Field surveys and numerical modeling of the December 2018 Anak Krakatau volcanic tsunami

Mohammad Heidarzadeh[1], Purna Sulastya Putra[2], Abdul Muhari[3], Septriono Hari Nugroho[2]

[1]**Brunel University London, Department of Civil and Environmental Engineering, UK**

[2]Indonesian Institute of Sciences (LIPI), Bandung, Indonesia

[3]Indonesian National Board for Disaster Management (BNPB), Jakarta, Indonesia

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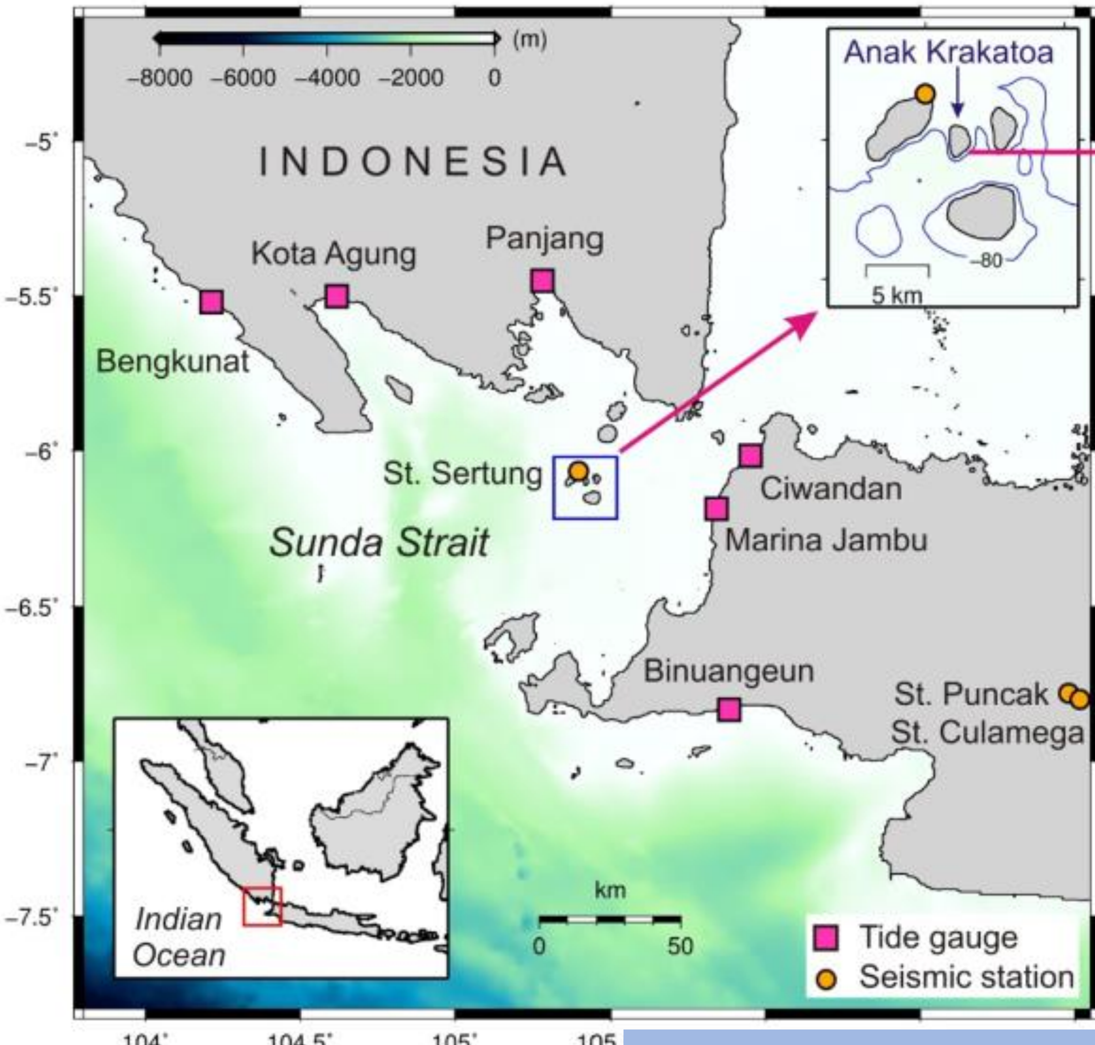
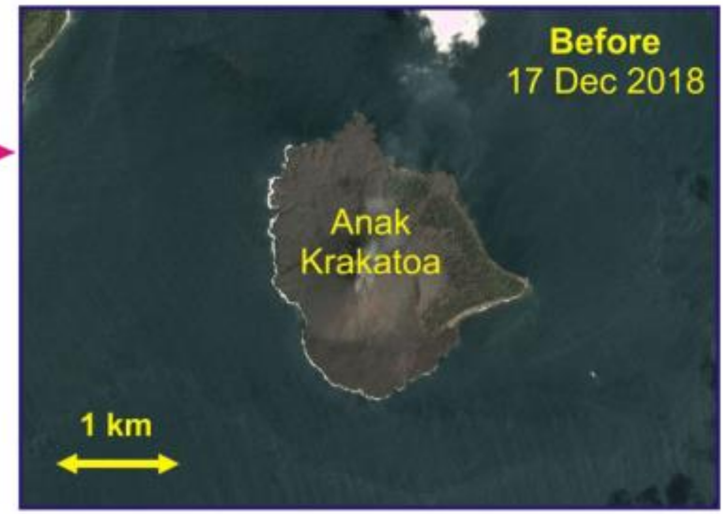
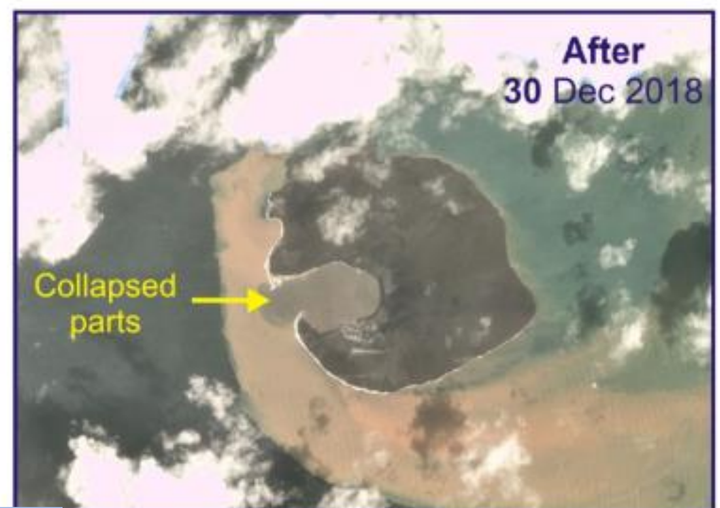
The December 2018 Anak Krakatau tsunami:

