Responses to Reviewer 2

In the following, Reviewer 2's comments are in bold, and my responses are shown in dark blue. In the revised manuscript, the changed texts are highlighted with yellow.

This manuscript presents the first probabilistic tsunami hazard analysis model for key locations on Vancouver Island using stochastic rupture scenarios of the Cascadia megathrust subduction zone. The study found that the use of a 3-component Gaussian component mixture distribution model provides an improved representation of tsunami wave heights at nearshore and offshore locations, compared with the use of a 1-component renewal model which overestimates the hazard. The author highlights the uncertainties in the study, with particular note on the coarse resolution which the simulations were performed which limit an evaluation of tsunami runup and inundation corresponding to the scenario models. The manuscript is well written with the figures and tables well-presented. The topic of PTHA, in general, is an area of ongoing and growing interest within the seismic and tsunami community and is highly relevant in coastal management and hazard adaptation/mitigation considerations. Apart from a few very minor queries which I have listed below that centre on clarifying some of the context and also figure presentations, I am pleased to recommend the paper for publication once the author has considered the queries listed below.

Thank you very much for your positive comments on my manuscript.

R2-1: In Section 2, I think it would be useful to add a section on historical tsunamis, or perhaps absence of, and some background on any paleo-tsunami investigations which have been carried out at, or adjacent to, the study site. I feel this will also help to set the context especially in relation to major historical ruptures which have occurred along the Cascadia megathrust zone. For example, the January 1700 event mentioned in line 37 could be expanded on in section 2 (as an example).

Agreed. In the revised manuscript, the following paragraph is added together with one figure: 'Moreover, the earthquake slip of the rupture zone can be inferred from historical tsunami heights. Fault slip can be constrained using the coseismic vertical displacements observed in the past events. The last significant earthquake along the Cascadia subduction zone occurred in 1700 with M9 [2,3], which ruptured the entire subduction margin. Evidence for the 1700 tsunami comes in the form of First Nation's myths in North America and written documents that recorded the damages and flooding in Japan. The sedimentary records of this event can be seen in the form of turbidity deposits, buried soils, and marsh data [3,6]. The ground subsidence observations for the 1700 event and the pre-1700 events are shown in Figure 2 [25].'

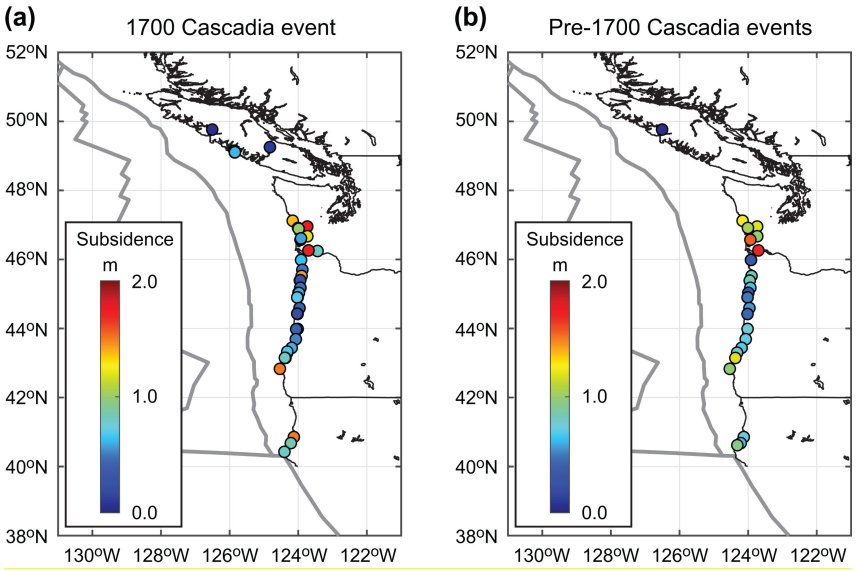


Figure 2. Ground subsidence observations based on various previous studies [24]: (a) 1700 event and (b) pre-1700 events.

R2-2: Lines 254-255 indicate that the Okada equations and Tanioka-Satake formulae were used to compute ground displacements, but the Tanioka-Satake formulae is not indicated in Figure 3 and in Figure 6.

Thank you very much for this suggestion. In Figures 3 and 6, the Tanioka-Satake equations are included.

R2-3: Lines 689-695 – the author raises an important point here, and it might be useful to specify "inundation" between "tsunami" and "risk" in line 695. That is, the use of onshore inundation/runup is becoming increasingly important for use in quantitative risk modelling of asset impacts, damages and losses.

Thank you very much for this suggestion. In the revised manuscript, 'inundation' is added.