18th World IMACS / MODSIM Congress, Cairns, Australia 13-17 July 2009
http://mssanz.org.au/modsim09

# Simulations of varying grid sizes on catchment yield by using calibrated and validated MIKE SHE models

**Ali, M[1], Silberstein, R[1], Ali, R[1], Hodgson, G[1]**

[1]*CSIRO Land and Water, Floreat, Western Australia.*

**Abstract :** MIKE SHE is a fully integrated and spatially distributed hydrogeological model. It was calibrated and validated for 31-Mile Brook catchment by using stream flow, rainfall, LAI, ET, topography and geology data. Approximately 60 shallow and deep observation well and piezometres were drilled in six transects in the catchment. The average depth of the bedrock was estimated from the drilling data. The geology and the soil types were derived from analysis of drill samples and existing literature. Eight years (1990 to 1998) stream flow data was available from the gauging station at the outlet of the catchment. Four years of this data were used in calibration and another four years for validation of the model. During calibration and validation of the model catchment grid size was varied from 400 x 400 m, 200 x 200 m, 100 x 100 m and 50 x 50 m. The calibration parameters were calculated for each grid size.

Model simulations were generally consistent with observed stream flow data; however the model was unable to simulate the observed peak flows. Despite this deficiency, the modelling study allowed quantification of the effective flow processes and provided an insight into their implications in determining the impact of different grid cell sizes on simulated catchment yield. The Nash-Sutcliffe efficiencies of the simulated flow during calibration and validation were calculated for each grid size to be between 0.65 and 0.69. The differences between cumulative observed and simulated flow were in the range of 8-12%. The calibrated model was used to simulate the catchment flow by estimating average climate for the study area. The average climate was selected by analysing the rainfall data from 1975 to 2007. Year 1998 was found to have average rainfall for the study area, and was used for the four different grid size simulations: 400x400 m (S1), 200x200 m (S2), 100x100 m (S3) and 50x50 m (S4) grid cells. The simulated monthly catchment yields were compared with the observed catchment yield for 1998. It was found that there was up to 20% more simulated stream flow for S4 than S1. It was found that by decreasing the grid cell size from 400x400 m to 50x50 m (Ratio1:8), the simulated annual catchment yield was increased from 56 mm to 67 mm (Ratio 1:1.2). An increase in grid cell size showed a decreasing trend in predicting the catchment yield.

The increase in catchment yield with decreasing grid size was probably due to a combination of two causes. The first cause is the kinematic wave calculation, which results during the numerical solution of the kinematic wave equation and generates numerical errors that cause the flood wave to disperse. This dispersion increases with increasing cell sizes. This can explain why the peak discharge decreased with an increase in grid size. Dispersion of the flood wave, however, also implies that it would take longer before all water leaves the catchment. Hence, there would be more time for infiltration. The second cause is that with the decrease in slope associated with an increase in grid size the flow will also slow down, so that there is more opportunity for infiltration to occur. These results show that a choice for a certain grid cell size should be dependent on the spatial distribution of the slope in the catchment. Where the slopes are relatively steep, smaller grid cell should be used.

*Abstract only*