Date: 22 December 2018
Runup height: up to 13 m

Source: Volcano eruption
Death: 437 people







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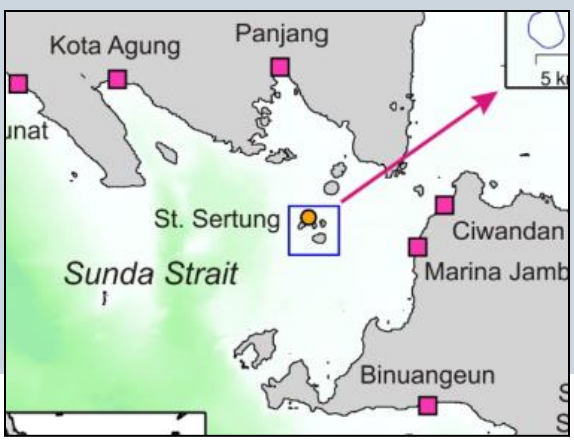
Methodology

1-Tide gauge data analysis

six tide gauges:
1- Ciwandan
2- Marina Jambu
3- Binuangeun
4- Panjang
5- Kota Agung
6- Bengkunat

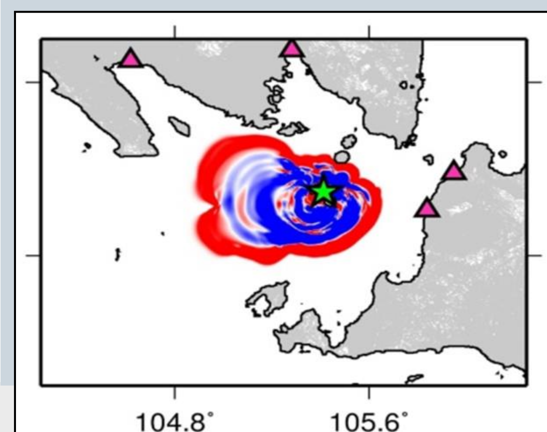


2- Field surveys

Along the coast of Java.

3- Numerical simulations and proposing a source model

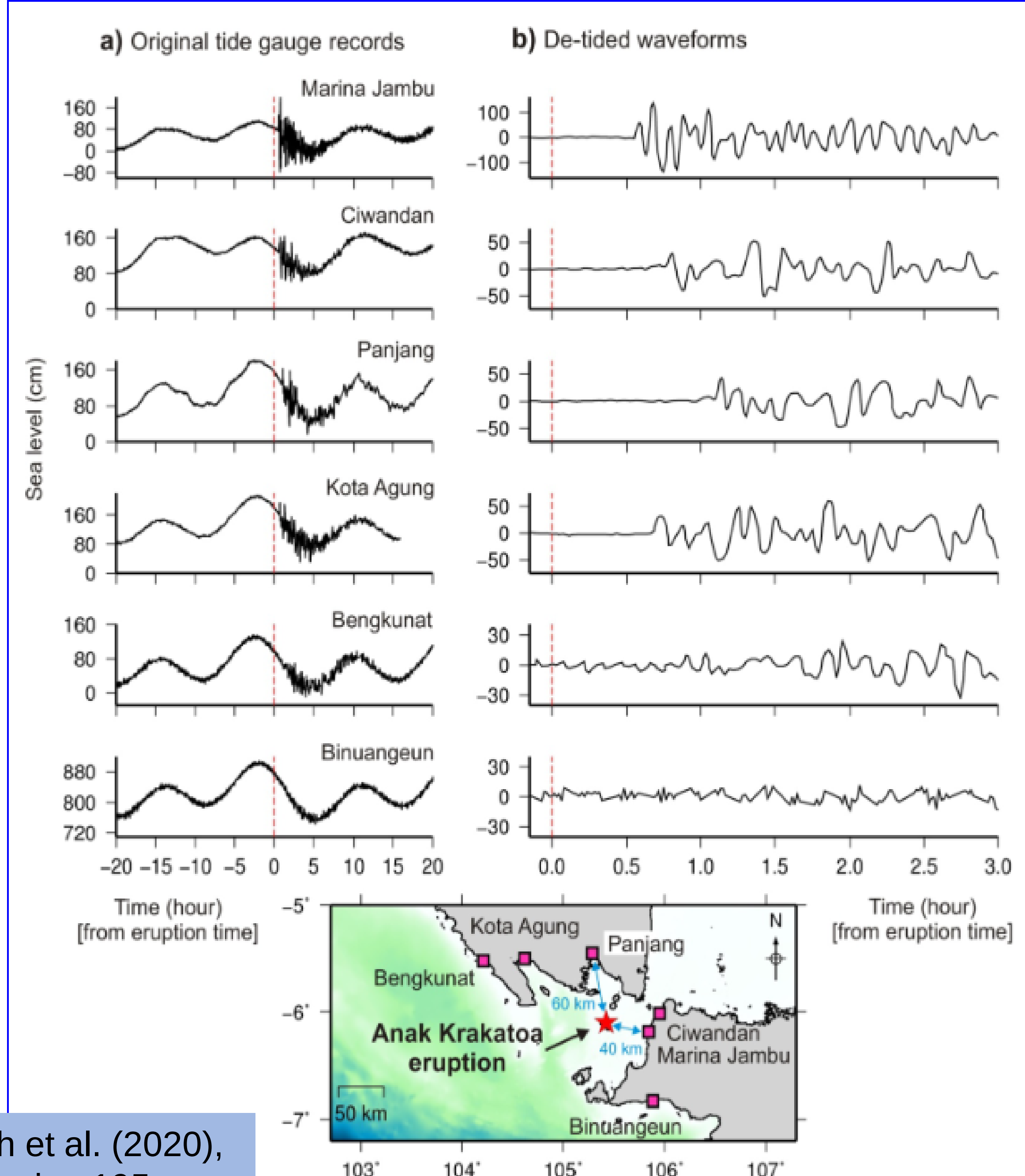
Nonlinear SW model of COMCOT (Wang and Liu, 2006). Single grid was used with resolution of 30 arc-sec.



