Elasticity of the Rainfall-Runoff Transformation under a Changing Climate

D. A. Post¹, J. Teng¹, F. H. S. Chiew¹, B. Wang¹, J. Vaze¹, S. Marvanek²
¹CSIRO Land and Water, Canberra, Australia; ²CSIRO Land and Water, Adelaide, Australia

Many studies examining the impact of climate change on runoff use a technique whereby the change in rainfall for a particular area is derived per degree of global warming. This change in rainfall is then used to drive a rainfall-runoff model to produce a change in runoff, which can also be interpreted per degree of global warming. Because of the technique used, the change in rainfall scales linearly with global temperature. That is, a two degree increase in global temperature will produce twice the change in rainfall as a one degree increase in global temperature. However, the form of the relationship between runoff and global temperature has not been assessed. A consistent relationship between runoff and global temperature, whether linear or curvilinear, would allow estimates of runoff to be derived for a given increase in global temperature quite easily based on just one rainfall-runoff model run. The absence of such a relationship would mean that future projections of runoff can only be derived through a far more painstaking and time intensive process of re-running rainfall-runoff models for each given increase in global average temperature. This paper investigates the nature of the relationship between runoff change and global average temperature across south-eastern Australia at a range of scales from 25 km² to 1,000,000 km² through multiple runs of a rainfall-runoff model covering projected temperature increases of 1.0, 1.3, 2.0 and 3.3 degrees, representing medium and high global warming scenarios for 2030 and 2060 respectively.