Tsunami Forecasting and Risk Analysis

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Tsunamis are often tragic events, killing thousands at a time and striking abruptly from distant locations. Two tsunamis in the last six months killed thousands of people with no warning. Currently, ocean simulation is done on supercomputers, but this isn't practical for an early warning system nor is it affordable to small agencies or villages in developing tsunami-prone areas. In this project, I created an accurate, affordable, real time model capable of tsunami forecasting. Two cases were studied: Palu, Indonesia; and volcano Anak Krakatau. I constructed a computer model of the ocean from scratch in over a thousand lines of code. This implemented the non-linear coupled partial differential shallow water equations. I achieved faster than real time simulation by parallelization on an inexpensive graphics card, as opposed to a supercomputer. I verified my code and validated its predictions against real events. My simulations of Palu reveal that an unusual combination of factors intensified this event and why this was unexpected historically. The bay geometry around Palu City was important, but the initial location was critical. My forecasting of Krakatau accurately predicted not just highly damaged areas, but the locations of safe zones. This is important because residents need to know where to flee to or where to stay put. I also deployed on online web server allowing implementation of my code by anyone for anywhere on the Earth. Future work could incorporate earthquake detectors into my model, to further its use as a tsunami early warning system.

Awards Won:

National Oceanic and Atmospheric Administration - NOAA: Second Award of $500