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Supplement of

How water, temperature, and seismicity control the preconditioning of massive rock slope failure (Hochvogel)

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S1 Measuring devices on summit

Fig. S 1: Photo of vibrating wire crackmeter “Crack06” without its protective wood roof.

Fig. S 2: Photo of vibrating wire crackmeter “Crack06” with wood roof.

Fig. S 3:Photo of tipping bucket rain gauge on the summit of Hochvogel.

Fig. S 4: Photo of the main crack with position of seismic station HV_1 (red ellipse).

Fig. S 5:Photo of seismic station SA_{22} during maintenance. During operation, the station is completely covered with rocks to protect the geophone from wind and rain.

Table S 1: Station info data for all used seismic stations.

ID	x	y	z	Installation depth	Sensor type	Logger type	gain
HVGL1	608448.5	5248421.2	2586	0	PE6B	Cube3ext	32
HVGL2	609674.9	5247154.4	1588	0.5	TC120s	Cube3extBOB	4
HVGL3	610726.5	5247060.3	1489	0.4	TC120s	Cube3extBOB	4
HVGL4	609216.5	5246298.4	1252	0.3	TC120s	Cube3extBOB	4
HVGL5	609620	5248034	1933	0.3	PE6B	Cube3ext	16
SA_21	608433	5248426	NA	0.4	PE6B	Cube3ext	16
SA_22	608436	5248451	NA	0	PE6B	Cube3ext	32
SA_23	608455	5248474	NA	0.4	PE6B	Cube3ext	32

S2 Snowmelt modelling configuration

```
[GENERAL]
BUFFER_SIZE = 370
BUFF_BEFORE = 1.5
DATA_QA_LOGS = FALSE

[INPUT]
COORDSYS = CH1903
TIME_ZONE = 1
METEO = SMET
METEOPATH = .\input
METEOPATH_RECURSIVE = FALSE
STATION1 = ZUGS1_2021.smet
SNOWPACK_SLOPES = FALSE
MERGE_STRATEGY = EXPAND_MERGE
TSG::CREATE = CST
TSG::CST::VALUE = 273
SNOW = SMET
SNOWPATH = ./input
SNOWFILE1 = ZUGS1

[OUTPUT]
COORDSYS = CH1903
TIME_ZONE = 1
METEO = SMET
METEOPATH = ./output
WRITE_PROCESSED_METEO = FALSE
EXPERIMENT = 2021
USEREFERENCELAYER = FALSE
SNOW_WRITE = FALSE
PROF_WRITE = TRUE
PROF_FORMAT = PRO
AGGREGATE_PRO = FALSE
AGGREGATE_PRF = FALSE
PROF_START = 0
PROF_DAYS_BETWEEN = 0.041666
HARDNESS_IN_NEWTON = FALSE
CLASSIFY_PROFILE = FALSE
TS_WRITE = TRUE
TS_FORMAT = SMET
TS_START = 0
TS_DAYS_BETWEEN = 0.041666
AVGSUM_TIME_SERIES = TRUE
CUMSUM_MASS = FALSE
PRECIP_RATES = TRUE
OUT_CANOPY = FALSE
OUT_HAZ = FALSE
OUT_SOILEB = FALSE
OUT_HEAT = TRUE
OUT_T = TRUE
OUT_LW = TRUE
OUT_SW = TRUE
OUT_MASS = TRUE
OUT_METEO = TRUE
OUT_STAB = TRUE

[SNOWPACK]
CALCULATION_STEP_LENGTH = 15
ROUGHNESS_LENGTH = 0.002
HEIGHT_OF_METEO_VALUES = 5
HEIGHT_OF_WIND_VALUE = 5
ENFORCE_MEASURED_SNOW_HEIGHTS = TRUE
SW_MODE = BOTH
ATMOSPHERIC_STABILITY = MO_MICHLMAYR
CANOPY = FALSE
MEAS_TSS = TRUE
CHANGE_BC = TRUE
THRESH_CHANGE_BC = -1
SNP_SOIL = FALSE

[SNOWPACKADVANCED]
VARIANT = DEFAULT
RESEARCH = TRUE
ADJUST_HEIGHT_OF_METEO_VALUES = TRUE
ADJUST_HEIGHT_OF_WIND_VALUE = TRUE
SNOW_EROSION = TRUE
WIND_SCALING_FACTOR = 1
NUMBER_SLOPES = 1
PERP_TO_SLOPE = FALSE
ALLOW_ADAPTIVE_TIMESTEPPING = TRUE
THRESH_RAIN = 1.2
FORCE_RH_WATER = TRUE
THRESH_RH = 0.5
THRESH_DTEMP_AIR_SNOW = 3
HOAR_THRESH_TA = 1.2
HOAR_THRESH_RH = 0.97
HOAR_THRESH_VW = 10
HOAR_DENSITY_BURIED = 125
HOAR_MIN_SIZE_BURIED = 2
HOAR_DENSITY_SURF = 100
MIN_DEPTH_SUBSURF = 0.07
T_CRAZY_MIN = 210
T_CRAZY_MAX = 340
METAMORPHISM_MODEL = DEFAULT
NEW_SNOW_GRAIN_SIZE = 0.3
STRENGTH_MODEL = DEFAULT
VISCOSITY_MODEL = DEFAULT
SALTATION_MODEL = SORENSEN
ENABLE_VAPOUR_TRANSPORT = FALSE
WATERTRANSPORTMODEL_SNOW = BUCKET
WATERTRANSPORTMODEL_SOIL = BUCKET
SOIL_EVAP_MODEL = EVAP_RESISTANCE
SOIL_THERMAL_CONDUCTIVITY = FITTED
ALBEDO_AGING = TRUE
SW_ABSORPTION_SCHEME = MULTI_BAND
HARDNESS_PARAMETERIZATION = MONTI
DETECT_GRASS = FALSE
PLASTIC = FALSE
JAM = FALSE
WATER_LAYER = FALSE
HEIGHT_NEW_ELEM = 0.02
MINIMUM_L_ELEMENT = 0.0025
```

```
COMBINE_ELEMENTS = TRUE
TWO_LAYER_CANOPY = TRUE
CANOPY_HEAT_MASS = TRUE
CANOPY_TRANSMISSION = TRUE
FORESTFLOOR_ALB = TRUE
ADVECTIVE_HEAT = FALSE

[INTERPOLATIONS1D]
ENABLE_RESAMPLING = TRUE
WINDOW_SIZE = 2419200

[FILTERS]
TA::FILTER1 = MIN_MAX
TA::ARG1::MIN = 240
TA::ARG1::MAX = 320
HS::FILTER1 = MIN
HS::ARG1::SOFT = true
HS::ARG1::MIN = 0.0
RH::FILTER1 = MIN_MAX
RH::ARG1::SOFT = TRUE
RH::ARG1::MIN = 0
RH::ARG1::MAX = 1
RH::ARG1::MIN_RESET = 0
RH::ARG1::MAX_RESET = 1
[TechSnow]
SNOW_GROOMING = FALSE
```

S3 Seasonal data analysis

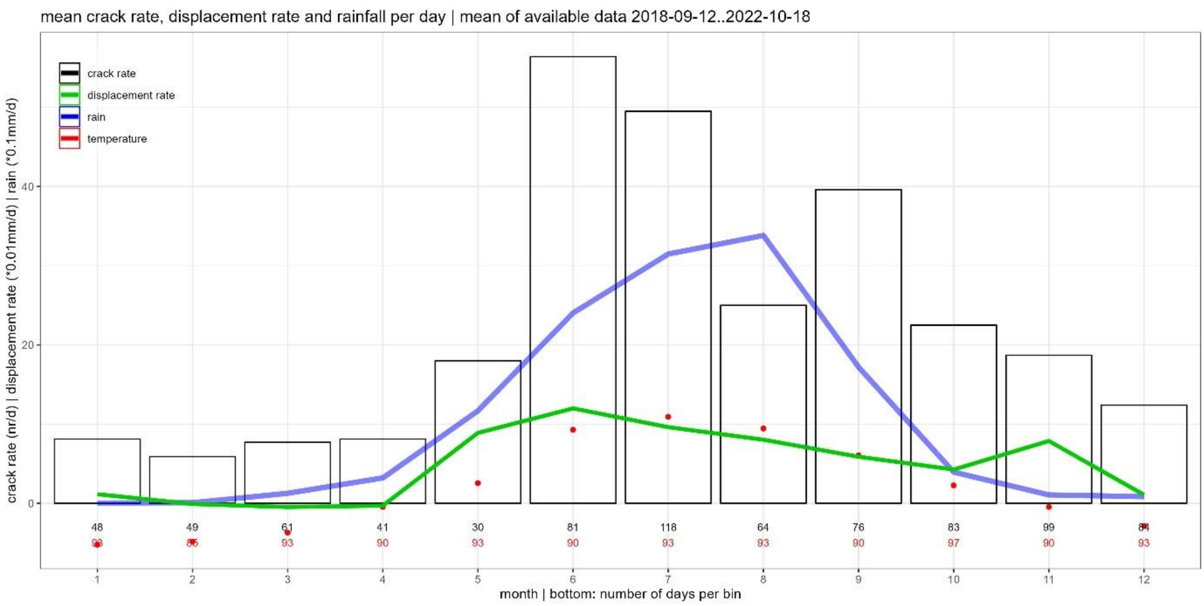


Fig. S 6: All available data averaged per month of the year. Note the generally higher values of all variables in the summer months (black bars: crack rate (events/d), green line: displacement rate (0.01mm/d), blue line: rain intensity (0.1mm/d), red dots: temperature (°C). The numbers in the bottom give the number of available data points per bin (black for cracks, red for other variables).

S4 Random Forest classifier

Table S 2: Features that have been used as input for the Random Forest classifier. Features 6-66 have been calculated for the station with the highest signal-to-noise ratio (SNR), once for the picked signal itself (prefix "pick_") and once for a longer signal including 3 s buffer before and after the picked signal (prefix "long_"), using the function "signal_stats" from eseis.

feature nr	**name**	**details**
1	snr_min	SNR of the station with the minimum SNR
2	snr_max	SNR of the station with the maximum SNR
3	dur_mean	mean signal duration of all stations that picked the signal
4	dur_diff	duration difference between the minimum and the maximum signal duration of all stations that picked the signal
5	t_risefall	ratio of rise to fall time
6	a_skewness	Skewness of the signal amplitude
7	a_kurtosis	Kurtosis of the signal amplitude
8	a1_kurtosis	Kurtosis of the filtered (0.1-1 Hz) signal amplitude
9	a2_kurtosis	Kurtosis of the filtered (1-3 Hz) signal amplitude
10	a3_kurtosis	Kurtosis of the filtered (3-10 Hz) signal amplitude
11	a4_kurtosis	Kurtosis of the filtered (10-20 Hz) signal amplitude
12	e_maxmean	Ratio of maximum and mean envelope value, see Hibert et al. (2017)
13	e_maxmedian	Ratio of maximum and median envelope value, see Hibert et al. (2017)
14	e_skewness	Skewness of the signal envelope
15	e_kurtosis	Kurtosis of the signal envelope
16	e1_logsum	Logarithm of the filtered (0.1-1 Hz) envelope sum, see Hibert et al. (2017)
17	e2_logsum	Logarithm of the filtered (1-3 Hz) envelope sum, see Hibert et al. (2017)
18	e3_logsum	Logarithm of the filtered (3-10 Hz) envelope sum, see Hibert et al. (2017)
19	e4_logsum	Logarithm of the filtered (10-20 Hz) envelope sum, see Hibert et al. (2017)
20	c_peaks	Number of peaks (excursions above 75)
21	c_energy1	Sum of the first third of the signal cross correlation function, see Hibert et al. (2017)

22	c_energy2	Sum of the last two thirds of the signal cross correlation function, see Hibert et al. (2017)
23	c_energy3	Ratio of c_energy1 and c_energy2, see Hibert et al. (2017)
24	s_peaks	Number of peaks (excursions above 75)
25	s_peakpower	Mean power of spectral peaks, see Hibert et al. (2017)
26	s_mean	Mean spectral power, see Hibert et al. (2017)
27	s_median	Median spectral power, see Hibert et al. (2017)
28	s_max	Maximum spectral power, see Hibert et al. (2017)
29	s_var	Variance of the spectral power, see Hibert et al. (2017)
30	s_flatness	Spectral flatness
31	s_entropy	Spectral entropy
32	s_precision	Spectral precision
33	s_sd	Standard deviation of the spectral power
34	s_sem	Standard error of the mean of the spectral power
35	s1_energy	Energy of the filtered (0.1-1 Hz) spectrum, see Hibert et al. (2017)
36	s2_energy	Energy of the filtered (1-3 Hz) spectrum, see Hibert et al. (2017)
37	s3_energy	Energy of the filtered (3-10 Hz) spectrum, see Hibert et al. (2017)
38	s4_energy	Energy of the filtered (10-20 Hz) spectrum, see Hibert et al. (2017)
39	s5_energy	Energy of the filtered (20-30 Hz) spectrum, see Hibert et al. (2017)
40	s_gamma1	Gamma 1, spectral centroid, see Hibert et al. (2017)
41	s_gamma2	Gamma 2, spectral gyration radius, see Hibert et al. (2017)
42	f_modal	Modal frequency
43	f_mean	Mean frequency (aka central frequency)
44	f_median	Median frequency
45	f_q05	Quantile 0.05 of the spectrum
46	f_q25	Quantile 0.25 of the spectrum
47	f_q75	Quantile 0.75 of the spectrum
48	f_q95	Quantile 0.95 of the spectrum
49	f_iqr	Inter quartile range of the spectrum

50	f_centroid	Spectral centroid
51	p_kurtosismax	Kurtosis of the maximum spectral power over time, see Hibert et al. (2017)
52	p_kurtosismedian	Kurtosis of the median spectral power over time, see Hibert et al. (2017)
53	p_maxmean	Mean of the ratio of max to mean spectral power over time, see Hibert et al. (2017)
54	p_maxmedian	Mean of the ratio of max to median spectral power over time, see Hibert et al. (2017)
55	p_peaksmean	Number of peaks in normalised mean spectral power over time, see Hibert et al. (2017)
56	p_peaksmedian	Number of peaks in normalised median spectral power over time, see Hibert et al. (2017)
57	p_peaksmax	Number of peaks in normalised max spectral power over time, see Hibert et al. (2017)
58	p_peaksmaxmean	Ratio of number of peaks in normalised max and mean spectral power over time, see Hibert et al. (2017)
59	p_peaksmaxmedian	Ratio of number of peaks in normalised max and median spectral power over time, see Hibert et al. (2017)
60	p_peaksfcentral	Number of peaks in spectral power at central frequency over time, see Hibert et al. (2017)
61	p_diffmaxmean	Mean difference between max and mean power, see Hibert et al. (2017)
62	p_diffquantile21	Mean difference between power quantiles 2 and 1, see Hibert et al. (2017)
63	p_diffquantile32	Mean difference between power quantiles 3 and 2, see Hibert et al. (2017)
64	p_diffquantile31	Mean difference between power quantiles 3 and 1, see Hibert et al. (2017)

