Supplementary material:

The impact of small-scale surface representation in WRF on hydrological modeling in a glaciated catchment

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1   Supplementary Figures
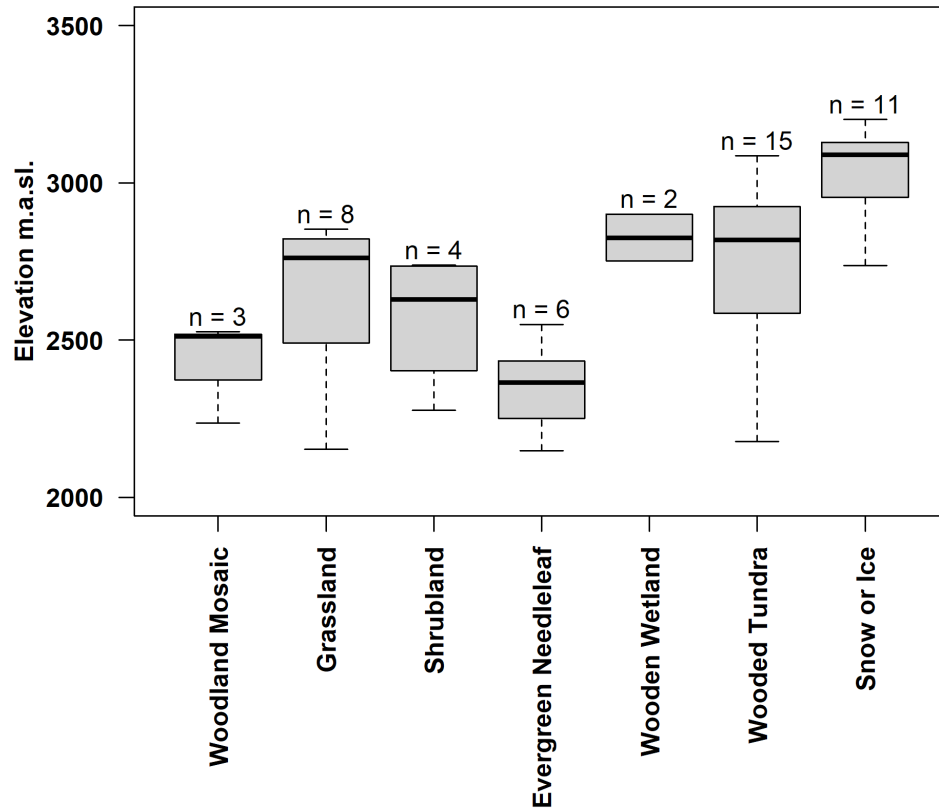
Figure S1. Boxplot of WRF land use categories and WRF elevation in m.a.s.l. of the upper Kauner Valley domain. The numbers above the boxes give the sample sizes.

a)

ETA 1 (2802m)

b)

ETA 5 (3057m)

c)

ETA 10 (3591m)

d)

