

Interactive comment on “Model evaluation by a cloud classification based on multi-sensor observations” by Akio Hansen et al.

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Dear Reviewer #1, Dear Reviewer #2,

thank you very much for your detailed and comprehensive comments, ideas and recommendations on our proposed manuscript. These are very interesting and valuable for us to further improve our results, the method and the manuscript. Thank you!

We will try to incorporate all your suggestions, which are very helpful! Furthermore, we will advance our writing and the structure of the argumentation to increase comprehensibility. Another native speaker will be involved into our internal review process for the revision.

Please excuse the possible misleading title as we've seen by your expectations in your

C1

reviews about the content. Therefore, we will change the title to a more precise one like: “Evaluation of clouds by a model-based cloud classification.”.

Both reviews suggest the application of forward operators. Most certainly the usage of forward operators to create synthetic observations will account better for the instruments' characteristics. This approach will also be physically more consistent at the comparison of the model with observations. Nevertheless, we also think our proposed simple approach of a model based cloud classification has already an additional value for the evaluation of clouds. The approach shows the great potential of a synthetic cloud classification, which can be directly compared with Cloudnet observations. In addition, this easily accessible product provides a fast and comprehensive view on the accuracy of the modeled cloud type and profile. The results are very helpful as a starting point of a more detailed analysis.

On top of these reasons, the simple approach has great advantages compared with the forward operator approach. One example is its fast application on new model output and the easily understandable assumptions. The computation of all forward operators for the three required Cloudnet remote-sensing instruments (cloud radar, microwave radiometer, LiDAR) takes already a lot of time. The operators have to be further on fully consistent with the model's microphysics. This introduces at the same time another source of uncertainty to the analysis. All applied assumptions must be carefully considered at interpreting the results. Accordingly, the results of our simple approach are much better traceable and show clearly certain model issues.

For the above-stated reasons, we still think our proposed simple cloud classification algorithm is worthwhile to be used by the community. From our point of view, the reader should see the new cloud classification as described in reviewer #2 comments: “. . .the authors make a useful, though simple, first step towards comparing hydrometeor types that are observed and modeled. This allows first glances into whether a model produces the right hydrometeor/clouds and can be used in time series, point to point comparisons or larger area comparisons. . .”. We see our cloud classification

C2

algorithm as the first version of such an approach, which will be for sure enhanced like most geoscientific models. From our point of view, GMD is a journal about Geoscientific Model Developments and explains developments and tools in this field.

We agree with both reviewers that the forward simulator strategy is worthwhile to investigate, and we are already working on that. Nonetheless, the comparison of the complex approach with our simple approach will likewise be an interesting research question, which we want to investigate.

Comment Reviewer #2:

"2) The data set of the comparison with observations is very limited: Only two months over a single location. Not only results this in a much larger statistical uncertainty than necessary, it also means that the melting ice & cloud droplet category is not hit within the dataset."

The focus of our study is on the cloud classification algorithm and how to use the new classification for a detailed model evaluation. Therefore, the limited dataset of two months of operational COSMO-DE forecasts for a single location is only exemplary used to present the methods. The results themselves have for sure a large uncertainty because of this limited dataset, which we'll write explicitly in our manuscript.

So far our algorithm doesn't account for any subgrid variability. Only one single class is possible for each model box. Thank you very much for this valuable feedback and the ideas concerning the variability at the coarse graining, the chosen hydrometeor threshold as well as the subgrid variability. We will investigate the open questions in detail. Furthermore, we plan to perform sensitivity studies on the thresholds and the coarse graining. We will provide error estimates and uncertainties at the revision of our text.

We apologize very much if the text is not precise enough that our proposed simple cloud classification is only similar to the Cloudnet Target classification but not fully

C3

consistent with it. Thank you very much reviewer #2 for sharing your impression with us. The suggested phrasing of "inspired by the CloudNet algorithm" is clear and easy to understand. We like this phrase very much and will include this into our text. Sorry for any misunderstanding regarding the Cloudnet Target classification. This synergetic product is one of the most comprehensive and most advanced multi-sensor products in our scientific field.

Thanks a lot for your further specific comments, ideas and findings. As explained before, we consider the following two suggestions, namely the usage of forward operators and the extension of the analyzed verification data set, to be beyond the scope and intention of our manuscript. Concerning all other suggestions and comments we fully agree with the two reviews. According to these issues we will be glad to revise our manuscript extensively if such an improved manuscript has the chance to be published by GMD. Therefore, we kindly ask for the possibility to revise our originally proposed manuscript.

Thank you very much once more for the reviews and thank you in advance for the chance to revise our manuscript,

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2018-259>, 2018.

C4