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Simulation of snow distribution and melt under cloudy conditions in an alpine watershed
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General comments
The study is definitely interesting and the results presented definitely worth publishing, given the scarce experimental evidence collected and published on the water and energy balance of high elevation catchments.
There are a number of major and minor aspects that should be addressed, as detailed below. Major comments relate to unclear elements of the proposed model and of data analysis.
Usage of the English language is poor at times, the manuscript should be by a native speaker or a professional editor.
I recommend publication after a major revision.

Answer: Many thanks for your helpful comments and kind suggestions, we have modified the manuscript in detail. This manuscript was reedited by a native speaker also. The following is our response.

Specific comments
Pg.3190 line 5: ***Abstract; the word "discriminate" in the sentence "A linear interpolation method was used to discriminate daily snow cover area under cloudy conditions.."is probably not correct, since the surface cannot be observed when cloudy;***
Answer: Yes. We have replaced it with another word "estimate"'.

Pg.3190 line 9: ***Abstract; is snow water equivalent also simulated? Why then is not mentioned in the list of variables which have been simulated?***
Answer: Snow water equivalent was also simulated. The value has been converted to snow depth so as to compare with the measured snow depth in the old version manuscript. In the modified manuscript, simulated and measured snow water equivalent was compared.

Pg.3190 line 21: ***rewrite "could be obtained through RS of near-infrared" as "can be observed at near-infrared…"***
Answer: Thanks! We have rewritten it.

Pg.3190 line 23: ***Introduction; not clear what is actually meant here by Snow Water Equivalent; please define prior to introducing eq. (1);***
Answer: We have added the illustration of SWE into this part as your suggestion.

Pg.3191 line 6: ***what do you actually mean by "snow existence durations"? the combination of these two words is particularly confusing;***
Answer: For calculation of SWE change using the energy balance method, two pre-condition should be known: at first, whether or not snowpack exist? If it is exist, then secondly, how much are the energy inputs for snow ablation? Eq(1) was introduced here to illustrate it. In practical operation, snowmelt was computed at each time step. Then, 'snow existence duration' is the sum

of time step within snow existence. Conceptually, the SWE change can be regarded as the function of energy inputs and the ‘snow existence time’. In fact, most of difficulties for computing snowmelt are in estimating the energy inputs in spatial and discriminating snow existence under different conditions such as cloudy days. These aspects are just what the authors want to deal with in this paper. So, Eq(1) was inserted here as the introduction of the goal of the paper. We modified the sentence as ‘The spatial and temporal variations in the snow are fundamentally driven by the energy and mass balance. If the energy inputs for snowmelt at each time step that snow was present could be assessed and it is considered that the snow duration (T) is a sum of all time steps for which snow existed, then the SWE change (ΔSWE) in a complete snow accumulation–melt period could be regarded as a function of the snow duration (T) and the energy input (E).’

Pg.3191 line 10*: the sentence “The discrimination of snow existence under clouds..” should be re-written by replacing “discrimination ”with “detection” or “assessment”*
Answer: Thanks, we have modified it.

Pg.3191 line 19: ***the sentence “Abundant data were wasted because it was…” is obscure, please rewrite.***
Answer: The sentence has been rewired as “However, even in those images with large area of cloud cover, many snow pixels were not affected. If those images are not used, then abundant data are wasted. It has been inconvenient to accurately represent snow accumulation and melt processes.”

Pg.3193 line 7: ***rewrite the sentence “Resolution of the MODIS data was degraded from 500 to 50m in order to match the DEM” as e.g. “the MODIS data were resampled to match the 50 m resolution of the DEM”***
Answer: Thanks. We have rewrite it as your suggestion.

Pg.3193 line 19: ***eq.(2) cannot hold for any number of cloudy days, so a threshold should be introduced to avoid interpolating linearly over excessively long gaps;***
Answer：4 days was set as the threshold. As following statistics indicated, the most frequent cloudy duration found was 1 day, accounting for 53.9% of the total samples, and the duration less than 4 days accounted for 91.0%. This suggests that more than half the cloudy durations were only 1 day and the rest were less than 4 days. As a result, we set 4 days as the threshold. We have described the reason in the paper.

Pg.3197 line 21: ***what is actually meant by τd? diffuse transmittance is a very peculiar concept, since diffuse light is by definition not transmitted but scattered; direct transmittance would make more sense, given the comments in the main text;***
Answer: By eq.(14), the solar radiation was divided into diffused transmission and direct transmission. Direct and diffused solar radiation all provide energy inputs for snowmelt. However, these two radiations distributed with different behaviors, as eq.(15) and (16) indicated. Direct radiation was influenced by terrain slope and aspect, while diffused radiation was influenced mainly by sky-view factor. We have highlighted the importance of direct radiation as your

suggestion in the paper.

Pg.3198 line 3***: the sentences "… τ d is assumed to be the same over the small watershed (30.27 km2)." and "Complex alpine terrain modified the exchange of direct and diffused solar radiation…" appear contradictory to me, please clarify.***

Answer: the sentence should be corrected as ' τ_d is assumed to be the same over the small watershed (30.27 km2) on an elevation level before solar radiation reaches the ground.'. Then, we thought that under this elevation level, "Complex alpine terrain modified the exchange of direct and diffused solar radiation…". In the study, DY station is almost the highest place of the watershed. We assessed the direct and diffused radiations using data from the AWS of DY station, and then calculated ' τ_d'. After this step, we considered the modification of terrain on the exchange of direct and diffused solar radiation.

Pg.3198 line 11: ***angle Z undefined in the sentence "Z is the angle between solar beam perpendicular to the slope"; between … and what?***
Answer: the sentence have been modified as 'Z is the angle between solar beam and a perpendicular to the slope'.

