From: Mr. Charles 'Chip' Guard, Tropical Weather Sciences

To: Mr. Leo Espia, Guam NTHMP SHMO

Via: Ms. Denille Calvo, Guam NTHMP Program Manager

Subject: Position Paper Concerning Tsunami Inundation Models and Climate Change

Background: Sea levels have been rising for the last several decades. More recently, global climate models have predicted various levels of sea level rise based on projected levels of atmospheric carbon dioxide (CO_2) input. Modelers apply the concept of Representative Concentration Pathways (RCP) to represent Low, Medium, and High Concentrations of CO_2 that produce various heights of sea level rise at various time periods up to the end of the century. At this time, the consensus among climate scientists is for a Medium RCP solution that produces a sea level rise of about 1 foot by 2050 and about 3 feet by 2100. However, for the High concentration RCP, rises by the end of the century could exceed 6 feet. The importance of knowing the sea level at any given time is that any tsunami wave will ride atop the actual sea level. So, if the sea level rises, a comparable tsunami will have a greater run-up height and a greater inland inundation.

Objective: The overall objective of this exercise is to determine if there is a current need to rerun Tsunami Inundation Models (TIMs) to account for projected levels of climate-induced sea level rise. It is very expensive to rerun the TIMs unless there is a very legitimate reason to do so. Such a reason might be a significant improvement in Digital Elevation Models (DEMs).

Approach: The current TIMs were developed by the NOAA Center for Tsunami Research Division of the Pacific Marine Environmental Laboratory (PMEL) in Seattle, WA in 2009. These models provide output in the form of the Maximum Expected Tsunami for various coastal locations of Guam based on 725 probable earthquake scenarios. Dr. Kwok Fai Cheung of the University of Hawaii will be providing TMIs for the Inarajan and Merizo coastal areas of Guam in the next year. His NEOWAVE model output will provide the more likely Maximum Probable [Tsunami] Event, which produces lower inundation values than the Maximum Expected Tsunami output provided by PMEL. Both models base their results are based on the highest of high tides.

I investigated the approaches of other jurisdictions and reviewed the tsunami literature, and I could find no instance where a jurisdiction actually reran the TIMs to consider the effects of climate-induced sea level rise. There is general agreement that using the NOAA Coastal Management Sea Level Rise Viewer is sufficient for estimating the effects of sea level rise.

Conclusions: There is too much uncertainty at this time in the climate model output to invest in costly reruns that could be less accurate than existing less costly approaches. Thus, there is no reason to rerun the TIMs or to even incorporate sea level rise into new TIMs at this time. I will introduce the climate change issue at the Pacific Tsunami Research Workshop to be held at the USGS Powell Center in Colorado in August 2022. The goal there will be to address a more formal strategy for consideration of climate-induced sea level rise. I do recommend that we look at the climate change issue using the NOAA Sea Level Rise Viewer as a task in our next NTHMP Grant.