The Cryosphere

Discussions

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Interactive comment on "A fully automated methodology for differentiating rock from snow, clouds and sea in Antarctica from Landsat imagery: A new rock outcrop map and area estimation for the entire Antarctic continent" *by* A. Burton-Johnson et al.

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General Comments

Burton-Johnson et al. present a new, largely automated method for identifying rock outcrops across all of Antarctica using Landsat 8 data. This paper contributes both a well-documented, open methodology as well as the resulting dataset. I wanted to especially commend the authors on their commitment to reproducible and open science.

The paper is clearly, concise, and open and will surely be widely used by the community (I know I will cite it when I update "Open Access Data in Polar and Cryospheric Remote Sensing", Remote Sensing, 2014). I look forward to seeing it fully published in The Cryosphere. Nevertheless, some edits could be made to make this method more applicable to future studies, to slightly expand the region over which Landsat data are applied, and to stylistically clarify a few points. See below for more specific comments.

Specific Comments

1) You include a short discussion of "how robust to a new sensor," but there are specific points you can include in the paper to better ensure this. Specifically, use units rather than DNs for thresholds (K, % reflectance), and also describe specifically how each threshold was set. For example, it appears that the NDSI threshold was the 95th percentile of sunlit rock. Including this would allow this method to be applied for future Landsats (to look for change), or with other sensors (to not rely on the ADD where Landsat coverage is unavailable).

2) The authors include a discussion and figure to illustrate the paucity of medial moraines in Antarctica. While this is largely true, I believe some manual cleaning must still be done. For example, in blue ice areas / the Dry Valleys, there may be some medial moraines which should be removed. A quick investigation of the Ferrar Glacier indicates this may be the case there.

3) Regarding extent of available Landsat 8 coverage – is there a mechanism in place to allow for updated data collections where Landsat 8 is now available rather than the ADD. Specifically: âĂ¢ A very quick EarthExplorer search showed that, for example, LC80021082016077LGN00 could possibly be used for Peter 1 Island. I would expect this to be the case for other sub-Antarctic islands. Please consider checking again for new Landsat 8 acquisitions, and discuss if there will be an updating procedure. âĂ¢ There have been very recent Landsat 8 off-nadir acquisitions which extend Landsat coverage further south (and more are planned for next year). Could you include these

in your analysis to reduce the areas where the ADD is needed? Will you be able to update next year to extend, too? Or is that prohibitive?

Technical Corrections

Title: This is not technically a fully automated method (manual cleaning is performed) – please edit title.

Title: "Landsat" should be "Landsat 8"

Abstract L9: I would suggest including an introductory sentence that provides motivation for the study.

Abstract L14: This is not a "fully automated" method – there is some manual cleaning. Please edit, perhaps to "largely" "nearly" or "overwhelmingly"

Abstract L18: May need to edit latitude (see Specific Comments)

Abstract L19: please indicate what physical areas 0.18% corresponds to.

P1 L21: I suggest citing appropriate examples where the ADD has been used.

P1 L26: Should "data" be treated as singular or plural?

P1 L27-28: Parenthetical note is perhaps presented too early for smooth flow of an introduction.

P1 L21-29: You should include some durable citation for the ADD if at all available. And/or a citation describing the dataset.

P2 L1: Consider adding a figure to illustrate the issues in the ADD dataset?

P2 L1: Comma after "Additionally"

P3 L8: "Landsat" should be "Landsat 8"

P3 L19: Follow parallelism in sentence structure – "...and be divided into sufficiently large scenes to allow for manual selection of suitable tiles for the entire continent."

P4 L1: Note that when building the Landsat Image Mosaic of Antarctica, Bindschadler et al. used TOA reflectance as well, given then largely dry and thin atmosphere over Antarctica. This could be a good supporting reference for TOA, if you wanted to include one.

P4 L10: I love that you're sharing your code! Perhaps also consider putting it on GitHub to allow sharing, editing, forking, etc.?

P5 Eqn2: You use the "TIRS" acronym, so to be consistent I think you should also use the "OLI" acronym, rather than referring to it as the Landsat 8 platform.