Pg.3198 line 13: ***neither text or equations make clear why two angles Z and ks are needed here; Z seems to be sun zenith angle + slope, with the latter being ks. It would be clearer using sun zenith angle (for a horizontal surface) and slope.***
Answer: for computing incoming solar radiation on a slope, we should consider the slope and the sun zenith. Z is defined as the angle between solar beam and a perpendicular to the slope. By this way, computation of direct radiation and diffused radiation can be separated clearly. Of course, other combinations of sun zenith angle and slope can also deal with the calculation of solar radiation on a slope.

Pg. 3199 eq.21***: this equation implies several assumptions which are not explained. If it has been found in literature, then a proper reference is missing.***
Answer: Yes. We have inserted two references about the assumptions into the paper.
"Bristow, K.L., G.S. Campbell, R.I. Papendick and L.F. Elliott.: Simulation of heat and moisture transfer through a surface residue-soil system, Agric. and Forest Met., 36,193-214,1986.
Campbell, G. S.: Soil physics with BASIC : transport models for soil-plant systems. Amsterdam; New York, Elsevier, 1985."

Pg. 3200 line 5: ***an illustration of the accuracy of linear interpolation for gap-filling the snow cover time series would be very helpful here.***
Answer: thanks. For illustration of the accuracy of linear interpolation for gap-filling the snow cover time series, we sampled those grids with continues snow existence. It is assumed those grids were obscured by clouds during different days, then SCF values of these grids were linear interpolated. The interpolation results were compared with the real observed SCF data, and mean errors (absolute value) corresponding to different gap-filling days were computed(fig.2.). It indicated that the mean errors are stable and small (about 5%) in those situations that the

gap-filling days are less than 5 days. However, the mean errors are not stable and having acute change when gap-filling days are greater than 8. The fig.2. has been inserted into the manuscript.

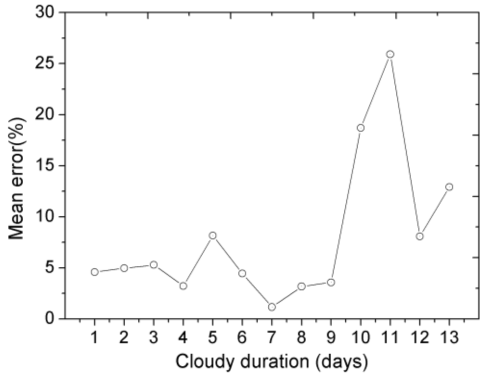

Fig.2. Mean error between interpolation and observed snow cover fraction during different gap-filling days

Pg.3201 line 5: ***validation by comparing model-based estimates of snow depth with measurements raises a major question. First, how is snow depth calculated? Could not find any equation giving estimates of snow depth. Second, I understand that having snow cover and snow water equivalent (SWE) it may be possible to estimate snow depth, but the authors must explain exactly how, especially taking into account that (assuming I understood it correctly) the SWE as calculated is an average over a period of time and it is not clear how accurate it can be when used to estimate snow depth on a given day.***

Answer: In our study, snow water equivalent (SWE) is the direct model results. For the validation, it is assumed that snow density is 0.3g/cm^3, then snow water equivalent was converted to snow depth. As you mentioned, we thought that validation by snow depth is not reasonable. In fact, besides snow depth, snow density was measured also on different vertical snow layers in field survey. For better illustration, in the modified manuscript, we computed snow water equivalent by measured snow depth and density, then modeled and measured SWEs were compared. The detailed illustration and latest results have been added into the manuscript, and the figure was replaced also.

Pg.3201 line 7: ***given the values in Fig. 3 a RMSE = 33.9 cm seems too large, please check***;

Answer: We have compared the results in SWE. RMSE between measured and simulated SWEs has been corrected to 3.2cm.

Pg.3202 line 1: ***"refrozen phenomenon" should be "refreezing phenomenon"***

Answer: Thanks! We have corrected it.

Pg.3202 line 21: ***units of soil heat flux density are not correct, should be Wm-2; do not use flow, if you mean (as it seems) soil heat flux density. Statements are rather confusing, soil heat flux density is considered constant and small during the snow season, the larger and variable, then still rather small, but still significant in relation with the energy balance of the snow pack. Some reference numbers or an illustration would be interesting. These are also difficult measurements to do, so readers are likely to appreciate it.***

Answer: We have modified the units of soil heat flux density. We have modified this paragraph as "Ground heat is usually regarded as a constant in modeling snow processes (Yang, 2008), a simplification that was also used in this study. In the snow season of 2008, the measured ground heat did not change very much in the Binggou watershed. Especially in the mid-winter, it was almost constant (approximately 10 W m-2). However, it fluctuated with increasing snowmelt during the later snowmelt season. When snow disappeared, the ground heat obviously increased. Although the magnitudes of ground heat are not large relative to other heat sources, such as shortwave radiation, a more accurate energy exchange computation must also be considered. Especially in the land-surface hydrology of cold regions, frozen soil plays an important role because the freeze-thaw cycle of soil significantly changes the soil hydraulic and thermal characteristics (Wang et al., 2010)."

Pg.3203 line 13: conclusions do not do justice to the interesting work and results presented, the authors are encouraged to elaborate further.
Answer: thanks! We have added a new paragraph into this part,
"Using the methods described in this paper, the physical processes of snow ablation and the snowmelt distribution can be modeled accurately. SCA data from RS were used as an input for snowmelt modeling, and a reasonable combination of SCA data and the energy balance method was introduced in the paper. The results indicate that in the alpine region without abundant ground gauges, it is practical and relatively accurate to simulate spatial and temporal snow distribution using snowcover information from RS data and observations from several local weather stations."