508   **Supplementary material**

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510   *Hydrology and Earth System Sciences*

511   Supporting Information for

512   # Stream water sourcing from high elevation snowpack inferred from

513   # stable isotopes of water: A novel application of *d-excess* values

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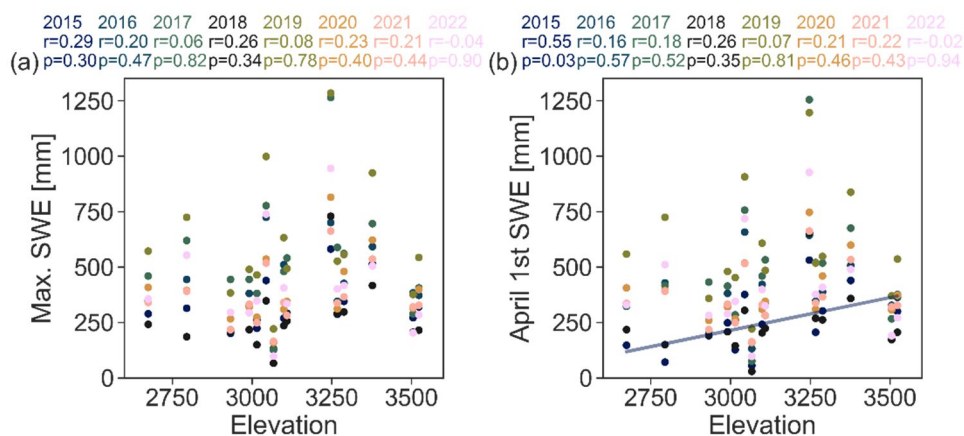
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524   **Suppl. Fig. 1 (a) Relation between maximum snow water equivalent (SWE) at the 15 SNOTEL sites in the Gunnison River**
525   **basin and the elevation of the SNOTEL sites for the years 2015 to 2022. (b) same as in (a), but with SWE on April 1st. Given**
526   **are the Pearson correlation coefficients for each year and the years are color coded (data from**
527   **https://wcc.sc.egov.usda.gov/reportGenerator/).**

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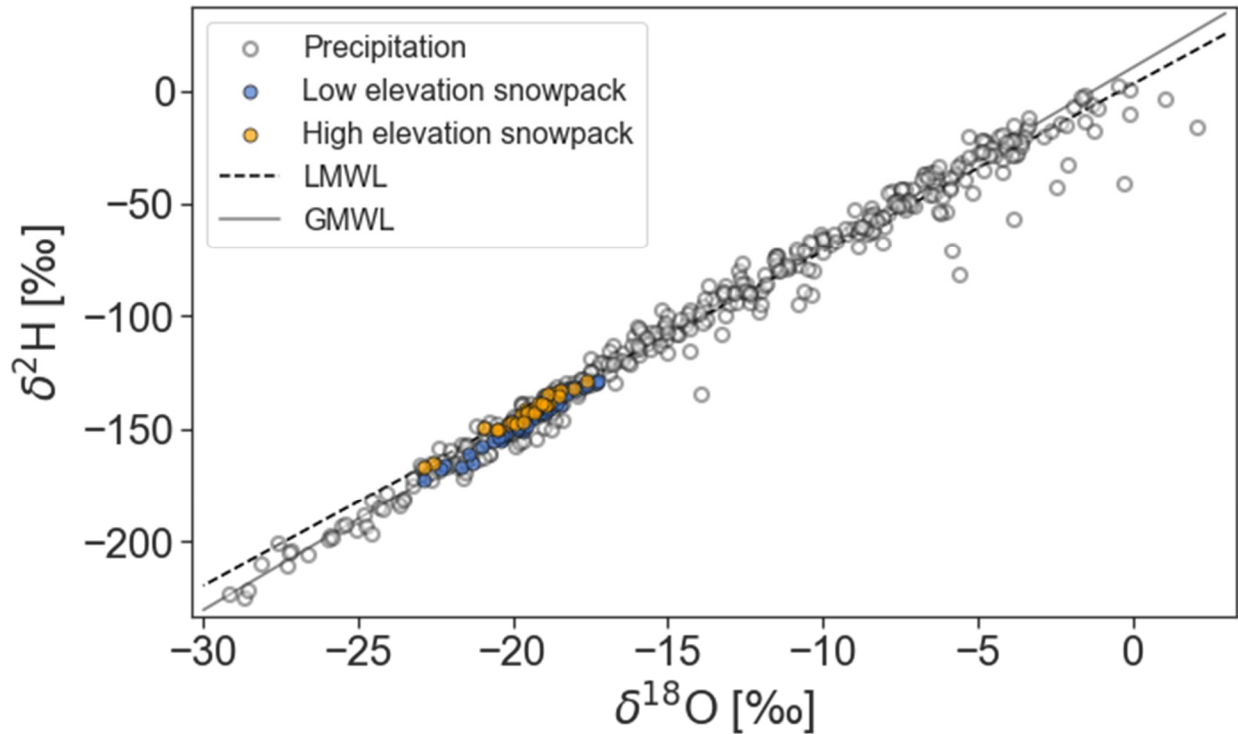
Suppl. Fig. 2 Precipitation samples from 2015 to 2022 (white points) and snowpack sampled at sites <3200 m a.s.l. ("Low elevation", blue) and sites above >3200 m a.s.l. ("High elevation", orange). Also shown are the Global Meteoric Water Line (GMWL: $\delta^2H = 8.2 \ \delta^{18}O+11.27$, Rozanski et al. (1993)) and the Local Meteoric Water Line (LMWL: $\delta^2H = 7.4 \ \delta^{18}O+2.4$, Carroll et al. (2022b)).