Results of tide gauge analysis

Highlight:

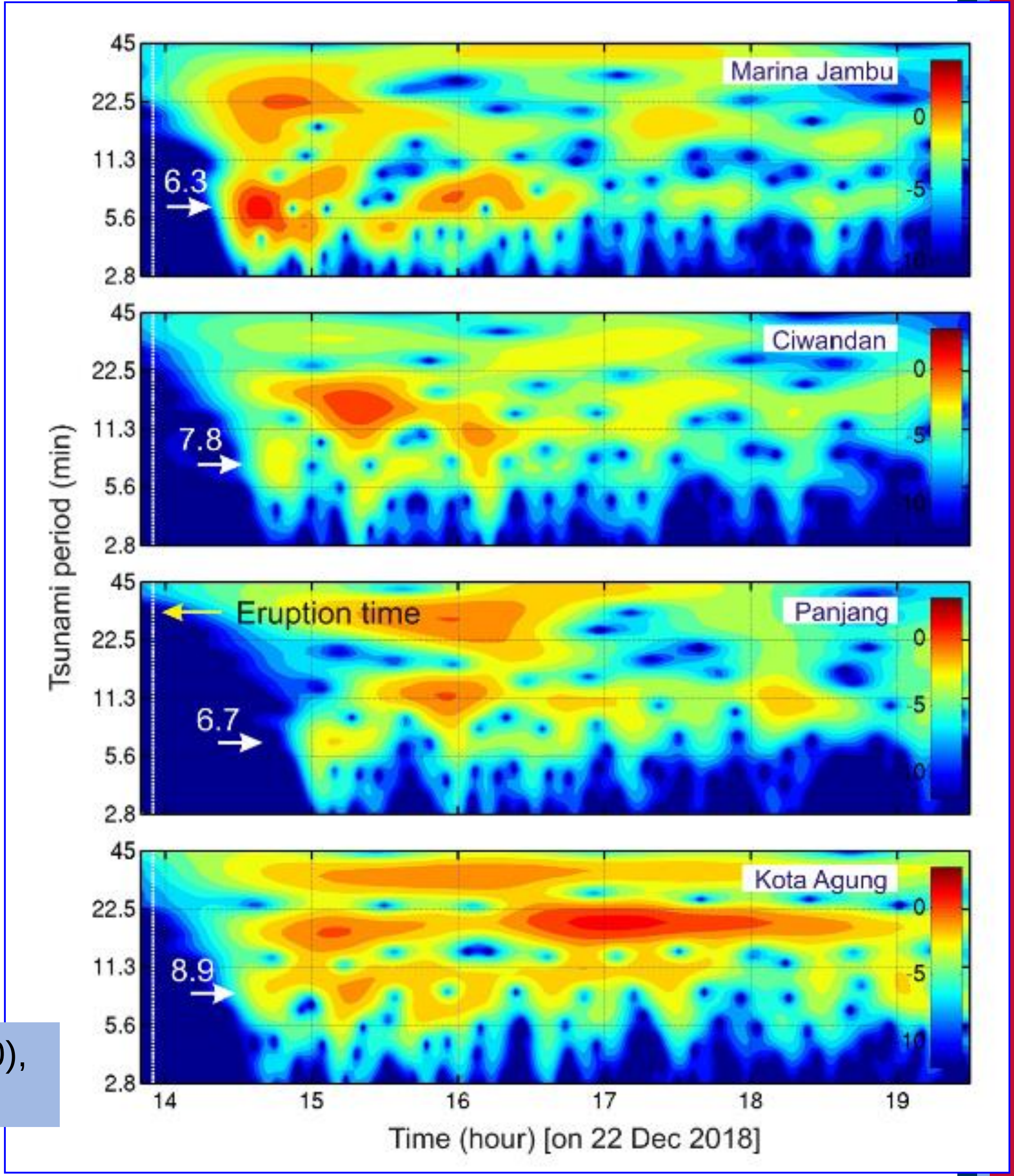
1) Maximum tide gauge amplitude is seen in Marina Jambu with zero-to-crest amplitude of 120 cm.
2) The two stations located outside of the Sunda Strait (i.e. Bengkunat and Binuangeun) received negligible tsunami waves.



Wavelet analysis

Highlight:

1) The initial tsunami wave has a period of 6-8 min.
2) Tsunami period band appears to be 5-30 min.



