Impact of sub-grid variability of precipitation and canopy water storage on hydrological processes in a coupled land-atmosphere model

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The impact of sub-grid variability of precipitation and water storage canopy is investigated by applying a new canopy interception scheme into the Community Atmosphere Model version 3 (CAM3) coupled with the Community Land Model version 3 (CLM3). Including such sub-grid variability alters the partitioning of net radiation between sensible heat flux and latent heat flux on land surface, which leads to change in precipitation through various pathways/mechanisms. The areas with most substantial changes are Amazonia and tropical Africa where convective rain is dominant and vegetation is very dense. In these areas, precipitation during December-January-February is increased by up to 2 mm/day. The enhanced large-scale circulation and atmospheric stability by including the sub-grid variability contribute to the increased precipitation. The cloud feedback plays an important role in modifying the large-scale circulation and atmospheric instability. Turning off the cloud feedback mitigates the changes in surface convergence and boundary layer height caused by inclusion of sub-grid variability of precipitation and water storage canopy, which reduces the difference in precipitation between the simulation with such sub-grid variability and the one without.