Supplement of

What can hydrological modelling gain from spatially explicit parameterization and multi-gauge calibration?

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Table S1. Performance comparison of Cases 3, 2, and 4 during the validation period, with runoff generation parameters held constant as in Case 4. Performance is quantified by the KGE metrics, with the best value for each sub-basin shown in bold.

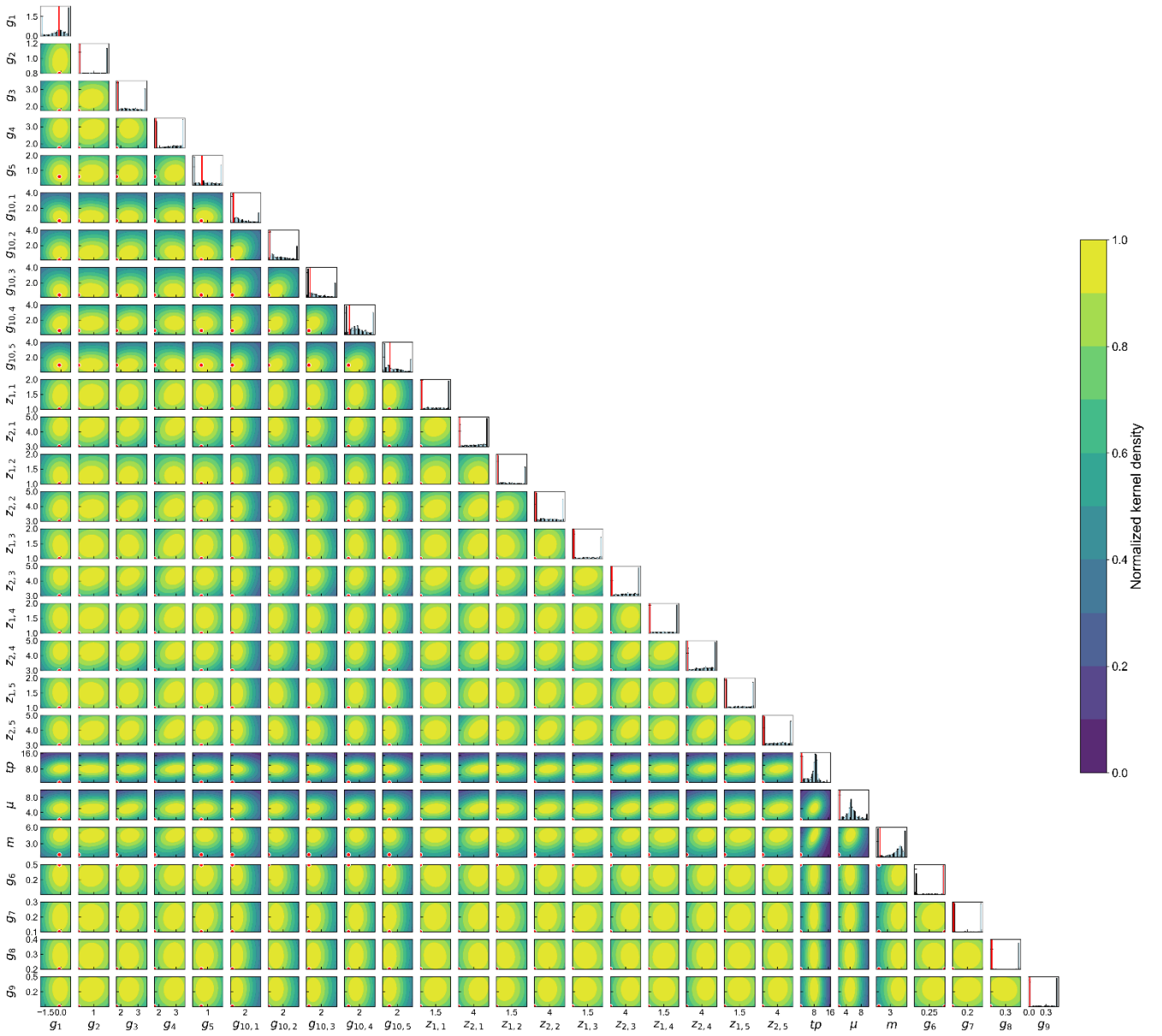|	Hanzhong	Yangxian	Youshui	Lianghekou	Shiquan
Case 3	0.494	0.632	0.376	0.589	0.672
Case 2	0.492	0.630	0.372	0.582	0.670
Case 4	**0.521**	**0.637**	**0.446**	**0.730**	**0.689**

Figure S1. Post-calibration parameter distributions for Case 8. The optimal parameters are shown as red dots and lines. The background contours represent the standardized kernel density estimate derived from all candidate solutions, where yellow shading corresponds to high probability density regions. The histograms along the diagonal represent the marginal distribution of each individual parameter.
