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MEMORANDUM

DATE: August 6, 2018
TO: Emily Northrop, CNMI Bureau of Environmental and Coastal Quality
FROM: Morgan Stephenson
PROJECT: Hydrodynamic Study of Saipan Lagoons

The following is a summary of the wave modeling section in the hydrodynamics study of Saipan lagoon. CDIP buoy 197 was used to provide the boundary condition to propagated wave energy to shore using the SWAN wave model. Figure 1 shows the location of the instrument locations used to calibrate the wave model. Figures 2 through 10 show comparison plots showing measured and modeled wave heights at ADCP 1, ADCP 2, ADV 1, ADV 2, ADV 3, ADV 4, ADV 5, ADV 6, and ADV 7 respectively. As a general legend for the comparison plots, the red dots are measured data and the blue line is model results. Overall, the wave model does a good job capturing the wave climate for the complex bathymetry off the west coast of Saipan. The comparison at ADCP 1 and ADCP 2 in deeper water shows that the model accurately represents wave energy coming in from the open ocean. The ADVs show that for the most part the wave model accurately captures wave heights in the shallower water across the entire lagoon. The largest discrepancies occur at ADV 1 and ADV 3. The strong model agreement at the ADCP 1 & 2 this indicates that the errors at the inshore instrument are dependent on the bathymetry and/or bottom friction which both have a strong influence on wave heights in shallow reef environments.

The previous SOPAC report found that the bathymetry data set obtained from UH has some erroneous values along the reef crest. Bathymetry in the wave model was corrected based on the SOPAC report's findings. Also, the UH data set transitions to a lower quality source at the northern end of the island, including the vicinity around ADV1, which could be easily explain the difference in measured and modeled wave heights at this location.

Bottom roughness values were assigned to the model based on aerial images and pictures from Sea Engineering's previous field efforts. There are several studies that show that wave height dissipation is primarily due to bottom friction on broad reef flats after the initial wave breaking at the reef crest. The wave study included a sensitivity study to test a range of appropriate bottom roughness values. There will be a continued effort to improve the wave model as needed during the hydrodynamic calibration but it could be that any minor improvements to the wave model will have negligible effects on the flow patterns.

