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Geoscientific Model Development Discussions

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Interactive comment on "Snow profile alignment and similarity assessment for aggregating, clustering, and evaluating of snowpack model output for avalanche forecasting" *by* Florian Herla et al.

Anonymous Referee #1

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A motivated and well conducted application of dynamic time warping alignments

Note - this comment only covers the aspects concerning the alignment algorithm.

General comments ————–

In their paper, Herla et al. develop a model to compare snow packing profiles based on the alignment of their stratigraphy. The alignment procedure is based on the dynamic time warping (DTW) algorithm; in short, it enables the flexible comparison and clustering of snow layer profiles.

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The paper is well written and it makes a convincing case for the use of DTW. Notably, it introduces non-trivial domain-specific adaptations: for one, a cost metric built from a weighted combination of heterogeneous discrete parameters (grain type, hardness, age). Each variable is preprocessed carefully in a knowledge-based way (e.g. grain type was addressed through a suitable similarity matrix). Another adaptation is the selection of open-ended alignments coupled with slope-limited patterns, with suitable weights and windows sizes serving as hyper-parameters. The description of the DTW algorithm and the construction of the local cost matrix D are appropriate and clear.

Specific and technical comments ——————

I only have a few minor comments, mostly for the sake of precision.

* Page 9. "In fig. 1..." . Figure 1 is illustrative, but it uses different warping parameters than your final set (e.g. constraints). Hence, consider adding "*As an illustration,* in Figure 1...".

* «no "stopping" or "going back" is allowed.» To be more precise: «no "going back in time" is allowed». Actually some patterns, such as your illustration of Figure 1, do allow local "stopping", as you note.

* In 2.2.4. (and possibly other places) "The symmetric Sakoe-Chiba local slope constraint" is mentioned. However Sakoe-Chiba's paper introduced *several* possible recursions (see their Table I). Specifically, the one you adopt appears to be "P=1, symmetric". This should be made explicit. You may also mention that it's "symmetricP1" in R.

* Please mention the dtw R package used and the corresponding version.

* "Mirroring D about its anti-diagonal". An alternative, possibly simpler way to express this is to say that one reverses both time series.

* Appendix A: "(the weighting factor 2 indicates that both indices i and j have been incremented)". Weighting factors, or slope weights, ensure that the normalisation pre-

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factor in A2 is path-independent and has that specific form. [This is well explained in Rabiner-Juang's book on speech recognition.] Either omit the sentence or rephrase slightly, e.g., "the slope weights depend on the local indices' increments and ensure that alignments can be compared".

* "(expressed as Manhattan distance)" to clarify: "(expressed as Manhattan distance *from the matrix origin, for symmetric recursions*)"

* Possible material for SI: - A figure with step patterns and weights, e.g. subfigure A) plot(symmetric2) because it is used in Figure 1, and subfigure B) plot(symmetricP1), used by your alignment, for comparison.

TG

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