CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Christopher A. Powers

Project Number
34592

Project Title
Investigating Vegetation as a Natural Barrier to Reduce Tsunami Power

Abstract

Objectives/Goals
Storm surges, created by high winds of storms, and tsunamis, generated by large disturbances in water, result in damage and flooding to coastlines if left unchecked. Current barriers have problems ranging from high cost to damage to the environment. Vegetation, if effective as a barrier, would remove many of the cons of artificial barriers. My experiment tested different types and configurations of vegetation as barriers to determine their effectiveness at reducing wave power. I hypothesized that mangrove trees in a canal-like grid configuration would reduce wave power most. The other types of vegetation I simulated were vegetated dunes, wetland shrubs, beds of sea grass, and a control. The other configurations were staggered clusters and a single thick patch.

Methods/Materials
I created a wooden wave tank, which included an artificial beach and a pushing mechanism to generate waves. I attached my simulations of each type of vegetation to wooden plates, which could be inserted onto the beach. I tested each barrier ten times at each of three positions: high, medium, and low, in relation to water level. For each barrier, I measured the distance waves traveled up the artificial beach and took slow motion videos for analysis.

Results
I calculated the average distance from the end of the beach, so higher values mean more effective barriers. In their high positions and staggered configurations, the distances away were 9.4" for mangroves, 12.6" for shrubs, and 6.0" for the control. The other barriers were less effective: grass- 6.2", other trees- 7.8", dunes- 7.5". Despite some experimental error, the average standard deviation was only 1.6". Most barriers were more effective at higher positions up the beach, where the splash impact was larger. At lower positions, the wave simply passed over the barrier. The staggered configuration was more effective than the grid configuration for both shrubs and mangroves because it had fewer gaps.

Conclusions/Discussion
Shrubs and mangroves were most effective because they combined highly frictional surfaces, large exposed surface areas, and effective configurations to reduce wave power and distance traveled inland. In the future, I would expand my testing by improving the simulations, testing new barriers/configurations/combinations of vegetation, and comparing their effectiveness to non-vegetative barriers.

Summary Statement
My project researched which type and configuration of vegetation would most successfully act as a tidal barrier by limiting tsunami and/or storm surge erosion and destruction in coastal regions.

Help Received
Father helped create waves while I measured them.