# ABSTRACT

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## TITLE: Correction of Excessive Precipitation over Steep Mountains in a General Circulation Model (GCM)

Excessive precipitation over steep and high mountains (EPSM) is a well-known problem in GCMs and regional climate models even at a resolution as high as 10km. The affected regions include the Andes, the Himalayas, Sierra Madre, New Guinea and others. This problem also shows up in some data assimilation products. Among the possible causes investigated in this study, we found that the most important one, by far, is a missing upward transport of heat out of the boundary layer due to the vertical circulations forced by the daytime subgrid-scale upslope winds, which in turn is forced by heated boundary layer on the slopes. These upslope winds are associated with large subgrid-scale topographic variance, which is found over steep mountains. Without such subgrid-scale heat ventilation, the resolvable-scale upslope flow in the boundary layer generated by surface sensible heat flux along the mountain slopes is excessive. Such an excessive resolvable-scale upslope flow in the boundary layer combined with the high moisture content in the boundary layer results in excessive moisture transport toward mountaintops, which in turn gives rise to excessive precipitation over the affected regions.

We have parameterized the effects of subgrid-scale heated-slope-induced vertical circulation (SHVC) by removing heat from the boundary layer and depositing it in the layers higher up when topographic variance exceeds a critical value. Test results using NASA/Goddard's GEOS-5 GCM have shown that the EPSM problem is largely solved.