

Land use and land cover change impact on the actual evapotranspiration in China

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Abstract: Evapotranspiration (ET) is a key variable in both the global carbon and water cycles, and its response to land use and land cover change (LUCC) remains a critical issue for climate modeling and sustainable water resource management. Existing studies have largely focused on the combined impacts of vegetation parameters—such as leaf area index (LAI), land cover type, reflectance, and emissivity—on ET, while the independent contributions of individual vegetation structural and physiological parameters have received limited attention. In this study, we employed a scenario-controlled experiment using the coupled carbon–water process model PML-V2 to disentangle and quantify the effects of different vegetation parameters on interannual ET variability across China from 2001 to 2020. Results demonstrate that PML-V2 effectively captures the independent driving effects of vegetation parameters on ET dynamics. Among these, LAI emerged as the dominant biophysical driver, increasing ET at a national average rate of 0.68 mm yr⁻¹, whereas land cover type changes exerted a minor negative effect (-0.04 mm yr⁻¹). Spatially, LAI-driven increases in ET were pronounced in northern China but slightly declined in the south. Other vegetation parameters exhibited negligible effects. In terms of contributions to ET variability, LAI explained the largest fraction (36%), followed by climate forcing (35%) and atmospheric CO₂ concentration (26%). These findings underscore the importance of accounting for the differentiated roles of vegetation parameters in future LUCC and ecological restoration strategies, particularly in water-limited northern China, to achieve a balance between ecological restoration and long-term water sustainability.