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Interactive comment on "The significance of vertical moisture diffusion on drifting Snow sublimation near snow surface" *by* Ning Huang and Guanglei Shi

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Dear reviewer, Thank you for your comments concerning our manuscript entitled 'The significance of vertical moisture diffusion on drifting snow sublimation near snow surface'. We are grateful to the comments on our manuscript and carefully considered every comment, and will make cautious revision accordingly. Below are our point-to-point responses.

Item 1: Does the snow sublimation in near-surface region have an impact on the mass and movement of snow particles? That is, Does the change in m also go into equations (4)- (6)? Response: Thanks for the comment. We do have calculated the impact of

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sublimation on the snow particles, and the results show that the loss in mass of a single particle due to sublimation during its whole movement process is less than 0.1% of its own mass. Thus, the change in m didn't go into equations (4)-(6).

Item 2: According to the authors, the blowing snow sublimation will reduce the air temperature. It is not clear how the effects of temperature change and the flow field are related in your simulation. Response: The temperature drop caused by snow sublimation is generally very small and does not exceed 2K. We verified that the temperature change of 2K has little effect on the wind field and it was ignored in our simulation.

Item 3: Usually the snow particles in the air are divided into suspension and saltation particles, and you seem to distinguish them simply by height. Please explain the reason. Response: In Aeolian study, scientists usually define the particles jumping near surface, as saltation particles, which are mainly composed of large particles; define the particles whose movement distance in the air is long, as suspension particles, which are mainly composed of small particles. For simplicity's sake, a critical height is given. That isïijN̆articles fly higher than the critical height are regarded as suspension, while particles move below the height are considered as saltation. Furthermore, some scientists believed that the blowing snow sublimation in the near-surface region cloud be ignored, so they assumed that relative humidity below the critical height, which was used to distinguish the saltation and suspended particles is 100%. In this paper, we chose three heights defined by other scientists (see Table 3), and calculated the blowing snow sublimation masses below these heights. The results show that all the sublimation masses below the three heights, account for more than half of the total sublimation mass (see Fig. 12). Because the difference of the critical height defined by different scientists very greatly (see Table 3), which made the simulation results produce a big difference. In this manuscript, we distinguish the saltation and suspending particles (Eq.2) based particles' flowing ability of the wind field. The diffusion equation was applied to describe the motion of suspended particles for small snow particles follow the wind field well. The Lagrangian particle tracing method was used to trace the

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motion of every large snow particle saltating in the near-surface region.

Item 4: Fig. 12 shows that snow sublimation occurs mainly in the near-surface region. It seems contradictory that in Fig. 13 the water vapor flux in the upper air is larger than that in the near-surface region. Response: Because snow sublimation occurs mainly in the near surface, the humidity will decrease with the height. The water vapor produced by sublimation will be transferred from the lower humidity area to the higher one, and the amount of water vapor flux is determined by the concentration gradient of water vapor, not by the amount of sublimation. Therefore, it is possible that the water vapor flux in the upper air is larger than that in the near-surface region.

Item 5: All the results in Figure 4 don't include the results of saltation particles sublimation, but why the results of this paper is larger than that of xiao et al.. Response: In the simulation of Xiao et al., they considered that the water vapor in the near-surface region was saturated. That is, the humidity in the near-surface region was assumed to be 100%. In our simulation, the humidity in the near-surface region would not attain to 100% because of the vertical transportation of water vapor. Thus, the calculated humidity of this paper is smaller than that of Xiao et al., and the sublimation result of this paper is larger than that of Xiao et al. accordingly.

Item 6: This manuscript refers that there is a negative feedback effect in the blowing snow sublimation. Actually Figure 9 shows that the saltation particles sublimation does have a significant negative feedback effect, but you did not take into consideration of the feedback effect of sublimation of the suspended snow particles? Response: It can be seen from Fig10a, 11a that the mass concentration as well as sublimation rate of the saltation snow particles is very high, so the saltation snow particles sublimation will strongly affect the temperature and humidity of the surrounding air. Therefore, it has a very strong negative feedback effect. However, it can be seen from Fig10b, 11b that both the mass concentration and sublimation rate of the suspension snow particles are much lower, so the effects of suspension snow particles sublimation on air temperature and humidity are very small. Therefore, its negative feedback effect is negligible.

Item 7: The writing proficiency of this manuscript need to improve because there are some writing errors in this paper. For example, the friction wind speeds in Figure 7 and Figure 8 are not expressed by the same symbol. In the first sentence of the abstract "Drifting snow sublimation is a physical process containing phase change and heat change. . .", the words "of the drifting snow" should be deleted. Response: Following the reviewer's suggestion, we have corrected these writing errors. We also found a native English speaker, who is an English teacher in my university to revise the English of this manuscript so that a clear description on the research will be displayed in the revised version.

Once again, thank you very much for your comments and suggestions. Best regards Ning Huang and Guanglei Shi

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