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Introduction

The supplementary information contains Table S1 and Figures S1-S4. Table S1 presents the parameters for models in load estimator for simulating carbon fluxes in the Shaliu River. Figure S1 shows the variations of the mean daily and monthly precipitations during recent ten years (2009–2018) at Gonghe weather station near Qinghai Lake. Figure S2 provides the concentrations of different forms of carbon and the relationship between dissolved inorganic carbon and cation concentration. Figure S3 shows the spatial-temporal variations of riverine carbon along the Shaliu River. Figure S4 shows the relationships between intra-annual DOC concentrations and river discharge at SLH-4 station in Shaliu River.

14 **Table S1.** Coefficients (\pm SD) and R^2 values for model 1 and model 6 in load estimator
15 (LOADEST) for simulating carbon fluxes in the Shaliu River.

	R^2	a_0	a_1	a_2	a_3	a_4
DOC	0.9894	6.4648 ± 0.0318	0.9595 ± 0.0212			
DIC	0.9928	9.1919 ± 0.0430	0.8978 ± 0.0590	-0.0321 ± 0.0135	-0.0509 ± 0.1250	0.1092 ± 0.0385

16 Note: model 1, $\ln(\text{DOC flux}) = a_0 + a_1 \ln Q$; model 6, $\ln(\text{DIC flux}) = a_0 + a_1 \ln Q + a_2 \ln Q^2 + a_3$
17 $\sin(2\pi \text{dtime}) + a_4 \cos(2\pi \text{dtime})$; flux in kg day^{-1} , Q in $\text{ft}^3 \text{s}^{-1}$, $\ln Q = \ln(\text{streamflow}) - \text{center of}$
18 $\ln(\text{streamflow})$, dtime = decimal – center of decimal time.

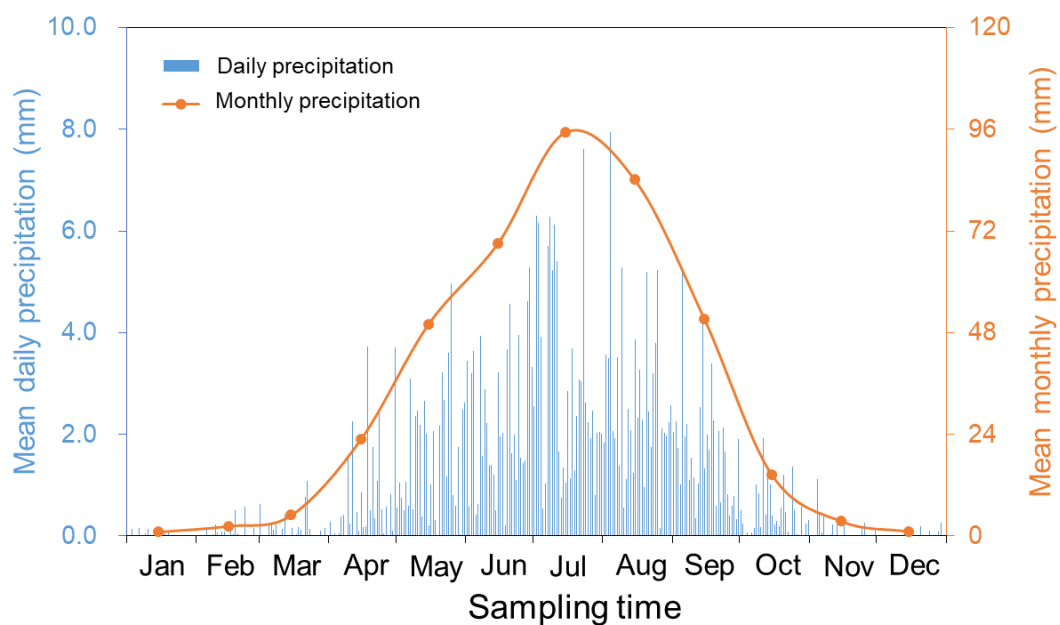


Figure S1. Variations of the mean daily and monthly precipitations during recent ten years (2009–2018) at Gonghe weather station near Qinghai Lake (data modified from <http://data.cma.cn/data/index/6d1b5efbdcfb9a58.html>).