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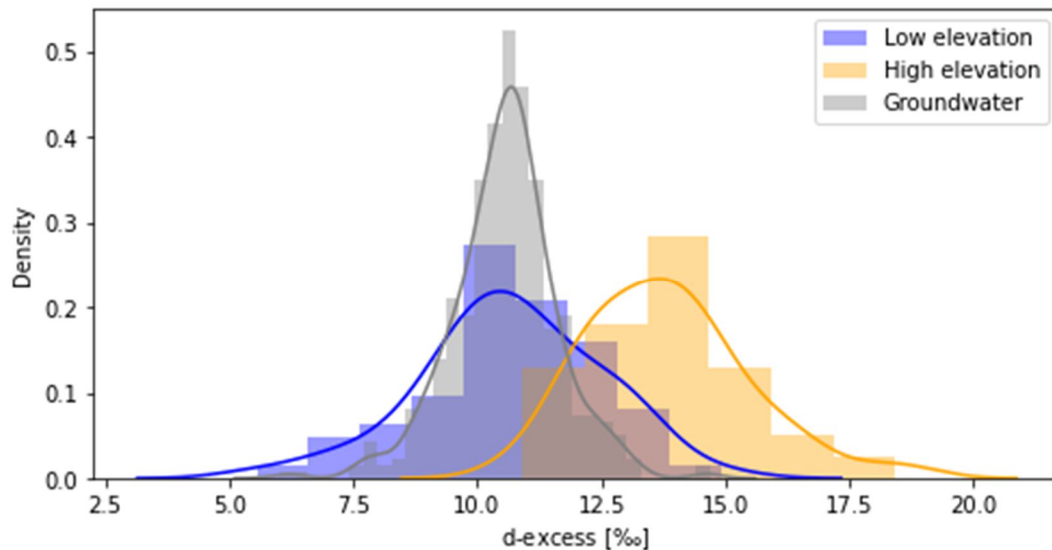
Suppl. Fig. 3 Histogram showing the distribution of snowpit d-excess for the sites <3200 m a.s.l. ("Low elevation", blue), sites above >3200 m a.s.l. ("High elevation", orange), and groundwater sampled at five wells between 2015 and 2022 (grey). The mean values for the low and high elevation snowpack (10.7 ‰ and 13.8 ‰, respectively) are significantly different (p<0.0001, t = -8.1) according to the t-test. The mean groundwater d-excess (10.5 ‰) is not significantly different from the low elevation snowpack.

