Supplementary Material

Table S1. Observed density and calculated radar velocity at Gulkana and Wolverine glaciers. Density uncertainty is the standard deviation of all density observations collected that year, density velocity error is uncertainty introduced by uncertainty in density observations. Probe velocity uncertainty is the standard error of the least-squares regression line.

Gulkana	**Density [kg m^{-3}]**	**Density Velocity [m ns^{-1}]**	**Probe velocity [m ns^{-1}]**	**Mean Velocity [m ns^{-1}]**
2013	365 ± 37	0.229 ± 0.005	0.216 ± 0.003	0.223 ± 0.003
2014	380 ± 29	0.227 ± 0.004	0.215 ± 0.003	0.221 ± 0.003
2015	328 ± 13	0.235 ± 0.002	0.228 ± 0.009	0.231 ± 0.005
2016	370 ± 27	0.229 ± 0.004	0.194 ± 0.005	0.211 ± 0.003
2017	366 ± 8	0.229 ± 0.001	0.227 ± 0.002	0.228 ± 0.001
Mean	362 ± 11	0.230 ± 0.002	0.216 ± 0.002	0.223 ± 0.001
Wolverine				
2013	446 ± 23	0.218 ± 0.003	0.193 ± 0.003	0.207 ± 0.002
2014	445 ± 43	0.218 ± 0.006	0.210 ± 0.002	0.214 ± 0.003
2015	414 ± 14	0.222 ± 0.002	0.235 ± 0.002	0.229 ± 0.001
2016	456 ± 6	0.216 ± 0.001	0.229 ± 0.003	0.223 ± 0.002
2017	438 ± 12	0.219 ± 0.002	0.217 ± 0.002	0.218 ± 0.001
Mean	440 ± 10	0.219 ± 0.001	0.217 ± 0.001	0.218 ± 0.001

Table S2. Glacier-wide average B_w from different approaches across study interval.

Method	**2013**	**2014**	**2015**	**2016**	**2017**
Gulkana B_w [m w.e.]					
MVR	1.38	1.44	0.96	1.31	0.65
Regression Tree	1.38	1.44	0.95	1.32	0.65
Z - CL only	1.40	1.38	0.81	1.27	0.65
Z - All	1.37	1.45	0.94	1.28	0.64
Site-Index	1.30	1.31	0.77	1.07	0.57
Profile	1.44	1.45	0.97	1.36	0.64
Mean	1.38	1.41	0.90	1.27	0.63
Wolverine B_w [m w.e.]					
MVR	2.83	2.17	2.70	3.56	2.14
Regression Tree	2.84	2.06	2.55	3.47	2.04
Z - CL only	2.31	1.87	2.36	3.37	1.77
Z - All	2.58	1.97	2.51	3.44	1.95
Site-Index	2.24	1.74	2.37	3.38	1.70
Profile	2.30	1.79	2.49	3.54	1.89
Mean	2.52	1.93	2.50	3.46	1.91

Figure S1. GPR surveys (a,c,e,g,h) and MVR model residuals (b,d,f,h,j) for Gulkana Glacier for 2013-2017.