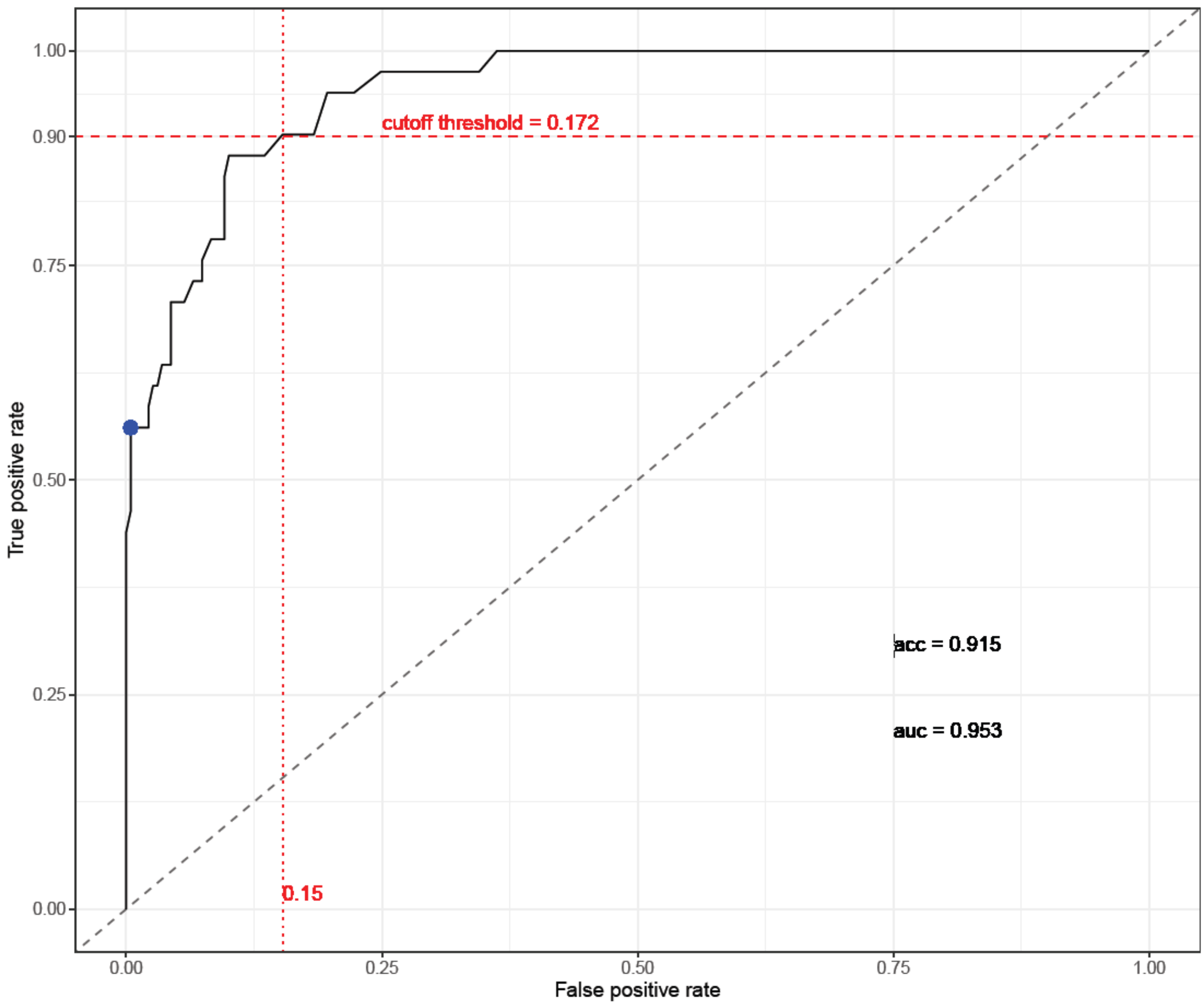


Fig. S 7: ROC (receiver operating characteristic curve) for the first step Random Forest Model showing the cutoff threshold of 0.172 for a true positive rate of 0.9 leading to a false positive rate of 0.15. The blue dot marks the point with the minimum mean misclassification error.

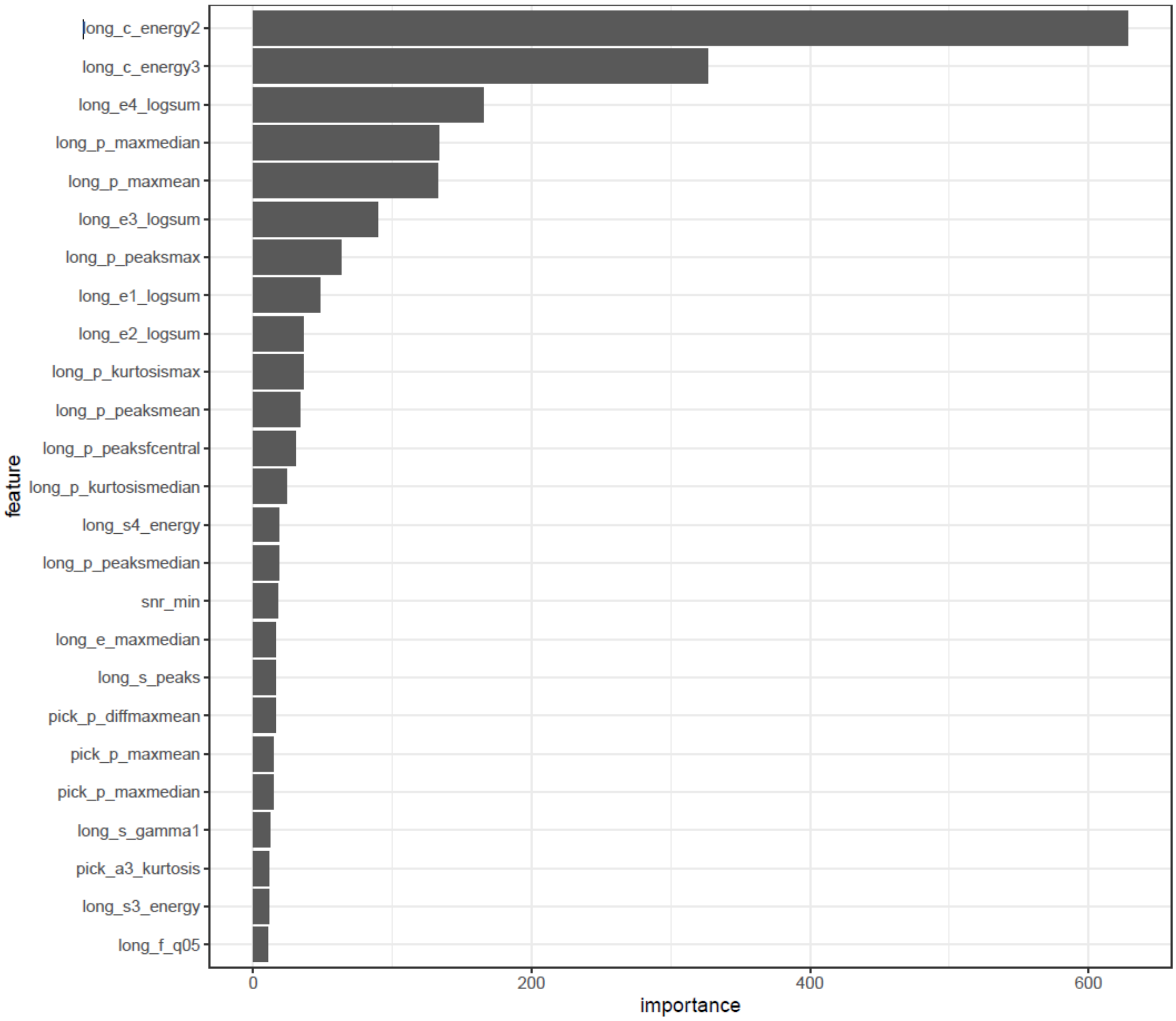
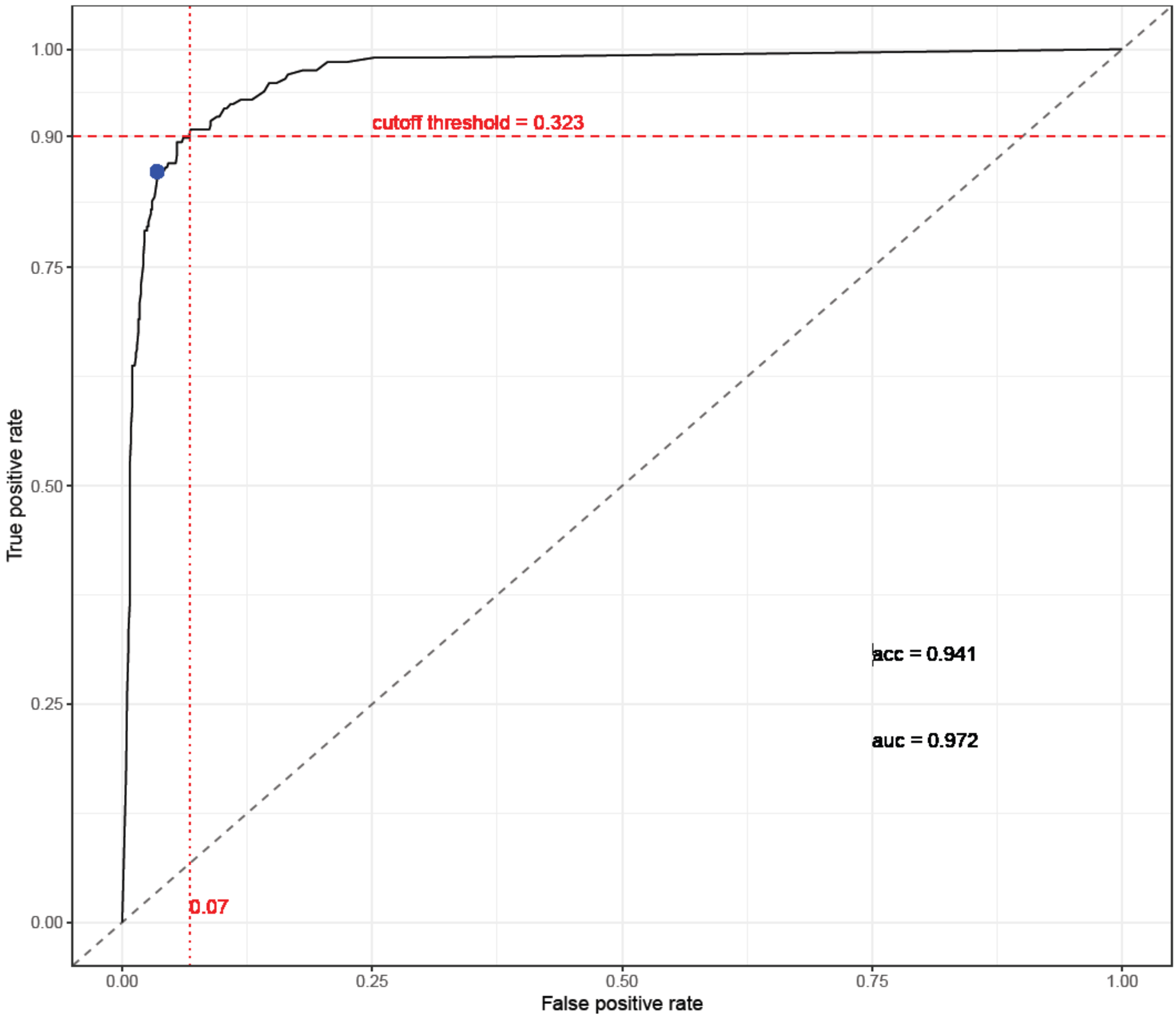


Fig. S 8: Variable importance of the 25 most important features in the final Random Forest model.



185 *Fig. S 9: ROC (receiver operating characteristic curve) for the refined Random Forest Model showing the cutoff threshold of 0.323 for a true positive rate of 0.9 leading to a false positive rate of 0.07. The blue dot marks the point with the minimum mean misclassification error.*

S5 Focus times

S5.1 Rain

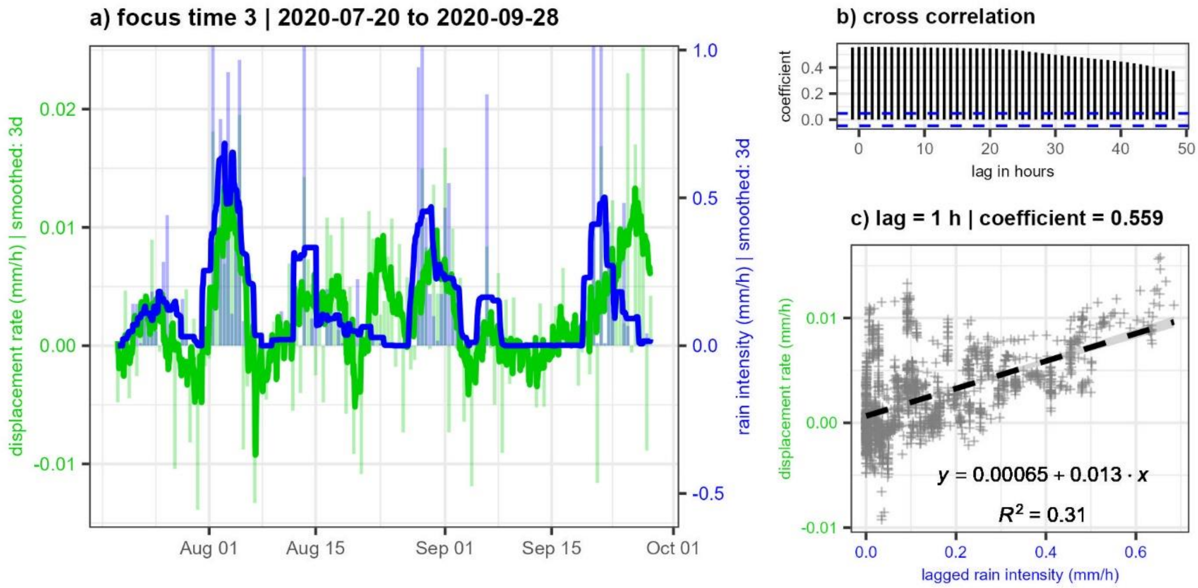


Fig. S 10: Detail plot of focus time 3. (a) displacement rate and rain intensity (lines 3 d smoothed, columns 12 h means). (b) cross-correlation coefficient of the two lines. The highest correlation appears with a lag of 1 h and a coefficient of 0.559. (c) scatter plot with linear trendline (95 % confidence interval as grey area) with 1 h shifted data.

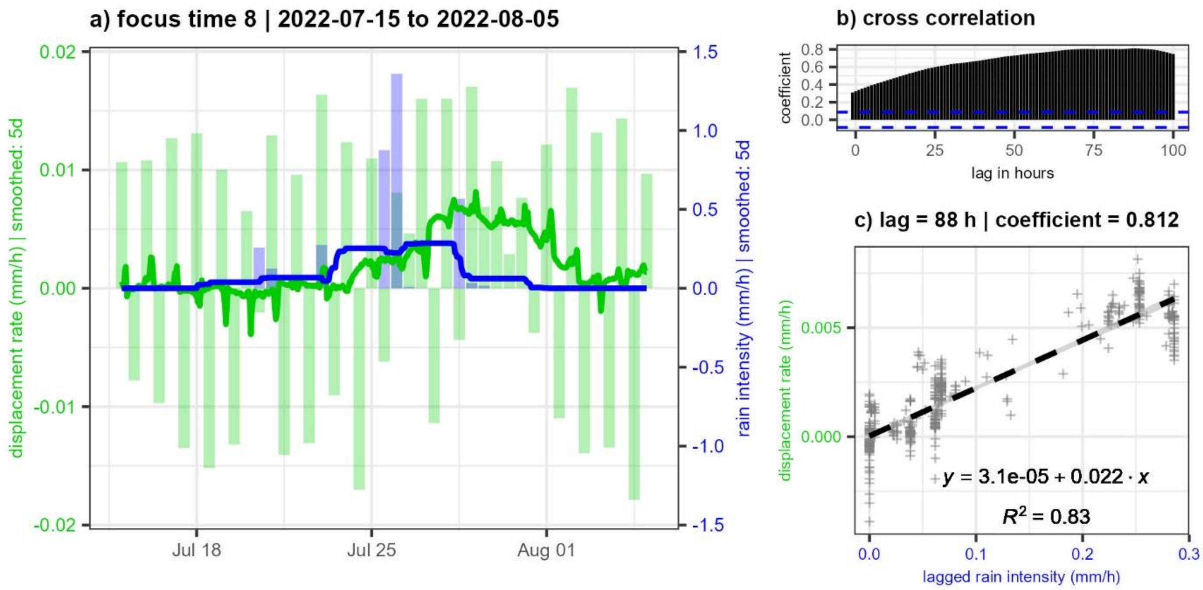


Fig. S 11: Detail plot of focus time 8. See how multiple consecutive rain events accumulate in one acceleration. (a) displacement rate and rain intensity (lines 5 d smoothed, columns 12 h means). (b) cross-correlation coefficient of the two lines. The highest correlation appears with a lag of 88 h and a coefficient of 0.812. (c) scatter plot with linear trendline (95 % confidence interval as grey area) with 88 h shifted data.

