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Supplement of

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Supplementary Material

A Year-Long Eddy Covariance Dataset over an Alpine Steppe on the central Tibetan Plateau: A Landscape Perspective on Carbon and Energy Fluxes

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Table S1. Input paramters used in Kormann and Meixner footprint modelling

Parameters	**Symbol**	**Unit**	**Source**
Measurement height	zm	m	EddyPro output file
Mean wind speed	WS	ms^{-1}	
Monin-Obukhov length	L	m	
Standard deviation of cross-winds	sv	ms^{-1}	
Friction velocity	ustar (u*)	ms^{-1}	
Wind direction	WD	degrees	
Roughness length	z0	m	Calculated from ustar, WS, WD, L, and zm

Table S2. Data availability after individual filtering steps (all units in percent of the entire period – 2018 July 14 to 2019 June 8). NEE = net ecosystem exchange; LE = latent heat flux; H = sensible heat flux; QC = quality control flagging (Mauder and Foken, 2004); IQR = interquartile range filter; Spk_Skew_Kurt = spike, skewness, and kurtosis filter; NightRg_Flag = night-time (incoming shortwave radiation, Rg = 0) based flag; u* = friction velocity threshold filter.

Flux variables	**Raw**	**QC**	**IQR**	**Spk_Skew_Kurt**	**NightRg_Flag**	**u***	**Gap filling**
NEE	91.6	73.4	68.5	46.6	42.3	32.8	100
LE	91.6	84.0	80.5	63.6	60.0	43.8	100
H	93.3	77.6	74.0	51.9	48.2	35.1	100

Table S3. Accuracy assessment of downscaled meteorology from ERA5 to site scale. Tsoil = soil temperature; SMC = soil moisture content; RH = relative humidity; VPD = vapour pressure deficit; Rg =

incoming shortwave radiation; r = correlation coefficient; RMSE = root mean square error; MAE = mean absolute error.

Met variables	r	RMSE	MAE
Tsoil	0.99	0.58	0.38
SMC	0.99	0.002	0.0009
RH	0.98	3.41	2.22
VPD	0.96	0.65	0.46
Rg	0.93	116	61

Table S4. Accuracy assessment of MDS and RF. Cross-validation accuracy assessment of marginal distribution sampling (MDS) and random forest (RF) gap-filling methods for net ecosystem exchange (NEE, µmol m^{-2} s^{-1}), latent heat flux (LE, W m^{-2}), and sensible heat flux (H, W m^{-2}). Values represent the mean root mean square error (RMSE) and its standard deviation (SD) across 10 cross-validation runs

	MDS		RF	
Flux variables	Mean RMSE	SD RMSE	Mean RMSE	SD RMSE
NEE	0.66	0.04	0.52	0.06
LE	29.13	0.67	4.42	0.59
H	18.55	0.74	10.54	0.46

Table S5. Descriptive statistics (mean, median, 25th, 75th, and 95th percentiles, minimum, maximum) of uncertainties in NEE, LE, and H during growing season (GS, May–Sep) and non-growing season (NGS, Oct–Apr), separated into mid-daytime (10–14 h) and night time (Rg < 5). Units: NEE in µmol m^{-2} s^{-1}; LE and H in W m^{-2}

			Mean	Median	p25	p75	p95	Min	Max
NEE	**GS**	***Day***	1.34	1.07	0.73	1.53	3.18	0.01	20.03
		Night	0.66	0.49	0.34	0.91	1.47	0.01	7.03
	NGS	***Day***	0.43	0.32	0.14	0.59	1.25	0.00	4.68
		Night	0.43	0.37	0.26	0.51	0.90	0.00	6.20
LE	**GS**	***Day***	25.2	15.13	9.09	32.92	76.54	0.39	134.2
		Night	24.59	25.50	8.4	34.48	52.97	0.39	118.9
	NGS	***Day***	13.02	6.58	2.73	15.62	47.2	0.01	123.4
		Night	18.08	13.88	7.10	24.60	48.34	0.16	71.82
H	**GS**	***Day***	29.73	19.83	8.20	43.24	88.32	0.04	188.84
		Night	12.28	11.85	3.98	18.49	24.53	0.21	44.36
	NGS	***Day***	11.86	6.02	1.69	15.52	45.30	0.06	145.04
		Night	19.22	17.83	8.98	26.88	42.92	0.15	77.37

