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Value of uncertain streamflow observations for hydrological modelling

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Supplemental Material

Model parameters

Table S1 Parameter ranges used for calibration of the HBV-model

Parameter	Description[a]	Unit	Min	Max
Rescaling Parameters of Input Data				
PCALT	change in precipitation with elevation	% $(100m)^{-1}$	5	15
TCALT	change in temperature with elevation	°C $(10m)^{-1}$	0.5	1.5
Snow and ice melt parameters				
TT	threshold temperature for liquid and solid precipitation	°C	-3	1
CFMAX	degree-day factor	$mmd^{-1}°C^{-1}$	0.06	10
SFCF	snowfall correction factor	-	0.4	1.6
CFR	refreezing coefficient	-	0.001	0.9
CWH	water holding capacity of the snow storage	-	0.001	0.9
Soil Parameters				
PERC	maximum percolation from upper to lower groundwater storage	mm d^{-1}	0	3
UZL	threshold parameter	mm	0	100
K0	storage (or recession) coefficient 0	d^{-1}	0.001	0.5
K1	storage (or recession) coefficient 1	d^{-1}	0.0001	0.2
K2	storage (or recession) coefficient 2	d^{-1}	2E-06	0.005
MAXBAS	length of triangular weighting function	H	1	7
FC	maximum soil moisture storage	Mm	50	550
LP	soil moisture value above which actual evapotranspiration reaches potential evapotranspiration	-	0.3	1
Beta	shape factor for the function used to calculate the distribution of rain and snow melt going to runoff and soil box, respectively	-	1	5

[a]a detailed description of the model parameters is given in (Seibert and Vis, 2012).

Significance of median model performance compared to the lower benchmark

Table S2 Significance of the differences in median model performance for each temporal resolution and an error group compared to the lower benchmark (Mann-Whitney U-test). The p-values of the Kruskal-Wallis test for the within group variability in the lowermost row shows that the median model performance of the different error groups was significantly different.

	No Error	Small Error	Medium Error	Large Error
Hourly	<0.01	<0.01	<0.01	<0.01
Weekly	<0.01	<0.01	<0.01	0.75
Crowd52	<0.01	<0.01	<0.01	0.40
Monthly	<0.01	<0.01	<0.01	0.03*
Crowd12	<0.01	<0.01	0.11	<0.01*
WeekendSpring	<0.01	<0.01	<0.01	0.40
WeekendSummer	<0.01	<0.01	<0.01	0.46
IntenseSummer	<0.01	0.01	0.04	0.21
Within error group	<0.01	<0.01	<0.01	<0.01

* These datasets result in significantly worse results than random parameters.

