

## **Supplementary information for**

### **Spatiotemporal Shifts in Organic Carbon Sources in Cascade Reservoirs - a case study in the Lancang River**

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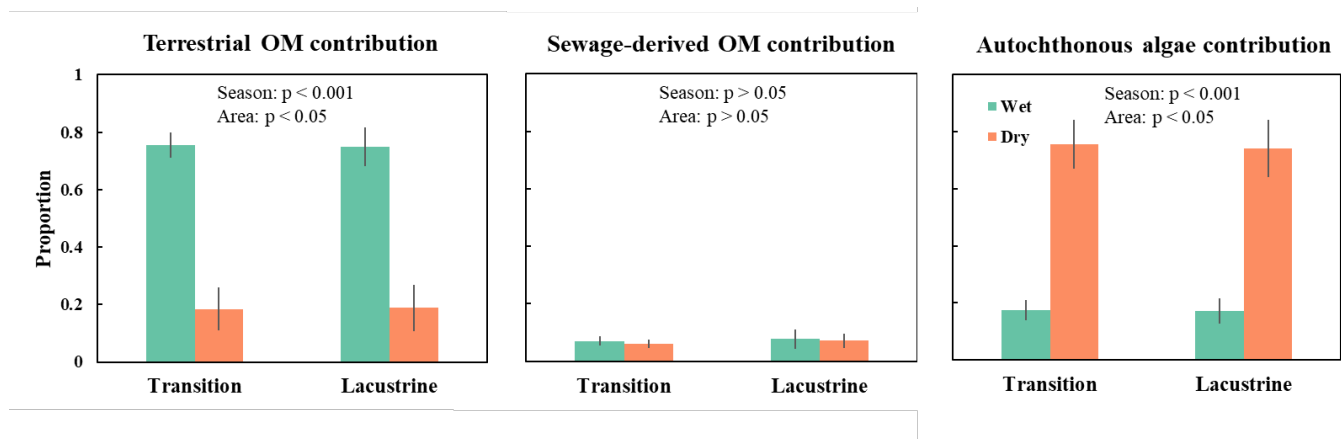
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**Fig.S1** Grouped Bar Chart of Mean and Standard Error of Three-Endpoint Contributions for Five Cascade Reservoirs in the Middle and Lower Reaches of the Lancang River (Transition vs. Lacustrine, Flood Season vs. Dry Season)

**Table.S1.** Information on reservoir construction in the middle reaches of Lancang River

| Source               | Constructi<br>on time<br>(year) | Dam<br>height<br>(m) | Water<br>level<br>(m) | Length of<br>backwater<br>area (km) | Installed<br>capacity<br>(MW) | Hydraulic<br>Retention<br>Time (year) | Sampling point information                |
|----------------------|---------------------------------|----------------------|-----------------------|-------------------------------------|-------------------------------|---------------------------------------|-------------------------------------------|
| Miaowei (MIW)        | 2017                            | 140                  | 1408                  | 66                                  | 1400                          | 0.02                                  | MIW4, MIW3, MIW2, MIW1                    |
| Gongguoqiao<br>(GGQ) | 2011                            | 105                  | 1307                  | 42                                  | 900                           | 0.01                                  | GGQ4, GGQ3, GGQ2, GGQ1                    |
| Xiaowan (XW)         | 2009                            | 292                  | 1069                  | 260                                 | 4200                          | 2.36                                  | XW8, XW7, XW6, XW5, XW4,<br>XW3, XW2, XW1 |
| Manwan (MW)          | 1993                            | 132                  | 997                   | 93                                  | 1500                          | 0.78                                  | MW4, MW3, MW2, MW1                        |
| Dachaoshan<br>(DCS)  | 2001                            | 115                  | 833                   | 155                                 | 1350                          | 0.3                                   | DCS5, DCS4, DCS3, DCS2, DCS1              |

**Table.S2** Characteristic  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  ranges of potential organic matter sources in freshwater ecosystems, with general descriptions and representative sources in the middle and lower Lancang River reservoirs.

| Source                        | $\delta^{13}\text{C}$<br>(‰) | $\delta^{15}\text{N}$<br>(‰) | Definition and possible sources in this study                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------|------------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Terrestrial organic matter    | −27.8<br>(±2.0)              | 5.4<br>(±1.5)                | Organic matter derived from the terrestrial environment, mainly supplied by upstream river systems and surrounding catchment areas. Includes recalcitrant riverine organic matter from upstream tributaries, terrestrial vegetation debris, and soils transported from the Tibetan Plateau and adjacent slopes.                                                                                                                                  |
| Autochthonous algae           | −16.0<br>(±2.5)              | 6.0<br>(±1.5)                | Organic matter produced within the aquatic system through primary production. Primarily from phytoplankton and periphyton proliferating in the impounded water, influenced by reservoir hydrodynamics and nutrient availability. Notably, the distinctive enriched $\delta^{13}\text{C}$ signature of this source reflects the influence of heavy DIC pools characteristic of the Lancang River's carbonate-rich lithology.                      |
| Sewage-derived organic matter | −4.5<br>(±2.5)               | 8.5<br>(±2.0)                | Organic matter associated with anthropogenic inputs, typically enriched in both carbon and nitrogen isotopes. It mainly originates from domestic wastewater, C <sub>4</sub> -crop based (e.g., sugarcane and maize) agricultural runoff, and other human-related discharges from surrounding settlements and farmlands, which collectively contribute to the unusually high $\delta^{13}\text{C}$ values observed in certain reservoir sections. |

