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Influence of lateral groundwater flow in a shallow aquifer on eco-hydrological process in a shrub-grass coexistence semiarid area

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Topography has a considerable influence on eco-hydrological processes resulting from the patterns of solar radiation distribution and lateral water flow. However, not much quantitative information on the contribution of lateral groundwater flow on ecological processes such as vegetation growth and evapo-transpiration is available. To fill this gap, we used a simple eco-hydrological model based on water balance with a 3D groundwater module that uses Darcy's law. This model was applied to a non-contributing area of 50km2 dominated by grassland and shrubland with an underlying shallow aquifer. It was calibrated using manually and remotely sensed vegetation data and water flux data observed by eddy covariance system of two flux towers as well as water table data obtained from HOBO recorders of 40 wells. The results demonstrate that the maximum hydraulic gradient and the maximum flux of lateral groundwater flow reached to 0.156m m-1 and 0.093m3 s-1 respectively. The average annual maximum LAI in grassland, predominantly in low-lying areas, improved by about 5.9% while that in shrubland, predominantly in high-lying areas, remained the same when lateral groundwater flow is considered adequately compared to the case without considering lateral groundwater flow. They also show that LAI is positively and nonlinearly related to evapotranspiration, and that the greater the magnitude of evapotranspiration, the smaller the rate of increase of LAI. The results suggest that lateral groundwater flow should not be neglected when simulating eco-hydrological process in areas with a shallow aquifer.