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Supplement of

Short-term velocity variations of three rock glaciers and their relationship with meteorological conditions

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1 Difference between velocity estimations corrected and uncorrected for mast tilt

Inclinometer measurements at the GPS mast allow correction of GPS positions for mast tilt (Wirz et al., 2014). Standard deviations in inclination (θ) are typically around 0.4° , and around 2.5° for the orientation (az) of the mast tilt. The correction for mast tilt is only appropriate where tilting is greater than the uncertainty of the inclinometer measurements (see supplementary material). This is only the case for R2b and R7c. For R7c, however, inclinometer data are not available over the entire period. However, sensitivity analysis have showed that for the intra-annual velocities differences corrected and uncorrected for the tilt of the mast at R2b are negligible and have no influence on the results presented within this study (e.g. Fig. S1). For better comparison we therefore only corrected the total displacement over the three years at R2b for tilt of the mast.

Fig. S1 shows the horizontal velocities estimated and direction of movement once calculated for the GPS positions not corrected for the mast tilt, and once corrected for the mast tilt, assuming the center of rotation lies 1 m within the boulder (2.5 m below the antenna).

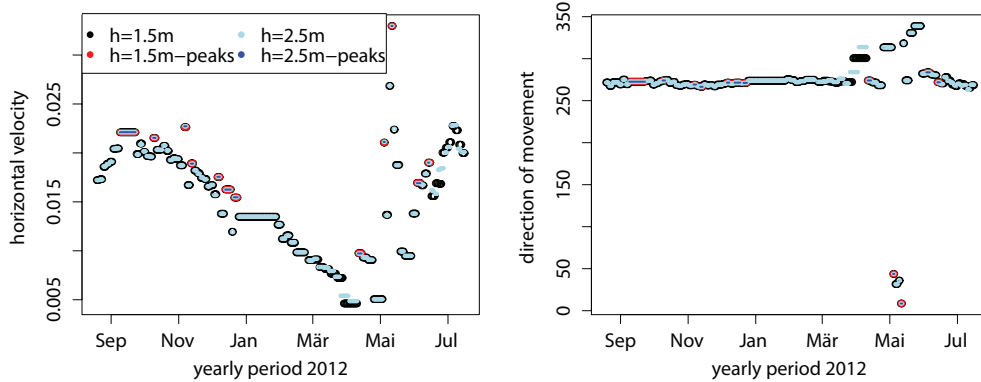


Figure S1: Estimated velocities using SNRT with SNR- $t=40$ for a one-year time-series (study year 2012) at R2b and detected peaks (with $t_p=6$), once corrected for a tilt of the mast (lightblue, assuming the center of rotation lies 1 m within the boulder on the Z-axis below the antenna, see Wirz. et al., 2014 for more details), and once not corrected for the mast tilt (black, at the antenna).

2 Spineplots

To visualize potential relationships between the individual explanatory variables and the occurrence of peaks we used spineplots (Friendly, 1994). Spineplots are used to visualize the frequencies of the occurrence of velocity-peaks as opposed to the absence of velocity-peaks (later called no-peak-periods) on potential meteorological variables. The width of the individual bars relate to the 25 %-quantiles of the explanatory variable. Since probably different processes and hence different meteorological variables were relevant for the occurrence of peaks during snow-cover and snow-free conditions, we distinguished between periods with an insulating snow cover (snow-cover period) and without (snow-free period, snow.ind). The snow-cover period includes the days where an insulating snow cover can be derived from GST data.

