Nonlinear Processes
in Geophysics
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Discussions

Interactive comment on "Large eddy simulation of sediment transport over rippled beds" *by* J. C. Harris and S. T. Grilli

Anonymous Referee #1

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General comments:

The authors apply novel hybrid LES technique, that is capable of performing Large Eddy Simulations for rapid varying flows in boundary layers forced by and external forcing such as encountered in coastal waves. This LES technique is applied in order to simulate the suspended sediment transport over a rippled bed. The results are compared to an existing data set of laboratory experiments. In this way the potential of this kind of simulations is shown.

The paper is well written and presents the works that is done in a clear way. However some clarifications and extensions are needed. Especially when discussing the results, the authors seem to focus on the hydrodynamic modelling to explain their results, while not discussion the consequences of the choice of their sediment transport modeling.

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Specific comments:

Section 3.1: It is stated that the sediment does not influence the flow (p 764 line 19). However, previously (eq 2) the sediment concentration is included in the buoyancy term of the momentum equation. These two remarks are thus not consistent with each other, especially since the effects of the buoyancy force is the most important one for suspended sediment transport. Note that the concentration of 10-6 as limit for two-way coupling effects (as quoted in this paper from the paper of Elgobashi, 1994) seems more appropriate for particles in gas than for particles in fluids. For the latter, the concentrations that two-way coupling occur need to be substantially higher. Very limited two-way coupling effects are found in experiments at higher concentrations (e.g. Best et al 1997, Muste and Patel 1997)

Section 3.1: Using a constant settling velocity is not consistent with the inclusion of density effects (if the mixture density increases, the sediment velocity decreases, because the buoyancy force increases). However, given that the concentrations are small this effect is probably not important.

Section 3.2: It is stated that the ADV does not have data due to high sediment concentrations close to the bed. I think another possible cause of data loss would be acoustic reflections from the bottom of the experimental facility

Section 3.3: The choice of the spanwise lateral boundary conditions (no slib walls) is somewhat surprising, where periodic boundary conditions would have been more appropriate. I wonder whether this particular choice of boundary conditions may lead to spanwise variations in the velocity and concentration fields.

Section 3.4 : An extra eddy viscosity is added close to the bed. The physical reason for this is not clear and should be explained.

Section 4.5 and 4.6 : Does the missing ADV data near the bed have a substantial influence on the experimental determined values of the sediment fluxes? Further

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Section 4.7. When discussing the near-wall modeling issues, the near bed boundary conditions for sediment is not discussed. I think this might be another issue. The equation of Van Rijn that is used was obtained and calibrated for steady flow conditions, thus using an average bed shear stress, rather than the instantaneous one used in the LES simulations. Some discussion of this issue is needed. Would the results change substantially when another equation is used?

Technical corrections:

p 755: line 14: "The perturbation scheme consist of first in dividing", "in" should be removed.

p 769: line 5: "At times, when there is", should be "At times, when there are" p 777: line 19 "minr" should be "minor"

fig 4 and 9: It would be helpful to the reader if the velocity fields (i.e. fig 2 and 7) could be plotted on top of this figure

fig 4 and 9: please add the unit (g/l) in which the log of the sediment concentrations is expressed.

References:

Best, Jim, Sean Bennett, John Bridge, and Mike Leeder. "Turbulence modulation and particle velocities over flat sand beds at low transport rates." Journal of Hydraulic Engineering 123, no. 12 (1997): 1118-1129.

Muste, M., and V. C. Patel. "Velocity profiles for particles and liquid in open-channel flow with suspended sediment." Journal of hydraulic engineering 123, no. 9 (1997): 742-751.

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