

## ***Interactive comment on “Surface-layer turbulence, energy-balance and links to atmospheric circulations over a mountain glacier in the French Alps” by M. Litt et al.***

### **Anonymous Referee #2**

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Surface-layer turbulence, energy-balance and links to atmospheric circulations over a mountain glacier in the French Alps

Litt, M. et al.

The paper uses eddy covariance and vertical wind-speed and temperature profiles to quantify the errors inherent in using the bulk aerodynamic method for energy balance modeling. Errors were estimated by comparing model outputs using the three approaches over two measurement periods. The authors used large scale weather patterns to constrain their comparisons.

The authors should be commended on their use of interesting datasets. However, they

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need to refocus the Results and Discussion sections to better elucidate the conclusions of the paper.

General comments

- Impact of changing sensor heights

In Section 2.2 a description of the changing sensor heights is given, as well as the manual lowering used to overcome these changes. The following remains unclear: was the 60-90 cm change accounted for in the flux calculations, or was a fixed height used (is unclear in Section 2.3)? Are the ‘mean’ heights given the height the sensors were changed to, the height after 5 or 7 days of change, or other? How do changing heights impact the flux results? Were different height values tested during calculation of the fluxes to understand possible errors?

- Surface properties

Sections 2.2 and 3.2 describe the changes to the surface observed in each campaign. Can the fetch properties also be added to Section 2.2 so that it is clear that the instrument heights are appropriate for the corresponding homogeneous surface (especially for the eddy covariance measurements).

- Calculation of roughness lengths

Section 3.2 describes the computation of roughness lengths using the profile data. Can you provide an explanation as to why the lengths were not calculated using the eddy covariance measurements, or, compare the lengths calculated using each method. Also, it would be useful to include an error range of the roughness length, as whilst it is stated that it ‘did not change significantly’, it would be useful for the reader to be able to evaluate the range (and associated error).

- Role of sublimation

Section 3.3 shows the formula used to calculate melt based on the SR50 measure-

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ments. Can you please add a comment to describe the role of sublimation, and why it is excluded from a mass loss calculation.

- Results

Currently the Results section combined comments related to both timing of events as well as classification by weather type. Please restructure to only focus on the weather patterns (as that is what is used in the Discussion section). Changing between time and pattern becomes confusing for the reader, as it becomes a lot of information to keep in mind.

- Results Section 4.1

Currently Section 4.1 is quite dense and difficult for the reader to pull apart. Please restructure in a way that is easier for a reader to follow. For example: "SF conditions are characterized by \_\_\_\_\_. This was observed \_\_\_\_\_ (example). The impact on melt is \_\_\_\_\_." In this way, the reader can focus (and retain) the most relevant information associated with each weather pattern (rather than interchanging between time periods and weather patterns).

- Results Section 4.2.2

As the paper is directed at a general glaciology audience and not at a specialized micro-meteorology community, there needs to be a better introduction to spectral analysis within this section as a reminder. Perhaps the addition of one or two sentences describing why the analysis is necessary and what relevance it has to the theme (ie that it will help to describe the turbulent boundary layer) is necessary to ease the reader into the section. Even though it is briefly described in Section 3.2, it would be beneficial to restate the information here. Also, the term 'Kansas curve' and 'Kaimal curve' is used interchangeably throughout the document – please standardize.

- Discussion Section 5.3

If there are concerns regarding the comparison with the weather patterns, these should

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be quantified.

-Results-Discussion-Conclusions disconnect

In the current form, there appears to be a disconnect between the Results, Discussion and Conclusions sections. Often, results required to support statements made in the conclusions (eg: erratic discrepancies between results during certain conditions) are not supported in the Results section, and additionally, certain sections of the Results (eg. Meteorology and wind regimes) are not fully utilized in the Discussion/Conclusions sections. I would recommend to the authors to visualize the conclusions and include only the results necessary to address those points.

Specific comments

P1 L3 Please clarify the time period in which each dataset was collected – from the description it seems that eddy covariance data and the profile data was collected during both the 2006 and 2009 study periods.

P2 L2 Change 'englacial' to 'glacierized' (or similar)

P5 L5 Why was a 1-hour period used instead of the standard 30-min run?

P5 L19 Please explain how the data was 'analyzed and compared'.

P6 L11 Change Table 3 to Table 2

P9 L4 Please minimize the use of brackets. It makes the sentence confusing for the reader.

P12 L9 Change 'again a after' to 'again after'

P13 L9 Please minimize the use of brackets. It makes the sentence confusing for the reader.

P13 L10 Change 'selecting 2 subsets' to 'selecting two subsets'

P13 L15 Please define GQR.

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P15 L9 Change 'previsions' to 'conclusions' (or similar)

P19 L20 The introduction of sublimation here seems out of context, should this be evaporation? There should be some mention of this ablation fraction in the results section.

Figure 3 Please increase the size of the graphic to improve readability.

Figure 8 It would be beneficial to replace this graphic with a direct comparison of each flux for the different weather patterns (scatterplots).

Figure 9 The error bars seem to be very small, please justify.

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Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2016-93, 2016.