Review ESSD: Atmospheric and cryospheric observations at the high-altitude Zarafshon River Basin and the Hydrographic Party Glacier (GGP), Tajikistan, 2018-2025
Svensson et al, 2026

The authors present an interesting overview of different types of data collected on and around the GGP glacier in Tajikistan in multiple campaigns since 2018. The data also includes continuous records from an automatic weather station near the glacier. These datasets can certainly be of use for a range of further studies and I commend the efforts to compile such a diverse collection of data from an understudied region. I believe this can be a valuable contribution for ESSD with some revisions. Most of my comments are related to manuscript structure.

The manuscript covers multiple datatypes, from snow chemistry to UAV photogrammetry. In the introduction, general comments on data scarcity are presented as motivation for the monitoring activities, with a focus on glacier mass loss. I suggest providing bit more detail here on the motivations for each type of measurements. Why were snow chemistry, aerosols, and surface reflectance assessed? This is partially hinted at in the conclusion but, in my opinion, would be more helpful to the readers in the introduction.

I believe the structure of the manuscript could be further improved by more clearly differentiating between 1) explanations related to the methods and data 2) results and 3) interpretations of the results. The content in Section 2 "Material and methodologies" and Section 3 "Description of datasets and key results" currently overlaps in some subsections. In other cases, the methods subsections seem short on details, which are then partially provided later in the corresponding "results" subsection. The authors make a few comments related to interpretation of the various datasets. I think these provide valuable context but should be separated from the results/data description. An additional "discussion" section would be useful for this. I would also suggest adding a subsection to the discussion where the known limitations of the datasets are summarised (such as comparability between surface reflectance and remote sensing reflectance, positional accuracy of the UAV and in situ data, challenges related to AWS operations, and similar)

Please see below for specific line by line comments.

Data: The data are accessible in the stated link. They are arranged by data type and each "data subset" has a readme file that explains the contents. The AWS data is provided in hourly intervals. The manuscript also mentions 10 minute data. A note might be added that the available temporal resolution in the data download is hourly and that 10 minute data was averaged or summed (I assume) to obtain the hourly values. This is currently not explained in the readme. It can be deduced from the manuscript but could be stated more obviously, preferably in the methods section.
I am struggling to open the DSM tif files from 2018 and 2019 in Qgis. The do not load or load only partially and produce the following error: "band 1: IReadBlock failed at X offset …. TIFFReadEncodedTile() failed". I am unsure if this is a problem with the files or my Qgis installation. The 2023 and 2024 DSMs and all orthomosaics load normally. Visually comparing the mosaics and DSMs from different years suggests they have some spatial offsets and are not perfectly aligned with each other. This is not unusual and of course the authors do not claim perfection, but it might be mentioned in a discussion section how to improve this either at the data acquisition stage or during post-processing.

Introduction
L31 *periods of draught*

drought (spelling)

L34 *both spatial and temporally*
—> spatially

L38 *changes on cryospheric variables*
on —> of

L63 *Being a small temperate cirque-valley glacier with typically winter accumulation, GGP has a northward facing orientation and is situated at the elevation range…*
Consider simplifying the phrasing. (e.g., "GGP is a small, north-facing, temperature cirque-valley glacier with mainly winter accumulation. It spans an elevation range of …:"

Fig. 1:
Panel b: In the legend, why is GGP glacier shown as a black square? I assume the blue outline on the google earth image indicates the outline of the glacier. I suggest changing the legend to match this, and indicating the year of the outline in the legend. Try to adjust the yellow labels so they do not overlap the white lines. Not sure I understand the meaning of the years in the AWS labels, particularly for the lower AWS ("AWS 2019 ->" ..?). I find the comment in the image (panel b, top right corner) a bit odd - I think this would work better in the caption. The caption can be adjusted to avoid explaining the abbreviation "AWS" multiple times. Consider adding a panel label for the photo in the lower left. For the Google image, the copyright may need to be included in the image (unsure), check journal guidelines.

Section 2.1.
L86 *the systematic Sentinel-2 satellite constellation*
What do you mean by systematic here?
I suggest citing standard references for the Landsat and Sentinel datasets, such as: Crawford et al, 2023, The 50-year Landsat collection 2 archive https://doi.org/10.1016/j.srs.2023.100103 and Drusch et al, 2012, Sentinel-2: Esa's optical high-resolution mission for GMES operational services https://doi.org/10.1016/j.rse.2011.11.026
Where did you obtain the images? Did you use RGB composites of bottom of atmosphere reflectance? If so, state that. Otherwise please explain what exactly you used.

Fig S1:
What is the source of the background image and the acquisition date? The lines are hard to see, consider different colours or thicker lines to improve visibility. The 2023 and 2024 GPS markers are hard to distinguish, consider different colours. I believe this figure could be improved in terms of color blind friendliness.

