Responses to Anonymous Referee #1

Comments 1

However, the paper has been written with a style barely adequate for a scientific International Journal. Therefore, my first suggestion is to perform a formal revision of the entire manuscript and to pay more attention to the punctuation and to the English grammar. In this respect, the sentences at Lines 53-58, 92-94 and 191-194 need to be rephrased more clearly.

Response

First of all, I would like to apologize for my poor English writing. A complete and careful revision has been completed as recommended by the reviewer, and the special attention was paid to sentences at Lines 53-58, 92-94, and 191-194 (corresponding to Lines 53-59, 92-95, and 209-212 in the revised manuscript respectively).

Comments 2

Moreover, I suggest to reduce the number of Figures: as an example, Fig. 10 can be aggregated to Fig. 7 or Fig. 2.

Response

Reviewer's comment is adopted and Fig. 10 is incorporated into Fig. 2 (it's Fig. 2f in revised manuscript).

Comments 3

Method (Lines 97-99). It is not clear how the authors determined the preset thresholds (0.8 for warm season and 0.7 for cold season). Please provide a clarification and add some details in the revised manuscript.

Response

This comment is aimed at Section 3.1, whose role in the paper is to describe the overall framework of MetSignal algorithm. Therefore, the thresholds (i.e. 0.8 for warm season and 0.7 for cold season) used in MetSignal_noise algorithm before are those adopted in Krause (2016). However, the reviewer's comment reminds me that this threshold should be a local value (similar to the membership functions) and needs statistical analysis to get the optimal result. Therefore, an objective statistical method is adopted to determine this threshold and details have been added in the revised manuscript (corresponding to Lines 113-118). The statistics results in Table 5 have also been updated due to changes in thresholds.

Comments 4

Method (Lines 112-117). The authors stated that a set of post-processing rules have been applied to adjust the classification results. I suggest to perform a sensitivity analysis to demonstrate the impact of such rules on the classification accuracy. What happens to the results of Tab. 5 if you do not apply the post-processing?

Response

A sensitivity analysis has been performed under the suggestion by reviewer, and the results are shown in the following table. Two methods were used to compute skill: the fraction of correctly classification for each echo type (FCC) and the overall Heidke

skill score (HSS) (Lines 234–239 in revised manuscript for details). By comparing the classification performance of the MetSignal algorithm before and after post-processing, it can be found that the classification skill of MetSignal algorithm in MET (NMET) will decrease (increase) without post-processing, which is due to the lack of special precaution in the ML regions and reduction of misclassification between AP and MET caused by post-processing respectively.

	FCC_{MET}	FCC_{NMET}	HSS
with post-processing	86.8 %	96.2 %	0.83
without post-processing	84.8 %	96.7 %	0.81

Although the results of the above sensitivity analysis prove the necessity of post-processing (HSS increases from 0.81 to 0.83), I think this sensitivity analysis is not necessary in this paper. Just like the response to comment 3, the role of Section 3.1 in this paper is to describe the overall framework of MetSignal algorithm, and the post-processing rules mentioned in Section 3.1 were not proposed by authors but an integral part of the raw MetSignal algorithm (Krause 2016). However, in order to achieve the same purpose of the sensitivity analysis suggested by the reviewer (i.e., to prove the importance of post-processing rules), a typical case has been added in the revised manuscript (corresponding to Lines 124-129).

Absolutely, if the reviewer still insists on adding this part to the paper, I'll make some adjustments.

Comments 5

Method (Line 198): I have some doubts about the criterion used to identify the melting layer. The latter, in this work, is defined as the region above 2.5 km. However, melting layer altitude can vary significantly from one meteorological event to another, because it is related to the freezing level height. Therefore, in my opinion, the authors must adopt a more objective criterion to detect melting layer in the training events. In this respect, a careful analysis of horizontal reflectivity vertical profiles may be very useful. As the light of such remark, an update of Fig. 10 and, therefore, of Fig. 11, is needed.

Response

The doubt proposed by reviewer about the altitude of melting layer is very insightful. The melting layer altitude does vary significantly from one meteorological event to another, and the lack of accurate and objective positioning of melting layer altitude is one of the defects of MetSignal_noise (as mentioned in Section 5). Therefore, at present, only through the analysis of existing data to determine the approximate location of the melting layer altitude, and need to adjust with the season and location. The altitude threshold of potential melting layer defined in this paper (2.5 km) is the result after analyzing the training set (i.e., all regions affected by the melting layer are higher than 2.5 km in the training set), and details have been added in the revised manuscript (corresponding to Lines 216-217). Therefore, the statistical result in Fig. 10 should be credible.

As can be seen from the title of Krause (2016), the core idea of MetSignal algorithm is as simple as possible on the premise of effectiveness. Therefore, it is obviously not suitable to use a melting layer identification method with the complexity comparable to the whole MetSignal algorithm. At present, I am trying to find a simple method to automatically obtain the melting layer altitude. The idea proposed by the reviewer that positioning the melting layer altitude by the horizontal reflectivity vertical profiles is of great reference value.

Comments 6

Method and Evaluation: I think that the authors should quantitatively assess the impact of the single impairments faced out in the Method section. In other words, I suggest to expand Tab. 5 and to present the results according to different scenarios: for example, what happens if you do not take into account the adjustment for Melting Layer Region in your algorithm?

Response

Reviewer's comment is adopted. The sensitivity analysis for the four improvement steps mentioned in Section 3.2 has been added in the revised manuscript (corresponding to Lines 256-274), and Table 5 is also expanded as suggested by reviewers.

Comments 7

Evaluation. The authors must provide some clarifications about the contents of Table 5. How did you determine the classification accuracy percentage of MetSignal and MetSignal_noise algorithms? I assume you used the contingency table approach. This is an important point to clarify. Moreover, the performance of the two methods shall be evaluated with respect to more than one statistical score.

Response

Reviewer's comment is adopted. An additional skill score (HSS) is added, and the score has been used in Table 5 is described in detail in the revised manuscript (corresponding to Lines 234-239).

Reference

Krause, J. M.: A Simple Algorithm to Discriminate between Meteorological and Nonmeteorological Radar Echoes, Journal of Atmospheric & Oceanic Technology, 33, 1875-1885, 2016.

Thanks again for the helpful comments.