

## COMMENTS TO REFEREE #2

### General comments

The manuscript presents parametrization of the snow depletion curves at a small plot in Mediterranean site. This parametrization is based on terrestrial time-lapse photography. The fitted curves are then implemented in a point snow model and tested for estimation of mean snow height and snow cover fraction.

Overall, the topic is interesting and within the scope of HESS. It is worth to publish, but I agree with the reviewer #1 that some revision is needed. I would also suggest to improve the discussion of the paper, relating the findings to existing literature, as well as to discuss the transferability of results to other regions. I would like to suggest to show the value of implementing this new approach into a snow model more clearly, e.g. by comparing the simulations with a “standard” approach.

Overall I would recommend to publish the paper after some moderate revision.

We would like to thank Referee 2 for the remarks and suggestions included in the revision. Following these general comments, we have included further discussion regarding the association between the identified accumulation/depletion curves and the main physical conditions during the cycles they describe. This is an indirect way for a first validation of the applicability of the curves beyond the local scale (see also the response to Referee 1). Additionally, we have included references to the context of other works regarding our results and conclusions in the Discussion section (see page 11 line 34 and page 12, lines 13, in the revised version).

Moreover, we have included in the discussion the comparison of the current results with those from a previous work in which standard depletion curves were used to test the performance of the snow model in these heterogeneous areas (see page 12, lines 1-14, in the revised version). This point was also addressed by Referee 1, and we have included further justification of the multiple-choice of curves during the same snow season to improve the model’s capability to reproduce the snow dynamics.

Balk, B., Elder, K.: Combining binary decision tree and geostatistical methods to estimate snow distribution in a mountain watershed, *Water Resour. Res.*, 36, 13–26, 2000.

Erxleben, J., Elder, K., Davis, R.: Comparison of spatial interpolation methods for estimating snow distribution in the Colorado Rocky Mountains, *Hydrol. Processes*, 16, 3627–3649, 2002.

Molotch, N. P., Colee, M. T., Bales, R. C., Dozier, J.: Estimating the spatial distribution of snow water equivalent in an alpine basin using binary regression tree models: The impact of digital elevation data and independent variable selection, *Hydrol. Processes*, 19, 1459–1479, 2005.

Molotch, N. P., Margulis, S. A.: Estimating the distribution of snow water equivalent using remotely sensed snow cover data and a spatially distributed snowmelt model: A multi-resolution, multi-sensor comparison, *Ad. Water Res*, 31 (11), 1503-1514, 2008.

### Specific comments

#### 1) Abstract: What is the GIS-based representation of snow?

We aimed at describing the grid-based spatial domain of distributed models to simulate the evolution of the snowpack. But we agree that this term may be unfortunate, and we have changed “GIS-based” into “grid-based” in the revised text.

**2) P.2, l.20: Please correct the typo in the name Kolbert.**

We apologize for this typo, which has been corrected in the revised version of the manuscript.

**3) Table 5 caption does not explain the table well. The meaning (or reference) of table headers is not explained.**

We have rewritten this caption (see page 22, lines 1-3, in the revised version) to clarify the information of the Table.

**4) “Each cycle corresponds to the time period between the beginning of a snowfall and the end of the associated melting. Not clear what is the meaning of associated melting.”. Perhaps it would be more clear if Fig.4 does indicate the start and end of selected cycles.**

Following this, we have changed this into “...to the time period between the beginning of a snowfall event and the end of the complete ablation of the snow or the occurrence of a new snowfall event”, (see page 4, lines 21-22, in the revised version).

**5) Fig.3: Would it be possible to indicate the position of rods in bottom panels?**

This information has been included in the revised version of Figure 3.

**6) Fig.5: The fit of Curve0 seems not be very close to the observations. Does this difference affect the model performance in accumulation phase? If yes, for which events and how?**

The representation of the Curve 0 in Fig.5 can be misleading since most of the dots in the figure are located very close to the line  $SCF^*=1$  and specifically near the  $h^*=1$ , and then they cannot be appreciated as much as those out of this domain in the Figure. Table 4 shows the determination coefficient for this fitted curve, 0.85; this also influenced the adoption of a single curve for the accumulation phase of each cycle. However, the curve succeeded in making the model simulate well the accumulation phases during the study period, as can be observed in both Figures 6 and 7 (please, note that numbers refer to those in the revised version), with divergences occurring mostly in the reproduction of snow depth values after those melting events that were not fully captured by the model, that is, when the memory of the model biases the simulation. This can be also explained from the general pattern of the snowfall events in these Mediterranean regions, where heavy but quick snowfalls are very usual, with less variability than that exhibited by the melting phases.

Following this comment, further detail has been included in the Discussion section (see page 10, lines 23-28, in the revised version).

**7) The length of cycles is confusing “The number of cycles and their duration varied considerably over the years, with a mean number of 18 +- 5 cycles per year and a mean duration of 49+-14 and 108+- 18 days for the accumulation and melting phases of each cycle, respectively.” This reads like e.g. 18 cycles per year, each has 49 days, so it is 18x49 days in a year?**

We have rewritten the sentence: The number of cycles and their duration varied considerably over the years, with a mean number of  $18 \pm 5$  cycles per year and a mean duration of  $3 \pm 1$  and  $6 \pm 5$  days for the accumulation and melting phases of each cycle, respectively. On an annual basis, the mean number of

days with melting and accumulation dominance was  $49 \pm 14$  and  $108 \pm 18$  days, respectively (see page 7, lines 21-24, in the revised version).