Modelling land use change at the large catchment scale: the Motueka example.

Tim Davie, Robbie Andrew, John Dymond
Landcare Research – Manaaki Whenua

As part of the Motueka Integrated Catchment Management study a model has been developed to provide a rapid assessment of the water balance throughout the catchment. The model is a simplification of Wigmosta et al (1994) and models the water balance as three stores (vegetation interception; rooting zone; shallow groundwater) within a 25m pixel; each pixel is linked to its neighbours through surface & subsurface flow. The model is being used to try and answer the question: what happens to water yield in the Motueka catchment when land use (and climate) change?

Margin to be left for note taking at presentation

Initial simulations using the model were presented at last year's HydroSoc, this paper concentrates on simulations using the model to predict impacts of land use change on the Motueka catchment. There are three scenarios that have been modelled:

a) Current land cover based on 1994 LCDB data;
b) Prehistoric vegetation based on a LENZ modelling approach;
c) Maximum coverage by pine trees (based on physiology and sensible policy)

The results from the initial investigations show some surprising results (e.g. figure one), suggesting that the current land use and maximum pine coverage are very similar but that the prehistoric vegetation cover (predominantly beech forest) is the most water conservative i.e. having higher runoff values than the others. This contrasts markedly with small catchment studies such as at Donald Creek (within the study catchment), which show pine and beech forest having similar interception and water yield and pasture considerably more water yield.

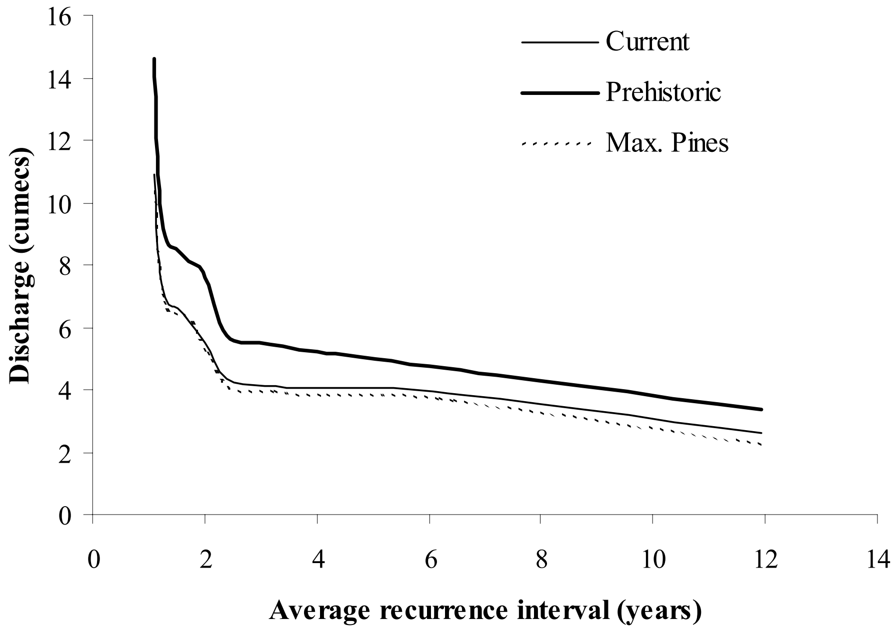

Figure 1: Low flow analysis (1990-2000) with three modelled scenarios

When the current land cover scenario is compared to measured summer flows (see figure 2) it shows a reasonable correspondence. However further analysis shows a large discrepancy between modelled and simulated low flows. It is believed that this discrepancy is to do with the way the model treats the regolith and shallow groundwater. The soil moisture levels in the model are remaining high throughout the simulation and the largest impact of the vegetation is through transpiration, rather than interception (contrary to field studies at the small catchment scale). Further work is currently being carried out to try and improve the regolith and shallow groundwater aspect of the model, prior to further simulations looking at different land use changes and possible climate change.

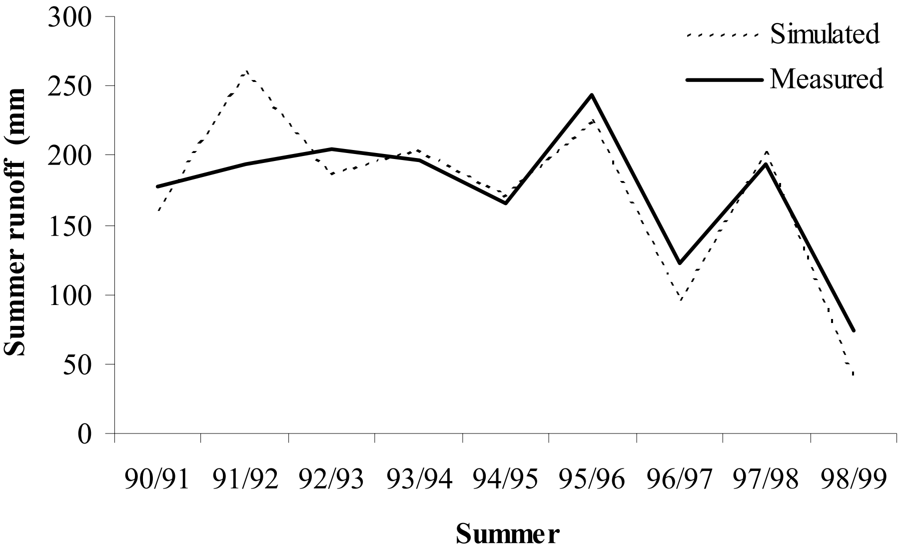

Figure 2: Summer runoff – observed vs simulated.

With improvements in the model structure, and further testing against a range of data sets, more confidence can be put in the predictions made through modelling large scale land use change.

Wigmosta,M.S; Vail, L.W.; Lettenmaier, D.P. (1994) A distributed hydrology-vegetation model for complex terrain. *Water Resources Research* **30**:1665-1679.