ETA 20 (6013m)
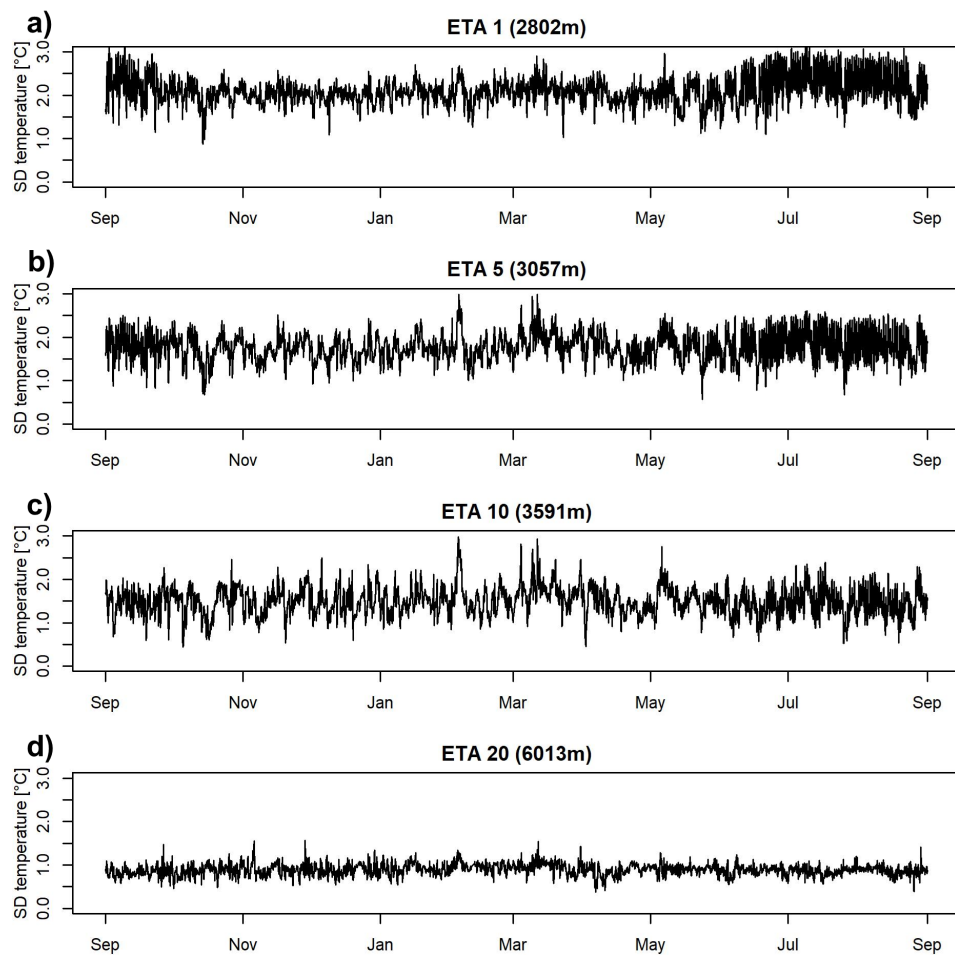
Figure S2. Hourly standard deviation of WRF temperature over the upper Kauner Valley for the period September 1974 to 1975 for eta levels (a) 1, (b) 5, (c) 10, and (d) 20. The altitude in the header is in m a.s.l..