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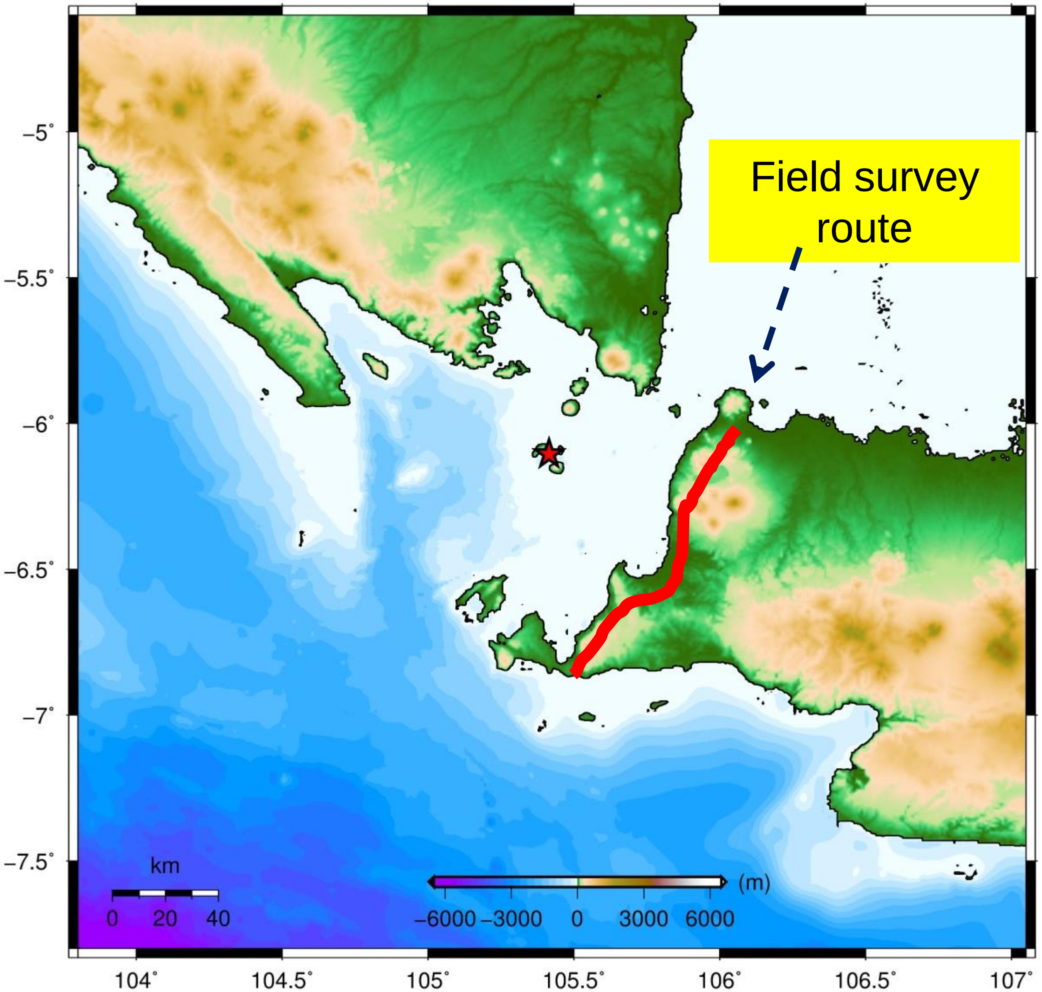
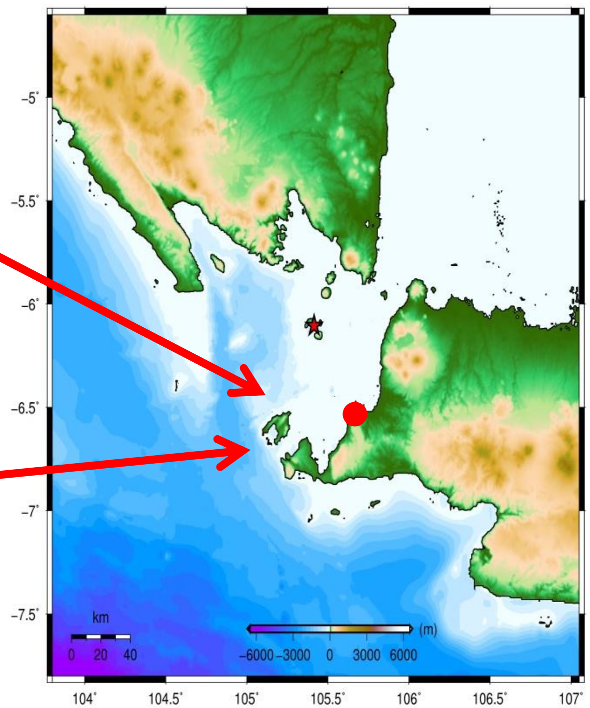
Field surveys

Date of field survey: 4-10 January 2020 (around one year after the event)
Location of field survey: The Java coast of Sunda Strait (the red line in the figure below)



