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Simulation of a heavy rainfall-induced landslide event over Kulonprogo, Yogyakarta in Indonesia using WRF: Sensitivity to cloud microphysics parameterization

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In this study, we used the Weather Research and Forecasting (WRF) version 4.2.1 model to simulate the characteristics of a rainfall-induced landslide that occurred on November 28 in Samigaluh, Kulonprogo. In addition, we investigated 22 different microphysics (MP) schemes to see how sensitive they were. The WRF model was employed with three nested domains, the innermost of which had a 1 km grid spacing and explicit convection. The model was run for 73 hours with GFS initial conditions from 00:00 UTC on November 26, 2018. We used reflectivity profiles from the Weather Radar in Yogyakarta and data from rain gauge stations in Kulonprogo to validate the simulated properties of the rainfall. Despite employing identical initial and boundary conditions and model settings, the MP approaches have significant variances in their thunderstorm simulations. To begin with, practically all of the extreme convection simulation methods over Samigaluh had the same pattern as the reported storm. For example, on November 27, radar data indicated the passage of three convective cores above Samigaluh, which the model in most MP schemes simulated. In comparison, the Ferrier_old scheme did an excellent job of simulating the convective cores' observable features. The MP schemes also had difficulties modeling the storm's updrafts. The Ferrier old scheme simulated surface rainfall distributions closer to data than the other three schemes (Goddard GCE, Morrison2, and WDM5). On the other hand, all four MP systems did an excellent job of simulating the convective variations associated with the thunderstorm. The model's generated reflectivity profiles, which showed three convective cores, were similar to the observed reflectivity profile. These characteristics match the simulated convective profiles, which peaked between 10 and 15 kilometers. The current research reveals that the microphysical systems in thunderstorm simulations have a lot of sensitivity and variability. The study also underlines the necessity for a multi-observational program such as Year of Maritime Continent (YMC) to improve the parameterization of cloud microphysics and land surface processes throughout the Indonesian region.