We very much thank the two reviewer for their thorough analysis of our article and for their valuable comments, annotations and suggested improvements. They had been carefully considered and most of them are accounted for in the revised manuscript. Answers and explanations to all detailed questions and annotations raised by the reviewers are provided in the following.
(RC: Reviewer comments; AC: Author comments)

RC 1: Due to the computationally intensive nature of the LES, it is understandable that a small timeframe is most suitable to demonstrate the expected variation of sensible heat fluxes over the glaciers. However, I think the paper would benefit from having more detail on the conditions of the hour for which statistics are presented. The authors describe a blue sky condition which is known to be favourable for the development of a katabatic boundary layer, however the strength of the boundary layer can also be affected by the ambient air temperature (data from the off-glacier sites seen in Figure 1 could aid this). Furthermore, could the LES be compared with a cooler/cloudier hour? Though adding some extra work, I think this would benefit the scientific community and be informative for when (under which conditions) sensible heat fluxes are most likely to be inadequately modelled.

> ***AC:*** *Measures characterizing the atmospheric condition (ambient conditions), such as lapse rates or heating rates, depend on the locations where the measurements are taken. At the slopes there is a well-mixed layer (~10-50 m) with nearly constant potential temperature (~10℃) and a thermally driven slope wind develops. The synoptic flow enhances or retards the slope winds and alters the temperature distribution. To test this, we have calculated the lapse rate on an east slope for each experiment (different large-scale forcing). When the large-scale flow aligns with the slope winds (easterly flow) the lapse rate is lower (0.0067 K/m or even lower) than for the other cases (~0.0078 K/m or even higher). We have attached two figures to this review to illustrate the advection of warm air over a ridge and how it impacts the lapse rates (ridge_east.pdf and ridge_west.pdf). The same argument holds for the heating rates of the near-surface layer. Therefore, it might be the best to provide a vertical atmospheric profile at the location Z2 on the Zufallferner. A new figure has been added showing the vertical temperature profile up to 10000 m. Above the Cevedale Peak the lapse rate is approximately -0.006 K/m, which corresponds to the profile given by the ERA-Interim data. Together with the temperature deficit (between the 2 m temperature and the free atmosphere, see Table 1) this provides a valuable information on the ambient air temperature in the valley.*
>
> *We also like to note, that the atmospheric background state for temperature and pressure from the ERA-Interim data was from the 17th August 2014 and not 12th August 2013 as given previously in the text (p6 L25/26).*
>
> *We agree with the reviewer that the scientific community would benefit from a greater variety of cases and more general conclusions on the sensible heat fluxes. In order to draw a general conclusion, however, a large number of experiments is needed to cover the wide spectrum of topographic and atmospheric constellations. Unfortunately, we have already reached our computational capacities and try to solve this in an upcoming project. Each LES run of 9 hours' simulation time requires a computational time of 5-7 days on a High-Performance Computer with 400 cores. This is the first time that high-resolution LES have been performed over alpine glaciers and it shows that this approach has potential to study small scale processes.*

RC 2: As the work details, the LES is not required to be an observed real-world case, as the realistic simulation of processes and their spatial variation is key. However, the authors indicate several weather stations in Figure 1 (which are not used). It would be interesting to present what the actual lapse rate on glacier would be and also compare the calculation of sensible heat fluxes using this measured data. If no AWS measurements are to be utilised in this study, please remove them from the figure.

> ***AC****: In an idealized setup, the surrogate atmosphere can only be compared with well-known characteristics of stable boundary layer and dynamical atmospheric features obtained from in-situ*

measurements on alpine glacier. These characteristics include the vertical (wind and temperature), sensible heat flux and turbulent structure of the boundary layer and should be of the same order of magnitude as the measurements (Section 3.1 and 3.2).