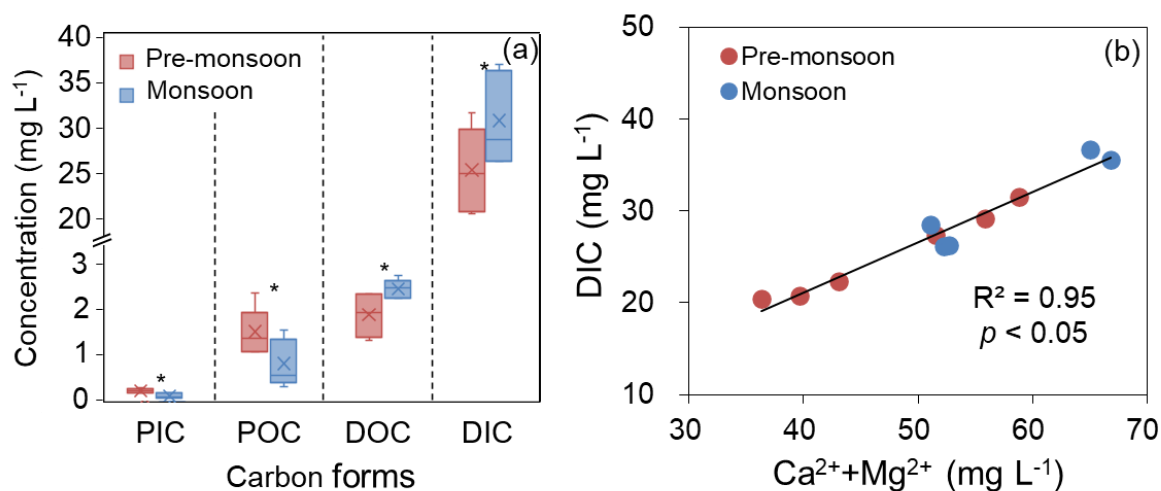


Figure S2. Concentrations of particulate inorganic carbon (PIC), particulate organic carbon (POC), dissolved organic carbon (DOC) and dissolved inorganic carbon (DIC) in the Shaliu River (a); Relationship between DIC and cation ($\text{Mg}^{2+} + \text{Ca}^{2+}$) concentrations during pre-monsoon and monsoon seasons (b). The solid bar and cross in the box mark the median and mean of each data set, respectively. The upper and lower ends of boxes denote the 0.25 and 0.75 percentiles, respectively ($n = 5$ in pre-monsoon season and $n = 4$ in monsoon season). Asterisks indicate significant differences between the pre-monsoon and monsoon seasons (Independent sample t tests, $p < 0.05$). The black line in (b) indicate the linear regression between DIC and cation concentrations in both seasons ($p < 0.05$).

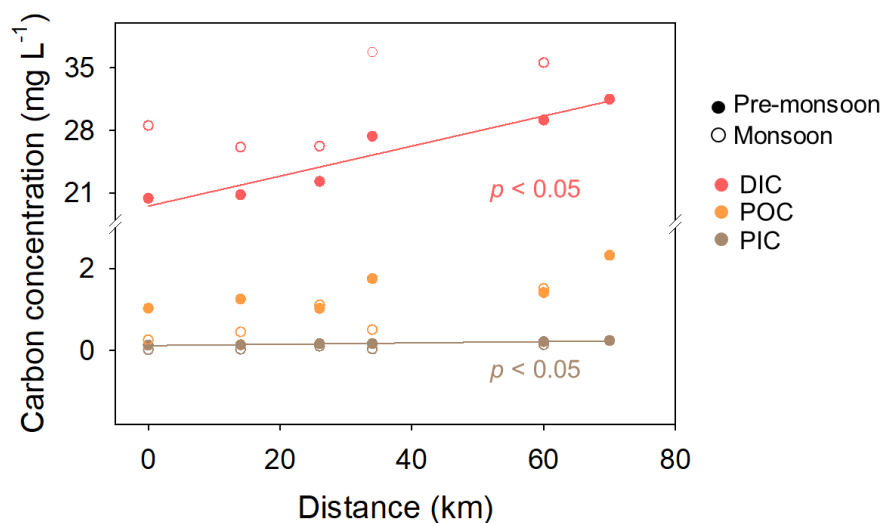


Figure S3. The spatial-temporal variation of dissolved inorganic carbon (DIC), particulate organic carbon (POC) and particulate inorganic carbon (PIC) in Shaliu River in pre-monsoon and monsoon seasons in 2015. The abscissa means the distance of the sampling sites from SLH-0. The red and brown lines correspond to the linear regression of data ($p < 0.05$), respectively.

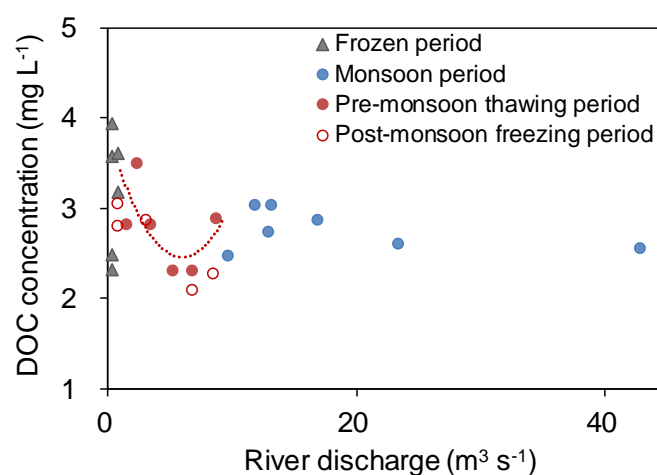


Figure S4. Relationships between intra-annual DOC concentrations and river discharge at SLH-4 station in Shaliu River. The red line indicates the variation trend of DOC with discharge in pre-monsoon thawing period. Frozen, pre-monsoon thawing, monsoon and post-monsoon freezing periods are referred as December to March, April to June, July to September, October to November based on measured soil temperatures, respectively.