

## ***Interactive comment on* “Sensitivity of modeled snow stability data to meteorological input uncertainty” by Bettina Richter et al.**

**Bettina Richter et al.**

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### **Reply to Referee 2**

We thank the referee for the positive and very constructive feedback. In the following we will reply point-by-point. Your comments are in blue, replies in black.

In their manuscript "Sensitivity of modeled snow stability data to meteorological input uncertainty", the authors perform a sensitivity analysis of modeled snow stability data and indices to uncertainties in the meteorological forcing data. For this purpose, the widely used snow cover model SNOWPACK is forced with disturbed meteorological input data implementing different bias scenarios on the single meteorological parameters resulting in 14,000 simulations.

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## General comments:

I understand that this is a model sensitivity study and the model has been validated in other studies. However, I would highly appreciate if you could add some model validation for your presented case study to get a better understanding of the model performance especially with respect to the model's sensitivity to forcing errors. As I understand, you have some observed profiles available, maybe directly at the WFJ site? You could add a validation plot in Sect. 2.2 (e.g. accompanying Fig. 1?) for the undisturbed reference run after averaging the SNOWPACK layers as described there. I see that you perform kind of validation by comparing the results to avalanche activity and AAI, but it would be very valuable to have a direct comparison to measurements, in the best case even within the uncertainty range figures (Figs. 3 and 5). In addition, you should add modeled snow depth from the reference run to Fig. 2 (which I assume is observed snow depth, information should be added to the Fig. caption). All this would bring the findings of the impacts of forcing uncertainty on modeled snow stability in better context to reality and build more trust in the models to be used in operational forecasting.

As suggested, we will add the observed snow profiles to Figure 1. We will then present weak layer and slab layers with observed snow stratigraphy and the reference run in section 2.2. Furthermore, we will add modeled snow depth from the reference run to Figure 2. As we do not have manually observed snow profiles at the dates, we present in this study, we cannot show observed weak layer properties. Furthermore, this would need considerably more details on how slab and weak layer properties were presented from manual snow profiles (e.g. grain size 1 is defined by average grain size of all crystals and grain size 2 is defined by average grain size of largest crystals), so we prefer not add manual data to Figures 3 and 5.

I think the bias/disturbing procedure to produce the disturbed meteorological forcings within the given ranges needs some more explanation. Specifically: at what time scale are the errors applied? Is it a constant offset applied to the time series for a scenario

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or does it have some time variability within the scenario? This should then be referred to in L. 301-306.

We will explain, how uncertainties are applied to the input in more detail. We will explicitly mention, that a bias  $b$  was randomly chosen for each variable and then that single value applied to the variable for a given time series. Furthermore, we will explicitly mention, that the given time series ranged from 1 October 2016 to 2 January 2017 for case WL, 3 January 2017 to 1 May 2017 for case SL and the entire season for case ALL.

### Specific Comments:

At some points in the manuscript you use “snow height”, but mostly “snow depth”. Please use “snow depth” consistently.

For more consistency, we will change snow height to snow depth throughout the manuscript as suggested.

L. 15: "...sensitive **to** precipitation..."

We will change as suggested.

L. 55: You state: "However, only a few studies have so far assessed the uncertainty of snow cover models." I would rather change this to, e.g., "However, only a few studies have so far assessed the impact of forcing uncertainty on the performance of snow cover models." because there are many studies available in literature which assess the performance and uncertainty of snow cover models in general.

We will change as suggested.

L.105: "For the sensitivity analysis, we introduced uncertainties to the meteorological input." This sentence could be removed here, as you explain this in the next sections.

We will remove this sentence as suggested.

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L. 150: I suggest to remove the sentence "For each scenario, 14,000 simulations were performed." here, as the number of simulations is explained in the following section 2.4. You could instead extend the last sentence of 2.4 (L. 170), e.g. like "...for each of the three applied scenarios."

As suggested, we will move the content of this sentence to the next section.

L. 274 "Precipitation influences weak layer and slab properties." instead of "Precipitation influences weak and slab properties."

We will change as suggested.

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