

Response to comments by Editor:

Dear authors,

This manuscript uses field data to improve snow modelling through the genetic particle filter algorithm. The topic is highly relevant and fits nicely within this SI. However, the manuscript requires significant improvements in order to be considered for possible publication in HESS. The Introduction section should be shorted, more concise and better highlight the research question and the need for this study, and use more updated references. The study sites must be better described, namely regarding the snow differences between the sites, so that we can understand the real application of your proposed method. The methodology requires relevant improvements to describe the genetic particle filter algorithm, and all the mathematical assumptions performed. The Results must be clearly presented and discussed. Discussion should clearly present the advantages of the proposed method comparing with others, and the limitations linked with the assumption performed. It is also important to compare the results with those from previous studies, and bring more references into this section. The Conclusions section must clearly identify the novelty and main messages of this study, and clearly identify why the proposed method is better than the available ones. Language editing is also required. More detailed comments have been provided by reviewers and must be considered in improving the manuscript. There was one late reviewer whose comments are provided below and should be also considered.

Reply: Thanks for your sincere and constructive suggestions. As you said, some significant weaknesses in this manuscript and we will thorough revise the manuscript according to the Editor and Reviewer's suggestion, thank you very much.

Reviewer 6:

In this manuscript, You et al. set up a particle filtering framework using the Genetic Algorithm to avoid particle filter-typical degeneracy and sample impoverishment issues. They apply this framework to snow depth measuring sites in different climatological regions, expecting to learn about particle filter performance at each of the sites. They analyze the assimilated snow depth with respect to the suitability of their particle filtering algorithm for application in different snow climates, the influence of the used particle number on performance metrics, and the influence of assimilation window length on the performance. The manuscript is structurally well-organized. The topic is in general very interesting and the effort to push the field of data assimilation forward is very much appreciated. However, in my opinion there are some significant weaknesses in this manuscript:

- a lacking motivation of the research question(s) relevance

Reply: Thanks for your sincere and constructive suggestions. The original goal of this study is to investigate the performance of genetic particle filter used as a snow data assimilation scheme across snow climates and we attempted to resample the particles using genetic algorithm, we will thorough revise the manuscript according to your suggestions.

- a superficial description of the measurement sites and their properties, making a meaningful interpretation of the results with respect to the research question(s) difficult.

Reply: Thanks for your sincere and constructive suggestions. we will thorough analyze the experimental results according to the reviewer's suggestion, thank you very much.

- a lacking presentation of the Genetic Algorithm and stressing why this method is the most suitable for the analysis

Reply: Thanks for your sincere and constructive suggestions. The degeneracy and sample impoverishment issues are common faults of particle filter, here, the genetic algorithm was used in resampling process was expected to effectively overcome these issues.

- a superficial interpretation of the results, in particular with respect to the overarching hypothesis (different filter performance in different "snow climates")

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

- issues with the used literature in the References section and in general a rather scarce literature selection. Difficulties in the use of English, which makes some sections of the manuscript hard to understand

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

- an intransparent (or simply not listed?) choice of model parameter values and meteorological values to perturb; unclear or not explained error distribution choices.

Reply: Thanks for your sincere and constructive suggestions. We will introduce the meteorological perturbation method in the manuscript.

- a results and discussion section that partly loses contact with the research questions

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

If this manuscript is accepted for a major revision process, it should be largely rewritten and then undergo line-by-line comments in a second review iteration. The focus should first be on the following aspects:

- reworking the manuscript research questions (is it about the filter performance in different climates as the title suggests or about the three questions formulated at the end of the introduction, or both?)

Reply: Thanks for your sincere and constructive suggestions. The original goal of this study is to investigate the performance of genetic particle filter used as a snow data assimilation scheme across snow climates

- a more comprehensive literature review on the technical literature regarding the research questions

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

- a more detailed description of the used particle filter method and why this filter is chosen to be the most suitable to answer the research question

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

- a more critical questioning of the results, in particular with respect to the 100-particle threshold (e.g. why in Fig. 7 a minimum exists at 100 particles).

Reply: Thanks for your sincere and constructive suggestions. We will explain the reasons in the revised manuscript.