

Numerical experiments on the meteorological tsunami over the East China Sea

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Meteorological tsunami is a kind of ocean long wave with the tsunami frequency band that is driven by atmospheric forcing such as pressure or wind disturbance at the sea interface. The coastal area of west Kyushu, Japan, is one of the regions that often observed the large amplified secondary oscillation higher than 1 m, which seemed to be resulted from meteorological tsunami. The present study is aimed to clarify the propagation and resonant process of the meteotsunami over the East China Sea by numerical experiment.

The multi-nested numerical model was developed with the mainframe of the model based on the Princeton Ocean Model 2008. To smooth the scale-down process, we suggested the blending coefficient, c , as a exponential function to the distance from the boundary of the daughter domain. Two kinds of the pressure disturbance model were examined in the present study. The first model was single triangular wave with the horizontal scale of about 300 km with the +3hPa barometric anomaly. We located such single pressure wave at the coastal area of the east China (121E, 30-33N), and moved to west Kyushu with the speed of 30 m/s. The spilling wave gradually grew ahead of the positive pressure disturbance, and moved much faster than the pressure wave when passing the Okinawa trough. The first spilling wave was reached to the west Kyushu coastal area 30-50 minutes before reaching the pressure wave. In Nagasaki bay, the secondary oscillation became maximized when the wave came from WSW direction (~255T), which was nearly same as the line direction from the mouth to nose of the bay without shadow effect by Goto Island. The maximum amplitude was 2.1 m at the third wave, when the backwash inside the bay overlapped with the inverse pressure effect. The second pressure model was a train of the small pressure waves. The horizontal scale of individual pressure wave was 30-100km and we generated 1-20 waves with the shape of the 2-dimensional Gaussian function. The pressure waves initially located at 31.2N 125E with the period of 20 minutes, moving toward Koshiki Islands, Kagoshima. The maximum intensity of each pressure anomaly was 2.0 hPa. As a result, the ocean long waves were amplified higher than 30 cm and reached to the wide area of west Kyushu. This result implied that the secondary oscillation is possibly amplified even if the pressure disturbance passed more than 100 km away from the harbor. The oscillation sustained for several hours inside the small bay with the mode of eigen oscillation became prevailed instead of the oscillation with the period of the pressure wave.

Keywords: Meteorological tsunami, East China Sea, pressure wave, multi-nested ocean model, resonance

