Assessment of Surface Exchange Coefficients in the Noah-MP Land Surface Model for Different Land Cover Types over China

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The parameterization of surface exchange coefficients ($C_h$) representing land-atmosphere coupling strength plays a key role in land surface modeling. Previous studies have found that land-atmosphere coupling in land surface models (LSMs) is overestimated, which affects the predictability of weather and climate evolution. To improve the representation of land-atmosphere interactions in LSMs, this study investigated the dynamic canopy-height-dependent coupling strength in the offline Noah LSM with multiparameterization options (Noah-MP) when applied to China. Comparison with the default Noah-MP LSM showed the dynamic scheme significantly improved the $C_h$ calculations and realistically reduced the biases of simulated surface energy and water components against observations. It is noteworthy that the improvements brought by the dynamic scheme differed across land cover types. The scheme was found superior in reproducing the observed $C_h$ as well as surface energy and water variables for short vegetation (grass, crop, and shrub), while the improvement for tall canopy (forest) was found not significant, although the estimations were reasonable. The improved version benefits from the treatment of the roughness length for heat. Overall, the dynamic coupling scheme markedly affects the simulation of land-atmosphere interactions, and altering the dynamics of surface coupling has potential for improving the representation of land-atmosphere interactions and thus furthering LSM development.