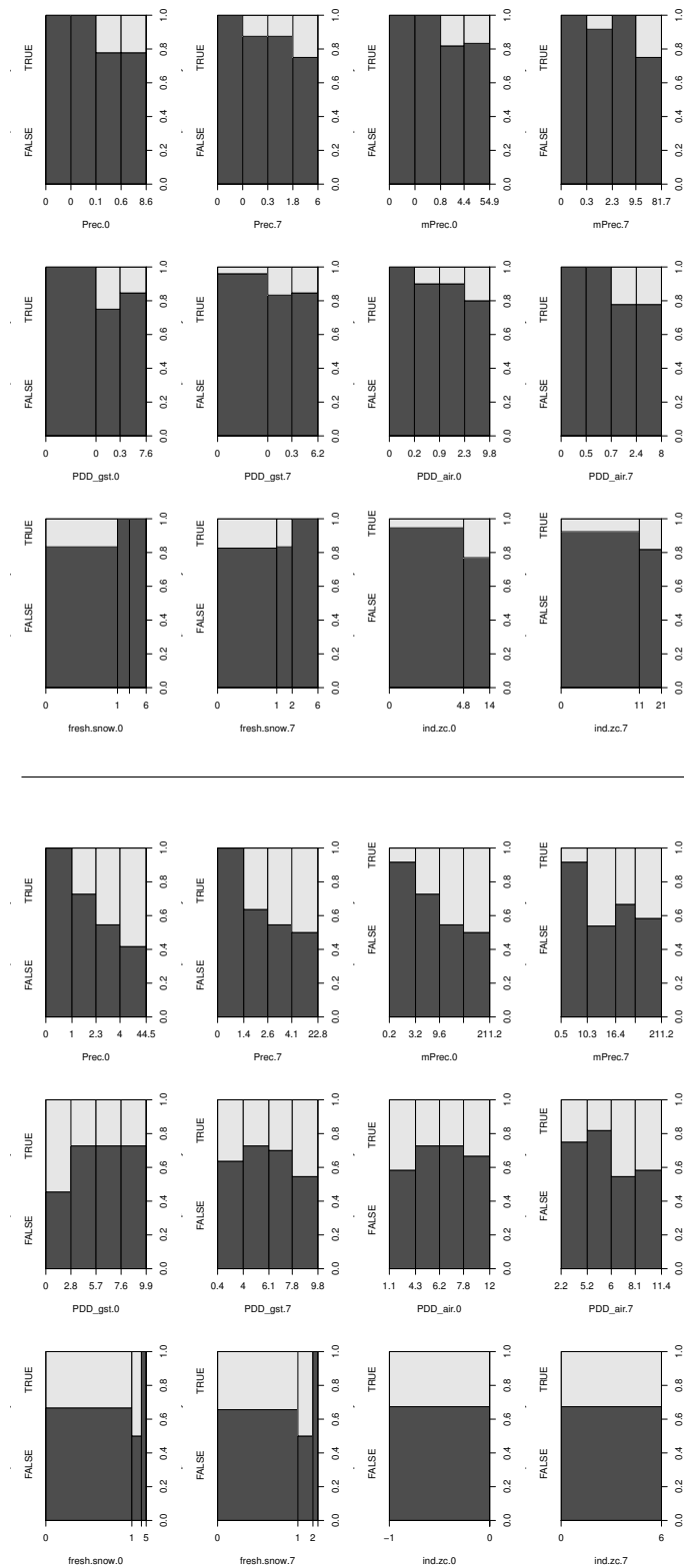


Figure S2: Spineplots for R7b (lower station on rock glacier Dirru). Frequencies of the occurrence of a peak as opposed to the absence of a peak conditional on potential explanatory variables. Bar widths refer to the 25%-quantiles of the explanatory variables. The upper plot refers to snow-cover conditions, the lower plot to snow-free conditions.

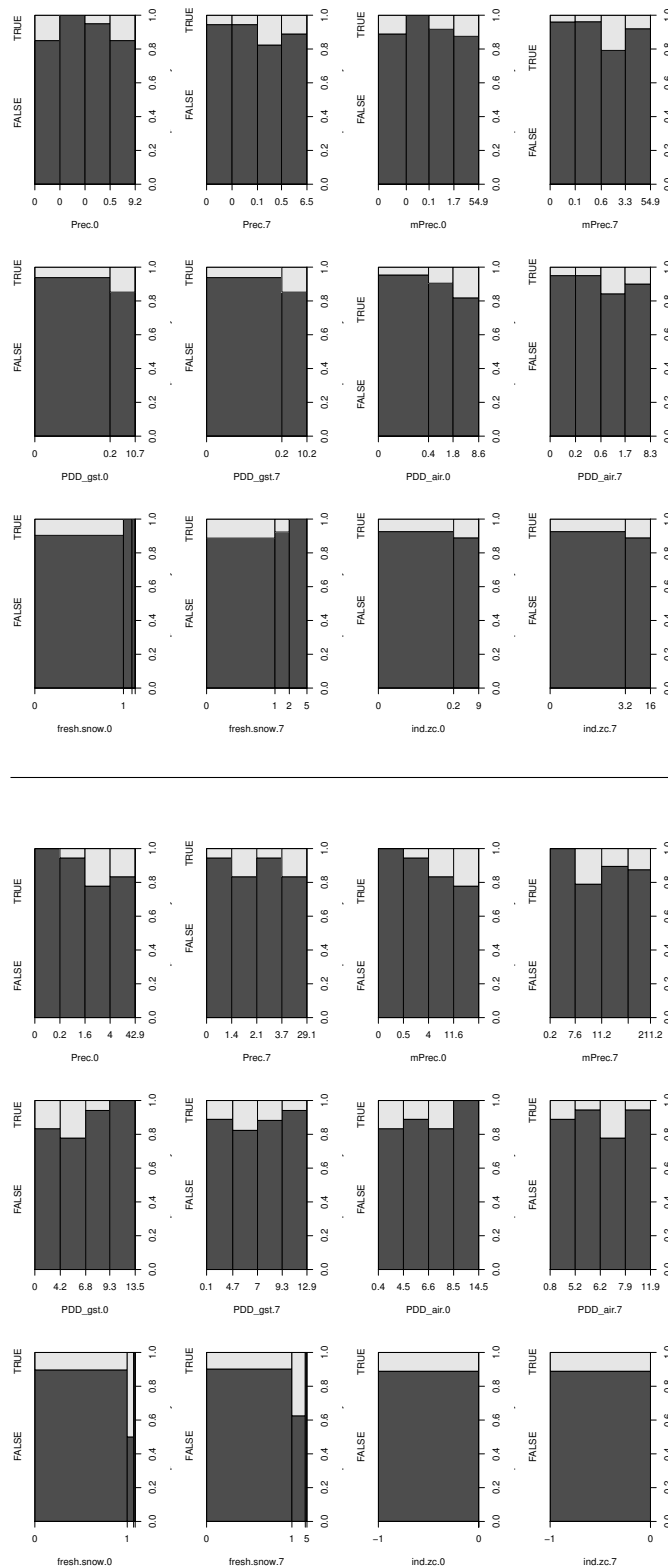


Figure S3: Spineplots for R2b (lower station on rock glacier Breithorn/Gugla). Frequencies of the occurrence of a peak (light grey) as opposed to the absence of a peak (darkgrey) conditional on potential explanatory variables. Bar widths refer to the 25%-quantiles of the explanatory variables, except for new snow (fresh.snow) and zero curtain (ind.zc). The upper plots (upper 3 lines) refers to snow-cover conditions, the lower plot to snow-free conditions.

3 Wilcoxon rank sum test

