



## **A drying tendency over land due to changing temperature and relative humidity gradients in a warming climate**

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Observations and simulations show a land-ocean contrast in the response of the water cycle to global warming, with larger magnitude changes in precipitation minus evaporation ( $P - E$ ) over ocean than over land. The ocean changes are closely tied to the local surface-air temperature changes via a simple thermodynamic scaling: the so-called “wet-get-wetter, dry-get-drier” mechanism. Over land, however, the response deviates substantially from the simple scaling. Horizontal gradients of surface temperature and relative humidity changes, not accounted for in the simple scaling, are found to be important over land, with changes in atmospheric circulation playing a secondary role outside the tropics. An extended scaling, incorporating the changes in temperature gradients and relative humidity gradients, is introduced and is shown to better capture the multimodel-mean response of  $P - E$  over land, including the projected drying over North America and Europe. The mechanisms leading to the drying tendency are discussed.