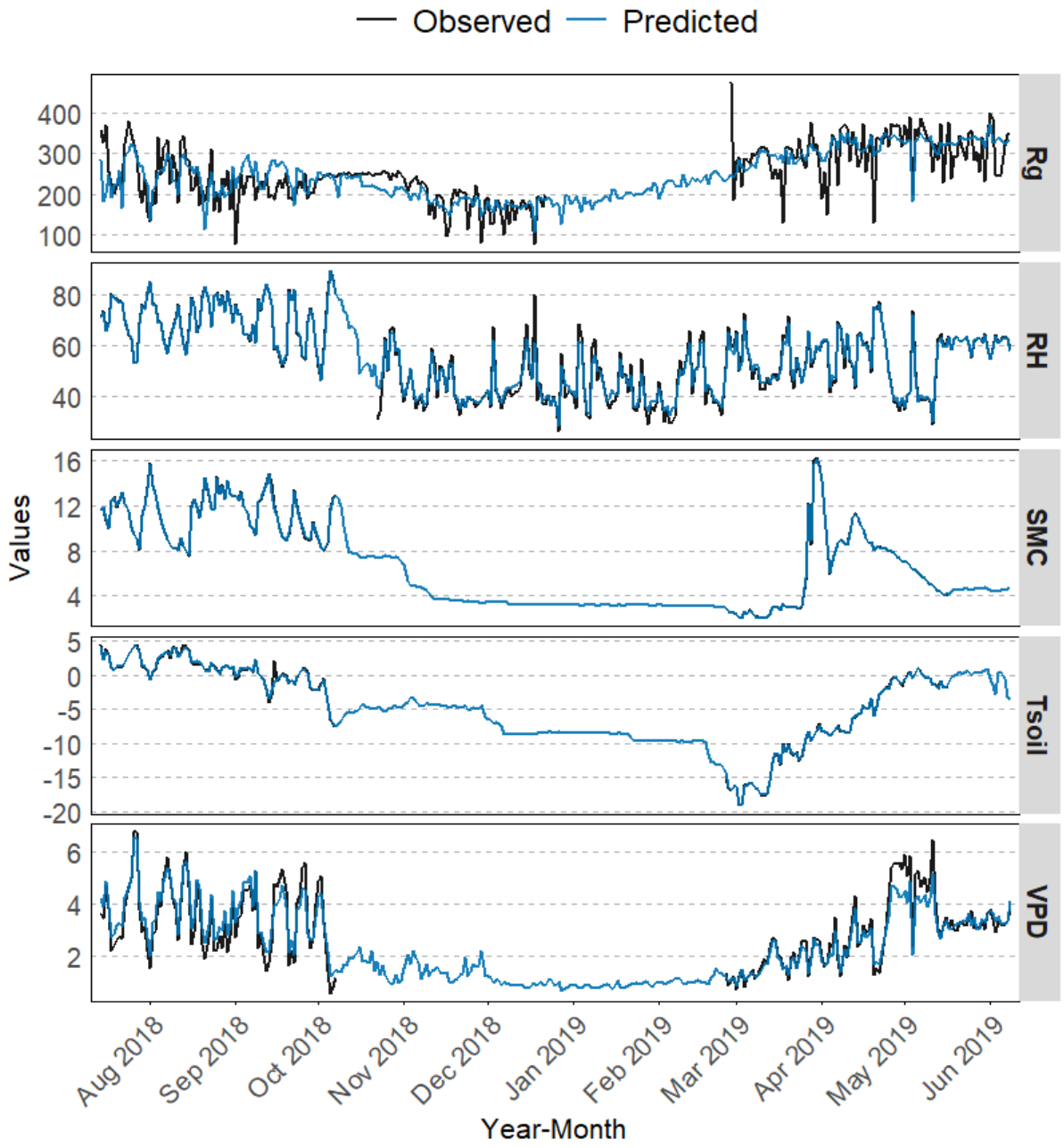

Figure S1: Daily meteorological variables at the site from July 2018 to June 2019. Observed values are shown in black, and downscaled ERA5 predictions at the site level are shown in blue. Variables include (from top to bottom) incoming shortwave radiation (Rg), relative humidity (RH), soil moisture content at 10 cm (SMC), soil temperature at 10 cm (Tsoil), and vapor pressure deficit (VPD). Each facet uses independent y-axis scales to reflect the range of the respective variable.

