Dear Editor,
We accomplished all the comments from the reviewers and now the paper results improved, more clear and understandable. Then, we acknowledge the two anonymous reviewers for the helpful suggestions.
Before uploading the reviewed manuscript, as suggested, the standard of English spelling and grammar will be improved by a professional, mother-tongue consultant.

Please find below the detailed comments and the responses to the reviewers' suggestions.
We hope now the manuscript could meet the reviewers' expectations and then it could be accepted for publication, otherwise we are open to new improvements.

Many thanks for your kind help,
Best regards,

Antonella Senese and Co-authors

***Referee #1:***

*The paper addresses an interesting issue in the field of glaciology and hydrology, i.e. the use of degree day approach based upon a proper temperature threshold. The methods, and results of the paper are sound, and provide an interesting subject for scientist working in this area of investigation. The adopted data set is considerably long and interesting, especially given the difficulties of working within high altitude criospheric environment. I suggest that the paper can be published after minor revision, mainly related to some lack in English use. Also, some sentences are awkward, border line unintelligible, and would need rephrasing I have provided extensive correction for English and other issues in the attached pdf. Also, the conclusions part is too long, and mostly a repetition of discussion. Therefore, I suggest that the authors provide shorter conclusions, and describe therein only essential outcomes, without too many repetitions, and also provide clues as to how their results may be of use to the large audience of scientists in the area of glaciology and hydrology. Further, it is widely known that degree day is adopted as a first approximation index for ice melting, also upon debris covered glaciers. I wonder whether the authors may provide their feelings about whether their findings may be representative/useful also in such cases.*

**We are grateful for the extensive correction for English provided by the Referee. We modified the manuscript accordingly, we shortened the conclusions and we added comments with regard to the adoption of our approach for ice melting, also upon debris-covered glaciers.**

***Referee #2:***

*The study is based on a long and continuous time series from an on-ice AWS, spanning years with rather different snow cover conditions. It presents an uncommon application of a PDD model used to reproduce the occurrence, rather than the magnitude of snow melt, and it is a relevant and interesting contribution to the field. The method applied seems to perform successfully but more details should be provided as discussed below.*

*The language needs to be improved significantly, as some parts are barely understandable (e.g. most of the 'Discussions' section) and grammar is often incorrect. Most sentences will need to be rephrased so I do not include specific suggestions. The title and abstract should be more focused. A thorough clean-up of the abundant repetitions is needed.*

**As suggested, the standard of English spelling and grammar will be improved by a professional, mother-tongue consultant.**

*It is important to note that the aim of the paper is to model the occurrence of surface melt conditions rather than quantifying melt. This is explicitly stated (1566, 4) but I did not pick it up immediately during the first reading and it may need to be better emphasized, starting with a more specific title. This is also important because it makes the study significantly more interesting and original than a mere exercise in applying the very well-known PDD concept to even one more site.*
*Some justification needs to be provided for taking the indirect and complex route of tuning the T_t and sDDF to best fit melt predicted by the surface energy balance model, instead of directly tuning them to best reproduce the occurrence of surface melt conditions as detected from emitted LW at AWS. It seems at times the focus of the paper oscillates between the stated aim and the modelling of surface melt totals. See also below my comments to Tab. 1 and Fig. 4.*

**We focused on both occurrence and amount of snow melting, and in particular in this reviewed version on the occurrence of snow melt and on the amount of snow ablation. Consequently we modified the title from "**Air temperature thresholds to evaluate snow melting at the surface of Alpine glaciers by T-index models: the case study of Forni Glacier (Italy)**" to "**Daily air temperature thresholds to evaluate snow melting occurrence and amount on Alpine glaciers by T-index models: the case study of the Forni Glacier (Italy)**". Moreover, we explained better these aims in the Introduction section.**
**Moreover, the second referee suggested us to detect the occurrence of snow melting and the actual beginning of such phenomenon without limiting our analysis to a fixed time frame starting on the 1st of April, the date used at the mid latitude for SWE evaluation, since this process can start before or later this time. Accordingly, in the new improved paper draft we evaluate the actual length of the melting season and we also distinguish the occurrence of the snow melting process (which results to start generally earlier, in March, when three conditions are found: positive energy budget, surface temperature at the melting point and surface albedo of snow) from the beginning of the actual diminishment of the snow cover which occurs later when refreezing phenomena at the surface and along the snow pack become negligible (and it is witnessed by snow depth data).**
**Distinguishing the occurrence of snow melting from the evaluation of the melt amount is fundamental. Despite the fact that snow melt starts early, it becomes an actual loss for the snow pack later, after a first period dominated by percolation and refreezing of meltwater. Later the melt process along the snow layer results into an actual snow ablation and in a mass loss. Detecting the occurrence of snow melt is important in studying snow avalanches (e.g. Luckman, 1977) or permafrost phenomena (e.g. Ling and Zhang, 2003). On the other hand, in studies aimed at computing the hydrological budget or the glacier mass balance the correct evaluation of snow melt amount is fundamental (e.g. Hock, 2005). Then now we distinguish between the beginning of snow melt and the beginning of the actual snow ablation.**

**The availability of high resolution data acquired by the AWS at the Forni Glacier surface permitted to discriminate these phenomena and the different time of their occurrence thus also permitting to look for specific air temperature thresholds witnessing these conditions.**

**From our data it results that every year the snow melting process starts from March: the energy balance is positive and the surface is at melting point. On the other hand in this period meltwater results affected by surface refreezing or by percolation into the snow pack and then refreezing. This is highlighted by the snow depth dataset acquired by the sonic ranger (see the following figure): the snow depth tends to increase or to remain almost stable until April/May (even if snow melt occurs), thereafter it shows a pronounced decrease. Consequently, the actual snow ablation begins later, when the snow cover curve starts to diminish (April/May), from this time meltwater run off prevails and the refreezing processes can be considered negligible.**

**Accordingly we now distinguish two different periods: the first one featuring snow melt (inferred by energy balance and surface temperature) but with an actual mass loss negligible due to the occurrence of melt water refreezing, and the second period featuring an actual snow ablation (deducted from snow depth trend). The end of second period corresponds to the date with surface albedo value lower than 0.4 featuring the beginning of the ice melting time.**

