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A roughness height parameterization method for different canopy structures

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Estimating the sensible heat flux (H) over vegetation from thermal infrared temperature requires an estimate of the excess resistance kB^{-1} (where k is von Karman constant and kB^{-1} is the inverse Stanton number), the difference in turbulent transfer efficiency between momentum and scalars. kB^{-1} has been the subject of considerable interest in micrometeorology, land surface model, and surface turbulent fluxes simulations, but there still does not exist a uniform method for use in remote sensing retrieval of land surface flux. This study is motivated by the application of one-dimensional turbulent diffusion methods to describe canopy-atmosphere interaction with remote sensing global land surface variables. Firstly, the uncertainties of the estimated sensible heat flux due to kB^{-1} parameterization for 7 different land covers (including needle forest, broadleaf forest, shrub, savanna, grassland, cropland, and sparsely vegetated land) were examined. We then tested and verified the performance of the kB^{-1} scheme in Su 2002 (in short Su02) by comparing H estimated by Su02 and H measured at 28 flux tower stations. Large differences in the accuracy of the simulated H are found for the seven land covers. The model predictions of H for grass, crop and sparsely vegetated land compare favorably with observed values. H is significantly underestimated at forest sites (whether needle or broadleaf) due to its higher kB^{-1} estimate for the canopy part. Several solutions and new method were innovated to eliminate the lower estimation. An effective leaf drag coefficient, effective leaf heat transfer coefficients, foliage shelter factor and new within-canopy momentum model was used to reduce underestimates of turbulent heat flux for high canopy because the sheltering effects and variable drag coefficients are not included in Su02 kB^{-1} scheme. In near future, the new canopy-atmosphere turbulent transfer model in combination of remote sensing data will be used to generate heat flux maps over the global land.