

Earth Surf. Dynam. Discuss., referee comment RC2
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Comment on esurf-2021-21

Tobias Bolch (Referee)

Referee comment on "Spatio-temporal variations in glacier surface velocity in the Himalayas" by Yu Zhou et al., Earth Surf. Dynam. Discuss.,
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The study investigates winter velocity of glaciers along the Himalayan arc for the periods 1999 – 2000 and 2017 – 2018 based on Landsat ETM+ and Sentinel-2 MSI data and relates the velocity and its changes to topographic parameters and glacier mass balance. The major finding is that “ glacier surface velocity in winter has uniformly decreased in the western part of the Himalayas between 1999 and 2018, whilst increased in the eastern part”. This finding contradicts earlier findings of Dehecq et al. (2019) for summer velocities. If true the results would be interesting and relevant.

However, the manuscript suffers from major flaws making the results questionable. The most important comments are detailed below:

- It needs to be better clarified why winter data were chosen. Moreover, the typical seasonal patterns of velocity changes need to be better considered for the comparison. Typically glacier speeds up in early summer but velocity decreases again in late summer after the subglacial drainage system is fully developed. It can also be possible that glacier speed in autumn is lower than in winter. The authors need to much better consider the literature in this regard and may consider to look at the seasonal changes at least for selected glaciers. S-2 data might be feasible for this. The authors may also think about using Its-Live data (Gardner, A.S., Fahnestock, M.A., Scambos, T., et al., 2020. ITS_LIVE regional glacier and ice sheet surface velocities. Data archived at National Snow and Ice Data Center. <https://doi:10.5067/6II6VW8LLWJ7>.)
- Glaciers are typically covered by snow in winter making it more difficult to obtain reliable velocity data. This is especially true to the western parts of the study region where winter accumulation prevails. The authors need to consider this effect and

provide much more information about the suitability of the selected data. Looking at figure 4 I have also the feeling that there are several miscorrelations and the outlier filtering needs improvement.

- The author's measure of the uncertainty needs several improvements.
 - The authors estimate the uncertainty by comparing the overlapping areas between two adjacent image pairs. However, they do not provide the information about the accuracy of the results over stable area which is the usual way to estimate the uncertainty. The authors should do so also taking snow cover into account.
 - The authors use stable glacier outlines, but specifically surging glaciers are changing strongly. This issue needs to be addressed in the uncertainty estimation.
 - The impact of the different resolution of the ETM+ and S-2 MSI data needs to be considered.
- The R-values of the correlations of the velocity/velocity changes are very low or impacted by outliers. This hints also that there is some problem with the derived results.
- Overall, the methods section needs much more details. I recommend to have an own data and methods section.
- In general, the overall structure needs improvement and more background information about the climate in the study regions provided. The own results should be better presented in an own section and the derived results (especially also of the statistical analysis) better put into context of the existing knowledge.

I recommend therefore to reject the manuscript in the current form but like to encourage the authors to improve and resubmit their work.