Table S1 shows the p-values of the Wilcoxon rank sum test p_w for all potential explanatory variables. It is distinguished between snow-cover and snow-free period and the positions (R2b, R7c).

Table S1: P-values of the Wilcoxon rank sum test.

Variable	R2b	R2b	R7c	R7c
	snow=0	snow=1	snow=0	snow=1
Prec.0	0.04	0.98	0.00	0.03
maxPrec.0	0.02	1.00	0.00	0.03
Prec.7	0.34	0.92	0.01	0.03
maxPrec.7	0.19	0.76	0.01	0.05
PDD _{air} .0	0.70	0.70	0.24	0.04
PDD _{air} .7	0.47	0.78	0.02	0.02
PDD _{gst} .0	0.51	0.63	0.12	0.03
PDD _{gst} .7	0.35	0.45	0.03	0.01
fresh.snow.0	0.70	0.50	0.73	0.10
fresh.snow.7	1.00	0.33	0.30	0.23
ind.zc.0	0.77	0.21	0.59	0.58
ind.zc.7	0.88	0.18	0.50	0.44

4 Logistic regression models

In the following main model results and description of the different logistic regression models are provided, e.g., variable estimations and confidence-intervals, AUROC, and AIC. Model results are provided for peak-detection applying different SNR-t and t_p .

