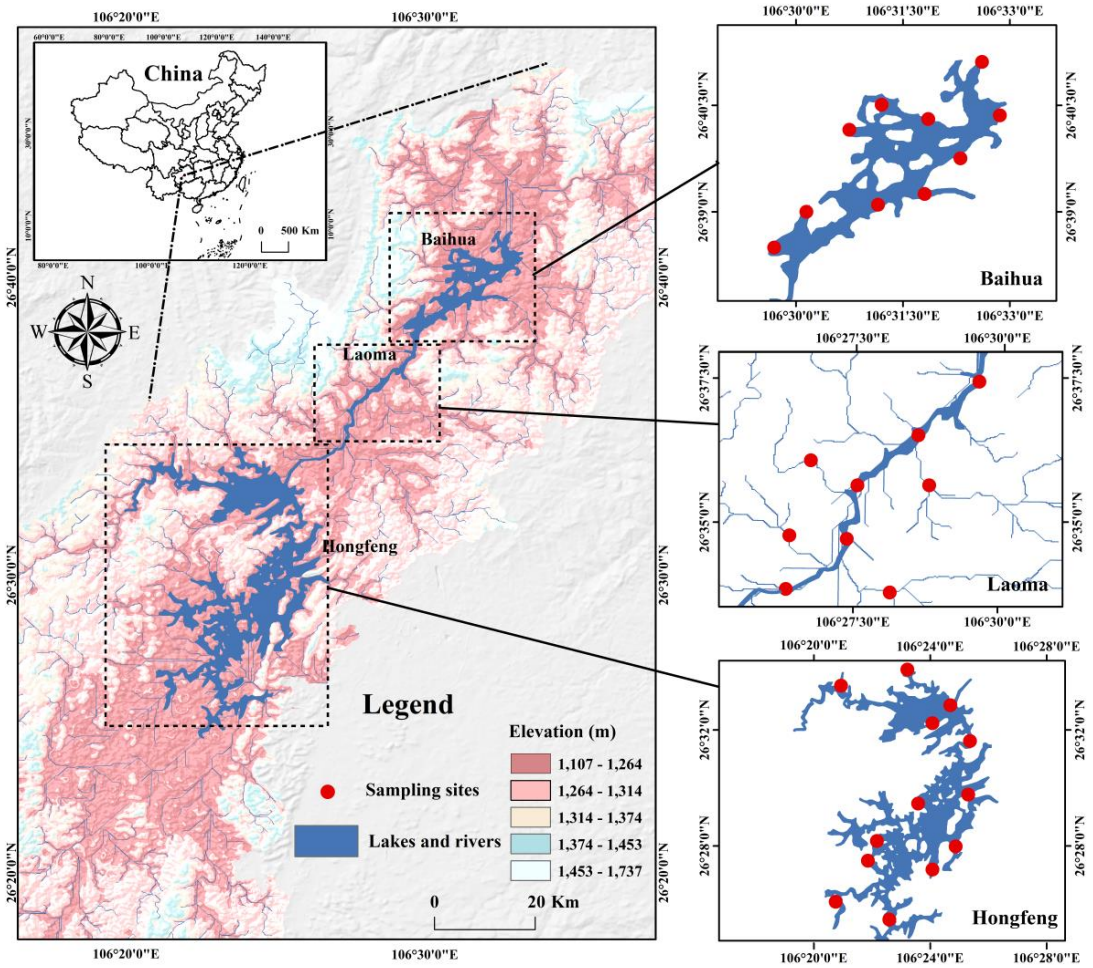

Fig. 1. Map showing DEM information and distribution of sampling locations in the karst lakes.