During the week of the 17th August 2014 we had temporarily installed two weather stations, one closed to Z1 on Zufallferner and another further down the valley. The glacier station measured between 13 and 14 h a mean wind velocity of 4.6 m/s at 2 m height above the surface. Even though this is closed to the simulated value (4.5-6 m/s, westerly flow), the two values are not comparable at all. The prescribed surface heating rate (1.2 K/h) of the surroundings is lower than the measured heating rate (4.1 K/hr) at that particular day. Furthermore, the idealized simulations do not account for differential heating by radiation which is important during the first two hours and leads to asymmetric cross-valley winds. Without doubt, the homogenous heating assumption is a major drawback of the code. Although the chosen heating rate is significantly lower and shadowing effects are absent the typical low level jet and the heat advection from the lateral boundaries are present. As indicated in the conclusion, due to conservative chosen boundary conditions the simulated advection effects might be weaker than the one observed in a real atmosphere.

To avoid confusion, we follow the recommendation of the reviewer and removed the stations from Figure 1.

RC 3: The authors also outline several sub-regions and 'virtual' sites of interest on Zufallferner though with no clear justification for why. I think it is important to demonstrate the spatial variation of wind fields along a glacier centreline and focus on specific sites (i.e. Z1-Z4), particularly when attempting to simulate and understand interactions of the glacier boundary layer with synoptic scale winds. Furthermore, the selection of temperature extrapolation locations is important although often somewhat arbitrary in many studies. However, the presentation of several different sites between figures (Figures 7,8,9 for example) and their naming conventions (Z3 changes to Za then to Zc) is misleading. The authors should add some additional reasoning to their choices of virtual sites. The authors should also guide the reader to aspects of figure subplots by labelling them (i.e. a-d). Misleading information for Figure 3 is particularly noteworthy.

AC: *We thought, virtual sites make it easier for the reader to follow the discussion. Each region shows a different flow pattern: (R1) ridge region with flow separation, (R2) a steep ice fall, (R3) katabatic wind region, and (R4) divergence of katabatic winds. We have removed the sub-regions in Figure 4, 6 and 7, while we kept the regions in Figure 2 for discussion. The justification for the regions is now given in the first paragraph of Section 3.1.*

"For the discussion we introduce four specific regions: (R1) ridge region, (R2) a steep ice fall, (R3) katabatic wind region, and (R4) divergence zone of katabatic wind. Local characteristics are discussed at four virtual sites on the glacier (Z1-4)."

We agree, that the focus of the discussion should be on the winds along the glacier centerline (Z1-Z4), and we think that has been done since most of the discussion of Section 3.1 is related to the wind fields on Zufallferner. However, the discussion on the dynamic and cross-slope winds (second paragraph of Section 3.1) helps to better understand the processes (interaction with the synoptic and thermal winds) that cause the spatial variation along the centerline.

Yes, the naming convention is misleading. We have changed labels of the locations used for interpolations to (S1-S5) and also labelled the subplots to guide the reader. From the text it is indeed not obvious how we have chosen the sites. The idea was to select sites with distinct flow and advection patterns: (Z0) at the tongue with almost pure katabatic wind (used as reference station), (Za) in the higher region which is influenced by strong advection, (Zb) at the lateral boundary of the glacier which is influenced by the cross-valley circulation, (Zc) very closed to Za but not affected by strong *heat advection, and (Zd) a second station on the glacier with dominantly katabatic wind. We now give the reason to our choice in the second paragraph of Section 4.2.*

"To explore how the choice of observation sites influences the spatial variation of the surface heat flux estimates, we define a set of virtual observation on Zufallferner with distinct flow and advection patterns: (S1) located at the glacier tongue with almost pure katabatic wind (used as reference station), (S2) in the higher region which is influenced by strong heat advection, (S3) at the lateral boundary of the glacier which is influenced by the cross-valley circulation, (S4) closed to S2 but less affected by strong heat advection, and (S5) a second station on the glacier with dominantly katabatic wind. For each combination of S1 and S2-S5 the heat fluxes are estimated according to Eq. 16."

RC 4: Finally, while it is clear from section 1 what the problems of the literature are (and it is very well written), I think it is important to stress in a little more detail what the aim of the paper is and add some more discussion regarding the applicability of an LES approach at the end.