Table S2: Logistic regression models based on velocity estimations using SNR-t=40 and $t_p=6$.

NS	Temp	AUROC	AIC	Model
Prec.0	PDD _{gst} -7	0.8279168	156.5617	PDD _{air} +zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
Prec.0	PDD _{air} -7	0.8279168	156.5617	PDD _{air} +zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
Prec.0	PDD _{gst} -0	0.8508287	152.0971	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:Temp+NS:snow.ind+NS:pos
Prec.0	PDD _{air} -0	0.8474163	154.9801	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos+Temp:zc.ind
max.Prec.0	PDD _{gst} -7	0.8085798	163.1643	PDD _{air} +zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
max.Prec.0	PDD _{air} -7	0.8085798	163.1643	PDD _{air} +zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
max.Prec.0	PDD _{gst} -0	0.8329542	160.0135	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos+Temp:zc.ind
max.Prec.0	PDD _{air} -0	0.8264543	164.3413	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:Temp+NS:snow.ind+Temp:zc.ind+Temp:pos
Prec.7	PDD _{gst} -7	0.8132922	167.6357	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+NS:pos
Prec.7	PDD _{air} -7	0.781443	169.8014	PDD _{air} +zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
Prec.7	PDD _{gst} -0	0.8282418	161.3419	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+NS:pos
Prec.7	PDD _{air} -0	0.8134547	167.9712	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+NS:pos
max.Prec.7	PDD _{gst} -7	0.7920052	174.5076	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+Temp:pos
max.Prec.7	PDD _{air} -7	0.7616185	176.6893	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+Temp:pos
max.Prec.7	PDD _{gst} -0	0.8119922	169.4514	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+NS:pos
max.Prec.7	PDD _{air} -0	0.7816055	173.8892	PDD _{air} +Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos+Temp:zc.ind

Table S3: Logistic regression models based on velocity estimations using SNR-t=20 and $t_p=6$.

NS	Temp	AUROC	AIC	Model
Prec.0	PDD _{gst} -7	0.739	286.426	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+zc.ind:pos
Prec.0	PDD _{air} -7	0.739	286.456	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+zc.ind:pos
Prec.0	PDD _{gst} -0	0.758	283.573	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+zc.ind:pos
Prec.0	PDD _{air} -0	0.739	286.456	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+zc.ind:pos
max.Prec.0	PDD _{gst} -7	0.728	288.436	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+zc.ind:pos
max.Prec.0	PDD _{air} -7	0.728	288.436	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+zc.ind:pos
max.Prec.0	PDD _{gst} -0	0.746	286.231	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+zc.ind:pos
max.Prec.0	PDD _{air} -0	0.728	288.436	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+zc.ind:pos
Prec.7	PDD _{gst} -7	0.742	282.741	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+snow.ind:pos
Prec.7	PDD _{air} -7	0.749	288.038	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+Temp:zc.ind+Temp:snow.ind+snow.ind:pos
Prec.7	PDD _{gst} -0	0.744	280.408	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+snow.ind:pos
Prec.7	PDD _{air} -0	0.734	283.171	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+snow.ind:pos
max.Prec.7	PDD _{gst} -7	0.721	286.173	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+snow.ind:pos
max.Prec.7	PDD _{air} -7	0.730	291.466	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:Temp+NS:zc.ind+NS:snow.ind+Temp:zc.ind+Temp:snow.ind
max.Prec.7	PDD _{gst} -0	0.732	284.515	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+snow.ind:pos
max.Prec.7	PDD _{air} -0	0.721	286.173	peak.true~NS+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+snow.ind:pos

Table S4: Coefficients of all final models, that were obtained based on velocity estimations with SNR-t=40 and $t_p=6$.

Variable	Estimate	Std. Error	z value	Pr(> z)
NS	Temp	AUC	AIC	mod
Prec.0	PDD _{gst} -7	0.8530367	142.2917	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
Prec.0	PDD _{air} -7	0.8351795	143.344	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:Temp+NS:pos
Prec.0	PDD _{gst} -0	0.8701299	137.8954	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
Prec.0	PDD _{air} -0	0.8525592	142.6296	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
max.Prec.0	PDD _{gst} -7	0.8175134	148.2477	peak.true~NS+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
max.Prec.0	PDD _{air} -7	0.8147441	148.4576	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:Temp+NS:pos
max.Prec.0	PDD _{gst} -0	0.8468296	144.6229	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
max.Prec.0	PDD _{air} -0	0.8175134	148.2477	peak.true~NS+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
Prec.7	PDD _{gst} -7	0.7851413	149.7464	peak.true~NS+zc.ind+snow.ind+pos+NS:pos
Prec.7	PDD _{air} -7	0.7851413	149.7464	peak.true~NS+zc.ind+snow.ind+pos+NS:pos
Prec.7	PDD _{gst} -0	0.8338426	145.6262	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:snow.ind+NS:pos
Prec.7	PDD _{air} -0	0.7851413	149.7464	peak.true~NS+zc.ind+snow.ind+pos+NS:pos
max.Prec.7	PDD _{gst} -7	0.8008021	154.8228	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+Temp:pos
max.Prec.7	PDD _{air} -7	0.7944996	155.7205	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+Temp:pos
max.Prec.7	PDD _{gst} -0	0.8118793	151.3701	peak.true~NS+Temp+zc.ind+snow.ind+pos+NS:zc.ind+NS:snow.ind+Temp:pos
max.Prec.7	PDD _{air} -0	0.7640374	153.3355	peak.true~NS+zc.ind+snow.ind+pos+NS:pos

Table S5: Coefficients of all final models, that were obtained based on velocity estimations with SNR-t=40 and $t_p=6$.