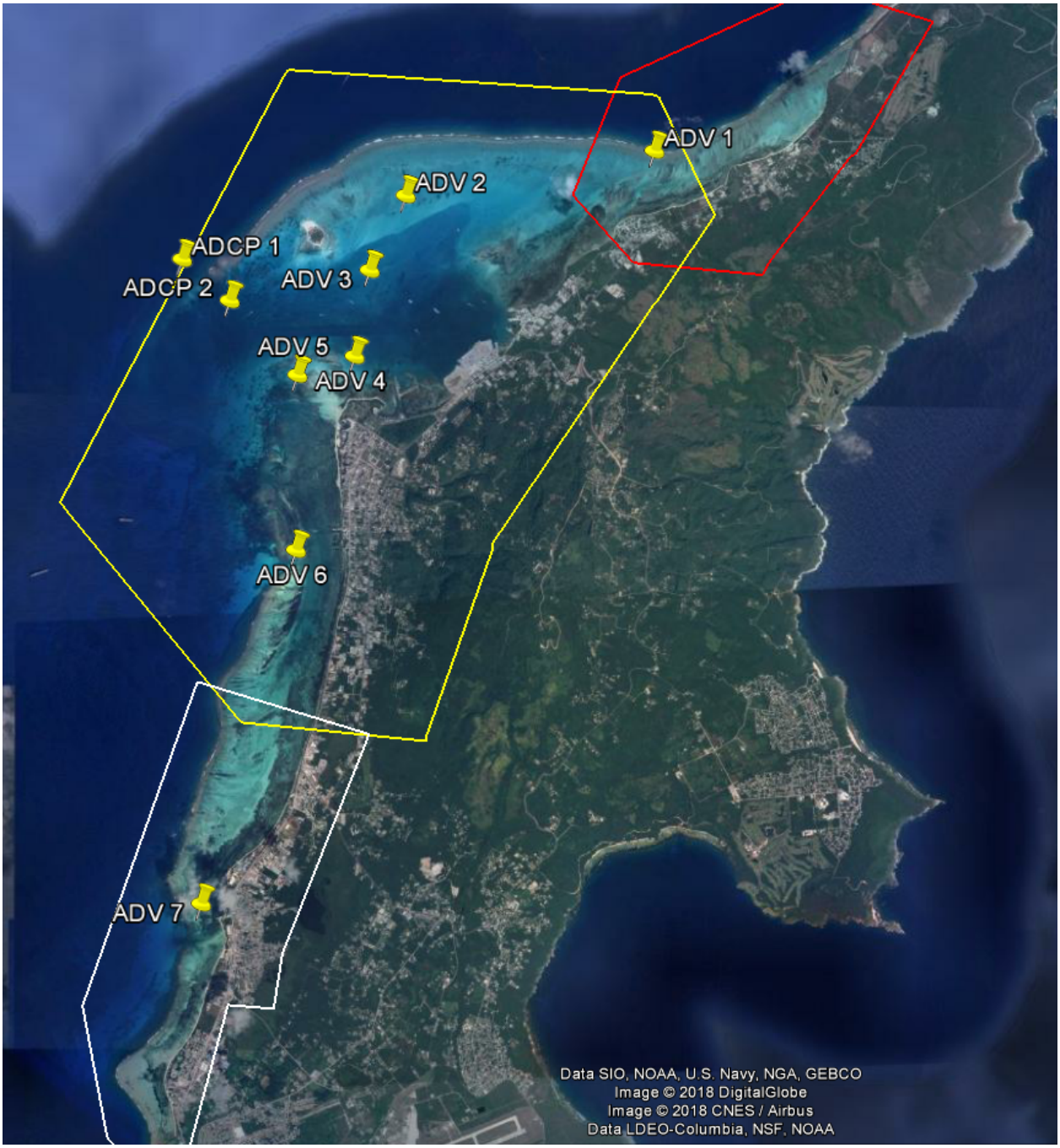

Figure 1. Saipan Lagoon instrument locations.

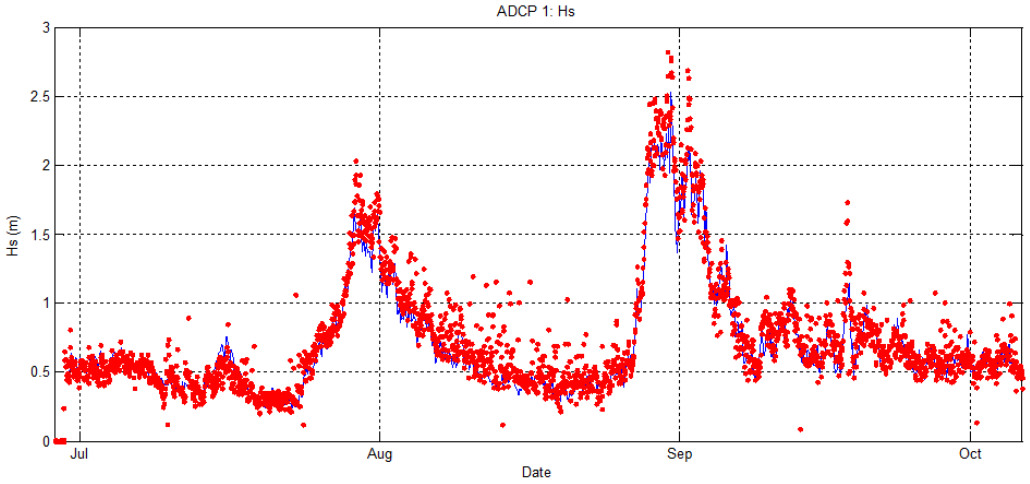

Figure 2. Time series plot of measured and modeled wave heights at ADCP 1.
Note: red dots are measured data; the blue line is modeled data.

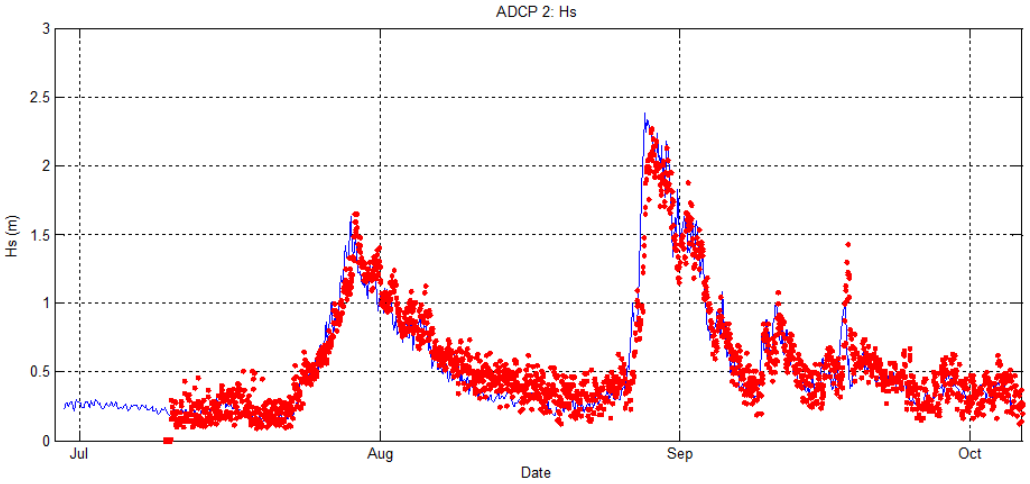

Figure 3. Time series plot of measured and modeled wave heights at ADCP 2.
Note: red dots are measured data; the blue line is modeled data.

