EGU21-9014
https://doi.org/10.5194/egusphere-egu21-9014
EGU General Assembly 2021

Robust modelling to address UPH19 to predict future hydrological responses for water resources adaptation under climate change

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This paper addresses the implications of UPH19 in extrapolating hydrological models to predict the future and assessing water resources adaptation to climate change. Many studies have now shown that traditional application of hydrological models calibrated against past observations will underestimate the range in the projected future hydrological impact, that is, it will underestimate the decline in runoff where a runoff decrease is projected, and underestimate the increase in runoff where a runoff increase is projected. This study opportunistically uses data from south-eastern Australia which recently experienced a long and severe drought lasting more than ten years and subsequent partial hydrological recovery from the drought. The paper shows that a more robust calibration of rainfall-runoff models to produce good calibration metrics in both the dry periods and wet periods, at the expense of the best calibration over the entire data period, can produce a more accurate estimate of the uncertainty in the projected future runoff, but cannot entirely eliminate the modelling limitation of underestimating the projected range in future runoff. This is because of the need to consider trade-offs between the calibration objectives, particularly in simulating the dry periods, versus enhanced bias that results from the consideration. Hydrological models must therefore also need to be adapted to reflect the non-stationary nature of catchment and vegetation responses in a changing climate under warmer conditions, higher CO_2 and changed precipitation patterns. This is an active area of research in UPH19, and some ideas relevant to this region will be presented.