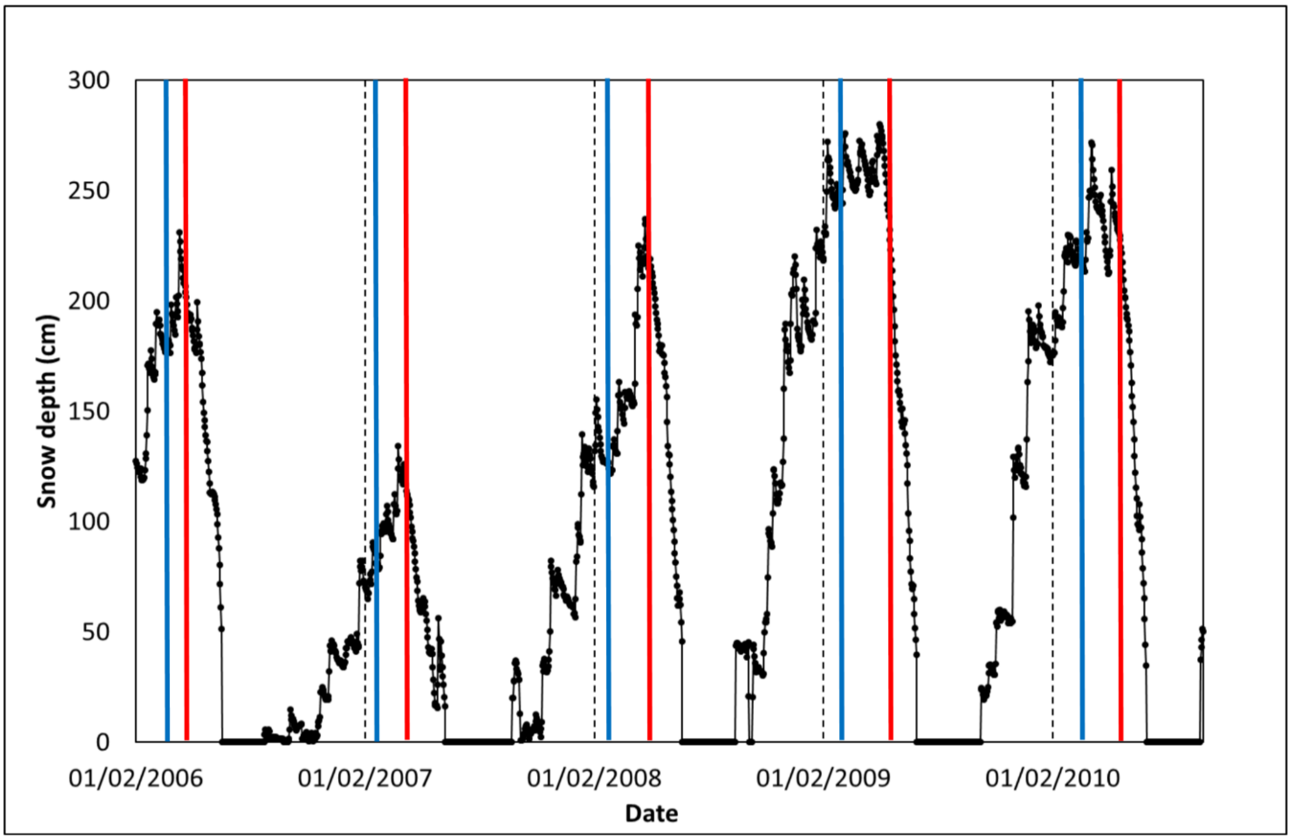


Figure 1: Snow depth data measured by the sonic ranger (Campbell SR50) installed on the mast of the AWS1 Forni. The beginning of the snow melting process is shown with a blue line and the beginning of the actual snow ablation with a red line.

This figure is now inserted in the new paper draft

**After having detected these different periods we analyzed the energy budget and the air temperatures they feature (i.e.: minimum, maximum and mean daily value) to find the most suitable daily air temperature thresholds witnessing the two conditions. The daily temperature threshold witnessing actual snow ablation conditions is then used to calculate the snow melt amount applying a T-index**

**approach and the results are compared to the snow water equivalent (SWE) derived from sonic ranger data and from snow pits to evaluate the reliability of such data modelling.**

**References:**


Hock, R. (2005). Glacier melt: a review of processes and their modelling. Progress in physical geography, 29(3), 362-391.

Ling F. and Zhang T. (2003) Impact of the timing and duration of seasonal snow cover on the active layer and permafrost in the Alaskan Arctic. Permafrost and Periglacial Processes, Volume 14, Issue 2, pages 141–150.

Luckman B.H. (1977). The Geomorphic Activity of Snow Avalanches. Geografiska Annaler. Series A, Physical Geography, Vol. 59, No. 1/2, pp. 31-48


*The **’Introduction’** section does not explain sufficiently the importance and interest of detecting surface melt conditions at sites where no on-ice AWS exist. None of the methods routinely used to detect melting conditions, notably microwave and thermal IR remote sensing is mentioned. Limits on spatial and temporal resolution/availability of these remote sensing techniques may make them not usable for a relatively small and complex topography glacier, but this will indeed provide additional justification for looking into a different method like the one presented here. No review of the state of the art is provided except for some information on PDD models, and nothing is said of what could be gained by adapting a PDD model for this use. The last point is particularly important because PDD models are essentially statistical tools empirically calibrated to fit observations over a longer period (the entire snow melt season in this study). Most importantly, the assumption that PDD, or any other single observable for that matter, is a workable proxy for available energy to melt snow and ice breaks down when pushed to sub-daily time scales, because the individual energy fluxes in the energy balance display a marked daily cycle and they each relate in a different way to air temperature. This issue should be introduced here and the validity of the proposed approach should be argued for in ’Discussions’. A direct comparison of ’melting surface detected from upwelling LW at AWS Forni’ vs. ’melting surface predicted by PDD model’ would be especially convincing.*

**We modified accordingly the Introduction section: we now explain better the importance of detecting surface melt conditions at sites where no supraglacial AWS are available, we now mention other melt approaches as well such as remote sensing, we have added more comments about T-index approaches.**

*1565, 20: correct, but then why use these daily averages at all, given hourly T_B were available (ad were used to produce Fig. 2)?*

**In our study, we have chosen to use daily values of air temperatures and not hourly data in order to develop a method suitable to be used for studying sites where no high resolution data are available.**
**In the new draft of the paper, we have modified the Fig. 2. Now daily values are shown from 2006 to 2012. Then we have corrected the correlation value and the root mean square error in manuscript accordingly. Please find below the new version of the Figure 2:**

