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Modeling of land surface-atmosphere exchanges of energy and evapotranspiration for the páramo highlands of southern Ecuador

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The study of land surface-atmosphere flux exchanges for mountainous regions has increased in the last decade. However, the prediction of water losses and energy fluxes in natural and disturbed environments of highland biomes is still unexplored. This is the case of the Neotropical Andean biome of the páramo, where this lack of research is noticeable for energy fluxes (net radiation; sensible, latent and soil heat) and actual evapotranspiration (ETa). The present investigation assessed the parameterization of a state-of-art Land-Surface Model (LSM) for the prediction of energy and ETa fluxes in representative páramo catchments of southern Ecuador. The LSM Community Land Model (CLM ver. 4.0) outputs were evaluated with (i) surface-level fluxes from the highest Eddy Covariance tower of the Northern Andean páramo Ecoregion, with complementary micrometeorological sensors; (ii) with remote sensing-derived ETa from an energy balance-based model (METRIC with Landsat imagery); (iii) and with ETa obtained from the closure of water balances of the catchments (WB). The CLM's energy estimates exhibited a clear underestimation on net radiation, sensible and soil heat fluxes, and showed a small overestimation on latent heat flux. On the other hand CLM derived ETa exposed a good correlation (Pearson R = 0.82) comparable to METRIC derived ETa (R = 0.83). However, a poor performance of WB derived ETa was observed (R = 0.46). Our findings highlight the CLM's plausibility for forecasting energy and ETa exchanges for this remote and fragile tropical biome, and provide insights on the ETa methods selection. This study contributes to the ecosystem functioning knowledge regarding the point and spatial-scale water losses through evaporative processes. Finally, it also provides support on the development of further LSM parameterizations for climate / land use change scenarios in this sensitive highland region.