2011 for Manila Bay using ensemble forecasting. Basically, this figure only shows the difference between the model results using different tracks, considering possible track changes. The results of the model were compared to the actual sea level data from the National Mapping and Resource Information Authority of the Philippines. Evidently, the result of the ensemble average agrees well with the actual sea level data. We believe that the results of the JMA Storm Surge Model is sound and can be used for analysis.

Referee Comment: from the enumerated factors that determine a storm surge, wind direction is vital, and in line with this, is it possible to show which storm path / track

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produces significant storm surges in the area (is it to the north, south of the study area?)

Authors' Response: Please see Fig. 2. Here are the ten tropical cyclones that produced the highest storm surge heights for Metro Manila. As we can see, the tracks that generated the highest storm surge heights can be found north of the study area.

Referee Comment: the authors mentioned that "PSWS 1 at 1 % probability of exceedance has higher flow depths compared to that of PSWS 2. This is not to be expected..." this is because of wind velocity used in the model are forecast winds. But the authors also mentioned using winds from JMA best track archive, which is a reanalyzed data, can this be explained further?

Authors' Response: The wind speeds that were used in the JMA Storm Surge Model are not forecast winds, but the wind speeds from the best track data of the JMA. To clarify, the Public Storm Warning Signals are forecast wind speeds and were only used in the study to categorize the tropical cyclones that hit a certain area, from PSWS 1, 2, 3, and 4. But the JMA best track data were used for the storm surge simulation.

Referee Comment: Figures - fig.2, are those simulated or from best track data?

Authors' Response: These tracks are the ones simulated using the JMA Storm Surge Model and used for this study. These tracks are also from the best track data of the Japan Meteorological Agency.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 6241, 2014.

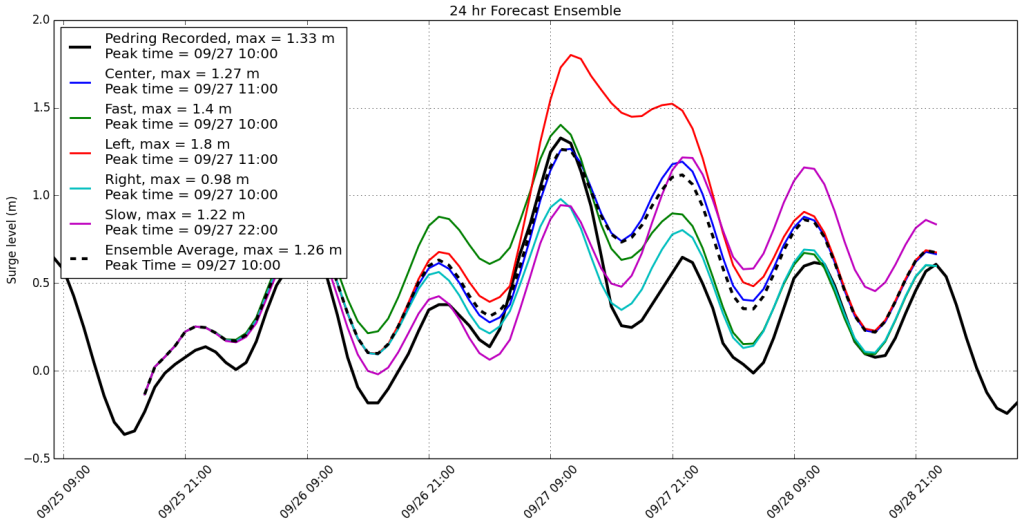

Fig. 1. JMA Storm Surge Model Validation

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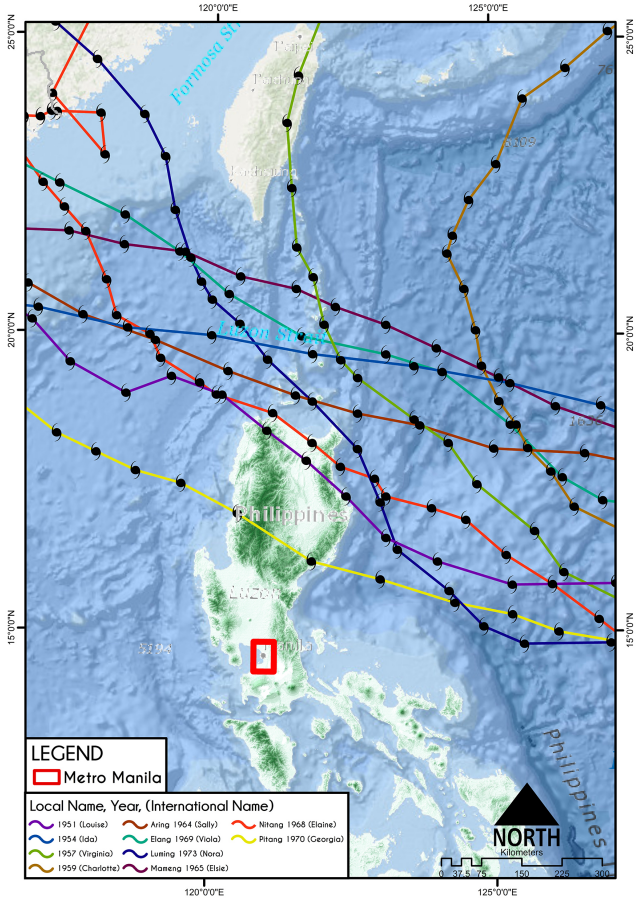

Fig. 2. Tracks of tropical cyclones that generated the highest storm surge heights for Metro Manila

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