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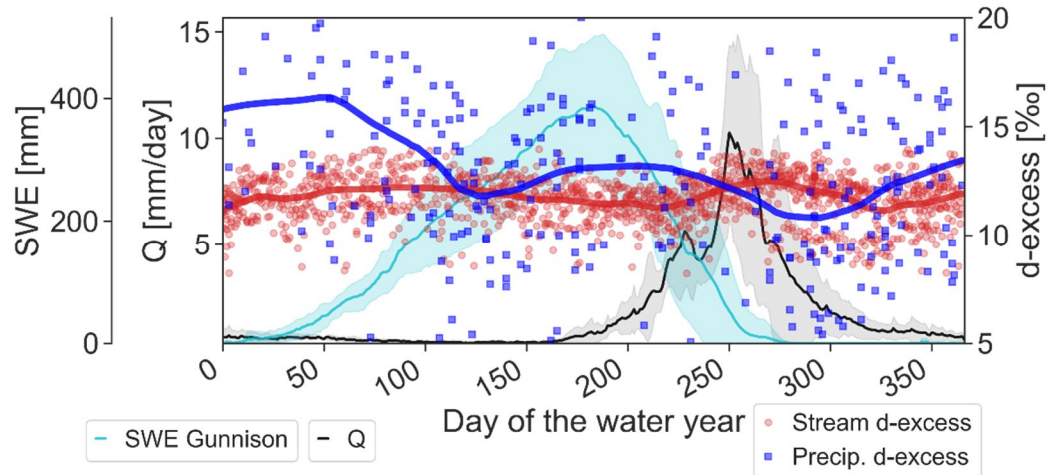
Suppl. Fig. 4 Median annual dynamics of snow water equivalent (SWE) at the Gunnison SNOTEL stations (cyan) and East River streamflow (Q, black) from water year 2015 to 2022 with semitransparent area representing the range. The d-excess of all stream water at East River (red) and precipitation (blue) samples collected between water year 2015 and 2022. The red and blue lines represent a lowess filter to show any trends in the data.

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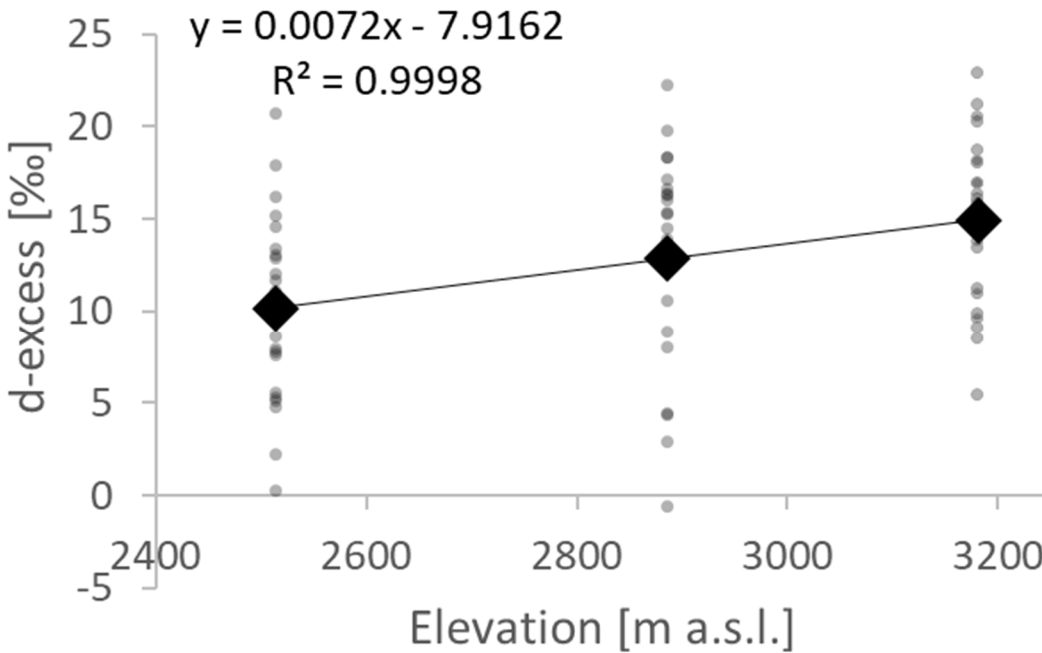
Suppl. Fig. 5 The d-excess of winter precipitation from samples collected between November and April during the water years 2021 and 2022 at the locations Estess (2513 m), Mount Crested Butte (2885 m) and Irwin Barn (3181 m). The black diamonds show the mean values and half-transparent dots are individual samples. The regression line shows the d-excess lapse rate of 0.7 ‰/100 m.

