Pre-collapse motion of the February 2021 Chamoli rock-ice avalanche, Indian Himalaya

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Response to Reviews

Review 1

Dear Authors,

The manuscript is written well and address the research questions defined by you. However, I have some suggestions/comments before the manuscript is accepted for publication in NHESS.

We thank the reviewer for these comments, and for their positive assessment of our manuscript. We have responded to the comments in detail below, with the review comments given in black and our responses in red.

Himalayan terrain many times induces decorrelations. due to its topography as well as vegetation. The authors have tried to implement simple DInSAR methodology and were unable to obtain good interferograms. Loss of coherence is the main challenge to the InSAR application in the area.
I am afraid that simple PSI technique will hardly yield any significant result. Even the techniques such as SBAS, SqueeSAR etc may also fail to produce anything. As a suggestion you can try A-DinSAR techniques such as SBAS or techniques based on distributed scatterers such as Quasi PS (Perissin & Wang, 2011; Razi et al., 2018) or SqueeSAR (Ferretti et al., 2011) in this region.

Perissin, D., & Wang, T. (2011). Repeat-pass SAR interferometry with partially coherent targets. IEEE Transactions on Geoscience and Remote Sensing, 50(1), 271-280.

Razi, P., Sumantyo, J. T. S., Perissin, D., Febriany, F., & Izumi, Y. (2018, August). Multi-temporal land deformation monitoring in V shape area using quasi-persistent scatterer (Q-PS) interferometry technique. In 2018 Progress in Electromagnetics Research Symposium (PIERS-Toyama) (pp. 910-915). IEEE.

Ferretti, A., Fumagalli, A., Novali, F., Prati, C., Rocca, F., & Rucci, A. (2011). A new algorithm for processing interferometric data-stacks: SqueeSAR. IEEE transactions on geoscience and remote sensing, 49(9), 3460-3470.

A study has been done like this on the same study area. They have claimed that they have used PSI on the regional level.
Kothyari, G. C., Joshi, N., Taloor, A. K., Malik, K., Dumka, R., Sati, S. P., & Sundriyal, Y. P. (2021). Reconstruction of active surface deformation in the Rishi Ganga basin, Central Himalaya using PSInSAR: a feedback towards understanding the 7th February 2021 Flash Flood. Advances in Space Research.

Thank you for pointing out the difficulties of performing InSAR measurements in such challenging terrain. As we note in our manuscript, shadowing and decorrelation are particularly problematic on this face. The primary issue is that the release zone is in radar shadow in the images of the ascending orbit and is affected by layover in the descending orbit. The additional tools that you mention (PSInSAR, SBAS, SqueeSAR etc.) are all time-series analysis tools. We did not attempt to generate a time-series for the Chamoli failure because the data quality is too low. In other words, too few coherent pixels are present in the failure area to allow for the extraction of a time-series or the generation of a stack, therefore we cannot apply time-series tools in this case.

Kothyari et al. (2021) do indeed present an attempt to reconstruct regional displacements using PSI. However, their regional map of cumulative ground displacement (Figure 8b) does not show any exceptional signal at the site of the Chamoli rock-ice avalanche. Instead, their results exhibit ~40 mm anomalies across the entire study area, suggesting that noise dominates over any signal. Their cumulative displacement timeseries also show no long-term pattern consistent with an unstable block, instead fluctuating around zero (as expected for noise). This is compatible with our finding that the data quality is too low to detect the displacement signal

For Figure 6b, I suggest the authors check all the available interferograms to confirm that the two areas marked with “Rock glacier motion” are always moving. From only one interferogram, it is hard to say the motion. The area marked with “Atmospheric noise” seems not so evident because there are some strange values in the surrounding area possibly caused by unwrapping errors due

to the low coherence. If these areas can't be confirmed from other interferograms, I suggest writing these areas are possible rock glacier motion or possible atmospheric noise. I suggest also writing "2.8 cm" in the caption of Figure 6 after "wrapped phase".

Thank you for this comment. The rock glacier motion was indeed labeled as such after the analysis of all available interferograms, as well as the study of optical images that identified the landscape features as such. The area denoted as "Atmospheric noise" cannot be caused by unwrapping errors, since our figure shows wrapped phase which has not yet been unwrapped. However, the cause of this specific fringe pattern is somewhat unclear, and we agree that labeling it with "possible atmospheric noise" is preferable. We have also implemented your suggestion for the addition to the caption.

In figure 6b, I'm not completely sure about the "atmospheric noise". I suggest to check the displacement time series, if available, because atmospheric noise can be identified as strange peaks.

We agree with this comment and have responded to it in more detail above.