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Atmosphere-surface fluxes modeling for the high Andes: The case of páramo catchments of Ecuador

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Highlights

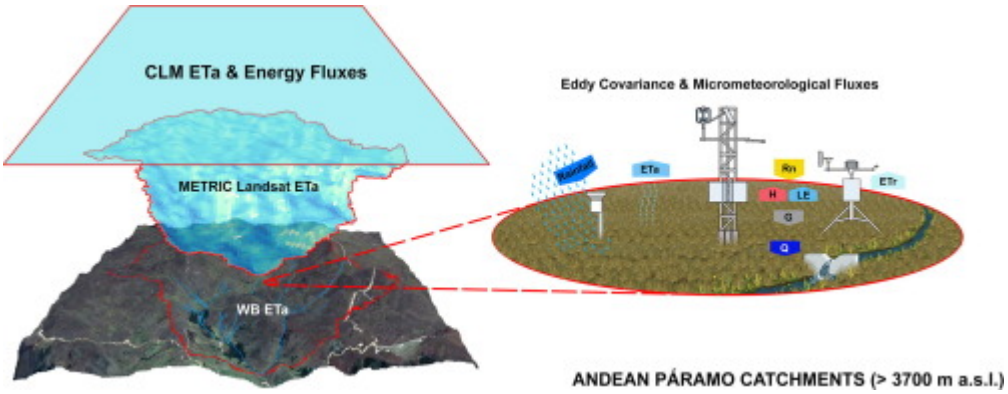
- Site-specific parameterization of the Community Land Model for páramo catchments.
- The CLM was evaluated with remote sensing, water balance and eddy covariance methods.
- This land-surface model proven useful for the prediction of actual evapotranspiration.

Abstract

Interest in atmosphere-surface flux modeling over the mountainous regions of the globe has increased recently, with a major focus on the prediction of water, carbon and other functional indicators in natural and disturbed conditions. However, less research has been centered on

exploring energy fluxes (net radiation; sensible, latent and soil heat) and actual evapotranspiration (ETa) over the Neotropical Andean biome of the páramo. The present study assesses the implementation and parameterization of a state-of-art Land-Surface Model (LSM) for simulation of these fluxes over two representative páramo catchments of southern Ecuador. We evaluated the outputs of the LSM Community Land Model (CLM ver. 4.0) with (i) ground-level flux observations from the first (and highest) Eddy Covariance (EC) tower of the Northern Andean páramos; (ii) spatial ETa estimates from the energy balance-based model METRIC (based on Landsat imagery); and (iii) derived ETa from the closure of the water balance (WB). CLM's energy predictions revealed a significant underestimation on net radiation, which impacts the sensible and soil heat fluxes (underestimation), and delivers a slight overestimation on latent heat flux. Modeled CLM ETa showed acceptable goodness-of-fit (Pearson R = 0.82) comparable to ETa from METRIC (R = 0.83). Contrarily, a poor performance of ETa WB was observed (R = 0.46). These findings provide solid evidence on the CLM's accuracy for the ETa modeling, and give insights in the selection of other ETa methods. The study contributes to a better understanding of ecosystem functioning in terms of water loss through evaporative processes, and might help in the development of future LSMs' implementations focused on climate / land use change scenarios for the páramo.

Graphical abstract



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Keywords

Tropical Andes; Páramo; CLM; METRIC; Evapotranspiration; Eddy covariance

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