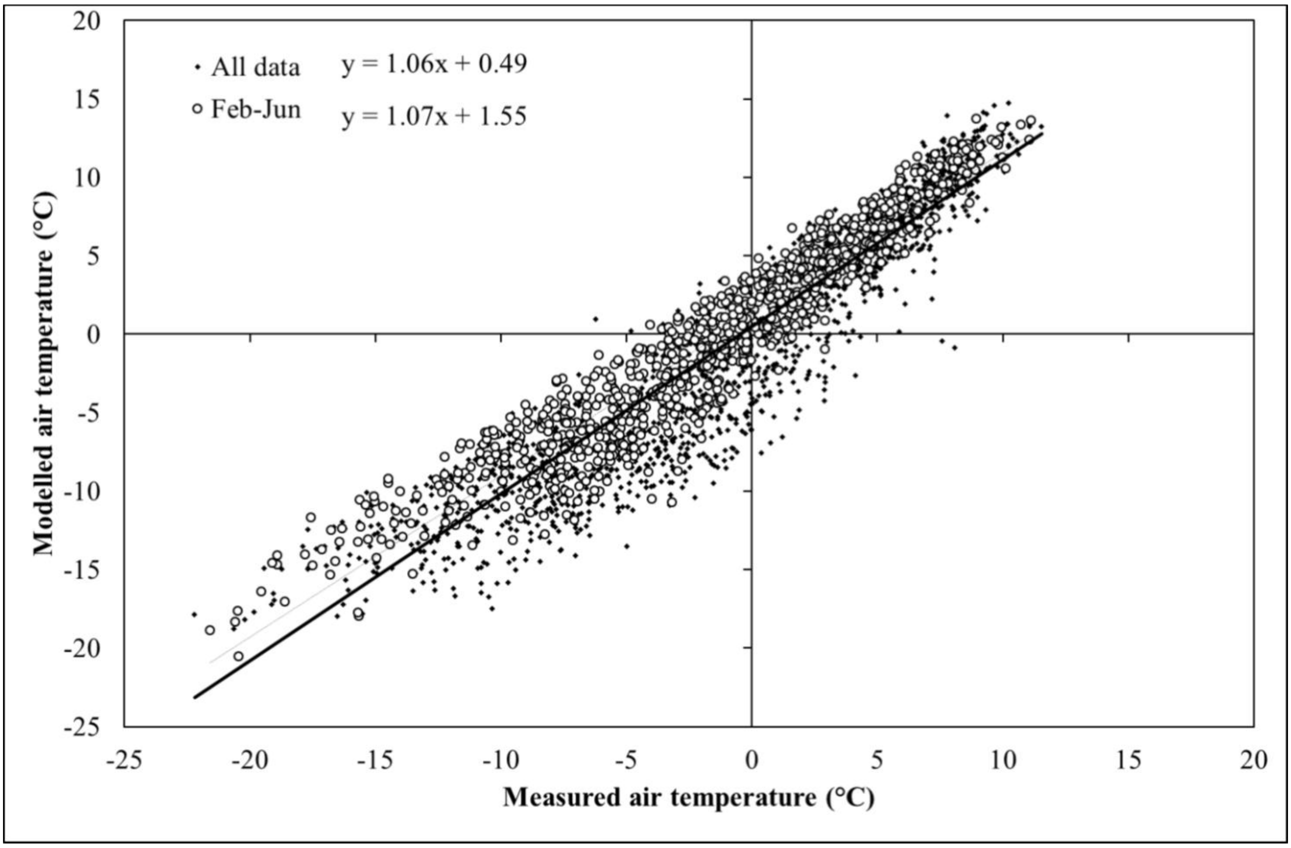


**Fig. 2: Daily temperatures recorded by the AWS1 Forni ($T_{AWS}$) from 2006 to 2012 (X axis) vs the modelled ones ($T_B$, Y axis) derived from Bormio data shifted to the AWS1 Forni elevation through the application of the mean tropospheric lapse rate.**

*eq. (2)-(5): please make it more explicit what exactly these equation calculate. Qualify terms like 'melt' and 'melt amount' as 'ice melt', 'snow melt', 'ice and snow melt' as appropriate. I think M_EB is 'snow and ice melt', M_3C is 'snow melt', M_PEB is 'snow and ice melt', M_Tindex is 'snow melt' - are these so?*

**We have modified accordingly. In particular M_EB is "The snow and ice melt amount derived from the energy balance", M_3C is "snow melt occurred with 3 driving Conditions", M_PEB is "snow and ice melt evaluated only considering the Positive Energy Budget", M_T-INDEX "The snow melt is also assessed by a T-index model".**

*eq. (5): is DDF the same as sDDF of eq. (6)? If so consider using the same symbol, if not explain the difference.*

**We have modified accordingly, thus we have replace DDF with sDDF in equation 5.**

*1569, 7: Some more detail about temperature inversions is needed here, perhaps showing how strong and how often inversions affect the actual lapse rate between the valley and glacier station, as they will be reflected in the choice of optimal T_t value. The text indicates that more valley stations exist from this region, so it should be possible to describe statistically how much the real lapse rate deviates from the assumed -6.5 K/km. Temperature inversion causing lower T_B may well be the reason for the low T_t threshold temperature needed to adequately reproduce snow melt. This is important in order to assess how much the results reported by this study are of local relevance (i.e., specific to this particular glacier and* *valley climate) or indeed of more general applicability as claimed in 'Conclusions' by analogy with findings from Greenland.*

**We have added more details regarding thermal inversion occurrence in *Data and Method* section. In particular, the weather stations available in this study area are located at Bormio (at 1225 m a.s.l., ca. 17 km far from the Forni Glacier terminus), Santa Caterina Valfurva (at 1730 m a.s.l., ca. 7 km far from the Forni Glacier snout) and at the dam of Frodolfo stream (at 2180 m a.s.l., ca. 2 km far from the Forni Glacier front). Analyzing the daily air temperatures measured at Bormio and at the Forni Glacier from 2006 to 2012, no thermal inversion occurs. Instead, Santa Caterina Valfurva and the dam of Frodolfo stream are affected by thermal inversion for about 9% and 1% of the entire period, respectively. For this reason, we chose the station installed at Bormio.**

**We modified from: "**We chose Bormio temperature record since this village is less affected by thermal inversion than other stations located nearby and inserted in the ARPA Lombardia meteorological network. By comparing $T_B$ data with data actually measured by the AWS1 Forni (Fig. 2) a high correlation value results as well (r = 0.91), with a root mean square error of the modelled temperature slightly over 3 K. Moreover the slope coefficient of the linear regression between measured and modelled temperatures at the AWS1 Forni site turns out to be very close to 1 (see Fig. 2).**"**

