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Numerical Analysis for the Shallow water model with two velocities

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The Shallow water equations (also called Saint-Venant's equations) are the usual model governing fluid flow in the rivers, channels or the oceans. They are used, for example, for the protection of the environment, the prediction of tides and storm urges, the transport of the sediment or the study of floods. Some references in the literature propose an improvement of the Shallow water equations to take into account the vertical profile of the horizontal velocity.

The objective of this work is to develop a scheme of the model with two velocities in the vertical profil based on an analysis of the Riemann problem. We look for a scheme able to exactly recover any subcritical steady solution in 1D over arbitrary topography.To do so, first we analyse the steady solutions following the Bernouilli's principle, even for supercritical regime. We then propose a well-balanced Riemann solver following a strategy proposed in a previous study. Finally, we validate our results with numerical simulations.

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