**Table. S3** Effects of site, sampling season and their interaction on water pH, DO, water nutrients, sediment nutrients and stoichiometric ratio in 25 plots on the Lancang River based on ANOVA. DTC indicates dissolved total carbon content in surface water; DTN indicates dissolved total nitrogen content in surface water; DTP indicates dissolved total phosphorus content in surface water; TC indicates sediment total organic carbon content; TN indicates sediment total nitrogen content; TP indicates sediment phosphorus content. Values are the means and SEs for corresponding replicate plots by each reservoir

| Reservoir        | Water chemical properties |            |            |            | Water nutrients |            |            |            |            |            | Sediment nutrients |            |            |            |            |            | Stoichiometric ratio |            |              |            |
|------------------|---------------------------|------------|------------|------------|-----------------|------------|------------|------------|------------|------------|--------------------|------------|------------|------------|------------|------------|----------------------|------------|--------------|------------|
|                  | pH                        |            | DO         |            | wTC             |            | wTN        |            | wTP        |            | sTC                |            | sTN        |            | sTP        |            | C/N-water            |            | C/N-sediment |            |
|                  | wet season                | dry season | wet season | dry season | wet season      | dry season | wet season | dry season | wet season | dry season | wet season         | dry season | wet season | dry season | wet season | dry season | wet season           | dry season | wet season   | dry season |
|                  |                           |            |            |            |                 |            |            |            |            |            |                    |            |            |            |            |            |                      |            |              |            |
| MIW (n=4)        | 8.33±0.05                 | 7.82±0.74  | 5.55±0.13  | 9.17±0.08  | 11.44±1.49      | 18.21±5.51 | 0.44±0.03  | 0.78±0.04  | 0.04±0     | 0.02±0     | 4.26±0.21          | 4.19±0.14  | 0.27±0.15  | 0.17±0.05  | 0.27±0.01  | 0.17±0.01  | 25.58±1.74           | 24.54±8.19 | 1.75±0.16    | 1.99±0.07  |
| GGQ (n=4)        | 8.36±0.01                 | 8.62±0.07  | 6.03±0.02  | 8.49±0.17  | 12.93±0.31      | 12.41±1.57 | 0.41±0.05  | 0.83±0.07  | 0.06±0.04  | 0.03±0.01  | 3.46±0.32          | 5.01±0.61  | 0.22±0.35  | 0.2±0.12   | 0.22±0.04  | 0.2±0.02   | 33.57±4.96           | 15.02±1.59 | 1.96±0.28    | 2.5±0.29   |
| XW (n=8)         | 9.01±0.07                 | 8.73±0.06  | 6.14±0.21  | 9.43±0.34  | 11.54±1.94      | 11.52±3.75 | 0.65±0.05  | 0.81±0.1   | 0.04±0     | 0.03±0     | 4.74±0.54          | 4.41±0.25  | 0.31±2.96  | 0.19±0.05  | 0.31±0.03  | 0.19±0.01  | 18.45±3              | 17.17±6.5  | 1.3±0.23     | 1.83±0.1   |
| MW (n=4)         | 8.12±0.04                 | 8.47±0.24  | 5.76±0.09  | 8.11±0.13  | 14.76±1.31      | 35.16±0.54 | 0.76±0.1   | 0.78±0.1   | 0.03±0     | 0.03±0     | 2.58±0.52          | 3.83±1.11  | 0.22±0.42  | 0.13±0.06  | 0.22±0.05  | 0.13±0.03  | 20.93±3.39           | 48.34±6.66 | 1.41±0.29    | 2.73±0.79  |
| DCS (n=5)        | 8.48±0.16                 | 8.52±0.15  | 5.71±0.13  | 8.16±0.1   | 19.19±2.35      | 19.86±2.39 | 0.62±0.1   | 1.09±0.08  | 0.06±0.01  | 0.03±0     | 3.43±0.28          | 3.27±0.71  | 0.31±0.56  | 0.16±0.09  | 0.31±0.03  | 0.16±0.02  | 37.13±8.6            | 18.23±1.71 | 0.89±0.09    | 1.45±0.31  |
| ANOVA P-values   |                           |            |            |            |                 |            |            |            |            |            |                    |            |            |            |            |            |                      |            |              |            |
| Reservoir        | 0.017                     | *          | 0.001      | **         | 0.000           | ***        | 0.09       |            | 0.627      |            | 0.08               |            | 0.413      |            | 0.09       |            | 0.08                 |            | 0.023        |            |
| Season           | 0.67                      |            | 0.001      | ***        | 0.08            |            | 0.000      | ***        | 0.018      | *          | 0.43               |            | 0.103      |            | 0.000      | ***        | 0.307                |            | 0.004        | **         |
| Reservoir×Season | 0.414                     |            | 0.04       | *          | 0.01            | **         | 0.13       |            | 0.399      |            | 0.40               |            | 0.678      |            | 0.307      |            | 0.006                | ***        | 0.64         |            |