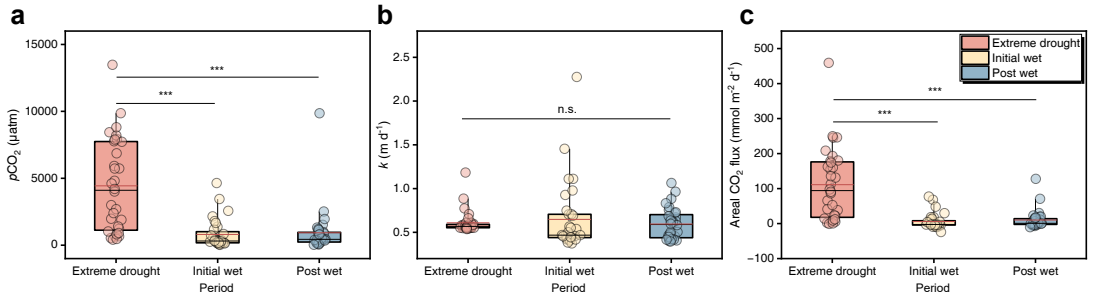

Fig. 2. Temporal patterns of pCO_2 (a), k (b) and areal CO_2 flux (c) across extreme drought, initial wet and post wet periods. The boxes with bars represent 25%–75% percentiles with 5%–95% percentiles. Black lines, white lines and dots show median, mean and all data, respectively. Asterisks indicate statistical significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; while n.s. indicates not significant ($p > 0.05$).

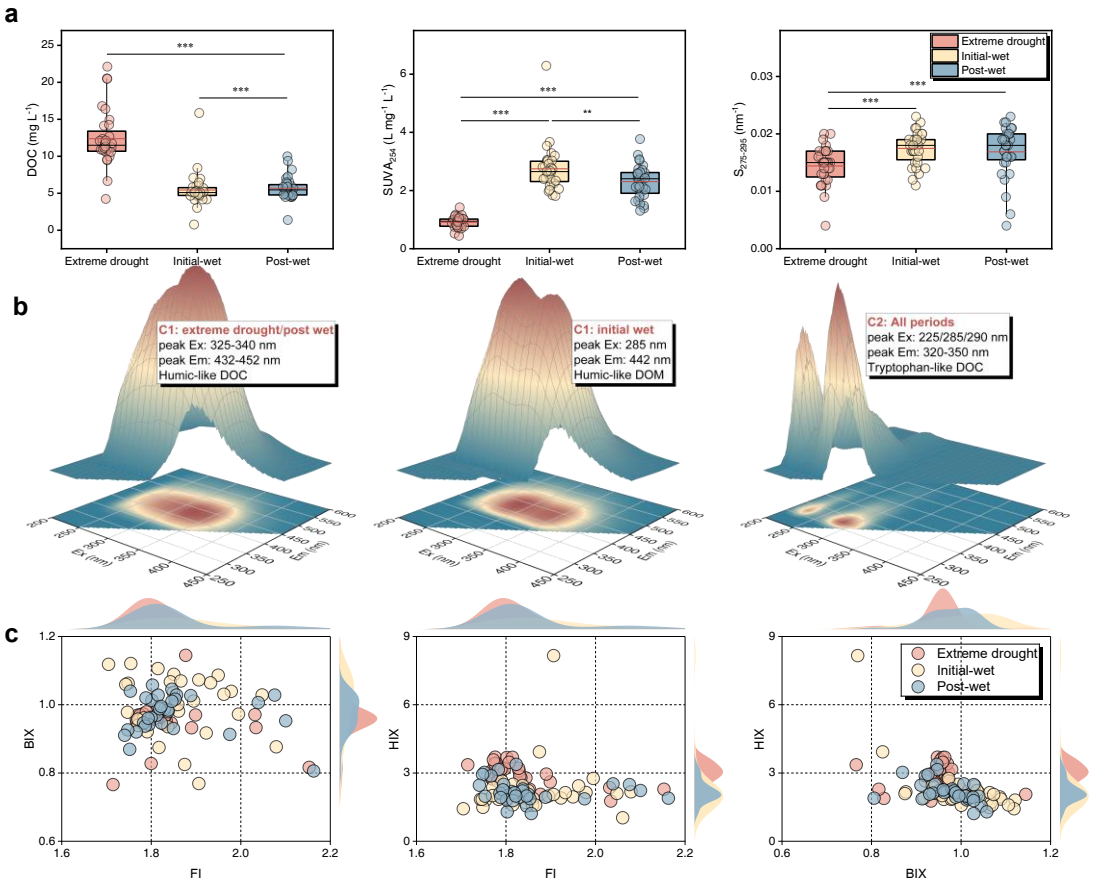

Fig. 3. Spectroscopic characteristics of DOC in the karst lakes. (a) Temporal patterns of DOC, $SUVA_{254}$ and $S_{275\text{-}295}$ over the study periods. Symbols and lines follow the same definitions as in Fig. 2. (b) 3D view of primary DOC fluorophores identified by PARAFAC analysis. (c) Distributions of FI, BIX and HIX over the study periods. Dots correspond to all data of these fluorescent parameters. The waves show Kernel Smooth distributions of the data.

