

Geosci. Model Dev. Discuss., referee comment RC2  
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## **Comment on gmd-2022-118**

Anonymous Referee #2

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Referee comment on "Optimization of weather forecasting for cloud cover over the European domain using the meteorological component of the Ensemble for Stochastic Integration of Atmospheric Simulations version 1.0" by Yen-Sen Lu et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-118-RC2>, 2022

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### **Summary**

This work utilizes the ESIAS-met in an attempt identify the ideal combination of microphysics, boundary layer, and cumulus parameterizations in producing accurate cloud cover forecasts while understanding the variability and sensitivity of the simulations in an operational forecasting ensemble environment. The authors utilize a large variety of common parameterizations, finding that the choice of microphysics parameterization is essential in simulating accurate cloud cover over the European domain.

### **General Comments**

My main concern is that there is no justification that the 6 cases provide enough information about the variety of cases that these parameterizations experience when in an

operational model. Are the case characteristics representative of the variability in weather patterns across the domain? Does this collection of 6 cases contain passing fronts, extreme weather, and calm conditions? Why are there no winter cases included?

Why only examine cloud cover? Simply using the fraction of a column covered by cloud could obscure important model deficiencies like putting the clouds too high, for example. Surely, the amount of light reaching the surface is different if the cloud cover comes in the form of cirrus instead of boundary layer clouds. The general conclusions of this work could be altered if, for example, column aerosol optical depth were considered instead of cloud cover. Column AOD is crucial for modeling pollution transport and boundary layer physics packages might play a more significant role (of course scavenging in the microphysics parameterization will also be important).

The authors do not utilize a satellite simulator package in order to make fair comparisons between models and observations. I am concerned that model is looking "straight down" at each column's respective zenith when computing cloud cover but the SEVERI instrument is observing at a sharp angle (some observations are made above the arctic circle from geostationary orbit!). The lack of cloud height information could potentially lead to mis-placed clouds. Have the authors noticed any persistent biases or noise related to the zenith angle of the SEVERI observations? In addition to cloud height-related issues, every observation comes with a minimum detectable signal but models mostly do not. For example, truly-existing thin cirrus may be undetected by SEVERI due to weaknesses in infrared detection of clouds and algorithm deficiencies. A satellite simulator would alleviate these issues a great deal, if implemented correctly.

There are many small typographical errors, mostly related to plurals. I noted many in the "technical corrections" but I am confident I did not document them all.

## Specific Comments

16: Which recent events in 2021?

95:96: "It is recommended that the surface layer physics be set with planetary boundary layer physics in WRF." Who is recommending this? Are you recommending it or is it the official recommendation from the WRF developers? It would be best if you would provide a source for this recommendation.

102: I recognize the need for shortening the parameterization acronyms. However, these shortened acronyms are used throughout the paper and are important to the interpretation of most figures so Table A1 and Table A2 should be added to Table 1 and Table 2. Table 1 and Table 2 have plenty of space for the shortened acronyms in parentheses behind the full names, for example.

123: Are your results sensitive to these near-arbitrary thresholds?

124: The ASOS acronym needs a definition.

135: The first model evaluation results utilize this Kappa score, but there is essentially no

preview of what a low-Kappa or low-Kappa means in terms of agreement with observations. Please provide some interpretation of this metric.

135-140: What is  $N$ ? Total number of subjects? I am also unsure what the "subjects" are. Please provide a definition for each variable in the equations.

156: Why are these cases chosen? Does the domain experience considerable variability in these cases? Fronts with strong precipitation? Mesoscale convective systems? It is very important to explain why these days were chosen so please provide a short description of each and, more importantly, why simulations of these 6 cases are capable of summarizing the variety of weather conditions that these parameterizations are expected to simulate in an operational environment. Lines 172-181 provide a cursory description of what cloud cover patterns through each case, but not a justification of why these cases are sufficient to understand the differences between the parameterizations.

Section 3.2: Please elaborate on the description of the observational dataset. What instrument makes the observations? What techniques to they use in their cloud retrievals (BT-contrast, CO2 slicing, etc.)? What sort of processing takes the product from pixel-level to gridded, quality-controlled distribution?

Figure 3: These are UTC times, right? Please state in the caption.

Figure 3 caption: The caption says the colors represent both cloud cover and time of day. I think the second sentence should be removed.

Figure 4 and Figure 5: These wallclock times would be more accessible to the reader if presented as hours, as is done with the Simulation Time. It would also be more convenient for the reader if the (a) and (b) plots had identical y-axis limits. They are very close now so why not make them identical?

Figure 4 caption and Figure 5 caption: There is no hourly simulation time, only total accumulated wallclock time

216-219: This mini-paragraph should be placed earlier in the manuscript because some science results have already been presented (Figure 6 and Figure 7). Near the first sentence in Section 4.2 or earlier would be good.

255: "Accounting for the support of the simulation of the graupel mixing ratio for ESIAS-chem, we predominantly use the microphysics of WSM5, WSM6, and Goddard." is more understandable when written similar to, "We continue with the WSM5, WSM6, and Goddard microphysics parameterizations because they include treatments of graupel mixing ratio for ESIAS-chem.", unless I am misunderstanding the meaning of this sentence.

281: I'm confused about the "maximum of the boxplot". In Figure 14a, the boxplot endpoints do not appear to be  $1.5 \times$  interquartile range greater than the third quartile (assuming you meant quartile instead of quantile). For example, the maximum boxplot edge for the W6-T combination is only a small amount greater than the third quartile.

284: Which cumulus parameterization can improve Kappa? Tiedke?

Figure 14 and Figure 15 do not really add much to the analyses because they present more data than can be reasonably interpreted by the reader. The most important data are the summary data, which are only shown as text. Also, these are only two of the days and there are no analyses that summarize the other four cases! I recommend banishing the time series plots to the supplemental material and replacing these two figures with heat-maps of RMSE,  $\sigma_{\text{bar}}$ , and  $x_{\text{bar}}$  and span all 6 cases.

310: Note that you've only investigated days during warm periods (mid-April to mid-September) so you cannot say with confidence that this is true for all time periods.

352:353: "but we should also consider the accuracy of the model physics". Yes, good point and one that is often not considered in ensemble modeling

354:355: I think this sentence is important but I am struggling to fully understand it. Please consider rewording for better clarity.

## **Technical Corrections**

23: Remove the "to" in "study to the impact"

23-24: Parentheses around references

Table 4 caption: Fix "Inaddition" to include a space

Figure 3: Move the legends upward into the white space and increase all text sizes

210: "figures indicate" instead of "figures indicates"

216: "model is run" instead of "model is runs"

220: Please mention figure 8a instead of just figure 8

Figure 8: Please label the subplots in the figure.

243: "wellby" should be "well by"

245: The word parameterizations is misspelled

265-266: You probably just want either "overall" or "over all" in this sentence and not both.

268: Missing space between sentences

Figure 15: Y-axes all say "Cloud Refraction" but they should say "Cloud Fraction"

308: There is a separate Conclusions section so there is no need to have "and conclusion" in this section heading.



339: Should say "not only changes the development of cloud cover fraction but also affects the"