Earth Surface
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Discussions

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Interactive comment on "sedFlow – an efficient tool for simulating bedload transport, bed roughness, and longitudinal profile evolution in mountain streams" *by* F. U. M. Heimann et al.

Anonymous Referee #1

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1 General comments

The paper introduces the development of a simulation tool for modeling the evolutions of the long profile in mountain streams. The terms of reference for this new tool are clearly exposed but the paper could be more efficient in the basic purpose of (i) the review of the existing tools and the need for a new one, (ii) the proposal for the modeling options and the demonstration of their efficiency. The question is whether the articulation with the companion paper is optimal. Several interesting issues are introduced whose demonstration and discussion are in the companion paper. Deviating from the basic purpose of the paper, the authors bring the discussion toward side issues, thus leading for each of them to an uncompleted discussion. Those issues are exposed

with a lack of synthesis (e.g. as concerns the active layer) and the lector misses the presentation of schematic cases in order to assess the efficiency and the robustness of the choices that were made. The presentation of a new model, adapted for steep slopes and apparently for catchment applications, that is available for the community has its value but it should be improved in several points.

2 Specific comments

Please give some indications of the typical space interval that is currently envisaged! Several issues depend on this parameter: the application at catchment scale (p.737, line 6), the justification for a simplified geometrical description, the importance of the abrasion, the downstream weighting for calculation of the bed elevation, and the stability of the calculation. It is unclear when the bed elevation is updated; the Fig.1 could indicate that the bedload transport in the 'local reach' will change the active layer (and we suppose the bed geometry) of the 'downstream reach' only. A precision of the typical space interval and of the Froude number may justify a downstream adjustment of the geometry. The bed roughness is pointed as a major issue in modeling sediment transport in mountain streams. This is true and a detailed description is made of the different options; this is however not the main objective as presented in the TOR. A sensitivity analysis, and the assessment for the difficulty for calibration would be a paper in itself. Skip those details? The consistency (p.745, l. 10) of the simultaneous use of a hiding function, a correction factor γ for the critical shear, and the possibility for a variable thickness of the active layer, as a function of is grain composition (p.747, l.22) is highly questionable. The different options for the interactions between the active layer and the underlying subsurface alluvium could be simplified because the second and the third approaches are only simplifications from the first method (with a small violation of the conservation laws). Another reason is that this issue is not discussed later by any comparison and the discussion. The numerical role of the active layer and the importance of its thickness could be underlined (see e.g. Belleudy: Numerical simulation of sediment mixture deposition part 1: analysis of a flume experiment,

j. of Hydraulic Research, Vol. 38, 2000, N° 6, doi: 10.1080/00221680009498295, 417-425). The Fig.3 is not very demonstrative in itself and simple and schematic test cases could have been brought to demonstrate the different ideas. A schematic test calculation could also be shown with the statement that 'grain size distribution will dynamically adjust' (p.750, l.3), whose discussion is done in the companion paper. The issue introduced by the Fig.2 is worth a development, it would need a demonstration of how sedFlow behaves, enventualy compared with other existing tools. The comparison with existing tools is rather disorderly: (i) The discussion about fractional transport in section 3.1 which is a complement to the section 2.3, could have been improved by its demonstration through simple cases. (ii) It could be better ordered as it begins the discussion on explicit calculation scheme, calculation speed and stability (p.750, l.17-24) which is detailed is the next specific section 3.3.

3 Technical corrections

The title of the paper could be improved: the mentions 'efficient' and 'bed roughness' could be dropped.

p.740, l.7-21 / Structure: The estimation of the energy slope for bedload transport is misplaced in section 2.1.1, flow routing. It should be moved to section 2.2, Bedload transport calculation.

Eqs 1, 2, 15, A1 / Typo : in equations use ∂ instead of δ for partial derivatives.

p. 746, l.1, section 2.2.2 : The title should mention that the updating concerns also the channel elevation or geometry.