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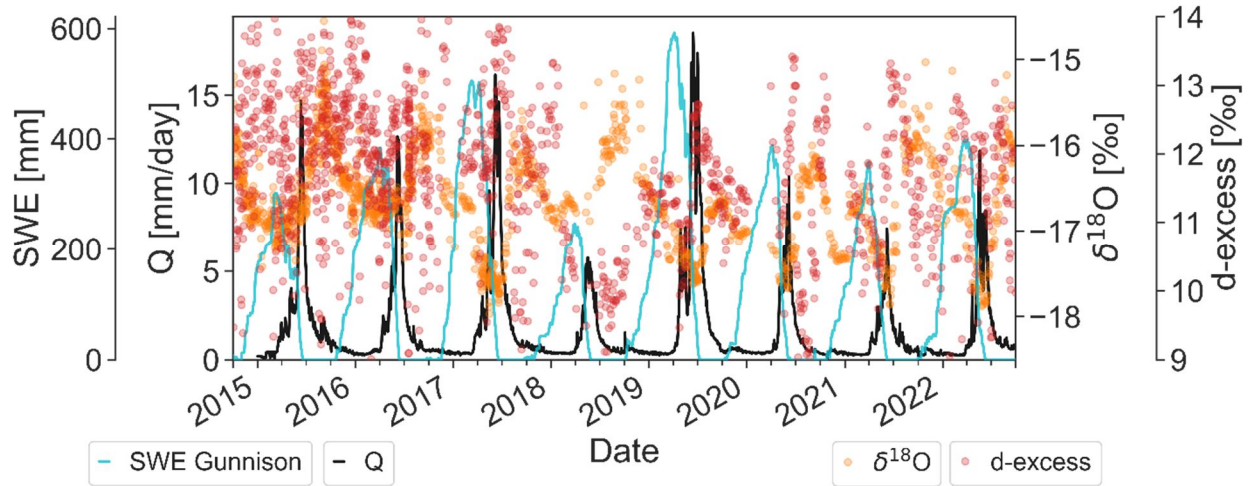
Suppl. Fig. 6 Snow water equivalent (SWE) at the Gunnison SNOTEL stations (cyan line), streamflow (Q, black line) at the East River, as well as the $\delta^{18}O$ (orange points) and *d-excess* (red points) of the stream water sampled at Pumphouse for the water years 2015 to 2022.

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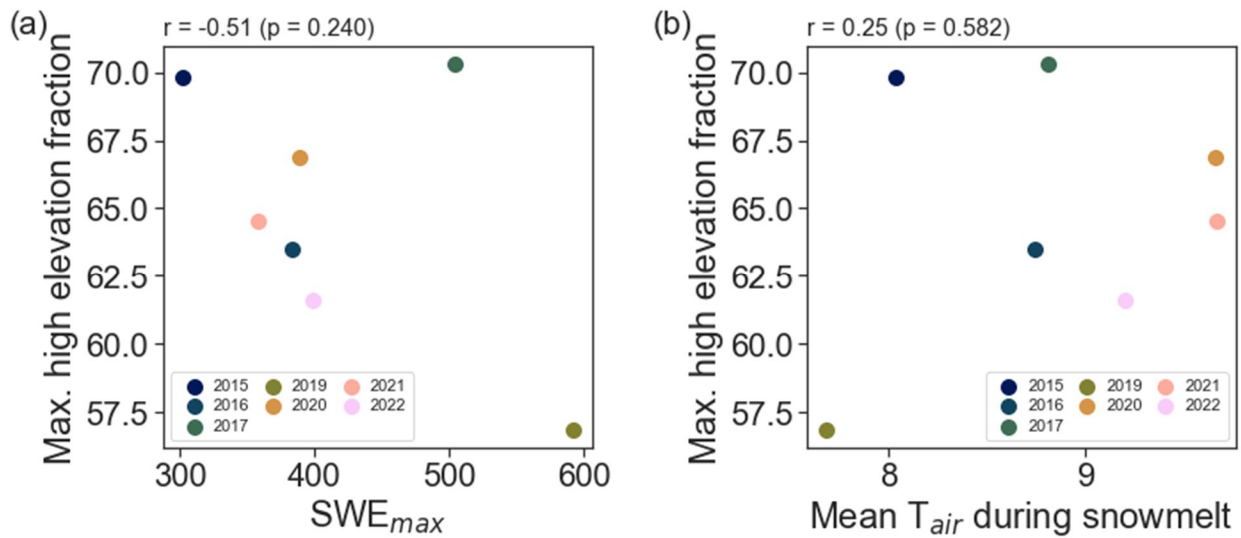
Suppl. Fig. 7 Relation between maximum fraction of high elevation snowpack contributions to the snowmelt runoff and the maximum snow water equivalent (in a) and mean air temperature during the snowmelt period (in b).