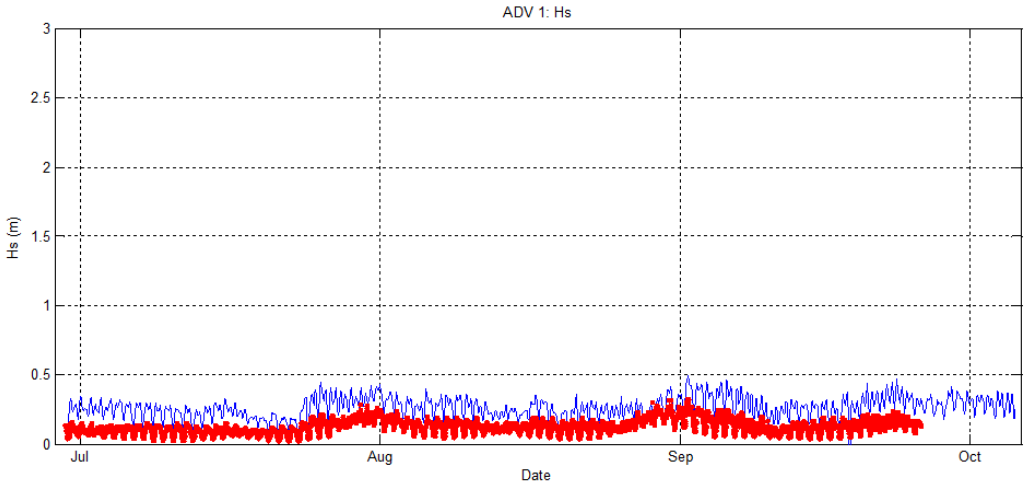

Figure 4. Time series plot of measured and modeled wave heights at ADV 1.
Note: red dots are measured data; the blue line is modeled data.

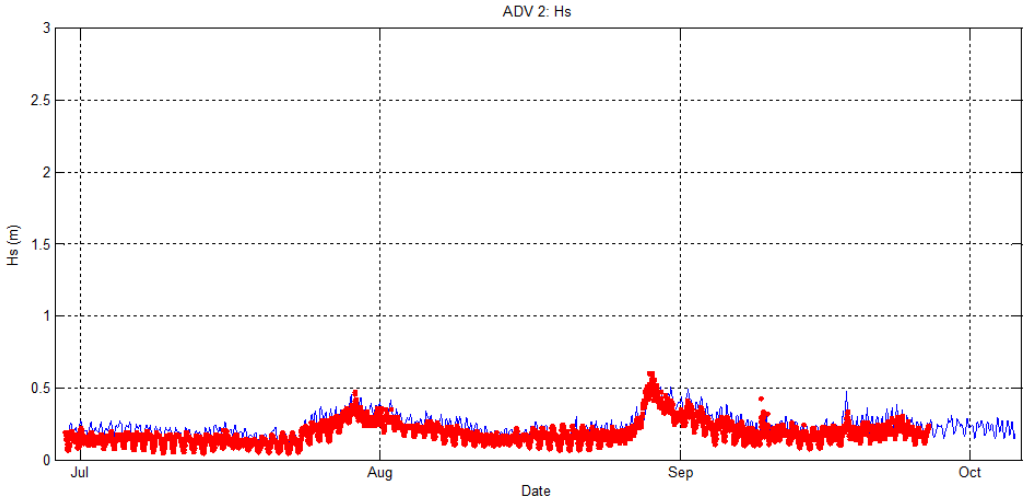

Figure 5. Time series plot of measured and modeled wave heights at ADV 2.
Note: red dots are measured data; the blue line is modeled data.

