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SIMULATION OF UNDULAR BORES EVOLUTION WITH DAMPING

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Abstract. Propagation of undular bores with damping is considered in the framework of perturbed extended Korteweg-de Vries (peKdV) equation. Two types of damping terms for the peKdV equation, namely linear and Chezy frictional terms, which describe the turbulent boundary layers in the fluid flow are considered. Solving the peKdV equation numerically using the method of lines shows that under the influence of damping, the leading solitary wave of the undular bores will split from the nonlinear wavetrain, propagates and behaves like an isolated solitary wave. The amplitude of the leading wave will remain the same for some times before it starts to decay again at a larger time. In general the amplitude of the leading wave and the mean level across the undular bore decreases due to the effect of damping.

Keywords. undular bores, damping, linear friction, Chezy friction, extended Korteweg-de Vries equation.

AMS (MOS) subject classification: 35Q53

1 Introduction

The extended Korterweg-de Vries (eKdV) equation

$$u_t + \alpha u u_x + \beta u^2 u_x + u_{xxx} = 0 \tag{1}$$

is an appropriate model to describe nonlinear wave evolution in stratified fluid flows, for instance large-amplitude internal waves in ocean (see [5–6]). The sign of the coefficient β depends on the fluid stratification [4–6].

The solitary wave solution of the eKdV equation (1) depends on the signs of the coefficients α and β. When the coefficient $\beta < 0$, the solitary wave solution of (1) is given by [4]

$$u(x,t) = \frac{\alpha}{\beta}\frac{B^2 - 1}{1 + B\cosh[\gamma(x - \gamma^2 t)]}, \tag{2}$$