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Comment on acp-2022-485

Anonymous Referee #1

Referee comment on "Characteristics of Aeolian sediments transported above a gobi surface" by Zhengcai Zhang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-485-RC1, 2022

Review for Characteristics of Aeolian sediments transported above a gobi surface, Preprint acp-2022-485

General Comments:

This paper examines aeolian sediment transport on “gobi” desert surfaces in China, which are desert surfaces that are fairly stony, with relatively little exposure of loose sediment (about 50%). The study uses field data from four sites in China’s Alxa Plateau to compare aeolian transport rates over gobi surfaces with those over what the authors call “shifting sand” surfaces and to examine how well published parametrizations for horizontal and vertical sediment transport are able to represent the gobi surfaces. The study sites are also used to infer the effects of surface disturbance on sand transport and dust emission.

Overall, the paper adds to the collection of datasets of sediment transport that have been collected at various locations around the world by researchers. There is a paucity of such datasets from Asia and the addition is a welcome contribution in that regard. In terms of impact, the finding that sediment transport rates over a stony surface are much higher than shifting sand surfaces is interesting, but a question arises about whether this is simply a result of very high wind speeds rather than anything that is specific to the stony surface cover. With respect to the quantification of dust (highly suspendible clay and silt, nominally smaller than 15 microns in size), it is unclear if the measurement techniques employed are adequate for accurate assessment of the transport of such particles in suspension. In my view, resolution of this is needed before any significant conclusions can be drawn about suspended dust in this system.

Specific Comments:

- Figure 1: All of the panels in Figure 1 are either too small, too difficult to decipher, or both to be helpful. Panel a shows a map with the words "Study Region" but none of the features on the map are labeled and the study region is not clearly marked. Panel b and c are OK, but if panel b was larger, then the underlying topographical features can be seen better. It's not clear what information is to be extracted from panels d-f. It is hard to see the instrumentation. Suggest replacing these with a plan view of the field measurements and a closeup view of the LDDSEG sampler, preferably as deployed in the field.
- Lines 85-95 describe the use of the LDDSEG sampler. It is stated that the sampler captures 86% of the particles being transported. Is this by mass or by number? Is there a difference in this efficiency by size? This is important, because if I understood correctly, the material in these traps is later used to quantify the dust fraction. How well does the sampler capture the dust fraction? Does the sampler have screens? How large are the openings?
- Lines 85-95: It's a minor point, but for clarity, were the measurements between S1u and S4d collected simultaneously or was each field site measured at a different time in the Jan 10 -14 period?
- Lines 95 – 100: There are two concerns I have with this measurement, one minor and one major. The minor concern is that "PM10" refers to suspended particulate matter with aerodynamic diameter of 10 microns or smaller. The Malvern digisizer is not able to estimate aerodynamic diameter. Did you use physical/optical diameter? If so, it would be good to explain that this is not "PM10" in the standard sense of the word. A greater concern that impacts several of the findings later in the paper is that the Malvern digisizer measurement is not ideal for measuring suspended fine dust. If I understand correctly, the instrument is not able to differentiate between dust particles that are free and suspended at the time of collection (i.e., they were in suspension in the air) from those that are simply attached to larger silt and sand particles (i.e., are just along for the ride while a sand particle saltates). If these dust sized particles that are being measured by this technique are not in fact suspended in the air when they are collected, then any conclusions about dust emissions or even horizontal transport of dust will be questionable.
- Lines 123 – 135: It would be good to state explicitly that the sampler had 50 distinct vertical bins.
- Line 151: What is the justification for choosing 0.07 m and 0.99 m as z2 and z1? Figure 4 suggests that the lower height (0.07 m) is located in a part of the profile that is transitional between two different regimes. Equation 9 is meant to be used with concentrations (mass/volume). How does the "horizontal concentration" work within equation 9? Why not convert to a regular concentration?
- Lines 159-162: "…This indicated that wind erosion occurred more easily on disturbed gobi surfaces than undisturbed gobi surfaces." It is difficult to follow the line of reasoning from the previous sentence to this one. In any case the differences in z0 from the two types of surfaces is very small and likely insignificant given the errors in curve fitting.
- Lines 190 – 194: What should the reader take away from the difference in the sediment transport rate of change between sites?
- Lines 196 – 202: Putting aside the issue mentioned earlier about quantification of dust, it is difficult to say generally that disturbed surfaces are 1.6 to 2.1 times more emissive than undisturbed surfaces without some estimate of what fraction of the surface is disturbed in terms of the area upwind of your sampling instrumentation? Considerable previous work has shown that disturbed surfaces can be orders of magnitude more emissive than undisturbed surfaces, when measurements are highly localized. So, this

"ratio" changes with distance from the disturbance area.

- Figure 5b: The x-axis expresses PM10 as a percentage. What does this percentage refer to? It is difficult to relate this directly to a suspended concentration of dust particles as it is currently expressed.
- Line 237: "These results indicate that the sand transport above a gobi surface are much larger than above a shifting sand surface." It does appear that sand transport is higher on the gobi surface, but it is not clear if this is due to the nature of the surface or simply the very high wind speeds.
- Section 4.1: I was not able to follow the importance of section 4.1. Suggest adding some explanation of the intent behind the analysis and why the approach was chosen.
- Lines 258 – 270: The discussion of PM10 transport and how it relates to u*/u*T is tenuous because of the previous concern raised about how PM10 was quantified.
- Figure 12: What height do the data in these three panels represent? Also, what is meant by frequency as the y-axis parameter? Is this particle size occurrence frequency?
- Lines 304 – 305: Here again, it would be good to put into context the wind speeds when concluding that transport rates above gobi surfaces are higher than those above shifting sand surfaces. Wind speed is a primary driver of aeolian transport and comparing two locations without comparing the winds they experience does not give a full picture of the inherent transport potential of the surface.
- Lines 321-322: The results do indicate a difference in transport magnitudes between gobi surfaces and shifting sand surfaces reported in the literature, but in my view, they do not offer insight into any underlying mechanisms.
- Lines 326 – 328: As mentioned above, these friction velocities are quite high and might be the main driver of high transport rates. This is important, but does not necessarily lead to insight into the mechanisms of transport.
- Lines 335 -337: These talk about the vertical transport of PM10 not being related to wind speed. This would be consistent with the possibility that most of the measured dust particles in the Malvern Digisizer were associated with larger silt and sand particles and not suspended on their own in the air.