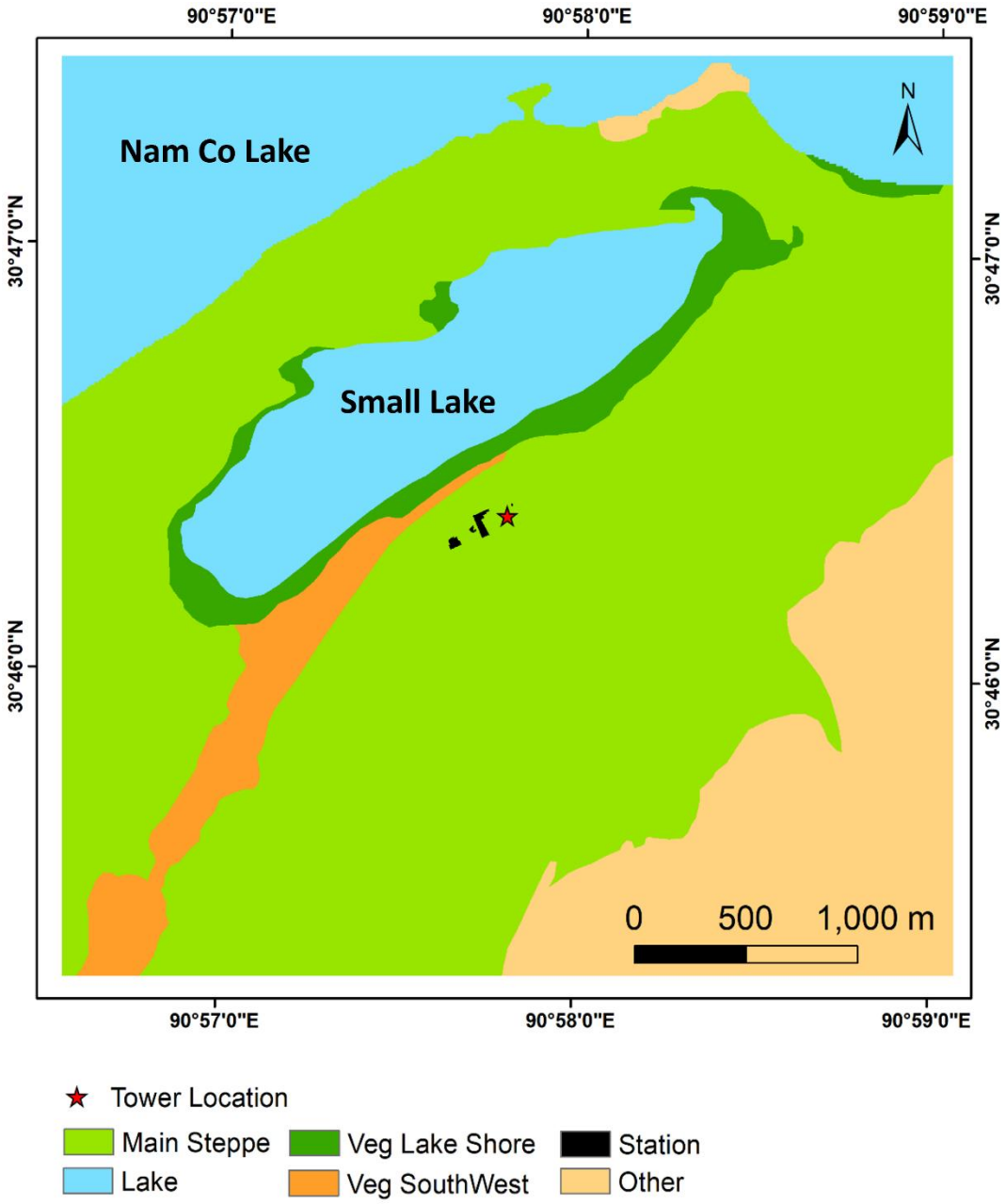

Figure S2: Land cover map of the Nam Co study area derived by digitization of cloud-free Sentinel-2 Level-1C MSI imagery (20 May 2019). Land cover units were visually interpreted and digitized using colour infrared (CIR) RGB composite (Bands 8-4-3) at 10 m spatial resolution.

