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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Runup, Inundation, and Sediment Characteristics of 22 December 2018 Indonesia Sunda Strait Tsunami" *by* Wahyu Widiyanto et al.

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Authors Response

Referee 1 – Anonymous

Overview: Widiyanto et al. conducted field surveys of the 22 Dec 2018 Anak Krakatau volcano tsunami along the coastlines of Sunda Strait and reported wave runup distribution. They also collected sediment samples and performed tsunami deposit analysis. I believe that this is an important study and the results are very useful. The manuscript reads well; its figures have good qualities and the structure of the manuscript is ap-

propriate. However, I found some unclear points in the manuscript that needs to be corrected before publication. The details of runup survey are unclear and I made comments to help authors to correct it. Also the manuscript needs to compare its results with published papers on the Anak Krakatau tsunami and explain how this work connects with existing literature. My recommendation is "Moderate Revision" with following comments. I encourage the authors to do the revisions quickly and resubmit soon in order to publish the paper earlier.

Response to overview: We would like to thank Referee 1 for encouraging comments and constructive suggestions towards improving our manuscript. We summarize comments from Referee 1, author's response, and author's changes in manuscript as follows. Changes in manuscript will be available in marked-up/revised manuscript if we have a chance to revise the manuscript.

Comment 1: Page 2, Line 13: please show two locations "Merak" and "Bakahueni" in Figure 1.

Response 1: Thanks for suggestion. Merak and Bakauheni are ferry ports with crowded traffic. They are important place to show. We add legends in Figure 1 in mark-up manuscript to show the two locations.

Comment 2: P2, L1-9: in this part of introduction, I think it would be very useful if you report the two recently published papers on the same event. They are: Muhari, A., Heidarzadeh, M., Susmoro, H., Nugroho, H.D., Kriswati, E., Supartoyo, Wijanarto, A.B., Imamura, F., Arikawa, T. (2019). The December 2018 Anak Krakatau volcano tsunami as inferred from post-tsunami field surveys and spectral analysis. Pure and Applied Geophysics, https://doi.org/10.1007/s00024-019-02358-2. Heidarzadeh, M., Ishibe, T., Sandanbata, O., Muhari, A., Wijanarto, A.B. (2020). Numerical modeling of the subaerial landslide source of the 22 December 2018 Anak Krakatoa volcanic tsunami, Indonesia. Ocean Engineering, 195, https://doi.org/10.1016/j.oceaneng.2019.106733. You could say like this: "The numerical modelling of the Dec 2018 Anak Krakatau tsunami was performed by Heidarzadeh et al. (2020) while Muhari et al. (2019) conducted field surveys of this event to record tsunami runup along the coasts of Sunda Strait".

Response 2: Thanks for suggestion. We report the two papers in part of introduction, and add them in part of reference belongs to marked-up manuscript.

Change in manuscript: The numerical modelling of the December 2018 Anak Krakatau tsunami was performed by Heidarzadeh et al. (2020) while Muhari et al. (2019) conducted field surveys of this event to record tsunami runup along the coasts of Sunda Strait.

Comment 3: P3, L36: here please clarify which coastline? We have two coastlines which are High Tide Coastline (HTC) and Low Tide Coastline (LTC). You measured runup based on HTC or LTC? This is very important to clarify.

Response 3: We measure based on the coastline of measurement time. The numbers shown in the manuscript version 1 were original measurement values. Now, we correct them for tide using WXTide version 47 software. Tsunami arrival times are determined based on tidal record that show tsunami waveform. Four tidal gauge record were obtained from Geospatial Information Agency, Indonesia. They are Marina Jambu, Ciwandan, Panjang and Kota Agung. Or we can use the tide gauge data in article by Heidarzadeh (2020) which is published officially.

Change in manuscript: The runup was measured by determining the height difference between the highest point of sea water rise onto land and the coastline. Runup is influenced by the characteristics of the ground surface and slope. The measurement results from our field surveys show that runup ranged from 1 to 9 m (Table 1 and Fig. 1). The values in the table and figure has been corrected for tide to obtain elevation from sea level at time of tsunami.

Comment 4: P3, L13-16: here you talk about runup measurements; but you do not

explain about tidal level corrections. The tide level at the time of actual tsunami was different from tidal level at the time of surveys. Please explain about this and the corrections that you made.

