

Observation of Coupled Seiche System in Ise Bay and Mikawa Bay by HF Radar

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The tsunami waves and the seiches generated by the “The 2011 off the Pacific coast of Tohoku Earth quake” were observed by the oceanographic radars in Ise Bay and Mikawa Bay. In the present circumstances, stationary measurements on coastal region and offshore region are main streams for tsunami measurement. These can only observe just one point on oceans. However, oceanographic radars can measure current velocities widely as well as the velocities generated by tsunami arrivals and natural oscillations. Thus, it is significantly useful tool for tsunami prevention system. The seiches are bay or harbor resonant oscillations in an enclosed basin, which are generated by direct external force from open ocean such as tsunamis. These produce anomalous tide level and swift currents. Thus, the observation of seiches is of extreme importance for the disaster prevention around the coastal regions.

We used the data observed by each two oceanographic radars installed in Nabeta (NABE) and Tsumatsuzaka (MATU) in Ise Bay, and MITO and MAGUSA in Mikawa Bay. We also examined the data obtained by tide gauge records to compare the effect of tsunami with the radar observations. To analyze the total velocity of the currents generated by the seiche, we used an Empirical Orthogonal Function (EOF). To verify the physical property of the results of the EOF analysis, we calculated the natural oscillation modes by the numerical model proposed by Loomis. The results of EOF analysis showed that the oscillation modes of 120-140 and 60-80 minutes period bands were distributed widely, whereas the oscillation mode of 30-40 minutes period band was distributed locally in Ise Bay. The EOF spatial patterns of each period were good agreement with numerical models.

At the time of the arrival of the tsunami, the sea surface height of the inner part of Mikawa Bay and Ise Bay oscillated alternately. Because Mikawa bay is coupled with Ise Bay on the entrance of the bay, there are some oscillations such as two simple coupled pendulums connected by a spring. In addition to the oscillation modes of Ise Bay, we will show the pendulum system in detail.

Keywords: Seiche, Ise Bay, HF Radar