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Improving the understanding of runoff generation at the hillslope scale with low-cost instream sensors

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Understanding runoff generation in hillslopes is critical for the design and management of on-farm dams, which often have small contributing areas but collectively can lead to significant changes in downstream hydrology. The small scale nature of farm dams (with a typical contributing area of 0.1km2 in the case study region in eastern Australia) means that the hydrology at the farm dam scale can be very different to the parts of the catchment that are regularly monitored by in-stream gauges, presenting a significant challenge to calibration of hydrological models and developing an appropriate representation of flow pathways through and around the dams. Furthermore, the large number of farm dams (with an estimated two million farm dams in Australia alone) means that traditional instrumentation approaches are unlikely to be scalable, suggesting the need for alternative low-cost sensors to supplement more expensive in-stream gauges.

This research presents the results of a combined modelling and monitoring study to assess approaches for simulating the hydrology at scales relevant to the study of farm dams. To illustrate the importance of simulating local-scale hydrology, a HydroGeoSphere model was established and a ‘multi-hypothesis’ framework adopted by inducing alternative flow pathways into the model at the hillslope scale while maintaining similar hydrological response at the aggregate scale. The role of low-cost temperature sensors was then explored to provide an indication of the intermittency of streamflow and the contributions of individual tributaries. This data supplements downstream flow gauges by allowing for improved calibration methods of hydrological models that couple surface-subsurface water processes.