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The use of Kohonen self-organising maps in assessing the impact of global climate change on the runoff of the Breede River in South Africa

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The Breede River, situated in the Western Cape, is the largest river in the province with a total catchment area of 12600 km^2. It supports transfer schemes into other basins within the Western Cape but also sustains one of the key agricultural regions in South Africa. It is this significance of the river that has prompted studies into the long-term viability of transfer schemes out of the catchment, under potential climate change scenarios. Due to the complexities of the catchment it is difficult to source a hydrological model that can capture the system dynamics of the river adequately. This limitation prompted the use of Self-Organising Maps (SOMs) in assessing the impact that global climate change may have on the flow in the river.

SOMs are a type of Artificial Neural Network that cluster data into a specified number of archetypal patterns. They are a powerful tool in synoptic climatology as they can be used to objectively classify a large number of daily synoptic states into a predetermined number of groups or archetypal nodes. The SOM algorithm also attempts to preserve the frequency distribution of the phase space of the sample data. This is an important feature in the context of this study. SOMs were used in this study to downscale Global Climate Model (GCM) data to catchment scale. This was achieved by using a SOM to group GCM atmospheric conditions in the control run (1979 – 1999) into 35 archetypal synoptic patterns, each with an associated frequency. This was then repeated for the GCM future runs (2079 –2099). Each archetypal synoptic

pattern in the control condition was linked with an observed associated runoff in the catchment. This allowed for an assessment of the change in frequency of each atmospheric state from control to future and hence a change in frequency of the associated runoff projected for the future synoptic condition. The end result of this was a quantified assessment of the projected change in mean annual runoff in the catchment from the present to the future under a particular climate change scenario.

Not only does this information assist in the process of long-term policy decisions made in relation to water transfer schemes but it also allows for an assessment of the future ecological sustainability of the catchment by assessing the projected future level of flow at each runoff gauging station.