

# **Finding of the unexpected tsunami due to the strike-slip fault at central Sulawesi, Indonesia on 28 September 2018, from the preliminary field survey at Palu**

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## 1. Introduction

A strike-slip fault earthquake where epicenter located at the north part of Dongala District, Central Sulawesi, Indonesia suddenly triggering the tsunami with the reported water level up to 8m inside Palu Bay, about 50 km to the south-east of epicenter. There are also observations of tsunami waves with run-up elevations of about 2 - 6 meters reported from the survivors at the damaged area, which should be limited to understand what the tsunami characteristics is at this event.

Therefore, a rapid post-tsunami survey was conducted from 4-6 October 2018 requested by the Ministry of Marine Affairs and Fisheries, Indonesia to understand characteristic and damages caused by tsunami and to find indications of possible tsunami generation aside of earthquake. The survey is aimed to obtain tsunami characteristics such as tsunami height, flow depth, inundation distance, damage characteristics and eyewitnesses account, which result should contribute the planning of reconstruction at the damaged area. In this preliminary survey we have the limitation of time and road condition to visit the coastal area inside of Palu bay which the tsunami would mostly effect after the earthquake. The survey points are shown in Fig.1. with the tsunami heights of splash wave (red color) and flow depth (blue color) measured in Palu bay.



Figure1. The result of field survey data showing the tsunami heights of splash wave (red color) and flow depth (blue color) measured in Palu bay overlaid in Google earth, without tidal correction (Muhari et al, 2018 JDR submitted).

## 2. Field Survey Data/Information around Talise beach at Palu city

A team consists of four scientists from Indonesia and Japan conducted measurement at Talise beach located at the endmost of the bay and in the area on the east side of the bay. The damage condition along the coast we observed a week after the earthquake and tsunami are shown in Photo 1-3. The destructive tsunami attacked the coastal causing the heavy damage on building and houses which distributed not uniformly along the coast. Photo 2 shows the sliding/subsidence along the coast where threes pulling up by the tsunami remains forward the sea. Along the Talise Beach, the tsunami trace at a distance up to 50 m from the coastline is found at a depth of splash wave of about 7-8 m from the ground level and about 9-10m from the sea level as stated by the two eyewitnesses as shown in Photo 4. Further inland, inundation depths were found in average of 1m as shown as trace of water at the wall inside the house, but splash wave marks outside the house were found up to 3.5 m from the ground. The inundation distance reached up to 300 m inland, but the damages are concentrated only in the area located less than 200m from the coastline. The summary of the tsunami characteristic on the cross-section obtained from the field survey is shown in Fig.2, suggesting the splash wave on the beach within 50 m and the inundating flow following with 1-2 m to the end of inundation less than 300 m.



Photo 1 Damaged house where the debris such as trees, cars and motorcycles affected the 1<sup>st</sup> floor



Photo 2 damaged coastal area where the subsidence in large area and backward trees to the sea are observed.



Photo 3 Damaged area due to the strong current of tsunami, causing scouring or erosion on the land where no houses remains.

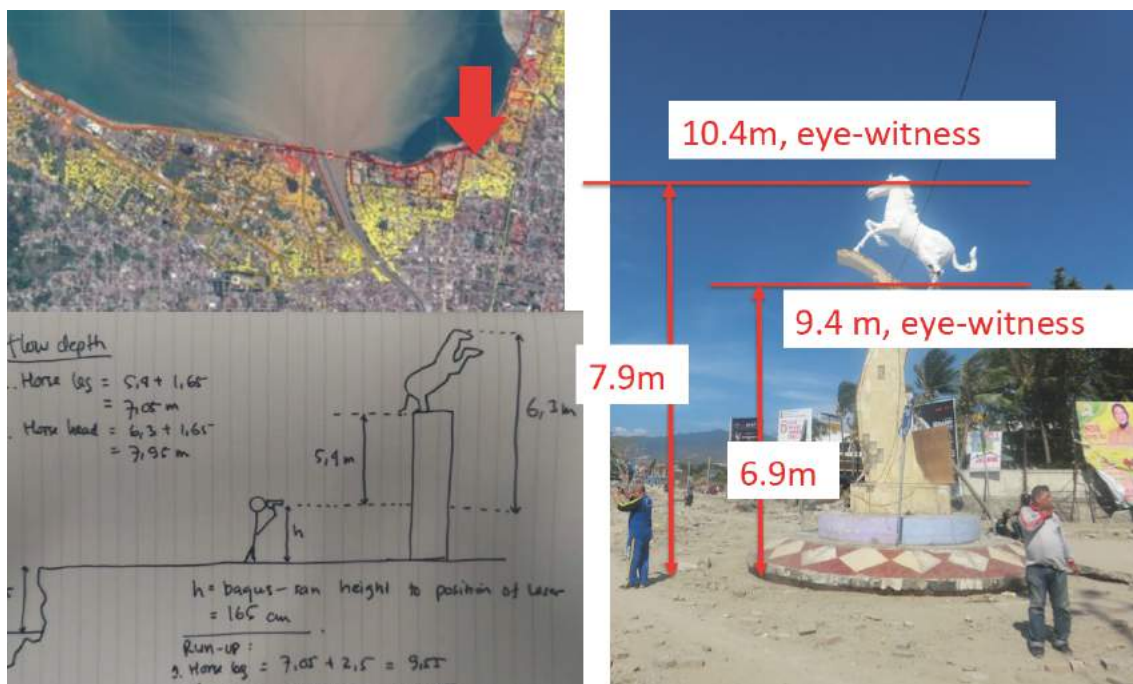


Photo 4 A depth of splash wave up to about 8 m from the ground level and about 10 m from the sea level as stated by the eyewitnesses, without tidal correction.