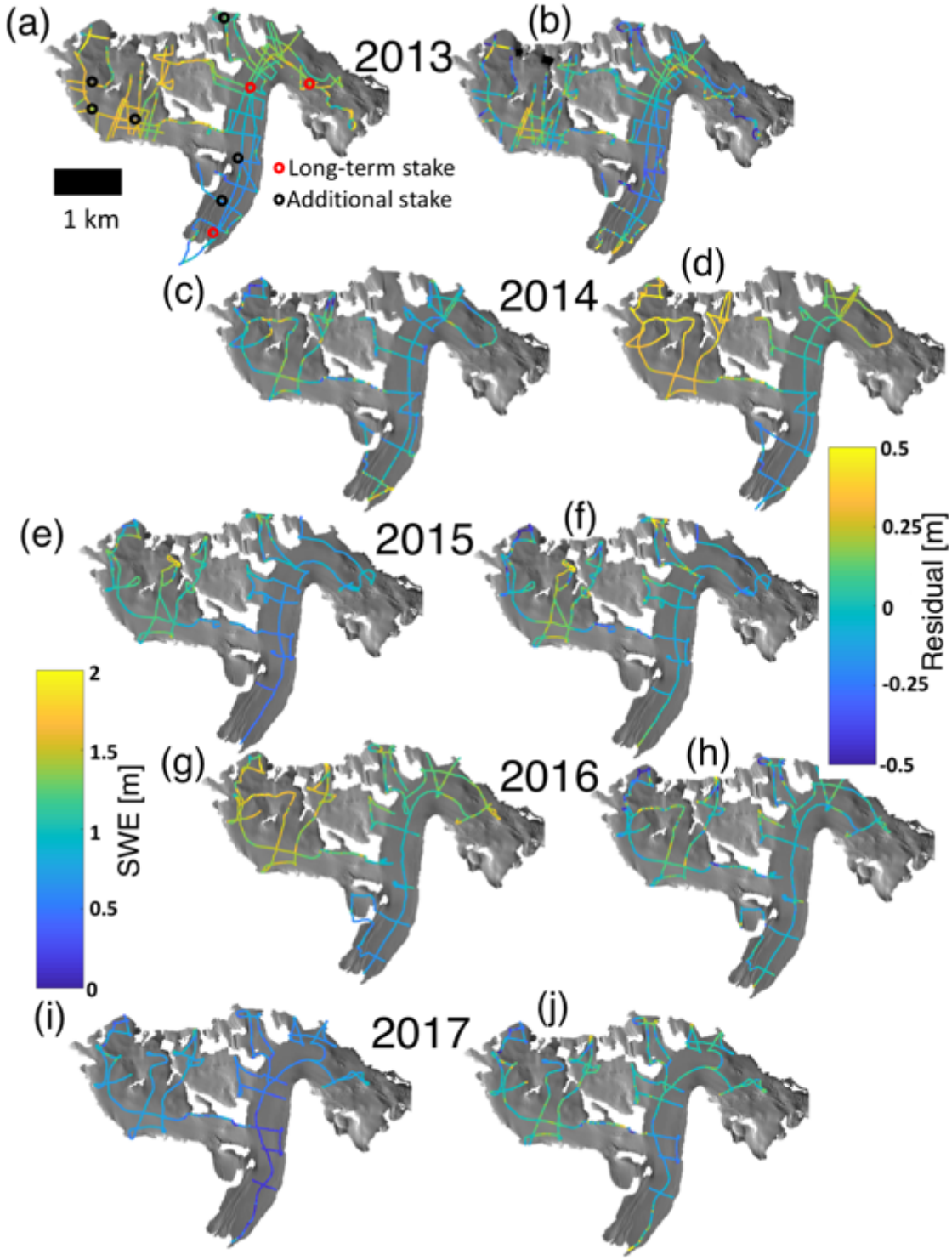

Figure S2. GPR surveys (a,c,e,g,h) and MVR model residuals (b,d,f,h,j) for Wolverine Glacier for 2013-2017.

