Response to Referee reports for NHESS-2021-180

R#: Referee number (1 or 2); C#: Comment/Response number; A: Authors' response.

Comments from Referee 1 and authors' response

R1C1) Minor/trivial change to sub-section headings, as shown in item B1 in the my "Final Report from Referee 1 on NHESS-2021-180-v3" attached.

AC1) Thank you. As suggested, we replaced sub-section headings.

1. Introduction

2. Beach Erosion Risk
2.1 Definition of beach erosion risk
2.2 Potential beach erosion risk
2.3 Combined potential erosion risk (CPER)

3. Assessment of Potential Erosion Area (PEA)
3.1 Background erosion from watershed and river (PBEA)
3.2 Reshaping of shoreline due to harbor breakwater (PREA)
3.3 Episodic storm caused beach erosion (PEEA)

4. Case Study at Bongpo-Cheonjin Beach
4.1 Site description
4.2 PBEA due to development in watershed
4.3 PREA due to construction of harbor breakwater
4.4 PEEA due to episodic storm
4.5 CPER curve for Bongpo-Cheonjin Beach

5. Discussions

6. Concluding Remarks

Comments from Referee 2 and authors' response

R2C1) There are some typographical and grammatical errors in the text. Please check it.

AC1) I corrected the typographical and grammatical errors by proofreading the whole.

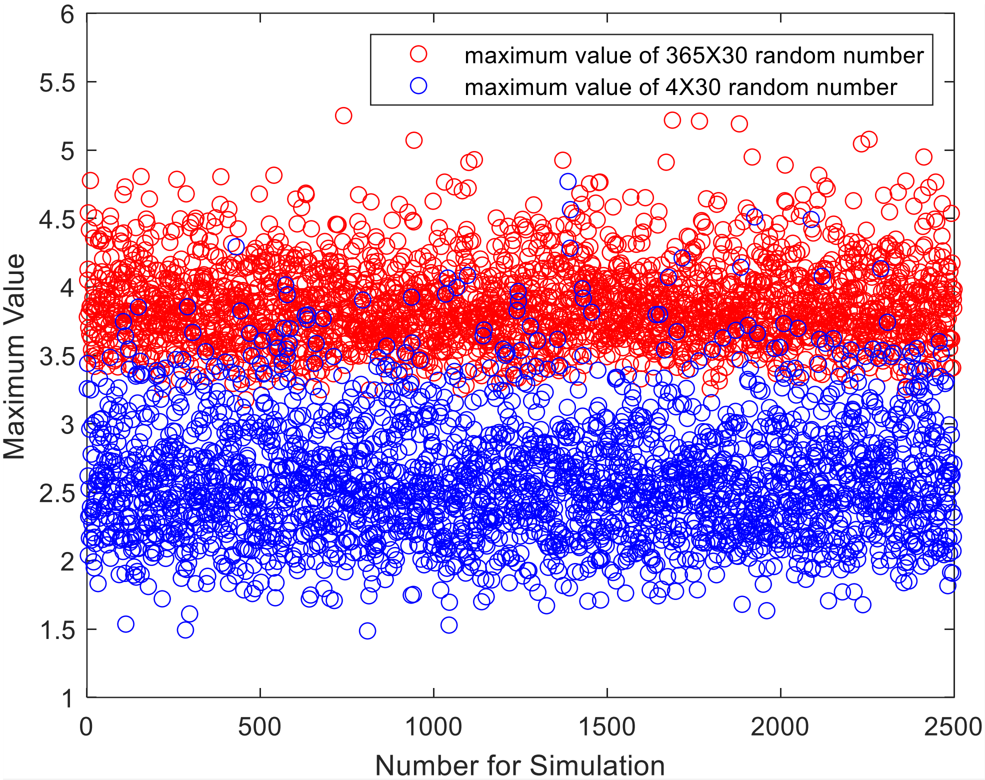
R2C2) [Lines 194 – 201] It is not clear how you pass from eq 7 to eq 8.
If by definition ΔQp = Qin – Qout Then the right hand of eq (8) should be Qin – Qout – KV, which is not equal to the right hand of eq (7)

AC2) Q_{in} and Q_{out} reperesent the total amount of sand entering and leaving the littoral cell. However, Q_p is distinguished from Q_{in}/Q_{out} in that it is a sediment discharge to a point source. The expression of these differences was not clear in previous manuscripts. Also, as you mentioned, there can be many misunderstandings about the expression. Therefore, to make the explanation clearer, the manuscript has been revised as follows.

> [L193-200] where Q_{in} is the ratio of sediment discharge mainly flowing into the littoral cell from a point source such as a river, and Q_{out} is the rate of sediment loss that is steadily lost to the open sea mostly due to the action of waves. However, Q_{out} includes the rate of sand loss due to artificial offshore sand extraction such as sand mining or dredging. In a natural state without artificial coastal zone development, the representative Q_{in} is the sediment discharge rate from the river, and is balanced with the loss of sand to the open sea due to the continuous wave action. The latter can be expressed as the product of the sediment loss constant K and the beach sediment volume V (Lee and Lee, 2020).
> If the difference between the point source and the sink sediment discharge in the sediment budget, excluding the sand loss to the open sea due to wave action, is defined as ΔQ_p, the following equation is obtained.

R2C3) [Lines 257-261] Surveys taken 4 times per year during 8 years do not necessarily reflect the real importance of storm-induced erosion in the site, especially if you are interested in the impact of extreme events. This is clearly reflected in the fact that you will never rely on an extreme wave analysis done with just 8 years of data. Moreover, results obtained in New Zealand do not necessarily apply to your site, since they depend on specific wave conditions and beach morphology. Looking to your approach I would say than more than "shoreline retreat due to episodic storm" you are reflecting "shoreline seasonal fluctuations".

AC3) Randomly observed shoreline data for 8 years (i.e., Accumulation of data sufficient for statistical analysis) include "shoreline seasonal fluctuations" as well as "shoreline retreat due to episodic storm". Assuming that the shoreline variability follows a normal distribution, it can be explained by generating a random number. If it is observed 4 times a year, the maximum value among 4x30 random numbers means the erosion width of the 30-year return period. On the other hand, if it is observed every day, it means the maximum value among 365x30 random numbers. Through this, it was confirmed that the two maximum values were 1.5 times different from each other. The figure below shows the simulation results of a normally distributed random number with a standard deviation of 1. In general, observations are not made during bad weather, but in this study, random observations were assumed.



R2C4) [Section 2. PBEA due to development in watershed] Looking to fig 9, the Cheonjin river has its mouth out of the Bongpo-Cheonjin beach, so I would not expect too much influence on the beach (depending on the potential bypass of material from the beach at the north, just in the river mouth). However, this component should reflect not only the effects of river inputs but the net effect of all agents acting at this t-scale, i.e. river plus long-term cross-shore exchanges with the shoreface (provided your beach has no sediment losses/gains through both alongshore ends). Looking to your results, I would say that at the decadal scale, your beach can be considered (more or less) as in equilibrium.

AC4) Thank you. We agree with your opinion. Following your advice, we added the following to Section 4.2:

[Lines 328-331] And since the estuary of the Cheonjin River is located outside the Bongpo-Cheonjin Beach, it is not expected to significantly influence on PBEW depending on the potential bypass of sediment from the beach at the north. Therefore, considering the net effect of all agents, at the decadal scale, the Bongpo-Cheonjin Beach can be considered (more or less) as in equilibrium.