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Spatial heterogeneity and scale-dependent relationships between biodiversity and ecosystem services

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The complex links of the biodiversity-ecosystem services are increasingly being recognized by the researchers and policy makers. In practice, it is necessary to answer some such scientific questions, for example, whether areas high in biodiversity coincided with areas delivering a high level of ecosystem services, and how did the multiple relationships including positive or negative and strong or weak associations vary with spatial scale and region? To identify the scale-dependent and location-specific associations between the biodiversity and ecosystem services, we first simulated the three types of ecosystem services including sediment retention, vegetation water retention, and vegetation carbon storage, and used habitat quality index as a proxy for biodiversity. After that, a GIS-based geographically weighted regression (GWR) model, in which biodiversity was dependent variable, and ecosystem services were explanatory variables, was employed to explore how these associations are sensitive to the variation of spatial scales and regional differentiation across the study area. Our study results revealed a mixture of negative and positive relationships between the biodiversity and four types of ecosystem services, and these associations showed the significant scale-dependence and spatial heterogeneity. In other words, the interaction process of the habitat quality index with different ecosystem services may operate at different spatial scales. Moreover, the positive or negative and strong or weak features indicated by sign and magnitude of coefficient estimates of GWR among these multiple relationships presented regional differentiation, suggesting tradeoff or synergy relationship has location-specific characteristics. In policy context, our research results underscored the importance of spatial heterogonous policies of ecosystem service management and biodiversity conservation, so as to incorporating the location situation and broader-scale priories.