Supplementary Material: Use of a new ultra-long-range terrestrial LiDAR system to monitor the mass balance of very small glaciers in the Swiss Alps

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Compiled February 14, 2016

Supplementary Table S1. TLS survey parameters for the individual surveys of Glacier de Prapio (PRA), Glacier du Sex Rouge (SER), St. Annafirn (STA), Schwarzbachfirn (SWZ), and Pizolgletscher (PZL).

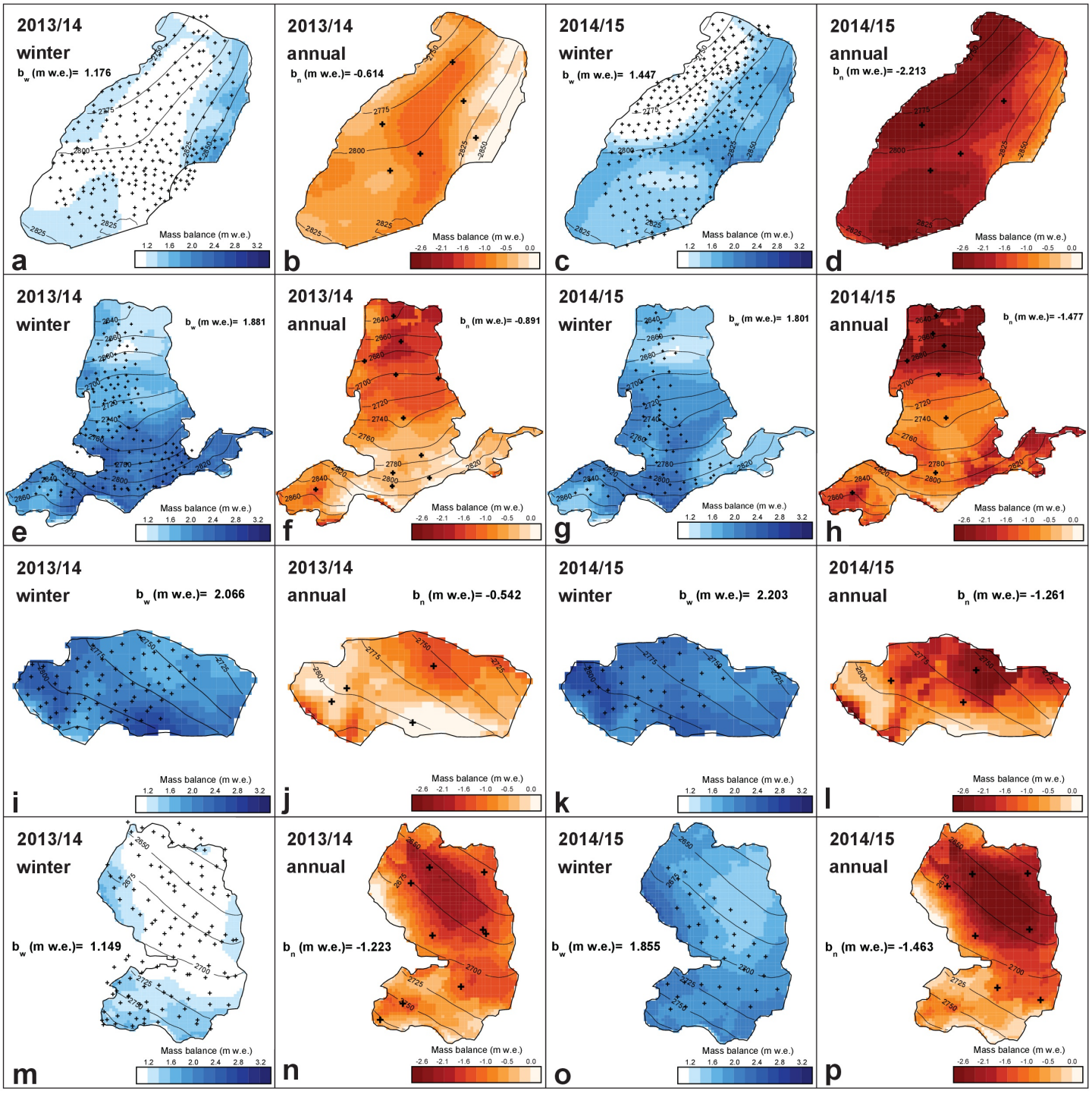
Date	Surface area scanned	Number of points measured	Point density	Total measurement time
	m^2		m^{-2}	min
PRA				
14.09.2013	1085207	1036512	0.955	4
22.09.2014	824338	30573624	37.089	21
21.09.2015	1102932	28267120	25.629	20
SER				
14.09.2013	1554719	1405526	0.904	6
22.09.2014	1281187	29516688	23.039	24
21.09.2015	1309371	58373504	44.581	37
STA				
06.09.2013	780497	8245020	10.564	7
26.09.2014	901390	29901956	33.173	21
28.09.2015	1160962	77473844	66.732	54
SWZ				
07.09.2013	259828	601234	2.314	2
26.09.2014	273159	20420736	74.758	17
28.09.2015	290835	27396352	94.199	24
PZL				
23.09.2013	148557	2350828	15.824	3
20.09.2014	295283	2148581	7.276	2
09.09.2015	989954	20752611	20.963	22