AC: *In the last two paragraphs of the introduction we now stress in more detail the aim of the paper.*

"To overcome this difficulty, we make use of high resolution Large-Eddy Simulations (LES). The LES are considered as pseudo-reality - a testbed to identify the shortcomings in the local surface heat flux estimates when the lack of observations restrict our micrometeorological knowledge to a few sites. The plausibility of the temperature interpolation algorithms and the derived surface heat fluxes can be more strictly tested in a surrogate world of atmospheric simulations, which offer a realization of atmospheric states in which all target variables are known. The pseudo-reality atmosphere is not required to be an observed real world case, but needs to be plausible realization of the atmosphere in the sense that relevant processes are realistically simulated. The advantage of such studies is that the surrogate atmosphere provides a perfect pseudo-observation of all the variables required to establish the skill of an interpolation method and hence the surface heat flux calculations. While surrogate atmospheres have been widely used in downscaling studies it's still a new approach in glaciological studies (Frias et al., 2006; Vrac et al., 2007; Maraun, 2012)."

Frías, M. D., E. Zorita, J. Fernández, and C. Rodríguez-Puebla (2006), Testing statistical downscaling methods in simulated climates, Geophys. Res. Lett., 33, L19807, doi:10.1029/2006GL027453.

Vrac, M., M. L. Stein, K. Hayhoe, and X.-Z. Liang (2007), A general method for validating statistical downscaling methods under future climate change, Geophys. Res. Lett., 34, L18701.

Maraun, D. (2012), Nonstationarities of regional climate model biases in European seasonal mean temperature and precipitation sums, Geophys. Res. Lett., 39, L06706, doi:10.1029/2012GL051210.

Specific comments

RC: 1 7: Add the temporal scale for which of the flux over- and under-estimates are found (i.e. 1 hour of statistics).

AC: *Changed to: "The glacier-wide hourly averaged surface heat fluxes are both over- and underestimated by up to 16* Wm^{-2} *when using extrapolated temperature and wind fields."*

RC: 1 18: Re-word "loss of information".

AC: *Changed to: "The reduced spatial and temporal variability ..."*

RC: 2 10: I think it is important to stress that this "over 50%" contribution from turbulent heat fluxes is typical for overcast conditions or for maritime glaciers (as is given by the studies you cite –e.g. Cullen and Conway, 2015) as otherwise the dominance is typically, from shortwave radiation. For your study you assess a clear sky condition and a continental glacier.

AC: *We have re-written that sentence: "The energy surplus can be critical for the ablation, considering that the turbulent heat flux can represent 50% of the total energy during pronounced melt events on maritime mid-latitude mountain glaciers in summer, and even up to 30% on continental glaciers (e.g. Cullen and Conway, 2015; Gillett and Cullen, 2011; Van den Broeke, 1997; Hock, 2005; Klok and Oerlemans, 2002; Oerlemans and Klok, 2002; Giessen et al., 2008; Moore and Owens, 1984)."*

RC: 2 13: Replace "peculiar" with "particular".

AC: *Done.*

RC: 2 25-26: Though I agree that there is still much to be understood about the impact of these assumptions on glacier melt rates, citing some of the work which has made attempts to use distributed temperature for this purpose would be suitable here. For example, Immerzeel et al. (2014) investigate this for a catchment/valley scale and Shaw et al. (2016) investigate this for a debris-covered glacier.

AC: *Done.*

RC: 3 19: I assume here that you refer to the surface boundary layer for "SBL"? Write out in full before using the acronym.

AC: *Yes, SBL refers to stable boundary layer. Done.*

RC: 3 20: What does SGS refer to? Write out in full as well.

AC: *SGS refers to subgrid-scale. Done.*

RC: 4 4: A minor point, but you are missing an equation number for eddy viscosity (this should be eqn 7).

AC: *We have added the missing equation number.*

RC: 4 9-11: This sentence needs re-writing. It is unclear what it is trying to say and the sentence has syntax errors.

> ***AC:** The sentence has changed to: "While, energy is transferred from the large to small scales according to the Kolmogorov energy cascade, it has been observed that locally there can be a significant transfer of energy from the residual motions to the resolved scales (backscatter)."*

RC: 5 2: Changes in temperature and phase from radiative forcing would be relevant if the LES approach was adopted over a longer time-frame. This may be worth adding to the discussion?

