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# Effects of a flood pulse on exchange flows along a sinuous stream

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Flood pulses are important events for river ecosystems: they create hydrological interactions at the terrestrial/aquatic interface that fuel biological productivity and shape the hyporheic-riparian habitats. For example, floods promote faunal activity and decomposition by increasing the supply of oxygenated water in downwelling areas, while the following recession periods tend to provide stable thermal conditions favoured by fish or insects in areas of groundwater upwelling. This 3-D modelling study investigates the effect of stream stage transience (with events characterised by their intensity and duration) on hydrological exchanges between the surface and the near-stream subsurface. It evaluates, in particular, its effect on streams of varying sinuosity by quantifying the dynamic response of: (1) subsurface flow paths, (2) the exchange pattern at the sediment-water interface, and (3) integrative measures such as total exchange flux and total storage. Understanding geomorphological controls on groundwater/surface water interactions is attractive because topography is generally better constrained than subsurface parameters, and can be used in data-poor situations. The numerical model represents a hypothetical alluvial plain limited by impervious bedrock on all four sides, and in which the channel meanders according to the sine-generated curve of Langbein and Leopold (1966). As the model (HydroGeoSphere) couples surface and subsurface flow, the stream stage transience is imposed by a fluctuating head at the channel inlet. Preliminary results show that a simple rectangular flood pulse in an idealised sinuous stream without additional complexity can generate multiple flow direction reversals at a single point in the channel. The initial conditions of the groundwater table, the channel sinuosity and the time characteristics of the flood pulse all control exchange flow features in different ways. Results are also compared with 'bank storage' analytical solutions that typically assume a straight channel. The discussion covers an evaluation of this work with respect to previous studies that considered the influence of sinuosity on interfacial exchange flows. It addresses the issue of steady vs. transient exchanges, which is of uppermost importance at the operational scale of river restoration schemes.

Langbein WB, Leopold LB. 1966. River meanders - theory of minimum variance. U.S. Geol. Surv. Prof. Pap. 422-H: 15 p.