

Earth Surf. Dynam. Discuss., referee comment RC1  
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## **Comment on esurf-2022-33**

Anonymous Referee #1

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Referee comment on "Linear-stability analysis of plane beds under flows with suspended loads" by Koji Ohata et al., Earth Surf. Dynam. Discuss.,  
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The manuscript deals with a linear stability analysis of flow over an erodible bed with suspended load. This is a resubmission of the manuscript esurf-2021-60, which I reviewed as well. At that time my suggestion was to reject the manuscript but I was open to a resubmission, which, however, "should involve a great deal of revision of the present manuscript, in particular in the way results are obtained, presented and discussed". Unfortunately, the present resubmission does not seem to have solved my concerns, so my suggestion remains that of a rejection. This time, I do not suggest a resubmission either.

Nonetheless, I remark in the following my general and specific comments, with some reference to the comments and rebuts of the original submission wherever the questions are relevant to the present resubmission too.

General comments:

The manuscript deals with a linear stability analysis of flow over an erodible bed with suspended load. The topic of dune-antidune formation has been deeply investigated in the past in terms of linear stability analysis, but the effect of suspended load has been neglected in recent theories, which assume bedload only. The inclusion of suspension represents therefore an interesting development.

My main concern remains the same. There is no such thing as the "formation of a plane bed". Plane bed is not a bedform with an extremely small wavenumber (or an infinite wavelength) as mentioned at line 61 of the revised manuscript. Plane bed is the result of the absence of bedforms, which corresponds to the stable "upper plane bed" region where neither dunes nor antidunes form and the growth rate is negative. Indeed, the problem under investigation is the stability of a uniform flow over an erodible plane bed with active

sediment transport. The focus of the paper must be on the effect of suspension on the formation of dunes and antidunes. If the unstable regions expand, the stable "upper plane bed" region shrinks, and viceversa.

The choice of the governing parameters is unfortunate, with an unnecessary and awful mix of dimensional and non dimensional quantities which makes the analysis of the results quite cumbersome. Finally the discussion is too concise and leaves many points unaddressed. This is true for the conclusions as well.

Specific comments:

1) Please show stability plots in the Fr-k space. The Froude number is THE stability parameter for dune-antidune stability the sub-super critical character of these bedforms being well established. If you want to show the effect of suspension on the dune-antidune stability, you should start from the marginal curves (the boundaries of the unstable regions) in this space.

2) In your rebut to the original submission, you stated "Actually, the Shields stress does not necessarily increase with Fr because the Froude number is normalized by the square root of the product of the flow thickness and the gravity acceleration.". This is a nonsense. Stability plots in the Fr-k space are obtained for a constant value of the grain size to depth ratio D (or of the friction coefficient  $C_z$ ), so that the Shields stress of the base uniform flow is strictly proportional to the square of the Froude number.

3) Related to the previous point, I confirm my concern: the role of suspension should become increasingly important as Froude is increased, hence moving from dunes to the upper plane bed region to antidunes. I expect marginal curves in the Fr-k space to be deformed by the effect of suspension, the smaller the grain size to depth ratio D the lower the value of the Shields parameter at which the marginal curves for dunes and antidunes are affected. I would like to see clearly this effect before wandering in the Fr-D space, where any information on the wavenumber is lost and the unstable regions for dunes and antidunes overlap (although they remain distinct in the Fr-k space) because the upper limit for dunes in terms of Froude number may be higher than the lower limit for antidunes, especially for finer materials.

4) Stop using dimensional parameters! Use Rep instead of the fixed dimensional grain size in figures 2 and 3. Use the grain size to depth ratio instead of the fixed dimensional flow depth in figures 4 and 5.

5) The wavenumber of maximum amplification is difficult to read in regions where dunes and antidunes overlap. Please use the growth rate of maximum amplification instead and

show the curves  $Fr_{ca}(D)$  and  $Fr_{cd}(D)$  that bound the instability regions in Figures 2, 3, 4 and 5. Moreover, are the latter of any help for the reader in order to understand the results of your analysis? Five lines of text in the manuscript (280-284) do not justify two pages of figures.

6) Before attempting a comparison with experimental data, provide the reader with some plots of your stability analysis to explain your results and choose more wisely the values of the parameter you fix: in figure 2b dunes disappear, meaning that suspension completely inhibits dune formation. This does not help much to understand what happens in between. Moreover, some pictures are really obscure: what are those color leaks in figure 3b at  $D=0.007$  and  $D=0.03$ ? For such a coarse bed material suspension should be irrelevant in the dune region, whereas the plot is remarkably different from figure 3a in that region. Hard to explain.