Response 4: The numbers appear in the manuscript version 1 especially in Table 1 and Figure 1 were original numbers come from measurement. We have not corrected them for tide therefore we need to correct them using tidal levels. We use WXTide version 47 software to correct it. The station we use is Ciwandan, Serang, and Teluk betung tidal gauge station. The corrected values will be shown in mark-up manuscript if this process continue to next stage.

Change in manuscript: Measurements of runup and inundation were conducted using conservative terestrial surveying methods with optical and laser devices (e.g., total stations, handheld GPS devices, and laser distance meters). We measured run-up and inundation based on coastline at the time of survey. Run-up were corrected to calculate heights above sea level because the tide level at the time of actual tsunami was different from tidal level at the time of surveys. We use WXTide software version 4.7 for correcting elevation. Elevation values of each survey site were corrected with the nearest tidal gauge available. We used 3 tide station in Ciwandan, Labuhan and Teluk Betung.

Comment 5: P3, L34-40: please compare your runup heights with those of Muhari et al. (2019) [Pure and Applied Geophysics, https://doi.org/10.1007/s00024-019-02358-2] and explain why Muhari et al. reported maximum runup height of 13 m but you report max runup of 8? Is that because you did not survey same points? Please clarify.

Response 5: Thanks for recommendation. Yes right. The difference is because we measured in different points. Our maximum run-up point (Cagar Alam) is located very far from maximum run-up point (Tanjungjaya) belongs to Muhari et al. Actually, we also have a measurement point near Muhari et al. measured. It is site Tanjungjaya-2 or local people call it Cipenyu Beach. The height of run-up is 9 m, we add it in marked-up manuscript and become the highest run-up in our survey. Nevertheless, this value is still significant different with Muhari et al. since we measure in flat valley part of Cipenyu Beach while Muhari et al. measured in hilly coast of Cipenyu Beach.

Change in manuscript: The measurement results from our field surveys show that run-up ranged from 1 to 9 m (Table 1 and Fig. 1). A runup height of about 1 m was found in many locations, at which no damage was found. The highest runup was found at the Tanjung Jaya 2, Cagar Alam, and Kunjir sites, with heights of 9.0, 7.8, and 7.7 m respectively. Site Tanjungjaya 2 is located in Cipenyu Beach. Muhari et al. (2019) reported maximum runup height of 13 m in area around Tanjungjaya/Cipenyu Beach as well. This value is significant different with our maximum run-up since we measure in flat valley part of Cipenyu Beach while Muhari et al. measured in hilly coast of Cipenyu Beach.

Comment 6: P3, L34-40: Here also please compare your surveyed runup heights with published tide gauge records of Heidarzadeh et al. (2020) [Ocean Engineering, 195, https://doi.org/10.1016/j.oceaneng.2019.106733]. For example, your runup heights how many times are larger than tide gauge heights reported by Heidarzadeh et al.? this information can be very useful.

Response 6: Thanks for the interesting recommendation. We compare our surveyed runup heights with published tide gauge records of Heidarzadeh et al. (2020) [Ocean Engineering, 195, https://doi.org/10.1016/j.oceaneng.2019.106733]. We use 3 tide gauges from the paper: Ciwandan, Marina Jambu and Panjang. Others (Kota Agung, Bengkurat, Binuangeun) are too far from our survey site. We read that maximum amplitudes at Ciwandan, Marina Jambu, and Panjang are 1.15 m, 2.8 m, and 1.25 m respectively. Ciwandan tide gauge is used to evaluate runup heights at site Karangsuraga, Pasauran, Sukarame and Pejamben. It results in average runup heights 4 times larger than amplitude at tide gauge heights. Note that the sites are relatively far from the tide gauge. Marina Jambu is used to evaluate runup heights at sites Sukamaju, Karangsari, Tanjungjaya 1, Tanjunglesung (1,2,3), Tanjungjaya 2, Banyuasih,

Kertajaya Sumur, Cagar Alam. It results in average runup heights 1.15 times larger than amplitude at tide gauge. Panjang tide gauge is used to evaluate sites of Bumiwaras, Wayurang 1, Wayurang 2, Kotaguring, Sukaraja, and Kunjir. It results in average runup heights of 3.1 times larger than amplitude at tide gauge.

