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A modified MOD16 algorithm to estimate soil evaporation and vegetation transpiration in urban garden area

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Accurately estimate and map soil evaporation (E) and vegetation transpiration (T) in urban woodland areas is great significance for precision irrigation, urban water resource allocation and management. However, customized dual-source models based on satellite imagery are lacking. This research, for the first time, developed a dual source approach to predict E and T in urban garden area. The method is improved from MOD16 algorithm, we advanced the MOD16 in following aspects: 1, an enhanced net radiant flux (R_n) and soil heat flux (G) calculation method is proposed; 2, The determination of vegetation canopy impedance couples into the impact of carbon dioxide emissions; 3, A physical mechanism-based β estimation method is proposed, to replace the empirical values in original model. Our model was test in 40 cloudless days based on 10 m Sentinel-2 imagery in Guiwan Garden area in Shenzhen city, southern of China. The Shuttleworth-Wallace, FAO-dual-K_c and Priestley-Taylor model were used to evaluate model performance, results suggest the modified MOD16 model successful produce and partition ET in city garden area, and outperformed than pervious MOD16 algorithm. The spatial distribution pattern demonstrate that E and T present obvious seasonal changes, with the range of 23-150 W/m² for E and 31-186 W/m² for T, proven the large amount water was lost through ET in urban garden area. Sensitivity analysis results show that the improved MOD16 model is more sensitive to vegetation index products and solar radiation, need to prioritize the accurate input of these two types of parameters. The modified MOD16 model significantly facilitate the accuracy of ET simulation in high-resolution, small-scale areas, provides a powerful tool to quantify the E and T in urban areas, and assessing the impact of climate change on the urban hydrological cycle.