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Interactive comment on "Physical theory for near-bed turbulent particle-suspension capacity" *by* Joris T. Eggenhuisen et al.

Anonymous Referee #1

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This is an interesting paper detailing a quasi-theoretical model for near bed suspended sediment capacity, based on a force balance. However, the authors must address the suitability of the model chosen, and the quasi-theoretical method by which it is derived, to the flow it is applied too.

The logic between balancing the upwards force and downwards gravitational force to determine near bed mass loading is sound. However, the assumption that the upwards force balance can be approximated by turbulent forces (derived from clear-water flow numeric and experiments) in this region is not. As the authors note this region is likely super saturated, dampening turbulent fluid motion. Moreover, in high concentration (here near bed) regions the fundamental mechanics for supporting sediment is not turbulent motion, rather particle-particle interactions (Jenkins & Hanes, 1998; Hsu, Jenkins & Liu, 2003; Berzi & Jenkins, 2008; Yu, Hsu, Jenkins & Liu, 2012). It is not clear

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why the assumption that clear-water dynamics approximates the mechanics sediment suspension is valid.

Aside from this, there are a few minor issues to address: pg1) L18-20 There have been many empirical and theoretical models of sediment transport capacity.

pg1) L23-25 The absolute capacity is determined by a diffusion approach (depending on the continuum / discrete model approach used) but must be appropriately closed. The reference concentration is a non-unique means to achieve this.

Pg3) L25 Not necessarily true for particle laden flow and permeable beds.

Pg4) can you give typical range of z imax in an open channel flow in comparison to the sheet-load layer thickness.

Pg4) can you expand this argument for clarity.

Pg4) Eq 7 – why is a quadratic formula justifiable (other than an empiric fit to data). The numeric and empiric evidence presented suggests that an exponential function would be more appropriate. If clear water flow dynamics are appropriate can this be derived from dynamics in the log-law regime predominately covered by the model.

Pg5) L2-5 Clarify what is meant by a “strong” agreement – what is the error, how does this compare to alternative formulations?

Pg5) L19 suggest writing 140 ± 20 (15%) for clarity.

Pg6) L9-15 How quickly does concentration change fundamental flow dynamics (near bed is likely of high concentration).

Pg6) L30-35 There are many alternative mechanisms for sediment suspension beyond turbulence saturation, e.g.: particle-particle interaction (granular diffusion) and matrix support, as evident in sheet layer and debris flow.

Pg7) L18 suggest delete red line

Pg8) L1 and L14 Note Z depends on d and therefore so does Cb (after eliminating ws)

Pg10) L10 Saying particle size bears no influence on capacity in flows near to the earths surface is far to vague. You must put this in context as at the flow-bed interface, and the particle size dependence of the remainder of the flow.

Pg12-14) References are incomplete and inconsistently formatted.

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