Forest Vegetation Monitoring and Runoff in Water Supply Catchments Affected by Drying Climate

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The south-west of Western Australia has experienced reduced rainfall over recent decades. Annual rainfall in the state's capital city, Perth, has declined by approximately 20% since the 1970's. In the same period, runoff into the water supply dams for the city of Perth has declined even more dramatically – of the order of 50%, though this reduction is variable with season and catchment.

Water use by vegetation is a major component of the water balance in Perth's supply catchments; water yields as measured by the percentage run-off are relatively low. Native eucalypt forest is the dominant vegetation cover type. As well as climatic changes, forest cover has been subject to disturbance from timber harvesting, fire (principally managed rotational burning) and mining. Thinning of forest is now being considered as a management option to increase water yields and is being trialled in one catchment. Water yield in a season is the product of a complex interaction of catchment characteristics, rainfall distribution and vegetation water use. Deterministic hydrological modelling is unable to capture this complexity and unable to predict impacts of particular thinning regimes and rainfall scenarios.

An alternative data integration approach has been undertaken to estimate effects of forest thinning on catchment run-off under different rainfall scenarios. The project is supported by the WA Premier's Water Foundation. The aim is to examine all available data to (a) identify combinations of thinning regime, catchment and rainfall distribution where increased runoff has occurred and (b) to estimate effects on run-off of feasible thinning regimes under projected rainfall scenarios. The project is assembling and analysing historical daily rainfall and runoff data from all available gauged catchments in the region. High resolution DEMs have been processed to produce a suite of derivative variables which can provide data on catchment characteristics relative to the gauging stations.

Forest disturbance data is provided from a consistently processed annual sequence of Landsat TM imagery since 1988. Spectral indices calculated from the sequence provide indicators of the timing and degree of disturbance of forest cover which are spatially distributed across catchments. These are combined with summaries of rainfall data and of DEM derivatives in the analysis. In total across the catchments, these data provide some hundreds of observed rainfall-runoff 'years' with associated image-derived forest disturbance histories. An additional major factor affecting runoff associated with the declining rainfall is the decline of groundwater tables in the region, for which only sample data exist.

The remote sensing data sequence provides strong evidence of general thinning of forest in the medium-lower rainfall zones over the last 20 years, perhaps an adaptive response to the reduced rainfall. The remote sensing processing and results on overall forest response will be presented. The data summary and integrated analysis of image, DEM and hydrological data will also be presented.