Supplementary Table S2. Dates, number (n), and spatial density of winter and summer glaciological mass balance measurements on Glacier du Sex Rouge (SER), St. Annafirn (STA), Schwarzbachfirn (SWZ) and Pizolgletscher (PZL). n refers to snow probings (winter survey) and ablation stake or accumulation pit measurements (summer survey).

year	Winter survey			Summer survey		
	Date	n	density (km^{-2})	Date	n	density (km^{-2})
SER						
2012	03.04.	21	78	24.09.	1	4
2013	23.04.	138	510	14.09.	5	19
2014	17.04.	224	828	22.09.	6	22
2015	22.04.	245	906	20.09.	4	15
STA						
2012	12.04.	31	143	03.10.	4	18
2013	13.03.	41	189	02.10.	10	46
2014	10.04.	153	705	23.09.	11	51
2015	15.04.	80	369	28.09.	9	47
SWZ						
2013	14.04.	60	1026	07.09.	2	34
2014	11.04.	76	1299	24.09.	4	68
2015	15.04.	31	530	28.09.	3	60
PZL						
2006	14.04.	61	689	13.09.	–	–
2007	02.04.	86	972	03.09.	2	23
2008	02.04.	43	486	25.09.	4	45
2009	07.04.	91	1028	13.09.	6	68
2010	02.04.	111	1254	22.09.	9	102
2011	26.04.	102	1153	24.09.	8	90
2012	30.04.	38	429	21.09.	8	90
2013	29.04.	119	1345	23.09.	9	102
2014	31.04.	118	1333	20.09.	9	135
2015	11.05.	50	565	27.09.	7	105

Supplementary Table S3. Measured (*meas*) and fixed date (*fix*) annual and seasonal mass balance variables (m w.e.) from 2006/07 to 2014/15 for Glacier du Sex Rouge (SER), St. Annafirn (STA), Schwarzbachfirn (SWZ) and Pizolgletscher (PZL).

hydrological	Annual period		Winter period		Summer period	
year	B_a^{meas}	B_a^{fix}	B_w^{meas}	B_w^{fix}	B_s^{meas}	B_s^{fix}
SER						
2011/12	–1.29	–1.19	1.36	1.44	–2.64	–2.63
2012/13	–0.71	–0.69	1.53	1.42	–2.24	–2.11
2013/14	–0.61	–0.67	1.18	1.27	–1.79	–1.94
2014/15	–2.21	–2.14	1.45	1.38	–3.66	–3.52
STA						
2011/12	–0.68	–0.66	1.35	1.41	–2.03	–2.08
2012/13	–0.29	–0.29	1.39	1.58	–1.69	–1.87
2013/14	–0.44	–0.58	1.88	1.97	–2.32	–2.55
2014/15	–1.48	–1.36	1.80	1.55	–3.28	–2.91
SWZ						
2012/13	0.28	–0.03	1.92	2.08	–1.65	–2.11
2013/14	–0.54	–0.27	2.07	2.16	–2.61	–2.43
2014/15	-1.26	-1.14	2.20	1.96	–3.46	–3.10
PZL						
2006/07	–1.84	–1.61	1.14	0.99	–2.98	–2.59
2007/08	–0.73	–0.71	1.45	1.70	–2.18	–2.41
2008/09	–1.22	–1.46	1.59	1.75	–2.81	–3.20
2009/10	–0.86	–0.71	1.18	1.10	–2.04	–1.81
2010/11	–2.02	–2.15	1.06	0.94	–3.09	–3.09
2011/12	–1.25	–1.19	2.00	1.97	–3.25	–3.16
2012/13	–0.59	–0.52	1.52	1.55	–2.11	–2.08
2013/14	–1.22	–1.30	1.15	1.12	–2.37	–2.41
2014/15	–1.50	–1.37	1.86	1.59	–3.36	–2.95



Supplementary Figure S1. Spatial distribution of direct glaciological annual and winter balance of (a-d) Glacier du Sex Rouge, (e-h) St. Annafirn, (i-l) Schwarzbachfirn, and (m-p) Pizolgletscher in 2013/14 and 2014/15 (measured periods, coinciding with start and end of LiDAR surveys). Cross symbols indicate the location of snow probings (winter) and mass balance measurements at stakes or firn pits (annual).