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Incorporation of groundwater losses and well level data in rainfall-runoff models illustrated using the PDM

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Abstract. Intermittent streamflow is a common occurrence in permeable catchments, especially where there are pumped abstractions to water supply. Many rainfall-runoff models are not formulated so as to represent ephemeral streamflow behaviour or to allow for the possibility of negative recharge arising from groundwater pumping. A groundwater model component is formulated here for use in extending existing rainfall-runoff models to accommodate such ephemeral behaviour. Solutions to the Horton-Izzard equation resulting from the conceptual model of groundwater storage are adapted and the form of nonlinear storage extended to accommodate negative inputs, water storage below which outflow ceases, and losses to external springs and underflows below the gauged catchment outlet. The groundwater model component is demonstrated through using it as an extension of the PDM rainfall-runoff model. It is applied to the River Lavant, a catchment in Southern England on the English Chalk, where it successfully simulates the ephemeral streamflow behaviour and flood response together with well level variations.

Keywords: groundwater, rainfall-runoff model, ephemeral stream, well level, spring, abstraction

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