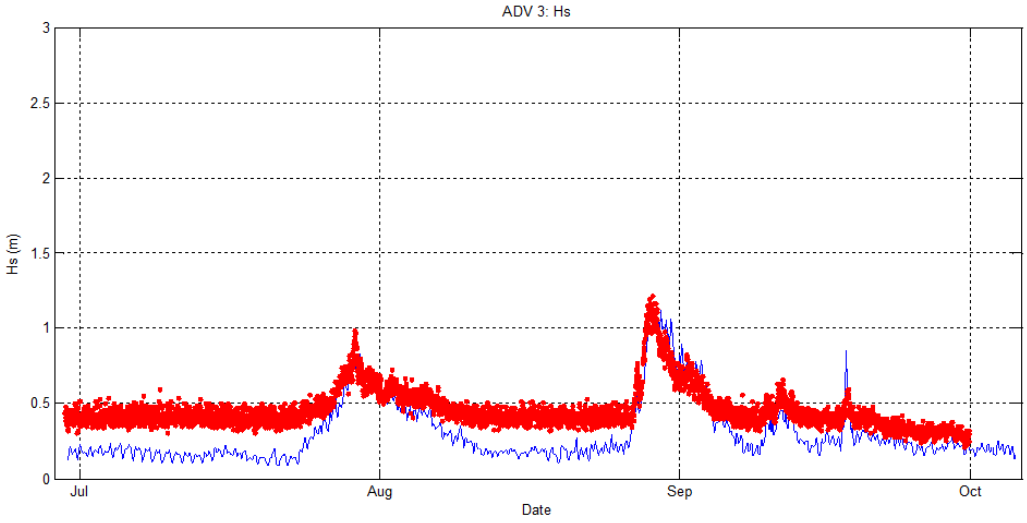

Figure 6. Time series plot of measured and modeled wave heights at ADV 3.
Note: red dots are measured data; the blue line is modeled data.

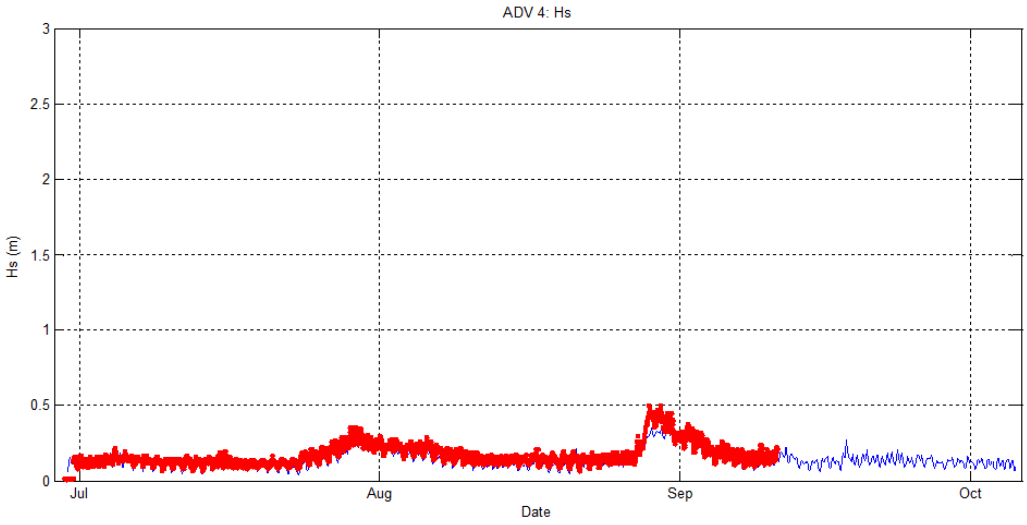

Figure 7. Time series plot of measured and modeled wave heights at ADV 4.
Note: red dots are measured data; the blue line is modeled data.

