



## **Explaining shifts in rainfall-runoff partitioning during decade-long drought in Australia**

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Significant shifts in annual rainfall-runoff partitioning were observed during a severe decade-long drought in Australia. During the drought, less runoff was generated for a given rainfall in comparison to other dry years. However, shifts in the rainfall-runoff behaviour were very prominent in some catchments, but not in others. We attempt to explain this variability in catchment drought response using a multimodel inference approach. We systematically analyse the relative role of 37 potentially influential factors, including both catchment and drought characteristics. We found that historically drier catchments, catchments with higher interannual variability of groundwater storage, less seasonal rainfall regime, and deeper soils had larger runoff deficits for a given rainfall during the decadal drought in comparison with shorter droughts. Interestingly, these most informative factors can, in theory, be known before the drought starts, which provides an opportunity to anticipate how rainfall-runoff partitioning might change in case of prolonged drought in any given catchment. In other words, our results can provide a measure of catchment susceptibility to shifts in hydrologic behaviour during prolonged drought. The associated physical explanations and mechanisms of change are discussed. We conclude that during extended climate drying, runoff deficits depend on whether catchment functioning changes, and this in turn is defined by the catchment biophysical structure.