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Tsunami Warning Improvement

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After the devastating tsunami caused by the 2011 off the Pacific coast of Tohoku Earthquake (the great Tohoku earthquake), the Japan Meteorological Agency (JMA) prepared a tsunami warning improvement plan in March 2012 based on advices of tsunami experts and relevant disaster management organs. JMA will start renewed tsunami warning operation in line with the plan from March 2013. Major improved points of renewed tsunami warning are as follows.

1) Measures to avoid underestimation of magnitude for huge earthquakes

JMA issued tsunami warning for the great Tohoku earthquake within three minutes with estimated maximum tsunami heights of 6m or 3m based on underestimated magnitude of 7.9, which were much lower than the real tsunami heights. JMA uses JMA magnitude (Mj) for tsunami warning, and Mj is, similar to Richter scale magnitude, calculated from maximum amplitude of short period displacement seismic wave, and has the property to saturate around 8.0. And there is no established method to estimate reliable huge magnitude value of much larger than 8.0 within several minutes. To deal with this matter, JMA will introduce tools with which validity of Mj estimation can be evaluated before the initial tsunami warning issuance. If the possibility of Mj saturation is detected with the tools, JMA will issue tsunami warning by replacing the magnitude by the maximum possible magnitude around the region close to the epicenter. In the oral session, these tools and maximum possible magnitude values will be introduced.

2) Change of tsunami warning messages

In relation to the tsunami warning for the great Tohoku earthquake, it was pointed out that the underestimated tsunami heights in numerical expression such as ”3m” based on Mj7.9 might have led to the delay of evacuation. And the number of tsunami height estimation levels divided into eight (0.5, 1, 2, 3, 4, 6, 8, 10m or more) was required to be reduced taking into account realistic variety of responses to be taken in emergency. Considering these matters, in the renewed tsunami warning, tsunami height estimation for such a huge event as described in 1) will be issued qualitatively, e.g., ”huge”, aiming at conveying impending danger. And the number of tsunami height estimation levels expressed in numerical value will be reduced to five (1, 2, 5, 10, over 10m).

3) More precise update of tsunami warning

For the great Tohoku earthquake, JMA could not calculate moment magnitude (Mw) within 15 minutes as with JMA’s normal operation, because of out-ranged large amplitude records observed with most of domestic broadband seismometers. In addition, cable-type sea-bottom pressure sensors’ data, which indicated large offshore sea level change about 15 minutes after the quake, could not be applied to warning update because such procedure and relevant technique did not established at that time. To deal with these issues, JMA is deploying broadband strong motion seismometers to acquire full scale of broadband seismic wave data and to obtain Mw robustly, and started the operation of utilizing sea-bottom pressure sensors’ data for warning update from March 2012. In addition, JMA deployed three buoy-type sea-bottom pressure sensors to detect tsunamis generated around Japan trench. Offshore observation results are planned to be reported in new information of ”offshore tsunami observation information”, together with existing GPS buoy data.

Along with the above mentioned tsunami warning improvement, JMA will promote education and awareness-raising activities on tsunami evacuation such as letting people to know the importance of immediate evacuation on feeling strong, or week but long-lasting ground shaking.

Keywords: The 2011 off the Pacific coast of Tohoku Earthquake, Tsunami warning improvement