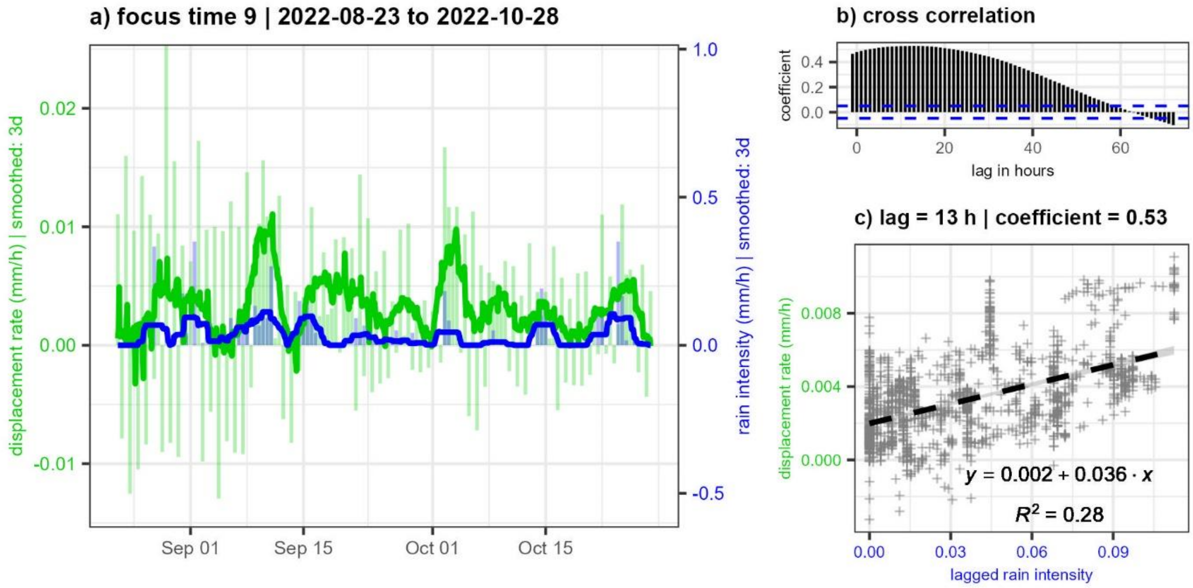


Fig. S 12: Detail plot of focus time 9. (a) displacement rate and rain intensity (lines 5 d smoothed, columns 12 h means). (b) cross-correlation coefficient of the two lines. The highest correlation appears with a lag of 13 h and a coefficient of 0.530. (c) scatter plot with linear trendline (95 % confidence interval as grey area) with 13 h shifted data.

S5.2 Snow

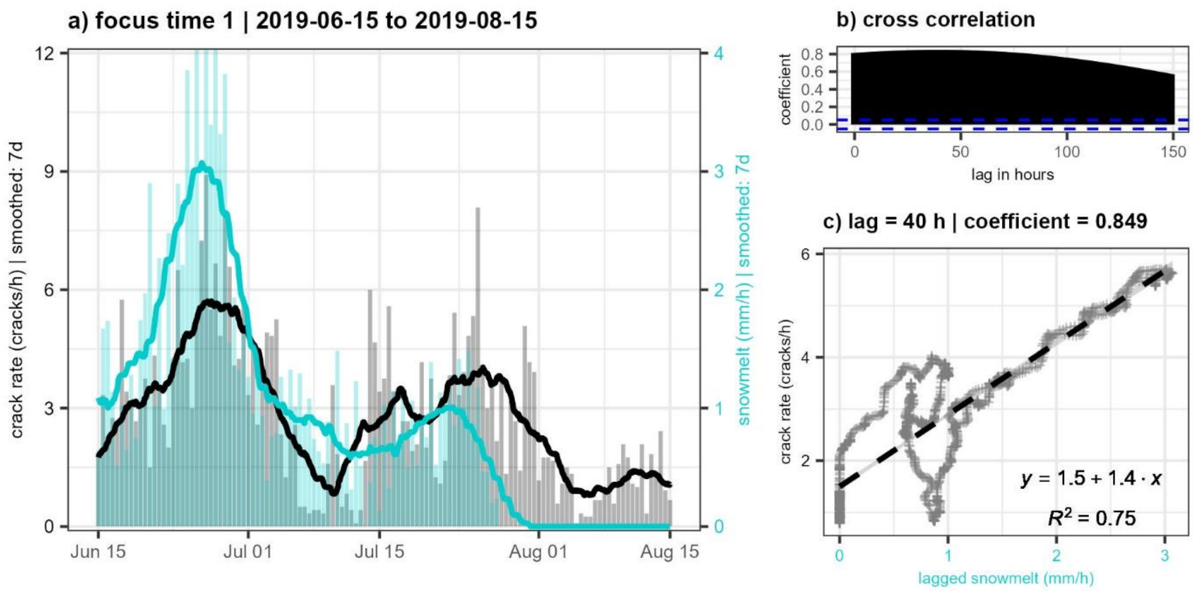


Fig. S 13: Detail plot of focus time 1. (a) crack rate and snowmelt (lines 7 d smoothed, columns 12 h means). (b) cross-correlation coefficient of the two lines. The highest correlation appears with a lag of 2 d and a coefficient of 0.849. (c) scatter plot with linear trendline (95 % confidence interval as grey area) with 40 h shifted data.

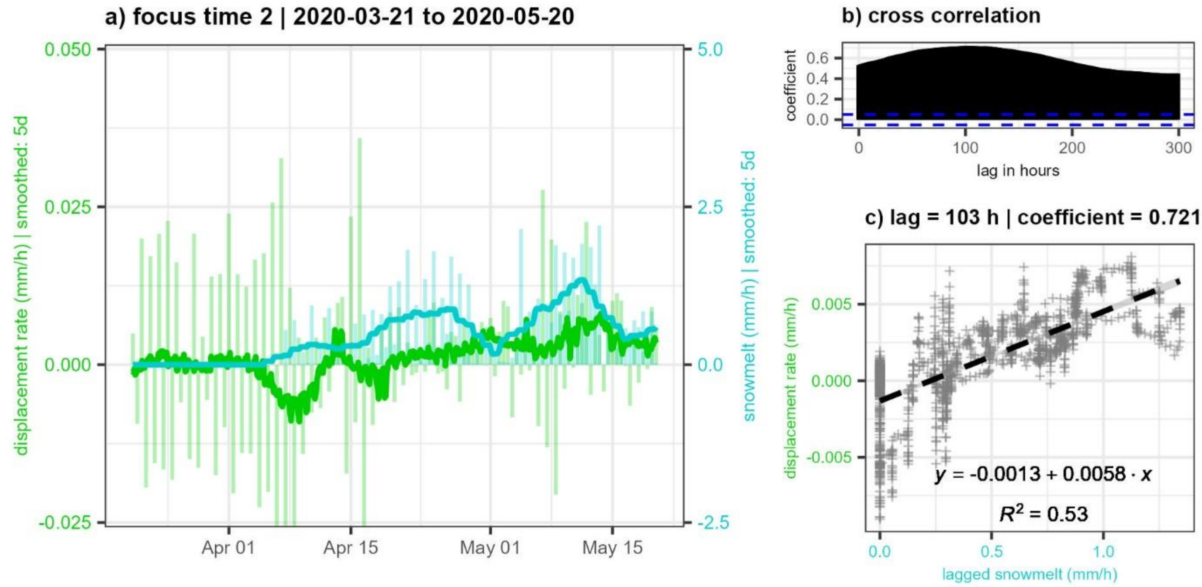


Fig. S 14: Detail plot of focus time 2. (a) displacement rate and snowmelt (lines 5 d smoothed, columns 12 h means). (b) cross-correlation coefficient of the two lines. The highest correlation appears with a lag of 4.3 d and a coefficient of 0.721. (c) scatter plot with linear trendline (95 % confidence interval as grey area) with 103 h shifted data.

S5.3 Seismic crack events

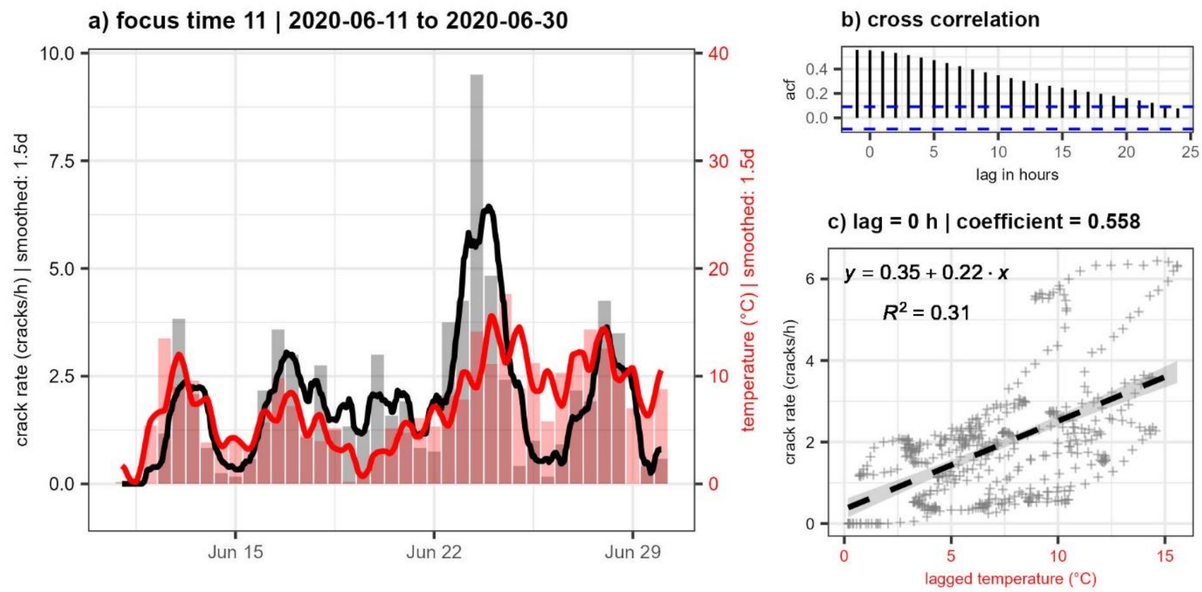


Fig. S 15: Detail plot of focus time 11. (a) crack rate and mean temperature (lines 1.5 d smoothed, columns 12 h means). (b) cross-correlation coefficient of the two lines. The highest correlation appears without any lag and a coefficient of 0.558. (c) scatter plot with linear trendline (95 % confidence interval as grey area) with data not shifted (0 h).

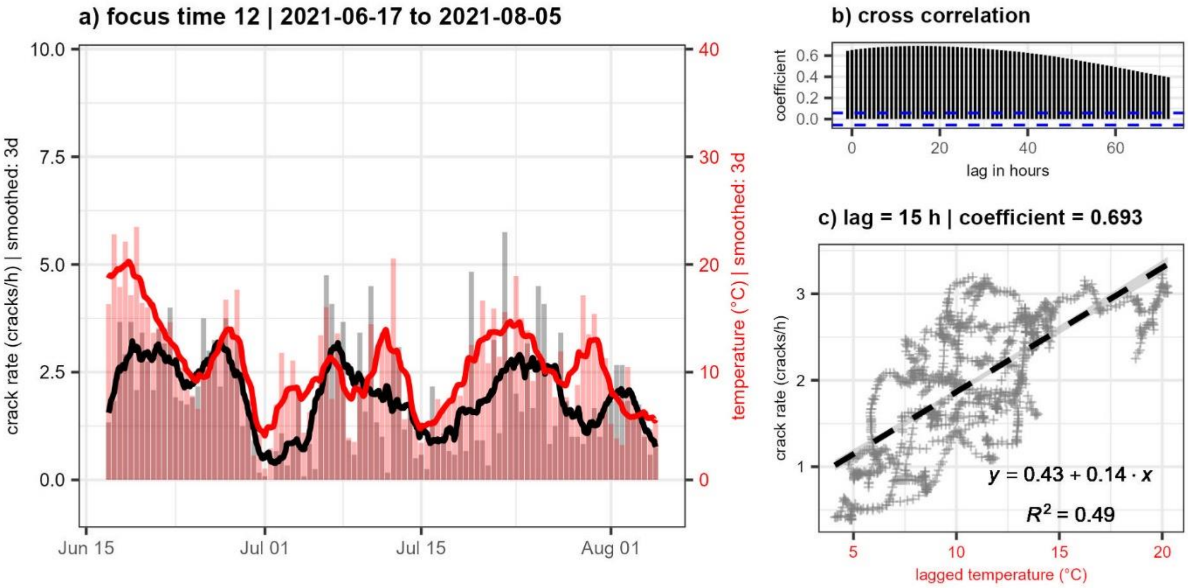


Fig. S 16: Detail plot of focus time 12. (a) crack rate and mean temperature (lines 3 d smoothed, columns 12 h means). (b) cross-correlation coefficient of the two lines. The highest correlation appears with a lag of 15 h and a coefficient of 0.693. (c) scatter plot with linear trendline (95 % confidence interval as grey area) with 15 h shifted data.

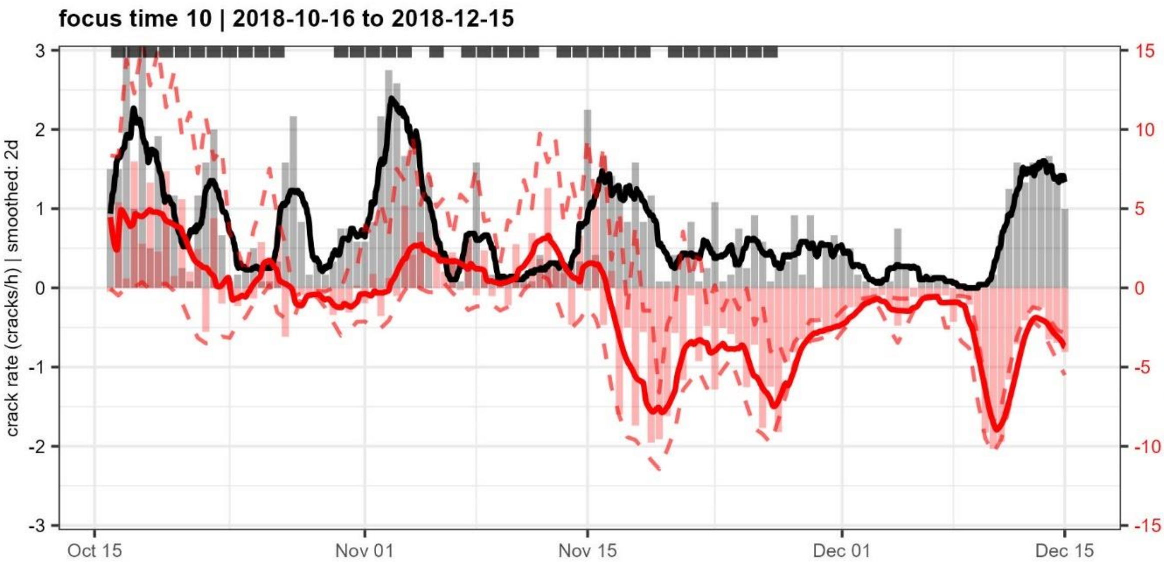


Fig. S 17: Detail plot of focus time 10. Crack rate, mean temperature (solid line), minimum and maximum temperature (dashed lines, all lines 2 d smoothed, columns 12 h means). Peaks in the crack rate coincide with days with freeze-thaw or thaw-freeze conditions (black bars on top). From mid-November onwards, crack rate increases during days with severe temperature drops.

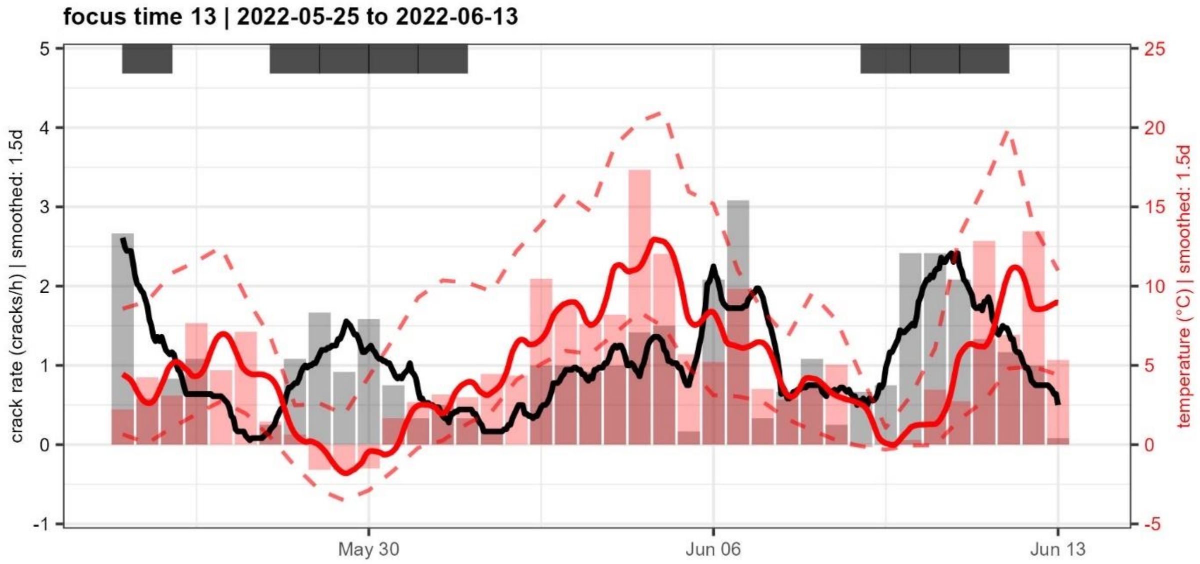


Fig. S 18: Detail plot of focus time 13. Crack rate, mean temperature (solid line), minimum and maximum temperature (dashed lines, all lines 1.5 d smoothed, columns 12 h means). Peaks in the crack rate coincide with days with freeze-thaw or thaw-freeze conditions (black bars on top). Beginning of June, crack rate increases with increasing temperatures.