Field surveys

Tanjung Lesung

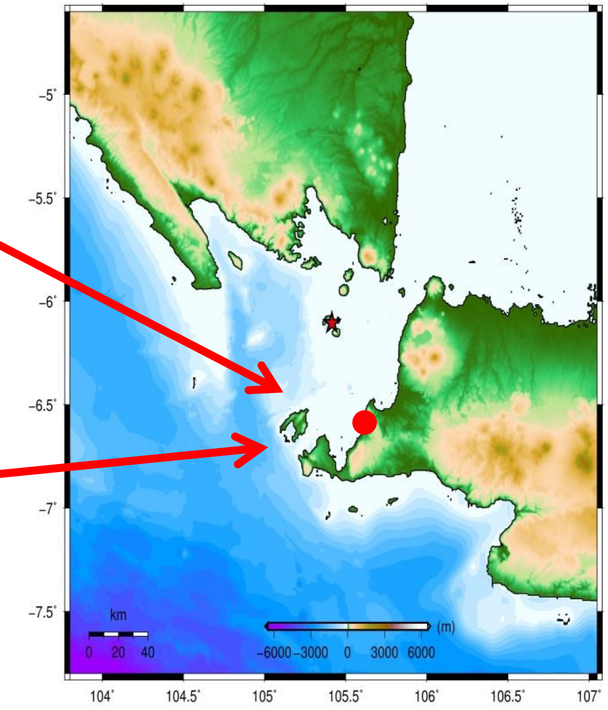


Tsunami height: 3-4 m

Field surveys

Kasavana Resort

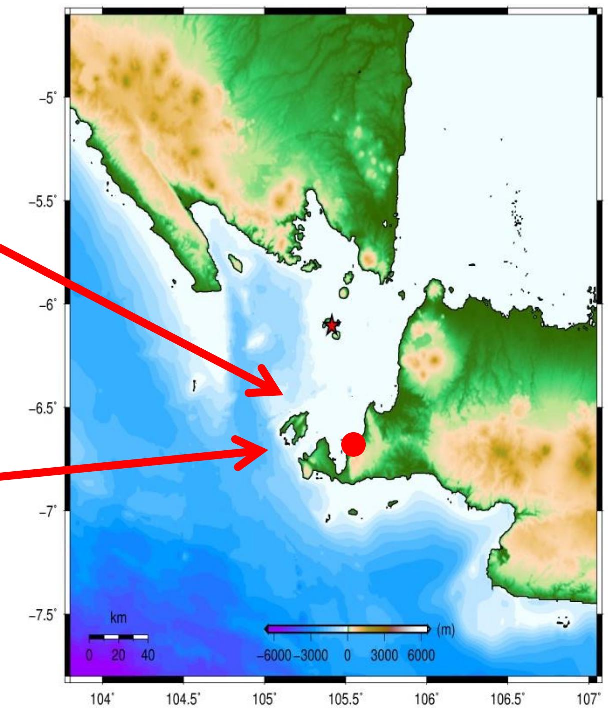
Tsunami height: 6.5 m



Field surveys

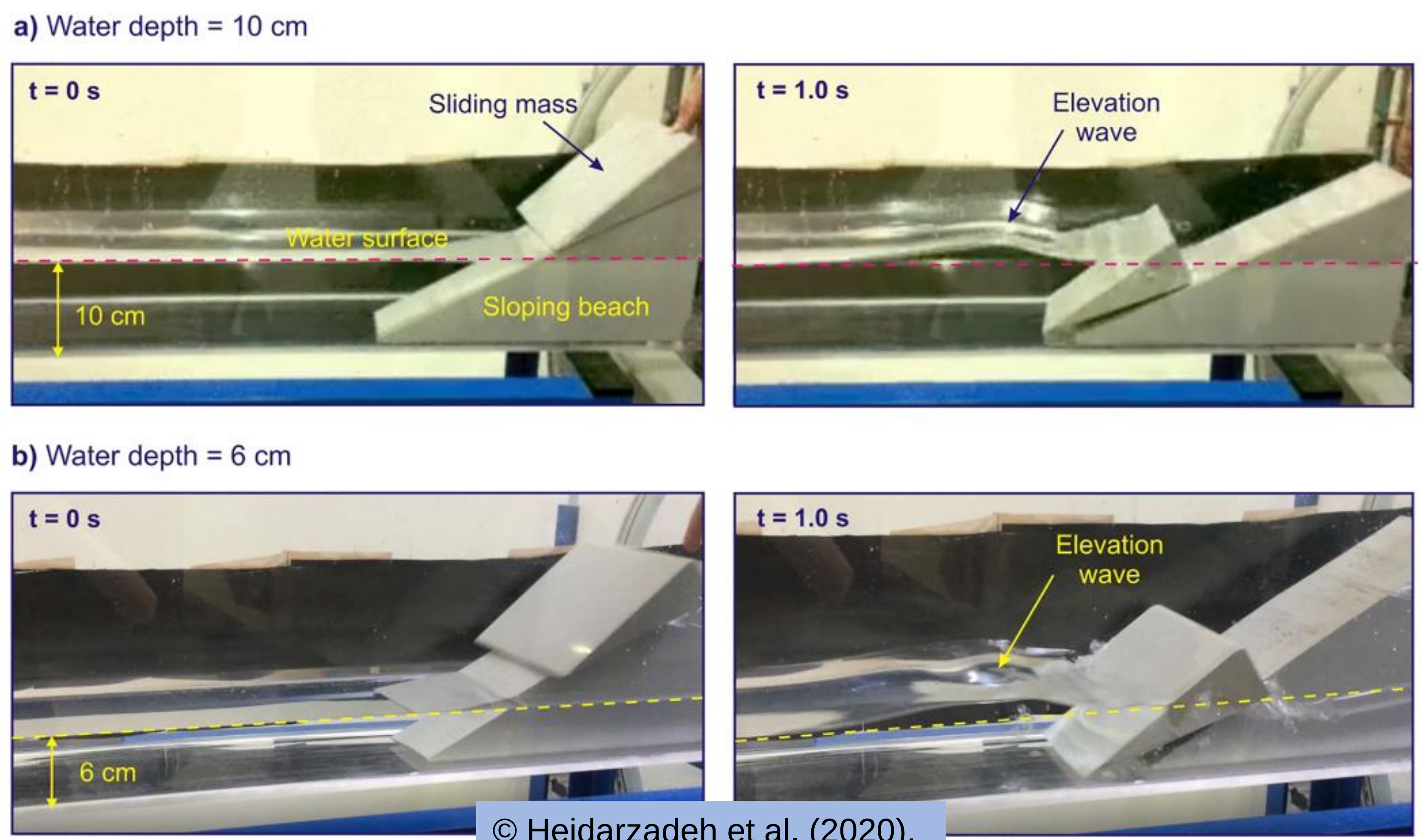
Sumur

Tsunami height: 2.7- 3.1 m



Numerical simulations

Our physical modeling showed that the initial tsunami source as a result of a flank collapse of a volcano is mostly a pure-elevation wave.



