

1. Please provide a citation for the RGI.

Thank you for this comment. We have added the formal citation for the Randolph Glacier Inventory version 7.0 at its first occurrence in Sect. 2.

2. Please describe the solution of equation 1 in more detail. Equation 1 does not necessarily have a solution (even with constraints) because if any two of the data sets are identical, a range of different weightings will produce the same misfit. Please include the solution technique used, and describe how degenerate solutions are avoided.

Thank you for this important comment. We agree that the original description of the solution of Eq. (1) was insufficient, particularly regarding the possibility of non-unique or degenerate solutions. We have revised Sect. 3.4 to describe the optimization procedure in more detail. The weights were estimated by minimizing the least-squares misfit between the UAV-derived reference velocities and the weighted satellite-derived velocities, using the sequential quadratic programming algorithm implemented in MATLAB `fmincon`, with explicit non-negativity and sum-to-one constraints on the three weights.

To address the possibility of degenerate solutions, we added additional diagnostic checks. Specifically, we examined whether any two input velocity fields were identical or linearly dependent over the common valid UAV calibration pixels, checked the rank/conditioning of the design matrix, and repeated the optimization from multiple initial weight vectors. These tests showed that the three input datasets were not degenerate in the calibration area, and the optimization converged to the same weight combination within numerical precision. Therefore, the final weights were stable and remained unchanged compared with the previous version.

3. If I read section 3.4 correctly, the three weights are single numbers that apply everywhere. Please provide these weights.

Thank you for this comment. The three weights are indeed sensor-level weights estimated from the UAV calibration area and applied as global constants to the monthly velocity maps. We have now explicitly reported them in Sect. 3.4:  $w_L = 0.3351$  for Landsat,  $w_{S1} = 0.0990$  for Sentinel-1, and  $w_{S2} = 0.5659$  for Sentinel-2. We also clarified that local

renormalization is applied only when some input datasets are missing, rather than re-estimating spatially varying weights.

4. I was confused why the infilling-with-S1 step was necessary and how it works. Infilling should only happen when  $M_{S2}=M_L=0$ , and in this case equation 2 gives  $F=S1$ . Please explain more about when and why the infilling is needed.

Thank you for pointing out this ambiguity. We agree that the previous description did not clearly explain the relationship between Eq. (2) and the subsequent Sentinel-1-guided correction/infilling step. As the editor correctly noted, when both optical inputs are missing ( $M_L = 0$  and  $M_{S2} = 0$ ) and Sentinel-1 is valid, Eq. (2) reduces to a Sentinel-1-only estimate. In our workflow, however, this value is treated as a preliminary fill rather than as a final corrected fused value. We found that directly accepting such Sentinel-1-only pixels produced noticeable local roughness and discontinuities, likely because Sentinel-1 offset tracking is less reliable in the steep and deeply incised terrain of the Kangri Karpo region and can differ from the Landsat- and Sentinel-2-derived velocity patterns. We therefore introduced the enhancement-coefficient field to locally correct the Sentinel-1-only estimates using neighbouring pixels where both the preliminary fused velocity and Sentinel-1 velocity were valid. We have revised Sect. 3.4 to clarify when the Sentinel-1-only preliminary fill occurs, why direct use of it is insufficient, and how the enhancement-coefficient correction is applied.

5. In section 3.4, the spatial variance does not seem like a particularly good measure of smoothness because (1) it has unintuitive units and values (to interpret the results here, the reader needs to take the square root of the values) and (2) it mixes signal (the spatial variation in velocity) and noise in a way that doesn't seem very informative. Is this really just the sum of the variance in the east- and west- components of the velocity over the monthly maps? It seems like it would be more informative to present the RMS deviation of each monthly map from a reference velocity map (perhaps the interannual mean of the fusion product).

Thank you for this helpful suggestion. We agree that spatial variance is not an ideal metric for evaluating image smoothness because its unit is not intuitive and it may mix real spatial velocity gradients with noise. Following the editor's suggestion, we replaced the previous spatial-variance-based smoothness metric with the root-mean-square deviation (RMSD) of each monthly velocity map from a reference velocity map. The reference map was defined as the 2015–2024 mean fused velocity map, and all velocity values were converted from  $m d^{-1}$  to

m yr<sup>-1</sup> before calculation.

The revised Figure 5 now presents the RMSD-based image smoothness assessment for Landsat, Sentinel-2, the fused product, GoLIVE, and ITS\_LIVE over Yanong and Xirinongpu glaciers. The fused product shows lower mean RMSD than the pre-fusion optical products in both test areas, with mean RMSD values of 37.8 m yr<sup>-1</sup> over Yanong and 69.2 m yr<sup>-1</sup> over Xirinongpu. We have revised Sect. 3.5 and Sect. 4.1 accordingly, replacing the previous spatial-variance calculation with the RMSD-based smoothness assessment.

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6. Please provide a citation for the elevation data used to calculate slope and aspect.

Thank you for this comment. We have added the citation for the elevation dataset used to derive slope and aspect. Specifically, slope and aspect were derived from the Copernicus DEM GLO-30 product, and the corresponding dataset reference has been added to the reference list.

7. The data availability section is incomplete. Data products derived during this study need to be published in a public repository and sources for other publicly available datasources used in this study need to be provided.

Thank you for this comment. We have revised the Data availability section. The derived 30 m monthly glacier surface velocity products for the Kangri Karpo region during 2015–2024, together with the main analysis products used in this study, have been deposited in Zenodo and are publicly available with a DOI. We also added the sources of all publicly available datasets used in this study, including Landsat 8/9, Sentinel-1/2, RGI 7.0, Copernicus DEM GLO-30, ERA5-Land, GoLIVE, and ITS\_LIVE.