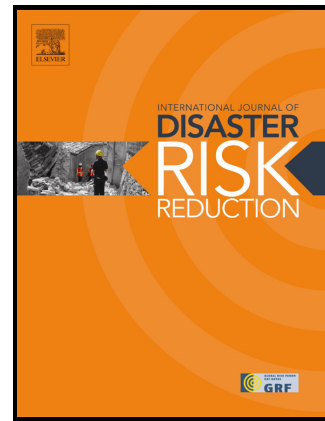


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# Development of Accurate Tsunami Estimated Times of Arrival for Tsunami-Prone Cities in Aceh, Indonesia

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## ABSTRACT

Ten years after the Indian Ocean Tsunami of 2004, the Aceh Province in Indonesia has made progress toward becoming a more tsunami resilient area. The government of Indonesia has undertaken a number of efforts to facilitate a better evacuation process, but a smooth evacuation process is still at large. A major issue is that the disaster management office for the districts are yet to have clear, accurate estimations of what would be the shortest time of the arrival of the tsunami waves. The worst scenario for these cities' tsunami evacuation procedures has yet to be determined. This study seeks to discern worst tsunami estimated times of arrival for the tsunami-prone cities in Aceh. A number of numerical simulations were performed using data from past events of tsunamis in this area and a future near-shore tsunami events anticipated by most of the disaster managers around the Mentawai Island. The Cornell Multi-grid COupled Tsunami (COMCOT) model was used as the tool for the simulations. Nine selected cities were determined as observation points, i.e., Sabang, Banda Aceh, Calang, Lageun, Teunom, Meulaboh, Singkil, Sinabang, and Tapaktuan. The results of this research show that the shortest ETAs are Banda Aceh 35 min, Sabang 22 min, Lageun 25 min, Calang 29 min, Teunom 29 min, Meulaboh 35 min, Sinabang 20 min, Singkil 53 min, and Tapaktuan 24 min.

Keywords: City Evacuation, Tsunami, numerical simulation, ETA, COMCOT

## 1. Introduction

The Indian Ocean Tsunami on December 26, 2004 left behind a stark landscape and initiated a drastic period of change for Aceh Province and the Nias Island of Indonesia. Approximately 230,000 people died and nearly 1,000,000 people suffering from clear images of the extensive damage caused by the tsunami were displaced [29]. Ten years after the tsunami, Aceh has been recovered from the severe destruction and is now in much better condition. A four-year rehabilitation and reconstruction process conducted in Aceh and the Nias Islands of Indonesia has brought significant changes to the area, including infrastructure improvements, new settlements, and new livelihoods [22,23,24,25]. At the present, Aceh has built eight tsunami escape buildings, a number of siren towers, and several well-designed tsunami escape roads. A provincial standard operating procedure (SOP) for tsunami evacuation has been formulated since 2011 [16]. The SOP is an official guideline for related stakeholders and emergency responders before and during emergency period [31]. Visible tsunami evacuation signs are found in most of the cities. Although not on a regular basis, the government and population of Aceh have performed some tsunami evacuation drills. However, disaster management authorities still have not figure out how to be prepared for a worst case scenario for emergency response to future tsunamis. In addition, they are unsure of how such a scenario should be incorporated into the existing SOP. One complication is that in cities that were not affected by the 2004 tsunami, the perception and the preparedness efforts are different or somewhat lacking, leaving them ill-prepared [26].

Concerns became even greater after the two major earthquakes (8.6 Mw and 8.2 Mw) that occurred on April 11, 2012. The earthquakes' epicenters were located off the western part of the Sunda-Subduction Zone [30].

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