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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 #1

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This paper describes the effects of turbulence on the bed downstream of a backward facing step. Using state of the art modelling techniques comprising of LES and DEM interesting results can be obtained. In this paper the well-known backward facing step is simulated. Provided that the simulations have resulted in a wealth of information, the presentation of the results is very limited and superficial and disappointing in relation to the promises of the title. In my opinion the line of reasoning "extreme fluctuations are responsible for particle entrainment" , needs a more careful analysis and description. This pertains especially to the mechanism of particle entrainment and motion as only

parameterized drag, interpolated pressure gradient and buoyancy was accounted for. As no aim for the research has been provided, nor any hypothesis stated, the paper appears to me as a fast presentation of simulation results. If the aim is to understand particle entrainment by large-eddy structures (of extreme amplitude), there is far more to say about the mechanisms of entrainment. At least a sketch should be added explaining the forces acting on a particle. The associated particle equation of motion should be provided with a discussion on the neglected forces. Also a discussion is needed on the resolved vs. the subgrid scales for pressure and velocity fluctuations. It is not clear from this paper how these scales relate to particle and pore sizes and how the unresolved sub-grid fluctuations (pressure and velocity) are represented other than using a sub grid viscosity.

The author could address in more detail how the findings of this numerical experiment relate to the simple relations that use critical shear stresses (Shields) etc. In order to be interesting for the readership it would be good to provide more clarity, also in a quantitative way about the gain in understanding and accuracy that comes from this research. Otherwise it is 'just an example' without context and from which no clear lessons are learned. Despite the information that cannot easily be obtained from experiments the conclusion in this paper are not containing any new insights nor do they provide suggestions for an improvement of current sediment transport modelling techniques.

Page 218 line 16: The periodic boundary conditions for the inflow section are inadequate as the length of the periodic section is of the order of the water depth, where 5 to 10 times the water depth is considered sufficient. No validation is provided on the velocity field.

In general there is insufficient information on the way the simulation was carried out. Reference to the JGR2014 paper is not enough service to the reader. Validation of the model is extremely limited only figure 2e contains some data. However, hardly any discussion is spent on the comparison and the cause of the differences.

If particles are removed from the bed is affects the bathymetry locally. The authors should explain more carefully how this phenomenon was dealt with. Were particles really eroded? Did bed forms appear?

Figure 2e, should be addressed in the results section. Fig 5, caption is not complete, triple (d)

The referenced literature is rather limited. Knowing the enormous numbers of papers on particle-turbulence interaction, granular and two-phase flows.

In my opinion the paper is publishable only in case it provides a careful and complete description of the simulation method, including its limitations. Furthermore, a clear aim should be formulated that will be of help in structuring the paper and leads to a clear line of reasoning that results in sound conclusions.

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