The Cryosphere Discuss., referee comment RC2
https://doi.org/10.5194/tc-2021-182-RC2, 2021

Comment on tc-2021-182

Ian Evans (Referee)

Referee comment on "Characteristics of mountain glaciers in the northern Japanese Alps" by Kenshiro Arie et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-182-RC2, 2021

Arie et al: comments by Dr Ian S. Evans, Durham University, for The Cryosphere, on -

Characteristics of mountain glaciers in the northern Japanese Alps.

The authors report very interesting observations on five Japanese glaciers, over several years. These are clearly exceptional compared with other glaciers, which is attributed to avalanching and perhaps wind drifting, combined with very heavy snowfall. They are narrow and linear.

All the Tables and Figures are clear and informative. The writing is concise and the structure is acceptable. The expression is readable but occasionally imprecise, with a strange use of 'between', and there are a few careless errors.

More context would be welcome, both on other possible glaciers among the " More than 100 perennial snow patches " in this region, and on comparison with other avalanche-fed glaciers and other glacierets / very small glaciers elsewhere. Can the feeding avalanche tracks be mapped? Are there cornices in winter, suggestive of wind drifting? Many aspects of the literature are well covered, but a number of other papers on glacierets or very small glaciers could be considered:

Bosson JB and Lambiel C (2016) Internal structure and current evolution of very small debris-covered glacier systems located in alpine permafrost environments. Frontiers of Earth Science 4(39), 1–17. doi: 10.3389/feart.2016.00039.

Capt M, Bosson JB, Fischer M, Micheletti N and Lambiel C (2016) Decadal evolution of a very small heavily debris-covered Glacier in an Alpine permafrost environment. Journal of Glaciology 62(233), 535–551. doi: 10.1017/jog.2016.56.

E Gachev, K Stoyanov - Present day small perennial firn-ice patches in the mountains of the western Balkan Peninsula. Stud Geomorphol. Carpatho-Balc., 2012 - igipz.pan.pl

EM Gachev - Small glaciers in the Dinaric Mountains after eight years of observation: On the verge of extinction? Acta geographica Slovenica, 2020 - ojs.zrc-sazu.si

E Gachev - Holocene glaciation in the mountains of Bulgaria. Mediterranean Geoscience Reviews, 2020 - Springer

E Gachev, I Mitkov Small glaciers in Pirin (Bulgaria) and Durmitor (Montenegro) as glacio-karstic features. Similarities and differences in their recent behaviour. - Quaternary International, 2019

Gachev E, Stoyanov K and Gikov A (2016) Small glaciers on the Balkan Peninsula: state and changes in the last several years. Quaternary International 415, 33–54. doi: 10.1016/j.quaint.2015.10.042.

Grudd H (1990) Small glaciers as sensitive indicators of climatic fluctuations. Geografiska Annaler Series A Physical Geography 72(1), 119–123. doi: 10.2307/521243.

Leigh JR, Stokes CR, Carr RJ, Evans IS, Andreassen LM, Evans DJA (2019). Identifying and mapping very small (<0.5 km2) mountain glaciers on coarse to high-resolution imagery. Journal of Glaciology 65(254), 873–888. https://doi.org/10.1017/jog.2019.50

Lindh L (1984) Studies on the transitional form between snowpatch and glacier in the Abisko Mountains, Sweedish Lappland. Svensk Geografisk Årsbok, 60, 145–156.

Nojarov P, Gachev E, Grunewald K (2019) Recent behavior and possible future evolution of the glacieret in the cirque Golemiya Kazan in the Pirin Mountains under conditions of climate warming. Journal of Mountain Science 16(1).
https://doi.org/10.1007/s11629-018-4957-7

Woo MK and Young KL (2014) Disappearing semi-permanent snow in the High Arctic and its consequences. Journal of Glaciology 60(219), 192–200. doi: 10.3189/2014JoG13J150.

Some of these state that mass balances tend to vary from year to year, positive throughout or negative throughout, rather than between accumulation and ablation areas.

On the 'Inventory of perennial snow patches…', the Higuchi et al. GeoJournal paper is only 8 pages. Might it be worth citing the fuller (81-page) Atlas ? –

Higuchi, K., Iozawa, T.: Atlas of perennial snow patches in Central Japan. Water Res. Lab., Faculty of Science, Nagoya U., 81 pp., 1971.

Also consider -

Watanabe - Studies of snow accumulation and ablation on perennial snow patches in the mountains of Japan. Progress in Physical Geography, 1988

Minoru Yoshida, Katsuhiro Yamamoto, Kenji Higuchi, Hajime Iida, Tetsuo Ohata and Toshio Nakamura, First discovery of fossil ice of 1000–1700 year B.P. in Japan. Journal of Glaciology 36 (123), 1990 , pp. 258 – 259. DOI: https://doi.org/10.3189/S0022143000009527 [Kuranosuke glacier]

Apart from the detailed corrections, and extending comparisons with avalanche-fed glacierets elsewhere, my main suggestion is to compare the (1.92 to 4.34) ratio of winter mass balance to local weq snowfall, with similar ratios for the other nine glaciers smaller than 0.11 km^2 in the Appendix (or consider similar ratios for balance amplitude).

DETAILS:

'likely' should usually be replaced by 'probably'.

Line 19 Why not 'very small avalanche-fed glaciers' ? 'Topographically controlled' is a broader class, including effects of aspect (shade) and shadow, and shelter from wind drifting snow off a plateau (not in this rugged part of the Japanese Alps !).

