

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2022-30

Anonymous Referee #1

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Referee comment on "A preliminary evaluation of FY-4A visible radiance data assimilation by the WRF (ARW v4.1.1)/DART (Manhattan release v9.8.0)-RTTOV (v12.3) system for a tropical storm case" by Yongbo Zhou et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-30-RC1>, 2022

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### Aim and relevance of the paper, Title and abstract

The present paper evaluates Observing System Simulation Experiments of a future satellite with the WRF-DART system. Radiances in the visible range are assimilated for a cyclone case. The authors demonstrate an improvement of the forecasts of cloud-related parameters and reveal weaknesses of the method.

Visible range satellite radiance assimilation is a rather recent field of research and evaluating the impact of a new satellite in OSSEs for a critical weather event is a future-oriented approach. Therefore, the present paper is highly relevant for the community. It promotes research in multiple fields at the same time: visible range radiance assimilation, the exploitation of a new satellite, and research on cyclones.

The title is informative and contains all relevant information, except maybe for the name of the satellite. Adding the name of the satellite to the title would make the word "preliminary" more meaningful.

Throughout the whole paper, the satellite is mentioned as "FY-4". However, FY-4 is a series of satellites. I believe the study uses FY-4B and this should be clearly mentioned throughout the paper.

The abstract misses two important pieces of information:

- 1) For which cyclone case was the study performed? Why was a cyclone case, and more specifically "this" cyclone case chosen for this pilot study of FY-4 SW radiance assimilation?
- 2) At the end of the abstract, an outlook is missing. What do the results imply? What

should be future steps of research?

The fact that different parameter settings were tested is important and should be mentioned in the abstract. This is clearly a strength of this paper.

Other remarks concerning the abstract:

L15: You might want to state that FY-4(B?) is a geostationary satellite located over Asia.

L16: You mention the experiment for which the best results were obtained without explaining what kind of experiments have been performed.

L18: As the previous sentence already contains "best results", I suggest to modify the beginning of this sentence to for example: "In this case, WRF could capture [...]"

L18: I suggest to modify the end of this sentence like this: "[...] and significantly improve the cloud water path and cloud coverage forecast."

L19: What does the word "its" refer to here? The simulation system? In this case you might write "The first is that the simulation system..."

## **Specific comments and remarks**

#Introduction and background:

L24: I suggest to add the word "satellite" to the beginning of the second sentence: "Most satellite DA-related studies [...]"

L33: "[...] only provide information on cloud top microphysics [...]"

L33: Better replace "weather radar" by "precipitation radar"

L37: This sentence is a bit misleading, you might want to say it like this: "Therefore, high-resolution satellite SW radiances provide information on cloud properties with a great significance for cloud-resolving model simulations."

L52: I suggest to change "in assimilating satellite radiance data" to "in satellite radiance DA".

L58: I suggest to remove the word "Nowadays".

L74: In my opinion there is no need to put the word hybrid in double quotes. Also, if you mention that "great achievements" have been made, you should state what these achievements are.

L80: You mention that RTTOV was "recently" enabled for DART. Do you have a reference for that information? Otherwise the word "recently" does not make sense.

L88: "Section 3" not "Sections 3"

#References:

The provided references are relevant and recent and include key studies in the field.

## #Methods:

You should probably add sources for the FNL and ERA5 data sets.

L91: So far nothing has been demonstrated and this sounds like a sentence from the conclusion. Maybe build this sentence like this: "This study demonstrates the performance of the WRF/DART-RTTOV [...]". Also, add the relevant information from the abstract: Mention FY-4 for example.

L99: Better: "horizontal grid boxes" instead of "horizontal grids".

L114: Why did you deviate from the CONUS physics suite for the microphysics scheme?

L115: This is the first time the reader learns about the dates of your experiments.

L119: The Betts-Miller-Janjic cumulus scheme is rarely chosen in the WRF literature. Can you explain why you chose this cumulus scheme?

L131: "It is noted that the Baran-2014 scheme has no explicit dependence on ice particle size." - and probably that is the reason why it was used?

L176: Didn't you already mention that you use 50 ensemble members?

L179: And probably that is the reason why you find that the vertical structure of the clouds is not very well represented in the simulations?

L184: And we do have a non-Gaussian problem here, right? This is why this information is given?

L188: Please give some more information about the cyclone event. Did the cyclone have a name? Which was the cyclone category at the time of the experiments? From where to where did it move? Does the type of cyclone event not have any influence on the simulations?

## #Results:

L230: Given how many details you provided in chapter 2, you should explain how DA actually changes the base state.

L232: Stating that something is "rather complicated" is not scientific. Please improve this sentence and explain what was complicated about it.

L280: "As indicated" -> Indicated where?

L305: This could have been explained above.

L359: What is a "weak" cloud? This is not a very scientific term.

L362: Do you have an idea why precipitation was not simulated in any of the DA experiments? It is indeed important to mention that, but you should also try to provide reasons.

L386: "QC = 7" and "QC = 4" are very DART-specific statements that only very few readers would understand, please rephrase this in an understandable way. This is also valid for Figure 11.

L392: What do you mean by "far observations"? What this mentioned before?

## #Discussion and Conclusions:

L436: You should explain what exactly is meant by "dense" here.

L445: Is it unable to influence the state variables in all the performed experiments?

L452: This is a bit short as a final sentence and an outlook is missing. What are the most urgent opportunities for future research? Once real FY-4B data will be available, should another cyclone case be used to validate the results? Please provide some more outlook on such questions.

## Figures and tables

Axis labels in the figures should start with capital letters. This should be corrected in Figures 2, 3, 4, 5, 6, 8, 10, 11

Figure 1:

- The colorbar misses a label.
- You might want to change the color of the ocean to blue instead of green.

Figure 2:

- I would remove the "unit:" in the axis labels unless this is required by the journal.

Figure 3:

- The resolution of this figure does not seem to be very good, it is a bit blurry. For example in (a2) it is almost impossible to distinguish the lines "iwc-prior mean" and "iwc-posterior"
- The " $\times 10^{-4}$ " in the horizontal axis label is a bit lost in all subplots on the right side. Please improve this.

Figure 4:

- What is the "R statement" on the right in the plot? Must it be there?

Figure 5:

- It is a good idea to make 1-4 correspond to a-d. But one has to search quite a bit to find the indication of the panels (a), (b), (c), (d). Please make these more visible, for example place them in the top left corner of each panel and in bold and with a larger font size.

Figure 11:

- The choice of line and marker style is not optimal in this plot, especially since the points in (b) and (c) are very dense. Is it possible to find a better solution?
- "QC = ..." are very DART-specific statements that only very few readers would understand, please rephrase this in an understandable way.

Figure 12:

The only reference to this figure is in line 406 and that sentence is more or less common knowledge that can be found in various studies. Considering how much information is contained in Figure 12 (4 panels with 3 lines each), the text must contain a deeper analysis of what we can learn from this figure. Otherwise it is not relevant.

### **Spelling, grammar, typos**

Table 1 caption: "data" instead of "dada"

L20: There is no need for using semicolons in this sentence. Please replace the semicolons by commas, e.g. "[...] cloud phases, the second [...] positively, and the third..."

L20: "The second is the its" -> Chose either "the" or "its"

L41: It is not common to write it like this. Better would be: "[...] in the study of Vukicevic et al. (2004), model [...]"

L45: "[...] while computing [...]"

L194: "are summarized"

L245: "would get the following formula" - that is a strange formulation.

L250: "is calculated by the following formular"

L359: "produced" and not "produce"

L415: as many observations as possible

L443: "was detected."