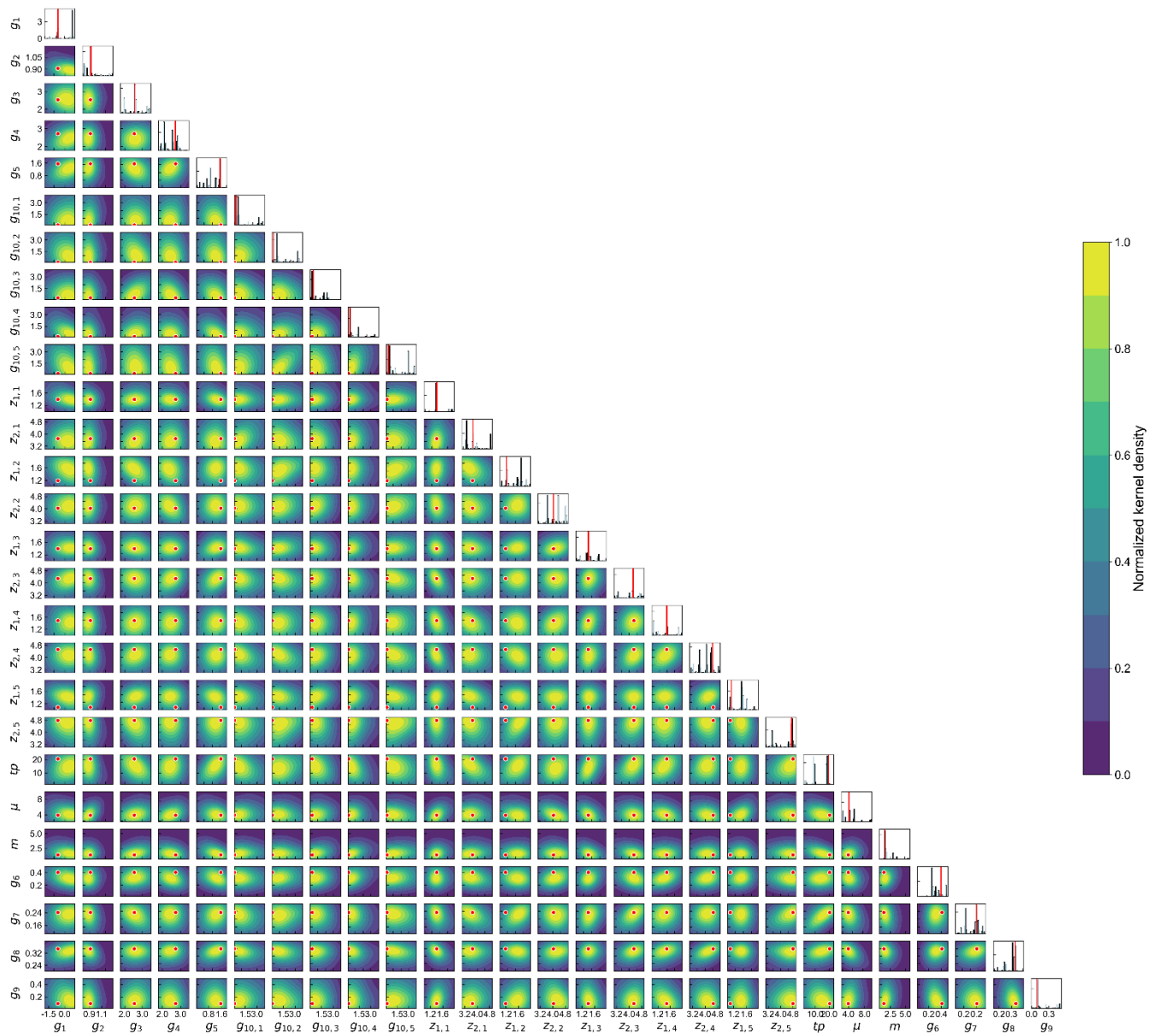
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Figure S2. Post-calibration parameter distributions for Case 5, following the same visualization conventions as Fig. S1. While the overall structure is similar, Case 1 exhibits more concentrated posterior distributions and different optimal values.
