

# ***Interactive comment on “A Livestock Trampling Function for Potential Emission Rate of Wind-blown Dust in a Mongolian Temperate Grassland” by Erdenebayar Munkhtsetseg et al.***

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[answers, 12pt]exam

## **Response to Referee #2 :**

We appreciate the Editor and Referee # 2 for their valuable and constructive comments for this manuscript, which greatly assist in improving the quality of the original manuscript. We have carefully checked and revised the whole manuscript according to the Referee #2's comments. Please find a point-by-point reply to the issues as follows. And we have also uploaded the revised manuscript file of 'acp-2017-94-revised.pdf'.

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## Comments raised by Referee # 2

This paper examines the effect of livestock trampling on the potential for dust emissions from Mongolian Steppe grass landscape. The basic approach is to use wind tunnel measurements (PI-SWERL) to measure windblown emissions on background (untrampled) surfaces and subsequently trampled surfaces. Two types of measurements are conducted. The first is in a controlled pen where livestock grazing was not allowed for some time. This area was apparently used to obtain background (undisturbed/ untrampled) levels of dust emissions. The area was then grazed by livestock (estimated density of 250 head per hectare) and re-measured for emissions. In separate tests, a transect of wind tunnel measurements was conducted in 2009 and again in 2010 through an area of actual livestock grazing with estimated densities of 201 and 241 head per hectare. The results are analyzed for dust emissions increases due to livestock grazing at different values of friction velocity.

Overall, this information is very valuable to the understanding of wind erosion, especially in the Mongolian Steppe. These kind of data are lacking from the literature and can be very helpful for estimating anthropogenic impacts on the dust problems within Asia.

I have two major concerns with the manuscript. The first is that it can be rather difficult to follow the discussion because the presentation is not always clear. I found myself having to guess the meaning of a lot of sentences and infer information where I would have liked to know for sure that the authors were conveying a specific point. The second is that while the data collected are quite valuable, the variation in conditions is rather limited and it is not clear that the extensive development of functional relationships is warranted or justified. These include somewhat limited temperature, relative humidity, and antecedent soil moisture information. They also include a limited range of livestock trampling which span from 201 to 250 head per hectare and are based on necessarily coarse estimates since it is difficult to know precisely how many sheep trampled over what area during what period of time.

In my view, both of these concerns can be addressed by substantially shortening the manuscript and sticking strictly to the main findings. Organizationally, I suggest greatly shortening the introductory and background information to the minimum necessary to convey the importance of livestock grazing to Asian dust. Technically, I recommend that rather than fitting a function of  $u_*$  and  $N$ , it would be better to simply provide an enhancement factor of emission due to livestock trampling at different values of  $u_*$  and stating that the information applies to N 250 head per hectare. The exact representation is up to the authors, but one option would be a curve that has  $u_*$  on the x-axis and enhanced emissions on the y-axis ( $F_N/F_{REF}$  in the notation of the manuscript, similar to what is now depicted in Figure 5a and b). This would also help show that there is apparently a  $u_*$  below which there appears to be little difference in emissions between trampled and untrampled steppe soil. Perhaps the discussion can then focus on the limited nature of the study and where additional information would be most helpful in future work.

**Response:** We completely agree to the Referee's comments given on our manuscript (MS); and by it, we have substantially improved quality of our MS. We strongly believe that the Referee # 2 will satisfy with the revised version of the manuscript. We greatly appreciate your contribution for the improvements of our manuscript giving us well-instructed comments. The major revisions are included:

1. The livestock trampling function ( $f_L$ ) is excluded from our MS. Our revised MS focuses on the scale factor of dust emission due to trampling as the Referee # 2 suggested.
2. We have shortened 'Introduction section'. We have added a tabular chart of a scale factor for a better illustration, and revised texts in 'Discussion section' for a clarity.

3. Since we have stuck to the main results, the related and associated parts (title, abstract, result, discussion) are justified and corrected as well.

