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Stochastic runoff connectivity (SRC) equations: integration with erosion models for water quality prediction

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In a companion paper at this conference a single-event steady-state rainfall-runoff model (including runoff-runon phenomena) is derived that quantifies the effect of the random spatial arrangement of rainfall and soil properties on i) infiltration-excess runoff delivery at a downslope boundary, and ii) the distribution of the "connected length" (the upslope length with a continuous runoff pathway adjacent to the stream boundary). The accumulation and loss of runoff down a slope is represented as a first-in first-out (FIFO) GI/G/1 queuing system. Runoff rate at a downslope boundary is analogous to the waiting time in the queue in this representation. The distribution of connected length can be represented analytically as a FIFO M/M/1 queuing system, and the mean and variance is derived for this property. Together these distributions characterise the degree of connectivity of the overland flow pathway (and by extension its associated pollutant load) for a given set of rainfall and soil conditions.

In this poster, the stochastic runoff connectivity (SRC) model is developed further. We show how the probabilistic SRC model outputs i) and ii) above can be integrated with physically based hillslope scale surface erosion models to predict the probability distribution of constituent (sediment, phosphorous, etc) delivery to the stream boundary. The performance of the model is compared to 2 years of multi-length erosion plot data, and 3 years of continuous small catchment export data from SE Australian forests.