**To: "**We chose Bormio temperature record since analyzing the 2006-2012 dataset this town results not affected by thermal inversion compared to other stations located nearby and inserted in the ARPA Lombardia meteorological network (e.g. the AWS at Santa Caterina Valfurva at 1730 m a.s.l., and the one located at the dam of Frodolfo stream at 2180 m a.s.l.). Santa Caterina Valfurva and Frodolfo dam AWSs are found to be affected by thermal inversion for about 9% and 1% of the analyzed period, respectively. By comparing daily $T_B$ data with data actually measured by the AWS1 Forni from 2006 to 2012 (Fig. 2, black dot) a high correlation value results (r = 0.94), with a root mean square error of the modelled temperature equal to 2.64°C. Considering only the period featuring snow melting (i.e. February-June), a RMSE value of 2.37°C results (Fig. 2, white dot). Moreover the slope coefficient of the linear regression between measured and modelled temperatures at the AWS1 Forni site turns out to be very close to 1 (see Fig. 2).**"**

*1569 last paragraph: consider clarifying the description of 'temporal length classes' and why these specific ones (0, 4, 6, 12, 24) where chosen.*

**We modified accordingly, from "**The snow melting is also assessed by a T-index model ($M_{T\text{-}INDEX}$) following Braithwaite (1985):

$$M_{T-IDEX} = \begin{cases} \sum T \cdot DDF, & T > T_t \\ 0, & T \leq T_t \end{cases} \quad (5)$$

where $T_t$ corresponds to the air temperature threshold (K) adopted by the model and DDF to the degree-day factor (mm $K^{-1}$ $d^{-1}$). The applied temperature data were $T_B$.

The snow Degree-Day Factor (sDDF) was found considering the degree days amount and the Snow Water Equivalent (SWE) values estimated from snow pits performed nearby the AWS1 Forni. The presence of snow or bare ice was deducted from albedo data (from AWS1 Forni) and then the length of the snow coverage period. In fact, the SWE was considered completely melted when the albedo becomes lower than 0.4. Finally the sDDF was calculated as:

$$sDDF = \frac{SWE}{DD_{glacier}} \quad (6)$$

where $DD_{glacier}$ is the sum of Degree Days (from $T_B$ data) in the time frame between a snow pit survey and the occurrence of ice albedo. Moreover we also considered different air temperature thresholds.

In order to detect the most suitable daily temperature threshold ($T_t$) to adopt in the T-index model for quantifying glacier melting in the April-June period, we considered hourly $M_{EB}$ values (obtained from AWS1 Forni data) and studied how long ablation occurred in each day (number of hours per day). Then we sorted these data according to temporal length classes (0, 4, 6, 12 and 24 melting hours per day).**"**

**To: "**Finally the snow melt is assessed by a T-index model ($M_{T\text{-}INDEX}$) following Braithwaite (1985):

$$M_{T-IDEX} = \begin{cases} \sum[(T_B - T_t) \cdot sDDF], & if\ T_B > T_t \\ 0, & if\ T_B \leq T_t \end{cases} \quad (6)$$

where $T_t$ corresponds to the daily air temperature threshold (K) adopted by the model and sDDF to the snow degree-day factor (mm $K^{-1}$ $d^{-1}$). This latter was found considering the degree days amount (depending on the chosen $T_t$) and the Snow Water Equivalent (SWE) values estimated from the snow depth data acquired by the sonic ranger and from the snow pits performed nearby the AWS1 Forni:

$$sDDF = \frac{SWE}{\sum_1^N (T_B - T_t)} \quad (7)$$

where N corresponds to the number of days necessary for melting the whole snow cover (i.e. up to the occurrence of ice albedo).

Both equations 6 and 7 depend on the daily air temperature threshold, thus they admit many solutions. In order to detect the most suitable $T_t$, we considered hourly $M_{EB}$ values (obtained from AWS1 Forni data) and studied how long ablation occurred in each day (number of hours per day featuring positive energy budget and surface temperature at the melting point). Then on the base of this computation we evaluated how many days featured null melt (0 $M_{EB}$ hours) and how many days featured 4, 6, 12, 18 and 24 melting hours (4, 6, 12, 18 and 24 $M_{EB}$ hours respectively). In this way we sorted the days according to the length of the melt process (which can occur on a part of the day or during all the time).Then we analyzed the air temperature conditions (min, max and mean daily values) of the different classes (i.e: days without melting, days with at least 4 hours of melting, days featuring at least half a time of melting, days with at least 18 hours of melting, days with continuous melt) and we also calculated the melt amount occurred in each class to evaluate its role with respect to the total melt amount. The temperature data found analyzing the different classes represent possible thresholds to be applied to calculate degree days driving snow melt. We performed several attempts of running the T-index model by applying the different temperature threshold values and the obtained melt amounts ($M_{T\text{-}INDEX}$) were compared with the ones from measured SWE thus permitting to select the most suitable and performing threshold values."

*It may be a language issue, or there may be a problem with the physics implemented into the surface energy balance model: page 1570, 17-22, does this mean that the surface energy balance model can at times produce melt even though surface T is below freezing? How else to explain that larger modeled melt is modeled when the Ts check is removed?*

**We performed a test to verify the importance of considering the surface temperature in computing melt from the energy budget. In fact, whenever a supraglacial automatic weather station is not present, we can estimate almost all the energy fluxes occurring at the glacier surface but the surface temperature cannot be quantified. Then, in order to evaluate the reliability of the melt amount computed without considering surface temperature, we calculated the melt amount neglecting the null surface temperature conditions and we found a higher value than the actual one. We also reported the value of the overestimation due to not considering surface temperature: "**In this way whenever surface temperature dataset is not available, the ablation results overestimated of 5.58%. This is due to the fact that when energy budget is positive but surface temperature below freezing the energy input is used to increase the surface temperature but melt does not occur until the melting point is reached. Without considering surface conditions all the positive energy input are used to compute melt thus driving a slight overestimation.**"**

*The paper uses many words but is still confusing about how exactly T_t and sDDF were estimated when calibrating the PDD model. While T_t is the primary focus of the paper, and the point is touched several times (1568-1569, 1572, 1574, 1575, and these repetitions must be removed), nowhere the interaction between these two parameters (as well as the impact of uncertainties in the actual lapse rate) is addressed rigorously. The current text gives the impression that the procedure was a qualitative one based on* *(visually?) comparing results obtained from various T_t values. If so, providing the reader with a plot of the values being compared would be helpful. Perhaps a schematic flow chart may be provided if there is no expressive way to accurately describe the procedure mathematically. Even better, provide some scatter plot showing how the chosen 'temporal length class' 'better explains magnitude and variability of snow melting' (1572, 26) compared to other possible choices.*

