This is a really interesting paper. Detailed regional assessments on cryospheric changes observed during the recent decades supported with advanced ground-based and space-born instrumentation will help us to better understand cryosphere-climate relationship. Discussion on the process how glaciers are to approach new balance due to changed climatic conditions is a key question. The present study provides significant contribution in this respect supported by a wealth of experimental data.

My brief comment concerns only a minor reorganization with $\alpha_r = AAR_{09}/AAR_0$ derivation. Authors wrote that "Field evidence from glaciers subjected to direct mass balance measurements in the Ortles-Cevedale group indicates an average value of 0.5 for the balanced-budget $AAR_0$". Kern and László (2010) have shown that there is a size-dependency in $AAR_0$. The relationship between glacier area (S) and balanced-budget AAR can be optimally described by a logarithmic regression (balanced-budget $AAR_0 = 0.0648 * \ln S + 0.483$); or as a crude estimation, an $AAR_0$ of 0.44±0.07 is best applied on glaciers with area in the range 0.01-1 $km^2$, 0.54±0.07 for glaciers covering area between 1 and 4 $km^2$ and 0.64±0.04 for glaciers larger than 4 $km^2$.

Hence, I believe that field evidence show 0.5 as a mean $AAR_0$, because these glaciers are quite small, only a few are larger than 1 $km^2$, so their $AAR_0$ is expected to scatter around 0.5. However, a more realistic approach is to estimate smaller $AAR_0$ for smaller glaciers.

Adopting the size specific $AAR_0$ approach the estimated current degree of imbalance (section 5.3) is expected to decrease. Consequently, the difference between current (i.e. 2009) snowline altitude and balanced-budget equilibrium-line altitudes (in section 6.2) can be expected to decrease, too. Similarly, the estimated area loss (50%) of the Ortles-Cevedale glacier system to reach equilibrium under current climatic conditions can be also expected to decrease if not the uniform 0.5 value but the size-specific $AAR_0$ value is used.

The recommended paper touched some other points those have link to the discussion of the present manuscript.

In addition, similarly to prof. Pelto, I remark that $AAR_0=1$ for glacierets is questionable. Tiniest ice bodies, with strong topoclimatic influence, frequently experience inter-annual negative or positive mass balance over the entire glacier surface (e.g. Hughes, 2008) and defining accumulation area for them is theoretically problematic. Maybe glacierets could be excluded from those parts when $AAR_0$ estimates are used.

Finally a technical comment:

p276 (eq.1) I guess $A_{87}$ instead of $A_1$ should be written in eq.1. Meaning of $A_1$ is not explained, however, if I understood well, then volume change is calculated as elevation change above the initial area. The reference date (i.e. initial area) of the study is 1987, and the glacier area from 1987 is written as $A_{87}$ latter in the text.

sincerely yours,

Zoltan Kern

References:


Hughes P.D., 2008. Response of a Montenegro glacier to extreme summer heatwaves in 2003 and 2007. Geografiska Annaler 192: 259-267.

Kern, Z.; László, P. (2010) Size specific steady-state accumulation-area ratio: an improvement for equilibrium-line estimation of small palaeoglaciers. *Quaternary Science Reviews* 29: 2782-2788. doi:10.1016/j.quascirev.2010.06.033