Response to comments by Reviewer #5:

Review on the "Investigating the performance of Genetic Particle Filter in snow data assimilation across snow climates" by You et al.

Snow is a critical hydrothermal variable in land surface that influences the surface energy and hydrological cycles. Snow data assimilation is also important to improve the modeling accuracy of snow and thus facilitates other related processes (e.g., albedo, snow melting runoff, and temperature). You et al. investigated the performance of genetic particle filter in snow data assimilation over eight stations and discussed the influences of different assimilating frequency and particle number. Although I am not very familiar with the data assimilation method especially the mathematical rule, I think the current research needs at least major revision to illustrate its novelty, introduce the method more clearly, analyzing the results in depth, and proofread the manuscript carefully. Detailed comments are below:

Major comments:

The novelty of this research is not clear. If the genetic particle filter is a new method, then its advantages against other methods should be investigated directly. If the "across snow climates" is a novelty, then I do not think the eight stations can represent snow climates considering the highly heterogeneous snow distribution. Finally, "the higher assimilating frequency, the higher simulation performance" is not surprising. Thus, I suggest the authors to clarify the novelty more clearly, so as to help the reader get the importance of this work. The method needs further introduction. Although the genetic particle filter data assimilation scheme is introduced in section 2.3, I am still confused that which variable you assimilate into the land surface model? If you only assimilate the snow depth, then how do you deal with other snow variables (e.g., snow water equivalent, snow density and snow age)? Also, how do you deal with the potential inconsistency between snow and ground temperature (for example, when the model shows no snow and the ground temperature is above zero, then how to assimilate the observed snow depth)? Actually, I am very concerned about the assimilation and evaluation. In figure 3, it seems you assimilate the observation every 5 days and then evaluate the model simulation at the same step? If this is the case, then will the direct insertion method show higher performance than the genetic particle filter?

Reply: Thanks for your sincere and constructive suggestions. Here, we assimilated the snow depth observation every 5 days, the temporal resolution of the simulation result and observation of snow depth are one day. To be honest, we have used the direct insertion method to improve the simulation result, however, the performance of direct insertion method even worse than particle filter.

The spatial difference. It seems the spatial difference among different stations is not strong and few information can be get (except the robust of the result, may be). Some insightful analysis on the spatial difference may help improve the manuscript. The writing needs careful proofreading.

Reply: Thanks for your sincere and constructive suggestions. We will thorough revise the manuscript according to the reviewer's suggestion, thank you very much.

For example:
L48: "succeeds in catching snow dynamics is" may be "succeed in catching snow dynamics is"
Reply: Thanks for your sincere and constructive suggestions. We have revised in the manuscript.

L51: "is aimed at investigating ... and obtain the ..." may be "is aimed at investigating ... and obtaining the ..."
Reply: Thanks for your sincere and constructive suggestions. We have revised in the manuscript.

L60: "However, this method possible result in ..." may be "However, this method possible results in ...".
Reply: Thanks for your sincere and constructive suggestions. We have revised in the manuscript.

L68: "this method does not require a model a model linearization." what do you mean?
Reply: Thanks for your sincere and constructive suggestions. The Kalman Filter is a useful tool for linear system but it requires a model linearization for a nonlinear system, the Monte Carlo approach was employed to approximate error estimates based on an ensemble of model simulations in Ensemble Kalman Filter (EnKF). As a result of this, the EnKF does not require a model linearization when used in nonlinear system.