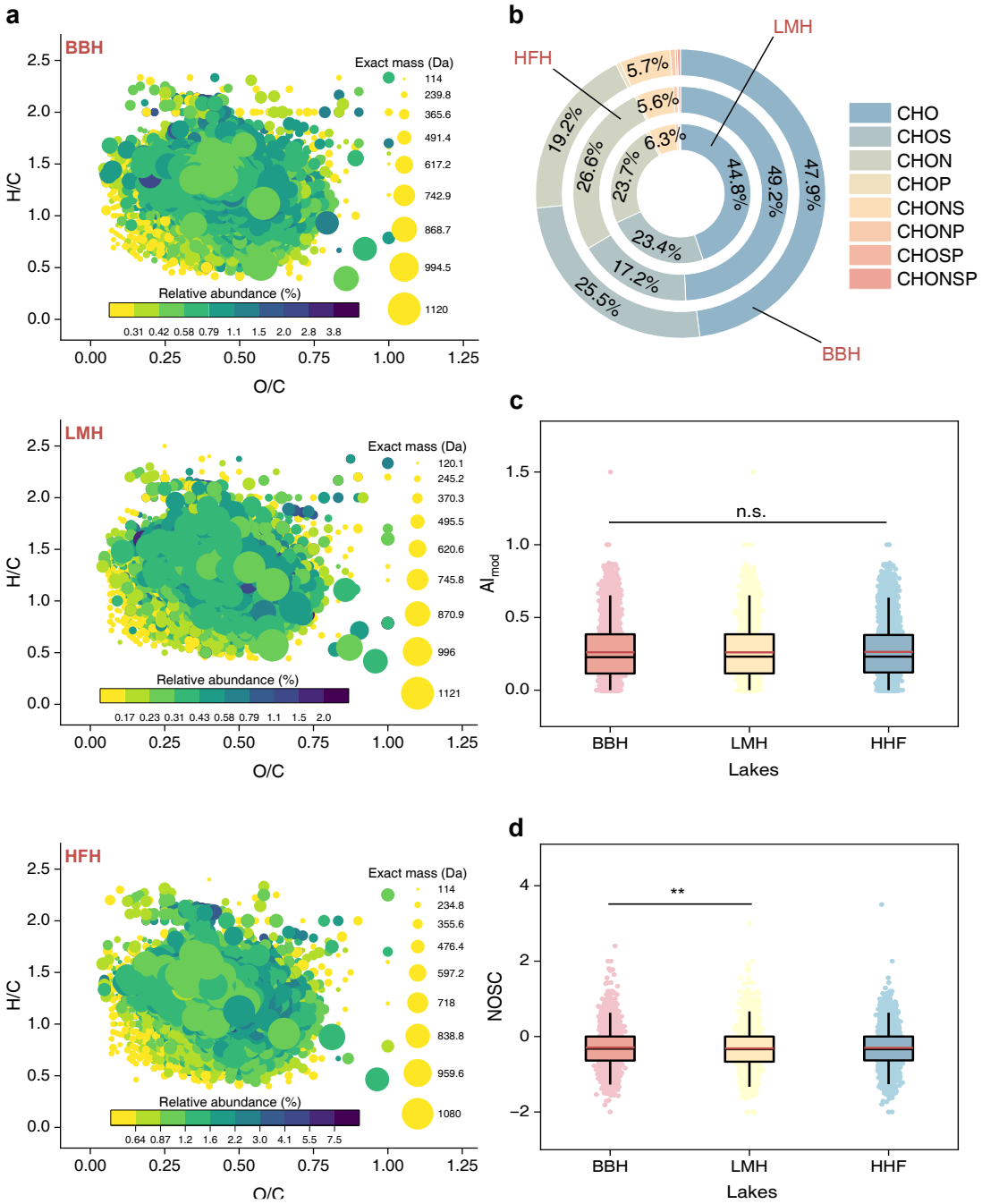

Fig. 4. Molecular characteristics of DOC in the karst lakes. (a) van Krevelen Diagrams plotting H/C against O/C with exact mass information of DOC molecules. (b) Proportions of primary DOC molecular formulas across the lakes. The AI-mod (c) and NOSC (d) across lakes. Symbols and lines follow the same definitions as in Fig. 2.

