There are many studies that use rainfall-runoff models with climate change projections to predict climate change impact on future water availability. This paper investigates whether rainfall-runoff models calibrated against historical climate data can be used to reliably predict runoff responses to changes in future climate inputs. The modelling experiments are carried out for four rainfall–runoff models using long records of historical daily climate and streamflow data from 61 catchments in southeast Australia. The results indicate that the models, when calibrated using more than 20 years of data, can generally be used for climate impact studies where the future mean annual rainfall is not more than 15% drier or 20% wetter than the mean annual rainfall in the model calibration period. It is generally more difficult for a model calibrated over a wet period to predict runoff over a dry period compared to a model calibrated over a dry period to predict runoff over a wet period. For southeast Australia, there is a good reason to use the recent records to calibrate rainfall–runoff models to represent the current prolonged drought over the region and for climate change impact studies where the large majority of climate models predict a drier future across this region.