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Interactive comment on "A new form of the Saint–Venant equations for variable topography" *by* Cheng-Wei Yu et al.

Anonymous Referee #2

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The manuscript describes an original re-formulation of the Saint-Venant equations, based on the introduction of a properly defined, mathematically equivalent, modified slope term in the momentum equation. A new "reference slope" is introduced with the aim of removing the mathematical issues related to the lack of Lipschitz smoothness condition in the original source terms, which may represent a major source of spurious oscillations in the numerical solution. Several numerical tests of the proposed form of the Saint-Venant equations are performed, in order to check the consistency of the proposed procedure, and to benchmark the solution procedure against widespread standard methods. Pros and Cons of the proposed method are finally discussed in detail. The manuscript concerns a very interesting topic, proposing an original and innovative approach with some potential to trigger new approaches even in different

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Discussion paper

fields. The research is clear in its design and the manuscript is well-organised and generally well-written. I suggest addressing few minor issues, that could contribute to clarify at some points the manuscript and to improve the manuscript quality:

- Line 42. In commenting eq. (4) the Authors should explain what they intend for "associated depth consistent with the above definition"

- Line 185. The manuscript should better explain why the interest is to "non-trivial definitions of z_R(x) that are close to S_0(x) but are guaranteed smooth". This may appear to be in contrast with the circumstance that the mathematical re-formulation of the momentum equation is equivalent for any choice (close or not) of z_R (x) (for the purposes addressed in the paper, at least for any choice providing Lipschitz smoothness).

- Line 210. The discussion here ("approximating cubic B-splines to the z_0(x)...") may suggest the idea that some choice of z_R (x) could be better than other ones. I think that a comment is needed.

- Line 471. The Authors should add in the revised manuscript a comment on the potential benefit provided by "automatic generation of approximate splines for large river network": is that essential for the successful application of the proposed methodology? Why?

- Please proofread the manuscript. For instance: Line 65. "an" should read "a". Line 473. Broken sentence? Line 266. "Being" should read "begin".

- Please double check the notation list. For example, momentum coefficient is in the notation list but not in the equations. Similarly, velocity and average velocity. Reference slope is not in the equation. Reference Slope is not in the notation list.

Based on the above comments, I am confident that the manuscript could be published, provided these few minor issues are accounted for in the revised version.

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