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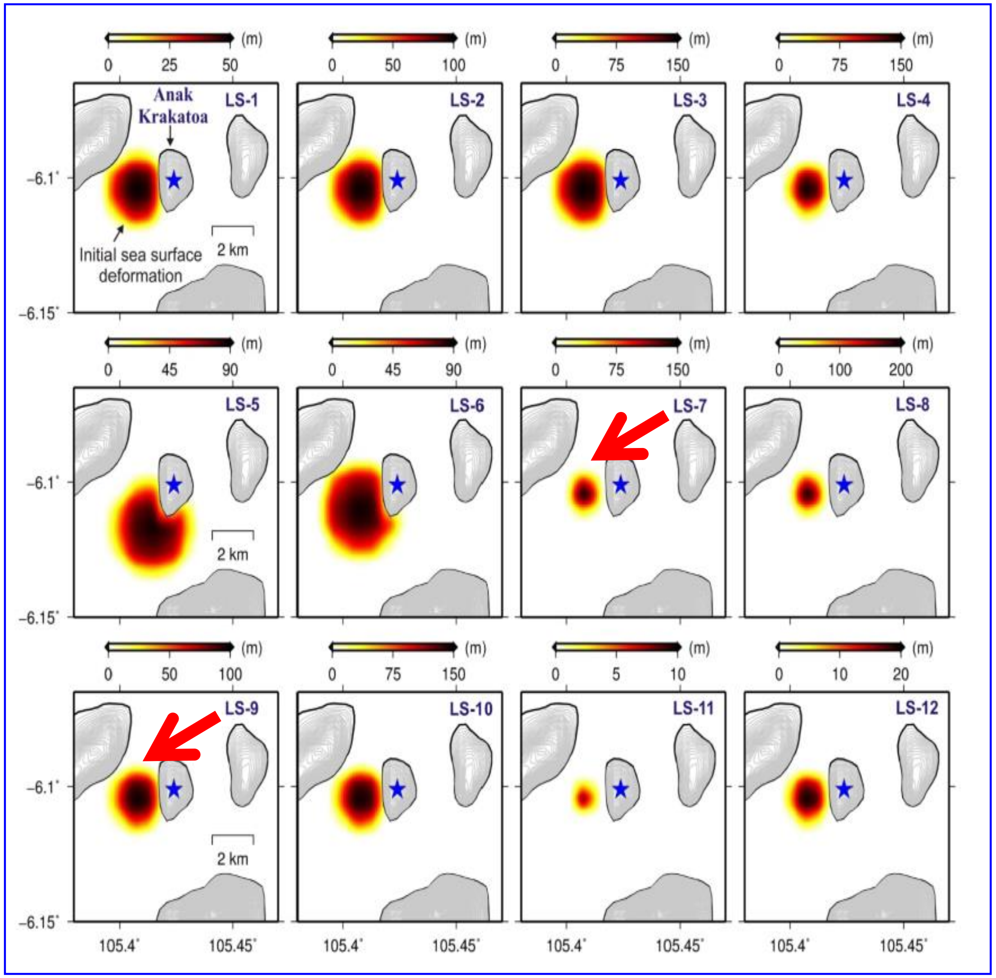
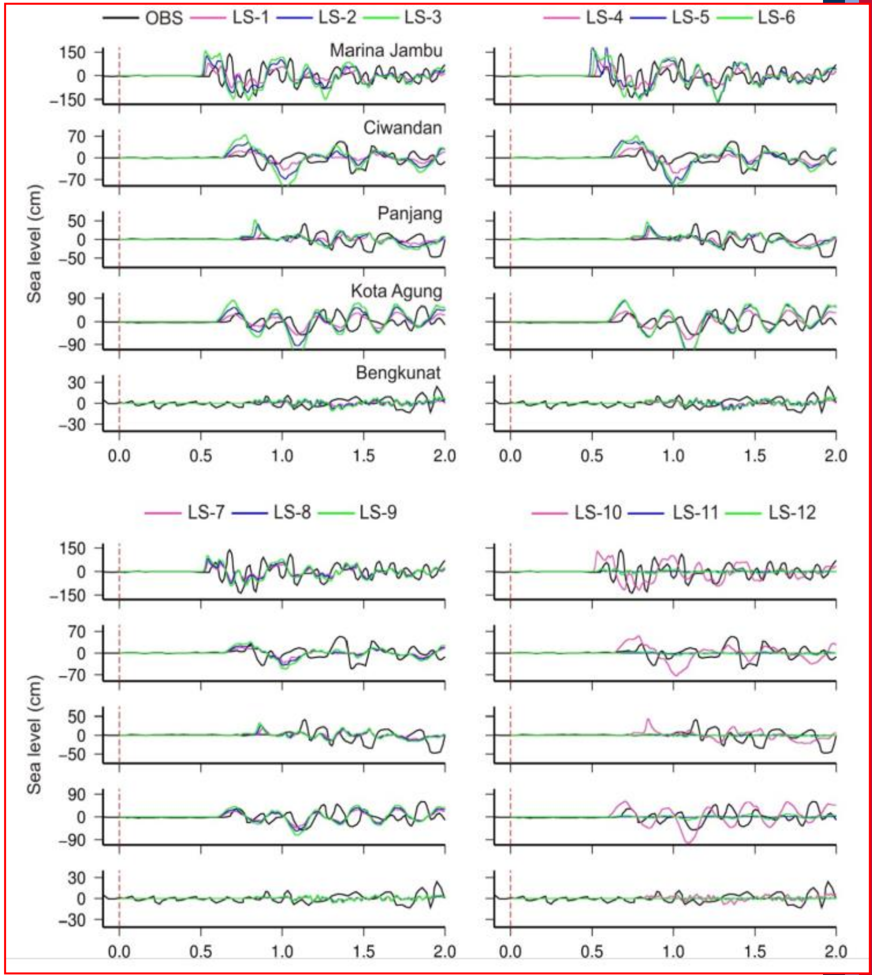
Numerical simulations

