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

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We acknowledge the referee's thoughtful comments.

The main comments of referee 1 touch on two important issues:

a) The manuscript does not address the relation between our criterion and treatments of high concentration basal sediment layers. Specifically, the referee points towards a series of established papers that extend the similitude between granular collisional flow and the kinetic theory of gasses to high-concentration collisional-sheetflow transport under strong shear (Jenkins and Hanes 1998 and following papers). Concentrations are high enough in this regime so that binary collisions between two particles take place constantly, yet not high enough to create enduring frictional contacts between grains, or force chains connecting many grains. Vertical gradients in particle collisions

within these high-density particle-fluid mixtures supply the upward forces to counter gravity forces in that analytical framework. This makes the referee question our choice of turbulence as the main support mechanism at the base of flow.

In answer to this comment it is important to stress the main achievement of Cantero et al.'s DNS work, which our manuscript strongly relates to. They established that the turbulent carrying capacity can be overloaded at low absolute concentrations. Turbulence extinction due to sediment oversaturation can consequently take place at low concentrations. This is contrary to the conventional assumption that sediment oversaturation is a high-concentration phenomenon.

A simple answer to the referee's comment is thus that our criterion is valid where the assumption that turbulence is the main support mechanism holds. In first instance, at low shear, this is true all the way down to the static bed. At high values of shear, and high basal sediment concentrations, we envisage stacked regimes of particle support. In a fully developed basal region these could include from the bottom upwards: a static bed of particles; a frictional regime of sliding grains; a collisional regime; a dynamic turbulent support regime; and a turbulent dispersion regime. Our manuscript focuses on the dynamic turbulent support regime

We recognize that the extension of our work to high-concentration basal regimes is an important issue to address in the future, but the integrated treatment of stacked static-frictional-collisional-turbulent support regimes is beyond the scope of this manuscript.

b) Secondly, there is a request for justification of the use of clear–water turbulent scales to determine the maximum concentration of sediment that can be suspended in what is, evidently, therefor not a clear-water situation.

The use of clear-water conditions as a scale for the vertical turbulent force is a pivotal issue in our manuscript. It is discussed on page 6, lines 7-23; but perhaps we should have made the importance more clear by giving this issue a more prominent role in the manuscript. Informally worded, I would say that the clear water turbulent scales indicate the budget that is available for the combined dynamic support of sediment and turbulent accelerations. In clear water all of this budget is applied to turbulent accelerations. Part of the budget is used for particle support in undersaturated conditions, this leaves a limited budget left-over to accomplish turbulent accelerations. These should thus, in presence of supported sediment, be suppressed with respect to the clear water condition. The papers by Graf and Cellino (2002) and Cantero et al. (2009) are cited as support. The saturation condition is determined by equating the gravity force acting on the basal sediment concentration to the clear water turbulent force scale (i.e. Gamma=1).

We will strive to clarify the discussion of these important issues in the revised manuscript.

The minor issues can be clarified or corrected in the revision.

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