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Land use and cover changes related to green and blue infrastructure planning for water resources management based on a Budyko framework

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Based on the interplays between land use and water resources, the green and blue infrastructure (GBI) is a central landscape approach for hydrological environment management. However, evidence-based principles of regional GBI planning are not well developed. The Budyko framework is widely used to explore water balance in land-use change studies. It provides a method to relate land use changes and streamflow variations based on two indices – the evaporative index (EI) and the dryness index (DI). Using the Dongjiang River Basin (DJ) as an example, we use the Geographically Weighted Principal Components Analysis (GWPCA) with adaptive kernels to classify the dominant land types based on local spatial variances. Then, we apply the Emerging Hot Spots Analysis (EHSA) to identify spatial-temporal hotspots of EI and DI for the Budyko analysis. From the EHSA, two wet years (1998 and 2016) and three dry years (2004, 2009, and 2018) are focused to investigate how land uses are related to water resources in different climatic conditions. On both catchment and hotspot scales, movements within the Budyko space are observed. These movements illustrate the associations between land use and hydrological response. These data-driven relationships can be used to explain the underlying mechanism of catchment forms (land surface property) and functions (evapotranspiration and runoff) for setting best practices for land use planning. Specifically, our results show that planners should consider to 1) reduce the area of croplands and trees, while increase the extent of grassland and water body on a catchment scale; and 2) increase rain fed croplands, broadleaved evergreen trees, and grasslands in the upstream catchment. Overall, this study highlights the scale considerations in land use planning, and land use strategies are developed based on reanalysis data and remote sensing products for catchment water resources management.