**CFD modelling approach for Dam break flow studies**

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**Rebuttal to Anonymous Referee**

We thank the referee for his time to review the paper and we've have tried to respond to all his questions and requests as it appears in the sequel.

*R: The obtained results from test case 1 do not show much as it is a frictionless (nonrealistic) example for which there are no experimental results.*

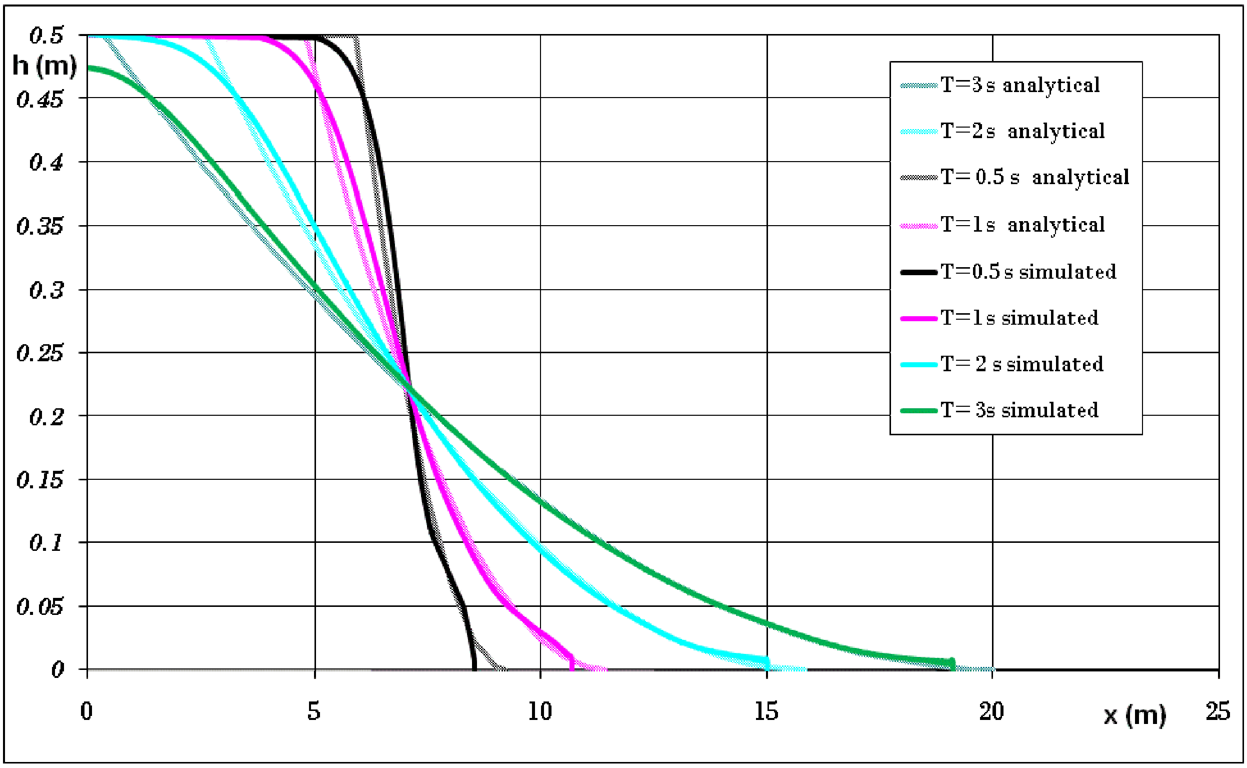
A: We decided to include the partial instantaneous dam break over a flat bed without friction because it has been widely simulated in literature with the SW approach. Even if analytical and experimental reference solutions for this test case are not available, we still think that it may add important information to the discussion, as it highlights differences between the SW and the 3D approach. However, in order to follow the suggestion of the referee, the discussion on the first test case has been shortened in the revised version of the paper.

*R: Comparison of the 3D model results with the experimental results from test case 2, presented in Fig 14, is interesting and shows some good quantitative agreement but the timing of the shock propagation seems not to be very accurate. At t=3s the modelled peak clearly lags behind the measured one. The conservation equations used in both models are expressed in terms of the primitive variables and it has been proven that in the presence of shock waves the solution of such non-conservative formulation of conservation laws converges to wrong solutions and provides incorrect shock speed. (see T.Y. Hou and LeFloch P. Why Nonconservative Schemes Converge to wrong solutions: Error Analysis, Mathematics of Computation, 62, pp 492-530, 1994). It has also been shown that even when using a conservative numerical method, the non-conservative formulation of the conservation laws shows much smaller shock speeds than the conservative formulation, with difference increasing with the shock strength. (See Fig 3.16, page 63 in Shock-Capturing Methods for Free surface Shallow Flows, E.F. Toro, 2001).*

A: The analysis made by the referee on the possible problems arising from the use of the non-conservative formulation of the conservation laws is right. However, the present 3d NS mathematical model is written in a conservative form, as emerges from the full set of governing equations reported in the paper (eqs. 6, 7 and 8). Regarding the numerical method, the effective advantage of using an open source software as OpenFoam is related to the fact that the user is free to choose among various numerical schemes and is not therefore restricted to those that are strongly stable or bounded, e.g. upwind differencing, or to a prescribed set. For each term (laplacian, divergence etc.) and for interpolations, time discretisations, pressure-velocity coupling different schemes are available and may be individually chosen. Our FV discretisation has been set as much conservative as possible (i.e. conservative scheme for the convective terms).

It should be also considered that in the presence of numerical "artifacts" as the k-epsilon turbulence model, the conservativeness of the numerical method may be not the only problem in the accuracy of the numerical results.

In order to prove the validity of the employed NS model in transient simulations, a dam-break in a straight channel 20m-long has been modelled and the numerical results compared to the analytical solution provided by Whitham [Gerald Beresford Whitham, "Linear and Nonlinear Waves", Wiley, 1974]. The numerical mesh is made up of 2000 cells with a grid-space of 0.01 m. The bed is horizontal and the bottom and wall friction is set to 0. At time zero, a 0.5 m high water volume on the 7 first meters of the channel is released instantaneously. A propagation wave moves downwards while a rarefaction wave goes back in the reservoir. The figure below shows the comparison between numerical and analytical data and highlights the capability of catching the front wave propagation.




*R: As the numerical methods used in both models are not shock-capturing they are not able to capture propagation of the shock waves accurately. Hence, the obtained results are not any news as they could have been predicted from the very beginning…. I would not recommend this paper to be published.*

A: Apart from the conservativeness of the employed equations and of the present numerical method, we do no understand why the present results are not new and we cannot agree with the conclusion that results from non shock-capturing methods are not worth to be published. We hope that the above responses may convince the reviewer that the present paper, after all the made revisions, may be acceptable for publication.

*R: The interesting research would be to compare realistic experimental results with results obtained by a model based on the conservative formulation of conservation laws solved by shock-capturing methods and results obtained from a 3D Navier-Stokes model used in this paper.*

A: We think that the idea of the referee could be interesting and significant also to assess the effect of the different discretisation schemes on this kind of problems and it will be taken into account for future work.