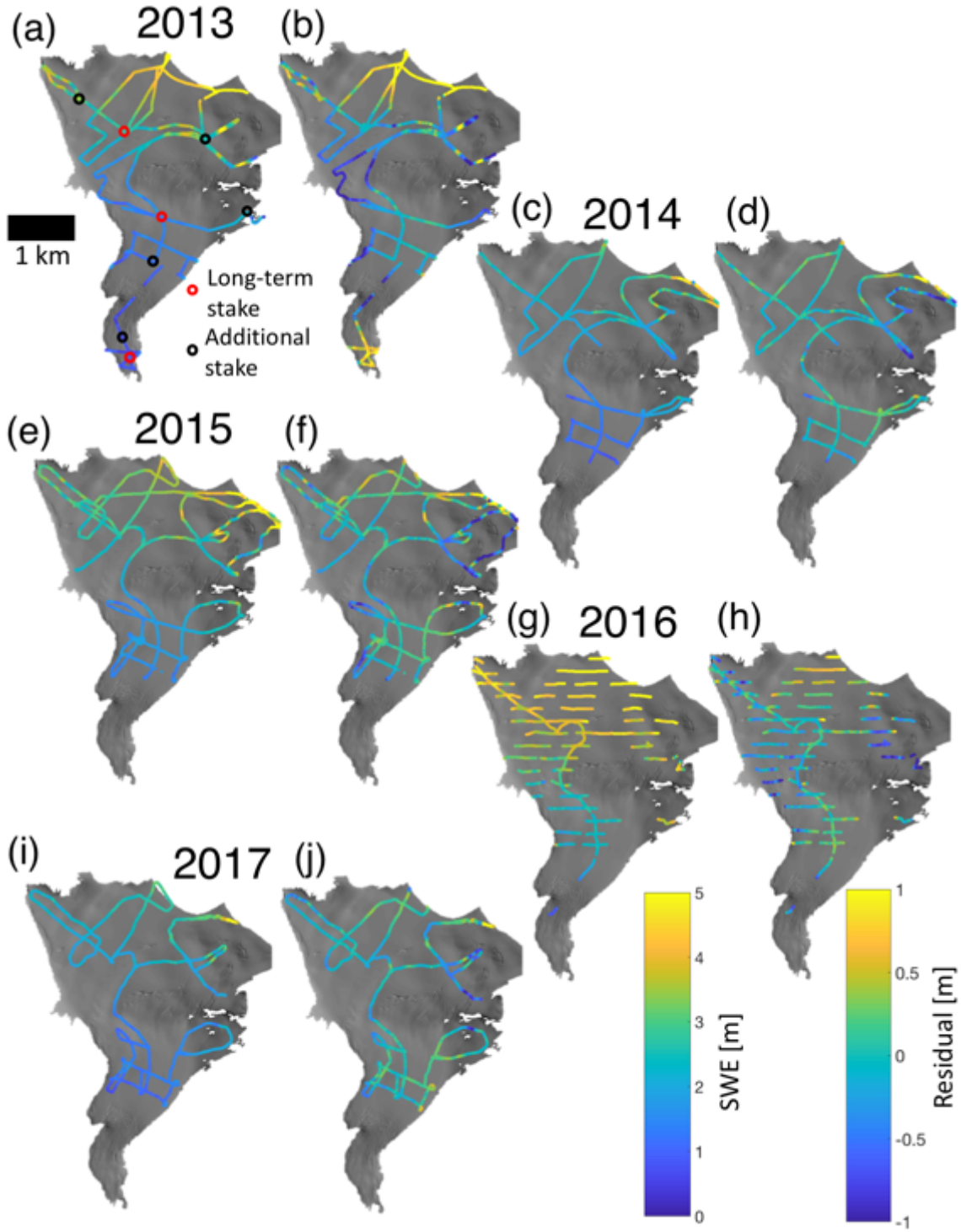

Figure S3. DEM-derived terrain parameters for Wolverine Glacier.

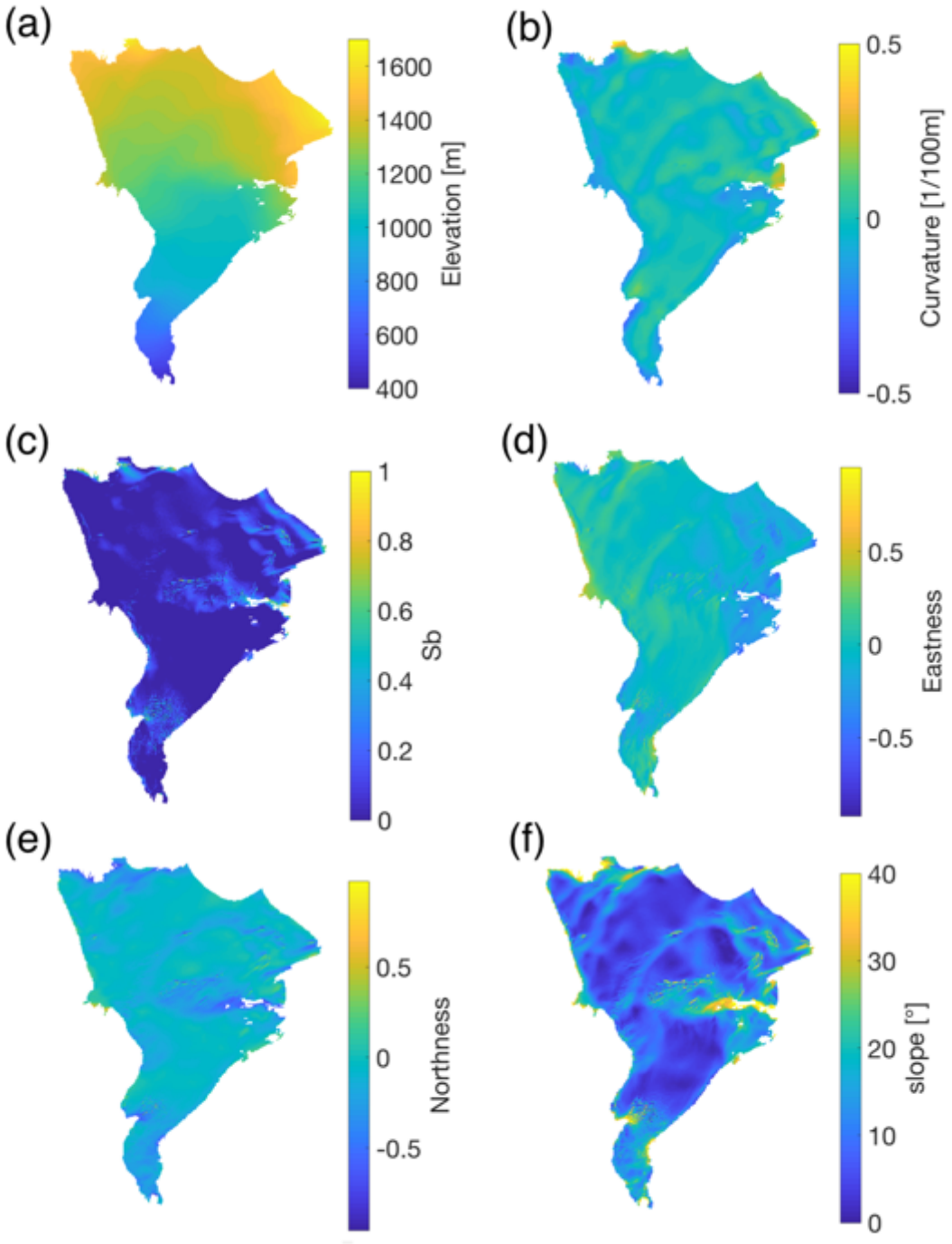

Figure S4. DEM-derived terrain parameters for Gulkana Glacier.

