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The influence of river discharge on tidal damping in alluvial estuaries

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Abstract

The tidal range, the difference between high water level and low water level, along an alluvial estuary can be described by Savenije's analytical equation [Journal of Hydrology 243 (2001) 205â€“215] analytical equation. This equation was derived from the complete St Venant equations in a Lagrangian reference frame. In the derivation of that equation the effect of river discharge was disregarded. Measurements in the Schelde Estuary show that this assumption is only valid in the lower part of the estuary, but that in the upper part the river discharge has an influence on tidal damping. In the downstream part of the estuary, where the cross-sectional area is large compared to the cross-sectional area of the river, it is correct to disregard the river discharge. However, in the upstream part of the estuary, where the cross-sectional area approaches that of the river, the fresh water discharge gains importance over the tidal flow and affects the tidal range. In this paper, the derivation of the analytical equation is expanded to include the effect of

the river discharge. It is demonstrated that the river discharge can have a considerable influence on tidal damping in the upper reach of the estuary. The river discharge affects tidal damping primarily through friction. A critical point along the estuary is the point where there is a single slack, upstream of which the fresh water velocity is larger than the tidal velocity. The location of this point varies with the river discharge. From that point onwards the effect of river discharge on damping is dominant. It is the point where the estuary becomes primarily of riverine character.

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Keywords

Tidal damping; Alluvial estuaries; Tidal hydraulics; Effect of river discharge

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