Variable	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-1.53	0.44	-3.45	0.00
NS	1.04	0.28	3.70	0.00
zc.indTRUE	3.65	1.52	2.41	0.02
snow.indTRUE	-3.40	1.63	-2.08	0.04
pos55	-0.87	0.48	-1.84	0.07
NS:snow.indTRUE	-0.71	0.24	-2.91	0.00
NS:pos55	-0.50	0.24	-2.11	0.04
(Intercept)	-1.53	0.44	-3.45	0.00
NS	1.04	0.28	3.70	0.00
zc.indTRUE	3.65	1.52	2.41	0.02
snow.indTRUE	-3.40	1.63	-2.08	0.04
pos55	-0.87	0.48	-1.84	0.07
NS:snow.indTRUE	-0.71	0.24	-2.91	0.00
NS:pos55	-0.50	0.24	-2.11	0.04
(Intercept)	-0.61	0.64	-0.96	0.33
NS	1.43	0.40	3.58	0.00
Temp	-0.17	0.09	-1.97	0.05
zc.indTRUE	2.68	1.39	1.93	0.05
snow.indTRUE	-2.94	1.56	-1.89	0.06
pos55	-0.75	0.49	-1.54	0.12
NS:Temp	-0.05	0.04	-1.16	0.25
NS:snow.indTRUE	-0.93	0.33	-2.79	0.01
NS:pos55	-0.56	0.27	-2.12	0.03
(Intercept)	-0.15	0.73	-0.21	0.84
NS	1.13	0.30	3.74	0.00
Temp	-0.24	0.11	-2.13	0.03
zc.indTRUE	3.32	1.62	2.05	0.04
snow.indTRUE	-4.72	1.80	-2.63	0.01
pos55	-0.93	0.48	-1.93	0.05
NS:snow.indTRUE	-0.83	0.26	-3.21	0.00
NS:pos55	-0.47	0.25	-1.92	0.05
Temp:zc.indTRUE	0.33	0.17	1.91	0.06
(Intercept)	-2.19	0.58	-3.80	0.00
NS	0.69	0.20	3.39	0.00
zc.indTRUE	3.75	1.54	2.42	0.02
snow.indTRUE	-3.07	1.63	-1.88	0.06
pos55	-0.46	0.54	-0.86	0.39
NS:snow.indTRUE	-0.55	0.19	-2.85	0.00
NS:pos55	-0.31	0.18	-1.74	0.08
(Intercept)	-2.19	0.58	-3.80	0.00
NS	0.69	0.20	3.39	0.00
zc.indTRUE	3.75	1.54	2.42	0.02
snow.indTRUE	-3.07	1.63	-1.88	0.06
pos55	-0.46	0.54	-0.86	0.39
NS:snow.indTRUE	-0.55	0.19	-2.85	0.00
NS:pos55	-0.31	0.18	-1.74	0.08
(Intercept)	-1.10	0.68	-1.62	0.10
NS	0.79	0.22	3.57	0.00
Temp	-0.24	0.10	-2.49	0.01
zc.indTRUE	3.63	1.59	2.29	0.02
snow.indTRUE	-4.18	1.69	-2.48	0.01
pos55	-0.38	0.55	-0.69	0.49
NS:snow.indTRUE	-0.65	0.21	-3.12	0.00
NS:pos55	-0.30	0.18	-1.61	0.11
Temp:zc.indTRUE	0.28	0.15	1.80	0.07
(Intercept)	-1.78	0.88	-2.04	0.04
NS	0.76	0.24	3.21	0.00
Temp	-0.02	0.13	-0.16	0.87
zc.indTRUE	2.05	1.33	1.54	0.12
snow.indTRUE	-2.62	1.55	-1.69	0.09
pos55	0.31	0.82	0.38	0.70
NS:Temp	-0.03	0.03	-1.13	0.26
NS:snow.indTRUE	-0.80	0.22	-3.65	0.00
Temp:zc.indTRUE	0.34	0.18	1.91	0.06
Temp:pos55	-0.26	0.15	-1.70	0.09
(Intercept)	-1.57	0.66	-2.39	0.02
NS	2.20	0.65	3.41	0.00
Temp	-0.04	0.09	-0.44	0.66
zc.indTRUE	28.00	2'120.61	0.01	0.99
snow.indTRUE	-27.17	2'120.61	-0.01	0.99
pos55	-0.56	0.51	-1.09	0.27
NS:Temp	-0.16	0.08	-2.07	0.04
NS:zc.indTRUE	1.94	115.12	0.02	0.99
NS:snow.indTRUE	-3.19	115.12	-0.03	0.98
NS:pos55	-0.51	0.36	-1.41	0.16
(Intercept)	-1.67	0.46	-3.64	0.00
NS	1.03	0.33	3.12	0.00
zc.indTRUE	3.68	2.02	1.82	0.07
snow.indTRUE	-3.22	2.11	-1.53	0.13
pos55	-0.68	0.47	-1.45	0.15
NS:snow.indTRUE	-0.58	0.30	-1.92	0.06
NS:pos55	-0.64	0.29	-2.17	0.03
(Intercept)	-1.35	0.59	-2.29	0.02
NS	2.16	0.54	4.01	0.00
Temp	-0.10	0.08	-1.22	0.22
zc.indTRUE	28.33	2'139.51	0.01	0.99
snow.indTRUE	-27.58	2'139.51	-0.01	0.99
pos55	-0.58	0.52	-1.11	0.27
NS:Temp	-0.16	0.06	-2.70	0.01
NS:zc.indTRUE	2.06	116.15	0.02	0.99
NS:snow.indTRUE	-3.09	116.15	-0.03	0.98
NS:pos55	-0.57	0.38	-1.49	0.14
(Intercept)	-1.62	0.68	-2.40	0.02
NS	1.94	0.55	3.54	0.00
Temp	-0.02	0.08	-0.25	0.81
zc.indTRUE	31.15	1'854.96	0.02	0.99
snow.indTRUE	-30.33	1'854.96	-0.02	0.99
pos55	-0.71	0.49	-1.46	0.15
NS:Temp	-0.13	0.06	-2.24	0.02
NS:zc.indTRUE	1.92	100.70	0.02	0.98
NS:snow.indTRUE	-2.87	100.70	-0.03	0.98
NS:pos55	-0.65	0.34	-1.91	0.06
(Intercept)	-4.52	1.44	-3.13	0.00
NS	1.33	0.50	2.67	0.01
Temp	0.40	0.20	1.94	0.05
zc.indTRUE	21.99	1'931.21	0.01	0.99
snow.indTRUE	-19.66	1'931.21	-0.01	0.99
pos55	0.09	0.72	0.13	0.90
NS:Temp	-0.14	0.07	-2.06	0.04
NS:zc.indTRUE	1.67	104.84	0.02	0.99
NS:snow.indTRUE	-2.53	104.84	-0.02	0.98
Temp:pos55	-0.20	0.13	-1.55	0.12
(Intercept)	-2.76	0.95	-2.91	0.00
NS	0.39	0.20	1.93	0.05
Temp	0.14	0.12	1.17	0.24
zc.indTRUE	19.71	1'203.05	0.02	0.99
snow.indTRUE	-18.97	1'203.05	-0.02	0.99
pos55	0.45	0.82	0.55	0.58
NS:zc.indTRUE	1.19	65.31	0.02	0.99
NS:snow.indTRUE	-1.44	65.31	-0.02	0.98
Temp:pos55	-0.26	0.14	-1.87	0.06
(Intercept)	-3.83	1.15	-3.32	0.00
NS	1.42	0.42	3.41	0.00
Temp	0.15	0.14	1.12	0.26
zc.indTRUE	21.69	1'935.05	0.01	0.99
snow.indTRUE	-20.02	1'935.05	-0.01	0.99
pos55	0.02	0.89	0.02	0.99
NS:Temp	-0.12	0.05	-2.38	0.02
NS:zc.indTRUE	1.58	105.05	0.02	0.99
NS:snow.indTRUE	-2.27	105.05	-0.02	0.98
NS:pos55	-0.35	0.30	-1.18	0.24
(Intercept)	-1.80	0.92	-1.97	0.05
NS	0.68	0.25	2.66	0.01
Temp	-0.15	0.09	-1.66	0.10
zc.indTRUE	3.88	2.63	1.47	0.14
snow.indTRUE	-4.15	2.68	-1.55	0.12
pos55	0.03	0.74	0.04	0.97
NS:snow.indTRUE	-0.49	0.26	-1.92	0.05
NS:pos55	-0.41	0.24	-1.70	0.09
Temp:zc.indTRUE	0.31	0.16	1.97	0.05