**As explained above, thanks to the helpful comments of the referee, we now focused firstly on the occurrence of snow melting process (finding the most suitable daily air temperature threshold witnessing such conditions, see the following Tab. 1) and secondly on the correct evaluation of the snow melt amount. The beginning of these two periods is shown in the Fig. 1. Then the actual snow ablation period is found between the actual snow cover diminishment and the bare ice occurrence (Fig. 1). A new analysis was performed focusing only on this period looking for a proper air temperature threshold for this specific issue as well (see the following Tab. 2). In particular, the identification of the most suitable air temperature thresholds was performed in a quantitative way by analyzing the air temperature conditions dominating the days featuring the largest ablation. These days were detected by sorting melting days according to the number of melting hours they have (0, 4, 6, 12, 18 and 24 $M_{EB}$ hours, respectively).**

**Then we applied a T-index model as well with different daily air temperature thresholds. The results were compared and also discussed with respect to the actual SWE ablation from field data (see the following Figs. 2 and 3). Our data indicate that minimum average daily temperatures of days with at least 18 $M_{EB}$ hours (273.6K) permit a good estimation of the actual snow ablation amount. On the other hand whenever the surface conditions have to be modelled (such as in studying snow avalanches or permafrost phenomena), a threshold of 268.6K can be considered suitable for detecting snow melt occurrence. In fact applying the largely used threshold of 273.15K, 89.7% of days featuring melt is detected, instead with 268.6 K (the minimum average daily temperatures of days with at least 6 $M_{EB}$ hours) the 98.8% of melting days is identified. Diagrams and plots showing such data are now included in the new draft of the paper.**

| **Snow melting** | **$M_{EB}$ hours** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Hours per day** | **All** | **0** | **≥ 1** | **< 4** | **≥ 4** | **≥ 6** | **≥ 12** | **24** |
| Number of days | 971 | 364 | 607 | 73 | 534 | 474 | 225 | 12 |
| % with respect to the total studied period | 100.00% | 37.49% | 62.51% | 12.03% | 87.97% | 78.09% | 37.07% | 1.98% |
| Cumulative $M_{EB}$ (m w.e.) | -8.77 | 0.00 | -8.77 | -0.13 | -8.64 | -8.32 | -5.10 | -0.34 |
| % with respect to the total cumulative $M_{EB}$ (m w.e.) | 100.00% | 0.00% | 100.00% | 1.44% | 98.56% | 94.92% | 58.18% | 3.83% |
| Mean average Daily $T_{AWS}$ (K) | 270.5 | 264.4 | 274.0 | 269.4 | 274.6 | 275.1 | 277.0 | 278.3 |
| Max of average Daily $T_{AWS}$ (K) | 282.1 | 274.1 | 282.1 | 275.0 | 282.1 | 282.1 | 282.1 | 282.1 |
| Min of average Daily $T_{AWS}$ (K) | 251.6 | 251.6 | 265.7 | 265.7 | 265.9 | **268.6** | 272.0 | 275.5 |

Table 1: Number of days and daily temperature values (mean, maximum and minimum of the average data) during snow melting season considering different temporal length classes of $M_{EB}$ hours per day. The air temperature data are recorded by AWS1 Forni ($T_{AWS}$).

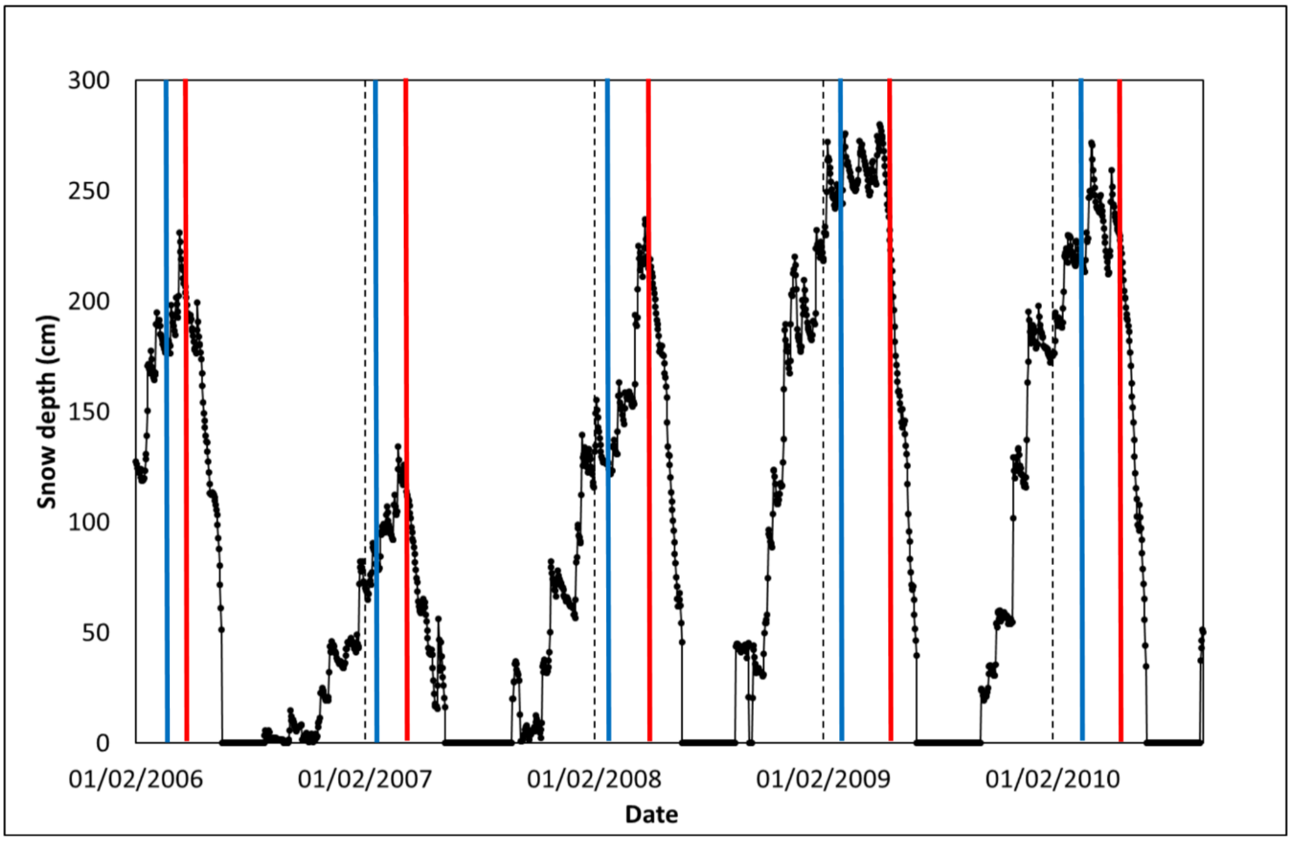


Figure 1: Snow depth data measured by the sonic ranger (Campbell SR50) installed on the mast of the AWS1 Forni. The beginning of the snow melting process is shown with a blue line and the beginning of the actual snow ablation with a red line.
This figure is now inserted in the new paper draft

