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Geoscientific Model Development Discussions
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Interactive comment on "TOPMELT 1.0: A topography-based distribution function approach to snowmelt simulation for hydrological modelling at basin scale" *by* Mattia Zaramella et al.

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We would like to thank the Reviewer Massimiliano Zappa for his review of the manuscript. We provide here a prompt reply to underline some aspects concerning the modelling methodology. We hope this will facilitate further interaction on the points listed in his review. The Reviewer underlines four main points, as follows.

1. "LUMPED or SEMI DISTRIBUTED. Here is the definition of lumped very broad and actually the implementation with elevation bands and radiation index classes heavily reminds me the definition of hydrological response units, also a semi-distributed approach. I think your approach is much more semi-distributed than lumped.

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Discussion paper

In the manuscript, we characterised TOPMELT as ‘lumped’ in order to make very clear the differences with a spatially distributed approach. However, we agree with the Reviewer that the model can be considered as ‘semi-distributed’, as this class of models do not make calculations for every point in the catchment but for a distribution function of characteristics. TOPMELT has the feature that the snow predictions can be mapped back into space for comparison with any observations of the snow properties.

2. INPUT PRECIPITATION Please expand on the techniques declared at page 4.

With the sentence at line 13, page 4, we mean that precipitation can be calculated by using a range of methods (Thiessen Polygons, multi-quadratic and Kriging), on the condition that the model input is an areal precipitation estimated starting from any of these techniques. The interpolation and averaging code of precipitation is not included in the version of TOPMELT illustrated in this manuscript, but it is included in the complete hydrological model code. For the case study of the paper, we used the Thiessen polygons to calculate an areal precipitation over the whole basin. We will clarify this issue in the revised version of the paper.

3. LIST OF VARIABLES I would welcome a Table with a list of the used abbreviations.

We will report the list of model variables in the revised version of the paper.

4. "DYNAMIC" RADIATION AREA AND INDEX: If you had static radiation regions instead of radiation classes you would not need the supplementary workaround for updating the states with a "migration". Can you better justify your choice, or, even better, compare your results to a version with static radiation sub areas selected using elevation, aspect and/or slope?

TOPMELT accounts for the seasonality of sun declination and for the visible horizon, therefore including both the effects of the temporal variability of the incident radiation angle and of shadowing. This makes the spatial distribution of radiation variable over time, which requires the updating of the snow states and represents a key feature of the model. We note that using of a static radiation distribution would require the identification of a reference date for which the distribution will be computed. This would bring some degree of arbitrariness in the modelling methodology. The paper already includes an analysis of the impact of decreasing the frequency of the snow state updating. This can be seen in Fig. 8, left panel, which shows the impact of updating the radiation distribution at decreasing frequency. The frequency ranges from 1 week, which is chosen as the reference temporal aggregation, to 2 weeks, 4 weeks, 8 weeks and 12 weeks. Fig. 1 below shows the scatter plots corresponding to the pixel-by-pixel comparison summarised in Fig. 8 of the paper, in terms of snow water equivalent (SWE). The scatter reported in Fig. 1 indicates that the impact of the decreasing frequency may have important consequences when the SWE spatial distribution is sought. In the revised version, we will further reduce the updating frequency in order to more completely answer the question raised by the Reviewer.

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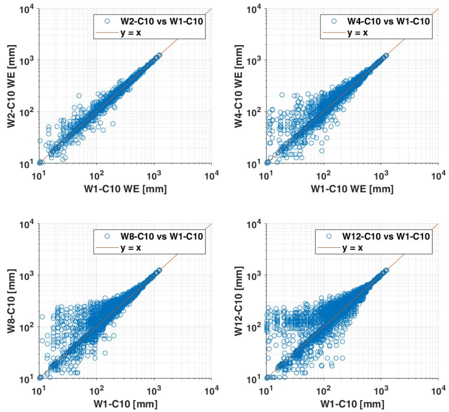

Fig. 1: Scatter plot of the pixel-by-pixel comparison of SWE, obtained by updating the SWE classes at decreasing frequency ranging from 2 weeks to 12 weeks. The updating frequency of 1 week is used as reference. The study period is from October 2010 to June 30 2011.

Fig. 1.

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