Earth Surf. Dynam. Discuss., 1, C590–C595, 2014
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Earth Surface Dynamics Discussions

Interactive comment on "Assessing the influence of sea walls on the coastal vulnerability of a pinned, soft-cliff, sandy coastline" *by* A. Barkwith et al.

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Received and published: 3 February 2014

Firstly the authors of the paper would like to thank the referees for taking the time to evaluate the article and for producing succinct comments and suggestions.

As both reviewers have noted, this paper is related to another paper recently submitted to the same journal (Barkwith et al., Earth Surf. Dynam. Discuss., 1, 855-889, 2013), where the project background and model description contain a greater amount of detail. The difference between the two papers is in the questions which they are trying to address. The paper without sea walls (natural), studies the influences of wave climate on a future, evolved morphology, while this [second] paper addresses the influence of

engineered structures on the evolution. The authors therefore would like to maintain the separation of the two studies into two separate papers; however, to highlight the link between these two papers we suggest an amendment to both of the paper titles (to be agreed by the appropriate editors):

Coastal vulnerability of a pinned, soft-cliff coastline, I: Assessing the natural sensitivity to wave climate [other paper]

Coastal vulnerability of a pinned, soft-cliff coastline, II: Assessing the influence of sea walls on future morphology [this paper]

As ESurf is an electronic journal, the physical pairing of these articles into the special issue is not considered paramount. By assigning a number into the title it should be clear that a companion paper is available.

To ensure that this paper is independent and self consistent, the manuscript will undergo a revision; particularly an expansion of the model description and validation sections. Responses to the more specific comments are contained below:

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1. (R1) "The text for this paper does not make it clear whether model behaviour is compared against historical data. I gather from a skim of Barkwith et al (Earth Surf. Dynam. Discuss., 1, 855-889, 2013, Fig. 4) that a comparison has been made, yet the question of whether this comparison represents 'validation' for the purposes of the present paper is not clear."

The model is calibrated against 15 years of observation compiled by Montreuil and Bullard (2012). This calibration allows the unknown [fixed] parameters (percentage of sediment lost to the offshore and formation resistance to erosion) within the model to be defined and for the simulated morphological changes to attain the closest match possible to their data, within the model limitations. This model calibration uses the same sea wall setup as used for this study and therefore is considered fit-for-purpose.

In the revised manuscript we will avoid the use of the term 'validation' as this implies that the data has been used to show the model is doing a good job rather than what we did, which was to find the be parameter setup with the closest fit to the observed data.

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2. (R1) "The paper explains that the analyses focus on comparing patterns and rates of coastline change between defended and undefended model runs. However, the question of the extent to which model runs replicate observed patterns seems important given that the results are described in practical terms (e.g. 100m in 90 years etc) that might find use in planning."

The comparison of the observed patterns to simulated data guides the validation phase of the modelling process. It would be possible to use this model in hindcasting sense, comparing simulated data to records over the previous 100 years. The accuracy of the initialising data would however introduce a large amount of uncertainty into the simulation. It is recognised that model limitations hinder the ability to produce the highly accurate forecasts needed for planning, however this study was more focussed on the mesoscale impacts of the sea defences on coastal evolution.

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3. (R1) "what extent is model comparison against historical data necessary for this sort of study[?]"

The historical data allows the unknown parameters and the model limitations in representing the system to be established. Cliff erosion provides sediment which is subsequently transported along the coast via longshore drift. Not calibrating the model to some observations of coastal retreat might significantly alter the amount of sediment in the system and therefore the system responses.

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4. (R1) "what defines the models dynamic steady state, which is achieved very quickly (ten years)[?]"

Dynamic steady state is achieved when the amount of sand being transported along the coastline shows a repeatable response to a particular set of driving factors. As the spin-up is undertaken using a two-year repeating wave climate, the response to the same events may be analysed to ascertain whether steady state has been achieved. The sediment transported along the coast was very similar in the 8th and 10th year of spin-up and therefore steady-state was deemed to have been established.

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5. (R1) "why was erosion simulated for 15 rather than 50 or 100 years[?]"

The 15 year validation period was selected to match the observations compiled by Montreuil and Bullard (2012). Future erosion is simulated for the 90 year period ending 2100.

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6. (R1) "why should coast with a seawall have the same erosion rate as a section of chalk cliffs[?]"

The CEM version used for this study only accepts two rock erodability factors. The chalk cliffs were represented using a very low erosion factor, and over the 90 year simulation period only undergo a negligible change. This rate of erosion was deemed acceptable for this study as the position of the sea walls remains in-situ and the sediment they provide to the system is well below 1%.

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7. (R1) "Please clarify the use of the term 'pinned"'

The use of the term pinned in this study refers to the coastline being fixed at one end due to the chalk headland. We include this definition in the revised manuscript.

8. (R1) “Please also check that locations referred to in the text are clearly marked”

We will ensure the locations are included for reference.

9. (R1) “It was a little surprising, given the similarities in the problem-space and approaches taken, to see no reference to the meso-scale modelling work of the East Anglia coast using the SCAPE model?”

Having read the reports on this work, the authors agree that there are some similarities that can be discussed and incorporated into both the introduction and discussion sections of this manuscript. The two pieces of work complement each other nicely, as the Dickson et al. (2007) focuses on the impacts of sea level rise on coastal evolution using a few selected scenarios and our study focuses on the sensitivity of the defended coast to a changing wave climate using an ensemble approach. As the reviewer commented, the geological constraints are similar at the two sites and therefore, further comparisons may be drawn from the data.

10. (R2) “Clarity is the aim. Moreover, this paper will require, as R#1 also notes (Earth Surf. Dynam. Discuss., 1, C389–C391, 2013), enriched descriptions of (1) what the CEM does to drive coastline change, (2) what the authors’ ensemble approach involves, and (3) what kinds of insights the ensemble approach lends to this particular application. The rationale is fine, but I think the argument, explication, and interpretations can be laid out in a more methodical, logical progression.”

It is agreed that the model description and setup require revision to maintain independence and self-consistence. Further attention can be given to the results and discussion sections of the paper with the aim of increasing clarity.

Montreuil, A.-L., and Bullard, J. E.: A 150-year record of coastline dynamics within a sediment cell: Eastern England, Geomorphology, 179, 168-185, 2012.

Interactive comment on Earth Surf. Dynam. Discuss., 1, 1127, 2013.