The Cryosphere Discussions

The Cryosphere Discuss., author comment AC1
https://doi.org/10.5194/tc-2021-2-AC1, 2021

Reply on RC1

James Ehrman et al.

Author comment on "Ice roughness estimation via remotely piloted aircraft and photogrammetry" by James Ehrman et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-2-AC1, 2021

Thank you for your constructive comment.

The text has been thouroughly reviewed by the authors to addresss issues of clarity in the methodology, disucssion, and hypothesis validation.

Regarding your specific comments:

- Re: Section 2
  - Subsections have been added to Section 2
- Re: Section 4.1
  - Additional text added to section to clarify.
  - In essence, the data gathered using the RPA in the land-based test scenarios required geo-rectification to make a meaningful comparison to the data collected with the GNSS survey equipment. For the comparison of data collected at the river sites, the exact elevation of the ice cover was not of concern, rather the texture and roughness height. The elevation of the ice cover, and any large trends in it were removed during the filtering stage.
- Re Section 3.2.4
  - Additional text was added to the section to clarify.
  - The observed ice Manning's n is the value derived from the RPA data using the methods outlined in section 3.2.3 (observed DEM -> filtered DEM -> statistical values representing roughness height (SD, IQR, etc...) -> Manning's n calculated from the statistical values using the Beltaos equation)
- Re Line 275
  - Additional text was added to the section to clarify
  - Since the Nezhikovskiy equation illustrates a relationship with ice thickness and subsurface ice roughness, a relationship between surface ice roughness (as observed by the RPA) and ice thickness would imply a further relationship between surface and subsurface ice roughness, since both have a definable relationship with ice thickness.
- Re Fig. 10
  - The figure axis was clarified to "RPA Observed Ice Surface Manning's n", and the y-axis has been renamed to "Nezhikovskiy Predicted Subsurface Ice Manning's n".
  - This naming convention has been applied throughout the work for consistancy
- Re End of Section 5.3.2
  - The text has been expanded in Section 5.3.2, as well as previous sections where this

possible relationship has been brought up.
    - The topic of this comment was addressed in comment response "Re Line 275"
- Re Beltaos Equation
    - Changes to the text have been made to clarify this.
    - The original formulation of the Beltaos equation requires the roughness height (D) of the subsurface of an ice cover. Since the hypothesis is that the roughness of the upper ice surface (surface) and the lower ice surface (subsurface) are the same, the roughness height observed with the RPA is used in the Beltaos equation to determine the observed ice Manning's n, which is then compared to the ice Manning's n predicted by the Nezhikhovskiy equation.
- Re Section 3.1.2
    - The text has been expanded to clarify.
    - The hydraulic radius was estimated using a 1D at-a-station hydraulic model based on Manning's equation. Ice thickness was determined through a combination of measurements using ice-coring equipment when safe, and visual observations from field visits, photos, and ice-transects.
- Re Line 255
    - Text has been clarified.
    - The algorithm used is "peakpick" available in R through the peakPick package.
- Re "i" in Eq. 2
    - Clarification has been added to the text.
    - "i" refers to ice, to distinguish the Manning's n associated with ice from the usual application of Manning's n, which is stream bed roughness.
- Re "p" in Line 275
    - The text has been expanded to clarify this.
    - In the context of this research, and through the evaluation of the significance of the applied linear models, the p value is a measure of the probability that the data show a significant trend through random chance, and not through an actual relationship. The lower the p value, to more confident one can be that a real trend has been detected, and thus an acceptable p threshold is selected, generally less than 0.05.
- Re Table 6
    - Text has been expanded to clarify.
    - The F statistic is another commonly reported criteria for the evaluation of linear regressions. It should be compared to the Critical F value (now included in the text). The F statistic also usually reports the degrees of freedom of it's components, which in this study is 1 and 4.

Your comments were very helpful in building a stronger paper, and the authors would like to thank you for your time in reviewing our work.