12 **Extreme outlier removal for the northern and southern side of the Alps**

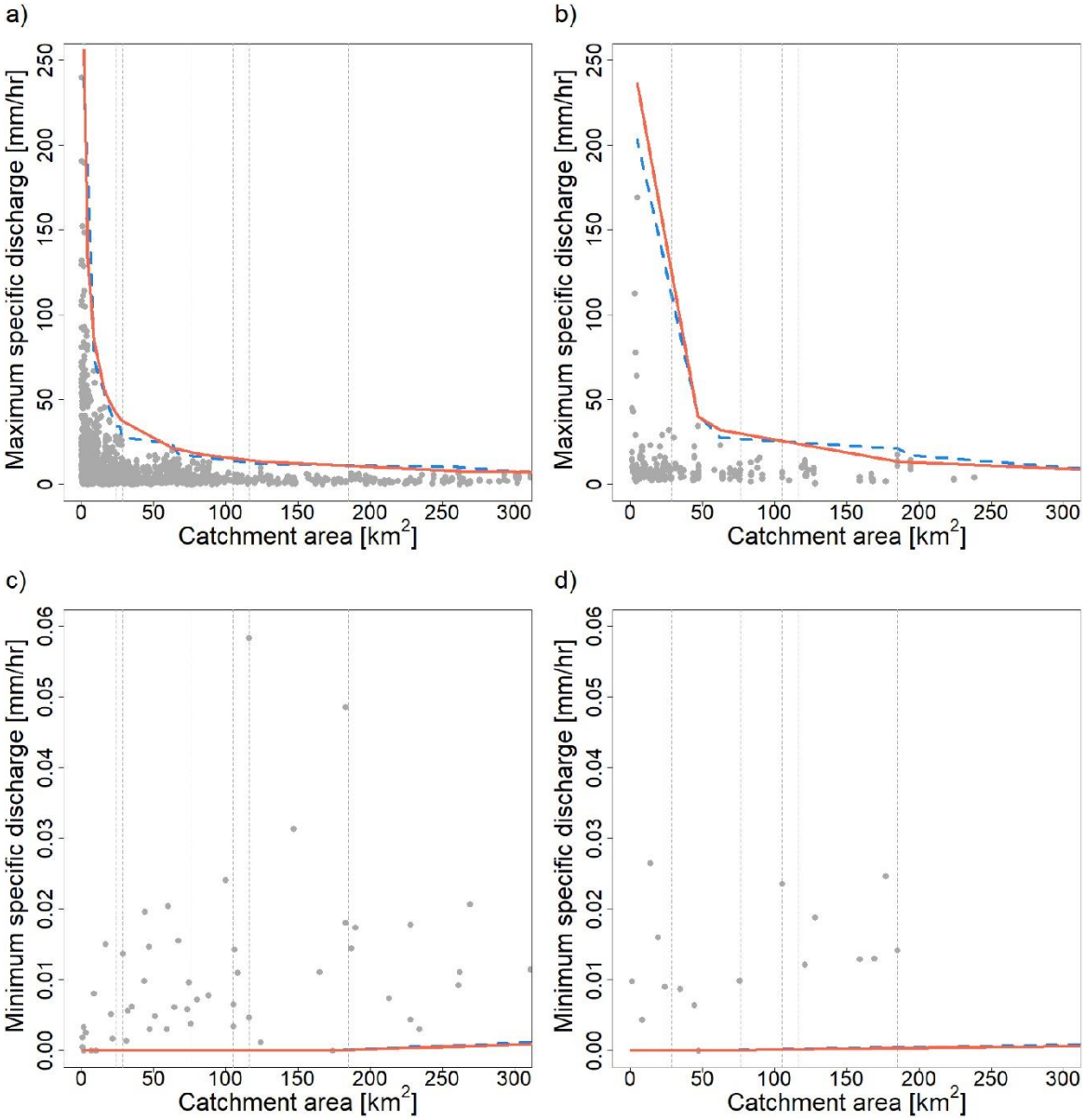

Figure S1 Relation between catchment area and maximum (a, b) and minimum (c, d) specific streamflow for catchments on the north (a, c) and south (b, d) of the Alps. The dashed light blue line is the Pareto front including the 20 % buffer. The red lines are the fitted logarithmic models used to find the maximum and minimum possible flow for each catchment.

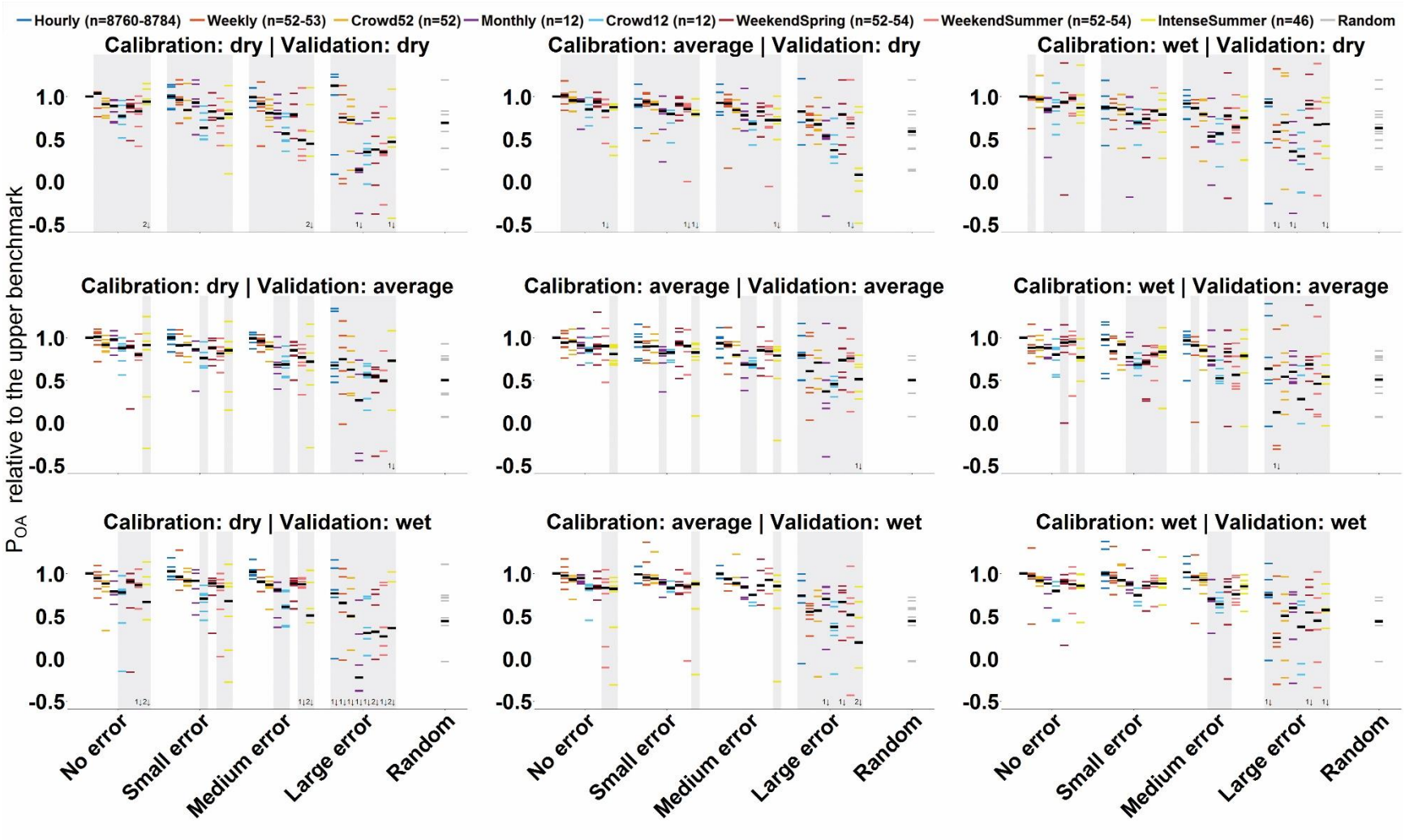

Figure S2 Median model validation performance for all datasets used for calibration during the different validation periods. Each horizontal line represents the median model performance for one catchment. The black bold line represents the median for the six catchments. The grey rectangles around the boxes indicate non-significant differences in median model performance for the six catchments compared to the lower benchmark with random parameters. The numbers at the bottom indicate the number of outliers beyond the figure margins. For the individual P_{OA} values of the upper benchmark (no error – *Hourly* dataset) in the different calibration and validation years see Table 4.