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Hillslope runoff generation with low-cost instream sensors

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Water policy, planning and design problems are often nested across scales and can require detailed understanding of upstream processes (e.g. distributed agricultural dams, upstream land use change and flow intermittency). Traditional approaches to streamflow monitoring are limited by sparse geographical coverage and relatively high costs of gathering observations with streamflow measurements typically collected at a catchment outlet. This can be problematic when attempting to understand the non-linear and complex runoff behaviour present on hillslopes and reaches throughout an entire river network. Differences in catchment characteristics result in highly variable drainage patterns. This presents challenges for the calibration of hydrological models regarding their ability to represent inter-catchment runoff behaviour. Low cost and innovative data collection approaches provide opportunities for water management questions which span multiple scales by complementing existing observations and addressing local data deficiencies.

This study combines process modelling and complementary data (e.g. from distributed sensors) to improve the representation of local scale flow processes. Paired (in-stream and on-bank) temperature sensors are implemented across nine headwater sites within a small catchment located in South Australia. A classification scheme was developed to infer whether the stream was 'wet' (flowing) or 'dry' (not flowing) and low flow metrics were determined at each site (e.g. number of zero flow days, number of zero flow periods and average duration of zero flow periods). The results demonstrated a high degree of heterogeneity of flow permanence within the small catchment area (10 km2). A physically based hydrological model, HydroGeoSphere, was calibrated to the outlet and validated with the classified 'wet'-'dry' binary data showing reduced performance at three out of four upstream sites. These results highlight the value of inexpensive data collection methodologies by providing opportunities to improve the calibration and validation of hydrological models.