We simulated 12 scenarios for initial landslide source model

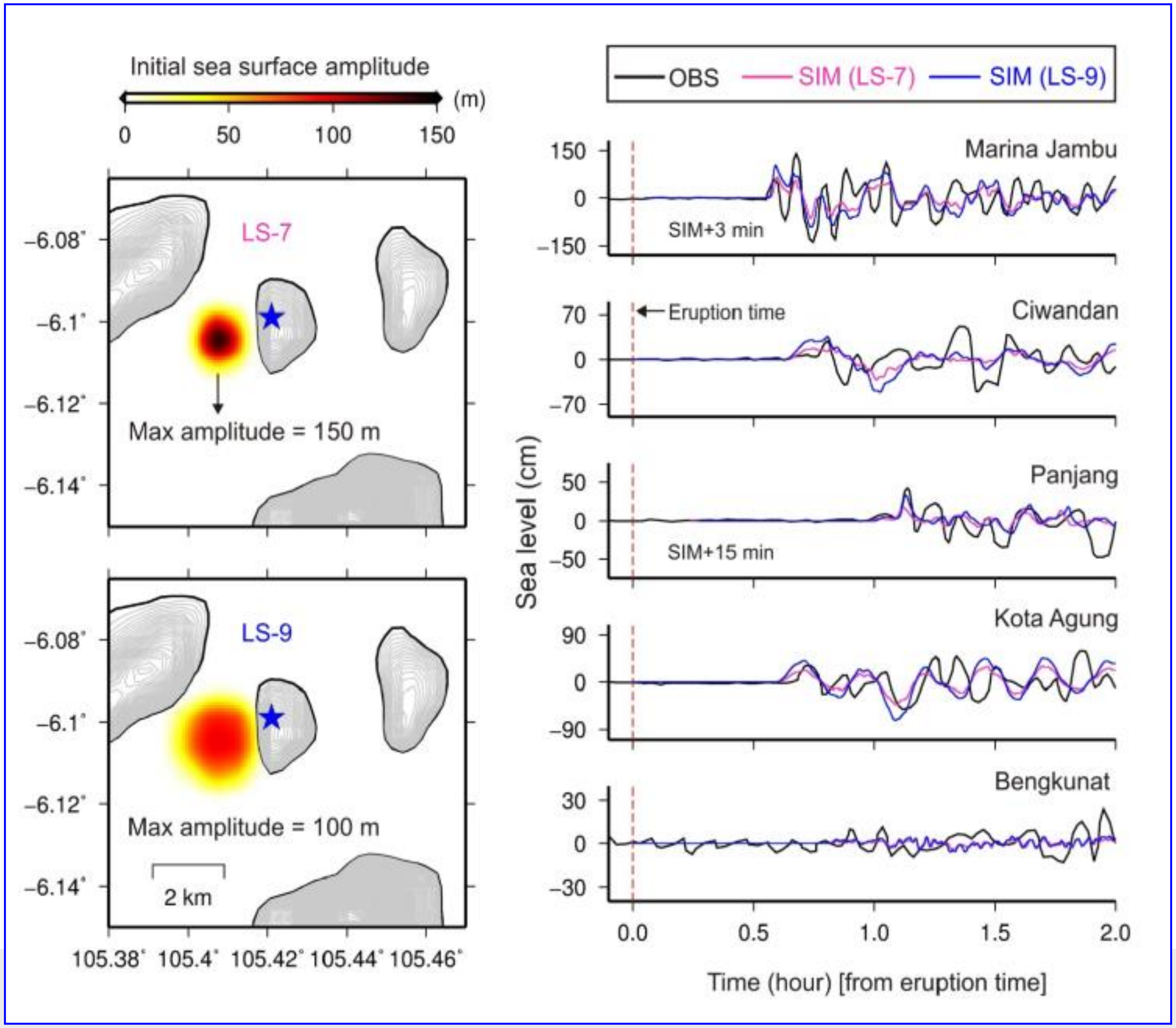
Modeling showed that scenarios 7 and 9 give better results





Numerical simulations

Final source model
- Initial amplitude: 100- 150 m
- Initial wavelength: 1.5 – 2 km

