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1 Surface runoff and soil erosion modelling: Effect of time-scale mismatch

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Mismatches between the scale of process representation, data availability and model computation are a major problem in hydrological modelling. In this study, the effect of model time-step on various aspects of surface runoff and soil erosion modelling is quantified at the plot scale. Potential methods of overcoming this problem are discussed.

A seven-parameter rainfall-runoff-erosion model is calibrated at sub-hourly (2-min and 6-min) and daily time-steps against observed daily surface runoff and soil erosion data from field studies in Nepal and Australia. Results show that model parameters differ significantly between model time resolutions. In particular infiltration capacity and soil erodibility parameters change by orders of magnitude when the computation time-step changes from sub-hourly to daily. While the sub-hourly model parameters are similar in magnitude to field measurements, the daily model parameters are physically implausible as a result of averaging in combination with the non-linear processes of infiltration excess runoff generation and soil erosion.

In addition to the loss of physical meaning for the parameters values, the daily model also has a performance penalty compared with the sub-hourly model. This is because the tuning of model parameters can not fully compensate for the time-averaging effect in runoff and soil erosion modelling at the daily scale. Another difference between the daily and sub-hourly time-step models is that the performance reduction in validation

compared with calibration is significantly bigger for the daily model. Some simple scaling techniques (e.g. Kandel et al., 2004, 2005) that are able to capture the sub-daily scale variability of forcing while running models at daily time-steps, have potential for resolving these problems.

Reference:

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