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Biogeosciences
Discussions

Interactive comment on "Short and long-term thermo-erosion of ice-rich permafrost coasts in the Laptev Sea region" *by* F. Günther et al.

Anonymous Referee #2

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General comments The manuscript summarizes a study examining the relative contributions of erosion near the foot and upper portions of permafrost-laden cliffs in the Laptev Sea region. Erosion rates at the lower sections of the cliffs are presumed to be related to mechanical abrasion by wave action and thawing (TA), while erosion rates at the upper sections are presumed to be related to solar insolation and heat advection causing thermal denudation (TD). The study is thorough, well credits prior work, and is well presented. With respect to the subject matter and scientific objective, I am excited to see this type of study as I see a strong need for this type of information and find it particularly relevant to assessing future rates of change. Based on limited research, am not aware of much literature addressing this topic.

The methodology is well described, including quantification of uncertainty in the reces-

sion rates, and appears to be repeatable. Equations are clearly presented and easy to follow. In summary, it is a very good paper and I fully recommend it be published, with some edits as outlined below.

Specific Comments The manuscript text is a bit long; the results and discussion sections cover too many topics. It is stated in the beginning of the manuscript that the overall objective is to assess the dependence of cliff recession (I prefer the use of the term recession for linear rates and erosion for overall volumetric changes) on geomorphology and relative contributions of water levels and atmospheric drivers. This is a great and very important question that needs to be answered and although providing estimates of carbon flux based on the estimated erosion volumes is also of great consequence, it distracts from the main aim of the paper and could be presented in a separate follow-up article.

Substantial conclusions are reached and the scientific methods and assumptions are valid and clearly outlined for the most part. It is mentioned that the biggest uncertainty with the NDTI approach is lack of accounting for the thermal niche at the bottom of the cliffs. Additionally, how was the base of the bluff deciphered from failed material residing at the base?

A minor semantics concern is that the term "TA" is somewhat deceptive. It is defined as erosion from the combined processes of mechanical wave action and thawing due to thermal gradients – maybe TMA (Thermal and Mechanical Abrasion) would represent the physics better?

There are several points of discussion in the text to the fact that the short term erosion rates are greater than the long-term erosion rates. Somewhere it should be noted that cliff failures are episodic, and that under such a short time period as the 'recent past' that is assessed in the study, it may be the cumulative effects of higher air and water temperatures and/or greater storm energy that caused the cliff failures to occur. Because of the episodic nature of the failures, much erosion might occur in a given

year while during prior and following years little erosion might take place.

It is recommended that a discussion regarding the cliff failure modes be included in the interpretation of the findings. The fact that TA and TD rates of erosion are very similar for alas coasts but not for the higher yedoma coasts is likely a direct reflection of cliff height (in addition to lithology and forcing mechanisms). Even in lower latitudes, it is quite common for high bluffs to erode via slides or retrogressive failures (Fig. 2 is a classic example of retrogressive failures).

Technical Corrections Pg. 2706, lines 9-12: run-on sentence. Suggest removing the last prepositional phrase 'to coastal thermo-erosion over the past 4 decades . . .'. Pg. 2706, line 10: suggest changing waterline to waterlevel. Pg. 2706 line 14: suggest changing to "... ranging in length from 73 to 95 km and analyzed. . .." Pg. 2706 line16: change "that" to "to" Pg 2707 line 17: change "The enhanced " to "Increased" Pg 2707 line 24: change "an" to "a" Pg 2711 line 2: add "and" after ". . .tundra, " Pg 2711 line 15: change to ". . .. development directed toward the coast." Pg 2711 line 25: change to " . . .drainages occur . . ." Pg 2713 line 17: typo "vincity" Pg 2714 line 22: ". . .rely. . ." Pg 2715 line 5: add comma ". . .. that is, ..." Pg 2718 Section 3.4 header: suggest changing digitilazation to "digitization" (do global change in document) Pg 2721 lines 21-23: Suggest rewording to something like. . . "The frequency of erosion rates between -0.5 and 3.5 m/yr are nearly consistent (0.03Pg 2722 line 12: mean is 0.91 for all 3 coasts. The sentence suggests that all three coasts are referred to.

Interactive comment on Biogeosciences Discuss., 10, 2705, 2013.