

10 years of glacier mass balance monitoring on Mullwitzkees (Hohe Tauern)

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Keywords

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Summary

In 2006, a mass balance monitoring programme was started on Mullwitzkees glacier (47.09°N, 12.38°E) within the core zone of Hohe Tauern National Park. The investigations on Mullwitzkees record the annual surface mass balances and interpret them in the light of the local weather conditions. The glacier is mainly exposed to the south and located on the south side of the main Alpine ridge, which is a weather and also a climate trend divide (AUER et al., 2007). Winter, summer and annual mass balances are determined for the hydrological years by using the direct glaciological method with ablation stakes, snow pits and snow depth soundings (HOINKES 1970, CUFFEY & PATERSON 2010). The glacier covers an area of almost 3 km² within an elevation range between 2700 m and 3400 m (FISCHER et al., 2015).

The mean annual specific glacier mass balance during the past 10 years was -820 mm w.e. (water equivalent), but shows great variance, from -1599 mm w.e. in one year to an increase of +117 mm w.e. in another. These extreme differences in mass balance were observed within two successive years 2013/14 and 2014/15 (Fig. 1, Tab. 1), resulting in an increased interannual variability, in contrast to earlier publications (STOCKER-WALDHUBER et al. 2013). A comparison of the annual summer and winter mass balances suggests that the annual mass balances of this glacier mainly depend on the ablation season (Tab. 1). This means that the state of Mullwitzkees is mainly driven by summer temperatures and summer snowfall events at the glacier. Snow accumulation during the accumulation season can be seen as the basis for the annual result, as it affects the length of the ablation season. The first ten years of measurements on Mullwitzkees revealed that the glacier state is close to equilibrium if the accumulation area ratio is close to 50% ($S_c/S \approx 0.5$), a condition which was almost reached in 2013 and even exceeded in 2014.

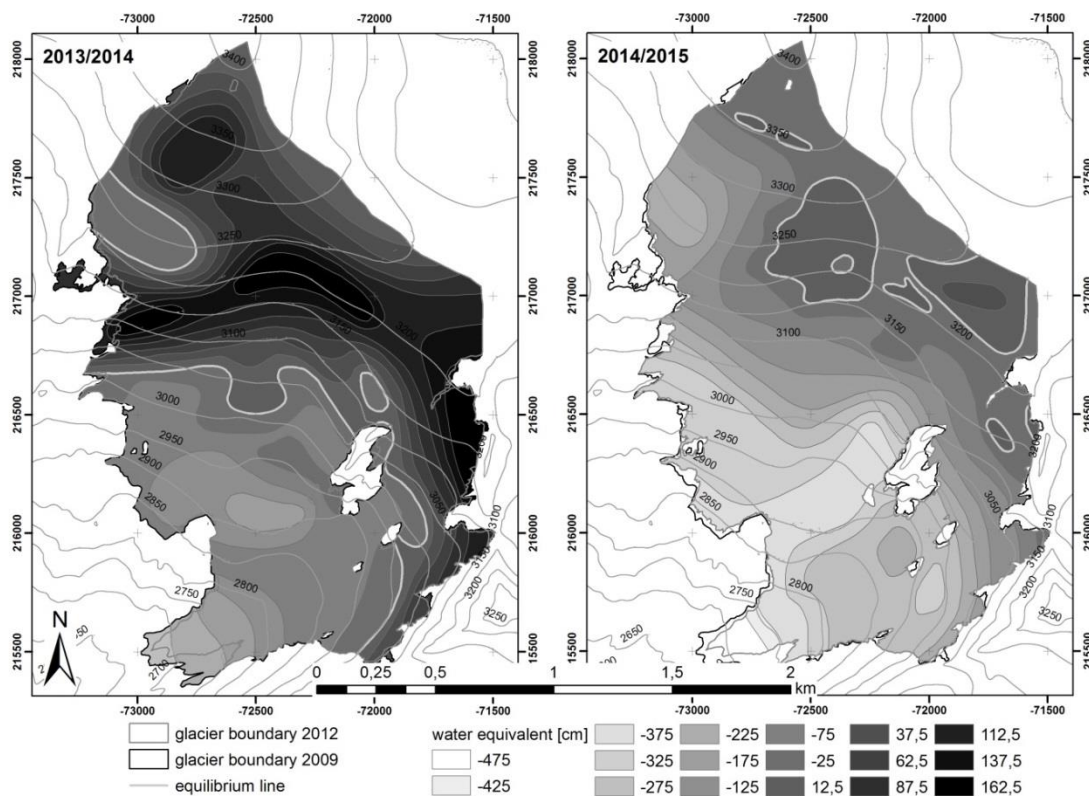


Figure 1: Spatial distribution of the most positive (left Fig.) and the most negative (right Fig.) annual mass balance during the first ten years of direct mass balance measurements on Mullwitzkees. The mass balance is coloured gradually in 50 cm w.e. increments within the ablation zone and in 25 cm w.e. increments within the accumulation zone.

	S_c	B_c	b_c	S_a	B_a	b_a	S	B	b	b_s	b_w	ELA	S_c/S
	km^2	$10^6 m^3$	mm	km^2	$10^6 m^3$	mm	km^2	$10^6 m^3$	mm	mm	mm	m	
2006/07	0,639	0,436	682	2,444	-4,897	-2004	3,083	-4,461	-1447	-2121	674	3187	0,207
2007/08	1,220	0,932	764	1,864	-2,912	-1562	3,084	-1,980	-642	-2052	1410	3115	0,396
2008/09	1,110	0,452	408	1,916	-1,926	-1005	3,026	-1,474	-487	-2006	1519	3116	0,367
2009/10	1,003	0,424	423	2,023	-1,906	-942	3,026	-1,481	-490	-1797	1307	3105	0,332
2010/11	0,431	0,107	248	2,501	-3,926	-1570	2,931	-3,820	-1303	-2127	824	> GN	0,147
2011/12	0,326	0,064	197	2,605	-3,806	-1461	2,931	-3,741	-1276	-2772	1496	> GN	0,111
2012/13	1,207	0,618	512	1,725	-1,256	-728	2,931	-0,639	-218	-1664	1446	3119	0,412
2013/14	1,727	0,134	776	1,205	-0,998	-829	2,931	0,343	117	-1044	1161	3044	0,589
2014/15	0,238	0,047	143	2,471	-4,523	-1830	2,798	-4,476	-1599	-2966	1367	> GN	0,117
2015/16	0,631	0,205	325	2,145	-2,587	-1206	2,776	-2,382	-858	-1894	1036	3196	0,227

Table 1: Characteristic numbers of summer, winter and annual mass balances on Mullwitzkees (STOCKER-WALDHUBER et al. 2016); S: area, B: total mass balance, b: specific mass balance, ELA: equilibrium line altitude, S_c/S : accumulation area ratio; indices: c: accumulation, a: ablation, s: summer, w: winter; >GN: above crest level.

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