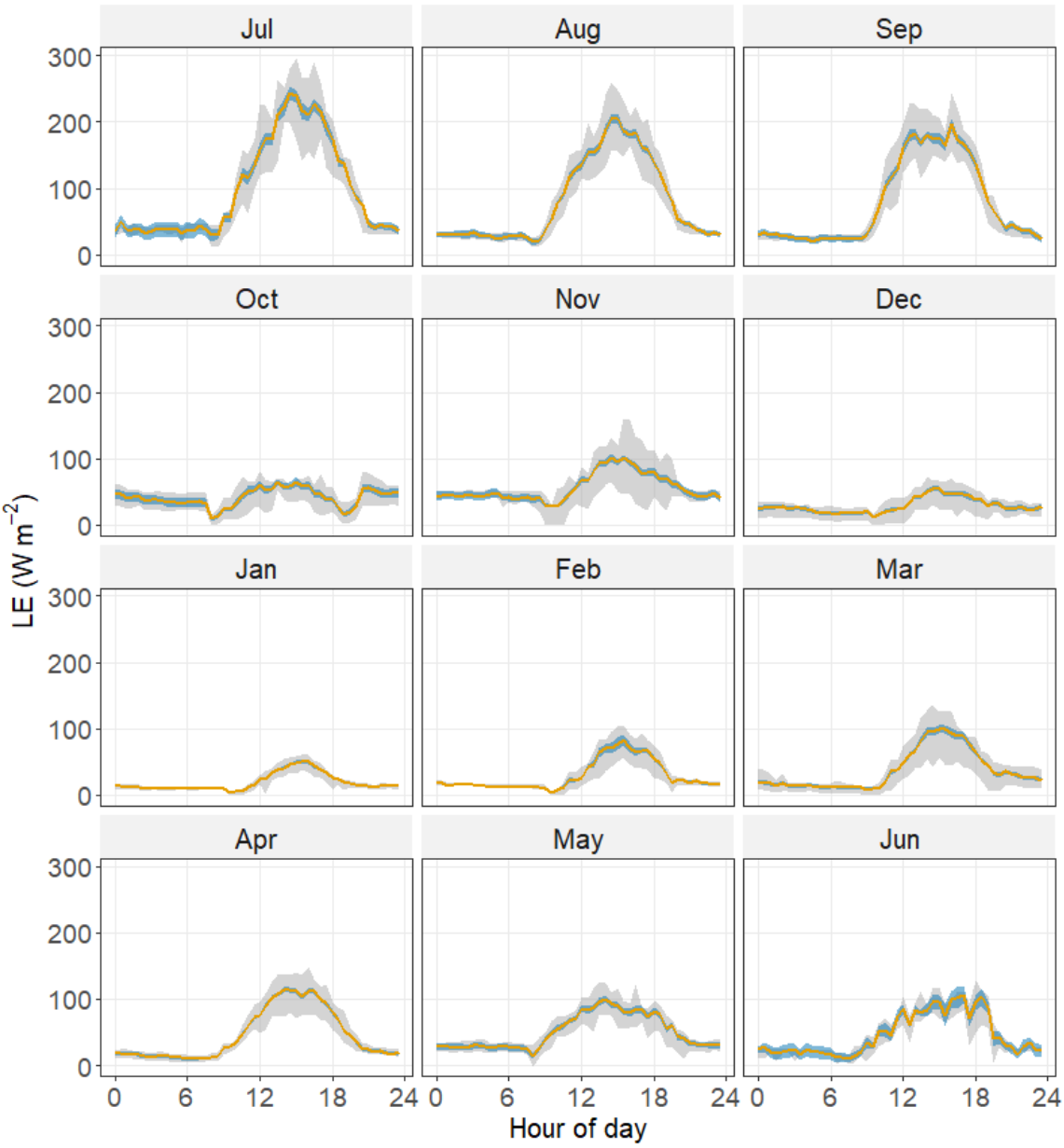

Figure S3: Diurnal cycle of latent heat flux (LE) for each month from July 2018 to June 2019. The orange line represents the mean gap-filled LE. Blue shaded ribbons indicate ±1σ combined uncertainty (random measurement error + gap-filling). Grey shaded ribbons show the interquartile range (25th–75th percentile) of half-hourly LE values, reflecting day-to-day variability.

