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Interactive comment on "Theoretical Interpretation of the Exceptional Sediment Transport of Fine-grained Dispersal Systems Associated with Bedform Categories" *by* Tian Zhao et al.

Anonymous Referee #1

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The manuscript presents an analytical model to calculate the suspended load across fine-graded dispersal fluvial systems. Essentially the paper combines an existing empirical expression for the suspended transport rate (Eq. (1)) with further existing empirical expressions for the bed drag coefficient that take into account the different roughness of different sand beds (dune bed, ripple bed, moving flat bed). The keyword here is "empirical": there seems to be no first-principle-based model input from the authors, which makes me question whether the paper is sufficiently novel to justify publication in ESD. From checking the journal scope, it seems that ESD focuses on the physical processes rather than engineering-like curve fitting. I therefore believe that the manuscript would be more appropriate for an engineering journal. In favor of the authors, one

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Discussion paper

could possibly make the point that the manuscript reveals the physical mechanism behind the transition from low to large suspended load in fine-graded systems (roughness changes). However, at least for me, it has always been clear that this is the reason for this transition and I am quite sure that there have been other studies in the past making this connection (though, to be fair, I cannot point out any).

This being said, my only major criticism concerning the paper's validity is the apparent unawareness of the authors of the mechanisms that lead to the erosion of dunes when sediment becomes finer: It is quite well known that the wavelength of the smallest bedforms is controlled by the saturation length, which describes the response of the transport rate to small changes of the flow (e.g., see the review by Charru et al. 2013, doi: 10.1146/annurev-fluid-011212-140806). It is also quite well known that suspended load has a much larger saturation length than bedload (Wu et al., 2007, ISBN: 9780203938485; Claudin et al. 2011, doi: 10.1017/S0022112010005823). Now, the finer the sediment the larger the proportion of suspended load load relative to bedload and thus the larger the saturation length. This implies that bedforms with short wavelength (i.e., dunes) are eroded, which leads to the mentioned decrease of roughness. In this context, it seems inconsistent to approximate the total transport rate as the transport rate of suspended load for all fine-graded systems (assumption 3 in line 76) because the presence of dunes in fine-graded systems consisting of larger particles (but still fine) is associated with bedload transport. One could possibly argue somehow around that, but I strongly feel that something is missing here.

Minor comments: - Supplementary material should be in PDF format (I cannot read the equations without commercial software).

lines: 14 and 63: add the word "empirical" before "bed roughness predictor" 23: define phi 48: define u and h 51: "c is the total sediment concentration by mass" - the quantity c does not appear above line 51. 100: define "dune" and "megaripple"

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