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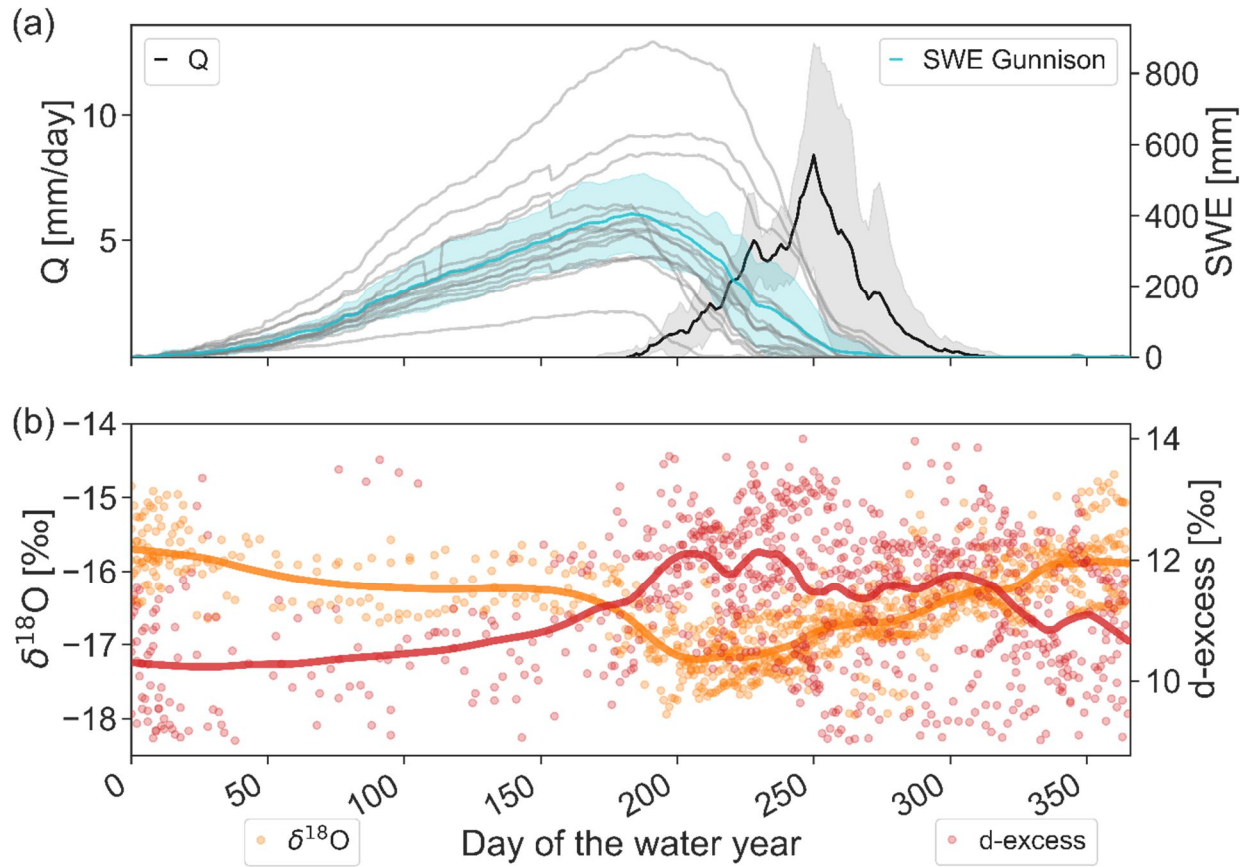
Suppl. Fig. 8 (a) Median annual dynamics of Coal Creek streamflow (Q, black) and snow water equivalent (SWE) at the individual SNOTEL sites within the Gunnison River catchment (grey) and the average of all sites (cyan) from water year 2016 to 2022 with semitransparent grey and cyan area representing the standard deviation of Q and SWE, respectively. (b) The δ^{18}O (orange) and *d-excess* (red) of all stream water samples collected between water year 2016 and 2022 from the East River at the Pumphouse location. The orange and red lines are a LOWESS fit to the data points.