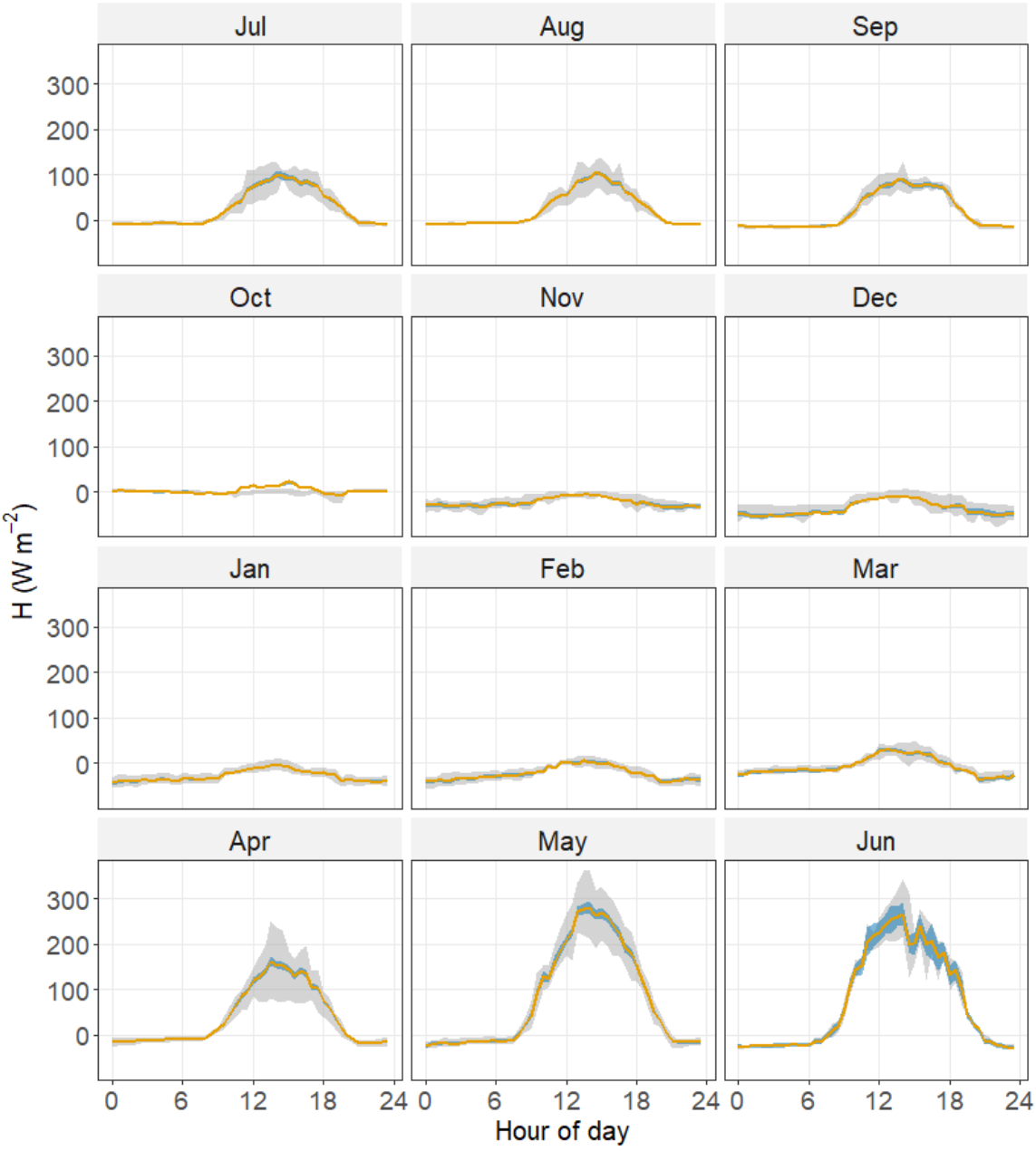

Figure S4: Diurnal cycle of sensible heat flux (H) for each month from July 2018 to June 2019. The orange line represents the mean gap-filled H. Blue shaded ribbons indicate ±1σ combined uncertainty (random measurement error + gap-filling). Grey shaded ribbons show the interquartile range (25th–75th percentile) of half-hourly H values, reflecting day-to-day variability.