Table S6: Coefficients of all final models, that were obtained based on velocity estimations with SNR-t=20.

Variable	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-0.62	0.42	-1.46	0.14
NS	0.07	0.12	0.58	0.56
Temp	-0.09	0.06	-1.38	0.17
zc.indTRUE	22.66	1'220.86	0.02	0.99
snow.indTRUE	-23.54	1'220.86	-0.02	0.98
pos55	-0.87	0.39	-2.22	0.03
NS:Temp	0.04	0.02	1.57	0.12
NS:zc.indTRUE	1.27	66.28	0.02	0.98
NS:snow.indTRUE	-1.28	66.28	-0.02	0.98
zc.indTRUE:pos55	1.07	0.68	1.56	0.12
(Intercept)	-1.01	0.26	-3.79	0.00
NS	0.19	0.10	1.92	0.05
zc.indTRUE	22.62	1'220.37	0.02	0.99
snow.indTRUE	-23.26	1'220.37	-0.02	0.98
pos55	-0.95	0.38	-2.48	0.01
NS:zc.indTRUE	1.28	66.25	0.02	0.98
NS:snow.indTRUE	-1.42	66.25	-0.02	0.98
zc.indTRUE:pos55	1.06	0.68	1.56	0.12
(Intercept)	-0.42	0.37	-1.13	0.26
NS	0.23	0.10	2.24	0.02
Temp	-0.11	0.05	-2.14	0.03
zc.indTRUE	22.93	1'226.37	0.02	0.99
snow.indTRUE	-23.87	1'226.37	-0.02	0.98
pos55	-0.80	0.39	-2.03	0.04
NS:zc.indTRUE	1.31	66.58	0.02	0.98
NS:snow.indTRUE	-1.45	66.58	-0.02	0.98
zc.indTRUE:pos55	1.00	0.69	1.46	0.14
(Intercept)	-1.01	0.26	-3.79	0.00
NS	0.19	0.10	1.92	0.05
zc.indTRUE	22.62	1'220.37	0.02	0.99
snow.indTRUE	-23.26	1'220.37	-0.02	0.98
pos55	-0.95	0.38	-2.48	0.01
NS:zc.indTRUE	1.28	66.25	0.02	0.98
NS:snow.indTRUE	-1.42	66.25	-0.02	0.98
zc.indTRUE:pos55	1.06	0.68	1.56	0.12
(Intercept)	-1.14	0.29	-3.96	0.00
NS	0.14	0.09	1.63	0.10
zc.indTRUE	20.17	1'109.84	0.02	0.99
snow.indTRUE	-20.77	1'109.84	-0.02	0.99
pos55	-0.93	0.38	-2.42	0.02
NS:zc.indTRUE	1.14	60.25	0.02	0.98
NS:snow.indTRUE	-1.24	60.25	-0.02	0.98
zc.indTRUE:pos55	1.04	0.68	1.54	0.12
(Intercept)	-1.14	0.29	-3.96	0.00
NS	0.14	0.09	1.63	0.10
zc.indTRUE	20.17	1'109.84	0.02	0.99
snow.indTRUE	-20.77	1'109.84	-0.02	0.99
pos55	-0.93	0.38	-2.42	0.02
NS:zc.indTRUE	1.14	60.25	0.02	0.98
NS:snow.indTRUE	-1.24	60.25	-0.02	0.98
zc.indTRUE:pos55	1.04	0.68	1.54	0.12
(Intercept)	-0.63	0.38	-1.68	0.09
NS	0.17	0.09	1.90	0.06
Temp	-0.10	0.05	-1.99	0.05
zc.indTRUE	20.46	1'115.47	0.02	0.99
snow.indTRUE	-21.32	1'115.47	-0.02	0.98
pos55	-0.78	0.39	-1.99	0.05
NS:zc.indTRUE	1.16	60.56	0.02	0.98
NS:snow.indTRUE	-1.26	60.56	-0.02	0.98
zc.indTRUE:pos55	0.99	0.68	1.45	0.15
(Intercept)	-1.14	0.29	-3.96	0.00
NS	0.14	0.09	1.63	0.10
zc.indTRUE	20.17	1'109.84	0.02	0.99
snow.indTRUE	-20.77	1'109.84	-0.02	0.99
pos55	-0.93	0.38	-2.42	0.02
NS:zc.indTRUE	1.14	60.25	0.02	0.98
NS:snow.indTRUE	-1.24	60.25	-0.02	0.98
zc.indTRUE:pos55	1.04	0.68	1.54	0.12
(Intercept)	-1.14	0.29	-3.96	0.00
NS	0.14	0.09	1.63	0.10
zc.indTRUE	20.17	1'109.84	0.02	0.99
snow.indTRUE	-20.77	1'109.84	-0.02	0.99
pos55	-0.93	0.38	-2.42	0.02
NS:zc.indTRUE	1.14	60.25	0.02	0.98
NS:snow.indTRUE	-1.24	60.25	-0.02	0.98
zc.indTRUE:pos55	1.04	0.68	1.54	0.12
(Intercept)	-2.16	0.53	-4.11	0.00
NS	0.43	0.15	2.77	0.01
zc.indTRUE	2.55	1.12	2.29	0.02
snow.indTRUE	-2.16	1.26	-1.72	0.09
pos55	-0.98	0.41	-2.41	0.02
NS:zc.indTRUE	0.16	0.12	1.33	0.18
NS:snow.indTRUE	-0.55	0.17	-3.26	0.00
snow.indTRUE:pos55	0.97	0.66	1.47	0.14
(Intercept)	-3.55	1.16	-3.07	0.00
NS	0.96	0.39	2.50	0.01
Temp	0.19	0.16	1.18	0.24
zc.indTRUE	1.59	1.21	1.32	0.19
snow.indTRUE	0.30	1.72	0.18	0.86
pos55	-0.63	0.31	-2.00	0.05
NS:Temp	-0.08	0.05	-1.55	0.12
NS:zc.indTRUE	0.20	0.15	1.39	0.16
NS:snow.indTRUE	-1.06	0.38	-2.79	0.01
Temp:zc.indTRUE	1.81	1.26	1.44	0.15
Temp:snow.indTRUE	-1.78	1.27	-1.40	0.16
(Intercept)	-1.78	0.57	-3.13	0.00
NS	0.47	0.16	2.94	0.00
Temp	-0.10	0.05	-1.87	0.06
zc.indTRUE	2.76	1.12	2.46	0.01
snow.indTRUE	-2.61	1.28	-2.03	0.04
pos55	-0.86	0.41	-2.08	0.04
NS:zc.indTRUE	0.21	0.13	1.54	0.12
NS:snow.indTRUE	-0.60	0.18	-3.41	0.00
snow.indTRUE:pos55	0.93	0.66	1.40	0.16
(Intercept)	-2.16	0.53	-4.11	0.00
NS	0.43	0.15	2.77	0.01
zc.indTRUE	2.55	1.12	2.29	0.02
snow.indTRUE	-2.16	1.26	-1.72	0.09
pos55	-0.98	0.41	-2.41	0.02
NS:zc.indTRUE	0.16	0.12	1.33	0.18
NS:snow.indTRUE	-0.55	0.17	-3.26	0.00
snow.indTRUE:pos55	0.97	0.66	1.47	0.14