S6 Running cross-correlations

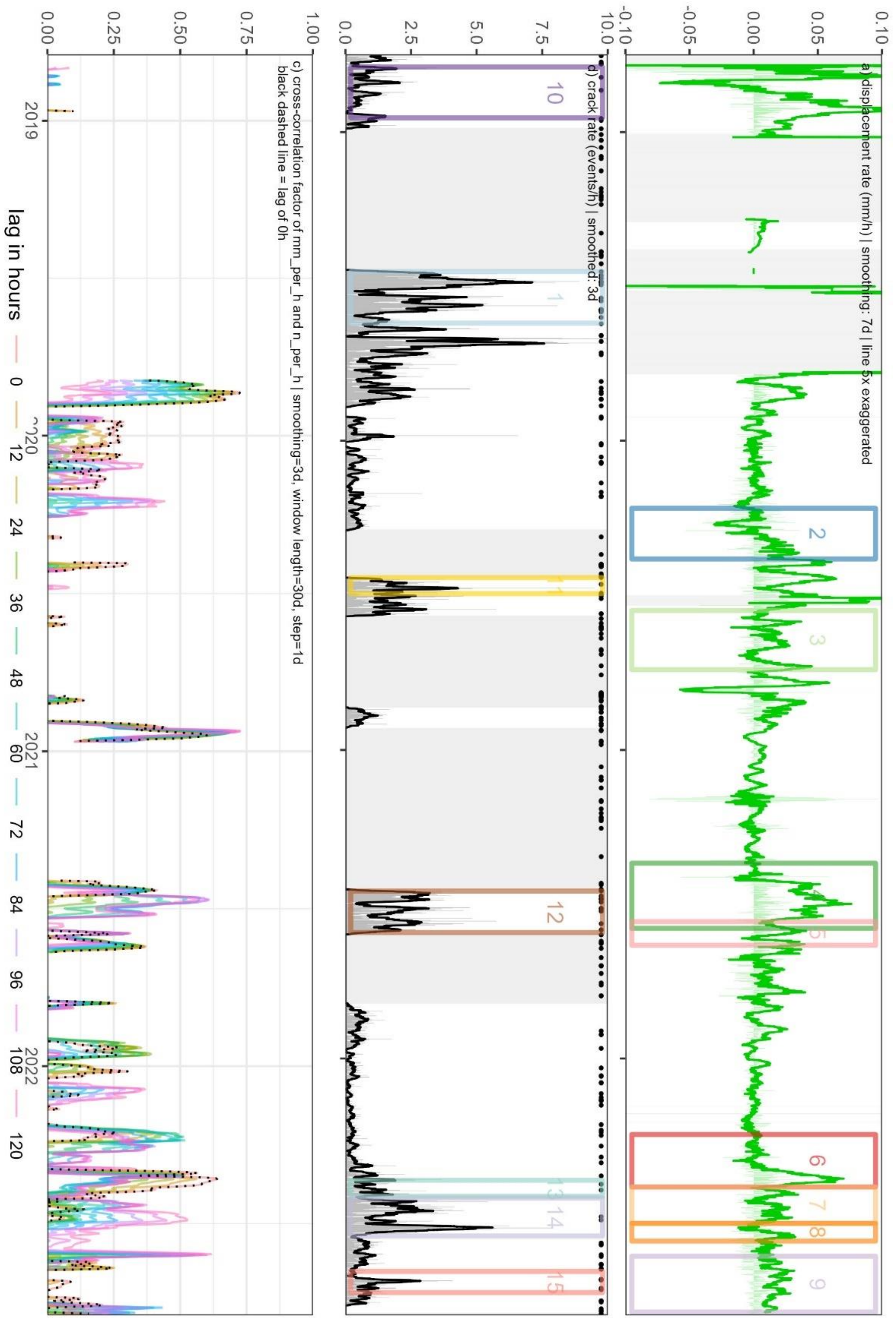
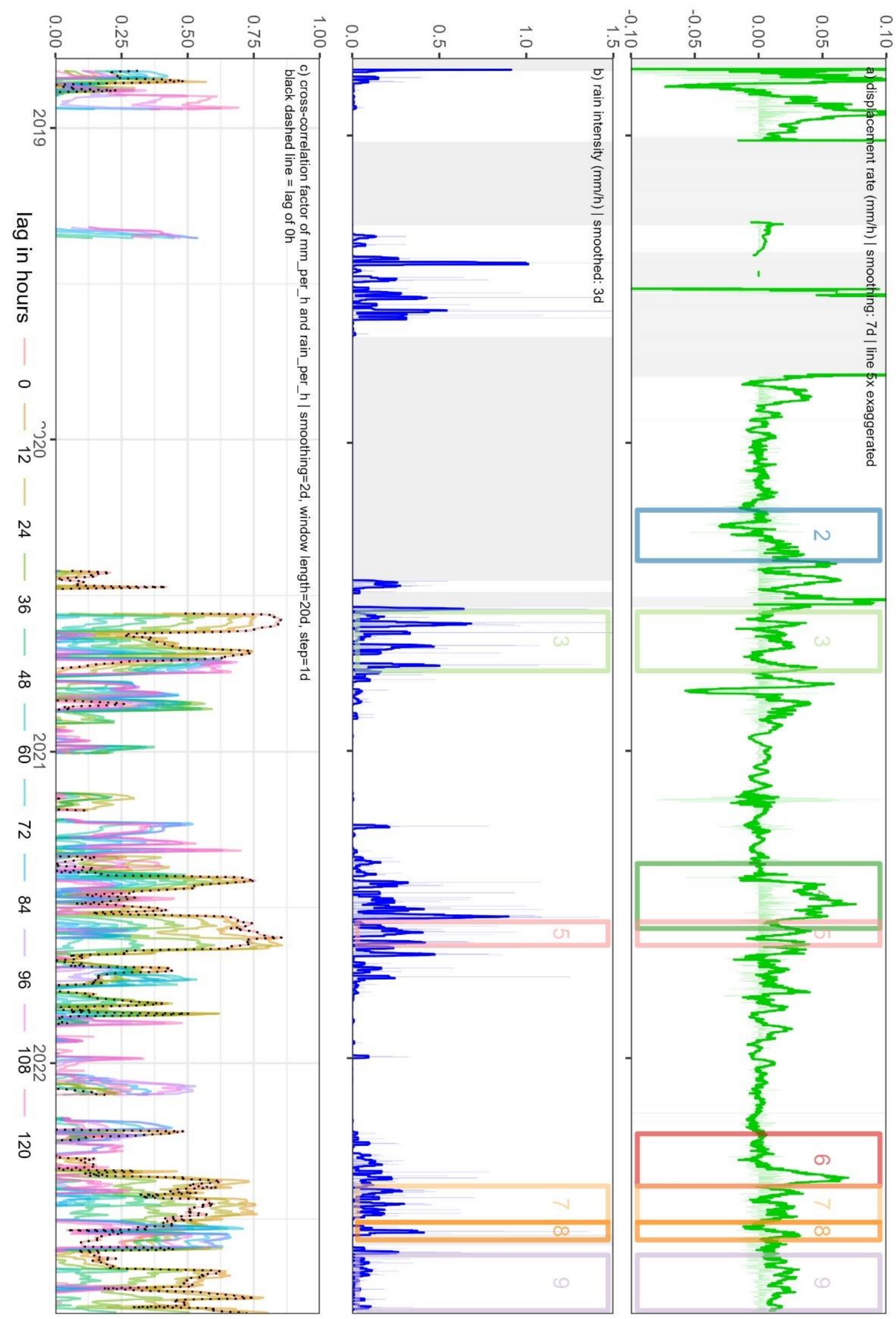


Fig. S 19: Analysed data between Oct 2018 and Nov 2022 with marked and numbered focus times (rectangles). Data are aggregated to 1 h resolution (see the degree of smoothing in the headers). Columns give 12 h means. (a) displacement rate (mm/h), (b) seismic crack rate (events/h), black dots mark the timing of earthquakes from the catalogue. (c) cross-correlation factor for running cross-correlation between the two curves for a 30 d window shifted in 1 d steps. Colours represent different time lags (see legend). The black dashed line marks a lag of 0 h.



250 *Fig. S 20: Analysed data between Oct 2018 and Nov 2022 with marked and numbered focus times (rectangles). Data are aggregated to 1 h resolution (see the degree of smoothing in the headers). Columns give 12 h means. (a) displacement rate (mm/h), (b) rain intensity (mm/h). (c) cross-correlation factor for running cross-correlation between the two curves for a 20 d window shifted in 1 d steps. Colours represent different time lags (see legend). The black dashed line marks a lag of 0 h.*

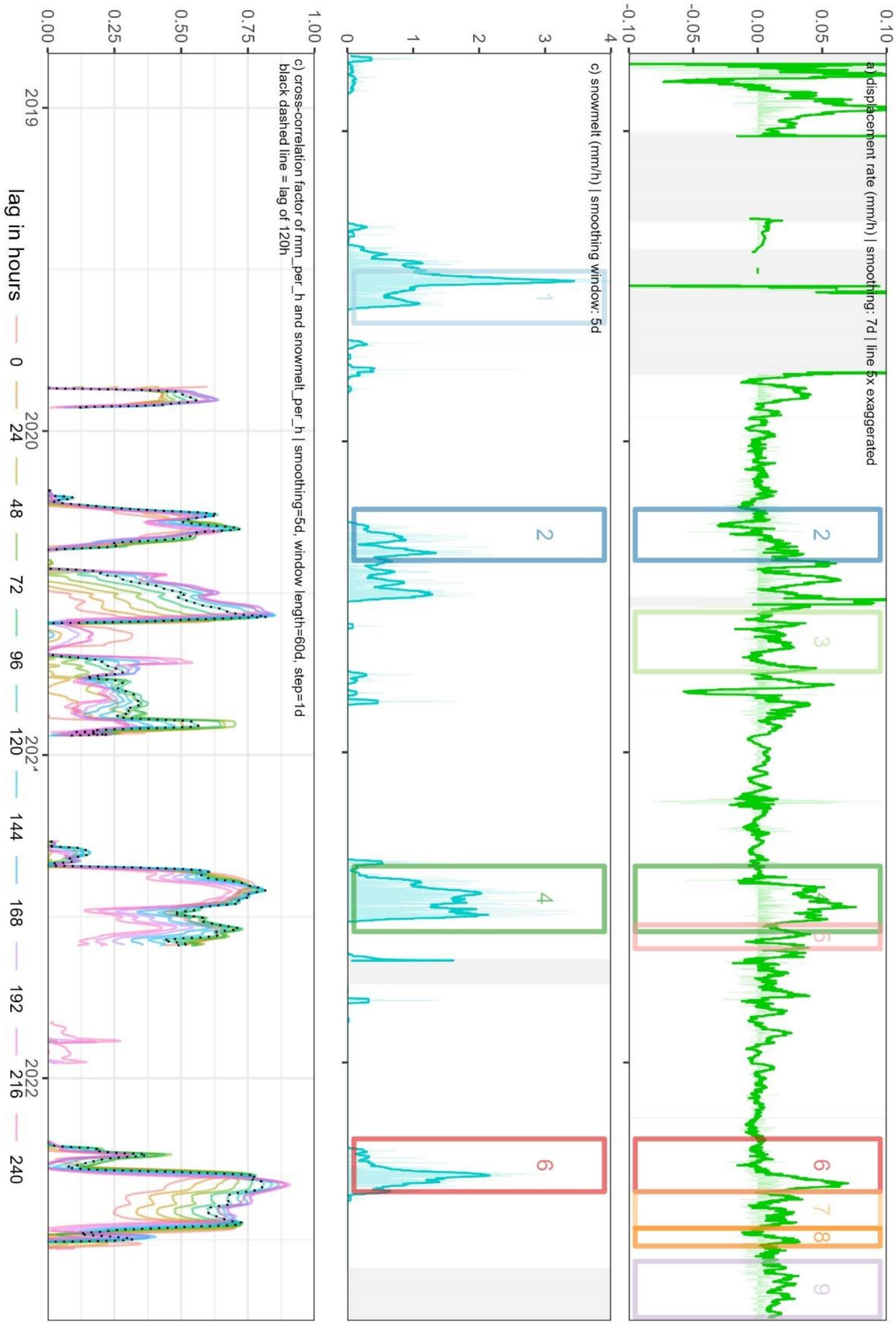


Fig. S 21: Analysed data between Oct 2018 and Nov 2022 with marked and numbered focus times (rectangles). Data are aggregated to 1 h resolution (see the degree of smoothing in the headers). Columns give 12 h means. (a) displacement rate (mm/h), (b) snowmelt (mm/h). (c) cross-correlation factor for running cross-correlation between the two curves for a 60 d window shifted in 1 d steps. Colours represent different time lags (see legend). The black dashed line marks a lag of 120 h.

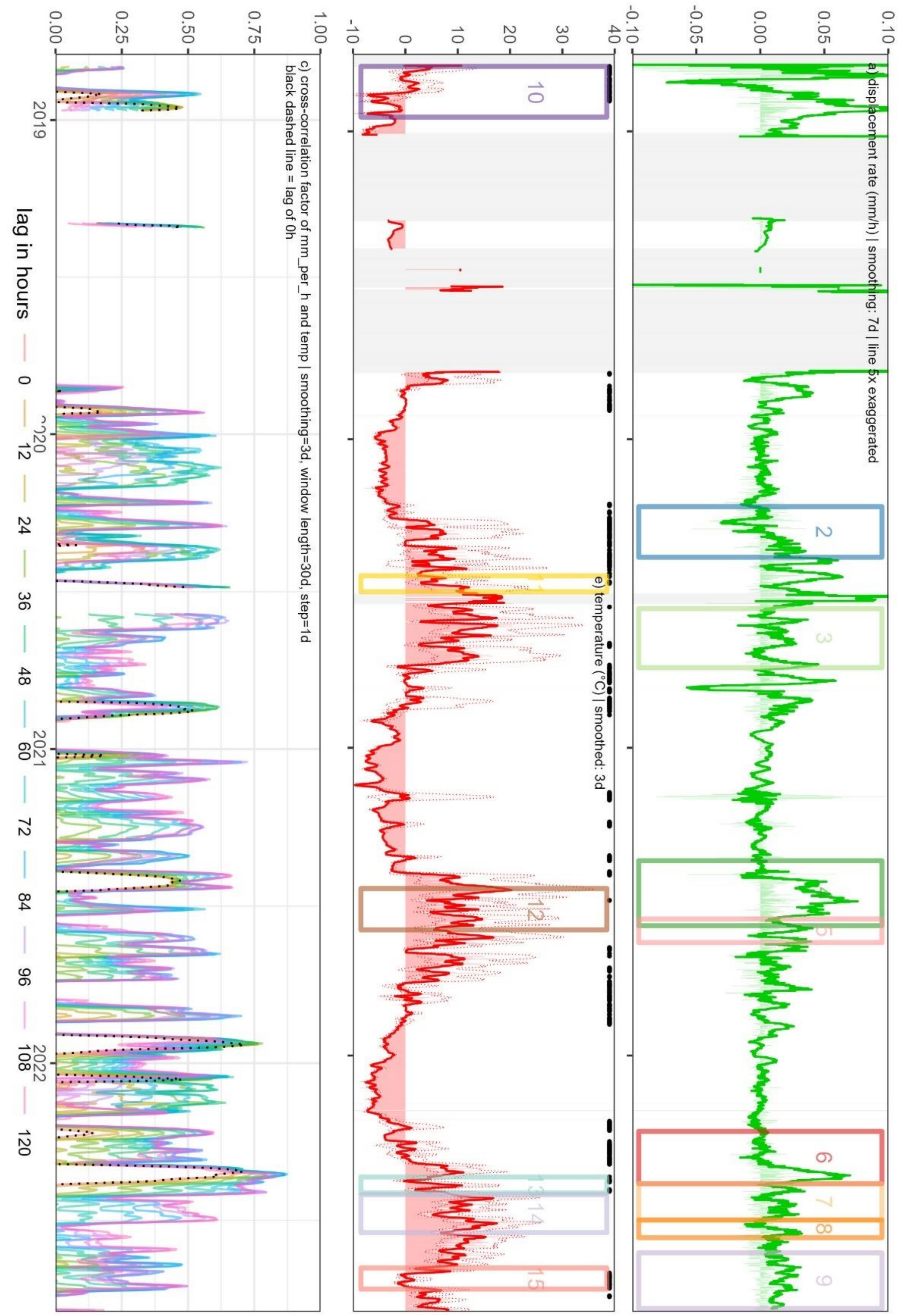


Fig. S 22: Analysed data between Oct 2018 and Nov 2022 with marked and numbered focus times (rectangles). Data are aggregated to 1 h resolution (see the degree of smoothing in the headers). Columns give 12 h means. (a) displacement rate (mm/h), (b) temperature (°C, solid: mean, dashed min/max). Black dots mark days with freeze-thaw/ thaw-freeze conditions. (c) cross-correlation factor for running cross-correlation between the two curves for a 30 d window shifted in 1 d steps. Colours represent different time lags (see legend). The black dashed line marks a lag of 0 h.