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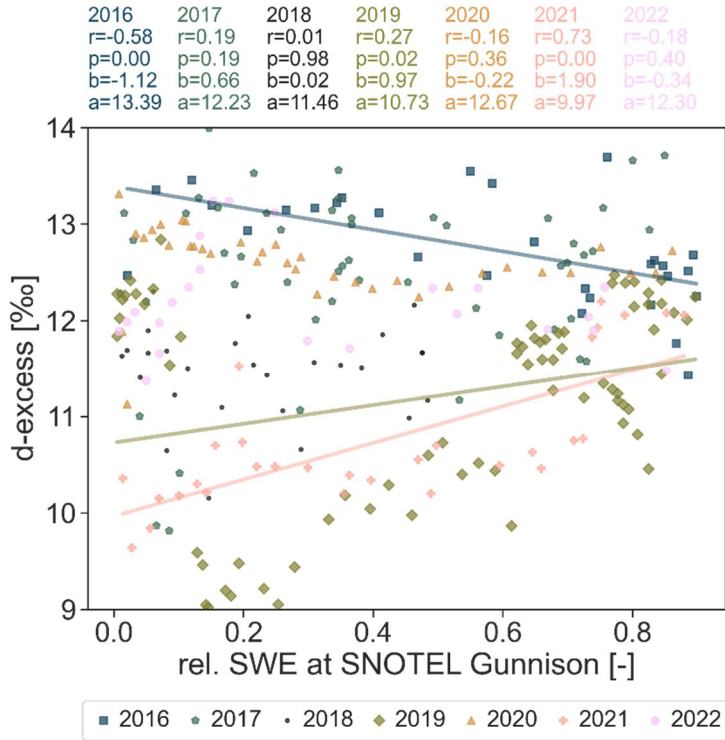
Suppl. Fig. 9 The *d-excess* of Coal Creek stream water during snowmelt for seven individual years, shown as a function of relative SWE measured at the SNOTEL stations across the Gunnison River catchment at the time of sampling. For each year, the Pearson correlation (r) and the associated significance level (p) are given as well as the intercept (a) and slope (b) of the regression.

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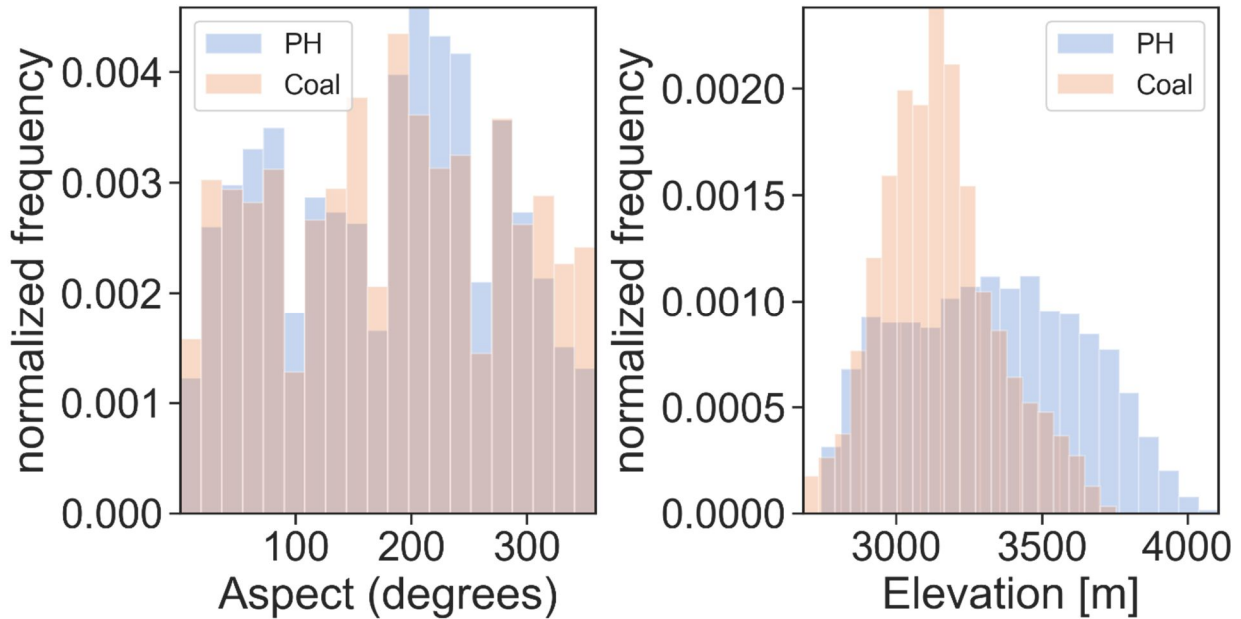
Suppl. Fig. 10 Distribution of aspect (left) and elevation (right) across the East River catchment defined at Pumphouse (PH, blue) and Coal Creek (Coal, orange).

