University of Southern Queensland

Statistical Downscaling of Precipitation Projections in Southeast Queensland Catchments

A Thesis submitted by

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Abstract

Southeast Queensland has experienced a reduction in annual rainfall over the last 40 years of about 200mm and evidence is emerging that links global warming to declines in sub-tropical rainfall. Population growth in the same region has remained above the national average since 1986 and level 5 water restrictions where enforced as dam levels dropped to 16.7% in 2007. Dam levels for the region returned to full capacity by the end of 2010 due to several consistent years of rainfall and runoff. However, regional water supply managers still require information of future rainfall, more specifically if there will be a continuation of the observed long term drying trend.

One of the tools that can assist the water supply industry in managing future water needs are Global Climate Models (GCM's). These deliver projections of future rainfall but on a scale that is unable to resolve regional physical processes as well as other features that determine local rainfall, such as topography and land surface composition. For example, the catchments of Upper Brisbane and Stanley in Southeast Queensland are located adjacent to one another. Despite their proximity, average annual rainfall substantially varies from 840mm at one station in the Upper Brisbane catchment to 1700mm at one location in the Stanley catchment. GCM's with spatial resolutions of several hundred kilometres are unable to supply regional rainfall information at a usable scale for policy makers.

Downscaling methods are employed to refine GCM's scale to a regional level. Statistical downscaling by linear regression of projected climate predictor variables on a monthly basis is used in this thesis to conduct an analysis of future rainfall at three stations in Southeast Queensland.

Statistical downscaling models provided average monthly rainfall for Peachester of 144.7mm/month, which is a good match for the observed average total of 142.8mm/month. Improvements are made over the rainfall totals derived from GCM data at the nearest grid point of 75.7mm/month. This location plays an important role in receiving the majority of the region's rainfall and providing a significant portion to the regions dams. Average rainfall at the other two locations of Mount Brisbane and Crow's Nest were adequately described by the GCM output at the nearest grid point and were not improved upon by implementing the statistical downscaling techniques. The use of specific humidity in the climate models proved an unstable climatic predictor variable which created overestimations. Both GCM and statistical downscaled models project rainfall in the region to remain relatively constant over the next 30 years with only a small decrease in average annual rainfall of 4 to 5%.

Declaration

I certify that the ideas, experimental work, results, analyses and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

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Signature of Supervisor

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