> ***AC:** In the last paragraph of Section 3.4 we now indicate the how insolation on slopes affect the circulation pattern.*
>
> *"We like to note, that the current version of the solver ignores differential surface heating by radiation and is therefore only suitable for idealized simulations. Differences in insolation on slopes due to exposure, aspect or shadow cause upslope flows to be inhomogeneous. The different onsets of the slope winds then lead to more asymmetric cross-valley circulations."*

RC: 5 16-17: How is the topography representative of many in the European Alps? Can you also add the mean slope of the glacier to this section?

> ***AC:** We have added more topographic information to this section:*
>
> *"The surface area of the glaciers is about 6.62 km² (2013) with an altitudinal extent from about 3750 m a.s.l near the summit of Hintere Zufallspitze, down to 2595 m a.s.l. at the lowest point of Zufallferner. The model domain includes a wide variety of topographic features such as steep slopes up to 50°, glaciated and unglaciated (summit-) ridges of various aspects, as well as larger glacier sections with smooth terrain and low slope angles. The mean slope angle of the glacierized terrain is 17°. The topography can be regarded as (i) typical for many glaciers in the European Alps and (ii) highly suitable for investigating the complex interaction of large-scale (synoptic) forcing and small scale topographic features."*

RC: 5 21: What grid size do you use for the ERA-Interim reanalysis data? Is this re-sampled from the 6 hourly temporal scale of ERA-Interim? Additional detail would be useful here.

> ***AC:** The ERA-Interim reanalysis data is available on a 0.75x075 degree grid. The ERA grid cell data above the investigation is mapped onto the LES grid. We have initialized the LES model with the vertical profile from 06UTC. It now reads:*
>
> *"The atmospheric background state for temperature and pressure is derived from ERA-Interim reanalysis data from 06 UTC. The vertical data is uniformly mapped onto the unstructured LES grid."*

RC: 5 28: Specify if the 100 m temperature is that from the ERA-Interim.

> ***AC:** Yes, the 100 m temperature is that from the ERA-Interim data. We have included now this information: "The pre-factor, C, is the temperature perturbation at the glacier surface, which in our case is the difference between surface temperature (273.16 K) and the ERA-Interim*

temperature at 100 m above the surface."

RC: 6 2: Why 8 m/s-1? Is this the mean value from the given six hour period of the reanalysis data?

> ***AC:*** *Yes, this is the mean wind velocity from the ERA-Interim data at 5500 m. We have added the following sentence at the end of the paragraph: "This corresponds to the mean wind velocity of the ERA-Interim data at 5500 m."*

RC: 6 8: It is unclear what you mean by this - "some sort of model". Please re-word this sentence.

> ***AC:*** *We have re-worded this phrase: "The filter and grid resolution are too coarse to resolve the near-wall motions, including in the viscous wall region, so that their influence closed to the wall are modelled by a shear stress model."*

RC: 6 23: How did you derive these values of z0? While your z0 fits within the range of published values (as you discuss later in section 3.4), a reference here would be useful. Do you have different values for snow and ice or is the spatial variation for all on-glacier surfaces constant? It would be interesting to plot the snowline for this day on to Figure 1 if it is known. Are the effects of different on-glacier surfaces (snow/ice) important here, considering a constant 273.16K surface temperature?