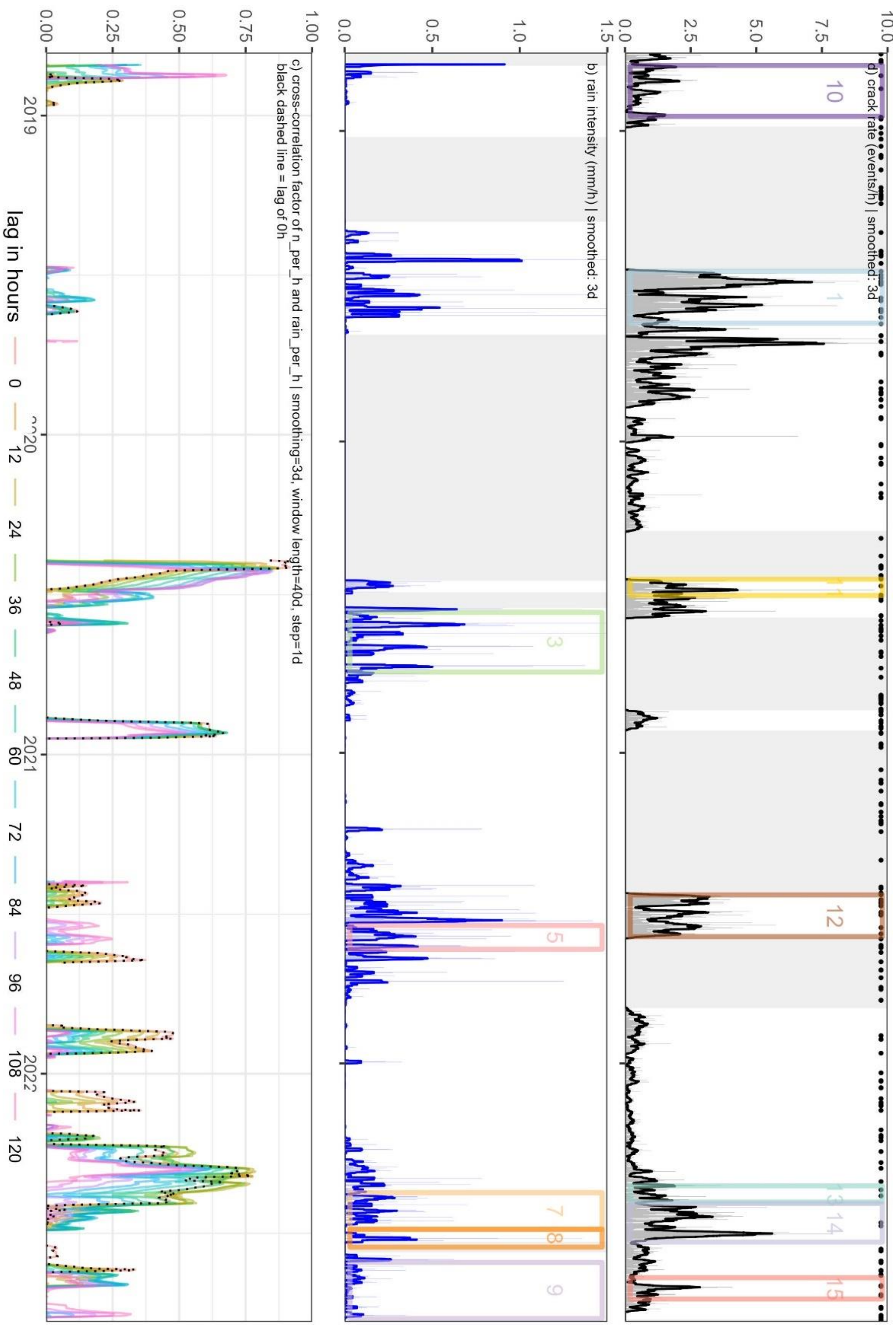


Fig. S 23: Analysed data between Oct 2018 and Nov 2022 with marked and numbered focus times (rectangles). Data are aggregated to 1 h resolution (see the degree of smoothing in the headers). Columns give 12 h means. (a) seismic crack rate (events/h), black dots mark the timing of earthquakes from the catalogue. (b) rain intensity (mm/h). (c) cross-correlation factor for running cross-correlation between the two curves for a 40 d window shifted in 1 d steps. Colours represent different time lags (see legend). The black dashed line marks a lag of 0 h.

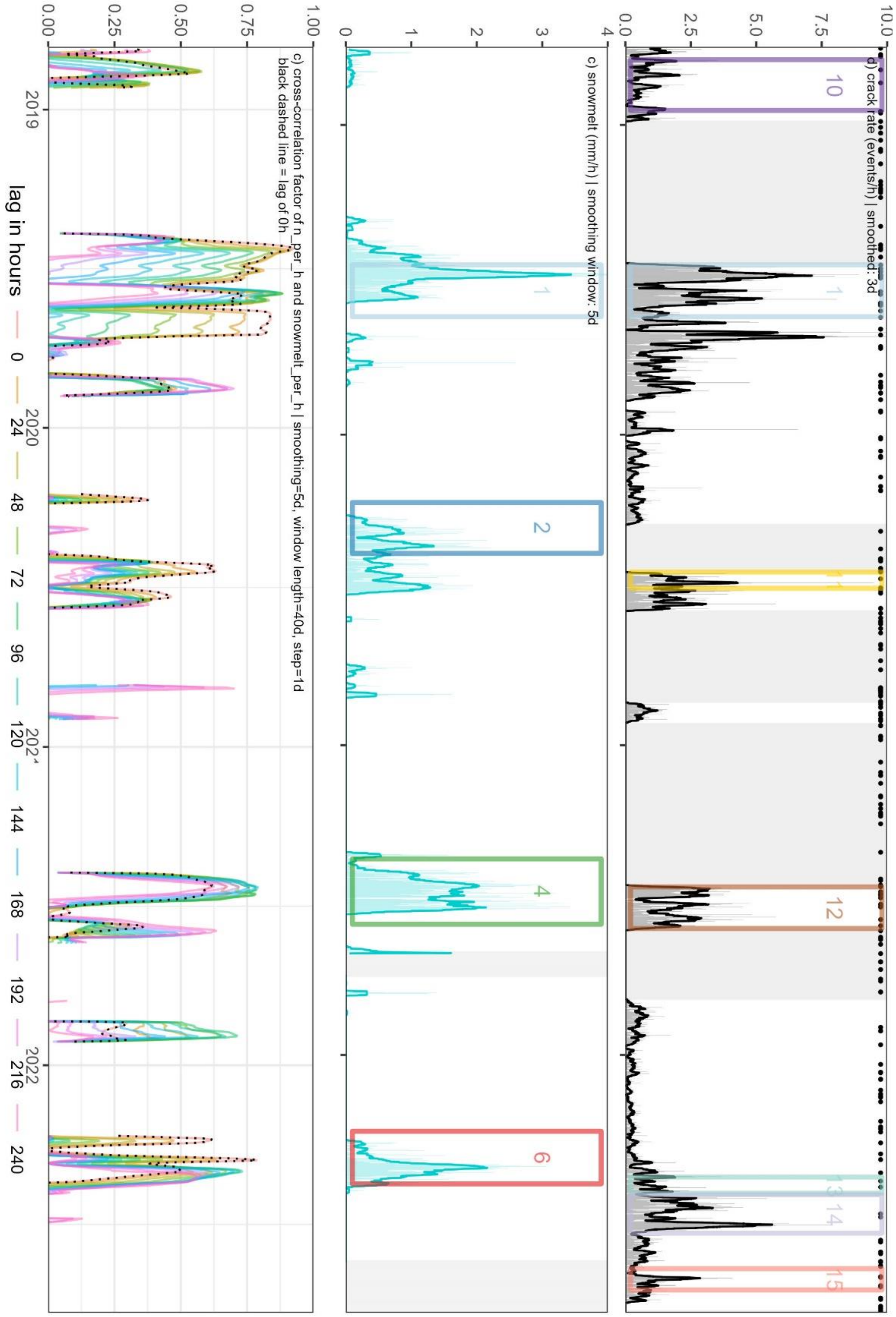


Fig. S 24: Analysed data between Oct 2018 and Nov 2022 with marked and numbered focus times (rectangles). Data are aggregated to 1 h resolution (see the degree of smoothing in the headers). Columns give 12 h means. (a) seismic crack rate (events/h), black dots mark the timing of earthquakes from the catalogue. (b) snowmelt (mm/h). (c) cross-correlation factor for running cross-correlation between the two curves for a 40 d window shifted in 1 d steps. Colours represent different time lags (see legend). The black dashed line marks a lag of 0 h.

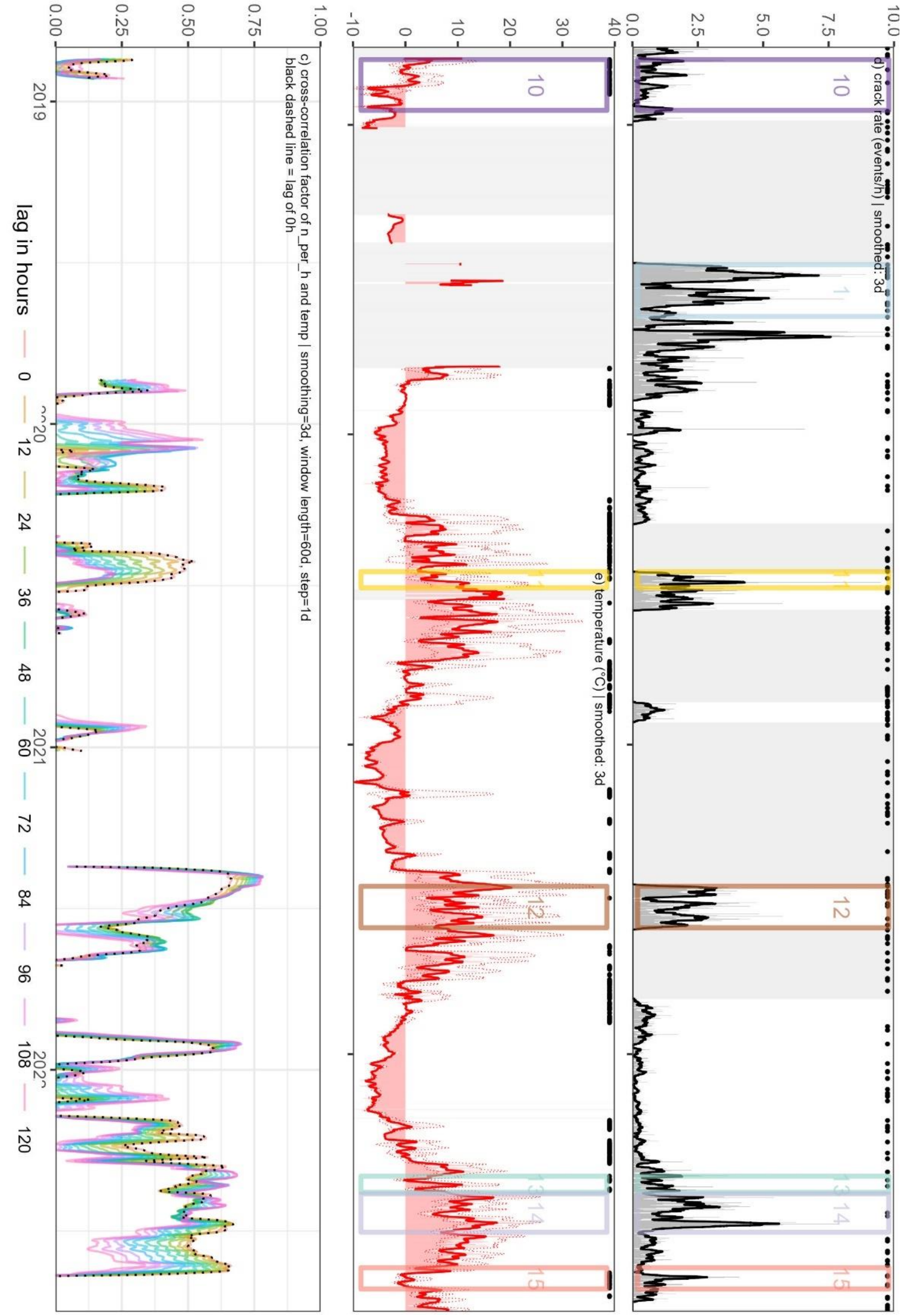


Fig. S 25: Analysed data between Oct 2018 and Nov 2022 with marked and numbered focus times (rectangles). Data are aggregated to 1 h resolution (see the degree of smoothing in the headers). Columns give 12 h means. (a) seismic crack rate (events/h), black dots mark the timing of earthquakes from the catalogue. (b) temperature (°C, solid: mean, dashed min/max). Black dots mark days with freeze-thaw/ thaw-freeze conditions. (c) cross-correlation factor for running cross-correlation between the two curves for a 60 d window shifted in 1 d steps. Colours represent different time lags (see legend). The black dashed line marks a lag of 0 h.

