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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Assessment of island beach erosion due to sea level rise: The case of the Aegean Archipelago (Eastern Mediterranean)" *by* Isavela N. Monioudi et al.

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We would like to thank the referees for the useful suggestions and constructive comments. Please find below our response to their comments

Referee #1

Comment 1: I would like the authors to clarify in the manuscript the drivers/components of the short-term sea level increases. Do they refer to extreme sea levels due to storm surges and waves (e.g. is wave setup included) or to storm surge alone?

Answer: This is a fine point by the reviewer. The drivers/components of the short-term sea level increases refer to extreme sea levels due to the combined effect of storm

surges and wave set up. We agree with the reviewer that it needs to be better clarified in the text and we will do so in the revised manuscript.

Comment 2: Pg.3, Lines 18 – 20 There are refs to US$ and then to € It is confusing. Please clarify; this may be confusing for the reader.

Answer: We will make the necessary changes to address this comment.

Comment 3: Also Pg. 8, Lines 21 - 22 12 SLR scenarios are mentioned, but only 11 are detailed.

Answer: This SLR scenario was missing by mistake. We will make the necessary corrections.

Referee #2

Comment 1: The width of the beach has been extracted from Google Earth images and 4 operators obtained consistent results on 400 beaches, and considers irrelevant the influence of the tide (0,15 m) on its position. But it does not take into account the fact that the baric tides can have a much greater value and add up to the astronomical one.

Answer: We certainly agree with the referee that beach width estimations from satellite snapshots may not represent mean conditions, as we have stated in the text (Section 3.1, beginning of page 7). Beach width estimations are controlled by the shoreline positions, which are dynamic coastal feature, showing large spatial and temporal variability; and being strongly controlled by the beach morphodynamic processes. Recent detailed research on one of the Aegean Archipelago beaches (Ammoudara, N. Crete) for which data of high spatio-temporal resolution are available (i.e. 10 month period hourly shoreline positions),has shown high shoreline position variability (up to 6 m, or about 10-12 % of the maximum width (Velegrakis et al., 2016). We believe that any method to record beach widths using satellite imagery snapshots, one-off land based topographic and/or LIDAR surveys or, even, video-imaging of limited duration may not provide synoptic information on the 'mean' beach conditions. Accurate estimation of mean shoreline positions requires long time series of high temporal resolution, from which estimations of the mean shoreline position could be obtained. However, such information is rarely available, particularly at the basin/Archipelago scale. Therefore, satellite imagery information appears to be the only alternative, which we deem adequate for a first assessment of the beach exposure to sea level rise over larger spatial scales. We will rewrite the text to clarify further the above issue.

Comment 2: Sediment texture cannot be retrieved from satellite images for pixel size at ground.

Answer: The sediment texture (e.g. sand or gravel) was not retrieved from satellite images, it was assessed on the basis of the available photos on the Google Earth application and other available information collated from scientific literature/reports. To address this comment there will be further clarification in the text to make it clearer to the readership.

Comment 3: No bathymetry data are presented for beaches, which affects the distance from the shore of the depth of closure, value that enters the erosion evaluation resulting in some SLR some models (e.g., Bruun).

Answer: Given the large (Archipelago) scale of the application, the input data of the models for the evaluation of beach retreat, could not be based on in situ measurements. So we used linear profiles of a wide range of beach slopes. The distance from the shore of the depth of closure and the surf zone width, values necessary for the use of the analytical models, were estimated on the basis of the beach slope. The lack of accurate bathymetry data may introduce some uncertainty. However the validation of the models showed that the results of the models set with the equivalent linear profile were reasonably close to those of the physical experiments, and that the use of the models in an ensemble mode gave improved projections, with differences between models and experiments ranging from about 3 % to 11 % (see section 4.2.1). The

aim of the exercise has not been to replace detailed modeling studies for individual beaches, but to provide ranges of beach erosion and flooding at a large (Archipelago) scale using minimum environmental information. We will make the necessary clarifications in the revised manuscript

Comment 4: Well-sorted sand was simulated, but data provided is D50, not sorting.

Answer: One of the input data needed for the models is the median sediment size D50 (not sorting), this is the reason that D50 data are provided and not sorting. We will modify the text in order to make it clearer to the readership.

Comment 5: Beach rock exposure do not degrade beach aesthetics, its presence is considered a positive factor in Coastal Scenery Assessment.

Answer: In this point we do not agree with the referee. Beachrocks not only can affect the actual widths of a sandy beach as they can promote beach sediment erosion and outcropping of the initially buried beachrocks (see Vousdoukas et al., 2007, Vousdoukas et al, 2009a), but also affect perceptions regarding the beach. The presence of weathered/deformed beachrock outcrops at the beachface, commonly colonised by assemblages of epilithic and borrowing organisms (Brattström, 1992) that form a 'slippery' mat, can make the access to the sea difficult, or even dangerous, and degrade the aesthetics and amenity value of the beach and, thus, affect its touristic potential (Vousdoukas et al, 2009b). Beachrock formation/outcropping may also change the biodiversity, since beachrock outcrops create habitats suitable for colonisation by hard-substrate species (e.g. corals, molluscs, algae and annelid worms) (Brattström, 1992; Vousdoukas et al., 2007; 2012). However, it is questionable whether the overall effect on the coastal ecology would be beneficial, particularly in view of the biodiversity losses in soft-substrate species (Brown, 1982). Beach aesthetics/scenery may also suffer by the presence of beachrocks, as beachrock beaches do not comply with the widely-recognisable beach model (long and wide beaches consisting of light coloured sands).

With regard to the tourists' perceptions on this subject, a contingent valuation study among European tourists showed that although the majority of tourists were not previously aware of beachrock phenomenon, half of them paid notice to the hard coastal sedimentary formations. Survey respondents believe that the authorities should undertake precautionary measures and that European Union should increase research funding in order to avoid further beachrock expansion.Actually, almost half of the respondents would be willing to pay an annual tax in the range of 13.2-16.4 € per household in order to contribute to this effort (Kontogianni et al., 2014).

We will clarify further the issue and add some refs in order to address the comment but due to space limitations we do not think that detailed documentation would be beneficial to the manuscript.

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