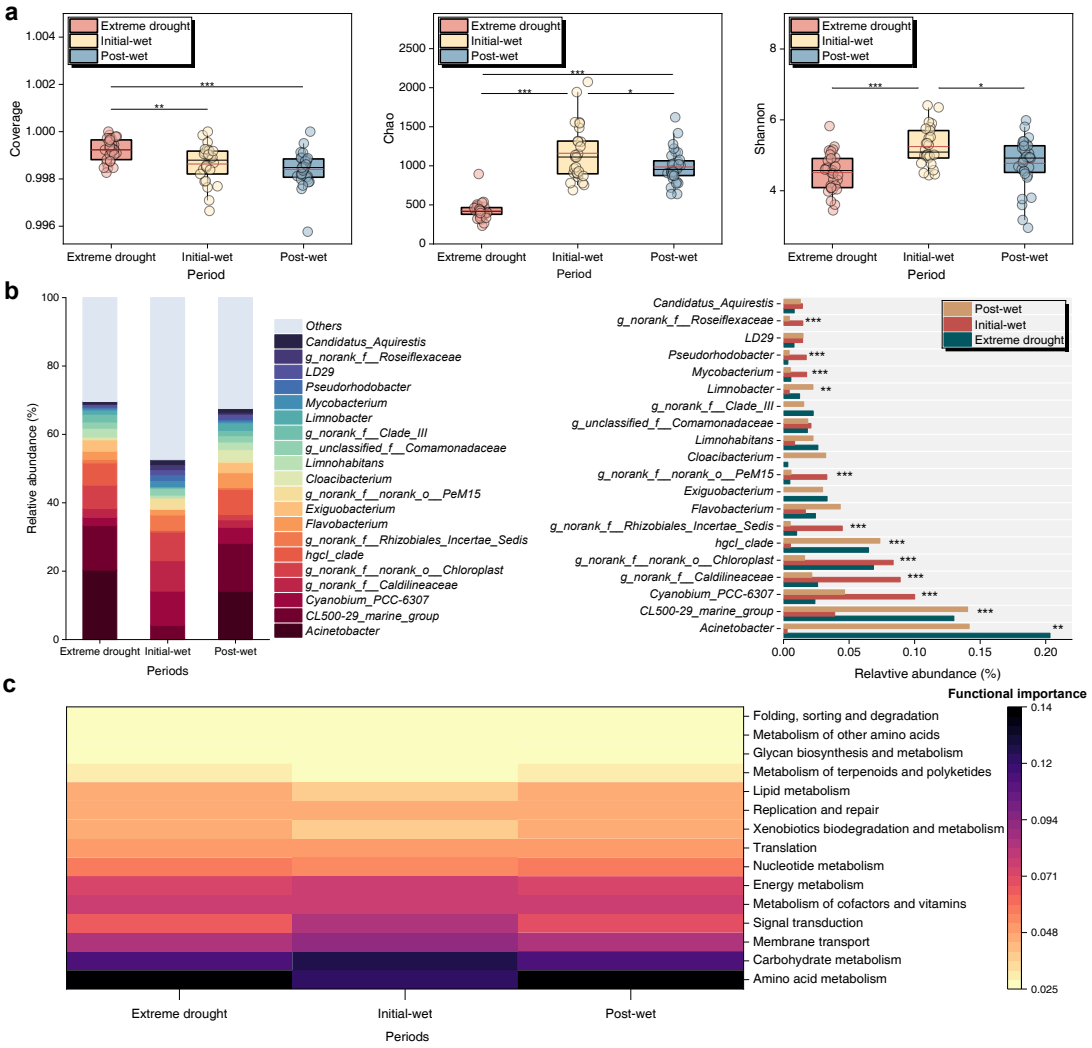

Fig. 5. Temporal variability of microbial communities and functions in the karst lakes. (a) Alpha diversity indices regarding Coverage, Chao and Shannon over the study periods. Symbols and lines follow the same definitions as in Fig. 2. (b) Comparison of the top 20 genera identified by relative abundance. (c) Potential microbial functions predicted by Tax4Fun based on the KEGG database.