> ***AC:*** *The values have been taken from literature. We have included some references.*
>
> *The roughness length for snow and ice are the same. We have added the following sentence: "The aerodynamic roughness height, z0, is set to 0.1 m for the land surfaces (e.g. Stull, 2012) and to 0.001 m for the glacier and snow surface (e.g. Braithwaite, 1995; Giessen et al., 2008; Brock et al., 2000; Hock, 2005; Greuell and Smeets, 2001), respectively. We assume similar roughness height for snow and ice since large parts of the glaciers were covered by a thin layer of fresh snow."*
>
> *This assumption is also discussed in Section 3.4:*
> *"A crucial assumption is the surface roughness length. To obtain more general results, uniform values of z0 for snow and ice with 0.001 m are used, which is in the range of commonly used values (e.g. Braithwaite, 1995; Giessen et al., 2008; Brock et al., 2000; Hock, 2005; Greuell and Smeets, 2001). The 'uniform' assumption ignores temporal and spatial roughness length variations. However, potentially such variations can have a strong influence on the magnitude of the surface energy fluxes (Brock et al., 2000; Giessen et al., 2008). We argue that this assumption is acceptable since large parts of the glaciers were covered by a thin layer of fresh snow."*
>
> *I think you refer to the effects of the surface characteristic on the atmosphere. Different roughness height would certainly impact the momentum flux and heat exchange at the surface. However, we think that it is more important (at least in the summer season) to account for non-uniform roughness changes, e.g. seracs, ice falls or the sudden change in roughness at the glacier boundary. While elements such as seracs are not resolved the model accounts for the sudden roughness changes at the glacier boundary. On large glaciers (e.g. Kronebreen and Kongsvegen) the sudden roughness change at the tongue due to huge seracs has severe effects on the flow. The Zufallferner is rather small and the influence from the surrounding may*

overwhelm the errors made by this assumption.

RC: 6 28: What is the hour of the 12th August that is being reported in this paper? I think this may be relevant for the time of day on the glacier and the expected temperature outside the glacier boundary layer and possible shading effects etc.

> ***AC:*** *The model has been initialized with the ERA-Interim profile from 06 UTC (see comment above) and a uniform surface temperature of 273.16 K (Section 2.3). On p6L28 we refer to the last simulation hour. We have now added this information.*
>
> *As mentioned in the second comment, the idealized simulations do not account for differential heating by radiation (shading effect). The surface temperature of the surrounding is given by the prescribed surface heating rate (1.2 K/h). At the end of the simulation the surface temperature is 10.8 K.*

RC: 7 8-9: Has the size of computational domain been altered to test the resultant differences in turbulent energy generation?

> ***AC:*** *Yes, we have tested various simulation setting. One concern was the development of gravity waves which would impact the boundary layer characteristics. However, we could not find significant differences between a domain size of ~15 km and ~10 km (and 12.5 m horizontal resolution). The simulations are more sensitive to the choice of the grid size. Only 60-70% of the kinetic energy was resolved when using a horizontal resolution of 25 m. Additionally, decreasing the horizontal resolution lead to greater aspect ratios of the prismatic layers, which required even shorter integration time steps (0.01 s). Decreasing the prismatic layers was not an option since this would affect the shear stress and momentum calculations closed to the surface. The choice of ~12 m was a good tradeoff between computational costs and model quality. Besides the computational domain setup, the choice of the subgrid-scale model is essential for the results. The Smagorinsky SGS model was to dissipative in the stable boundary layer which led to numerical instabilities.*
>
> *We have added the following text to Section 3.4: "When decreasing the horizontal grid resolution to 25 m the resolved kinetic energy was only 60-70%. Additionally, a coarser grid leads to greater aspect ratios of the prismatic layers, which requires very short integration time steps (0.01 s) to guarantee stability. Increasing the prismatic layer heights is problematic since this affects the shear stress and momentum calculations closed to the surface. The choice of ~12.5 m is a good tradeoff between computational costs and resolved scales."*
>
> *"We have also tested the dynamic Smagorinsky model, but the simulations are found to be unstable due to large fluctuations of C_s."*
>
> *Additionally, we have added a new paragraph at the end of Section 3.4 which should highlight the limitation of the LES solver: "We like to note, that the current version of the solver ignores differential surface heating by radiation and is therefore only suitable for idealized simulations. Differences in insolation on slopes due to exposure, aspect or shadow cause upslope flows to be inhomogeneous. The different onsets of the slope winds then lead to more asymmetric cross-valley circulations."*

RC: 7 9: What is meant by opposite DEM boundaries? I think that a new figure providing a schematic of the layers/grids used for the LES would be very useful, albeit selective of the key things to include. The description of the LES model is detailed well, though considering it comprises a large proportion of the paper, the addition of a figure could be beneficial to aid the reader.