| **Actual snow ablation** | **$M_{EB}$ hours** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Hours per day** | **All** | **0** | **< 4** | **≥ 4** | **≥ 6** | **≥ 12** | **≥ 18** | **24** |
| Number of days | 272 | 3 | 5 | 264 | 254 | 149 | 64 | 8 |
| % with respect to the total studied period | 100.0% | 1.1% | 1.8% | 97.1% | 93.4% | 54.8% | 23.5% | 2.9% |
| Cumulative SWE (m w.e., the distribution over the length classes is evaluated through $M_{EB}$ computation) | -3.57 | 0.00 | -0.01 | -3.56 | -3.50 | -3.05 | -1.30 | -0.24 |
| % with respect to the total cumulative SWE (m w.e.) | 100.0% | 0.0% | 0.2% | 99.7% | 98.0% | 85.4% | 36.4% | 6.7% |
| Mean average Daily $T_{AWS}$ (K) | 276.3 | 270.3 | 273.0 | 276.5 | 276.6 | 277.5 | 277.5 | 278.8 |
| Max of average Daily $T_{AWS}$ (K) | 282.1 | 274.1 | 275.5 | 282.1 | 282.1 | 282.1 | 282.1 | 282.1 |
| Min of average Daily $T_{AWS}$ (K) | 266.5 | 267.7 | 266.5 | 268.6 | **268.6** | **272.1** | **273.6** | 275.5 |

Table 2: Number of days and daily temperature values (mean, maximum and minimum of the average data) during actual snow ablation period (i.e.: the time frame between the beginning of the diminishment of the snow depth indicated by sonic ranger data and bare ice exposure derived from albedo values) considering different temporal length classes of $M_{EB}$ hours per day. The air temperature data are recorded by AWS1 Forni ($T_{AWS}$).

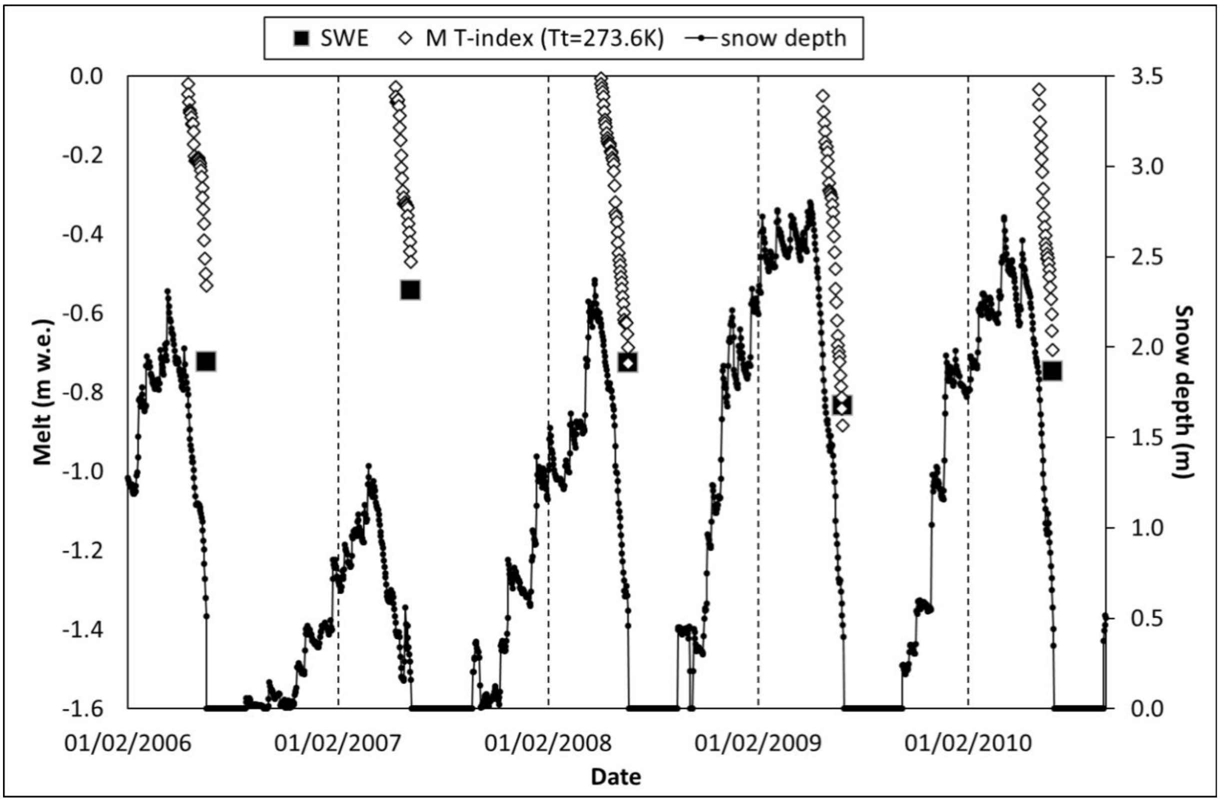

Figure 2: Comparison of the actual snow ablation (by T-index model) with the measured SWE. In this case, a threshold of 273.6 K is applied to T-index approach. The trend of the snow depth measured by sonic ranger is shown as well.