Table S7: Confidence intervals for the variables of the different final models, that were obtained based on velocity estimations with SNR-t=20.

variable	2.5%	97.5%	variable	2.5%	97.5%
(Intercept)	-2.472	-0.723	(Intercept)	-2.934	-0.325
NS	0.552	1.662	NS	1.001	3.562
zc.indTRUE	1.178	7.356	Temp	-0.227	0.142
snow.indTRUE	-7.336	-0.713	zc.indTRUE	-55.894	763.504
pos55	-1.801	0.097	snow.indTRUE	-669.746	73.676
NS:snow.indTRUE	-1.228	-0.266	pos55	-1.534	0.510
NS:pos55	-1.057	-0.132	NS:Temp	-0.327	-0.013
(Intercept)	-2.472	-0.723	NS:zc.indTRUE	-3.174	38.806
NS	0.552	1.662	NS:snow.indTRUE	-40.759	1.800
zc.indTRUE	1.178	7.356	NS:pos55	-1.302	0.021
snow.indTRUE	-7.336	-0.713	(Intercept)	-2.640	-0.832
pos55	-1.801	0.097	NS	0.436	1.737
NS:snow.indTRUE	-1.228	-0.266	zc.indTRUE	0.824	9.079
NS:pos55	-1.057	-0.132	snow.indTRUE	-8.876	-0.242
(Intercept)	-1.913	0.603	pos55	-1.572	0.293
NS	0.778	2.299	NS:snow.indTRUE	-1.196	-0.016
Temp	-0.355	-0.008	NS:pos55	-1.311	-0.146
zc.indTRUE	0.465	6.229	(Intercept)	-2.573	-0.230
snow.indTRUE	-6.779	-0.372	NS	1.162	3.291
pos55	-1.711	0.243	Temp	-0.255	0.056
NS:Temp	-0.127	0.001	zc.indTRUE	-69.272	699.360
NS:snow.indTRUE	-1.649	-0.379	snow.indTRUE	-824.222	47.107
NS:pos55	-1.174	-0.130	pos55	-1.579	0.511
(Intercept)	-1.633	1.277	NS:Temp	-0.283	-0.047
NS	0.608	1.798	NS:zc.indTRUE	-3.240	38.489
Temp	-0.472	-0.029	NS:snow.indTRUE	-40.559	2.016
zc.indTRUE	0.617	7.248	NS:pos55	-1.397	0.009
snow.indTRUE	-9.118	-1.742	(Intercept)	-3.006	-0.335
pos55	-1.879	0.047	NS	0.920	3.088
NS:snow.indTRUE	-1.387	-0.363	Temp	-0.188	0.142
NS:pos55	-1.049	-0.099	zc.indTRUE	-49.189	636.401
Temp:zc.indTRUE	-0.005	0.684	snow.indTRUE	-587.007	58.871
(Intercept)	-3.457	-1.172	pos55	-1.644	0.304
NS	0.331	1.137	NS:Temp	-0.256	-0.020
zc.indTRUE	1.262	7.562	NS:zc.indTRUE	-2.590	33.951
snow.indTRUE	-7.011	-0.379	NS:snow.indTRUE	-33.664	1.873
pos55	-1.434	0.723	NS:pos55	-1.412	-0.069
NS:snow.indTRUE	-0.951	-0.193	(Intercept)	-7.526	-1.838
NS:pos55	-0.727	-0.049	NS	0.401	2.371
(Intercept)	-3.457	-1.172	Temp	-0.001	0.816
NS	0.331	1.137	zc.indTRUE	-61.048	655.445
zc.indTRUE	1.262	7.562	snow.indTRUE	-649.457	64.041
snow.indTRUE	-7.011	-0.379	pos55	-1.310	1.561
pos55	-1.434	0.723	NS:Temp	-0.271	-0.009
NS:snow.indTRUE	-0.951	-0.193	NS:zc.indTRUE	-2.802	36.252
NS:pos55	-0.727	-0.049	NS:snow.indTRUE	-33.652	2.575
(Intercept)	-2.539	0.156	Temp:pos55	-0.454	0.048
NS	0.401	1.273	(Intercept)	-4.742	-1.000
Temp	-0.443	-0.061	NS	0.008	0.813
zc.indTRUE	1.027	7.504	Temp	-0.091	0.380
snow.indTRUE	-8.254	-1.358	zc.indTRUE	-35.840	393.376
pos55	-1.379	0.839	snow.indTRUE	-389.551	37.145
NS:snow.indTRUE	-1.095	-0.267	pos55	-1.117	2.138
NS:pos55	-0.739	-0.031	NS:zc.indTRUE	-1.457	23.472
Temp:zc.indTRUE	-0.030	0.584	NS:snow.indTRUE	-22.474	1.436
(Intercept)	-3.632	-0.165	Temp:pos55	-0.547	0.006
NS	0.353	1.285	(Intercept)	-6.221	-1.664
Temp	-0.282	0.242	NS	0.645	2.292
zc.indTRUE	-0.206	5.346	Temp	-0.121	0.424
snow.indTRUE	-6.307	0.023	zc.indTRUE	-69.378	613.268
pos55	-1.270	2.013	snow.indTRUE	-616.737	70.112
NS:Temp	-0.095	0.010	pos55	-1.388	1.938
NS:snow.indTRUE	-1.275	-0.414	NS:Temp	-0.218	-0.022
Temp:zc.indTRUE	-0.015	0.696	NS:zc.indTRUE	-2.863	36.432
Temp:pos55	-0.569	0.030	NS:snow.indTRUE	-35.437	2.486
			NS:pos55	-0.995	0.046
			(Intercept)	-3.710	-0.091
			NS	0.211	1.221
			Temp	-0.345	0.024
			zc.indTRUE	0.370	10.691
			snow.indTRUE	-11.093	-0.451
			pos55	-1.268	1.676
			NS:snow.indTRUE	-1.021	-0.011
			NS:pos55	-0.943	-0.017
			Temp:zc.indTRUE	0.002	0.631

Table S8: Confidence intervals for the variables of the different final models, that were obtained based on velocity estimations with SNR-t=20.

