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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterisation of the melting layer variability in an Alpine valley based on polarimetric X-band radar scans" *by* Floor van den Heuvel et al.

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We would like to thank the anonymous referee for his precise and insightful comments. We have added numbers to our responses which correspond to the order of the referees comments:

(1) The antenna was actually rotated while pointing in the vertical direction, which is why the term "vertical PPI scan" has been used here. The words "(rotating 360 degrees)" have been added to this line to emphasize this.

(2) Information on the DPP and FFT modes have been added to Table 1.

The terms "vertically pointing PPI scan (360 degrees rotation)" and "ZDR calibration scan" refer to the same scan. Since ZDR is neither used within the context of this study nor for the melting layer detection algorithm, it was not considered relevant to give more information on ZDR calibration. To clarify this, on Page 4, line 18 "(rotating 360 degrees)" has been added and on Page 5, line 16 "ZDR calibration scan" has now been changed to "vertical PPI scan (rotating 360 degrees)" so that it is similar to section 2.1.

The beam width and antenna rotation rate are given in Table 1.

The melting layer detection algorithm requires that the RHI scans should be interpolated on a Cartesian grid. Best performance was obtained for a Cartesian grid of 25 m (Wolfensberger et al. 2016). In order to clarify this, the last line of section 3.1 (Page 6, line 27) has been adapted to "Otherwise, the default settings found to be optimal and described by Wolfensberger (2016) were used, including interpolation of the RHI scans on a 25 m resolution Cartesian grid."

(3) Unfortunately, for the Valais data only very few near horizontal PPI scans are available and only at the beginning of the campaign. Because the radar was located in a deep Alpine valley, any non-vertical PPI scan was for a considerable part blocked by mountains, and thus not considered very useful.

(4) This is mentioned on page 6, line 24: "In order to limit the effects of beam broadening, the melting layer detection algorithm has been set to detect up to a maximum distance of 10 km from the radar".

The trapping of cold air in the valley may happen regularly in the Valais, and could explain the bending of the melting layer towards the ground near Sion. For the case in Fig. 4 for example, we have observed a cold gradient between Evionnaz (∼10 km West of the radar) and Sion (at the same altitude, ∼20 km to the East and in the direction of the RHI scan), of about -0.6 °C. This explanation has been added to the label in Fig.4: "The bending of the melting layer towards the ground is probably related to the trapping of cold air in the valley and the observed negative temperature gradient towards the East (in the direction of the scan)."

(5) The FFT equation (former equation 2) has been removed. The other equations illustrate the relation between spectral slopes and fractions of variance explained by component, and are therefore considered helpful for understanding the results of this study and for the comparison with other studies. The text on Pages 7-8 and Lines 19 – 6 has been adapted accordingly.

(6) The term "Spatial lags" has been changed to "spatial scales" in the figures as well as in text.

(7) The interpolation of the melting layer detections is part of the melting layer detection algorithm as mentioned on page 6, line 25: "holes in the detected melting layer tops and bottoms were interpolated up to a maximum length of 1500 metres". However, in Fig. 5 it is really the median filtering (for representational purposes only) which suggests these relatively large gaps. For the quality check of the melting layer detection we refer to the paper by Wolfensberger et al. 2016.

The observed spikes (of more than 100 m) occur at the 25- 50 metre horizontal scales, which are not included in the first ten components analyzed in this study. The referee correctly noted that these abrupt changes may influence the spectral slope. However the effect on the fractions of variance explained by component remains minor, as illustrated by Fig 7. on Page 10 to which the influence of a hypothetical median filtering before performing the detrending and bell-tapering has now been added, as well as lines 27 - 30 on page 10: "Artefacts from the melting layer detection algorithm or noise from the original measurement may have some influence on the spectral slopes, which is why Fig. 7 also shows the effects of performing an additional median filtering of the melting layers before de-trending and tapering. It appears that the effect of median filtering on the fractions of variance explained by component is minor, and that de-trending and tapering of the melting layers is sufficient."

(8) In fact, both in Payerne and in Valais, the hemispheric scan was performed from 0 – 180 degrees, Thus, 20 km ranges are possible and observed in some cases (though dependent on ML length and terrain, as observed in Figure 4). In the Valais, as mentioned on page 5, line 16, the scan strategy changed during the campaign. Figure 4 comes from the second scan strategy which was more hindered in the 0-23 degrees elevation range by terrain. However, many of the RHI scans included in this analysis come from the first scan strategy, during which measurements up to 20 km were possible. As can be observed in Figure 11 Page 13 both campaigns have a comparable number of scans within these spatial scales. Admittedly, 20 km is the absolute upper limit, which is why the bin is defined as 15-20 km, so that the longest series from both scan strategies and campaigns can be included in this group.

To emphasize this, the following lines have been added:

Page 9, lines 21-22 : "The largest wavelengths (or spatial scales) correspond to distances of 20-15 km for melting layers which spanned almost the entire hemispheric scan."

Lines 12-15 Page 13 : "The coordinate plots also show that the larger spatial scales (20-15 km) are equally well represented in both campaigns even though for the Valais campaign these only occurred in the first two events because of a change in scan strategy which hindered the visibility in the 0-23 degrees elevations afterwards."

(9) Indeed, this is a known deviation for this radar (page 11, lines 33-34). The melting layer detection is based on gradients of Rhohv and ZH, which are scaled. As such, the absolute values should not have an influence on the detection. This has now been added to lines 33-34 page 11: "[..] this is a known deviation for this radar, but does not affect the melting layer detection algorithm which is based on scaled gradients of Rhohv and ZH."

(10) Fig 11. Page 13. has been adapted so that now it only consists of 2 panels instead of 4, improving the readability. It is in the interest of showing the intra-event

variability that all the lines are shown, since the box plots in Fig. 9 page 12 already give a measure of the spread of the entire dataset.

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2018-145/amt-2018-145-AC3-supplement.zip

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