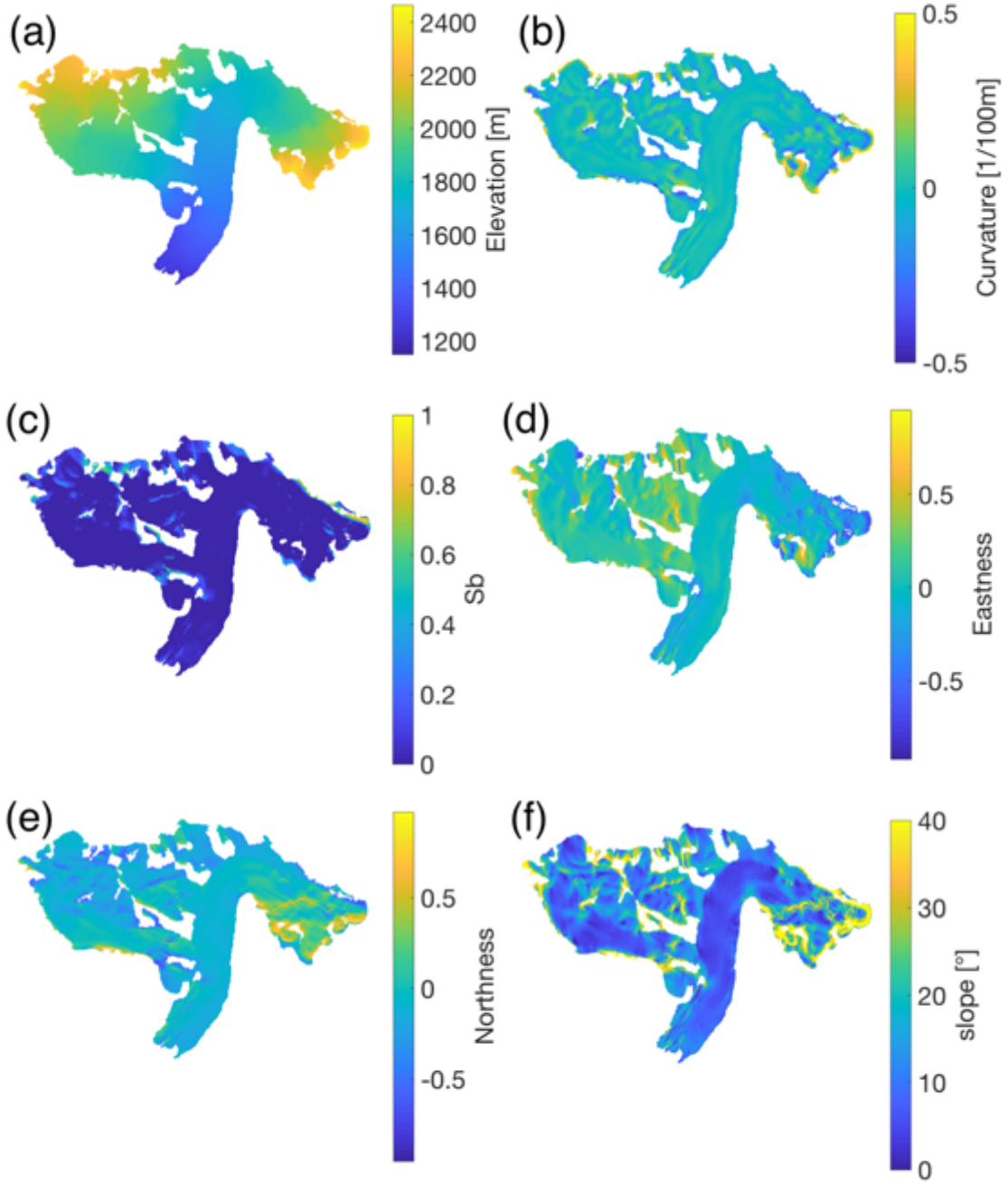

Figure S5. Example of training (black lines) and test (red lines) datasets for the 100 iteration loop for Gulkana. This same procedure was applied to both glaciers and all years.

