We thank the anonymous reviewer #2 and Peter Kuma for their feedback on the updated article. As suggested, we have shortened the caption of Fig. 2 by moving it into a dedicated Section. The (current) dependence on the black-box algorithms from manufacturer ceilometers has also been made explicit in the introduction, conclusions and in Sec. 4. Our detailed replies to the different suggestions are provided below.

The authors
July 2024

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Editor

1) The authors carefully replied to the comments of the two reviewers made in the discussion phase. The manuscript was adapted accordingly.

With respect to the general criticism of reviewer 1, the authors plausible outlined their approach and philosophy, explained the position of ampycloud within the full processing chain of SMART and addressed the limitations of ampycloud more clearly. Therefore, I see most of the criticism removed. To my understanding, ampycloud might not be the final and perfect solution for cloud detection with ceilometers, but also small contributions to the scientific discussion are helpful. Thus, I also honor the approach of the authors to make the algorithm publicly available. Their tool might help other researchers using ceilometer measurements and lead to further development of cloud detection algorithms, as already announced in their replies.

An additional reviewer commented on the revised version of the manuscript after the discussion phase and raised minor issues. The authors should consider these issues in another revision of the manuscript. Especially the crucial dependence of ampycloud on the black box algorithm used in the Vaisala CL31 should be discussed in more depths. I recommend to outline a strategy to adapt ampycloud for next generation ceilometer in future.

Reply: The fact that ampycloud relies on cloud base hits reported by ceilometers (via black-box algorithms) is now written explicitly in the abstract of the article and in the conclusion. The Kotthaus (2016) reference has been added to Sec. 4 (where the reliance on cloud base hits is being discussed) together with the following clarifying sentence:

"This (current) reliance of \textsf{ampycloud} on cloud base hits (as reported by ceilometers via black-box algorithms) should not be overlooked by users interested to combine datasets from multiple ceilometer brands/ models."

We have also updated the package documentation (i.e. the webpages hosted on Github describing how to use the ampycloud Python package) to stress the dependence of the code on the ceilometer algorithms.

2) I finally recommend to shorten the caption of Fig. 2. This hardly will work in the final journal layout. The discussion of figures should be made in the main text. For this specific figure you could either provide and describe the ampycloud output screen in figure section 2.4 or discuss the figure as one example in an extra section. The current version of the caption is also hard to understand and orientation is difficult, e.g. I'm lost for "The final selection of cloud layers is shown in the top right of the diagram. To the bottom left, the number of ceilometers contributing data to the diagram is indicated...". That's why it would be OK to just have a caption like "Example of ampycloud. Details are explained in Section...." and then carefully guide through the individual parts in the main text.

Reply:

The description of Fig.2 is now made inside the (new) Section 2.5, with the Figure caption simply referring to it for details.

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Referee 3

1) Dear Editor and Authors,
Here I present only a high-level review of the manuscript as requested by the editor. First, I want to disclose that I am not an expert on aviation rules and regulations, and I can only comment on the atmospheric physics aspects of the manuscript. I find the proposed algorithm reasonable and the authors' presentation satisfactory, although some points are unnecessarily convoluted. The biggest shortcoming is the reliance on the instrument's determined cloud base and vertical visibility. The authors present the algorithm as a way of avoiding the black box algorithms of ceilometers, but their algorithm is still crucially dependent on the black box algorithm used in the Vaisala CL31. There is no guarantee that different current or future models will use the same underlying algorithm, and this can in turn make the authors' algorithm unreliable depending on which particular CL31 models are used (I recommend reading Kotthaus et al., 2016 on this matter). It would obviously be much better to base the proposed algorithm on the backscatter reported by the instrument. This would also allow for more complex processing because the backscatter provides information about cloud thickness and can measure multiple cloud layers in one profile, to the extent that the laser signal is not attenuated. That said, if the potential
users of the algorithm are warned about this and perform testing on their set of ceilometers before operational use, it might not be a big issue.

Reply: See our reply to the Editor comment #1.

2) I cannot judge the compliance with ICAO rules, and Referee 1 might have valid concerns on this. I also agree with Referee 1 that the methods used are perhaps too complex for the task. At the same time, performance is not really an issue with this algorithm because it is sufficiently fast for operational use.
Another smaller issue is that the algorithm description (slicing, grouping, and layering) is relatively complicated,
and the manuscript would benefit from a preceding section describing all three steps and the motivation for them in a high-level overview, as well as a better description of the parameters. For example, by adding a one-sentence description of each in Table 2. Overall, I am inclined to recommend the publication of this manuscript.

Reply:

A high-level description of the 3 algorithm steps, and their inter-dependence, is provided at the start of Sec. 2.2. Following the referee's comment, we considered moving it at the start of Sec. 2.6, but eventually opted to

keep it in its current position (which we think offers a better flow to the reader).

Regarding the suggestion of adding a brief sentence for each parameter in Table 2, we remain of the opinion that doing so would complicate the Table while not being necessarily easier to understand. In particular, not every parameter can be easily understood with a single, short sentence in isolation. Instead, having the link to the specific Section where each parameter is defined should allow readers to easily locate the description (in context) of each item in Table 2.