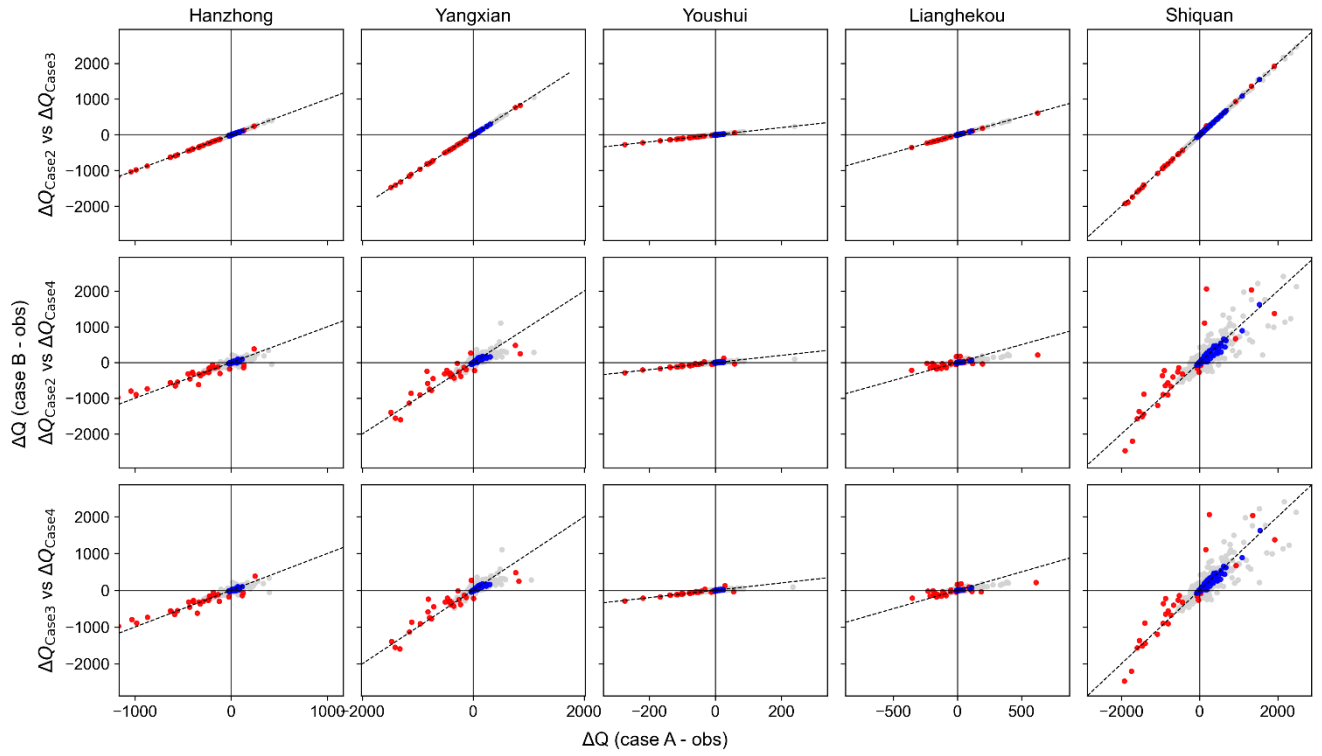
Figure S3. Scatter plots of simulated residuals (ΔQ) for Cases 3, 2, and 4 during the validation period, using the runoff generation parameters from Case 4. Red and blue dots represent high flows (exceedance probability < 2%) and low flows (exceedance probability > 70%), respectively. The dashed line indicates the 1:1 line.