Geophysical Research Abstracts
Vol. 14, EGU2012-1592, 2012
EGU General Assembly 2012

Explicit solution to tidal damping equation in alluvial estuaries

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An explicit solution of the tidal damping equation is derived in a Lagrangean reference frame. Simple expressions for the tidal amplitude and velocity amplitude are proposed under the assumption that the tidal amplitude is small with respect to the flow depth. The solutions were compared with the classic linear solutions, which have been the reference test for a long time. It was found that an asymptote exists due to the balance between friction and convergence of banks. Given the detailed time varying, space varying tidal current distribution that the explicit solution provides, it is possible to estimate the net transport of water through estuary, i.e. the Stokes drift velocity. In general, the Stokes drift velocity increases proportionately with the square of velocity amplitude but inversely with the celerity of tidal wave. Sensitivity experiments were carried out in order to investigate the relation between stokes drift velocity and other parameters, such as channel depth, bed roughness, shape estuary, and river discharge.