

An unstructured numerical model for turbulent shallow water flow: Assessment and validation. Application to a meandering channel.

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ABSTRACT

The GITS research group have been working for years in the development of 2D hydraulic numerical models (Bateman *et al.*, 2007; Medina *et al.*, 2008). The research framework have been focused on a structured grid model, named FLATModel, but some years ago, also an unstructured grid model was developed. This model, called SWUNST (Shallow Water Unstructured) reached a high stage of development, but its validation couldn't be properly studied. The goal of the present study is going on with the validation of the SWUNST model.

SWUNST is an own implementation model, with a general structure taken from the Nsc2ke model, proposed by Mohammadi (Mohammadi, 1994). The main characteristics of the SWUNST model are: unstructured grid, finite volume, Godunov method, Runge Kutta fourth order for temporal discretization, first and second order for spatial discretization, turbulence models, and wall laws in boundary conditions. During the study process several subjects have been implemented, such as multiple boundary conditions, different spatial discharge distribution at the entrance and water level boundary condition.

The first part of this study consists in a detailed description of the theoretical background of the model, like the definition of the shallow waters hydraulic equations, the turbulent models implementation or the boundary conditions definition.

The aim of second part of the document is to make the model validation. In order to achieve it, several cases have been studied. In first place all the water surface profiles have been compared with SWUNST results. In second place, experimental laboratory results have been used (Pena, 2004). Finally, the results of DEHMA Laboratory experiments (Escanciano, 2000) were compared with the model simulations.

The most important conclusions that could be taken from this work are, on one hand, that the 1D theoretical case have been reproduced very well by the SWUNST model. On the other hand, in the 2D cases (vertical slot fishway or meandering channel) the model didn't reproduce the results in a correct way, with a low accuracy. This fact could be driven by the second order discretization in the space that the model uses, which doesn't take into account the TVD restriction (Harten, 1983).

Since the main conclusions have been described, the study defines some proposals that could be developed in the future in order to improve the SWUNST model; for example, the improvement of the second order scheme used, and to validate the turbulent models using the no slip boundary condition applying wall law.