L94 *This methodology better assesses the ice front variation*
Better than what? Are you comparing it to something specific?

General remark: For what time of year was the terminus position delineated? How were the satellite images selected? (manual selection of snow and cloud free satellite scenes, averaging over multiple images, something else?) I think this sections warrants a bit more detail on the mapping process including image selection.

Section 2.2
L97 *semi-professional grade quadcopters*

Semi-professional is vague, I suggest just stating the make and model.

L98 *…were used…*

Should be "was used" in the current sentence structure

L102 *the drone was able to fly for about 20 min at about 4 km altitude*

Clarify altitude above sea level here (assuming that is what you mean, rather than flight level above ground)

L104 *was used utilizing*

Consider going through the manuscript to simplify phrasing (this could be something like "was used with")

L109 *such as large boulders or part of rock spread around the glacier*

PartS of rock? Are parts of rock different from large boulders?

L110 *During 2023 and 2024 the drilled ablation stakes positions were marked with red crosses of about 2 m arm length, but not all of them were found on acquired images.*

How was this marking done in the field? Did you attach additional red poles/some other material to the ablation stakes? Please explain. Consider mentioning in a discussion section why this did not work as anticipated (crosses too small to see, otherwise disappeared?)

L113 *and to generate the digital surface models (DSM) and orthomosaic overlays of GeoTIFF and Google Maps tiles*

How/why is the DSM and orthomosaic generation related to google Maps tiles? Unclear. Please state the spatial resolution of the orthomosaics and DSMs somewhere.

Section 2.3

L122 *The approximate accuracy of the measurement is within 5 to 10 m under normal conditions*

Consider specifying positional accuracy, assuming that is what you refer to here. How did you determine the accuracy? (e.g., information provided by GPS manufacturer?) The sentence is missing a period.

Section 2.5

L128: *Glacier ablation was measured with the conventional glaciological method (e.g., Cogley et al., 2011), with stakes being drilled into the ice throughout the glacier ablation zone, which are traditionally transformed into ice ablation by multiplying the height change by an assumed ice density of…*

Consider simplifying the sentence by breaking it into two parts. Start a new sentence after "ablation zone" (e.g., "Measurements of height change are transformed into ice ablation by….")

L130: *Stakes with a height of 4 m*

Were the stakes inserted fully into the holes or did you leave them partially sticking out? (as is sometimes done if accumulation may occur)

Refer to Fig 3 in this section to indicate the location of the stakes. In Fig 3 it seems like the stake network was expanded in 2025. Any particular reason for this? From the figure it is not clear to me if the markers represent the position of all stakes as measured in a given year, of if they represent the position of the stakes drilled in that year. As in, do the blue markers indicate the position of the stakes drilled in prior years AND new ones drilled in 2025, or only the latter?

Section 2.6

L136 *this location had to be shifted*

Why did it have to be shifted?

L143 *All parameters are measured with a 10 s time resolution*

Do you really have 10 second resolution? Should this be 10 minutes?

Fig. 2: Add date and name of photographer if possible.

Sec 2.7

L 153 *"transported back to Helsinki in a melted state but light-protected state to the laboratory in Finland .."*

Consider rephrasing for readability, remove extra period at the end of the sentence.

L166 *(Waters)*

Is this a reference with missing year? Unclear

Sec 2.8

L168 *The prevailing surface reflectance at the glacier, in connection with snow sampling, was determined with a handheld spectroradiometer,*

What do you mean by prevailing?

What does "in connection with snow sampling" mean? Snow sampling was carried out in 2018 and 2019 as per sec 2.7. Sepctroradiometric measurements were carried our in 2019 and 2023…?

L173 *The measurements were conducted by first taking a white reference measurement (Spectralon Labsphere Inc.), followed by measurements of the glacier surface, and finally followed by another white reference measurement. This allowed minimizing the effects of instrument response to changes of the field brightening conditions.*

Please clarify if you took multiple measurements at one location (then presumably averaging over multiple spectra for one point) or were moving between different measurement points

at similar times of the day —> What time of day?

Does "*minimising the effects of instrument response*" imply you did extra processing to account for this? If so, what were the processing steps?

Refer to Fig 3 in this section to indicate measurement locations.

Sec 2.9

Where was the atmospheric aerosol sampling carried out? Multiple measurement points or only one, why those locations? Can this be added to Fig. 3?

Fig 3: State the acquisition date of the image (at least the year). Check color-blind suitability of marker colours.

Sec 3.1

"Landsat-5 carried the Thematic Mapper (TM), collecting data across seven bands, including visible, near-infrared, mid-infrared, and thermal infrared spectrum. Landsat-7 used the Enhanced Thematic Mapper Plus (ETM+), including a high-resolution panchromatic band…."