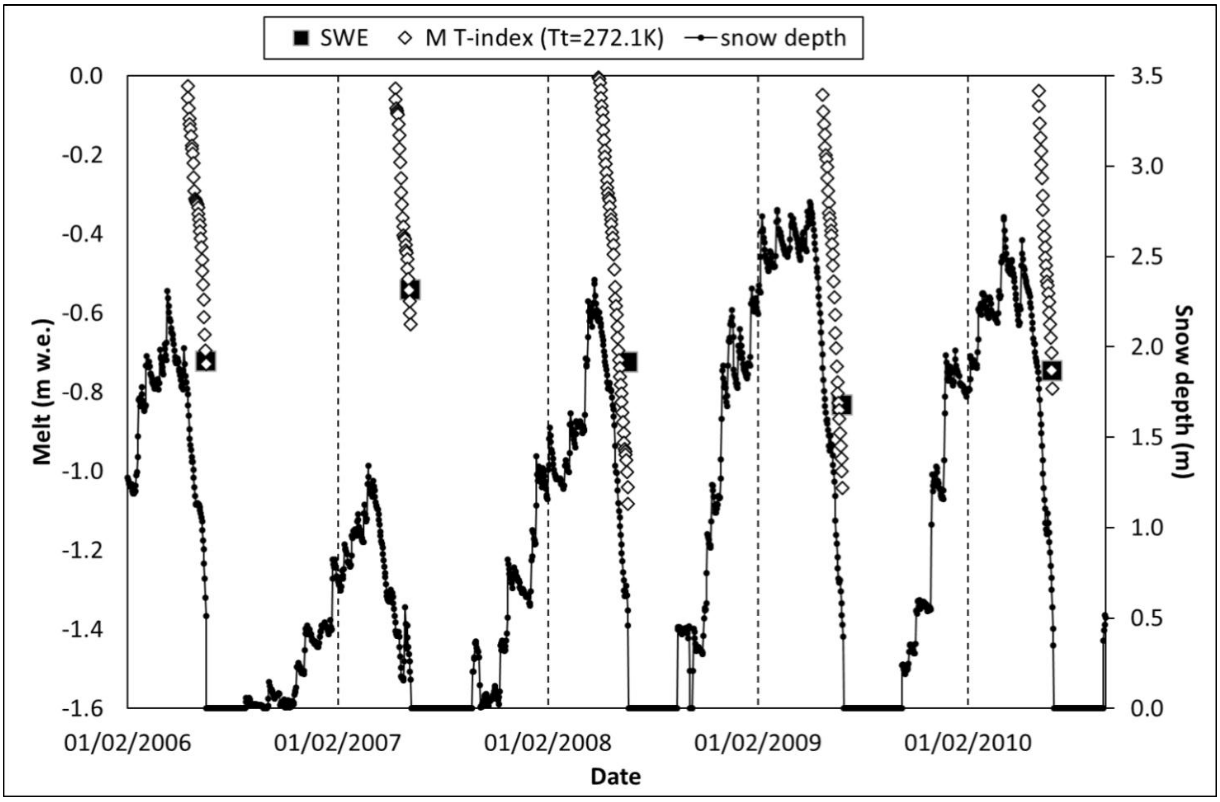

Figure 3: Comparison of the actual snow ablation (by T-index model) with the measured SWE. In this case, a threshold of 272.1 K is applied to T-index approach. The trend of the snow depth measured by sonic ranger is shown as well.

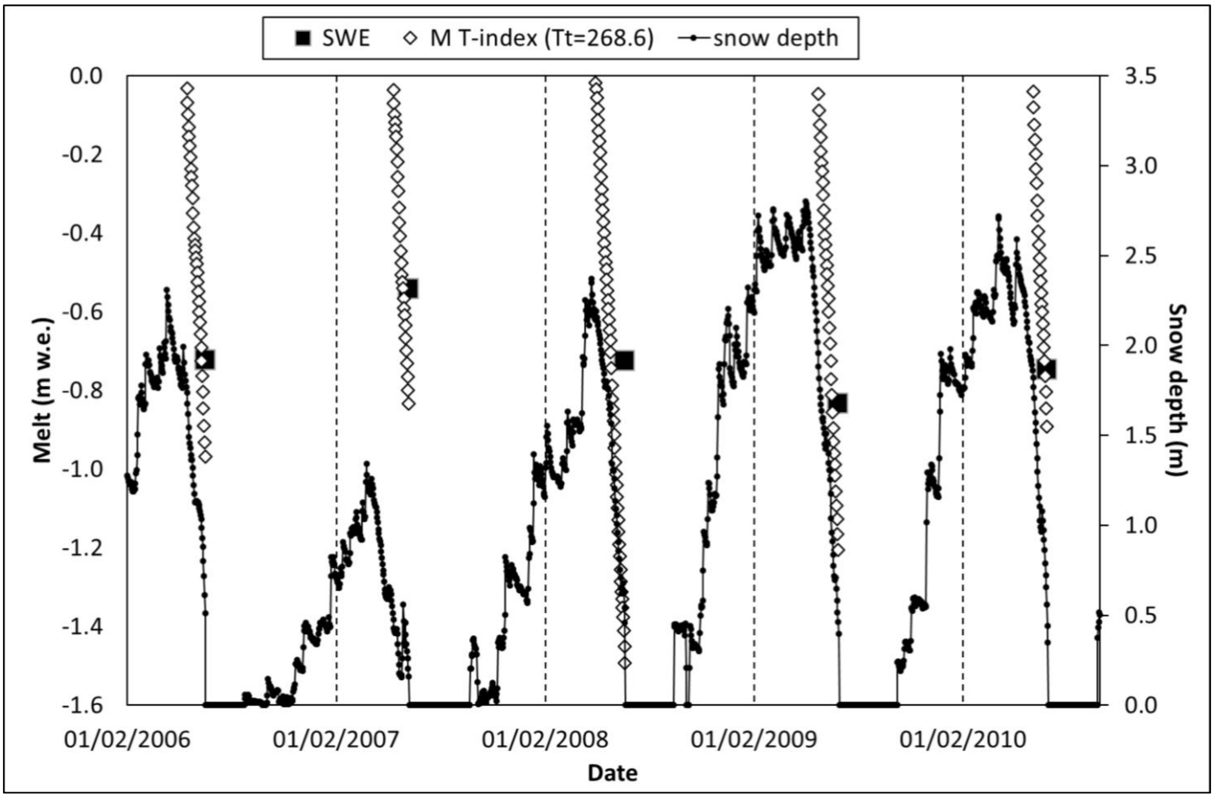


Figure 4: Comparison of the actual snow ablation (by T-index model) with the measured SWE. In this case, a threshold of 268.6 K is applied to T-index approach. The trend of the snow depth measured by sonic ranger is shown as well.

