

Geosci. Model Dev. Discuss., referee comment RC2
<https://doi.org/10.5194/gmd-2021-28-RC2>, 2021
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a novel approach

Anonymous Referee #2

Referee comment on "ArcticBeach v1.0: A physics-based parameterization of pan-Arctic coastline erosion" by Rebecca Rolph et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-28-RC2>, 2021

General description of the paper

First of all, thank you for allowing me to review the paper. The paper was well written, the problem statement and the solutions are explained in detail. The writers developed a simplified model for large scale modelling despite limited available measurements of the parameters. The authors coupled basically three major numerical modules with different physical processes like cliff and beach erosion with storm surge interactively. The models, albeit simplified, are based on real-world physics. The authors used mainly water level to calibrate the model. The other inputs of the forcing parameters like wind speed, wind temperature and water temperatures were taken from global models.

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Major comments

Technical issues

[a] Uniform statistical distribution is used for sensitivity analysis. In Table: 1, a range of

the most influential parameters are provided. The range for each environmental parameter is quite broad. Justification to apply uniform distribution is under question. Did the authors try any other distributions with central tendency?

[b] The authors explained the effect and importance of the 'offset water level' as a proxy for some excluded physical process. Section 4.2.1 might be the place where it may be explained how water level offset indirectly compensates or estimates the notch erosion mechanism [authors did mention that the process is excluded in line 66 and also in Section#1 citing the notch erosion mechanism is not so common] Was equation#1 used to indirectly calculate notch erosion since the equation covers the portion of the cliff that is in contact with warmer seawater? This can be one explanation of why the model works despite excluding the block failure by the wave-created-notch mechanism.

[c] Assessment of how the model is performing should be determined. As a proof of concept, the model makes a strong argument. However, the accuracy of the validation is still warranted.

[d] A flow chart may be included in 'Chapter#2: Methods' to describe the methodology concisely. For example, it is not clear from the descriptions when and where the erosion process was 'not simulated' in the model. As understood, two binary switches (on/off) exist in the model: (1) the open water season in the time domain and (2) collapsed but not-yet-eroded sediments on the beach in the space domain.

Comments in general

Introduction

The introduction is well written. The requirement to establish a pan-Arctic level model is explained. The authors explained sufficiently the requirement of a simple physics-based model and the benefits of such a computationally inexpensive model.

Methods

The conceptual models are explained in this section. The major numerical modules are erosion module comprising cliff and beach erosion based on thermal energy transfer from water to the cliff via convection and a quasi-steady storm surge model based on wind

speed. The conductive heat transfer and solar radiation are not included in the model. The authors did not provide the explanation of excluding the other two heat transfer mechanism but it is reasonable to assume, the *solar radiation* is indirectly included in the seawater temperature inputs, whereas the effect of the *conduction* is 'felt' as time-lag which can be ignored when modelled for a long duration.

The authors correctly identified the problem of determining absolute water level at the toe of the cliffs and provided the detailed methodology of circumventing the issue and reaching a reasonable solution. A small description of the statistical method of Monte Carlo is also provided which might be elongated.

Results

Results are discussed by comparing the outputs of the model with the observations. However, the estimation of the accuracy is not determined. One of the model outcome anomalies is the underestimate of the erosion from 2002 to 2009 is identified, but authors need to provide a strong explanation of the deviation.

Grammar and Comprehension

The script is admirably laid out. It is recommended to re-write very few sentences (marked in the attached pdf)

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Recommendation

The journal paper is recommended to publish with minor modifications. The work provides a novel approach to simulate coastal erosion. This is one of the early efforts to understand

Arctic coastal erosion on a global level. The authors chose to use simplified models in favour of lower computation expenses and it is reasonable to exclude some physical processes. The novelty of the work is the coupling of the modules, calibration of the coupled model with water level and application of the model in two different sites.

Please also note the supplement to this comment:

<https://gmd.copernicus.org/preprints/gmd-2021-28/gmd-2021-28-RC2-supplement.pdf>