69 presumably end-winter: best to give a date for this, here.

73-78 ‘glacial erosion valleys’ are usually termed ‘glacial troughs’.

82 ‘with little debris’

Table 1 Karamatsuzawa cannot be 1.03 km^2. That contradicts the Introduction and all the maps.

Also, the average inclination is sometimes close to (altitude range)/ length, but not for Komado and Karamatsuzawa – i.e. it is not overall inclination. Perhaps define how it was calculated.

95-96 ‘from an altitude range’

155-155 How can you be so precise, unless photos were taken daily?

158 ‘between … and …’ ??

Fig.4 Why does the ’10 m’ buffer zone extend much further, especially downglacier in c and d, and upglacier in a ?

Fig.5 caption Not ‘Each circle represents’ – delete that. Rather ‘The following numbers of glaciers in each region are included: …’ [thereafter, repetition of ‘glaciers’ is unnecessary]

179 ‘amounts’

180 ‘accumulation increases with’

186-187 The sentence seems redundant, if you just mention ‘profile and gradient’ earlier.

219 should it be ‘within’ rather than ‘between’?

221 again unsure how ‘between’ is being used.

Fig.7 on left: ‘slope’

230 & 234: ‘5 to 13 m’, not 5 to 11 m. (From Table 4: winter 5.63 to 12.72, summer 7.16 to 11.64.) Per glacier, summer balances vary up to 1.6 m, so are not exactly constant, just with much smaller variation than for winter.

238 ‘nearly constant’ is an exaggeration. I would say ‘is much less variable’

243 Add ‘It is reassuring that balances are closely correlated between the five glaciers, over this time period (Figs. 9 and 10).’

Table 3: seems like ‘correction’ should read ‘corrected’. Caption should remind reader what the correction is for. (The text does not even mention correction, except for lines 111-114 on the DSM: is that relevant, or is the correction for emergence velocity?)

251-252. Yes, but it is more logical to say that standard deviations increase linearly with amplitudes.

Fig.11 Not m ! Numbers on y axis are in mm, unless 000 is deleted throughout.

255-262 As emergence velocity has presumably been used above, should this section come earlier? More explanation of how it was used is needed.

Fig. 11 provides an interesting comparison between regions, but is not the most relevant way of comparing mass balance data with the results in Japan. Clearly glacier size is important: the larger the glacier, the less important the topographic effects including avalanching and wind drifting of snow. As the Japanese glaciers are 0.11 km^2 or smaller, I suggest focussing on comparison with the small number of glaciers in the Appendix which are also of such tiny areas. I think there are nine: numbers 20, 21, 27, 51, 56, 74, 139, 151 and 180. One is in New Zealand, three in the Andes, four in the Alps and one in Apennines (Calderone is not in the Alps.) As the winter balances in Japan are 1.92 to 4.34 times the average direct snowfall (2.93 m), it would be useful to calculate similar ratios for the other very small glaciers. I think that would reveal that glaciers e.g. in the Urals have similar ratios, from what has been termed 'suralimentation' ('over-feeding'). That is , the Japanese glaciers are exceptional (practically 'outliers') in absolute terms, but probably not in amplitude relative to direct snowfall. (More accurate ratios could be calculated from annual snowfall values, rather than e.g. average snowfall at Tateyama Murododaira.)

Table 5: 'a^{-1}'

275 'from typical glaciers,' - although I would rather say 'from valley glaciers' because many cirque glaciers also have much snow-drift and avalanche input.

293-2895 Indeed: the dependence of Ural glaciers on wind-drifting (from summit plateaus) and consequent avalanching was noted long ago by Dolgushin:

Dolgushin, L. D., 1961: Main features of the modern glaciation in the Urals. International Association of Hydrological Sciences Publication, 54: 335-347.

295 Not narrow valleys, but cirques.

298-299 delete one of the repeated 'In addition,'s.

302 delete 'likely' ?

313 'vertical profiles'

315 'become negative throughout' OR 'Even if the glacier can become an ablation-area throughout'

325 It might be good to mention (somewhere) that (from the maps in Fig.3 and photos in Fig.2), the glaciers seem to receive avalanche snow throughout – not just at their upstream ends. Also, the evidence for some wind-drifting effect (despite the lack of plateaus or even rounded summits – the ridges are rugged) comes from the eastward component of aspect of all five glaciers.

336 'tend to have annual balances strongly …'

349 Yes, very probably, but by how much ?

349 '2°K'

354 delete first 'the'.

359 'very little' - not 'almost no'.

362 'of a typical'

364 'in Japan often had negative winter balance gradients'.   Fig. 13 does not really show negative annual balance gradients, and line 281 states "the gradients vary significantly". OK they did not have ELAs: that is because of the lack of positive annual mass balance gradients.

375 Appendix A: Another 3-orders-of-magnitude error: clearly the amplitude for #1 cannot be 10.7 km. The 4 columns ABw – SBn must be in mm, not m !

391 'fee' ??

406 'Ödenwinkelkees, central Austria,'

429 '4(4), 303-311'

439 'The Cryosphere'

Incidentally, as a participant in ICG Excursion B7 in 2001 led by N. Matsuoka, with Kotaro Fukui, I was privileged to see the Kuranosuke glacier(et). Although this was described as a 'perennial snow patch', and 'no active glaciers exist in Japan', distorted bedding structures in the ice seemed indicative of (possibly former) flow, thus fulfilling the definition of 'glacier' (WGI and Cogley et al. 2011: 'showing evidence of past or present flow').

-Ian S. Evans