> ***AC:*** *In order to guarantee a fully turbulent atmosphere the boundaries are specified as period. Such boundaries require that faces on the opposite boundary (faces of grid cells) are equal within a certain tolerance. To do so the mesh grid points on opposite boundaries have been slowly displaced to match each other. The inner grid points are relaxed to get a smooth transition from the boundaries towards the inner domain. We have added a new figure showing a sketch of the relaxation procedure.*

RC: 7 15: Remove “very”

> ***AC:*** *Done.*

RC: 7 18: Remove “it turns out that” and add a supporting reference for M-O application.

> ***AC:*** *Done.*

RC: 8 14: Why these sites? Please add some brief justification/description.

> ***AC:*** *We’ve added a justification for that choice (see comment above).*

RC: 8 15-16: Remove “Apparently” – Spelling mistake “luv” – Assumed to be “lee”?

> ***AC:*** *Done.*

RC: 8 25: Replace with “Generally, katabatic winds: : :.”

> ***AC:*** *Done.*

RC: 9 7: “for mountain glaciers during CLEAR sky conditions”.

> ***AC:*** *Done.*

RC: 9 12: “Similarly, : : :.”

> ***AC:*** *Done.*

RC: 9 12-14: The downslope winds at Z4 would also be weaker due to a minimal fetch of the boundary layer too.

> ***AC:*** *Yes, this is an important aspect which we have included now: "Similarly, a reduced fetch and, in particular, a strong shear associated with a rapid veering of the winds with height can drastically reduce the wind velocity."*

RC: 9 16: Please add the wind direction cases to Figure 3 as they are currently just interpreted from the same positioning as Figure 2. Also, it would be beneficial to add letters a-d to all subplots to more easily direct the reader to the appropriate information from the text.

> ***AC:*** *Done (see comment above).*

RC: 9 16-17: This doesn't appear to be the case for the bottom left figure, which I assume to be the Northerly wind case. Are the authors only referring to the westerly (upper left) case here?

> ***AC:*** *We have added a comment to which Figure and subplots we are referring to.*
>
> *"The intensity and height of the wind maximum decreases down-slope for most cases (see Fig. 5a, b, d), ..."*

RC: 9 15-20: I think this paragraph could do with greater clarification about which cases are being described. Again, some detail about conditions during the considered time period would be interesting. Does the free-air meteorology represent the typical cycle of the region?

> ***AC:*** *We now refer to the specific cases and have given more details on the ambient conditions (see comment 1). The free-air meteorology indeed represents a typical stratification for the region (see Figure 4).*

RC: 10 2: Change "shapening" to " ,shaping".

> ***AC:*** *Done.*

RC: 10 15: Rewrite as "More importantly, the distortion: : :.."

> ***AC:*** *Done.*

RC: 11 1: Rewrite as "On the one hand, distributed mass: : :."

> ***AC:*** *Done.*

RC: 11 5-6: spelling correction "of course".

AC: Done.

RC: 11 18: I think adding Brock et al. (2006) here would be suitable.

AC: Yes, this reference absolutely suits here and has been added.

RC: 11 31: remove "used".

AC: Done.

RC: 13 1: Again, I think some justification for these two 'virtual' points is needed.

AC: To test the influence of the flow direction on the lapse rates and derived surface heat fluxes the location were chosen in a way to have a preferable large vertical altitude difference between the stations. We have given this justification in text: "To illustrate how the flux estimates depend on the local flow conditions, we defined two virtual observation points at Zufallferner, with preferable great vertical altitude differences between the sites (S1 and S2, see Fig. 10)."

RC: 13 2: Change the acronyms here and elsewhere in the manuscript as Z0 and z0 (roughness) are too similar.

AC: We have changed Z0 to S1.

RC: 13 20: It is not clear where in Table 2 that 7 Wm -2 is derived from. Please clarify. Is this underestimated relative to the LES for just the west case, 6.9 Wm-2?