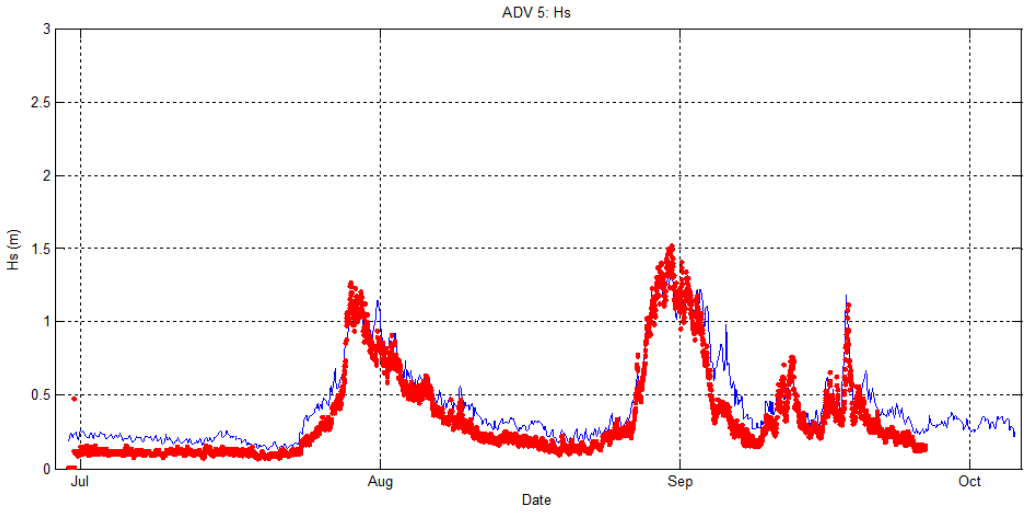

Figure 8. Time series plot of measured and modeled wave heights at ADV 5.
Note: red dots are measured data; the blue line is modeled data.

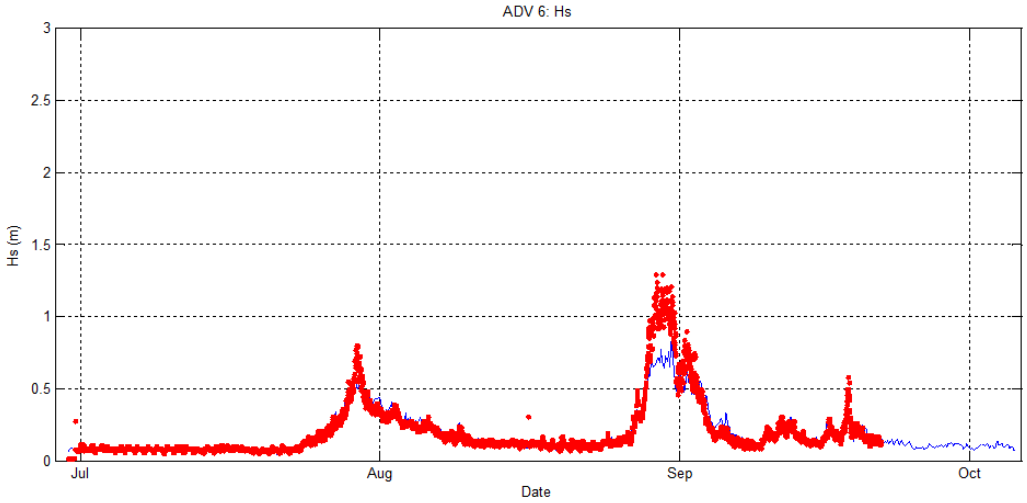

Figure 9. Time series plot of measured and modeled wave heights at ADV 6.
Note: red dots are measured data; the blue line is modeled data.

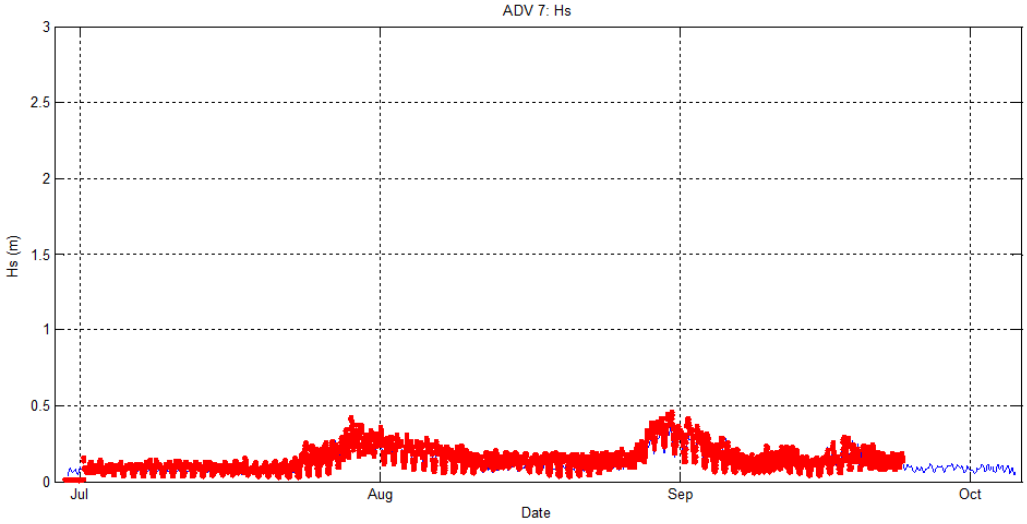

Figure 10. Time series plot of measured and modeled wave heights at ADV 7.
Note: red dots are measured data; the blue line is modeled data.