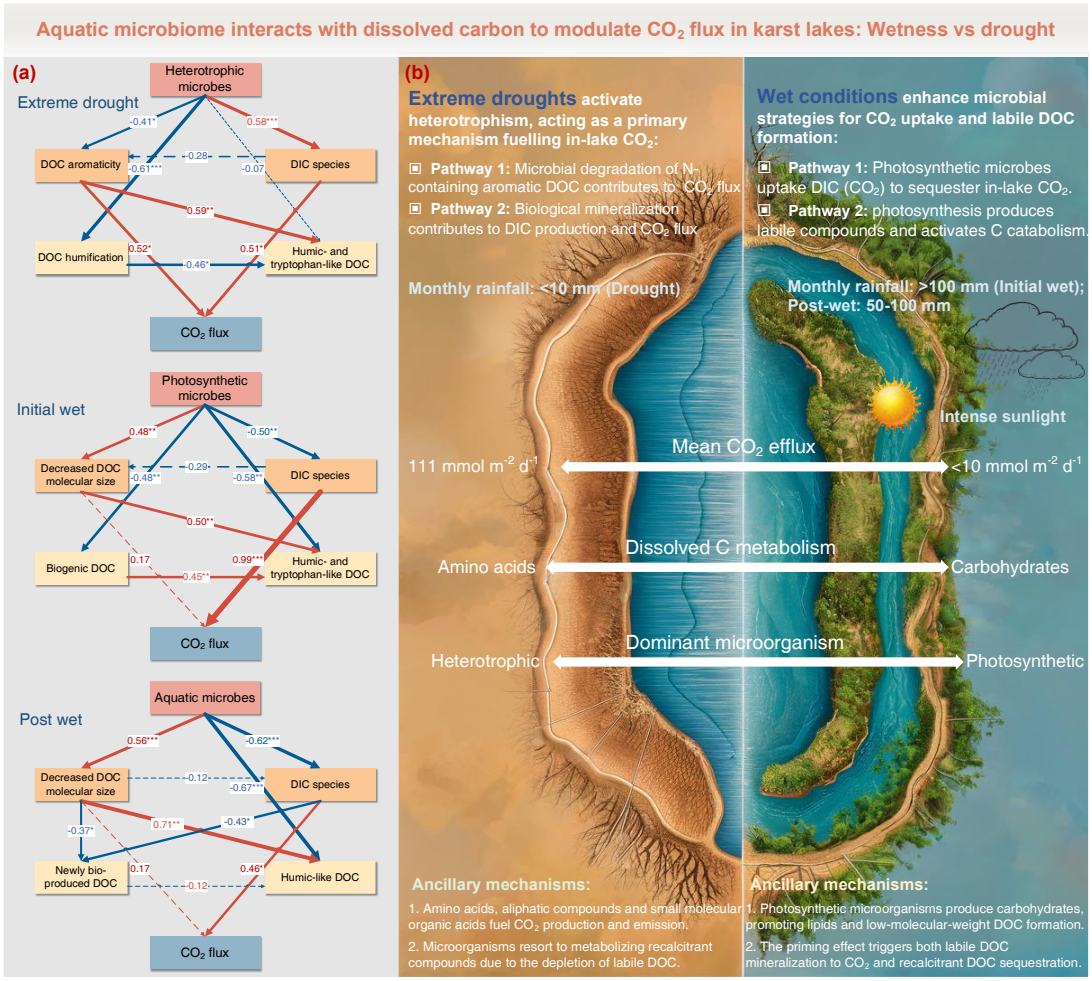

Fig. 6. Temporal pathways of aquatic microbiome-dissolved C interactions involved in CO_2 emission modulation in karst lakes. (a) The structural equation model showing temporal pathways of CO_2 flux driven by microbial communities and DIC-DOC turnover. Red and blue arrows represent positive and negative effects, respectively. Path coefficients are shown along the arrows. (b) A conceptual framework illustrating how microbiome interacts with dissolved carbon to modulate CO_2 emissions.