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Comment on acp-2022-485

Anonymous Referee #3

Referee comment on "Characteristics of Aeolian sediments transported above a gobi surface" by Zhengcai Zhang et al., Atmos. Chem. Phys. Discuss.,
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Review of Characteristics of Aeolian sediments transported above a gobi surface by Zhang et al.

The paper analyzes aeolian sediment transport above a "gobi" surface, which is characterized by high amounts of gravel. The paper concludes that both the horizontal and vertical sediment transport are much larger than those from a shifting sand surface and that this difference resulted from a larger sand transport rate and saltation height above the surface, which is related to the gravel cover and soil crusts on the gobi surface.

General comments

The data collected is interesting, particularly given that such datasets are relatively scarce. However, there are multiple flaws in the application of the methodology and therefore in the results. Also, it is not clear whether the higher sand transport in this study compared to previous ones over shifting sands is just due to a different wind regime (higher wind speeds). In any case, there are not clear insights into the mechanisms that may cause the higher sand transport and the justification seems speculative.

- The uncertainties associated with the measurements are not quantified, and therefore they not taken into account when assessing the results. For example, given that the paper attempts at providing insights into the size distribution, the information provided on the efficiency of the LDDSEG vertical segmented sediment sampler is notably insufficient. Does the 86 % refer to particle mass or number? What is the efficiency per particle size range? Does the efficiency change as a function of wind speed? Typically, passive samplers are much less efficient for small particle sizes. Given that the study also focuses on the dust "PM10" fraction, this aspect is critical, but nothing is discussed in that sense. Another example, is the rather crude derivation of the friction velocity

based on only one measurement height.

- What is PM10 in this paper? Is it the fraction derived from the Malvern analysis? If the "PM10" fraction is based on the Malvern analysis of the collected samples, how can we know the fraction of dust particles that were already airborne compared to those attached to other particles? I believe this is not possible.
- In eq 9. the gradient method to obtain the vertical dust flux relies on ambient dust concentrations (kg/m^3) above the saltation layer. In your study you use c_1 and c_2 in $\text{kg}/(\text{m h})$ which are units of saltation flux at heights within the saltation layer. These units are wrong, and the units of F (vertical dust flux) are also wrong and inconsistent with your already incorrect "concentration" units. Throughout the paper the units of vertical flux are also expressed in $\text{kg}/(\text{m h})$ when in reality the vertical dust flux should be in $\text{Kg}/(\text{m}^2 \text{ h})$. In other words, you are expressing both concentrations and vertical fluxes with units of horizontal flux. There seems to be a certain lack of understanding of the vertical dust flux, which is defined throughout the paper with very different names (vertical sediment transport, vertical dust flux, vertical sand flux...). I believe that with your measurements you cannot obtain the vertical dust flux appropriately. You are measuring the horizontal fluxes in the saltation layer and at the same time, as mentioned in points 1 and 2 above, the PM10 fraction is likely very uncertain. This implies that the results in many figures (Figures 5, 6, 9 10) are incorrect and that the associated conclusions may be flawed.
- In the conclusions it is stated: "the characteristics of sand transport and the underlying mechanisms for gobi surfaces differed from those for sandy surfaces." However, the paper just concludes that the coefficients that best fit the equations are different than for sand surfaces and does not provide any insight into the mechanisms.

Specific comments:

Figure 1g mentioned in the caption is missing

Line 92: 7 or 8 periods?

In eq 1 R H and M are not specified. How these factors were calculated? How the final values in Table 4 were calculated?

Line 122: Note that you do not infer the friction velocity threshold from observations, you calculate it based on an approximation, which is likely uncertain.

Line 123: Why mean and not median diameter?

Table 5: 10^{-3} instead of 10^3 . Note that the differences in roughness are small (probably much smaller than the uncertainty in the method to derive the roughness length)

Line 190... I do not understand the description of Figure 4a here. Are you really referring to Figure 4a?

Figure 6: you mention PM10 concentration but in reality, it is the fraction of PM10.