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Evapotranspiration partitioning in CMIP5 models: uncertainties and implications for simulated climate and projections

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Evapotranspiration (ET) is a key determinant of surface climate over land, as it modulates the surface energy budget and thus near-surface climate. The response of ET to anthropogenic forcing, in particular, is of interest to understand large-scale features of hydroclimate change with warming over land that stand in contrast to oceanic changes, such as enhanced warming and decreased relative humidity.
Evapotranspiration can typically be decomposed into three main components: plant transpiration, soil evaporation and canopy interception. Here we investigate how the partitioning of ET into these three components is represented in CMIP5 simulations. We show that there are large uncertainties between models in the mean present-day partitioning, with links to mean climate characteristics over land. On the other hand, CMIP5 models simulate robust patterns of changes in ET partitioning into the future, notably a marked contrast between decreased transpiration and increased evaporation in the Tropics, whereas transpiration and evaporation both increase at higher latitudes and both decrease in parts of the Subtropics. The origin of the tropical pattern is interpreted to lie in the simulated effect of atmospheric CO_2 on plant physiology; CMIP5 simulations separating out this effect are analyzed to test this hypothesis. Finally, the implications for future land ET change of model differences in mean partitioning and future partitioning changes are explored.