AC: We have rewritten this paragraph:

"On a glacier-scale, the bulk approach underestimates the average heat flux between 5.2 (-16.6%) and 6.9 Wm^{-2} (-20.3%) for the westerly, easterly and northerly flow (see Tab. 2). The local differences for the southerly case, however, almost cancel each other (0.8 Wm^{-2}, 2.2%) ."

RC: 13 26-28: To my understanding, Figure 9 shows the differences in sensible heat fluxes between the LES and bulk method when data are extrapolated using lapse rates (Table 3) between different site combinations. It is not clear however whether a particular wind case (of the LES) is presented in the figure. As mentioned earlier, the naming convention and the way in which it changes between subsections of the paper is confusing and needs changing. Furthermore, although the test of lateral sites is interesting and an important aspect of glacier micro-meteorology to consider, why was site Zb selected in its current position? Was this randomised?

AC: Yes, Fig. 9 shows the differences in sensible heat fluxes between LES and bulk method using the westerly flow case. The site (Zb, now called S3) is located at the boundary of the glacier which is influenced by the cross-valley circulation. We have now given a justification of the choice (see comment above):

"To explore how the choice of observation sites influences the spatial variation of the surface heat flux estimates, we define a set of virtual observation on Zufallferner with distinct flow and advection patterns: (S1) located at the glacier tongue with almost pure katabatic wind (used as reference station), (S2) in the higher region which is influenced by strong heat advection, (S3) at the lateral boundary of the glacier which is influenced by the cross-valley circulation, (S4) closed to S2 but less affected by strong heat advection, and (S5) a second station on the glacier with dominantly katabatic wind. For each combination of S1 and S2-S5 the heat fluxes are estimated according to Eq. 16."

RC: 13 29-30: Re-word "lack to reflect"

AC: We have changed the sentence to: "Evidently, the bulk approach in concert with interpolated temperature fields underestimates the spatial surface heat flux variability."

RC: 13 30: You mention variability in time. However, this paper is only demonstrating statistics for one hour (p6, l27-28). Although it is likely that the bulk approach would poorly represent this temporal variability, Figure 9 does not show it.

AC: That's correct. We have removed the comment on the temporal variability (see comment above).

RC: 13 32: Refer to Table 3 here.

AC: Done.

RC: 14 1: "Similarly, : : :."

AC: Changed.

RC: 14 1: I think it is better to refer to a "shallow" temperature gradient/lapse rate rather than "small", however, the scientific community does not always agree on this and it is a minor point.

AC: We have followed your recommendation and used the expression 'shallow'.

RC: 14 4-5: This is a crucial point, though it could perhaps be supported with measured data as well, which will still represent relative temperature differences at two on-glacier locations (through use of lapse rates) even if the LES isn't designed here to represent the observed absolute values.

AC: Please refer to RC 2, where we have discussed this issue.

RC: 14 7: replace “what generates” with “that generates”.

***AC:** Changed.*

RC: 14 12: Perhaps re-word this as we are talking about a much small period of time than just a summer.

***AC:** We have re-written the sentence as follows: “The idealized LES experiments demonstrate that heat advection associated with the wind systems shape the thermal conditions on the glaciers during the course of a summer day with clear sky conditions.”*

RC: 14 16: Check the consistency of spelling using British/American English – here referring to “Parametrised” - (http://www.thecryosphere.net/for_authors/manuscript_preparation.html). (See p11, l15 / p12 l9 etc)

***AC:** We have checked the consistency of spelling.*

RC: 14 24-25: The difference in lapse rate between Z0-Za and Z0-Zc is strong, presumably due to the heat advection from the south west ridge of Zufallferner (Box R1). I think it would be useful to refer explicitly to this potentially large difference over a small (200 m?) distance on the glacier.

***AC:** We have taken up this idea and added the following sentences: “Generally, the sensitivity of the calculated lapse rates to the choice of the observation sites is related to the steep gradients between the advected warm air masses and the ambient cold air masses on the glacier. Shifting stations by even small distances (<= 200 m) can potentially lead to remarkable differences in the calculated lapse rates of ±0.005 Km^{-1}.”*