S7 Earthquake analysis

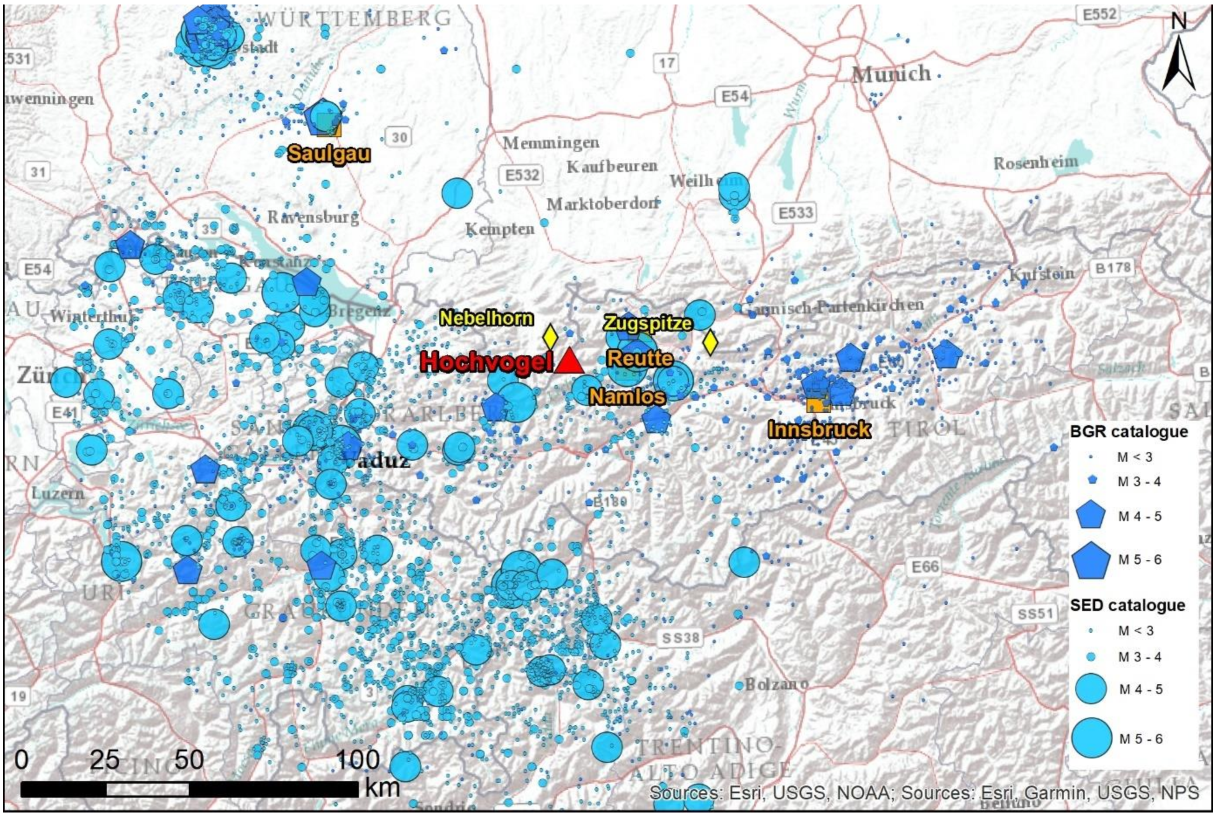


Fig. S 26: Map showing all earthquakes of the catalogue with M>2 and less than 150 km away from the Hochvogel. Note the clustering of events along the valleys next to the Hochvogel region: Inn, Lech, Alfenz and Rhein. Yellow diamonds mark the two snow stations at Nebelhorn (2075 m a.s.l.) and Zugspitze (2420 m a.s.l.). Basemap and labelling source: Esri, USGS, NOAA, Garmin, NPS.

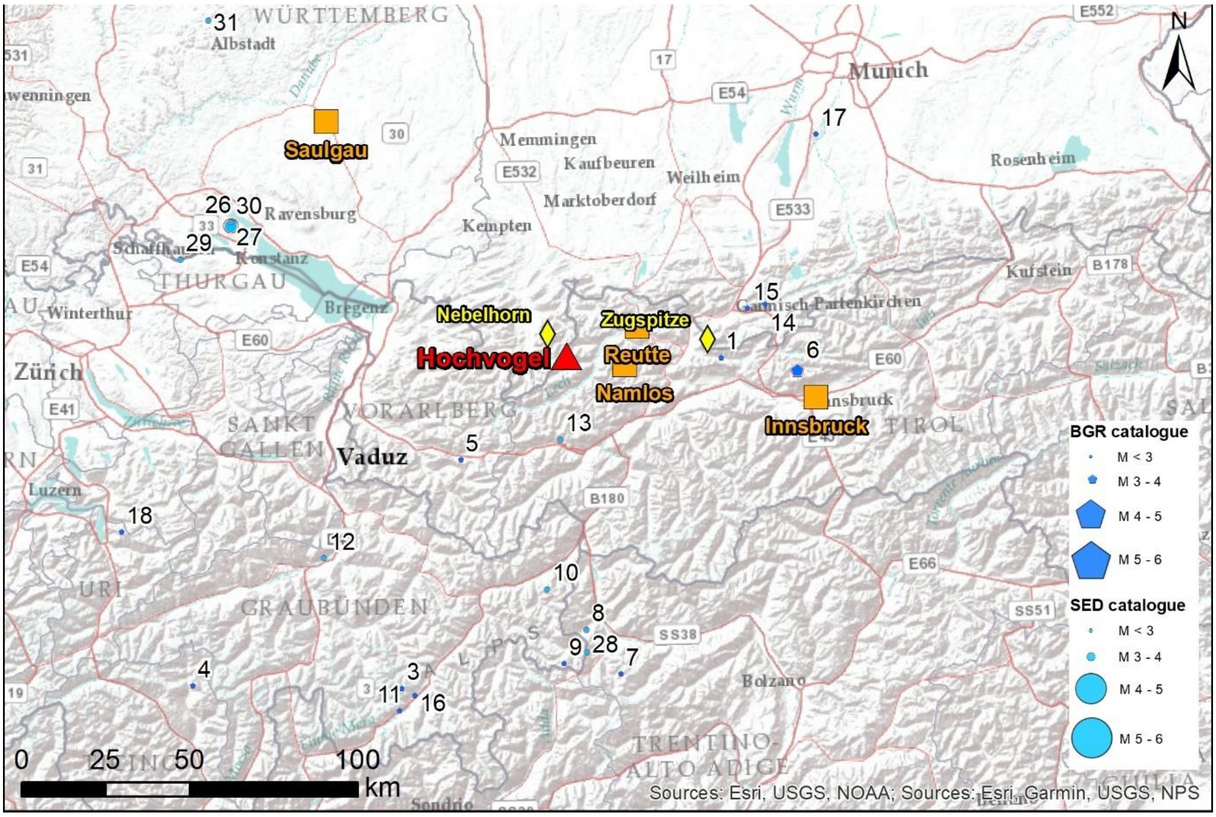


Fig. S 27: Map showing all earthquakes of the catalogue with M>2 and less than 150 km away from the Hochvogel that happened during station operation of HVGL1 at the summit an at least one more station further down. Events are labelled with a ID-number between 1–31. Yellow diamonds mark the two snow stations at Nebelhorn (2075 m a.s.l.) and Zugspitze (2420 m a.s.l.). Basemap and labelling source: Esri, USGS, NOAA, Garmin, NPS.

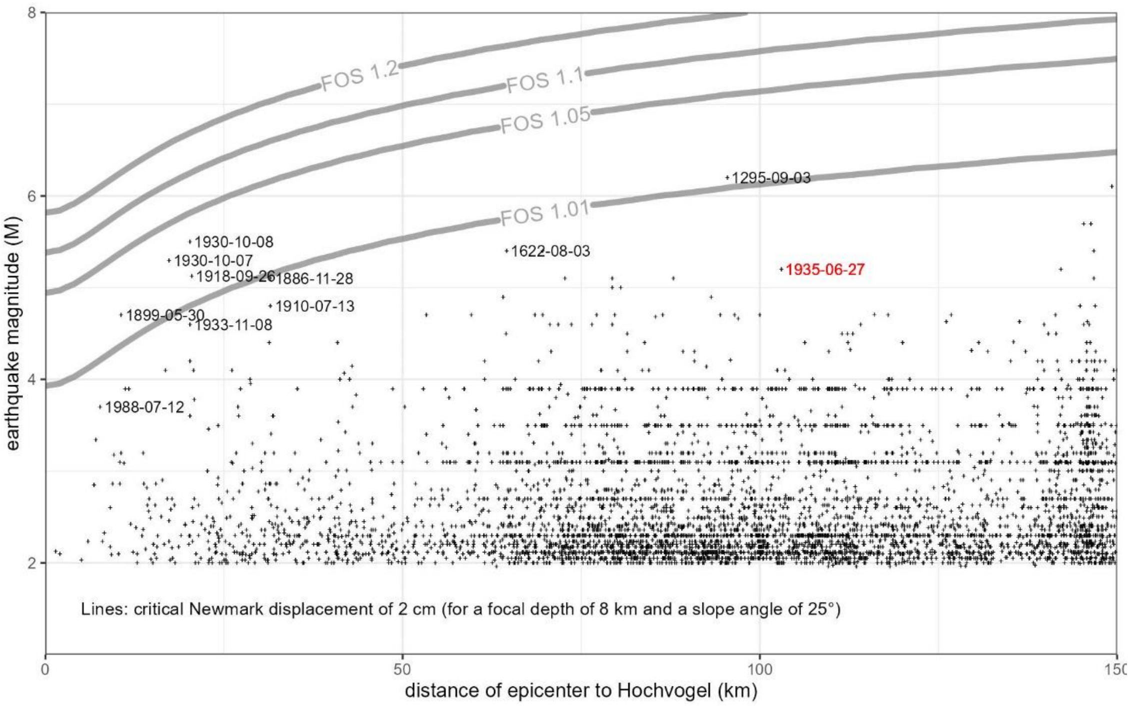


Fig. S 28: Lines indicate for different factors of safety, at which magnitude and distance of an earthquake a theoretical Newmark displacement of 2 cm is expected. This calculation is based on the mean focal depth of 8 km and a slope angle of 25°. All earthquakes from the catalogues are plotted with black crosses. The earthquakes with the 10 biggest Newmark displacements are labelled in black with their dates. The Saulgau 1935 event is labelled in red.

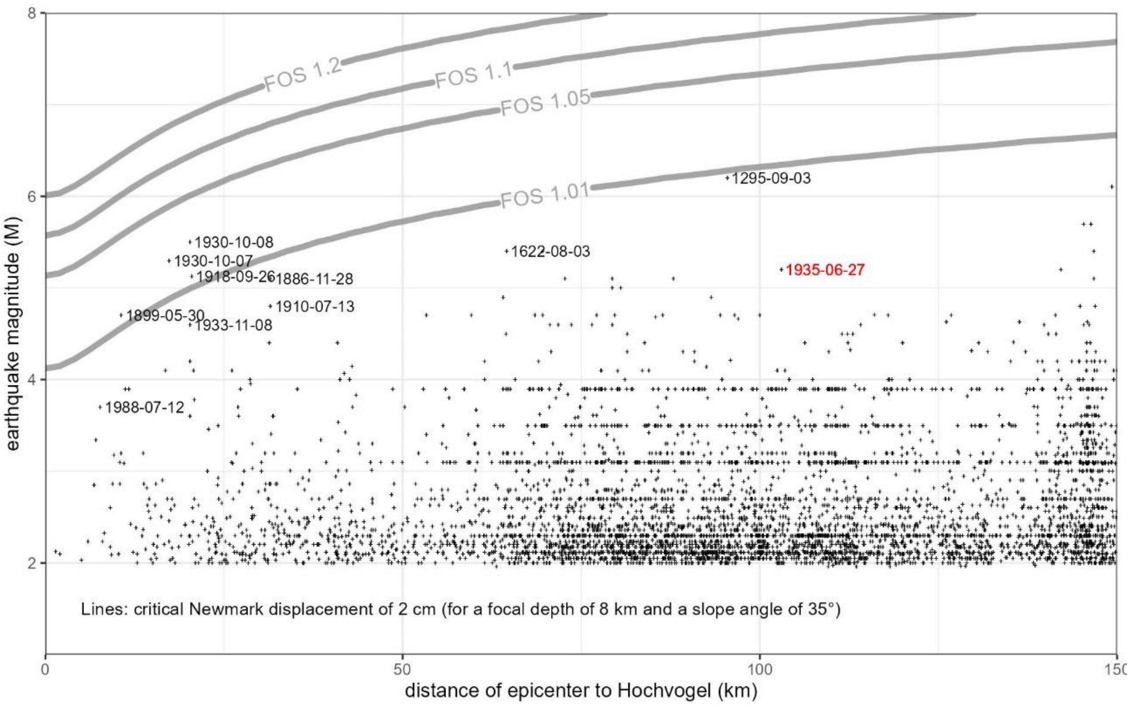


Fig. S 29: Lines indicate for different factors of safety, at which magnitude and distance of an earthquake a theoretical Newmark displacement of 2 cm is expected. This calculation is based on the mean focal depth of 8 km and a slope angle of 35°. All earthquakes from the catalogues are plotted with black crosses. The earthquakes with the 10 biggest Newmark displacements are labelled in black with their dates. The Saulgau 1935 event is labelled in red.

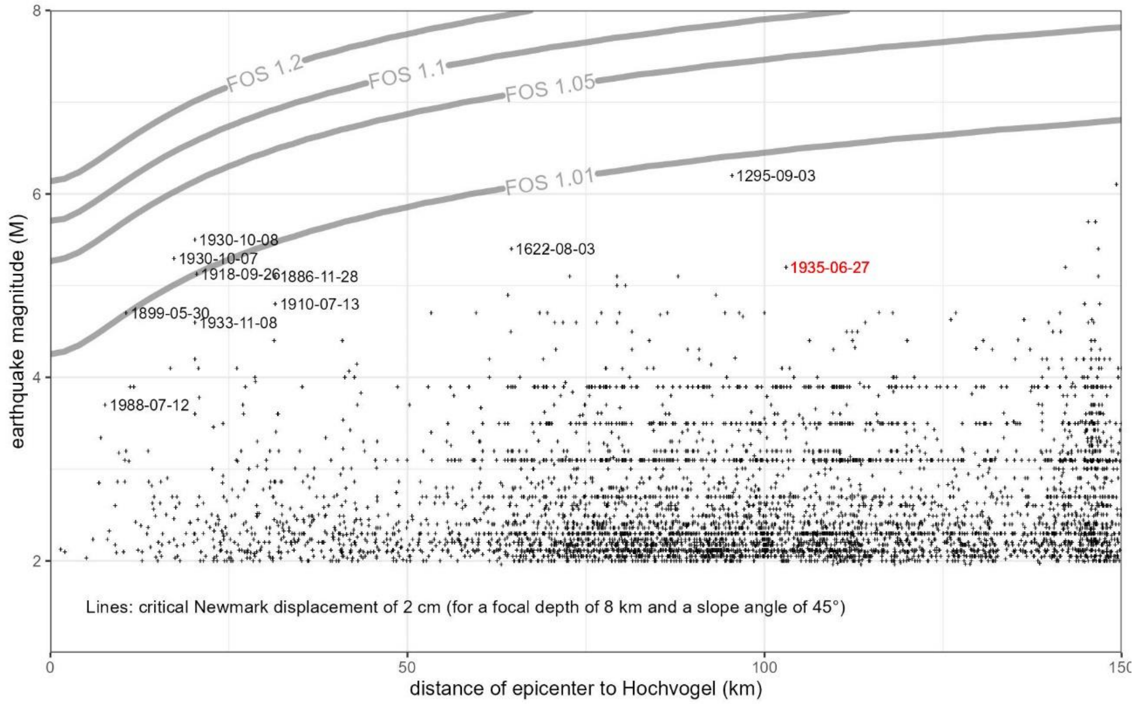


Fig. S 30: Lines indicate for different factors of safety, at which magnitude and distance of an earthquake a theoretical Newmark displacement of 2 cm is expected. This calculation is based on the mean focal depth of 8 km and a slope angle of 45°. All earthquakes from the catalogues are plotted with black crosses. The earthquakes with the 10 biggest Newmark displacements are labelled in black with their dates. The Saulgau 1935 event is labelled in red.

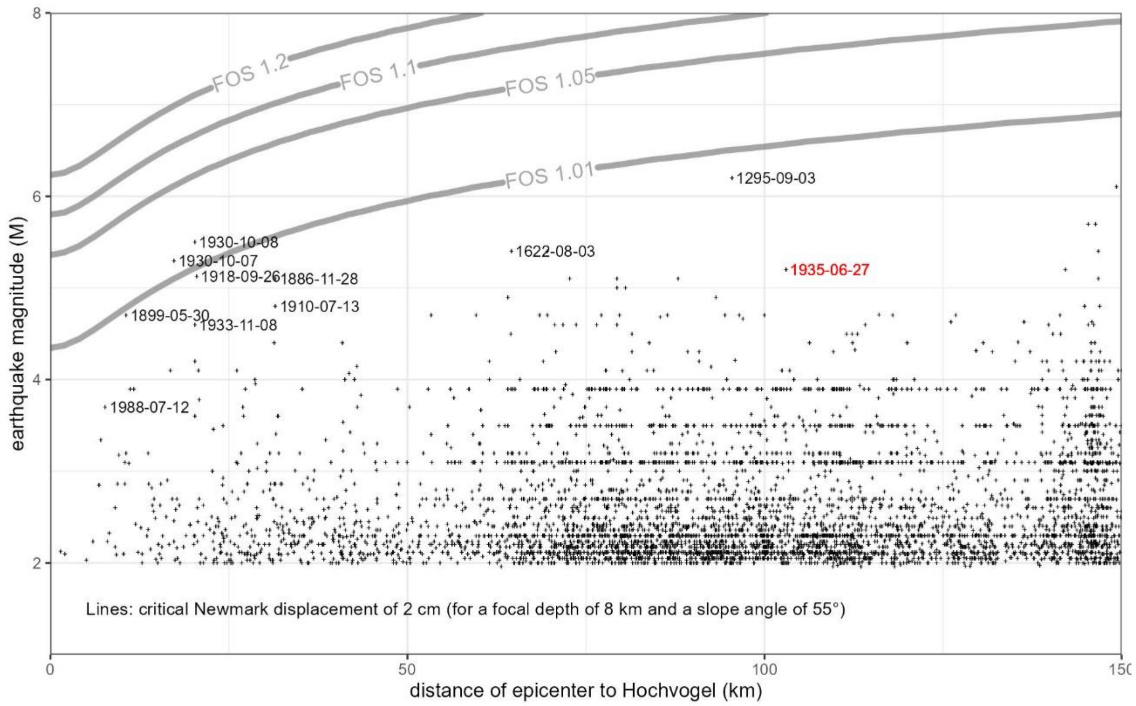


Fig. S 31: Lines indicate for different factors of safety, at which magnitude and distance of an earthquake a theoretical Newmark displacement of 2 cm is expected. This calculation is based on the mean focal depth of 8 km and a slope angle of 55°. All earthquakes from the catalogues are plotted with black crosses. The earthquakes with the 10 biggest Newmark displacements are labelled in black with their dates. The Saulgau 1935 event is labelled in red.

