The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2018-234-RC2, 2019

The Cryosphere Discussions

Interactive comment on "Rapid retreat of permafrost coastline observed with aerial drone photogrammetry" *by* Andrew M. Cunliffe et al.

Anonymous Referee #2

Received and published: 1 February 2019

Cunliffe et al. present a case study for an eroding permafrost coastline along the Canadian Beaufort Sea Coast using historic photos, satellite images, and airborne images acquired from a UAV. The imagery ranged in spatial resolution from 3.5 m to 0.02 m and consisted of images acquired between 1952 and 2017 and focused on a 500 m segment of coastline. It appears that the historic imagery was already published previously (could be better clarified in the paper) and the novelty of this paper was the high temporal image acquisition using UAVs in 2017. Seven UAV surveys were used to create high spatial resolution orthophotos and digital surface models to assess coastal change rates on the order of days to weeks during July and August of 2017.

The paper is well written and organized. The study design and presentation of results are clear but need to be improved. In particular, the mismatch in image spatial reso-

lution and temporal observations require further consideration in the paper. A number of suggested edits and revisions are provided below to help refine the paper to make it suitable for publication in The Cryosphere.

General Comments

- The comparison between decadal-scale erosion rates from images with a spatial resolution that ranged from 0.5 m to 3.5 m with coastal change positions determined from images with a spatial resolution of 0.02 to 0.04 m requires further validation. This is particularly important given the assertion that erosion rates in 2017 was 14.5 m/yr compared to a long-term average rate of 2.2 m/yr, or as stated in the abstract more than six times faster. The authors need to include a suitable image from 2017 or 2018 at a resolution that is more in line with image resolutions available historically to demonstrate that the increased resolution of the UAV imagery is not responsible for the measured increase in erosion, simply due to being able to better detect the feature of interest. Doing a quick survey of images available from DigitalGlobe shows that there are some potential options available for the study site in 2017 and 2018 that could provide this necessary check.

- On line 30 of the abstract the authors report that in 2017 mean coastal retreat was 14.5 m/yr. However, in table 2 it appears that there were only 40 days of erosion analyzed during this period. It appears that the 14.5 m of erosion refers to the magnitude of shoreline change and not an annual rate. This critical point needs to be better clarified and the mismatch in temporal periods among observation periods given more careful consideration. One consideration could be that the image acquired on 2016-07-27 be compared with the image acquired on 2017-08-15 to determine the most recent annual erosion rate instead of using the 2017-07-06 for this. Reporting it in this manner and then using the UAV image acquisitions within this latter annual-scale period to assess event driven erosion patterns and controls might make for a cleaner analysis and presentation of results.

- Considering that the historic remote sensing data was apparently previously published (is this what previously analysed refers to on line 23 page 5) the authors need to enhance their methodology and presentation of the imagery acquired with the UAV surveys. The authors should provide information on the altitude of the UAV during image acquisition, the orientation of the flight paths relative to the coastline, why they recommend using front lap and side of 10 and 20 respectively while only using 5 and 10 respectively, the number of ground control points established in the field, and why the authors did not constrain their orthophotos and digital surface models using ground check points when this method is recommended in the literature. All of this should be correctable and is not seen as a major sticking point. The authors are also encouraged to maximize the use of their UAV data by analyzing the digital surface models constructed in Agisoft. Currently this assessment consists of four sentences in the results section. The authors mention that erosion occurring after the fourth UAV survey prevented proper construction of digital surface models in the latter efforts. However, the digital surface model data acquired during the first surveys combined with the shoreline positions digitized from the latter time period orthophoto mosaics should provide sufficient information to add this element to the paper.

Specific Edits and Questions

- Replace the use of grain with resolution throughout the paper

- Consider changing the use of drone to UAV throughout the paper

- Equation 1 seems to be incomplete according to variables presented in Table 1 to determine shoreline change uncertainty. Check this.

- Was the CTD data acquired in 2015 or during the study period in 2017. Check line 7 on page 7. If from 2015 how is it relevant to this study?

- Specify whether the time lapse camera in operation for 4 days imaged the study coastline during the observation period.

- Change cm per day on line 16, page 7 to m per day

- Please explain the significance of the linear regression method being more conservative than the end point method as reported on lines 23-25, page 12

- Adding field photos of the study coast would add useful information to the paper and provide a context for understanding the permafrost characteristics at the site

---

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2018-234, 2018.