ABSTRACT

Tsunamis are the seismic generated waves which causes the huge displacement of water volume in ocean from deep water to the coastal regions. Tsunami detection and investigation of its early warning is the very important issue nowadays which supports our existing system more precise. This thesis proposes the mathematical model to investigate how to compute and analyze the tsunami wave parameters and the retrieval of its early warning using remote sensing technique to improve the detection rate. The different methods available for the evaluation of the tsunami detection systems are also introduced. The most important scope of this work is to analyze how the tsunami wave parameters can be calculated and integrated with the remote sensing tools to provide the early warning to the concerned authority or governments for the quick action. This research work is twofold: (1) to compute and analyze the tsunami wave parameters such as Eigen functions in deep, intermediate and shallow water regions, and (2) to retrieve the tsunami detection factor using radar remote sensing technique.

The computational and algorithmic analysis of tsunami wave parameters are achieved in three steps: the first step is to calculate the earthquake fault parameters such as length, width, area and displacement from the epicenter, which corresponds to the effect of its variation with respect to the earthquake magnitude. The variation of each fault parameters have been measured and recorded out over the certain moment of magnitudes (M). This shows smaller values as compared to the earthquake magnitude M9.5 at which all the parameters shows very large response. The second step involves the measurements of water wave angular frequency in deep, intermediate and shallower region of ocean. The values of angular frequencies in deep water shows the lesser response as compared to other two water conditions because, in deep water the angular velocity of water particles travels with the lesser speed as compared to the shallower region as per Airy's wave theory. The simulation results show the angular velocity in deep ocean is very less and moderate in the intermediate water and very high on the coastal region. It indicates the higher impact on coastal region. The third step involves the simulation study of measurement of tsunami Eigen functions such as orbital velocity, acceleration, wave potential in deep, intermediate and shallower water regions. The simulation result shows the resultant orbital velocity and accelerations in deep, intermediate and shallow water regions provides the similar response as angular velocity due to same proportion of the water displacement from deep to coastal regions. Hence the dynamic forces are very high approximately 1 *Km* from the beaches. Once the Tsunami waves approaches to the beach, wave height increases whereas particle acceleration decreases because near the coast, due to geological structure of the earth's surface, inertia and gravity forces increase to the extreme limits, while particle acceleration and velocity values reach close to zero. The wave potential Eigen function has also been plotted and measured with respect to the water depth condition and the similar response is obtained in the simulation result. The validation of each result has also been presented with the standard simulated data which shows the results as less than 10% of the accuracy. For the second work, Tsunami detection function (*q*-factor) was developed which is well known as *q*-factor estimates. *q*-factor works on the principle of selected radar band threshold. The tsunami reaches around an hour afterward the earthquake, as specified through the relationship in the velocities in altered bands. These effects in a high-pitched upsurge in the *q*-factor, descriptive the tsunami appearance. This radar functions for only 40 *minutes* in the hour, causing in the 20-*minutes* gaps noticeable in plots. The entrance of the tsunami is specified by relationship between velocities in altered bands early about 2.5*h* afterward the volcanic activity. *q*-factor demonstrates a sudden conversion in magnitude about 8 *min* afterward the start of the velocity relationships. At this point, the velocity is declining, representing that the tsunami is stirring offshore, subsequent in the negative *q*-factor. The future improvements in integrated tsunami detection systems can also be easily incorporated in this technique in order to obtain better detection capabilities.

KEYWORDS: Tsunami, Eigen functions, Integrated Early Warning Systems, Radar