variable	2.5%	97.5%	variable	2.5%	97.5%
(Intercept)	-1.461	0.202	(Intercept)	-1.976	-0.217
NS	-0.111	0.361	NS	0.311	1.122
Temp	-0.211	0.034	Temp	-0.226	0.025
zc.indTRUE	-25.544	446.649	zc.indTRUE	1.196	6.673
snow.indTRUE	-496.186	15.782	snow.indTRUE	-7.161	-1.350
pos55	-1.654	-0.107	pos55	-1.797	-0.151
NS:Temp	-0.008	0.079	NS:zc.indTRUE	-0.005	0.615
NS:zc.indTRUE	6.125	27.645	NS:snow.indTRUE	-1.295	-0.421
NS:snow.indTRUE	-26.875	0.862	snow.indTRUE:pos55	-0.252	2.372
zc.indTRUE:pos55	-0.255	2.447	(Intercept)	-3.154	-0.285
(Intercept)	-1.548	-0.503	NS	0.391	2.180
NS	0.024	0.407	Temp	-0.185	0.229
zc.indTRUE	-38.642	374.720	zc.indTRUE	-0.095	5.679
snow.indTRUE	-430.866	27.875	snow.indTRUE	-5.991	0.545
pos55	-1.713	-0.204	pos55	-1.924	-0.289
NS:zc.indTRUE	-2.782	NA	NS:Temp	-0.216	0.022
NS:snow.indTRUE	-23.544	1.360	NS:zc.indTRUE	-0.030	0.694
zc.indTRUE:pos55	-0.256	2.430	NS:snow.indTRUE	-2.283	-0.525
(Intercept)	-1.164	0.307	Temp:zc.indTRUE	-0.295	5.255
NS	0.053	0.449	Temp:snow.indTRUE	-5.232	0.362
Temp	-0.222	-0.013	snow.indTRUE:pos55	-0.235	2.390
zc.indTRUE	-28.810	430.600	(Intercept)	-1.848	-0.213
snow.indTRUE	-433.610	27.499	NS	0.298	1.092
pos55	-1.576	-0.032	Temp	-0.230	-0.012
NS:zc.indTRUE	-1.221	24.980	zc.indTRUE	1.300	6.781
NS:snow.indTRUE	-23.695	1.337	snow.indTRUE	-7.251	-1.470
zc.indTRUE:pos55	-0.325	2.384	pos55	-1.769	-0.122
(Intercept)	-1.548	-0.503	NS:zc.indTRUE	0.007	0.630
NS	0.024	0.407	NS:snow.indTRUE	-1.268	-0.408
zc.indTRUE	-38.642	374.720	snow.indTRUE:pos55	-0.268	2.365
snow.indTRUE	-430.866	27.875	(Intercept)	-2.240	-0.895
pos55	-1.713	-0.204	NS	0.239	0.991
NS:zc.indTRUE	-2.782	NA	zc.indTRUE	0.964	6.393
NS:snow.indTRUE	-23.544	1.360	snow.indTRUE	-6.630	-0.959
zc.indTRUE:pos55	-0.256	2.430	pos55	-1.889	-0.266
(Intercept)	-1.732	-0.601	NS:zc.indTRUE	-0.040	0.506
NS	-0.001	0.330	NS:snow.indTRUE	-1.168	-0.348
Temp	-0.222	-0.013	snow.indTRUE:pos55	-0.227	2.384
zc.indTRUE	-35.536	340.441	(Intercept)	-3.262	-1.191
snow.indTRUE	-400.019	24.177	NS	0.137	0.742
pos55	-1.693	-0.180	zc.indTRUE	0.823	5.678
NS:zc.indTRUE	-2.557	NA	snow.indTRUE	-5.435	-0.039
NS:snow.indTRUE	-25.495	-11.250	pos55	-1.792	-0.192
zc.indTRUE:pos55	-0.271	2.414	NS:zc.indTRUE	-0.050	0.430
(Intercept)	-1.732	-0.601	NS:snow.indTRUE	-0.906	-0.235
NS	-0.001	0.330	snow.indTRUE:pos55	-0.306	2.291
Temp	-0.211	-0.005	(Intercept)	-5.962	-1.451
zc.indTRUE	-25.941	394.911	NS	0.251	1.755
snow.indTRUE	-446.443	15.832	Temp	-0.122	0.517
pos55	-1.562	-0.015	zc.indTRUE	-0.395	4.802
NS:zc.indTRUE	-0.845	24.308	snow.indTRUE	-3.546	3.533
NS:snow.indTRUE	-23.046	0.989	pos55	-1.248	-0.011
zc.indTRUE:pos55	-0.336	2.370	NS:Temp	-0.188	0.018
(Intercept)	-1.390	0.096	NS:zc.indTRUE	-0.039	0.563
NS	0.021	0.367	NS:snow.indTRUE	-1.854	-0.375
Temp	-0.211	-0.005	Temp:zc.indTRUE	-0.275	5.298
zc.indTRUE	-25.941	394.911	Temp:snow.indTRUE	-5.276	0.318
snow.indTRUE	-446.443	15.832	(Intercept)	-2.943	-0.710
pos55	-1.562	-0.015	NS	0.170	0.797
NS:zc.indTRUE	-0.845	24.308	Temp	-0.207	0.002
NS:snow.indTRUE	-23.046	0.989	zc.indTRUE	1.013	5.893
zc.indTRUE:pos55	-0.336	2.370	snow.indTRUE	-5.905	-0.422
(Intercept)	-1.732	-0.601	pos55	-1.681	-0.057
NS	-0.001	0.330	NS:zc.indTRUE	-0.019	0.516
Temp	-0.211	-0.005	NS:snow.indTRUE	-0.960	-0.268
zc.indTRUE	-35.536	340.441	snow.indTRUE:pos55	-0.352	2.263
snow.indTRUE	-400.019	24.177	(Intercept)	-3.262	-1.191
pos55	-1.693	-0.180	NS	0.137	0.742
NS:zc.indTRUE	-2.557	NA	zc.indTRUE	0.823	5.678
NS:snow.indTRUE	-25.495	-11.250	snow.indTRUE	-5.435	-0.039
zc.indTRUE:pos55	-0.271	2.414	pos55	-1.792	-0.192
(Intercept)	-1.390	0.096	NS:zc.indTRUE	-0.050	0.430
NS	0.021	0.367	NS:snow.indTRUE	-0.906	-0.235
Temp	-0.211	-0.005	snow.indTRUE:pos55	-0.306	2.291
zc.indTRUE	-25.941	394.911	(Intercept)	-3.262	-1.191
snow.indTRUE	-446.443	15.832	NS	0.137	0.742
pos55	-1.562	-0.015	zc.indTRUE	0.823	5.678
NS:zc.indTRUE	-0.845	24.308	snow.indTRUE	-5.435	-0.039
NS:snow.indTRUE	-23.046	0.989	pos55	-1.792	-0.192
zc.indTRUE:pos55	-0.336	2.370	NS:zc.indTRUE	-0.050	0.430
(Intercept)	-1.732	-0.601	NS:snow.indTRUE	-0.906	-0.235
NS	-0.001	0.330	snow.indTRUE:pos55	-0.306	2.291
Temp	-0.211	-0.005	(Intercept)	-3.262	-1.191
zc.indTRUE	-35.536	340.441	NS	0.137	0.742
snow.indTRUE	-400.019	24.177	zc.indTRUE	0.823	5.678
pos55	-1.693	-0.180	snow.indTRUE	-5.435	-0.039
NS:zc.indTRUE	-2.557	NA	pos55	-1.792	-0.192
NS:snow.indTRUE	-25.495	-11.250	NS:zc.indTRUE	-0.050	0.430
zc.indTRUE:pos55	-0.271	2.414	NS:snow.indTRUE	-0.906	-0.235
(Intercept)	-1.732	-0.601	snow.indTRUE:pos55	-0.306	2.291
NS	-0.001	0.330	(Intercept)	-3.262	-1.191
Temp	-0.211	-0.005	NS	0.137	0.742
zc.indTRUE	-35.536	340.441	zc.indTRUE	0.823	5.678
snow.indTRUE	-400.019	24.177	snow.indTRUE	-5.435	-0.039
pos55	-1.693	-0.180	pos55	-1.792	-0.192
NS:zc.indTRUE	-2.557	NA	NS:zc.indTRUE	-0.050	0.430
NS:snow.indTRUE	-25.495	-11.250	NS:snow.indTRUE	-0.906	-0.235
zc.indTRUE:pos55	-0.271	2.414	snow.indTRUE:pos55	-0.306	2.291

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