Earth Surf. Dynam. Discuss.,
https://doi.org/10.5194/esurf-2018-12-RC1, 2018

Earth Surface Dynamics Discussions
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EGU

Interactive comment on "How to explain variations in sea cliff erosion rates? Insights from a literature synthesis" *by* Mélody Prémaillonet al.

L. Naylor (Referee)

larissa.naylor@glasgow.ac.uk

Received and published: 29 March 2018

General Comments

This paper presents a much improved, extended and comprehensive database of global coastal cliff erosion which brings together the rapidly expanding number of papers in this field, in a rigorous and comprehensive analysis. Of particular import is that their analysis allows for improved understanding of the importance of rock resistance over lithology or climatic parameters as the key factor controlling erosion rates. They found that rock mass properties like joints and fractures are a fundamental control of coastal rock cliff erosion rates. They have come to these conclusions through creating a thorough, rigorous and repeatable database that can be extended through time as

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Discussion paper

more papers are published. It is thus of great scientific importance and serves as a valuable tool which can be built upon. The authors are to be highly commended for their efforts.

I really enjoyed reading this manuscript and once a moderate level of corrections are made, this will make a superb and much needed contribution to the literature. The key areas for improving this manuscript lie in six areas:

a) Improving the explanation of your methods and statistical analyses. Why did you use the tests you did? Which aspects did you test statistically?

b) Considering 'dating techniques' as an additional category of how erosion is measured and adding this category into your analysis (eg Figure 5) or explaining where this content best fits in your classification from 1D to 3D studies.

c) Threshold, non-linear behaviour of coastal rock cliff erosion. Many of the types of cliffs included often display threshold-driven, non-linear behaviour. Whilst I appreciate you needed to standardise your reporting of erosion to mm/yr-1, I also wonder if it is possible to evaluate the degree of stochasticity /non-linearity in the database. For example, it may be that certain rock resistance types are more prone to non-linear, stochastic erosion events or that the temporal frequency between erosion events varies by rock resistance category or another parameter. Finding a clever way including this alongside your mm/yr-1 would improve awareness of the behaviour of these systems for risk managers, hazard scientists and geomorphologists alike.

d) Wider context. In places, the analysis and discussion of this paper is too narrowly focussed on coastal rock cliff erosion, rather than drawing on evidence from recent shore platform research which displays similar trends around the importance of geological contingency, the importance of rock mass properties and weathering/rock breakdown (bio/chem/phys) processes helping prepare rock coast landforms for erosion. This includes the early conceptual models of cliff erosion by Sunamura as well as recent papers on rocky shore platforms.

e) Figure 1 and your discussion of it shows the importance of the wider geomorphic context in influencing erosion rates. This does not appear to be taken into consideration in the current version of your model. It would be useful for the authors to explore how this may be possible, so that a global analysis of how submarine to cliff-top coastal landforms vary around the globe and how this affects erosion rates. For example, what proportion of cliffs globally are currently shielded by offshore features such as those in part of Figure 1? Does this vary by rock resistance of the cliffs or are other factors influencing this? I realise that much of this may be beyond the scope of your current paper, but it may be useful to signpost this in your current paper, perhaps using data from both parts of Figure 1 as an example to illustrate how cliff erosion rates are modified by their wider geomorphic context, and thus are partly geomorphologically controlled.

f) Lastly, it would be useful to signpost the wider significance of your work for coastal hazards scientists, geologists and in the context of changing storminess and sea level rise. It also would be helpful to highlight the potential to extend the database to include shore platform erosion rates. This would help show the wider relevance and import of your work.

Specific Comments (SC), Technical Comments (TC)

Title

SC - You may wish to change the title to better capture the global database /analysis that is, to me, a significant strength of your paper and a very strong addition to the literature.

Abstract

SC - Show the wider relevance of your important work here

Introduction:

TC - First sentence needs reference and second sentence needs a direct quotation.

SP – wave-cut vs shore platform needs a little more discussion

TC – para 25 Fig 3 or Fig 5?

TC – para 30 cite Viles 2017 Geomorphology

Method:

SC – define your boundary conditions and cite Kennedy who first used this term explicitly in rock coast geomorphology

SC – systematic search method needs improving, this can either be quite simple as per Figure 1 in Naylor et al. 2010 or following the more detailed PRISMA method (Moher et al. 2015) stemming from medical science.

TC – Merise needs a year , pg. 3 para 25

SP – pg 4, Para 10 sentence 1 examples adding would be helpful to aid understanding of your database.

TC – pg, 4 para 5, first sentence could be reworked

SP – section 2.3.1. a) Only English is mentioned here but Spanish and French is mentioned earlier. B) define your search method and strings (perhaps as supplementary material), this will make this part of your work reproducible and improve rigour.

SP – 2.3.4 add Hurst et al. 2017 as reference for 1000s of years scale

SP - 2.3.5 last sentence is unfinished

SP – 2.3.9 can you validate your assertion in the last sentence?

SP – 2.4.4 Not all of your core readers will be familiar with the Hoek Brown criterion as it is a geotechnical/engineering criteria. I recommend you add some background information and some rationale for why this was the best metric to use. Here it would be good to explain why Selby 1980 is less suitable than Hoek Brown.

Section 3:

SP – 3.3 See comment above about dating methods.

SP – 3.4.1 fewer medium resistance rock studies, perhaps make this as a suggestion for future research in your conclusions, along with the present geographic limitations?

Section 4: SC- Para 5, page 11 - more detail on this conference, a specific pers comm would help here too.

SC- Weathering, jointing, discontinuities – Sunamura included these parameters in his early conceptual models of rock cliff, rock coast and shore platform erosion, showing how they contributed to the reducing the resisting force of rocks. The influence of these on erosion processes and rates has been more recently discussed for rocky shore platforms (See Cruslock et al. 2010, Naylor and Stephenson, 2011, Stephenson and Naylor 2012) and biology (Naylor et al. 2012).

SC - 4.2.1 para 20, this is where the threshold, non-linearity comment above relates.

SC - 4.2.3 pg 12, para 10, I recommend you refer to Kennedy et al. 2014 here as this volume has no chapter on Africa, which accords with your analysis of rocky cliffs. Doing so would strengthen this point.

SP – pg 12, para 20, does this mean it relates only to softer rocks? Please clarify. TC - Pg 12, para 25, I think this is table 2?

SC - Page 13, para 25 there are many newer rock coast evolution models including consideration of the impacts of climate change (e.g. Limber, Ashton, Trenhaile) that are worth looking at to improve your link to modelling.

Technical comments for the whole the Manuscript:

Minor improvements to your English is needed occasionally throughout the manuscript Measure often needs to be measurement

Page 13 – inshore could be confused with ‘inshore waves’; I recommend using terrestrial instead.

Page 20, what does Q83 refer to? Also add a final sentence, or extension to it that shows which rock categories this relates to.

In a few places you talk about rocky coast erosion, your topic is coastal rocky cliff erosion. For clarity about your scope and the contents of your paper, the latter term should be used throughout.

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