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Interactive comment on "Detectability of seismic waves from the submarine landslide that caused the 1998 Papua New Guinea tsunami" *by* Akio Katsumata et al.

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Dear Referee #2

We revised the manuscript according to the comments from referees.

First, Katsumata et al are trying to find the signature of the submarine slide in the seismic record, without mentioning and describing in the figures that 4 aftershocks were identified during the 22 Minutes following the main shock (Synolakis 2002). In Figure 3 JAY record shows that waves of the two largest aftershocks are arriving at 09:09.30 and 09:10:30 (not mentioned by the authors). Synolakis specified

that one of the aftershocks at 09:02 mb 4.4 could correspond to the submarine landslide. In Figure 1 an additional record filtered 0.1- 1 s would probably help to show the high frequency waves of this aftershock, in fact the slide. Long duration of main shock (> 2-5 min) and aftershocks occurring in the tens of minutes after the main shock could definitively masked the waves generated by the submarine landslide generated in the 10-20 minutes following the quake. But as this event was identified and located by seismic waves picking and measurement, signal should be visible on the JAY record at higher frequency (> 1 Hz).

- We added descriptions about aftershocks. And we missed to describe importance of landslide size estimation for tsunami warning purpose in the previous manuscript. We are interested in detection seismic signals with periods close to the landslide duration. We added these things in "Introduction".

Second, the synthetic records obtained by modeling by Katsumata et al, for the closest station JAY, are of much bigger than the waves on records, in the 50-100s band. As mentioned by Fryer, the slide could be a slump type, or debris avalanche type, and in addition, the rheology parameters could vary extremely. The conclusion is, because no signal is visible in the bandwidth 50-100 s on the JAY station record, the hypothesis of the synthetic source and propagation performed by the authors is probably not correct. Katsumata et al should performed other synthetic records, knowing that in the Figure 2 shows that , at JAY station, in the bandwidth 0.5s to 100s, no clear signal is visible at the theoretical arrival time of the waves of the slide.

- Analatical solution for an unbounded homogeneous media shows that far field displacement is proportional to the force amplitude (e.g., Aki and Richards, 2002). Whereas complex process may affect the seismic records and total energy may change extremely according to travel distance, the peak force acting on the ground should be constrained by the total mass and its acceleration.

The calculation procedure was checked with the result of Takeo (1990, JGR). It is true that the synthetic amplitude in Fig. 5 is too large compared with the observed records. Seismic phases are not recognized either at GUMO, CTAO, WRAB, and DAV. A simple explanation for those would be that the assumed force might be too large. We do not insist on the correctness of the assumption. Rather our conclusion is that detection of landslide with long-period seismic wave is difficult after a big earthquakes.

Third, other processing methods exist to help to identify waves visually or by signal processing : computation of spectrograms is one of the efficient method, and computation of polarization parameters of waves.

- We added spectrogram in Figure 2.

Conclusion : Katsumata et al finally demonstrate that the synthetic record obtained for JAY seismic station doesn't match with the observed record in the specific band (50-100s). JAY record shows that no signal is visible in the bandwidth of 0.5s to 100s, 13 minutes after the quake, when the slide waves are expected. The conclusion of the authors is not relevant : other type and parameters of the slide could be modeled to compute synthetic records and compare with JAY record in higher frequency band (0.1 - 1s). Detect, identify and warn a tsunami due to submarine or aerial slide following large earthquake is definitively a complex challenge, essentially because of the duration of the quake and also the number and magnitude of aftershocks. As mentioned by Katsumata et al., S-net and DONET equipped with accelerometers, seismometers and pressure sensors are the most likely candidates to detect and warn submarine landslide. Nevertheless seismic arrays and seismic stations located closer to the slide (< 100 km) could be able to detect slide waves. In addition, hydroacoustic arrays (Synolakis) and

coastal seismic station located on islands close to the epicenter could also help to detect T phase generated by the quakes and those generated by the slide. This paper needs major revision.

- Our main concern is tsunami warning. To issue a proper tsunami warning, height of tsunami should be estimated. Size of landslide is an indispensable factor to estimate tsunami height. Detection of a landslide may be possible with short-period seismometers or hydrophones. However those instruments are not useful to estimate size of a landslide. We changed the manuscript so that out interest on long period seismic records would be expressed explicitly.

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2018-317/nhess-2018-317-AC2-supplement.pdf

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