The description of all the satellite sensors would be better suited for the methods section and could be shortened. As far as I understand, you visually delineated the terminus in true color composites. Is the list of spectral bands given here relevant for your approach and if so, how? Table 3: As above, how were those images selected? You might consider making a figure similar to Fig S3 showing the images listed in the table.

Fig S2: How was the 1973 outline "reconstructed"? Digitised from a map? Please explain, I suggest adding this to the methods subsection explaining the terminus mapping.

L 212 *on the order of 200 m over for this 50-year period*

"over for" —> phrasing (choose either over or for)

L213 *areal decrease*

area decrease

L214 *The yearly appearance of GGP in the month of September during the 2018 to 2024 expeditions years displays the annual variation in snow conditions*

It would be good to comment here on whether these images are considered representative of minimum summer snow cover extent. Is the snow cover in 2018-2020 mainly left over from the previous winter, or were there smaller summer snow falls that may affect the surface conditions of the glacier during image acquisition?

L215 *From this imagery it is especially visible how the snow conditions have diminished at an exceptional rate during the last years*

I can see what you mean but this is rather qualitative and you have not previously introduced snow cover change as a focus of the monitoring. Consider moving this to a more general discussion section (or expanding this part to a quantitative approach).

Sec 3.2

L227 *MTP*

Abbreviation not explained

Much of the information in this section could be placed in a table. This might make it easier for the readers to compare different years and keep an overview.

Table 4: error values in 2023 appear considerable larger than in the other years. Can you comment on reasons for this?

L239 *The DSM and orthomosaics (Fig. 5) indicate on high-resolution the glacier surface characteristics for each respective expedition years, and the dynamics occurring on year-to-year scale.*

What do you mean by dynamics here? Are you referring to glacier movement (dynamics) or something else? If the intention is to highlight a specific aspect of the imagery, please explain clearly what it is and where we can see it in the figure.

Fig. 5: acquisition date of the background image? Maybe add a border around the UAV images to better distinguish them from the background. There is red-ish colouring in some of the orthomosaics - did you observe algae that cause this or is it due to something else? Is it possible to compute elevation change maps from your DSMs?

Sec 3.3

Fig. 6: This is an okay visualisation but since you have the UAV imagery you could consider making a multi-panel figure with the orthomosaics of all years to visually show the change and how the GPS points align with the imagery.

Sec 3.4

L257 *At the same time, from the images it is visible that more snow had ablated in 2023*

Phrasing - what does "at the same time" mean here? Maybe something like "Furthermore" would be better, or omit this entirely and start the sentence with "From the images".

Sec 3.5

266 *was laterally from -4 m to 11.5 m*

Laterally as in sideways? Also applies to "lateral flow" a few lines down - to my understanding lateral implies a sideways movement. I assume you mean movement of stakes with the direction of the ice flow? Consider rephrasing.

The usage of the stakes to track movement was not introduced in the methods section. Rather, the methods indicate that the stakes were used to measure ablation, which is not mentioned here. I think this should be harmonised to present a consistent overview of measurements and results (i.e., add mention of stake movement tracking to the methods and add some information on ablation results here)

3.6

L270 *10 min average*

Above it says 10 sec - see earlier comment

L271 double period

L280 and following: Some of this should be in methods/is repeated from methods (like station position, reason for changing the position, …) I recommend restructuring to clearly separate the content presented in the methods and results sections.

Wind direction: I assume this is a circular mean? Please confirm

Sec 3.7

Check repetitions from methods and clearly separate methods and results/dataset description

L345 *and this layer can possibly be interpreted as the previous year's surface layer with the higher concentration being due to melt amplification (Doherty et al., 2013)*
This is a bit speculative and may be better suited for a discussion section.

3.8

As above, I recommend restructuring to clearly separate the methodological content from results/ data description and interpretation/discussion. You link the reflectance data to the chemical composition (L360) but this remains vague and we can't see it from the figures ("*The black and red impurity spots in the midsection had even lower reflectance (Fig. 10b), which had coinciding chemical compositions, with elevated ammonium amounts*")

Fig 10: please add somewhere how many measurements were used for the averages. I suggest adding grind lines to the plots. In panel b, were the dashed lines selected to show particular impurities? Are these single measurements or also averaged over multiple spectra? Are these dashed lines included in the average and std (solid lines)?

(Fig 10, panel b: Might the pronounced dip in the curves in this panel be related to the chlorophyll absorption band at ~680nm?)

3.9

See above comments on clearly separating methods, results, and interpretations. In my opinion, information on timing and duration of the measurements would be better suited to the methods section, whereas comments on the origin of particles would be suitable for a discussion section, where the described data are briefly interpreted.