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Evaluating land surface hydrological processes using water isotopic measurements and implications for land-atmosphere feedbacks on precipitation in climate change

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Climate models show wide disagreement in projections of hydrological changes over land. Strengthening the credibility in projections requires a careful evaluation of the representation of hydrological processes in climate models. With this purpose, we present observable diagnostics based on water isotopic measurements to detect biases in land surface models that are relevant for the land surface hydrological response in climate change. First, a sensitivity study with the isotope-enabled land surface model ORCHIDEE on several instrumented sites shows that soil water isotopic measurements can detect biases in the evaporation/transpiration partitioning that are not always detectable by traditional hydrological observations, but that have a significant impact on the hydrological response to temperature and precipitation changes. Second, we extend our sensitivity study to global land-atmosphere coupled simulations using the isotope-enabled general circulation model LMDZ. We show that the intra-seasonal fluctuations of water vapor isotopic composition reflects the magnitude of land surface-atmosphere feedbacks on precipitation at intra-seasonal scales in regions known as land-atmosphere feedbacks "hot spots". We use water vapor isotopic measurements by satellite to discriminate the most realistic simulation for land atmosphere feedbacks, and we examine the implications for land-atmosphere feedbacks in the context of climate and land use change.