Anonymous Referee #2

General Comment

Nanni et al. developed a processing protocol for the detection and assessment of short-term glacier velocity changes from satellite EO and applied the method in an interesting study on seasonal variations of glacier velocity in the Pamir mountains (2013-2020) and its connections with local climate. The primary source data for generating high spatial- and temporal-resolution time series of ice velocity are NASA/USGS Landsat 8 and Copernicus Sentinel-2 optical satellite imagery, which are processed using the open source COSI-corr software. The post-processing steps include an extensive filtering procedure, calibration and central flowline velocity extraction. In this way the authors analyzed tens of glaciers with different characteristics and generated detailed spatiotemporal velocity plots for investigating seasonal variations in ice velocity.

Most of the glaciers exhibited an annual recurring speed-up in the spring/summer and roughly half a lesser pronounced additional speed-up in autumn/winter, separated by slower velocities in between. Looking in more detail the spatiotemporal pattern revealed an upstream migration over time for the spring/summer speed up and a downstream migration for the autumn/winter speed up in most cases. Using the long-term averaged (1933-1995) air temperature dataset from a nearby station the authors find a good correlation of the evolution (timing and location/elevation) of the speed-up events with the migration of the isotherms, while other factors seem to have lesser pronounced or no relation (slope, orientation, velocity). The authors further provide a convincing discussion on the role of the efficiency of the subglacial hydrologic system, varying during the year, as a main driver for the observed accelerations.

The topic of this paper, seasonal variations of glacier surface velocity and its climatological controls, is very interesting and relevant, in particular thanks also to recent advances in modern computing technology and increasing availability of satellite EO data. This paper by Nanni et al. is a well written, illustrated and referenced manuscript and a valuable and original contribution of interest for the glaciology and wider community. The authors givea good motivation for their work, a detailed description of their methods and results and provide a set of interesting observation and a thorough discussion. The outcome provides new insights on seasonal variability of glaciers and environmental drivers in particular relevant for glacier and climate research. Some specific comments, corrections and suggestions for improvements are provided below.

We sincerely thank the anonymous referee for providing such a positive summary of our work. We have addressed the different comments and suggestions, and this has helped improve the manuscript.

Specific comments:

Pg 2 – Ln 25: of the same order noise: of the same order as the noise
This was changed accordingly in the main text.

Pg 2 – Ln 26: which limits: complicating

This was changed accordingly in the main text.

Pg 2 – Ln 30: 10-day glacier velocity changes over 7 years: I know what is meant, but found this notation somewhat confusing. Later on it is also mentioned that 20-day time steps are used. Consider rephrasing, also elsewhere.
This was rephrased. It now reads:
We analysed thousands of images and retrieve, for 7 years, velocity changes over 10-day intervals for 38 glaciers in the Pamir.
...

Pg 2 – Ln 42: compared to noise: compared to the noise
This was changed accordingly in the main text.

Pg 2 – Ln 43: velocity changes over 48 glaciers: velocity changes for 48 glaciers
This was changed accordingly in the main text.

Pg 2 – Ln 45: Both result from changes in meltwater input: Wording too strong, 'both appear to result'
This was changed accordingly in the main text.

Pg 3 – Ln 50: future changes: future change
This was changed accordingly in the main text.

Pg 3 – Ln 58: poor spatial coverage: poor spatial and temporal coverage
This was changed accordingly in the main text.

Pg 3 – Ln 63: Consider adding: T. Strozzi, A. Luckman, T. Murray, U. Wegmuller and C. L. Werner, "Glacier motion estimation using SAR offset-tracking procedures," in IEEE Transactions on Geoscience and Remote Sensing, vol. 40, no. 11, pp. 2384-2391, Nov. 2002, doi: 10.1109/TGRS.2002.805079.
This was changed accordingly in the main text.

Pg 3 – Ln 72-73: The references seem to be provided as examples of ice velocity derived from images with a large time interval (annual to multi-year time periods) to support the previous sentence "The time interval … of the measurement.", but note that in at least some of these references (e.g. Rignot) this is not the case. In general for SAR imagery a shorter time span is advantageous due to better coherence.
We specified that large time intervals are better especially for optical images:

The time interval between optical images that are correlated is an important parameter, as a larger time interval will increase the signal (i.e., the displacement) relative to the noise of the measurement.

Pg 4 – Ln 93-98: New generations…: Worth mentioning here is also the crucial role of systematic acquisition planning.
This is now mentionned.

Systematic acquisition planning and new generations of medium-resolution, short-recurrence-time optical sensors

Pg 5 – Ln 112: recovered: retrieved
This was changed accordingly in the main text.

Pg 5 – Ln 117: meteorologic: climatic (as in your title)
This was changed accordingly in the main text.