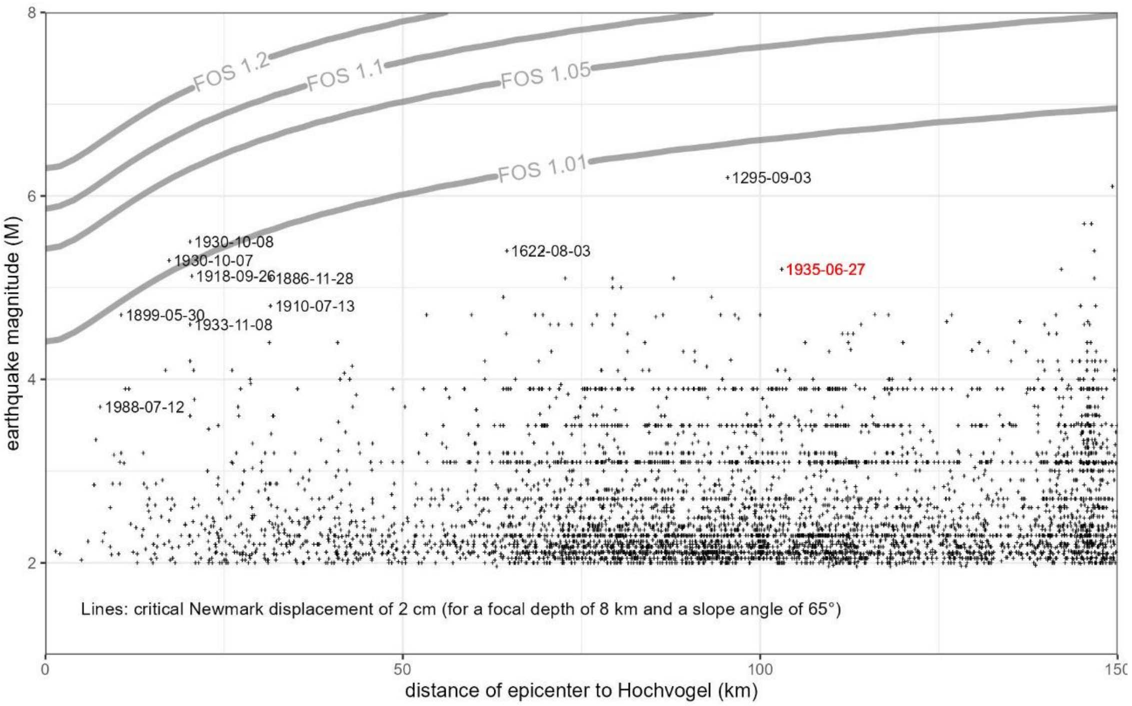


Fig. S 32: Lines indicate for different factors of safety, at which magnitude and distance of an earthquake a theoretical Newmark displacement of 2 cm is expected. This calculation is based on the mean focal depth of 8 km and a slope angle of 65°. All earthquakes from the catalogues are plotted with black crosses. The earthquakes with the 10 biggest Newmark displacements are labelled in black with their dates. The Saulgau 1935 event is labelled in red.

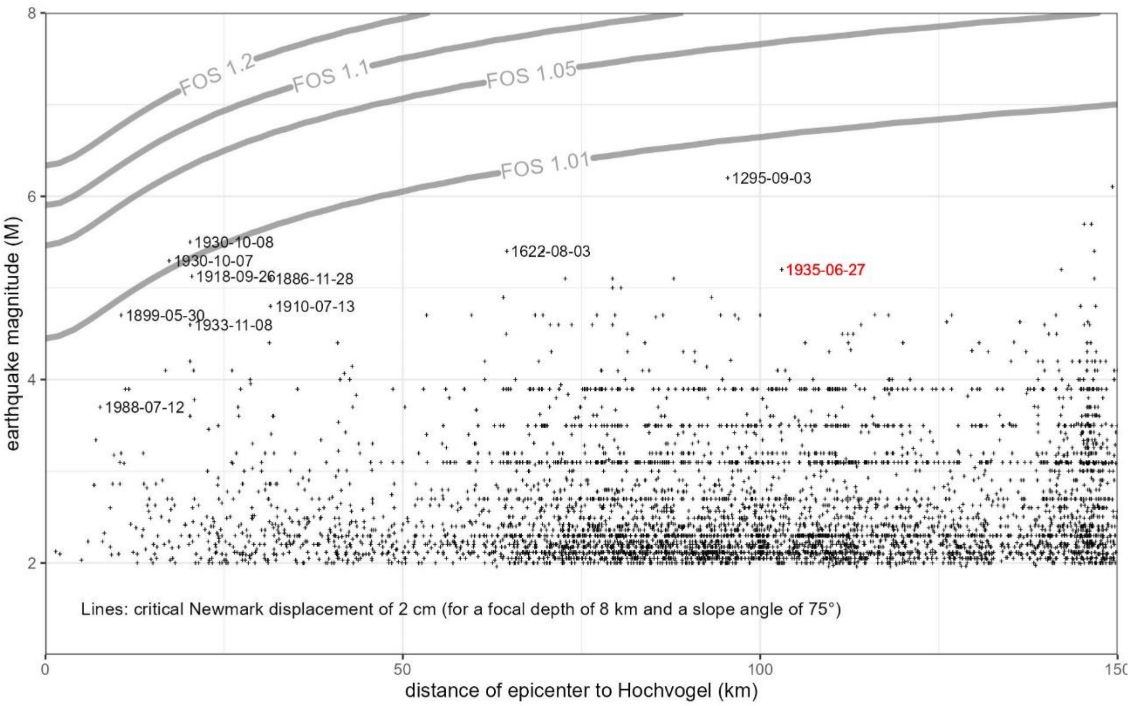


Fig. S 33: Lines indicate for different factors of safety, at which magnitude and distance of an earthquake a theoretical Newmark displacement of 2 cm is expected. This calculation is based on the mean focal depth of 8 km and a slope angle of 75°. All earthquakes from the catalogues are plotted with black crosses. The earthquakes with the 10 biggest Newmark displacements are labelled in black with their dates. The Saulgau 1935 event is labelled in red.

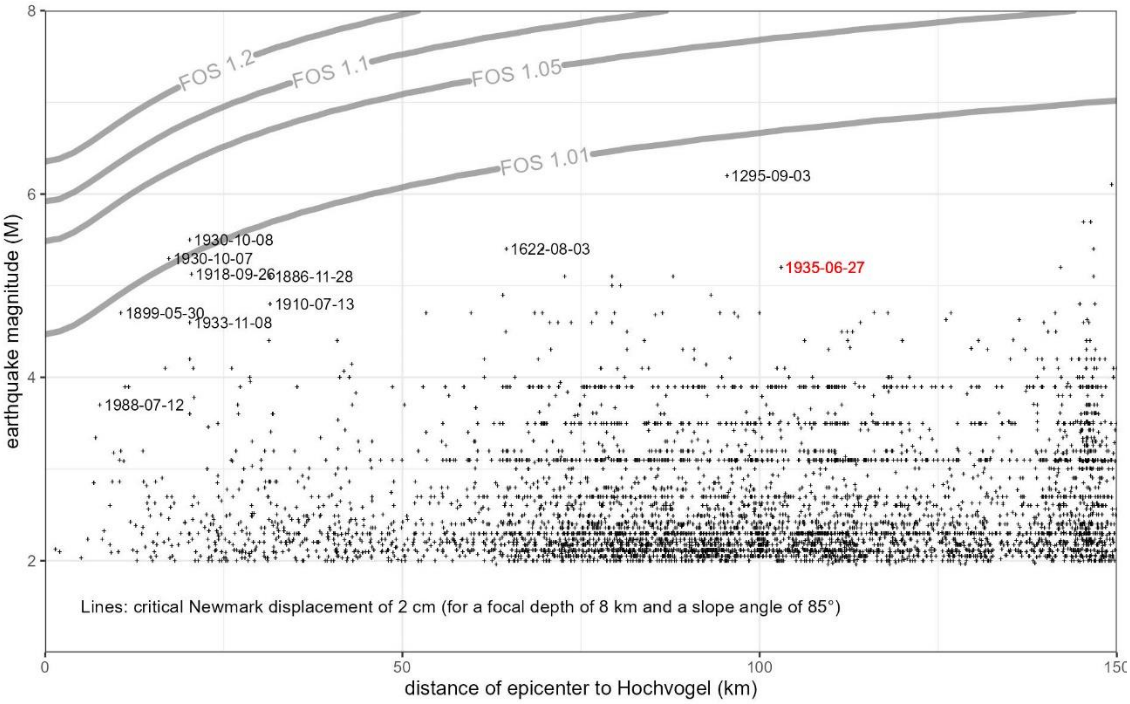


Fig. S 34: Lines indicate for different factors of safety, at which magnitude and distance of an earthquake a theoretical Newmark displacement of 2 cm is expected. This calculation is based on the mean focal depth of 8 km and a slope angle of 85°. All earthquakes from the catalogues are plotted with black crosses. The earthquakes with the 10 biggest Newmark displacements are labelled in black with their dates. The Saulgau 1935 event is labelled in red.

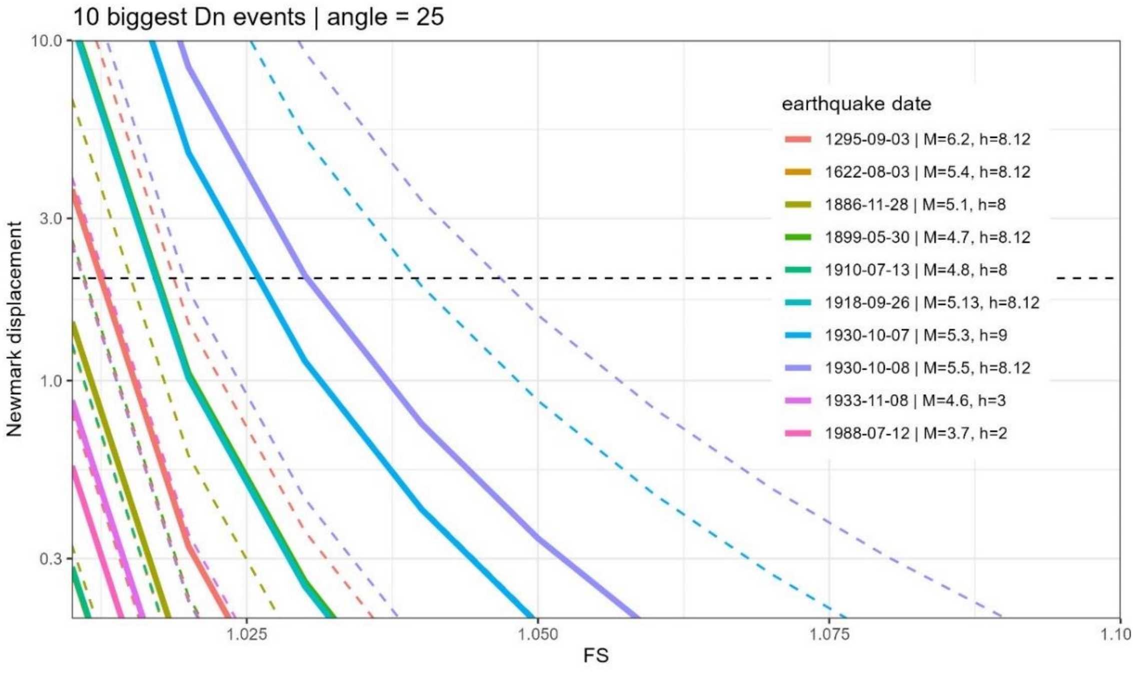


Fig. S 35: Theoretical Newmark displacement against Factor of Safety (FOS) of the 10 events with the biggest Newmark displacement for a slope angle of 25°. Dashed lines mark uncertainty according to the formula. Displacements are only noteworthy for very low FOS.

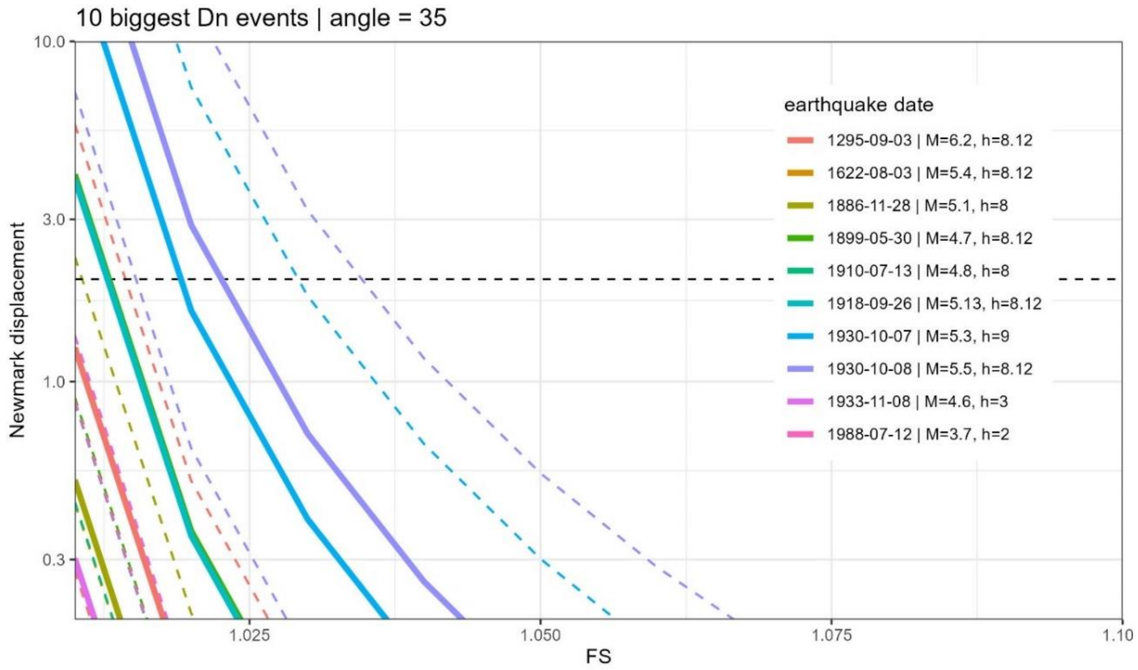


Fig. S 36: Theoretical Newmark displacement against Factor of Safety (FOS) of the 10 events with the biggest Newmark displacement for a slope angle of 35°. Dashed lines mark uncertainty according to the formula. Displacements are only noteworthy for very low FOS.