Change in manuscript: Our surveyed runup heights are compared with published tide gauge records of Heidarzadeh et al. (2020). Three tide gauges from the article (Ciwandan, Marina Jambu and Panjang) are used. Maximum amplitudes at Ciwandan, Marina Jambu, and Panjang are 1.15 m, 2.8 m, and 1.25 m respectively. Ciwandan tide gauge is used to evaluate runup heights at site Karangsuraga, Pasauran, Sukarame and Pejamben. Marina Jambu tide gauge is used to evaluate runup heights at sites Sukamaju, Karangsari, Tanjungjaya 1, Tanjunglesung (1,2,3), Tanjungjaya 2, Banyuasih, Kertajaya Sumur, Cagar Alam. Besides, Panjang tide gauge is used to evaluate sites of Bumiwaras, Wayurang 1, Wayurang 2, Kotaguring, Sukaraja, and Kunjir. It is indicated that averaged runup heights of each site associated with the tide gauge are 4 times, 1.15 times, and 3.1 times larger than maximum amplitude at the Ciwandan, Marina Jambu, and Panjang respectively. The sites are relatively far from the tide gauge.

Comment 7: P4, L1: please show location "Sumur" in Figure 1.

Response 7: Alright, we show location Sumur in Figure 1 and will appear in marked-up manuscript.

Comment 8: P4, L6: same comment as before for coastline; HTC or LTC?

Response 8: We measured inundation distance based on the coastline of surveys time. The numbers shown in the manuscript version 1 were original measurement values. Correct values with tidal data will be shown in marked-up manuscript.

Change in manuscript: The distance from the runup point to the coastline is defined as the inundation distance (IOC Manuals and Guides No. 37, 2014). This distance can be easily obtained using a distance measurement instrument or GPS. We used total station for this purpose. The coastlines elevation in our survey were corrected with tide elevation of several tide gauge in Sunda Strait. The results of our field measurements show that the inundation distance ranged from 10 to 290 m (Table 1 and Fig. 1). We

Comment 9: P4, L3; 250 m. Add “m”.

Response 9: Thanks for thorough review, we add “m” in the value.

Change in manuscript: The topography is relatively flat but suddenly rises at a distance of about 250 m from the coastline due to a long hill.

Comment 10: how much is the value of gamma?

Response 10: Gamma is a comparison factor between uprush time and total uprush plus backwash time. In our paper, gamma varies from 0.03365 to 0.889192. We use some asumption, e.g. velocity of tsunami flow 5-6 m/s and period from the time of first wetting to final drying of inundated ground 2-5 hours. They depend on length of inundation and morphology.

Comment 11: Figure 1: Please make the distance scale more clear and visible.

Response 11: OK, thanks. We modify it in order to be visible and clearer. It will be ready in marked-up manuscript.

Comment 12: Figure 2: please increase fontsize. Most texts cannot be read.

Response 12: Alright, we increase the font size in order to be readable. It will ready in marked-up manuscript.

Comment 13: Figure 3: please add name of each location after the letters “a”, “b”,: : :.in each panel.

Response 13: Thanks for your suggestion to make the figure clearer. Location name for a is Carita Beach ; b = Tanjung Lesung; c = Cagar Alam; d = Cagar Alam; e = Tanjung Lesung; f = Tanjung Lesung; g = Cagar Alam.

Comment 14: Figure 4; please add some location names in this figure’; for example location names of 2, 4, 10 and 14.

Response 14: Thanks. Actually, there are location names in Figure 4, but they are not readable. We make them more visible and we add other location names and site number to Figure 4. Location name of 2 is Pasauran; 4 = Pejamben; 10 = Tanjung Lesung; 14 = Cagar Alam.

Comment 15: Figure 5: Please add location name in each panel.

Response 15: Thanks for your suggestion. We add the location name to Figure 5 while the coordinates of the test pits can be seen in Table 2. The location name of upper left panel is Cagar Alam, upper right is Sukarame, lower left is Karangsuraga, and lower right is Cagar alam. These name will appear in marked-up manuscript.

Comment 16:: Figures 6 and 7: please combine these two figures to only one figure with two panels.

Response 16: Thanks for your suggestion. One figure with two panels will make the manuscript more effective and efficient. We combine Figure 6 and 7 and will be ready in marked-up manuscript.

Comment 17: Table 1: in column 3, please add time as well. You have only date now. What time of the day? This is very important because we can see how tidal status was at the time of your survey.

Response 17: We recorded the times of survey for each site. We add them in column 3 of Table 1 in marked-up manuscript.

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