Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2015-795-AC3, 2016
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impacts of moisture transport on drifting snow sublimation in the saltation layer" *by* N. Huang and X. Dai

N. Huang and X. Dai

daixq08@lzu.edu.cn

Received and published: 29 April 2016

We'd like to thank Referee #3 for the insightful comments and positive evaluation of our work. We have studied comments carefully and will do our best to revise and improve our manuscript. The comments by the reviewer are repeated and the responds are as follows.

In this study, the authors present an interesting research to evaluate the effect of drafting snow sublimation in the saltation layer, which is rarely studied, but important for the hydrological balance of snow cover. A snowdrift model with considering the coupling effects of snow sublimation, temperature, humidity and moisture transport is established to address their ideas and research. They describe their models and methods concisely and clearly and analyze the results reasonably.

Reply: We thank the reviewer for the positive evaluation of our work.

They present a well-written article, but the Results section seems a little short and has no comparison with the measurements or published data.

Reply: Just like the reviewers and Prof. Yaping Shao, we also think that some measurements are necessary for validation of our simulation results. Unfortunately, the measurement of snowdrift sublimation in the saltation layer is very difficult to conduct at the present stage. Even so, we will try to conduct such measurements in our future studies.

The authors need to carefully check their manuscript again to do a better job of defining the parameters they use for the controlling equations, for example, the definition of the sublimation rate S.

Reply: Thanks. We will carefully check the manuscript again to make the parameters of the controlling equations more clearly.

The prognostic equations of potential temperature and specific humidity (Eqs. 11 and 12) seem to be different from the reference, which may lead to misunderstandings (just as the comments of reviewer 1). In order to express the calculation of temperature and humidity more clearly, it would be better to derive the prognostic equations from the basic convection diffusion equation.

Reply: Thanks for the insightful comment. We will derive the prognostic equations of potential temperature and specific humidity from the basic convection diffusion equation in the revised manuscript.

Why each calculation takes 60 s and doesn't show the sublimation rate when it tends to be stabilized?

Reply: Thanks for the insightful comment. By considering of the required time of drifting snow development and the capability of computer, the simulated time was set as 60s, which is significantly surpass drifting snow development time (about 2-3 s) and

could be actualized easily on PC. That is indeed that, the sublimation rate is hard to be stabilized in this 60s, but our results could expose the issues that we care about. Theoretically, the snow sublimation may vanish finally with the development of time. As we state in our manuscript, DSS has an inherent self-limiting nature due to the feedback associated with the heat and moisture budgets. On one hand, snow sublimation absorbs heat, which decreases the temperature of the ambient air and the saturation vapor pressure; on the other hand, it will induce the increment in the moisture content of the ambient air. Both of the above two points can increase the relative humidity of ambient air. It may lead to a saturated layer near the surface finally, and thus sublimation will vanish. Here, we show the temporal evolution of drifting snow sublimation within 60 s to compare our results with the previous study.

I agree that it could be discussed if the variation of temperature could induce some effects on velocity field. The evolutions of snow particles concentration should be discussed.

Reply: Thanks. Indeed, the variation of temperature could induce some effects on velocity field. However, we found that this effect can be ignored by testing (Fig. 1). In our study, the temperature varies between 261.5 K and 263.15 K. The variation of temperature due to snow sublimation is below 2 K, which is relatively low. From Figure 1, we can see that the effect of variation of temperature on velocity field is very small. Thus, we didn't take this effect into consideration. In addition, following the reviewer's suggestion, we will add a figure to show snow particles concentration profile evolution in the revised manuscript.

On the whole, this work is a fundamental research and obviously focusing on science common topics, which is interesting and well present.

Reply: Thanks for the positive evaluation of our work.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2015-795, 2016.

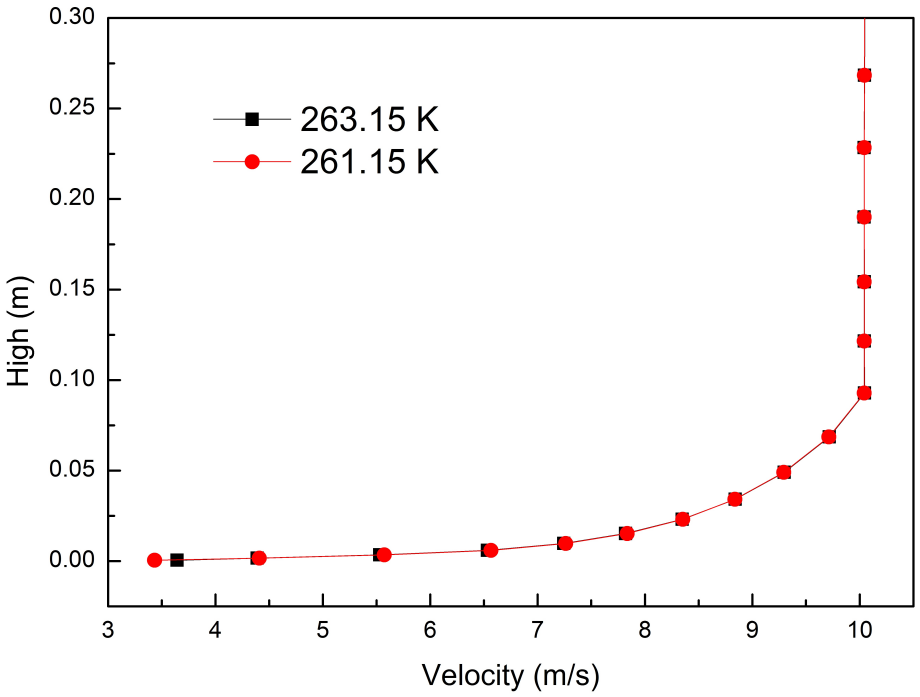

Fig. 1.