

Review of
Multiple modes of shoreline change along the Alaskan Beaufort Sea
observed using ICESat-2 altimetry and satellite imagery
Bryant et al. 2024-1656

This article presents estimation of the retreat rate of an 8 km shoreline in Alaska from time series of satellite optical images (Planet) and high-resolution satellite laser altimetry (ICESat-2). The retreat is estimated for 3 years continuously along the coastline (imagery) and along three transects (altimetry). Both methods results in similar rates estimate and highlights the interannual and spatial variability of the retreat patterns. The processes potentially leading to these retreat patterns are explored.

I appreciated reading this article as it is well written, presented and concise. The methods are well explained and make good use of novel datasets. I have no background on the specific topic of coastal dynamic and cannot evaluate the quality or novelty of this work to this regard. However, from the introduction, it sounds like this is the first work using ICESat-2 data at such spatial resolution to estimate coastal retreat rate. If this is the case, it should be emphasized as a novelty of this article. Furthermore, I suggest the authors to consider the following improvement before considering the article ready to be published.

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L8 Speed formatting See the Cryosphere Author Guideline : “(e.g. 10 km h⁻¹ instead of 10 km/h).”

L12 : “*Our topographic profiles from ICESat-2 highlight three distinct shoreline types...*” Are the shoreline types really distinguished from the ICESat-2 data? It seems more like an optical images analysis. Maybe as well move this sentence before the previous sentence.

L15 “*can provide*” => “*provide*” (if it did, of course)

L20 Hard to read, citations should be moved at the end of the sentence.

L29 “*During the open water season, ~~when~~ i.e. the coasts are not sheltered by sea ice*”

L34 “*to be highly variable on local scales (~10s of meters)*” at what temporal scale are the rate variable ? Decadal like for the regional scale rates ? Or on shorter term ? I think it is important to always specify the spatial and temporal scale of the changes considered.

L67 “*Satellite-based...*” unclear if this is what will be developed in this article or pre-existing studies? In the latter case, cite studies. For instance, is there no work based on the ArcticDEM dataset?

L76 “*cm-to-dm*” write in full letter, dm is not so clear

L79 “*sub-satellite ground track*” ?

L80 “*repeat-track mode*” what other mode is there?

L83 “*water(Jasinski*” missing space

L85 “*< 10 m*” write with words

L88 “*photon data (ATL03)*”

L93 “*Jones et al. (2009)*” I would delete this to alleviate the ()

L110 “*(with negative shoreline change indicating retreat)*” to move at the first occurrence of rates description in the text

L112 “*storm occurrence, ~~and~~ storm power*” ?

L117 “by *CNES Airbus*” maybe give the satellite name. From a rapid check on <https://www.intelligence-airbusds.com/en/4871-ordering>, I get the feeling that what is shown on Google Earth might be a mosaic of a Pléiades and SPOT-6-7 images possibly on 19-09-2018 https://www.intelligence-airbusds.com/satellite-image/?id=DS_PHR1A_201809192213155_FR1_PX_W154N70_0219_03392 https://www.intelligence-airbusds.com/satellite-image/?id=DS_SPOT7_201809192147155_FR1_FR1_FR1_FR1_W153N71_02602

L120 “composition” ? Could it be more precise? geometry ?

L124 “by *Gibbs and Richmond (2015) and Jones et al. (2009)*” a bit too much importance given to citations, makes reading complicated in this part.

L130 “as *an inundated*”?

L130 “by *low elevations*” isn’t this characteristic of all the area ? Maybe give the range of elevation in the area in Study Site.

L156 “when *retreat when ocean*” ?

L162 “*time interval*” ? Interval between two successive data acquisition?

L172 “*using implemented in matplotlib contour in Python*” ?

L197 “(*ground tracks 3r,2r, and 1r, labeled in Fig. 1 (a)*)” this is, the most surprising methodological point to me. Due to the switch between forward and backward orientation, the right and left beam can be the strong or the weak beam. I understand that the time series obtained here is composed of weak and strong beam data. Although I would not expect big differences between the elevation of either beam, it should be at least commented and explained. As well, why only use the right beam? Adding the left one would increase the data sampling and if too redundant, it would provide an estimation of the uncertainty of the method.

L207 “*the SlideRule Python Client*” I know that SlideRule is public but is the code of this article available somewhere?

L213 “*uncertainties propagated from ATL03*” what error field from ATL03 are used for this uncertainty calculation?

L215 Why using 80 % overlapp ? Sounds like a lot of repetitive data? Were other values tried (no need to reprocess anything if not)?

L231 “*We identified the intersection between each ICESat-2 track and the corresponding imagery-derived shoreline and compared the shoreline positions and north-south retreat estimates derived from Planet and the two ICESat-2 boundaries*” I have one doubt: were the retreat from Planet and ICESat-2 calculated along the same direction (the only one possible being the ICESat-2 track) for the comparison?

L241 “*find that they range*”?

L245 “2019” This is just style and nothing mandatory but I would avoid starting a sentence with a year. For instance, a few sentence further: “*in late October. 2021 saw*” is not easy to read. The “.” seems an error.

L251 “*Imagery-derived shorelines **position and** retreat rates*” alternative title to avoid shoreline repetition

L258 “*corresponding to a **position** change ~~estimate~~ uncertainty of 3.1 m*”

L258 : “2.2 m, corresponding to a change estimate uncertainty of 3.1 m” this assumes uncorrelated error of both shoreline, maybe worth mentioning

L260 “*Only 6 segments across the 3-year*” maybe give somewhere the total number of segments

L264 “*Region 1 showed moderately high retreat*” Moderate or high? Sounds opposite.

L267 “with 15% of valid shoreline segments” maybe provide this metric for other years. It is hard to evaluate its meaning otherwise.

L275 “(-70.1 m of shoreline change)” this made me think: could tides and waves have an impact on the shore detection (depending on the tide, wave amplitude and the bathymetry)?

L288 “we note that it consistently falls between the upper and lower” is this result consistent with the errors estimated for both estimates (ICESat-2 and Planet). Do the error bars overlap?

L306 “that may correspond to toppled bluff material” anything visible on the Planet imagery to back this hypothesis?

L313 “(Fig. A7(b))” => “(Fig. A7.b)” I would avoid nested brackets.

L314 “in Airbus imagery from Google Earth (Fig. 6(c))” for another study: could Landsat images be useful?

L319 “a slight lowering (by 0.23 m)” I would avoid brackets as much as possible to ease the reading.

L334 “are higher than long-term historical estimates and similar to recent observations” a visual way to represent that (for future work or here it seems relevant) could be to represent with lines or rectangles previous results and results of this article on the same timeline (x axis being time, y the position change). As is done for glacier mass balance. For instance, see Fig. 8 in Falashi et al. 2023 (<https://tc.copernicus.org/articles/17/5435/2023/>). Rectangles instead of lines allow to show range or uncertainty.

L416 “in *the* 90th”?

L473 “AK” => “Alaska”

L474 “We found ~~annual~~-km-scale variability in shoreline **annual** change”?

Figure 4 If I guess correctly: add in the caption that the dashed lined are drawn assuming stable shore position during ice-on periods and evolving linearly during ice-free period?

Figure 5 Add the 1:1 line.

Figure 6 It could be useful to show a Planet image as background on the left pannel. It is a bit confusing to see the shoreline more advanced into the sea, even more with the 2024 copyright date. Maybe as well zooming in a bit more? It is hard to get information from the background image at this resolution.