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Impact of urban canopy models and external parameters on the modelled urban energy balance in a tropical city

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This paper provides the first comparative evaluation of four urban land surface models for a tropical residential neighbourhood in Singapore. The simulations are performed offline, for an 11-month period, using the bulk scheme TERRA_URB and three models of intermediate complexity (CLM, SURFEX and SUEWS). In addition, information from three different parameter lists are added to quantify the impact (interaction) of (between) external parameter settings and model formulations on the modelled urban energy balance components. Overall, the models' performance using the reference parameters aligns well with previous findings for mid- and high-latitude sites against (for) which the models are generally optimised (evaluated). The various combinations of models and different parameter values suggest that error statistics tend to be more dominated by the choice of the latter than the choice of model. Stratifying the observation period into dry / wet periods and hours since selected precipitation events reveals that the models' skill generally deteriorates during dry periods while e.g. CLM/SURFEX has a positive bias in the latent heat flux directly after a precipitation event. It is shown that the latter is due to simple representation of water intercepted on the impervious surfaces. In addition, the positive bias in modelled outgoing longwave radiation is attributed to neglecting the interactions between water vapor and radiation between the surface and the tower sensor. These findings suggest that future developments in urban climate research should continue the integration of more physically-based processes in urban canopy models, ensure the consistency between the observed and modelled atmospheric properties and focus on the correct representation of urban morphology and thermal and radiative characteristics.