

JMA's Tsunami Warning Improvement Plan

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After the devastating damage caused by the 2011 off the Pacific coast of Tohoku Earthquake, the Japan Meteorological Agency (JMA) established the Advisory Meeting for Tsunami Warning Improvement (June-September 2011) to consider the strategic plan on JMA's tsunami warning improvement, inviting tsunami experts and relevant disaster management organs. Based on the Advisory Meeting's discussion, JMA crafted the Tsunami Warning Improvement Plan in September 2011. To tailor the expression of tsunami warning messages along the context of the plan, JMA held another advisory meeting, i.e., the Advisory Meeting on Tsunami Warning Criteria and Bulletin (September 2011 to January 2012), focusing on. The Advisory Meeting summarized the recommendation on tsunami warning criteria and expression of warning messages in February 2012. In this paper, the measures to improve JMA's tsunami warning in line with the above mentioned improvement plan and recommendation are outlined.

The major issue of JMA's tsunami warning for the 3.11 event was that the 1st bulletin of tsunami warning issued three minutes after the quake was based on underestimated $M_{jma}7.9$, and thus underestimated tsunami height of 3m or 6m might have resulted in the delay of evacuation. M_{jma} , equivalent to surface wave magnitude (M_s) for shallow events, has an advantage of fast availability, but inherently saturates at around 8. To deal with this problem, JMA will introduce tools with which validity of M_{jma} estimation can be evaluated before the 1st tsunami warning issuance. If the possibility of much larger magnitude than M_{jma} estimation is detected by the tools, JMA will issue tsunami warning by replacing the magnitude by the maximum credible magnitude around the region close to the epicenter. In this case, as there is large uncertainty of tsunami height estimation, JMA will not issue tsunami height estimation numerically but qualitatively aiming at conveying emergency situation to the people.

For the 3.11 event, JMA could not calculate M_w within 15 minutes as with JMA's normal operation, because very large seismic waves went off the scale of most of JMA's broadband seismographs. And offshore tsunami observation data of cabled ocean-bottom pressure gauges deployed around Japan could not be applied for tsunami warning update. These issues led to the delay of tsunami warning upgrade for the 3.11 event. In order to deal with these matters, JMA is planning to deploy 80 new broad-band seismographs with larger measuring range to calculate M_w within 15 minutes in case of such a huge earthquake as the 3.11 event, and promote the utilization of ocean-bottom pressure gauges. In the updated tsunami warning bulletin based on M_w , tsunami height estimation is expressed numerically, because the uncertainty is diminished enough at this stage.

Tsunami height categorization will be decreased from eight (0.5m, 1m, 2m, 3m, 4m, 6m, 8m, ≥ 10 m) to five (1m, 3m, 5m, 10m, > 10 m), taking into account the realistic variation of countermeasures in time of emergency and forecast error range. Estimated tsunami height shown in the bulletin is the maximum value in the margin of error.

The above described tsunami warning improvement measures will be put into operation by the end of 2012, subject to the schedule for system modification of not only JMA but also the organs responsible for transmitting and using tsunami warning bulletin.

Keywords: Tsunami warning, Improvement plan

Table 1: Category and criteria of tsunami warning and tsunami height estimation

Category		Present	Improvement Plan		
		Expression of tsunami height	Expression of tsunami height		Estimated height
			Numerical	Qualitative	
Tsunami Warning	Major Tsunami	10 m or more, 8m, 6m, 4m, 3m	Over 10m	Gigantic *)	10m -
			10m		5m - 10m
	5m	3m - 5m			
	Tsunami	2m, 1m	3m	High *)	1m - 3m
Tsunami Advisory		0.5m	1m	(Blank)	0.2m - 1m

*) Expression in English is under consideration.