3
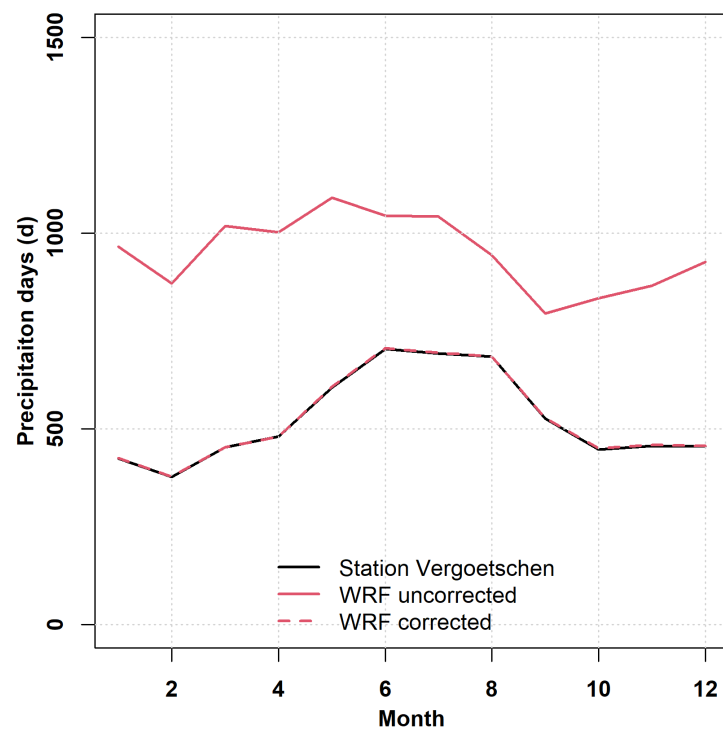
Figure S3. Monthly sum of wet days at station Vergoetschen (black line) and the corresponding WRF grid cell as uncorrected (red line) and after the frequency correction (red dashed line).
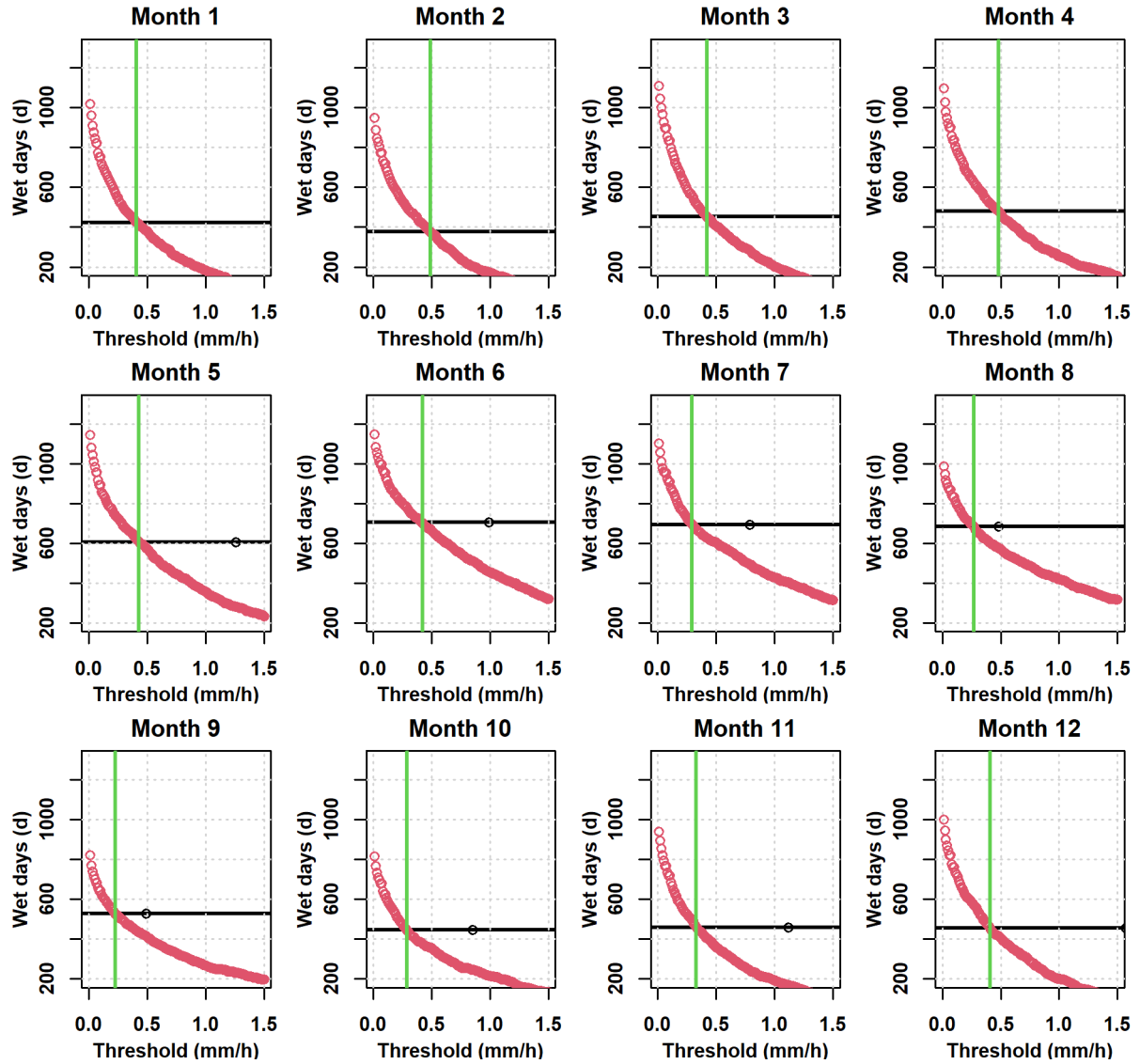
Figure S4. Monthly sum of wet days at station Vergoetschen (black horizontal line) and step-wise increase of the threshold value (mm h^{-1}) (red circles) to identify WRF time steps whose precipitation is to be set to zero for frequency matching. The point of absolute minimum error between observed and WRF precipitation days is indicated with the green vertical line.
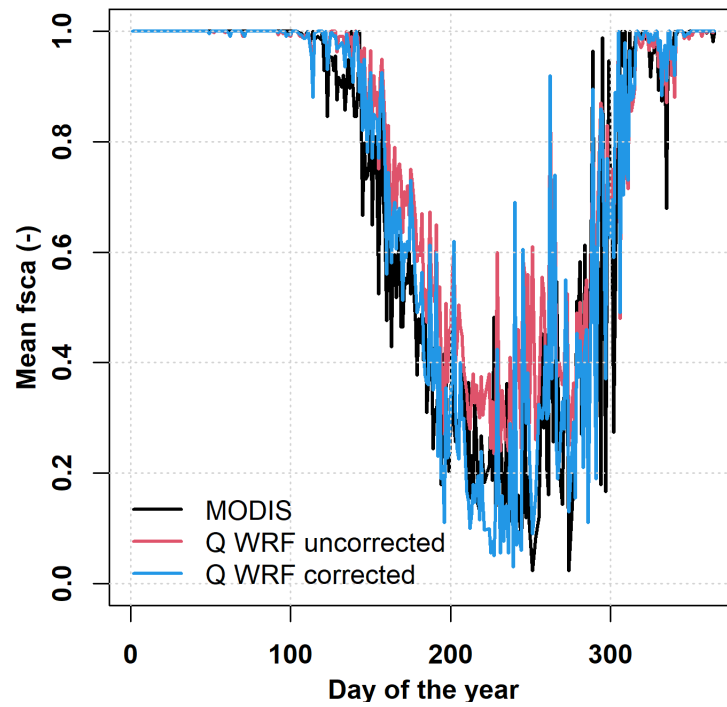