### Point by point response

1. This paper examines the effect of livestock trampling on the potential for dust emissions from Mongolian Steppe grass landscape. The basic approach is to use wind tunnel measurements (PI-SWERL) to measure windblown emissions on background (untrampled) surfaces and subsequently trampled surfaces. Two types of measurements are conducted. The first is in a controlled pen where livestock grazing was not allowed for some time. This area was apparently used to obtain background (undisturbed/ untrampled) levels of dust emissions. The area was then grazed by livestock (estimated density of 250 head per hectare) and re-measured for emissions. In separate tests, a transect of wind tunnel measurements was conducted in 2009 and again in 2010 through an area of actual livestock grazing with estimated densities of 201 and 241 head per hectare. The results are analyzed for dust emissions increases due to livestock grazing at different values of friction velocity.

Overall, this information is very valuable to the understanding of wind erosion, especially in the Mongolian Steppe. These kind of data are lacking from the literature and can be very helpful for estimating anthropogenic impacts on the dust problems within Asia.

**Response:** Thank you very much for your careful reading of our manuscript. We greatly appreciate your positive comment and given a value on our work.

2. I have two major concerns with the manuscript. *The first* is that it can be rather difficult to follow the discussion because the presentation is not always clear. I

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found myself having to guess the meaning of a lot of sentences and infer information where I would have liked to know for sure that the authors were conveying a specific point. *The second* is that while the data collected are quite valuable, the variation in conditions is rather limited and it is not clear that the extensive development of functional relationships is warranted or justified. These include somewhat limited temperature, relative humidity, and antecedent soil moisture information. They also include a limited range of livestock trampling which span from 201 to 250 head per hectare and are based on necessarily coarse estimates since it is difficult to know precisely how many sheep trampled over what area during what period of time.

**Response:** We totally agree to the two major points raised by the Referee # 2.

- Firstly, we have revised 'Discussion section' according to the Referee's point by adding a tabular chart for scale factor (Fig.7) and editing text.

[Page 19, Figure 7; Page 17]

- Secondly, our data was obtained in the limited condition. Yes, the further study is needed to investigate and develop a such functional relationship as Referee # 2 mentioned. Livestock trampling time span is on annual. We have clarified it in the manuscript.

[Page 8, Line 15]

3. In my view, both of these concerns can be addressed by substantially shortening the manuscript and sticking strictly to the main findings.

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information to the minimum necessary to convey the importance of livestock grazing to Asian dust.

Technically, I recommend that rather than fitting a function of  $u_*$  and  $N$ , it would be better to simply provide an enhancement factor of emission due to livestock trampling at different values of  $u_*$  and stating that the information applies to N 250 head per hectare. The exact representation is up to the authors, but one option would be a curve that has  $u_*$  on the x-axis and enhanced emissions on the y-axis ( $F_N/F_{REF}$  in the notation of the manuscript, similar to what is now depicted in Figure 5a and b). This would also help show that there is apparently a  $u_*$  below which there appears to be little difference in emissions between trampled and untrampled steppe soil.

**Response:** We highly appreciate comments raised by Referee # 2. We have revised our manuscript according to the Referee's point.  
- We have shortened 'Introduction section' as recommended by Referee # 2.

[Page 2-3]

- The livestock trampling function (fL) is no longer in the central focus of this MS. Instead, MS focuses on the (enhancement) scale factor of emission due to livestock trampling as the Referee # 2 suggested. We have separated Figure 5a and b into two figures (Figure 5 and Figure 6) to present the  $u_*$ -magnified and  $N$ -elevated scale factor. For a better presentation (and more clarified 'Discussion section'), we have added a tabular chart of scale factor in Figure 7.

[Page 15, Figure 5; Page 17, Figure 6; Page 19, Figure 7]

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- Perhaps the discussion can then focus on the limited nature of the study and where additional information would be most helpful in future work.

**Response:** Thank you for pointing it out. We obtained dust data on the limited nature; so that our result represents the limited condition. Yes, we agree to the comment. It is important to mention our study limitations and mention additional information those are needed to be explored for future research work. We have discussed the limited nature of the study and future work.

[Page 19, Line 17-24; Page 20, Line 1-6; 12]

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