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Interactive comment on “Modulation of glacier ablation by tephra coverage from Eyjafjallajökull and Grimsvötn volcanoes, Iceland: an automated field experiment” *by* Rebecca Möller et al.

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This manuscript presents an interesting data set on snow pack evolution underneath different defined tephra coverages. This dataset has the potential for interesting investigations in relation to engergy transfer on tephra covered glacier surfaces and might form the basis for further interesting studies. However, there is one major issue, which I want to raise and which needs to be used for a detailed revision of the manuscript: the measurements carried out on the test plots are not ablation measurements, but distance measurements. In contrast to ice surfaces, where the assumption of constant density holds rather well, snow packs will change considerably during the ablation pe-

riod. If there exists a snow pack of 2.7m with a mean density of 410 kg/m^3 the elevation change of the surface is by no means directly transferable to ablation rates. There are a number of other processes involved (compaction, refreezing, rain percolation, melt, lag in run-off) which makes it complicated to convert surface elevation change into ablation rate. Therefore, these observations cannot be directly related to ablation conditions of sub-tephra ice surfaces. It needs a careful revision of the manuscript to present these complicated processes in the correct framework. The fact that water will not be present at the surface of the snow layer, together with the soft texture of the snow probably enables rather stable conditions for the experiment. The test plots would have probably been destroyed much earlier on an ice surface. It is a pity that no camera was installed in addition to the SR50 sensors. This could have provided valuable additional information about the conditions of the test plots and might have explained some of the irregularities found in the data set. Also, thermistors in the snow pack would have provided necessary information about percolation conditions and possibly compaction. This might be a useful recommendation for future experimental setups. Our detailed experiments (Juen et al., 2013) demonstrated that the surface morphology of spatially restricted tephra layers can change very fast, preventing the collection of sensible data. I might be useful to refer to this publication during revision.

Minor comments:

Introduction: Reference to Östrem, 1959 is missing. Many of the basic findings were already mentioned in this first publication on sub-debris ablation and credit should be given to him.

P. 2, L. 2: “influences from tephra cover” on what?

P.2, L.4: This is not correct. Most parameterisations for debris cover are also valid for debris thicknesses in the order to centimetres. Evatt et al., 2016 even provides a closed formulation for the gradual evolution of the debris cover from dust to m-scale.

P.2, L.8: see comment above.

P.2, L.13/14: This is incorrect. Juen et al., 2013 provides a very detailed study about energy transfer through debris cover, including the effect for tephra layers. Even though the observation period is very short, the findings are of interest for your study.

P2, L. 29: The vertical density profile would be interesting to see, in order to evaluate the ablation conditions.

P.3, L13/14: At what initial height above the surface were wind and radiation sensors installed. This important for the calculation of the turbulent fluxes.

P.3, L.18: If you use the SR50 sensor without additional information it is only a distance measurement, not an ablation measurement. In the case of underlying ice, the relation with ablation is rather straightforward, but for snow this is rather complicated.

P.3, L.32: The information about the total elevation change at the site and the depth of the holes for the aluminium structure would be useful for understanding the situation.

P.4, L.6: I doubt that this is correct. It rather depends on the specification of the temperature sensor. Does it provide the mean temperature (IR radiation) across the footprint, or does it report maximum and/or minimum temperatures? Also, it depends on the distance between the sensor and the surface, because the footprint might be larger than the sample plots for long distances (i.e. late in the season). There needs to be a more detailed description.

P.4, L. 24ff: As discussed above, the distance measurements are not identical to ablation measurements: Therefore, the presentation needs to be altered.

P.4, L.30: The maximum elevation change of 2.97m is larger than the snow thickness in the region of the experiment. This means that at least parts of the test sites were snow free at the end of the data set period. Are there any indications for the loss of the snow cover in the data?

P.5, L.19-21: This is a crucial finding and requires more attention. Because the distance measurements are not directly related to ablation, there might be other pro-

cesses, which influence the elevation change underneath the thick tephra covers. One possible reason could be that the test plots were too small. Snow is a media with an open pore space, in contrast to ice. Warm temperatures, wind and high humidity can considerably change the internal structure in the snow pack and a surface cover of 70 cm in diameter definitely does not inhibit lateral influence through the open pore space.

P.5, L.22-25: Again, this is related to the porosity of the snow pack. Rain cannot penetrate the ice surface and results in run-off with very little effect on ice melt. For a snowpack, rain percolates into the snow layers and might cause compaction, melt, run-off or refreezing, in dependence on the air temperature, amount and temperature of the water and the temperature of the snow pack.

P.5, L.25: This has nothing to do with wet or dry tephra, but with the amount of rainfall and the according temperatures. Our experience shows that under melting conditions the thin tephra layers are always wet, due to their porosity and ability to absorb water.

Fig. 3: It would be useful to present also the daily distance measurements, not only the cumulated. This data would provide a better understanding of the daily variations. Already in Fig. 3 it is evident that the thick tephra layers reduce the surface lowering considerably during the initial phase with intact test plots (until mid-July).

References: Evatt, G.W., Abrahams, D., Heil, M., Mayer, C., Kingslake, J., Mitchell, S.L., Fowler, A.C. & Clark, C.D., 2015. Glacial melt under a porous debris layer, J. Glaciol., 61 (229), 825-836.

Juen, M., Mayer, C., Lambrecht, A., Wirbel, A. & Kueppers, U., 2013. Thermal properties of a supraglacial debris layer with respect to lithology and grain size, Geografiska Analer, Series A, Physical Geography, doi:10.1111/geoa.12011.

Östrem, G., 1959. Ice melting under a thin layer of moraine, and the existence of ice cores in moraine ridges. Geografiska Annaler, 41, 228–230.

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