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ABSTRACT

Earthquake with magnitude ≥ 7, epicenter in the sea, and depth <100 km, is not always able to generate a significant tsunami. It's need other parameters that can be used as an indicator of a potential tsunami, namely the duration rupture, dominant period, and T50Ex. We have developed tsunami potential determination system using calculation of rupture duration (Tdur), dominant periods (Td), T50Ex, and the products (Td*Tdur, Tdur*T50Ex) with real time waveform from InaTEWS, and then do validation for the occurrence of earthquakes in 2014. 624 events earthquake in 2014 calculated by the real-time system and the result was 99.19% (619 events) in accordance with actual occurrence. Futhermore, Tsunami potential determination system has been validated with list of past 18 tsunamigenic events in Indonesia from 1992-2016, that yield 89% accordance with actual conditions. Tsunami Potential Determination System is quite consistent in validation and could be the support system for existing Indonesia Tsunami Early Warning System.

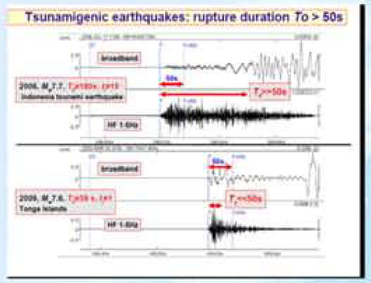
INTRODUCTION

* Earthquake with magnitude ≥ 7, epicenter at sea, and depth < 100 km, are not always cause a significant tsunami.
  For example:
  - Padang earthquake September 30, 2009 Mw 7.6 (no tsunami)
  - In contrast , Flores earthquake May 14, 1995 with Mw = 6.9 (tsunami)
* Lomax and Michelini have found that the rupture length (L) parameters of an earthquake are the most dominant parameter as the cause of the tsunami
* Lomax and Michelini (2009: 2011) have also found an association between L and rupture duration which can be stated that the duration of the rupture is proportional to the length of the rupture.
* To estimate the duration of rupture (To or Tdur) can be done by analyzing the dominant group P-wave seismograms from high-frequency seismograms of earthquakes.
* Another parameter is the dominant period of the P wave, which is the peak value of Time Domain (τc).
* Another parameter is T50 Exceedance (T50EX) the RMS ratio of amplitude when the duration of rupture (Tdur) reaches 50-60s with the amplitude when the duration of rupture 0-25 s.

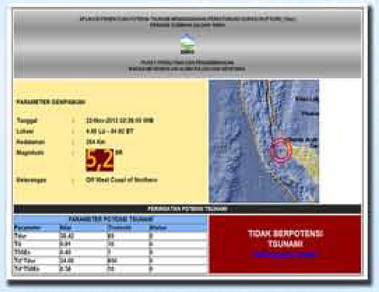
METHODS AND MATERIALS

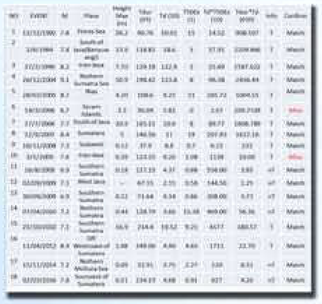
Calculation sotfware of Td, Tdur and T50Ex is a computer program that serves to estimate the parameters of earthquake sources; Duration of rupture (Tdur), dominant period (Td), duration of more than 50 seconds (T50Ex) of P waves recorded by local seismic stations using direct procedure method. This software also computes the multiplication between Tdur with Td (Tdur * Td) and multiplication between Td with T50Ex (Td * T50Ex). Both of these multiplications give a description of the area of rupture.

Therefore, the multiplication result is a strong indicator of tsunami occurrence. If there is a significant difference between the two multiplication products, then the multiplication between T50Ex and Td is prioritized for use as a decision-making material whether the earthquake caused a tsunami or not. The tsunami potential indicators of each parameter are: Tdur> 65, Td> 10, T50Ex> 1, Tdur * Td> 650, Td * T50Ex> 10. (Table 1)



Parameters	Criteria	Yes	No
Rupture Duration(Tdur)	> 65 s	v	
Dominan (Td)	> 10 s	v	
T50EX	> 1 s	v	
(Tdur * Td)	> 650	v	
(Td * T50EX)	> 10	v	
Summary	Potential Generating Tsunami		





Validation of tsunami potential determination system in real time. This application is set for earthquake with magnitude > 4, for region in Indonesia. Warning of tsunami potential is given if parameters Td * T50Ex> 10 and Td * Tdur> 650. The earthquake signal from InaTEWS network obtained 3 minutes after the earthquake event is initial parameter for the system. The time required for data transfer, read signal (waveform), P picking, and calculation of potential parameters about 1 minute, so the total time required about 4-5 minutes. (Fig. 2)

624 events earthquake in 2014 calculated by the real-time system and the result was 99.19% (619 events) in accordance with actual occurrence, it's mean that the system states no tsunami potential and no tsunami incident field. Meanwhile, 0.81% (5 occurrences) are not appropriate, it's mean that the system states that the earthquake has the potential to be tsunami, but in reality is no tsunami

Validation of tsunami potential determination system with tsunamigenic event in the past. Tsunami potential system has been validated with list of 18 tsunamigenic events in Indonesia from 1992-2016. An earthquake event is considered as a tsunami event if the wave height ≥ 0.5 m. Than we validated results from calculation of duration rupture (Tdur), dominant period (Td), and T50Ex, and the product (Tdur*Td, Td* T50Ex) and matching the calculation results with actual conditions in the field (tsunami or not) (Table 2).

Based on the results we find 16 events (89%) from the calculation results in accordance with actual conditions, and only 2 event not match with the actual condition (11%). We also find that tsunami events with wave height ≥ 5 m, like Flores (1992), Banyuwangi (1994), Nothern Sumatra Sea (2004), Nias (2005), South of Java (2007), and Mentawai (2010) also have a high value Tdur*Td and Td*T50Ex. In contrast, tsunami events with wave height ≤ 5 m, have a less value of Tdur*Td and Td*T50Ex.