VERTICALLY-INTEGRATED AND MOMENT EQUATIONS FOR NON-HYDROSTATIC FLOW MODELLING MATLAB PLATFORM

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Abstract This work presents a MATLAB software platform for depth-integrated non-hydrostatic flow modelling using the Vertically-Averaged and Moment (VAM) equations model. First, the structure of the user-friendly graphical interface is described. Then, the model is applied to two open-channel and coastal non-hydrostatic flow tests. The comparison of the results with experimental data highlights the accuracy of the VAM model and the potential of the present software platform for modelling non-hydrostatic flows.

Keywords: non-hydrostatic flows, depth-integrated model, software platform, coastal applications, open-channel tests.

Introduction

The use of non-hydrostatic models is often required to provide realistic predictions in coastal and open-channel flows, where the development and use of depth-integrated simulation models is a common practice.

The purpose of this work is presenting a user-friendly MATLAB software platform to apply the Vertically-Averaged and Moment (VAM) equations model to simulate non-hydrostatic flows in a number of coastal and open-channel flow cases. The platform is freely available on GitHub:

https://github.com/Frncch/VAM_Model_Software

Description of the software platform

The initial window of the software platform allows the user to select between coastal or open-channel flow applications (Fig. 1a). The open channel flow application enables the numerical experimentation on Favre waves and flow over Gaussian obstacles (Fig. 1b). The coastal flow application models the solitary wave propagation over horizontal bed and the solitary wave propagation with run-up (Fig. 1c). All the applications include numerous editable options to customize the numerical experiment.

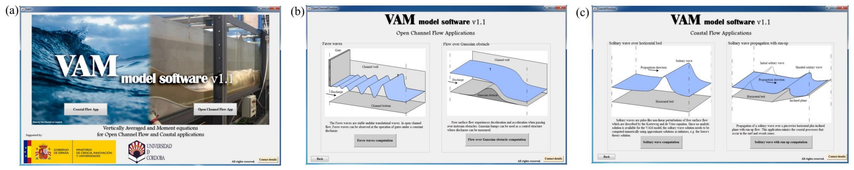

Figure 1. Software platform screens: (a) main menu, (b) open-channel flow apps, and (c) coastal flow apps.

Application of the software platform

Fig. 2 shows the applications for flow over a Gaussian obstacle and solitary wave propagation with run-up using the experimental data of Sivakumaran (1981) and Synolakis (1986), respectively. As compared to the standard Saint-Venant model solution, the VAM model yields more accurate results for both tests. More details and applications of the software platform are shown in Gamero et al. (2020).

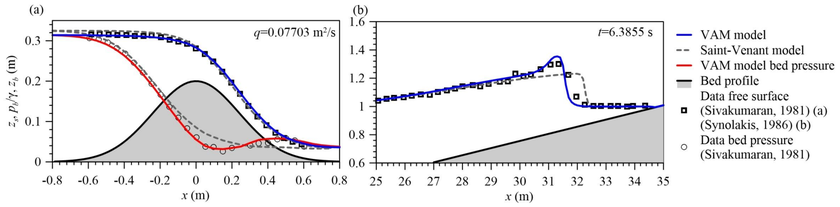

Figure 2. (a) Flow over a Gaussian bed with q = 0.07703 m^2/s (Sivakumaran, 1981), (b) solitary wave propagation and run-up over a beach profile at t = 6.3855 s (Synolakis, 1986), where z_s is free surface level, p_b is bed pressure, z_b is bed level, γ is specific weight of water, x is longitudinal distance and t is time.

Conclusions

The easy-to-use environment and the accuracy of the results highlight the potential of this user-friendly MATLAB software platform for modeling open-channel and nearshore flows, where non-hydrostatic pressure and non-uniform velocity shall be accounted for. This entails a useful hydraulic tool suitable for teaching and research purposes.

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