Geophysical Research Abstracts
Vol. 13, EGU2011-4052-1, 2011
EGU General Assembly 2011
© Author(s) 2011

Exploring linear and nonlinear solutions to the tidal hydraulic equations

Huayang Cai (1), Hubert H.G. Savenije (1), and Marco Toffolon (2)

(1) Department of Water Management, Delft University of Technology, Delft, Netherlands (h.h.g.savenije@tudelft.nl), (2) Department of Civil and Environmental Engineering, University of Trento, Italy (marco.toffolon@ing.unitn.it)

Analytical solutions of tidal hydraulic equations in convergent estuaries are investigated through linear and quasi-nonlinear models. Relevant dimensionless parameters describing tidal wave characteristics are identified in terms of independent quantities, namely the estuary shape and the tidal forcing. For given topography, friction, and tidal amplitude at the downstream boundary, the main dynamics of tidal wave propagation along the estuaries can be reproduced with a quasi-nonlinear model and a modified linear model. Based on the full non-linearized St. Venant's equations, but an assumed simple periodic solution, a new set of analytical equations have been derived building on the work by Savenije et al. (2008) by including a modified coefficient, that takes account of the tidal amplitude-to-depth ratio. Different versions of the analytical solutions are compared with numerical results for a wide range of parameters, which provide insights into the strengths and weaknesses of the quasi-nonlinear model. Possible improvements may be reached by modifying the expression for tidal damping through energy considerations in tidal wave propagation.

Keywords: tidal dynamics; analytical solution; convergent estuaries; energy consideration