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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Design Considerations of Artificial Mangrove Embankments for Mitigating Coastal Floods – Adapting to Sea-level Rise and Long-term Subsidence" *by* Hiroshi Takagi

Anonymous Referee #2

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General comments

The paper addresses a topical theme and provides important insight for the design of mangrove restoration. Mangrove restoration has sparked in popularity in an attempt to make up for their alarming global loss and because the features they offer for coastal protection is particularly interesting for adaptation and risk reduction. However, successful restoration cases have been, in general, very scarce. Rates of successes have been characteristically low, in part due to lack of adequate designs for initial protection of seedlings and embankments. This paper specifically addresses the latter point and provides useful information for restoration on the ground. I suggest its publication after

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Discussion paper

addressing a few key points.

First, the paper focuses on tide attenuation to show the potential of mangroves to reduce coastal flooding. However, it is not clear from the onset of the paper that 'mitigation of coastal floods' only refers to 'ocean tides'. Furthermore, if it is unclear if this term refers only to astronomical tides throughout the paper since other drivers of flooding are cited and discussed. The paper refers to waves, storm surges, tides and tsunamis. While wind waves are short waves; surges, tsunamis and (astronomical) tides are long-waves that behave differently to each other. This point must be clarified and the author should provide a clear definition of what tidal propagation refers to within the scope of the paper. In the same regard, scope and goal of the paper could be better framed in Figure 1 too (see specific comments below).

Similarly, it is confusing how deterministic astronomical tides are relevant in the context of EcoDRR and catastrophic coastal flooding. Tides are one of the factors of extreme sea levels but they rarely are the main driver in extreme flooding events. It is assumed that tide propagation is used here as way to measure flood reduction more broadly (storm surges?) and given that the equation is the same for both types of long waves, but this requires further clarification.

On the same token, it should be clarified that tide attenuation is only tested for specific tide characteristics (1 amplitude and 1 tide period in Figure 4), for different geometries of the embankment. While the analyses focuses on highlighting the effects on the different embankment geometries, the discussion should merit some acknowledgement of the fact that flood events with different characteristics (amplitude and celerity-duration) would behave differently.

Also, some reorganization and text improvement should help to facilitate the reading and an overall understanding of the paper main contributions. Some suggestions are included in the specific comments.

Finally, it should be clarified (maybe in discussion) that the paper refers only to tide attenuation and the consolidation of the embankment over time but other factors, such as the diversity of species, are also critical for flood reduction and good ecological performance. Diverse species increase friction (manning coefficient) in the mangrove forests and reduces flooding but are also a key component to becoming functional ecosystems, in the context of Eco-DRR. Many restoration cases in the past have failed to recognize the species diversity as a clear factor in restoring mangrove forests for flood protection.

Specific comments

Page 2 line 8-10 – Phrase unclear. line 10-12 – rephrase. Maybe: mangroves provide key ecosystem services such as: . . . Also, explain ecological resilience in this context.

line 6. Move 'salt marshes have also . . .' after 'vegetation decreases. . . '

line 21. Not all urban areas are suffering subsidence and sea level rise. Clarify and express better that: 'mangroves can help reduce risk in urban areas under threat from sea level rise and subsidence'

line 29-31. See (Sasmito et al. 2015) for a discussion on mangroves and sea level rise.

Page 3 Line 3 onwards. Clarify and define tides, surges and tsunamis. Line 13. Remove or describe sections at the end of the introduction Line 25-27. How is it affected by erosion of the waterfront? Clarify that erosion of the waterfront (for example from wave action) is not considered in the model.

Line 29 onwards. While figure 1 describes the overall approach and design of the numerical experiment, the text in section 2.1 is described as conclusions rather than methods or hypothesis that the paper will test. It is suggested to rewrite this paragraph to better express what scenarios the experiment will address and compare.

Line 6. Describe differences between surges, tides and tsunamis and that only tides will be used in the paper.

Page 5. Where is ue (eq 5) used in eq 6 and 7?

Page 5 and 6. It is unclear where sediment deposition (later analyzed in the paper) appears in these equations. Is this through a linear sediment accretion rate (section 2.4)?

Line 31. MSL : Mean Sea Level

Page 7. Section 2.5. Format or describe the case study.

Line 30. Consider removing.

Page 8. 1st paragraph. Only by soil consolidation?

Line 12. Because mangroves trap sediment... Line 24. Tide attenuation scenario is unclear. Line 26. Reduce the tidal energy? Unclear.

Page 9. Line 1-3. Outline better the 3 factors: plants height, water depth, embankment width and depth.

Line 4. Define vegetation growth rations. This variable is also used in subsequent figures but is unclear what it refers to.

Line 12-15. This paragraph is discussion material.

Paragraph in line 20. How tidal amplitude influences the analysis? It is not defined in the paper that tide attenuation is only tested for a specific tidal amplitude and tide period. However, flood attenuation would depend on the wave amplitude and celerity (i.e. period) in relation to the geometry of the embankment (depth and width), as seen in equations. In other words, for the same tide properties, different embankments geometries provide different attenuation factors, but for the same embankments, different tides would exhibit different behavior too. If sensitivity of the results to tides (and other flood events) is not explored, it should be properly acknowledged and described.

Line 30. The results presented confirm . . .

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Page 10. Line 2. Use SLR consistently throughout Line 3. Tide amplitude and period too?

Line 19. Both potential and negative effects: Line 19. Paragraph also discussed in results. Consider consolidating.

Line 29. Erosion of embankments usually occurs from wave action at the forest front when the area is not properly sheltered from it.

Line 30. Diversity of species in the forest should also be consider to provide better frictional drag and functional ecological performance.

Page 11. Define and use MSL for mean sea level consistently throughout Line 4. Use static rather than stable. Line 6. Rewrite. For example: For example, climate patterns such as El Niño Southern Oscillation can increase sea level and these variations have been shown to larger than historic trends in sea level rise (e.g. Losada et al. 2013).

The authors may consider adding a final discussion point on how these results could inform flood attenuation for other events that are not ocean tides.

Line 16. Keep the mangrove surface level up with . . .

Line 20. These values of attenuation are specific to the tide amplitude and period.

Technical comments on Figures

Figure 1. It is confusing that ocean tides are here related to catastrophic flooding on urban areas (e.g. panel a). The sketch and text in the corresponding section should be more clear on what the sketches represent and what is the particular scope of the paper.

Figure 3. add the sedimentation rate. 1cm/yr?

Figure 4. Define "vegetation growth rates" and "growth ratio". Do they represent the same variable?

Figure 5. The 3D perspective is confusing. Suggestion: 3 panels, one for each water depth.

ADDITIONAL REFERENCES

Losada, I.J., Reguero, B.G., Méndez, F.J., Castanedo, S., Abascal, A.J. & Mínguez, R. (2013). Long-term changes in sea-level components in Latin America and the Caribbean. Glob. Planet. Change, 104, 34–50. Sasmito, S.D., Murdiyarso, D., Friess, D.A. & Kurnianto, S. (2015). Can mangroves keep pace with contemporary sea level rise? A global data review. Wetl. Ecol. Manag., 24, 263–278.

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