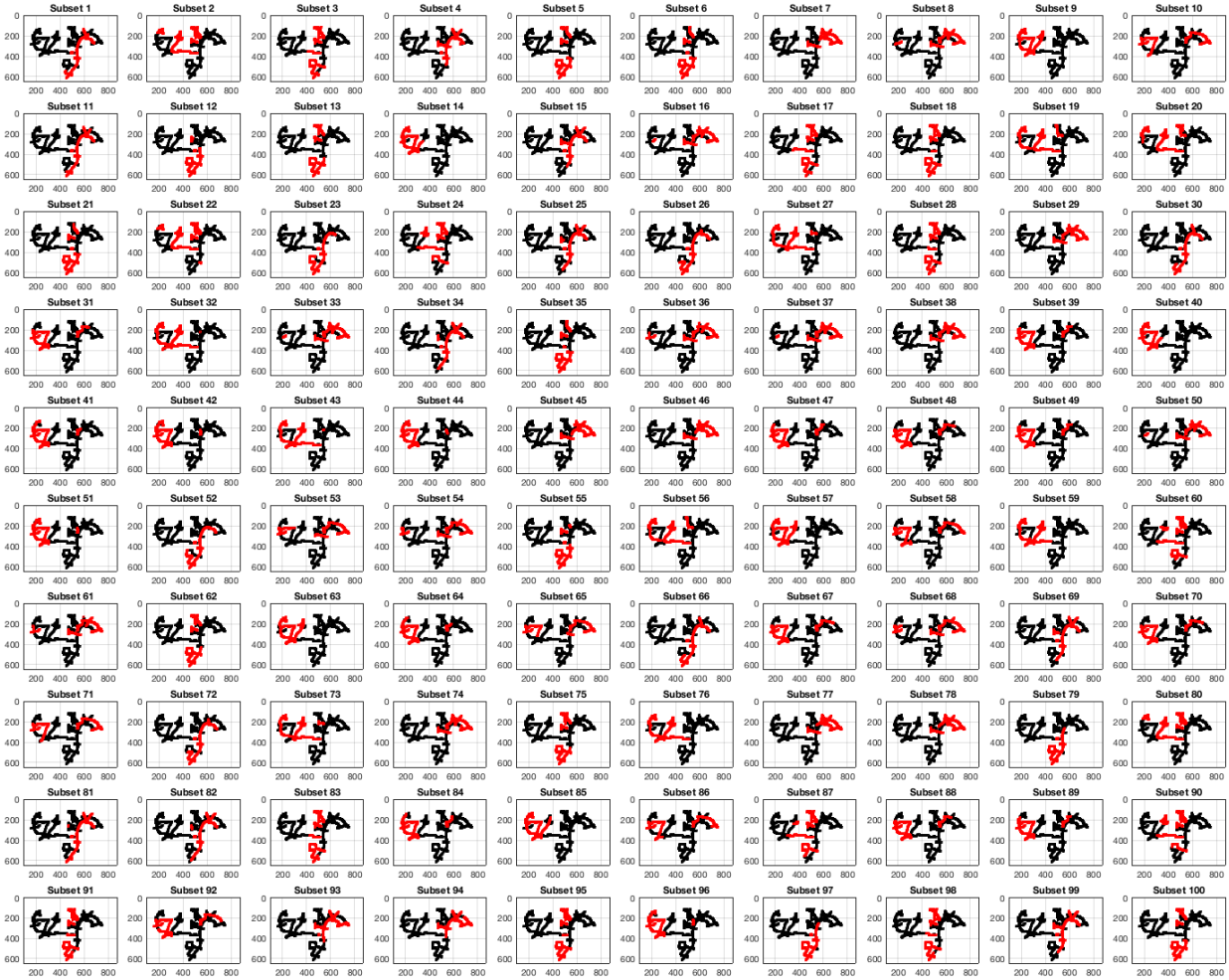

Figure S6. Average wind rose from *in situ* weather station for (a) Wolverine and (b) Gulkana over the five-year study period.

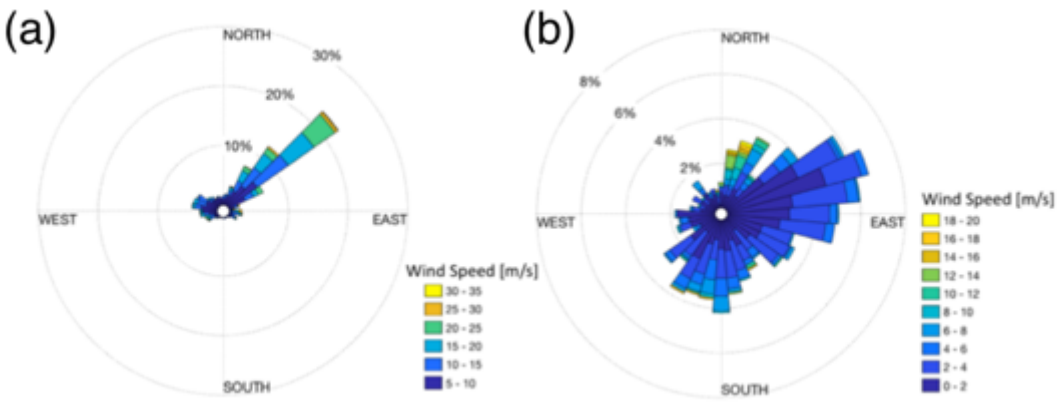

Figure S7. Distributed normalized SWE fields for Gulkana glacier from MVR (a,c,e,g,i) and regression tree model (b,d,f,h,j) for 2013-2017.

