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Several studies show that uncertainties in the representation of land surface processes contribute significantly to the spread in projections for the hydrological cycle. Improvements in the evaluation of land surface models would therefore translate into more reliable predictions of future changes.

The isotopic composition of water is affected by phase transitions and, for this reason, is a good tracer for the hydrological cycle. Particularly relevant for the assessment of land surface processes is the fact that bare soil evaporation and transpiration bear different isotopic signatures. Water isotopic measurement could thus be employed in the evaluation of the land surface hydrological budget.

With this objective, isotopes have been implemented in the most recent version of the land surface model ORCHIDEE. This model has undergone considerable development in the past few years. In particular, a newly discretised (11 layers) hydrology aims at a more realistic representation of the soil water budget. In addition, biogeophysical processes, as, for instance, the dynamics of permafrost and of its interaction with snow and vegetation, have been included. This model version will allow us to better resolve vertical profiles of soil water isotopic composition and to more realistically simulate the land surface hydrological and isotopic budget in a broader range of climate zones.

Model results have been evaluated against temperature profiles and isotopes measurements in soil and stem water at sites located in semi-arid (Yatir), temperate (Le Bray) and boreal (Labytnangi) regions. Seasonal cycles are reasonably well reproduced. Furthermore, a sensitivity analysis investigates to what extent water isotopic measurements in soil water can help constrain the representation of land surface processes, with a focus on the partitioning between evaporation and transpiration. In turn, improvements in the description of this partitioning may help reduce the uncertainties in the land surface hydrological response to climate change.

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