

Abstract: SIRG-NZ (Snow and Ice Research Group New Zealand) 2005.

Optimisation of SnowSim, a snow storage model, to the Lake Pukaki catchment, New Zealand.

SnowSim is a snow storage model developed for New Zealand's major South Island hydro-electric catchments (Fitzharris and Garr 1995) and later revised to cover the whole of New Zealand (McAlevy 1998). The model requires the use of four parameters: temperature elevation lapse rate, snow/rain temperature threshold and two "melt factor parameters" for the temperature-index based snow melt component of the model. For the New Zealand wide version of SnowSim these were set to $0.007\text{ }^{\circ}\text{C m}^{-1}$, $2.5\text{ }^{\circ}\text{C}$, $3\text{ mm }^{\circ}\text{C}^{-1}\text{ d}^{-1}$ and $8\text{ mm }^{\circ}\text{C}^{-1}\text{ d}^{-1}$ respectively. A review of lapse rate measurements in the Pukaki catchment reveal $0.005\text{ }^{\circ}\text{C m}^{-1}$ to be a spatial and temporal average for the region (down from $0.007\text{ }^{\circ}\text{C m}^{-1}$ as used in the New Zealand SnowSim). Combinations of the remaining parameters, set within likely physical limits, were modeled and outputs compared firstly to measured snow water equivalent data at a high elevation climate station, and secondly to measured lake inflow data. A closeness of fit criteria where "1" represented a perfect model, 0 represented a model as good as the annual average, and a negative value represented a worse than annual average output, was used to determine the quality of model output. A snow/rain threshold of $1.5\text{ }^{\circ}\text{C}$, and melt factor parameters both of $1\text{ mm }^{\circ}\text{C d}^{-1}$ were found to provide the optimum model output when compared to the climate station snow water equivalent data, with a closeness of fit criteria value of 0.93 (from 0.26 using the default New Zealand SnowSim parameters). A snow/rain threshold of $2.5\text{ }^{\circ}\text{C}$, and melt factor parameters both of $1\text{ mm }^{\circ}\text{C d}^{-1}$ were found to provide the optimum model output when compared to the lake inflow data with a closeness of fit criteria value of 0.6 (from 0.16 using the default New Zealand SnowSim parameters). These findings demonstrate the need to tune SnowSim to the location of choice prior to application, as well as the difficulty in using point measurements to determine "catchment scale" parameters. The findings also demonstrate the ability of SnowSim to closely model both point and catchment scale seasonal snow processes.

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