572 **Suppl. Table 1 SNOTEL sites located in the Gunnison River Basin (data from**
573 **https://wcc.sc.egov.usda.gov/reportGenerator/).**

Station Id	Station Name	Elevation (m)	Latitude	Longitude	County Name
380	Butte	3108.96	38.8944	-106.95	Gunnison
1059	Cochetopa Pass	3066.59	38.1627	-106.6	Saguache
409	Columbine Pass	2795.32	38.4182	-108.38	Montrose
538	Idarado	2990.7	37.9339	-107.68	Ouray
618	Mc Clure Pass	2674.32	39.129	-107.29	Gunnison
622	Mesa Lakes	3099.21	39.0574	-108.06	Mesa
675	Overland Res.	3015.39	39.0904	-107.64	Delta
680	Park Cone	2932.48	38.8198	-106.59	Gunnison
682	Park Reservoir	3044.04	39.0443	-107.88	Delta
701	Porphyry Creek	3288.18	38.4886	-106.34	Gunnison
713	Red Mountain Pass	3377.18	37.8917	-107.71	San Juan
1128	Sargents Mesa	3504.9	38.2856	-106.37	Saguache
737	Schofield Pass	3247.03	39.0147	-107.05	Gunnison
762	Slumgullion	3523.49	37.9908	-107.2	Hinsdale
1141	Upper Taylor	3266.54	38.9907	-106.75	Gunnison

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Station Id	Station Name	Elevation (m)	Latitude	Longitude	County Name
1030	Arapaho Ridge	3345.48	40.351	-106.38	Grand
1061	Bear River	2777.34	40.0615	-107.01	Routt
1041	Beaver Ck Village	2610.61	39.5987	-106.51	Eagle
335	Berthoud Summit	3448.51	39.8036	-105.78	Grand
345	Bison Lake	3341.83	39.7646	-107.36	Garfield
913	Buffalo Park	2819.1	40.2284	-106.6	Grand
1101	Chapman Tunnel	3078.48	39.2621	-106.63	Pitkin
408	Columbine	2794.1	40.3959	-106.6	Jackson
415	Copper Mountain	3207.41	39.4892	-106.17	Summit
1120	Elliot Ridge	3215.34	39.8638	-106.42	Summit
485	Fremont Pass	3452.16	39.3801	-106.2	Summit
505	Grizzly Peak	3395.17	39.6465	-105.87	Summit
542	Independence Pass	3230.27	39.0754	-106.61	Pitkin
547	Ivanhoe	3212.9	39.2923	-106.55	Pitkin
970	Jones Pass	3177.84	39.7645	-105.91	Grand
556	Kiln	2933.4	39.3172	-106.62	Pitkin
565	Lake Irene	3255.87	40.4145	-105.82	Grand
607	Lynx Pass	2718.51	40.0783	-106.67	Routt
618	Mc Clure Pass	2674.32	39.129	-107.29	Gunnison

1040	Mccoy Park	2900.48	39.6023	-106.54	Eagle
622	Mesa Lakes	3099.21	39.0574	-108.06	Mesa
1014	Middle Fork Camp	2733.75	39.7957	-106.03	Grand
658	Nast Lake	2661.21	39.297	-106.61	Pitkin
669	North Lost Trail	2809.95	39.0782	-107.14	Gunnison
675	Overland Res.	3015.39	39.0904	-107.64	Delta
682	Park Reservoir	3044.04	39.0443	-107.88	Delta
688	Phantom Valley	2756.92	40.398	-105.85	Grand
737	Schofield Pass	3247.03	39.0147	-107.05	Gunnison
802	Summit Ranch	2856.28	39.718	-106.16	Summit
842	Vail Mountain	3142.49	39.6177	-106.38	Eagle
869	Willow Creek Pass	2902.61	40.3473	-106.1	Grand

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