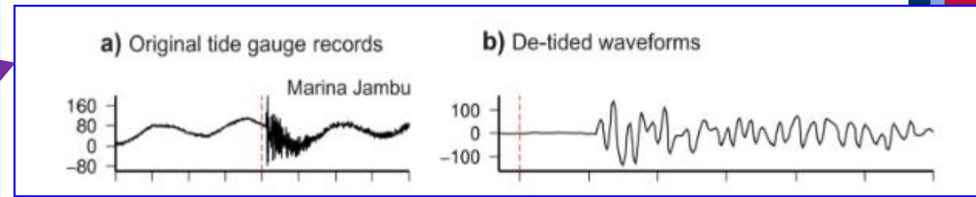


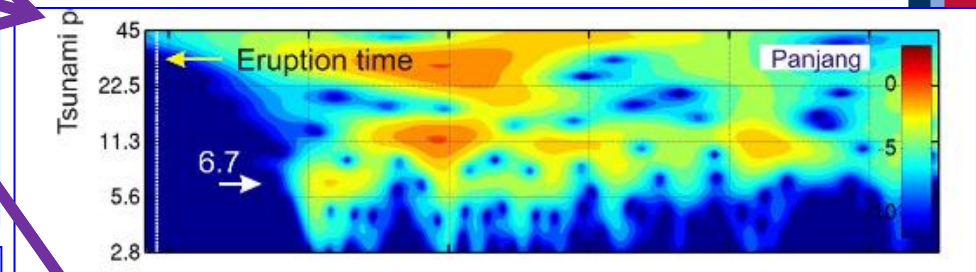
Note:
The initial source model has an amplitude of 10-150 m. Note that the runup in the near-field (distance < 5 km), based on the survey by **Fritz et al. (2020)**, was **83 m**. This implies that the initial wave should have been huge in order to be able producing a runup of 83 m.

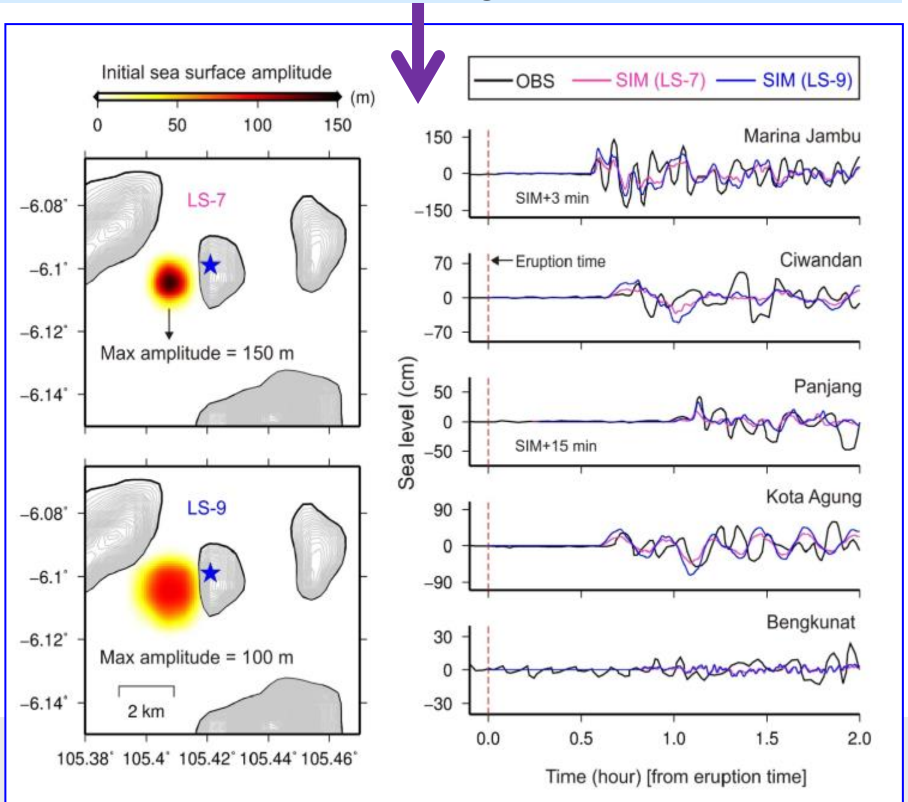
Summary

Summary of results:

1) Max tide gauge amplitude: 120 cm
2) Initial tsunami period: 6-8 min
3) Surveyed tsunami heights: 3-7 m
4) Tsunami source model:
- Initial amplitude: 100- 150 m
- Initial wavelength: 1.5 – 2 km







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Numerical modeling of the subaerial landslide source of the 22 December 2018 Anak Krakatoa volcanic tsunami, Indonesia

Mohammad Heidarzadeh [a,*], Takeo Ishibe [b], Osamu Sandanbata [c], Abdul Muhari [d], Antonius B. Wijanarto [e]

[a] Department of Civil & Environmental Engineering, Brunel University London, Uxbridge, UB8 3PH, UK
[b] Association for the Development of Earthquake Prediction, Tokyo, 101-0064, Japan
[c] Earthquake Research Institute, The University of Tokyo, Tokyo, 113-0032, Japan
[d] Ministry of Marine Affairs and Fisheries, Jakarta, 10110, Indonesia
[e] Badan Informasi Geospasial, Cibinong, Indonesia

The pdf can be downloaded freely!

A R T I C L E   I N F O

Keywords:
Volcanic tsunami
Anak Krakatoa
Sunda Strait
Numerical simulations
Indonesia
Wavelet

A B S T R A C T

The eruption of the Anak Krakatoa volcano (Indonesia) in December 2018 produced a destructive tsunami with maximum runup of 13 m killing 437 people. Since the occurrence of this rare tsunami, it has been a challenge as how to model this tsunami and to reconstruct the network of coastal observations. Here, we apply a combination of qualitative physical modeling and wavelet analyses of the tsunami as well as numerical modeling to propose a source model. Physical modeling of a volcano flank collapse showed that the initial tsunami wave mostly involves a pure-elevation wave. We identified initial tsunami period of 6.3–8.9 min through Wavelet analysis, leading to an initial tsunami dimension of 1.8–7.4 km. Twelve source models were numerically modelled with source dimensions of 1.5–4 km and initial tsunami amplitudes of 10–200 m. Based on the qualities of spectral and amplitude fits between observations and simulations, we constrained the tsunami source dimension and initial amplitude in the ranges of 1.5–2.5 km and 100–150 m, respectively. Our best source model involves potential energy of 7.14×10^{13}–1.05×10^{14} J equivalent to an earthquake of magnitude 6.0–6.1. The amplitude of the final source model is consistent with the predictions obtained from published empirical equations.