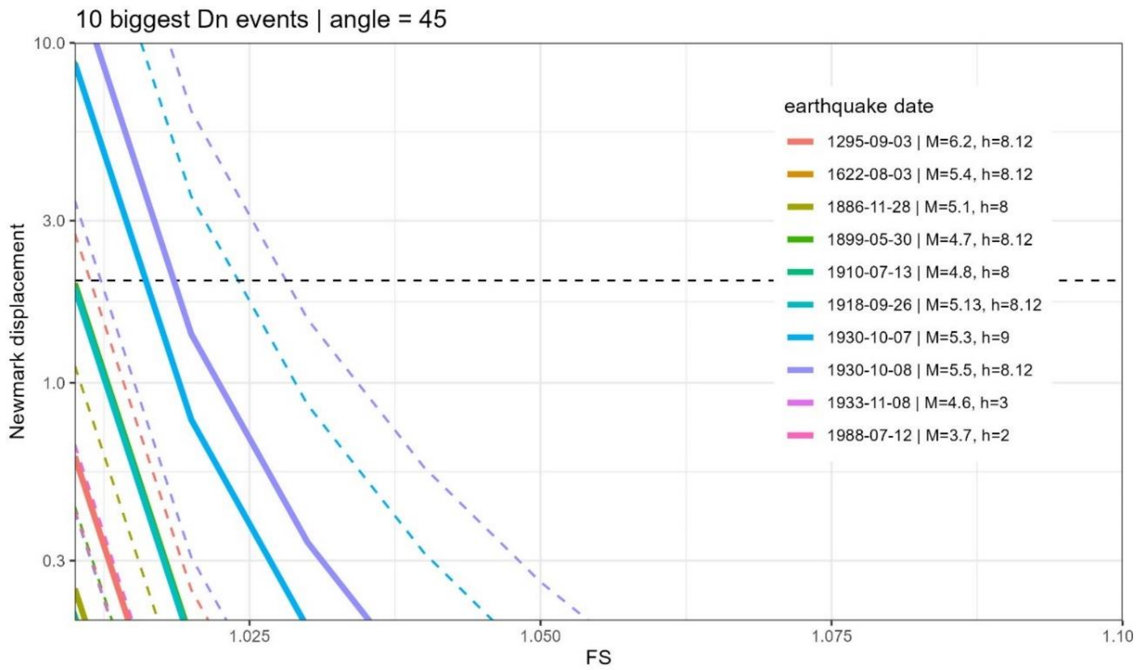


Fig. S 37: Theoretical Newmark displacement against Factor of Safety (FOS) of the 10 events with the biggest Newmark displacement for a slope angle of 45°. Dashed lines mark uncertainty according to the formula. Displacements are only noteworthy for very low FOS.

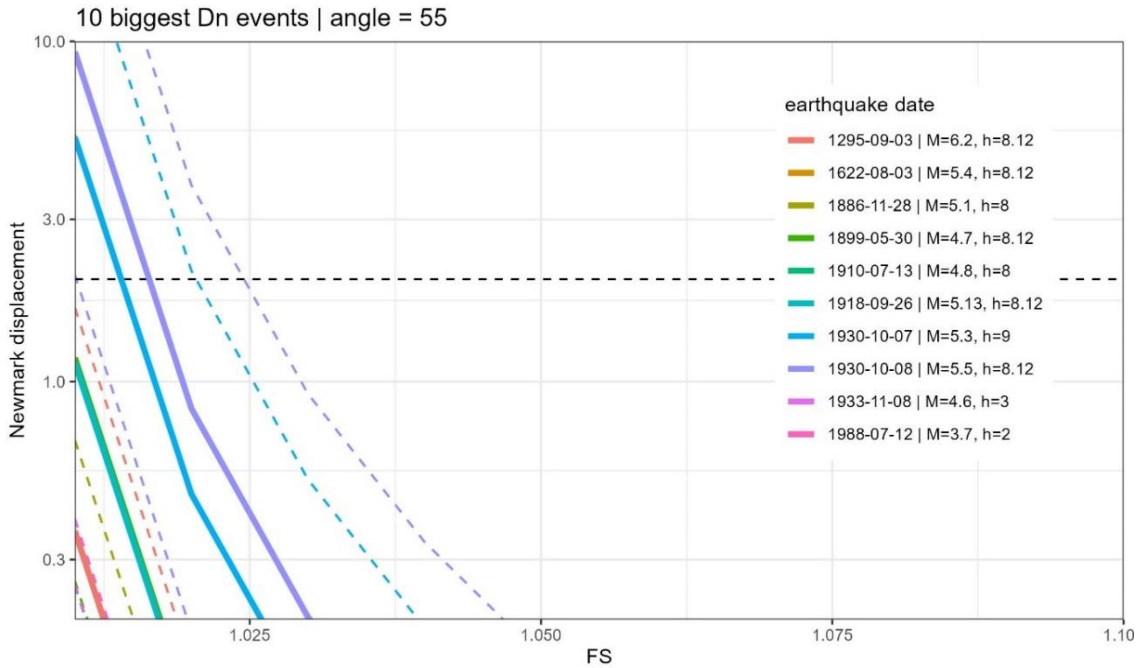


Fig. S 38: Theoretical Newmark displacement against Factor of Safety (FOS) of the 10 events with the biggest Newmark displacement for a slope angle of 55°. Dashed lines mark uncertainty according to the formula. Displacements are only noteworthy for very low FOS.

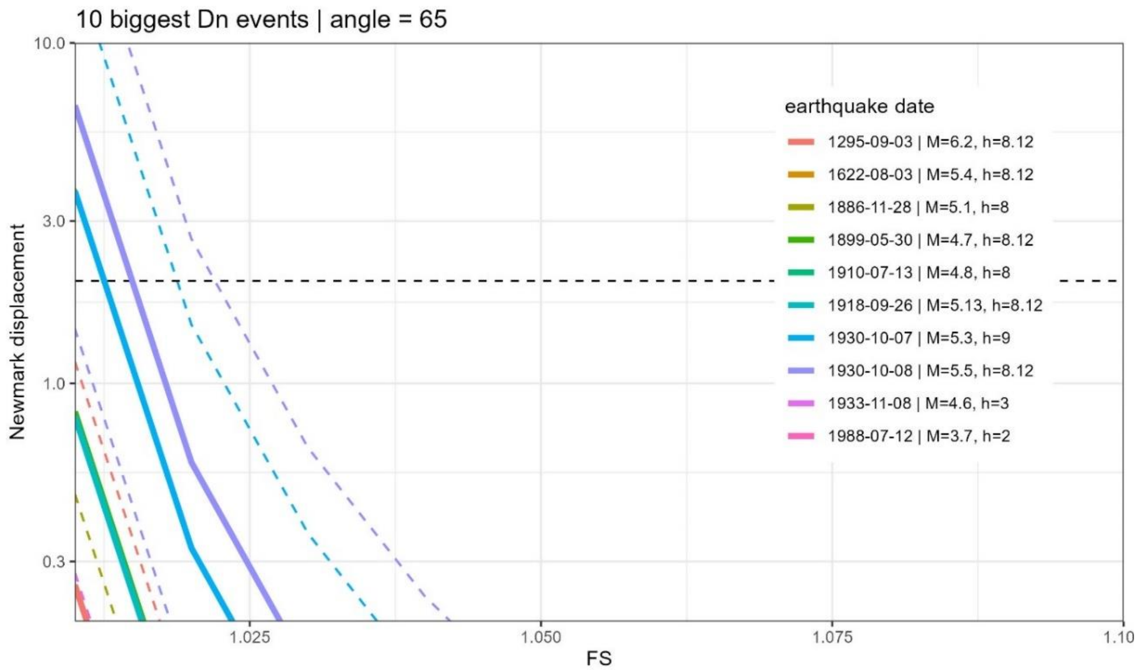


Fig. S 39: Theoretical Newmark displacement against Factor of Safety (FOS) of the 10 events with the biggest Newmark displacement for a slope angle of 65°. Dashed lines mark uncertainty according to the formula. Displacements are only noteworthy for very low FOS.

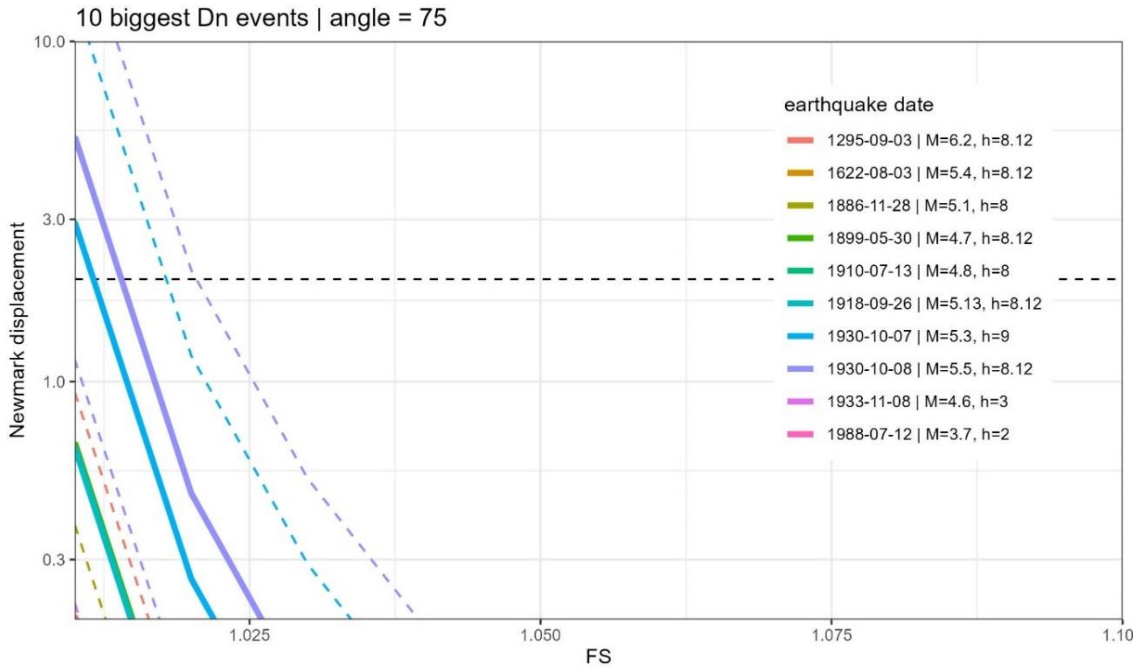


Fig. S 40: Theoretical Newmark displacement against Factor of Safety (FOS) of the 10 events with the biggest Newmark displacement for a slope angle of 75°. Dashed lines mark uncertainty according to the formula. Displacements are only noteworthy for very low FOS.

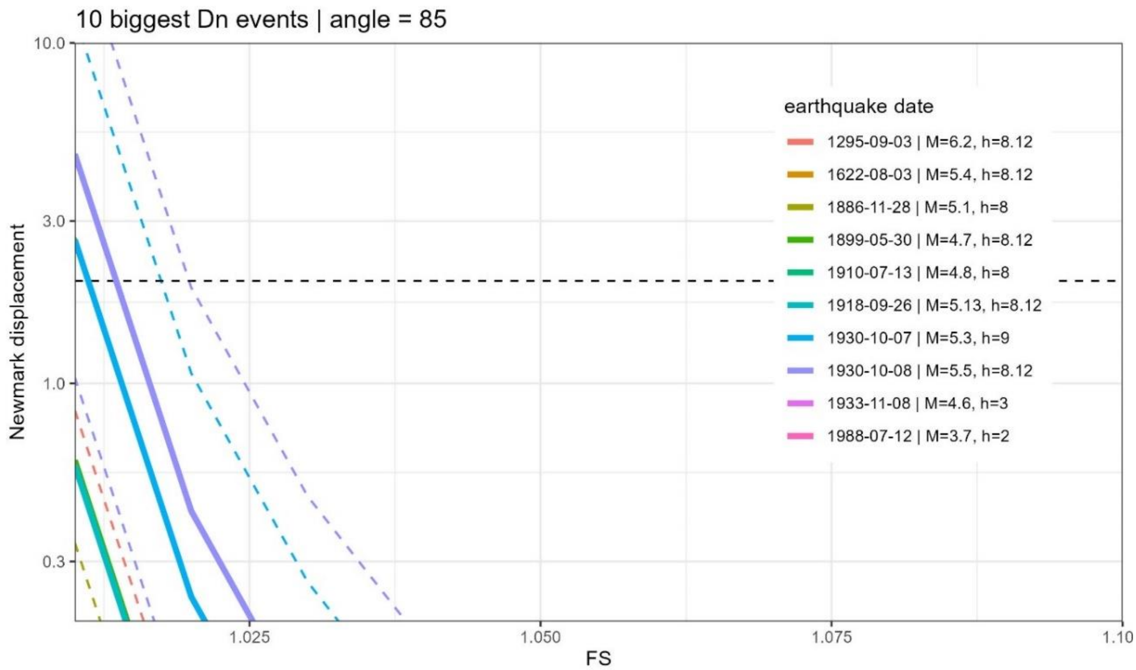


Fig. S 41: Theoretical Newmark displacement against Factor of Safety (FOS) of the 10 events with the biggest Newmark displacement for a slope angle of 85°. Dashed lines mark uncertainty according to the formula. Displacements are only noteworthy for very low FOS.

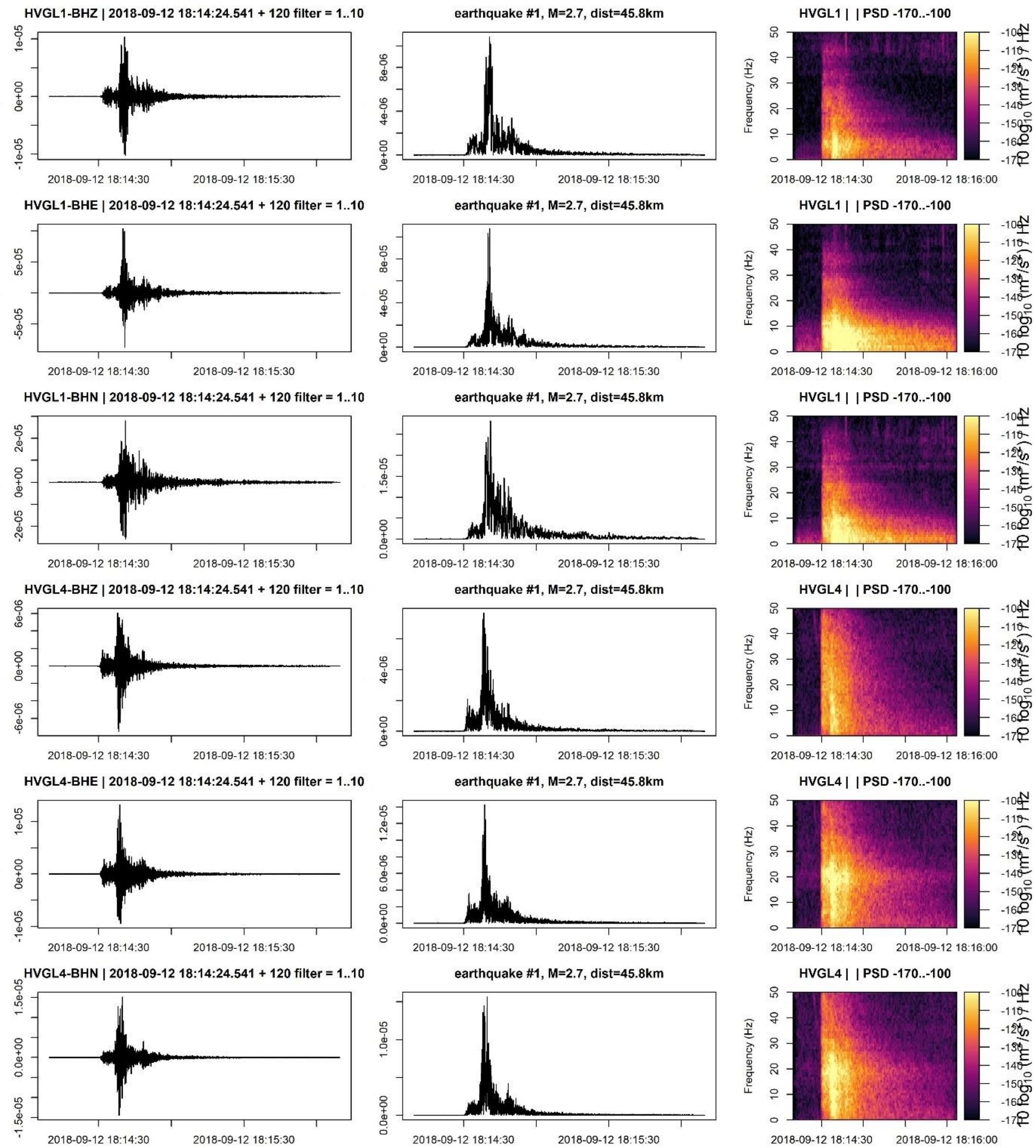


Fig. S 42: Example of measured seismic signal of HV1 at summit (top three rows) and HV4 in valley (bottom three rows) for all three components (top: Z, middle: E, bottom: N) for earthquake events 1 (left: seismogram, middle: envelope, right: spectrogram).