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Earth Surface Dynamics Discussions

Interactive comment on "The role of velocity, pressure, and bed stress fluctuations in bed load transport over bed forms: numerical simulation downstream of a backward-facing step" *by* M. W. Schmeeckle

Anonymous Referee #2

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I recommend publication of the manuscript esurfd-2-715-2014 in the journal Earth Surface Dynamics after some minor revisions. The Author presents results using a novel simulation approach that was recently published in the Journal of Geophysical Research (Schmeeckle, 2014). The results explore the role of pressure fluctuations in and out of the porous bed on recorded sediment transport events. Unfortunately, much of the background and methods that would be appropriate to include in the present manuscript have already been published in the Author's recent manuscript in the Journal of Geophysical Research and have been omitted here. However, these missing

details do not detract from the focus and significance of the results presented here. Namely, the simulations demonstrate that these "sweep events", long thought to be responsible for intermittent bursts of sediment transport, exerted strong pore pressure fluctuations that are positively correlated with the observed transport. Additionally, the simulations quantify the magnitude of the pore pressure fluctuations for the single case of the backward-facing step presented here. This Reviewer knows of no existing experimental measurements that provide time series quantification of such pore pressure fluctuations inducing sediment transport under similar flow conditions.

The main scientific issue I have with the manuscript involves the Author's choice of the "two-way" coupled version of the CFDEM code. The reason for the choice provided in the Methodology Section of Schmeeckle (2014) does not explain the implications of the choice. Particularly, the "two-way" coupled version of typical Large Eddy Simulations (LES) or other turbulence resolving flow solvers with the Discrete Element Method (DEM) allow for a much more trivial and efficient solution for the pressure. However, the more rigorous, "four-way" coupled version introduces difficulties in solving for pressure and often requires an iterative and computationally expensive solver. Since, even the "two-way" coupled results are extremely novel and difficult to obtain in this case, I feel it is only necessary for the Author to provide a separate discussion that qualitatively explores the implications (relative to the results being presented on pore pressure fluctuations) of using a "two-way" versus "four-way" coupled simulation. For example, how much might the lack of coupling in continuity affect the magnitude of the pore pressure distribution/fluctuations?

Additionally, below is a suggested list of minor edits. 1) Starting in the Abstract and throughout the manuscript the word "further" when referring to distance downstream should be changed to "farther" – at least 7 instances. 2) Page 716, line 24, I believe this statement is in gross error! Experiments do exist. Consider recent work by Knowles & Kiger, Experiments in Fluids, 2012; van der Werf et al., JGR, 2007; others van der Werf and colleagues. Additionally, under simulations the recent work of Penko et al,

JGR, 2013 was omitted that is a turbulence resolving, sediment transport model that does not rely on empirical transport formulations. 3) Page 718, line 7, insert “(DEM)” 4) Page 718, lines 21-22, the description of the “vertical dimension” is confusing. Consider revising to more clearly define the coordinate system. 5) Page 719, lines 13-15, consider moving the sentence “The lower boundary. . .” to the Results Section where the slice locations is described. 6) Page 720, line 6, replace “in other words” with “i.e.” 7) Page 720, line 12, consider revising as “. . .data examined in this article is 20 s at a rate. . .” 8) Page 720, line 21, remove extra “positive” 9) Page 721, line 17, revise as “. . .more than an order of magnitude. . .”

Interactive comment on Earth Surf. Dynam. Discuss., 2, 715, 2014.