*The optimal values found for T_t critically depend on the details of how albedo was used to identify the exact date of complete snow melt. Calculating and using albedo values from on-ice AWS data is in general not straightforward, so a bit more details are needed. How was albedo calculated from AWS radiometer observations?*

**We have added an equation (4) in order to clarify the computation of albedo:**

**"**The albedo values are quantified from the solar radiation measured by the AWS1 Forni (CNR1 net radiometer, Kipp & Zonen):

$$\alpha = \frac{SW_{out}}{SW_{in}} \quad (4)$$

where SWout corresponds to the reflected shortwave radiation and SWin to the incoming one (both measured in W m$^{-2}$). The chosen threshold of 0.4 is driven by the reflectivity values generally featured by the ice and the snow. Indeed in a previous study (see Tables 1 and 3 in Senese et al., 2012a), the mean ice albedo was found always lower than 0.4 analyzing data from 2006 to 2009.**"**

*How sensitive is the optimal value found for T_t to the choice of 0.4 as the albedo threshold between ice and snow? In the model, albedo alone controls the date when SWE is assumed to have completely melt, but the text mentions that snow pits data are available for all but one year. Please show how well the modeled cumulative snow melt compares to the actual measured SWE at the date albedo drops below 0.4.*

**The AWS is located at the glacier melting tongue, at 2700 m of elevation, an area featuring bare ice during the largest part of the summer. Here all the snow cover melts and also a strong ice ablation occurs (the net mass balance is c. -5 m w.e. per year, see Senese et al., 2012). The chosen albedo threshold fits well with the fate of snow cover which resulted almost completely melted by the T-index approach in the**

**period featuring albedo lower than 0.4. As reported in previous diagrams (Figs. 2, 3 and 4) we compare the actual snow ablation (black dot in the graph) with the measured SWE (black square in the graph). This latter is quantified by the sonic ranger measurements (shown in the previous graph, Fig. 1) and considering a fresh snow density of 140 kg m$^{-3}$ (Senese et al., 2012). For a more exhaustive analysis, we have considered the values obtained by the T-index model as well.**

*1571 (and Tab. 1 and 2): here and elsewhere in the paper there are many details about melt in April-June vs. rest of the melt season, why is this of interest for the purpose of this manuscript? Why is the focus on calendar months instead of the actual snow melting season for each particular year? And why are modeled cumulative snow melt figures discussed relative to ice melt (tangential to this study) and not to observed SWE from snow pits?*

**We estimated both the snow and the ice ablation (Fig. 3 in the manuscript) with the aim at detecting the period featuring only snow melting processes. In this way, we found that at the latitude and altitude of the Forni Glacier the snow melting season generally starts from March/April and finishes in June. This assumption was already investigated by Bohr and Aguado (2001). In effect they found that April 1 SWE provides a more accurate estimation of the total seasonal precipitation with mean errors of approximately 4-6%. Despite that, now we don't start from April 1, but we have investigated the actual snow melting period and the actual snow ablation period that vary among the analyzed years.**

G.S. Bohr and E. Aguado (2001). Use of April 1 SWE measurements as estimates of peak seasonal snowpack and total cold-season precipitation. WATER RESOURCES RESEARCH, VOL. 37, NO. 1, PAGES 51-60.

*Snow pit data is mentioned but not presented at all in the paper I think.*

**We now show the measured SWE and we have added these information in the manuscript.**

*1571, 6: M_EB has units of length not time*

**We have explained the mean of "M_EB hour per day" in the *Data and Methods* section as cited above.**

*Tab. 1: the paper deals with modelling the occurrence of snow melting conditions and I understand the PDD model was calibrated to that purpose. Why is it relevant to provide this much detail on snow and ice melt totals, and how do these modeled values compare to actual mass balance observations at the site of AWS1? The total for Annual M_EB seems to match exactly the cumulative melt in Fig. 3, but is Fig. 3 showing measured or modeled values? Assuming Fig. 3 shows measured data (does it?) and the model delivering M_EB was calibrated to reproduce that total, how well do individual years perform compared to observations? Add a column to show this, as it is important to assess how good a benchmark the surface energy balance model is for the calibration of T_t and sDDF.*

**We agree with the referee, probably for the purposes of the paper is not necessary to describe in details the total glacier melt then in the new draft we did not report that diagram and we instead added the diagrams showing the measured snow depth and its seasonal and interannual variability.**
**As regard the comparison between measured melt and melt amount derived from energy budget it was reported in a previous paper dealing with glacier mass balance and it resulted an agreement between the two records of about ±3% (Senese et al., 2012) thus supporting the application of $M_{EB}$ in this study to detect the most suitable $T_t$.**

*Tab 2: 'number of days' do you mean 'Number of days with snow melt'? This table is incomplete without a column showing the ground truth of observed surface melt conditions from emitted LW at AWS1 Forni.*

**We have modified the caption accordingly.**
**In the fourth row the "Cumulative MEB (m w.e.)" is shown. In the reviewed version of the manuscript we have modified this table considering the period of the snow melting and not starting from April 1. Moreover we have added another table with the results regarding the actual snow ablation showing the measured SWE as well.**

*fig. 2 are these temperature points from the entire year or only during the snow melt seasons examined in the paper? Frequency and strength of inversion layers can vary seasonally quite a bit, and of interest here are exclusively those points during the snow melt season (possibly for more than one year, using different colors).*

**We have modified accordingly (see the new Figure above). Now the Fig. 2 shows daily values both during 2006-2012 period and only during February-June periods. Moreover comparing the air temperatures measured at Bormio and at the Forni Glacier, no thermal inversion occurs.**

*Fig. 3 is this measured or modeled? If modeled, how does it compare to observations?*

**These snow and ice melt values are estimated from the energy balance. The error was estimated in a previous study (Senese et al., 2012) resulting equal to 3%. This error is report in *Data and Methods* section.**

*fig. 4 These are curves of cumulative melt, not melt rates. Regardless, as with most time series plotted as time series, this figure is scarcely effective at showing which T_t performs best. Consider a scatter plot of (M_Tindex-M_PEB) vs. T_t, perhaps using different markers for different years. 1...638 as 'day' numbers on the x axis is unhelpful if the intention is to show the date snow disappears. Finally, neither cumulative melt nor melt rates are the focus of this paper, so please consider whether PDD model performance in matching the surface energy balance cumulative melt is the key point to focus on, or rather the performance of the PDD model in matching observed surface melt conditions, which is not shown in any table or figure.*

**Now we have included diagrams and plots showing the comparison among modelled SWE melt and observed SWE to permit the evaluation of the performance of the T-index model.**