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Development of Rice Paddy Model Based on Noah LSM: Consistent Parameterization of Subcanopy Resistance from the Ponded Water to Dense Rice Canopy

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We developed a rice paddy model based on the Noah LSM considering the standing water layer during the irrigation period. In the model, we adopted a consistent subcanopy process from thin to thick canopy conditions and considered small scalar roughness length of water surface in rice paddy field. We evaluated the model's performance against observations from three rice paddy sites with different leaf area index (LAI) and water depths during the growing season. Two simulations were performed in an offline mode: the fixed irrigation simulation of Noah LSM with saturation moisture in the top two soil layers during the irrigation period (IRRI) and the developed model simulation (RICE). The evaluation results showed that RICE outperformed IRRI in the simulating ground, sensible (H) and latent heat (LH) fluxes and topsoil temperature (T_{soil}) on hourly and diurnal time scales. Two sensitivity tests of RICE were performed in relation to the subcanopy resistance and standing water layer: RICE without consideration of small roughness length of water surface during the irritation period (BARE) and RICE with a constant standing water depth (FIX). The sensitivity tests showed that BARE calculated very low subcanopy resistance values when the sum of LAI and stem area index was less than 2 m^2 m^{-2}, which resulted in cold biases in the daily mean T_g and T_{soil} and also led to overestimation of daily mean LH. There was no significant difference in RICE and FIX with hourly and seasonal time scale statistics, suggesting that H, LH, T_g and T_{soil} of the developed model are not sensitive to changes in water depth. The structure of the developed model was also discussed.