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Influence of the land-atmosphere coupling on cloud development and precipitation over Southeastern Brazil

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The processes of interaction between the land surface and the atmosphere may play an important role in mesoscale convection and precipitation. Numerical weather and climate prediction models still do not correctly represent surface-to-atmosphere changes. The objective of this study is to investigate the influence of the land surface-to-atmosphere coupling on cloud development and convective precipitation over the Southeast region of Brazil. The effects of the land-atmosphere coupling are analyzed through simulations with the Eta regional model in very high spatial resolution (1 km), using the NOAH surface scheme. Different values were tested for the Zilitinkevich coefficient (Czil) which partitions the heat/moisture and momentum roughness lengths and indirectly determine the coupling force between the land surface and the atmosphere. The results showed that improvements in the precipitation simulation can be obtained by changing the value of the surface-to-atmosphere exchange coefficient. Changes in parameter values impact partitioning of surface flows resulting in changes in atmospheric fields near the surface. We have found that in general the increase in Czil leads to a decrease in latent and sensitive heat fluxes and, consequently, causes an increase in surface temperature. A decrease in surface temperature was observed in tropical forest areas when the value of the Czil coefficient was dynamically varied as a function of the height of the vegetation. The substitution of the default value (0.2) for the value of 0.8 and values that vary dynamically due to the roughness of the vegetation cover showed the best results in the simulation of the precipitation event. These values decreased precipitation overestimates and increased their amount in regions where it was underestimated. Improvements in the simulation of surface fluxes and in the atmospheric field were obtained by adopting the dynamic coupling coefficient. The tests need to be analyzed for other regions. The results support the use of a dynamic coupling formulation, but caution about complex terrain should be taken. Overall, these results point out that the evaluation and enhancement of the land-to-atmosphere coupling could potentially improve the performance of the model in simulation of convective clouds and precipitation.