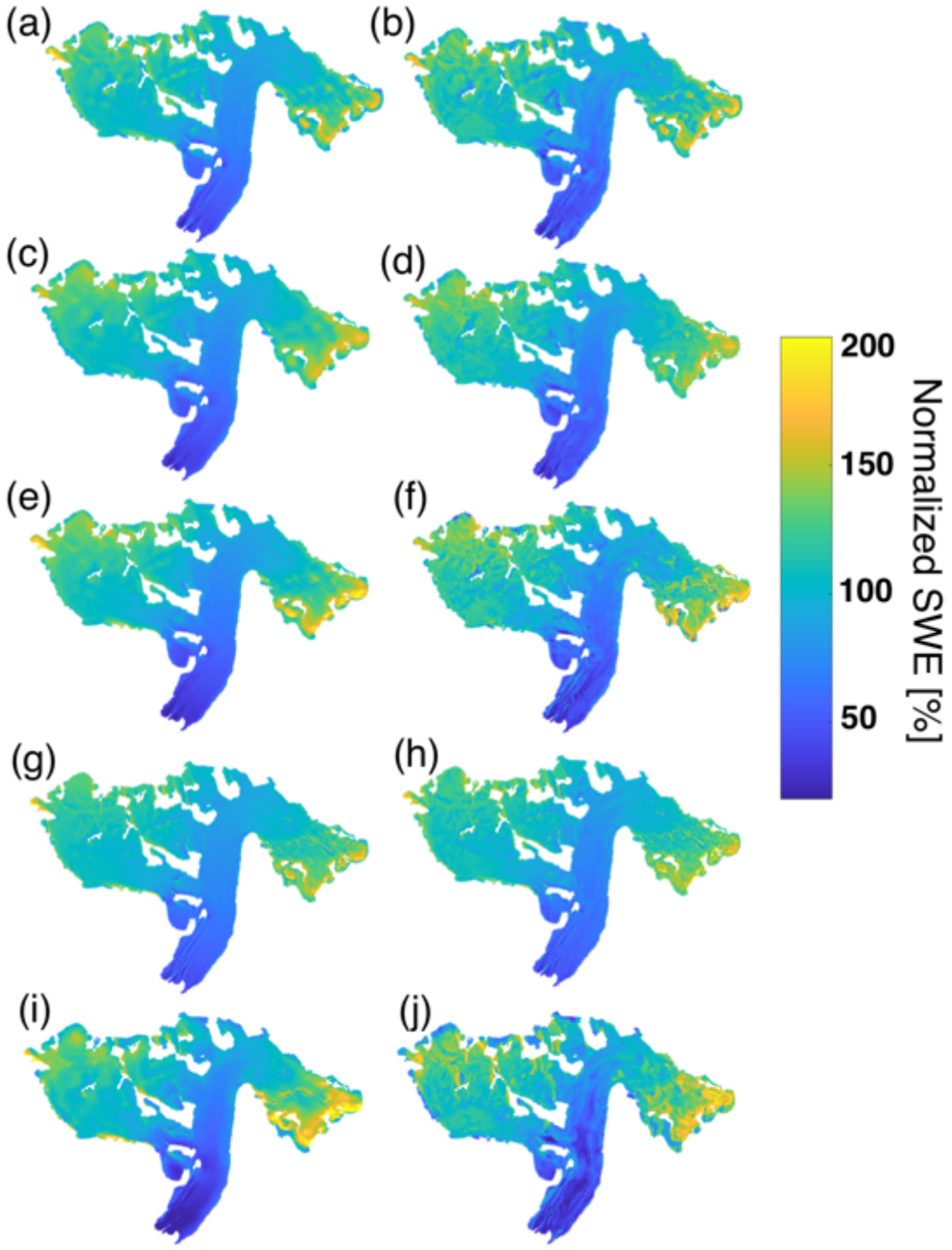

Figure S8. Distributed normalized SWE fields for Wolverine glacier MVR (a,c,e,g,i) and regression tree model (b,d,f,h,j) for 2013-2017.