Pg 8 – Ln 153: for the time periods above: mention the time period here again.
This was changed accordingly in the main text.
We downloaded Landsat 8 and Sentinel 2 images that cover our study area for the time period 2013-2020.

Pg 8 – Ln 163: ESA Sentinel-2: Copernicus Sentinel-2
This was changed accordingly in the main text.

Pg 9 – Ln 187: we used the quality assessment band: it is not mentioned how this band is used, presumably as to mask the flagged pixels. Please explain.
This was changed accordingly in the main text.

We used the quality assessment band for Landsat 8 images to flag and remove pixels where clouds

Pg 12 – Ln 244: for each pixel of all measured velocities: for each pixel and of all measured velocities
This was changed accordingly in the main text.

Pg 13 – Ln 257-273: Was there any longer term velocity trend for any of the glaciers and did you remove this? If not, could this affect your results?
We did not observed clear long-term trend, as also supported by the study of Dehecq et al., 2019.
We precised it to:
In agreement with Dehecq et al., (2019) we did not observe any clear long-term trend in the velocities that we could correct for.

Pg 14 – Ln 289: changes in the velocity: changes in the velocity relative to the multi-annual mean
This was changed accordingly in the main text.

Pg 14 – Ln 290: spring 2013 to winter 2019-2020: if I read these graphs correctly, they seem to run from spring 2013 to winter 2020-2021 (end of 2020). Please check.
This was changed accordingly in the main text.

From spring 2013 to winter 2020-2021

Pg 14 – Ln 292-293: Such changes are higher than those described in the study of Lambrecht et al. (2014): How much higher?
This was changed accordingly in the main text.

Such changes are two to three times higher than those described in the study of Lambrecht et al. (2014).

Pg 14 – Ln 299-300: likely because of the combination of Landsat 8 and Sentinel-2 data:

it would perhaps be interesting to mention if you found any differences in measured velocities between L8 and S2 for the same time period.

In line with Millan et al., 2019 we did not find important changes between the two datasets when considering the same time span. The combination provides a better temporal coverage and therefore allows to have a more robust estimation of the velocity field.

Pg 17 – Ln 348: H765Glacier: H765 Glacier
This was changed accordingly in the main text.

Pg 19 – Ln 378: 20 glaciers: Please check, in Figure 6 and several other places in the manuscript you mention 24.
We checked and corrected where needed, this is indeed 24 glaciers

Pg 19 – Ln 386: created: created
This was changed accordingly in the main text.

Pg 23 – Ln 458: Figure 8c: Describe figures in the correct order (first 8a & 8b).
This was changed accordingly in the main text and the two sentences are now switched

Pg 23/24 – Ln 464/465: there is no clear influence of the glacier velocity on the downglacier migration rate: 1) add reference to figure 8e; 2) maybe it is a trick of the eye, but to me there appears to be a negative correlation.

There is indeed a slight negative correlation. This is now mentioned in the text:

When normalizing the migration rate with the slope of the glacier, the downglacier migration rate appears to be negatively correlated with the glacier velocity (Figure 8e).

Pg 28 – Ln 538: describes: follows
This was changed accordingly in the main text.

Pg 30 – Ln 586: (-0.05 m.d-1, -18.25 m.year-1): why negative if you talk about accelerations?
This was a typo which has now been corrected.

Pg 32 – Ln 643/646: the links do not work
It should work now.

Figures:
The figures and additional video supplement are nice and very informative, some minor comments below:

Fig 1: Caption: “mountain range area”: “mountain range”
This was changed as suggested.

Fig 1: Caption: “m.d-1” : “m d-1” also elsewhere in manuscript.

This was changed as suggested.

Fig 1: Caption: linear scale going from black (no displacement) to white (fast displacement): the scale seems to go from yellowish white to blueish white, but not from black to white.

This was changed as suggested.

Fig 1: Caption: background elevation: background shaded relief

This was changed accordingly in the text.

Fig 1: Caption: '(c): (c)

This was changed accordingly in the figure.

Figure 3: 3b) Add label for vertical axis

This was changed accordingly in the figure.

Figure 3: Consider making c & d the same size.
We extended the panel (d) in order to give a better picture of the dynamic since. Making both panel the same size would decrease the readability of the figure.

Figure 4: The color scale mentions m.d-1, I assume this must be %

This was changed accordingly in the figure; it was indeed in %

Figure 4: Add label to y-axes
The units (km) refer to the elevation and the (m/d) to the velocity. We specified it in the caption

Figure 4: Some numbers are partly obscured (see for example 4d x-axis)
We modified the figure to correct this

Figure 4: 4f) W731 seems to show up to 5/6 speed-up events, are these real, could you elaborate?
Figure 5: Add label to y-axes
The label is the month of year as already shown

Figure 6: n=24: see previous point regarding comment on Pg 19-Ln 378.
This was checked in the text and indeed it is 24 glaciers, and not 20 as mentioned on line 378