Figure S5. Day of the year mean fractional snow covered area (fsca) of MODIS (black line), uncorrected (red line) and corrected (blue line) WRF temperature for the period 2007 to 2015.
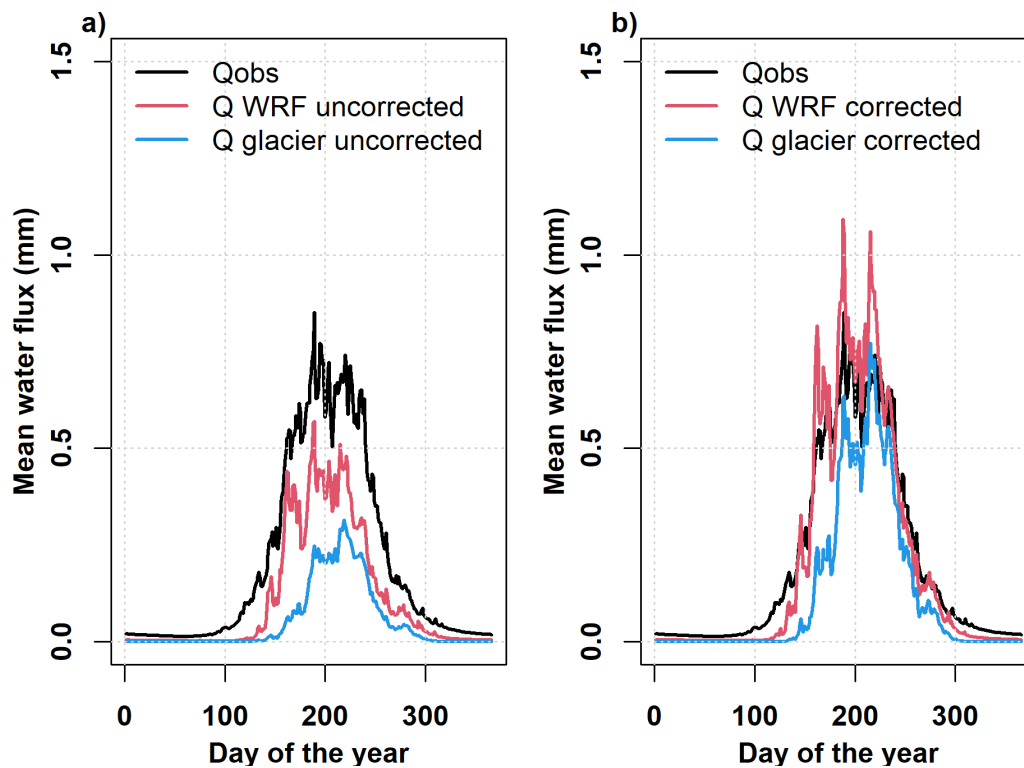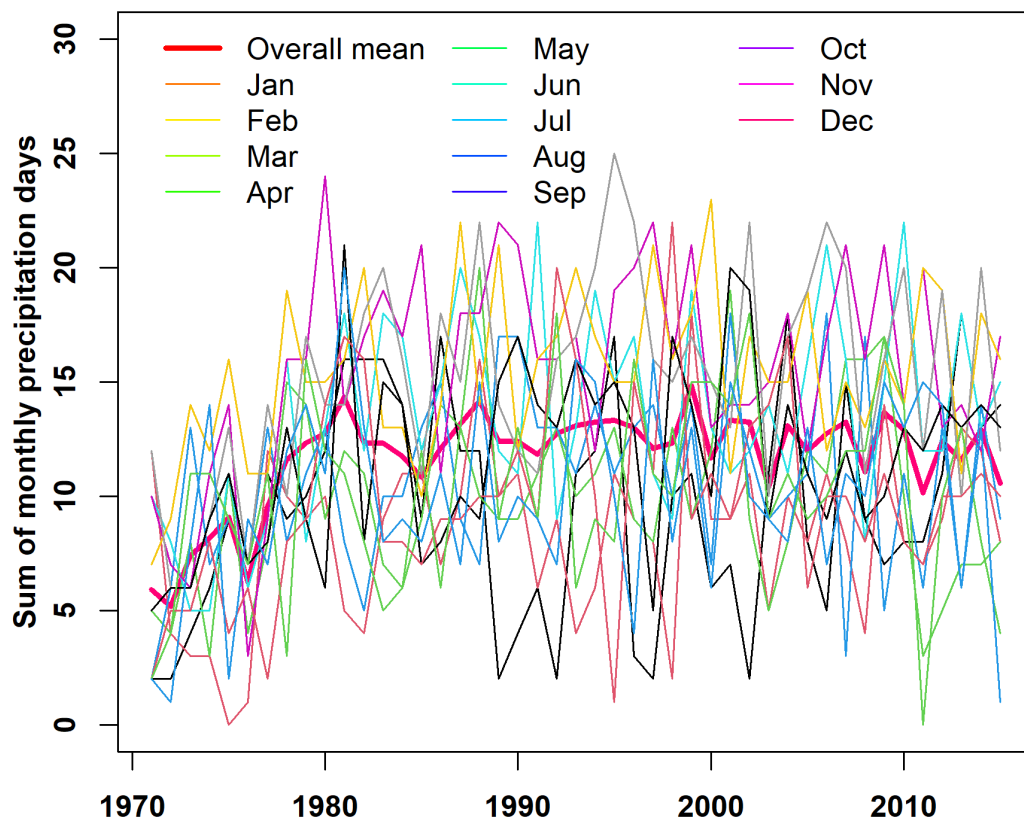
Figure S6. Observed (black line) and simulated (red line) mean water flux at streamgauge Gepatschalm and the simulated contribution from the glacier melt (blue line) with uncorrected (a) and corrected (b) WRF temperature for the period 2007 to 2015.
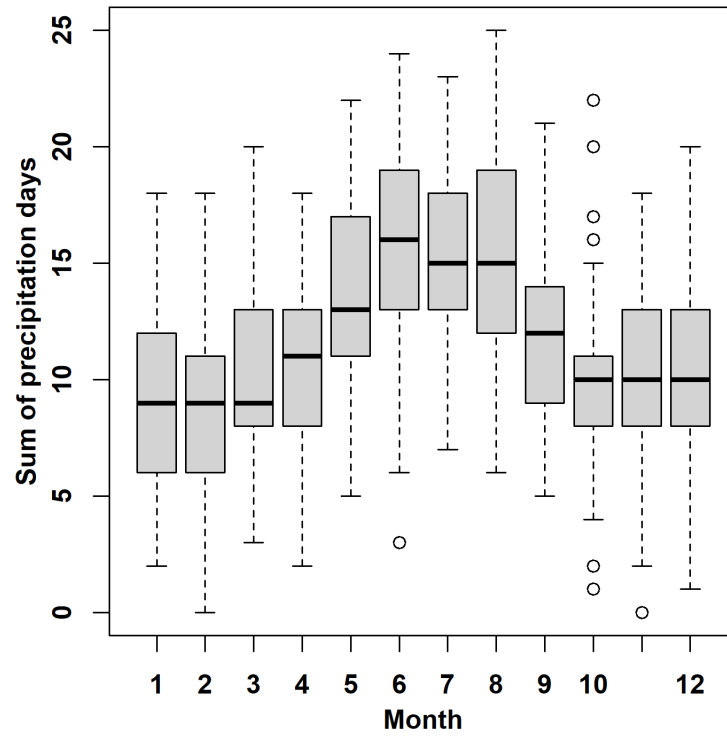
Figure S7. Boxplot of monthly precipitation days at the station Vergoetschen for the period 1971 to 2015.

Figure S8. Spaghetti plot of monthly precipitation days at the station Vergoetschen for the individual years over the period 1971 to 2015. The red thick line represents the overall mean of all months.

2   Supplementary Tables

Table S1. Statistics of the Kolmogorov–Smirnov (KS) test between observed, uncorrected, and corrected WRF temperature at four stations. The null hypothesis of the KS test is that the two samples have the same distribution. The D-statistic gives the maximum absolute as well as the maximum vertical difference between the ECDFs.

Site	T uncor same distribution	T uncor D-statistic (-)	T uncor max vertical difference (°C)	T cor same distribution	T cor D-statistic (-)	T cor max vertical difference (°C)
Dammfuss	Yes	0.08	-3.06	Yes	0.03	17.46
Gepatschalm	Yes	0.08	9.66	Yes	0.07	9.63
Weisssee	Yes	0.05	-3.8	Yes	0.03	6.45
Vernagt	Yes	0.13	6	Yes	0.03	5.6