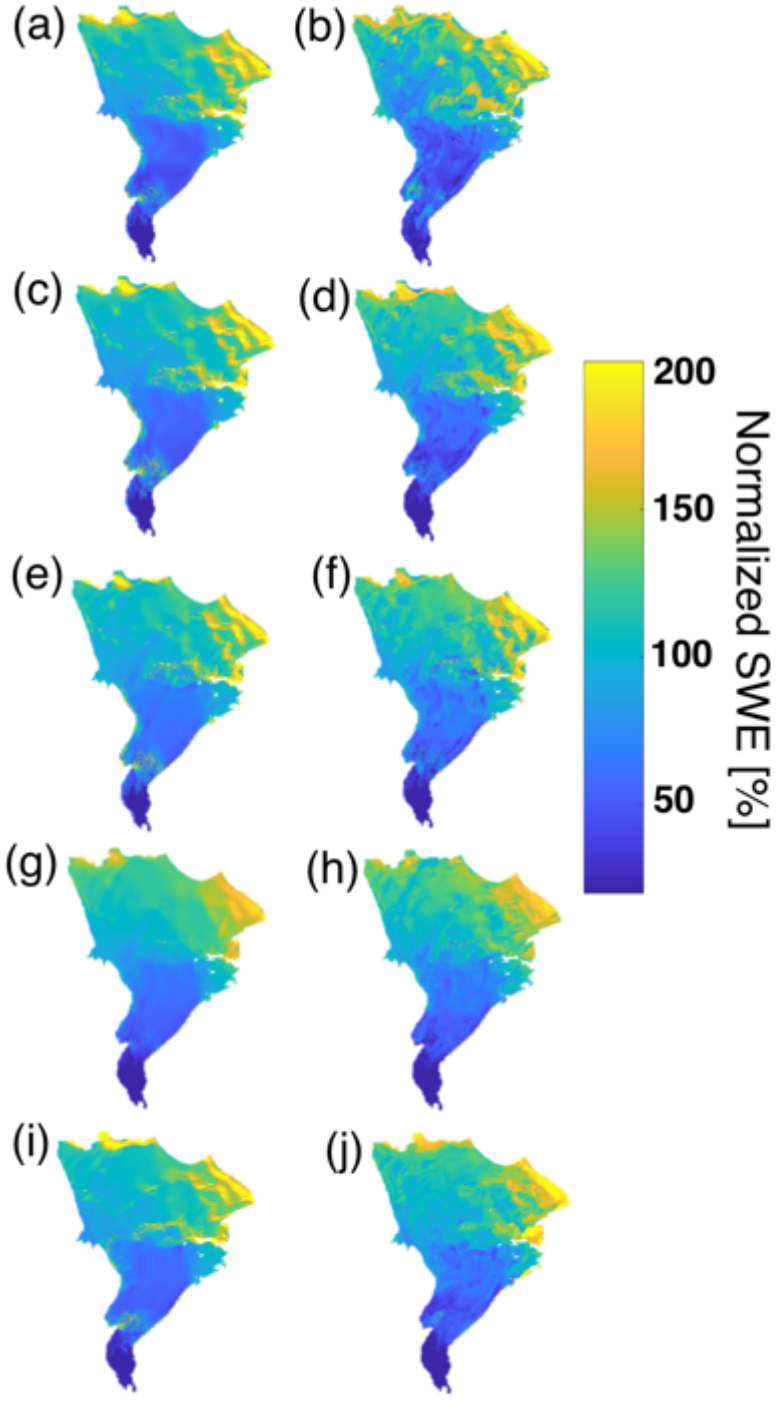

Figure S9. Median out-of-bag predictor importance estimates from the regression trees for (a) Gulkana and (b) Wolverine glaciers.

