The Response of Precipitation to Initial Soil Moisture over the Tibetan Plateau: Respective Effects of Boundary Layer Vertical Heat and Vapor Diffusions

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This study investigates the influences of initial soil moisture over the Tibetan Plateau (TP) on precipitation simulation, and the respective effects of boundary layer vertical diffusion for heat (K_h) and vapor (K_q). Results indicate that the responses of boundary layer vertical diffusion to soil moisture are obvious mainly in the daytime. Wetter land surface corresponds to weaker vertical diffusion, which could strengthen thermal forcing and dynamic lifting in the lower atmosphere, and encourage water vapor saturation near the top of boundary layer to prevent the environmental dry air entrainment/invasion, these would be beneficial to more convection and precipitation. Wetter land surface over the TP could enhance the contrast between the cold in the northwestern TP and the warm in the southeastern TP, which would be conducive to the southeastward propagation of precipitation.

The simulation of heat and moisture in the boundary layer could be improved by perturbing the relative intensity of K_h and K_q. From the perspective of heat and moisture, K_h affects atmospheric stability, while K_q affects moisture and its vertical transport in the boundary layer. The K_h and K_q have competitive effects on precipitation intensity by influencing relative importance of moisture and atmospheric stability conditions in the boundary layer. Adjusting the relative intensity of K_h and K_q would deactivate the competitive effects. Stronger K_h but weaker K_q would alleviate the overestimated precipitation by inhibiting vertical transport of moisture to the top of boundary layer and attenuating convective instability in the boundary layer.