Review of Picard et al., Spatio-temporal evolution of snow depth observed by time-lapse laser scanning in the Alps and in Antartica, submitted to The Cryosphere Discussions

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The paper by Picard, Arnaud, Panel, and Morin entitled "Spatio-temporal evolution of snow depth observed by time-lapse laser scanning in the Alps and in Antarctica" introduces and discusses a laser scanning snow depth instrument based on the combination of a commercially available lasermeter with an in-house designed two-axis scanning platform. The authors describe design and functionality of the sensor, describe its deployment at Col de Porte France and Dome C Antarctica, and evaluate its accuracy and spatial resolution. Measurements obtained at the two deployment sites are used to illustrate the effectiveness of the instrument to measure the spatial and temporal evolution of the snow pack within the range of the sensor.

The paper is generally well written and organized with some minor grammatical and clarity issues. The title of the paper implies that the focus is on the evolution of snow packs at the two research sites but 90% of the paper is really about characterizing a new scanning instrument for measuring the spatial and temporal evolution of a snow pack and the two research sites are used as examples of the instrument application. If the focus of the paper was actually on the spatio-temporal evolution of snow packs in the Alps and in Antarctic, I would argue that the limited spatial and temporal extent of this project are largely inadequate. However, both sites are extremely suited for a proof-of-concept which is really the focus of this paper. Following this, I would suggest a revision to the title to something like "The design and application of a scanning lasermeter for monitoring the spatio-temporal evolution of snow depths and its application in the Alps and in Antarctica". More specific revisions are suggested below, including some suggestions to improve the English wording and grammar.

Abstract:

Page 1 Line 6: Change "copies" to "instruments" and following "Antarctic" and "French Alps" add "(Dome C)" and "(Col de Porte)". Consider changing "daily" to "continuously".

Line 11: It might be unclear to some readers what is meant by "disconnected from snowfalls" so please clarify.

Line 12: Suggest changing "At last" to "Finally, ".

Line 13: Define RLS

Introduction:

Page 2 Line 10: "their formation *are* still not…"

Page 3 Lines 7-8: The wording in this sentence is a bit off. Try "The instrument is able to scan areas of over 100 square metres, every day, for a cost less than ten single ranging probes, or a tenth of the cost of a common TLS."

Line 10: change "copies" to instruments (perhaps other occurrences of this as well)

Line 12: "…during one *of* the winter…"

Lines 16-18: The sentence "The specific…" is awkward and needs to be re-worded.

Materials and method:

Line 30: I assume that you mean that you tested the Dimetix as a stand-alone instrument for several years. You should clarify this.

Line 31: "…take point measurements into a 2D scanner…". Remove "only"

Page 4 Lines 2-3: Are these specifications from the manufacturer? Reference?

Line 4: I'm not sure what you mean by "…and individual range measurements." Do you mean "…with individual range measurements" as in not to get the two confused. Perhaps clarify this.

Line 5: Perhaps use the term "manufacturer" instead of "constructor". This occurs in several other places as well.

Line 8: "Among them, it was found that the brightness of the environment during our early tests was an important…"

Line 19: "drop from 0.8 ms-1 on…" is confusing, re-word.

Line 20: should be a comma after 10 m and again after 30 m to make the sentence read better.

Line 30: "The chosen potentiometer model *has* a linearity…"

Page 5 Line 1: What is "(1 unitcm resp.)" mean. I don't understand what the respective reference means. Please clarify.

Line 2: "…but is not compensated by differencing."

Line 4: "…the other above mentioned sources…".

Line 13: should be a comma after "parameters"

Line 14: Is the lifetime of the laser provided anywhere? This might be a good place to do this.

Line 22: The formatting of the equation seems to be messed up.

Line 26: "…allows *us* to sample…"

Line 27: comma after "30 s"

Line 28: "…except during the 4 hours when the RLS…"

Lines 31-32: add "(left)" and "(right)" after Col de Porte and Dome C to indicate their position in the figure.

Page 6 Line 4: "consequence" should probably be plural

Line 7-8: I think you could find a way to more simply state that the structure sinks as the snow beneath the mount densifies.

Line 10: Is "stacks" supposed to be "stakes"?

Line 23: "It consists of the following…"

Line 27: should be "…to remove ranges that are too short…and ranges that are too long…"

Page 7 Line 30: Is there a reference for the WMO-SPICE experiment? Several papers have been citing "Nitu, R et al.(2012) " WMO intercomparison of instruments and methods for the measurement of solid precipitation and snow on the ground: organization of the experiment" or Rasmussen et al (2012) "How well are we measuring snow: The NOAA/FAA/NCAR winter precipitation test bed".

Results:

Page 8 Lines 14-15: The sentence might read better if the i.e. part of the sentence is contained in parenthesis

Line 26: Perhaps "dysfunction" should be "malfunction"

Line 28: "…the *specifications for the* lasermeter is for a …"

Line 31: I may have missed something but why the interruption period during Austral spring? Please clarify this is you haven't done so.

Page 9 Lines 1-2: "…is the jamming of the stages. This could be caused from snow accumulating in the cap housing of the device or possibly because …"

Line 27: "…variations give *a* higher bound…"

Page 10 Line 11: "weak" should maybe be "low" or "unacceptable"

Line 23: "measure" should be plural

Line 26: "…which prevents any further exploration of this hypothesis."

Page 11 Line5: "technique" should probably be plural

Line 7-8: "…it would tend to negatively bias all the snow depth measurements at Col de Porte while Dome C would not be affected."

Line 17: "similarly" should just be "similar".

Line 20: "…averages *a* hundred single…"

Line 24: "…when evaluated *at* single points."

Page 12 Line 32: sentence would be more readable by changing to "…which remained high (around 8 cm) until 22 April 2015, only a few days before…"

Page 13 Line 11: Change "vain" to "it difficult".

Line 14: "…(Figure 3) than it is at Col de Porte."

Line 19: "of the failure" should be "for the failure"

Lines 20-23: The sentence "…and it was shown that…" is a bit confusing and should be re-worded.

Line 24: insert comma after “period”

Line 25: remove “of” from the first sentence. What is mms^{-1}? Should that just be ms^{-1}?

Page 14 Line 7: “value” should probably be plural. Same in line 8.

Line 10: “due *to* redistribution…” and “measured *at* any…”

Line 15: Missing a parenthesis after “…for the RLS.” Remove the rest of that sentence.

Line 16: “…are similar except *for* a general…”

Section 3.6: These sections provide the “proof-of-concept” test for the sensors which is appropriate, but they do have some extraneous information that has been added about the conditions of the snow pack at the sites. Some of this is relevant for the testing of the instrument and some, although interesting, is not as relevant. You should consider reducing these sections.

Discussions:

Page 14 Line 27: “…designing *a* snow depth survey…”

Line 28: “determine” should be “determining”

Page 15 Line 4: “…in 2015, the *trends in the* 5-point mean…”

Line 16: “snowfalls” and “events” should be singular

Lines 18-19: I think the sentence should be “…that are sufficient to reduce the error due…”.

Conclusions:

Lines 31 onward: put this paragraph into the context of the sensor test, otherwise it is just extraneous information.

Page 16 Line3: “Further work includes improvement…”

Line 8: “…is continuous” should be “are a continuous”

Line 16: “…paves the way *to answer* questions…”

Line 21: “communicate” should probably be “determine”.

Figures:

Page 22 Figure 2: a close up photo of the instrument would be useful and interesting.

Page 28 Figure 8: Scale on the right hand side should indicate units. A north arrow on the figure would also be good. In the caption, wind slab should be two words.