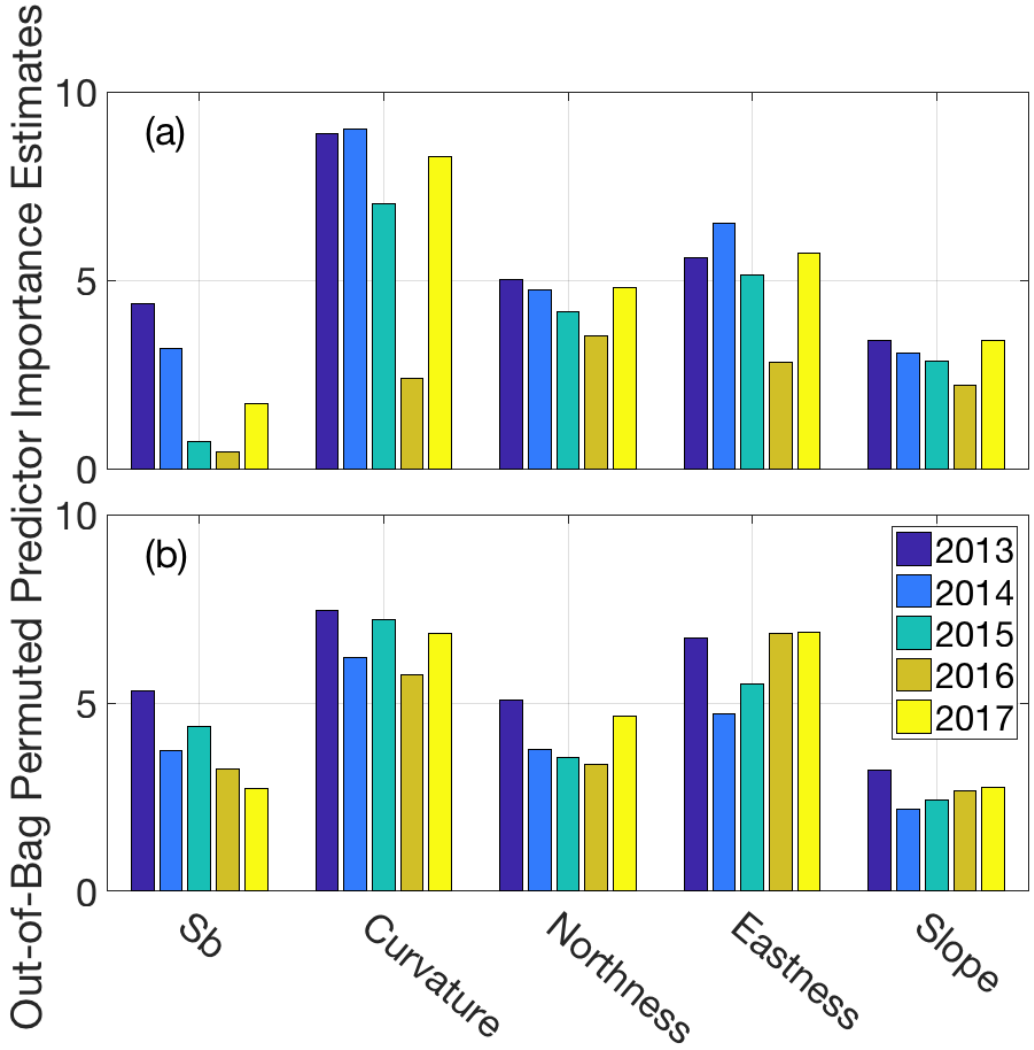

Figure S10. Photograph of the off-glacier terrain near Wolverine Glacier showing significantly greater spatial variability in SWE. Photograph was taken in April 2017.

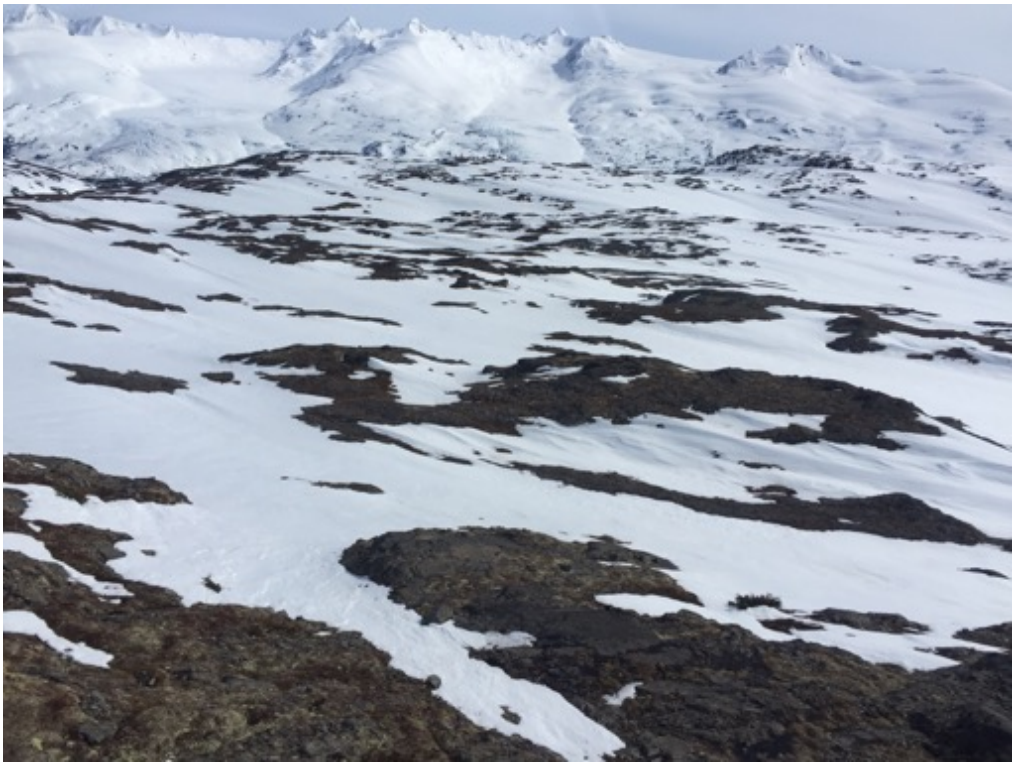

Figure S11. Photograph of Wolverine Glacier's lower icefall in May 2014 showing exposed ice.