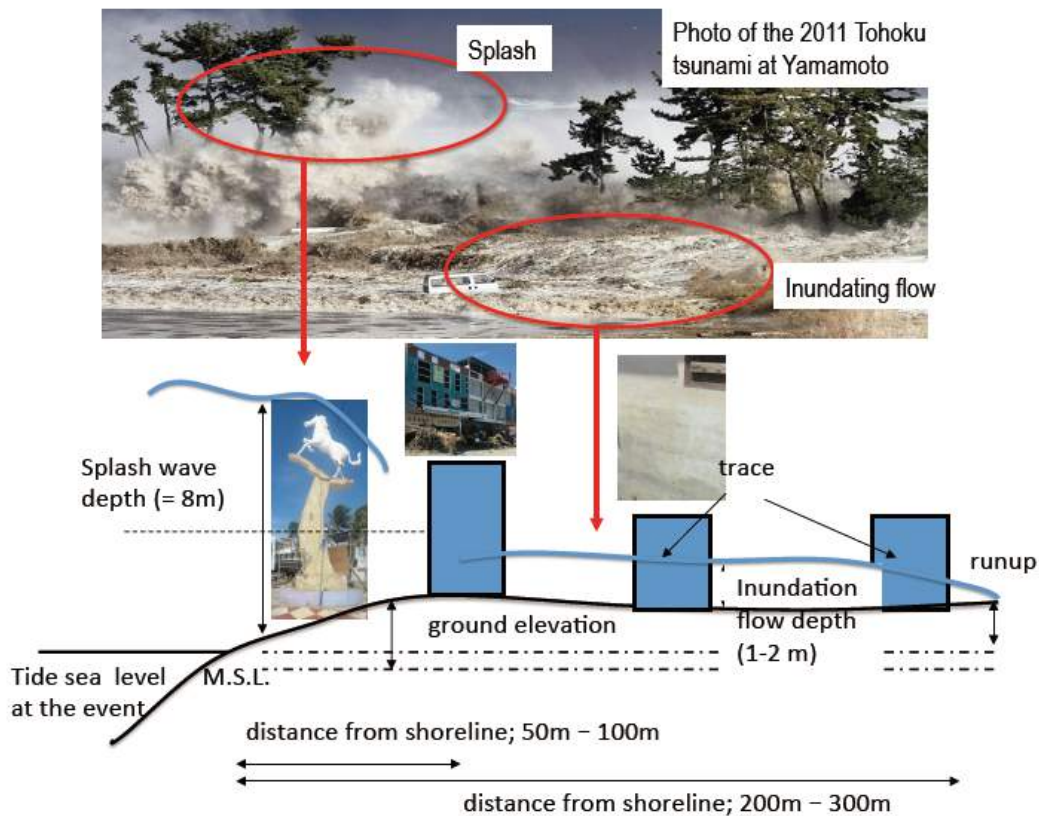


Figure 2 Cross section of the tsunami and topography at the Palu with splash wave/inundation flow depth (Muhari et al, 2018 JDR submitted)

### 3. Field Survey Data/Information in the east coast of Palu bay

At Pantoloan along the east side of the bay, the large vessel with about 50m long was landed where the inundation depth was measured to be around 2 m and ground height was 2.3m, so that inundation height was about 4 m. But the inundation stopped 180 m from the coast, suggesting the length of this tsunami seems to be short. About tsunami behavior, the residence said that tsunami arrived in a few minutes after the earthquake motion.

Along the east side of the bay, at Pantoloan the large vessel with about 50 m long was landed shown in Photo 5. Here, then inundation depth was around 1.9 m and ground height was 2.3m, so that inundation height was about 4.2 m. But the inundation stopped 180m from the coast. That means the length of this tsunami seems to be short. About tsunami behavior, the residence said that tsunami arrived in a few minutes after the earthquake motion.



Photo 5 The large vessel with about 50m long was landed at Pantoloan

The port in Pantoloan, there were also many containers and small ships. The inundation height was 4.9m. The gantry crane was fallen because the foundation part had disappeared as shown in Photo 6. And the residence suggests that tsunami was coming from west north side.



Photo 6 The gantry crane was inclined and almost fallen at Pantoloan

At Mamboro, there was more serious damage as shown in Photo 7. The inundation depth was around 4.5m and the ground height was around 2.0m. And the maximum splash height was 10.1m above the sea level. Photo 8 shows the house located nearby sea, which had some evidence of the splash wave. It indicated that the inundation flow speed seems to be relative high like bore.



Photo 7 The destruction status at Mamboro



Photo 8 The house located nearby sea, which had some evidence of the splash wave, without tidal correction

#### 4. Summary

Based on the described available data/information, we can summarize that the tsunami in Palu bay has a relatively short period of wave, indicating the arrival onshore and creates huge impact at the distance of 50 m from the coastline where the maximum flow depth reaches up to 8 m. This flow depth is rapidly decreased when it passing through dense population into average of 1m flow depth

inside the house located at the distance about 150m from the shoreline. The above-mentioned findings suggested that tsunami might be generated by mechanism other than the strike-slip earthquake, where this suspected source should be located near by the impacted areas with relatively narrow width of source geometry.

## 5. References

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