Response to comments by Reviewer #3：

Summary: The study is focused on the simulation of snow depth with a simple energy balance model with assimilation with observations. The data assimilation scheme is based on a genetic particle filter algorithm. The main conclusion is that this algorithm performs well for snow depth simulations.

Recommendation: the manuscript is in general terms poorly written. The English needs would need extensive copy-editing, and this deficiency often hinders the understanding of technical and scientific aspects of the study. In addition, the manuscript does not include important information that is critical to understand what has been done. One is that there is no description of the genetic particle filter algorithm itself, which is surprising. Unfortunately, I cannot recommend the publication of the manuscript. A revision would entail rewriting the manuscript almost completely.

Main points

1）The presentation is poor. The English needs very extensive revisions; acronyms are not defined (for instance SD, which I interpret to be snow depth! SWE and GPF are not defined either). The discussion is restricted to the own results and does not place the results in the framework of previous studies (what has been learned, what is the novelty?)

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

2）The destitution of important technical aspects is missing. The genetic algorithm is essentially not described the paragraph starting in line 218 is so obscure that essentially nothing can be understood. The reader is not informed of many technical aspects. What are the 'particles'? how are they genetically generated? what are the crossover and mutation operators? why the genetic algorithm would improve on the deficiencies of other particle filters?

Reply: Thanks for your sincere and constructive suggestions. We will introduce the Genetic Particle Filter algorithm in detail in the revised manuscript, including the selection, crossover and mutation process for the particles. The random samples propagating in state space are used to approximate the probability density function of state variable, in this case, the integral operation was replaced with the sample mean to obtain the minimum variance estimate of the state. And the sample members are called "particles" in particle filter. The particles were generated by forcing the model operator with the perturbed meteorological forcing data. The crossover operators are below equations:

$$x_m^{'} = \alpha x_m + (1-\beta) x_n \qquad (1)$$

$$x_n^{'} = \beta x_n + (1-\alpha) x_m \qquad (2)$$

Where α and β are the empirical crossover coefficient, $\alpha = 0.45$, $\beta = 0.55$ in this paper. The mutation operator is,

$$x_k^{'} = x_k + \eta * Uniform \quad (3)$$

where the $Uniform$ represents random of uniform distribution and η is the empirical coefficient which was set to 0.01 in this paper. The problem of particle degradation solved by conventional resampling methods like multinominal resampling and systematic resampling always results in particle impoverishment, the diversity of particles will be greatly enhanced using the genetic algorithm in particle resampling.

3) I kept wondering of the utility and meaning of some of the mathematical assumptions. For instance, equation 9 seems to be unnecessary complicated. The distribution of the random noise w is just uniform in (-2,2), so there is no need for the additional complexity of equation 9. Also, why would the temperature errors be uniformly distributed? why between -2 and 2 and which units represent those numbers (I guess C?). This is an example of a problem that goes through the whole manuscript.

Reply: Thanks for your sincere and constructive suggestions. Here the unit of these numbers is Kelvin. And the perturbation method of meteorological forcing data was referenced in Lei et al. (2014). We think this method is very effective in snow data assimilation. We will thorough revise the manuscript according to the reviewer's suggestion, thank you very much.

Reference:

Lei, F. N., Huang, C. L., Shen, H. F., et al. (2014), Improving the estimation of hydrological states in the SWAT model via the ensemble Kalman smoother: Synthetic experiments for the Heihe River Basin in northwest China, Advances in Water Resources, 67: 32-45.