P5 L8: Please clarify whether "liquid water" refers to ocean, on land, or melt ponds on ice (or all of the above). It is a little confusing right now.

P5 L11-12: What is "blue intensity"? Reflectance? Some index?

P5 L23-24: Aren't all Antarctic satellite images already provided in Antarctic Polar Stereographic? Why is any reprojection necessaru?

P5 L26: "Landsat", not "LANDSAT"

P6 L3-6: Include total area used for this? What about an error matrix for this test?

P6 L11: reference formatting

P7 L14: See Specific Comments.

P7 L15: Have you considered including some quality information in the dataset, which indicates the date/image from which a particular polygon was digitized?

P7 L20: Somewhere in the discussion, it would be good to acknowledge the issues that TIRS has been having, its recalibration efforts, etc. This is important if your TIRS thresholds are at all sensitive...

P7 L27: What was used as "truth" for this manual removal?

P8 L7: Include space after "km2" and before "total"

P8 L10-17: See Specific Comments. The modification and selection of thresholds should be discussed more in depth in methods to facilitate this cross-application.

P8 L26: Period after "respectively" (not a comma)

P8 L27: May need to amend sentence with information about subantartic islands / off-nadir acquisitions (see Specific Comments).

P8 L27: Include are which 0.18% corresponds to.

P8 L28: "...48% of the previous estimate (0.37%, _____ km2)."

Figure 1: The snow reflectance line is solid in the legend but dashed in the figure. Make it solid in the figure. Consider using line colors from ColorBrewer to help colorblind readers.

Figure 2: Where did these data come from? Are the shadowed areas rock, it is hard to the viewer to see.

Figure 3: I don't find this figure very helpful – especially given Specific Comment regarding Ferrar Glacier. Could be removed or combined with other figure I suggest (illustrating issues with ADD).

Figure 4: In general, I don't see a systematic use of boxes and arrows to indicate particular inputs/outputs/actions. For example, rather than have an arrow pointing at "Identify Sunlit Rock" or "Identify Shaded Rock," these should be larger boxes (possibly shaded background) which encompass the specific tasks which achieve those goals. âĂć In the top box "corrected" is not the right word, I don't think. "Pre-calculated" or just removed it, perhaps? âĂć Relatedly, when are mask arrows being added or removed from each other? Clarify. âĂć Units should be used either instead of or in addition to the DN values for TIRS and Blue âĂć Remove superfluous steps (e.g. possibly reprojection, or "repeat steps for all Landsat images" âĂć What method specifically was used for mosaicking Landsat rasters? What process used for overlapping areas? âĂć What connectivity or filtering was used in polygonization? âĂć Rather than clipping

ADD to a particular latitude, consider clipping to specifically areas of no Landsat? âĂć Caption can deleted "using the new methodology" – this is implicit.

Figure 5: Regarding y axis units – some are clear (e.g. NDSI, NDWI), but it would be good to clarify the units/scaling factors for TIRS, Blue, etc. Also, again, what is "Blue Intensity"? Do you mean reflectance? Finally – how were test areas selected? And are "n" values pixels?

Figure 6: See Specific Comment regarding islands and coverage.

Figure 7: Include NDSI threshold either annotating figure (or in supplementary information if you think that would be too crowded). Also, consider organizing a-j by type of scene (or labeling as such) to make translation between text (P6 L11-16) and the structure of the figure easier. Two specific comments: "tree" should be "three" and "Automated Outcrop Identification" should be "Automated Outcrop Identification (presented here)"

Figure 8: How were areas chosen to not use any Landsat imagery? What if outcrops are showing up in new locations? Is there a method to handle that sort of change? Or inform selection of imagery from other sensors?

Figure 9: Should "Jr" have a period after it in the citation?

Figure 10: I would cut off the y axis of part b at 2 or a little below and include a label to indicate the large bar. It would make the rest of the figure more readable.

Figure 11: In the figure, it is not clear what is seawater – partly because it is zoomed in so much, and partly because of the lack of color. Please fix the figure to clarify this. Consider including a "because..." at the end of the caption to explain the conservative estimation.

Supplemental data: Include list of Landsat scenes as txt or csv (in addition to PDF) to allow it to be more easily used in the future.

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