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Impact of land surface processes on the South American warm season climate

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The present study demonstrates that (1) the simulation of the South American warm season (December-February) climate by an atmospheric general circulation model (AGCM) is sensitive to the representation of land surface processes, (2) the sensitivity is not confined to the "hot spot" in Amazonia, and (3) upgrading the representation of those processes can produce a significant improvement in AGCM performance. The reasons for sensitivity and higher success are investigated based on comparisons between observational datasets and simulations by the AGCM coupled to either a simple land scheme that specifies soil moisture availability or to the Simplified Simple Biosphere Model (SSiB) that allows for consideration of soil and vegetation biophysical process. The context for the study is the UCLA AGCM. The most notable simulation improvements are along the lee of the Andes in the lower troposphere, where poleward flow transports abundant moisture from the Amazon basin to high latitudes, and in the monsoon region where the intensity and pattern of precipitation and upper level ice water content are more realistic. It is argued that a better depiction of the Chaco Low, which is controlled by local effects of land surface processes, decisively contributes to the superior model performance with low-level flows in central South America. The better representation of the atmospheric column static stability and large-scale moisture convergence in tropical South America contribute to more realistic precipitation over the monsoon region. The overall simulation improvement is, therefore, due to a combination of different regional processes. This finding is supported by idealized AGCM experiments.