Response to Reviewer #2

General Comment:
I recommend you to fundamentally rework the text - potentially with the help of an English language expert.

Our response:
The manuscript was polished very carefully to avoid typo errors and misleading due to improper description. We hope that the revised manuscript could meet the standard of GMD for publishing.

Remark:
Please find a few closing remarks from my side:
* Replace „assimilation" by „data assimilation"

Our response:
Corrected. Sometimes "data assimilation" is abbreviated as "DA" for simplicity. The revisions are marked in red in the revised manuscript (L32 and L292 for "data assimilation". Throughout the manuscript for "DA")

Remark:
* Replace "impacts" by "impact". There is no plural
Our response:
Corrected throughout the manuscript. The revisions are marked in red in the revised manuscript.

Remark:
* Revise all articles („the") carefully.
Our response:
Corrected.

Remark:
* Re-check all your prepositions: e.g. "compared to" instead of "compared with"
Our response:
I searched the difference between "compared to" and "compared with". Here is a representative answer
(https://www.dailywritingtips.com/compared-to-or-compared-with/):
"compare to" is to point out or imply resemblances between objects regarded as essentially of a different order;
"compare with" is mainly to point out differences between objects regarded as essentially of the same order.
*Thus, life has been **compared to** a pilgrimage, to a drama, to a battle; Congress may be **compared with** the British Parliament.*

In our manuscript, both comparisons stress the differences between two items. Therefore, we think "Compared with" is more appropriate than "Compared to". (L69, 373, 425, 542)

Remark:
* Re-check all your figure captions for completeness and understandability
Our response:
All checked. We added subcaptions for Figures 2, 3, 9, 10, 13, 14, 16. In addition, Figures 1, 6, and 12 were revised. The rvisions were marked in red in the revised manuscript.

Remark:
* Please correct: FSS measures the spatial accuracy of a spatially inhomogeneous variable on a certain spatial scale. Thereby it mitigates the double penalty problem
Our response:
Corrected. (L309-311)

Remark:
* Add the verification of short-range forecasts in the outlook. I highly appreciate that you have included first guess forecast verification. However, the DA is actually targeted at improving cloud forecasts and related quantities during longer-term forecasts
Our response:
Thank you for pointing this out. On one hand, the limited impact of the DA on rain rate is partly caused by the shortcomings of the DA procedure, including the inabilities of the DA to improve cloud vertical structures and cloud phases. On the other hand, the rain rate is influenced by the spin-up effects. The spin-up effects may introduce false alarm precipitation due to the interactions between the model dynamics and microphysics when smaller scales are now well represented in the initial conditions and lateral boundary conditions (Short and Petch, 2022). In this study, we started to assimilate the synthetic FY-4A visible radiance data after 2-hour cold start and run the model for 10-hour forecast (02:00 ~ 12:00 UTC). This is a too short time period to exclude the spin up. Improvements on precipitation should be expected for longer forecasts. (L641-647)

Remark:
* A comment on why precipitation may not be improved in your forecasts.
1. Precipitation is subject to strong spin-up effects: you may observe improvements in longer forecasts
Our response:
Corrected. (L641-647)

Remark:
2. In general I suppose that improvement of horizontal location error of cloud fields

can subsequently lead to better spatial precipitation accuracy - at least in many cases, e.g. deep convection where vertical cloud structure is less important since the cloud may extend from boundary layer up to troposphere

Our response:

We agree with you that improvement on horizontal cloud location errors could improve precipitation forecasts in some cases. For example, the vertical cloud structure is less important for some deep convection since the cloud may extend from boundary layer up to troposphere (Hu et al., 2021). (L638-640)

Remark:

3. In my experience, due to a) the strong dependence of reflectance on subgrid-scale parameterized clouds and b) the strong interaction of VIS radiances with model biases and c) the fact that nearly every process related to clouds, precipitation and radiation is subject to parameterization and potentially compensating model error often requires a well-tuned model or additional model tuning to really obtain a positive impact on precipitation forecasting from better cloud fields

Our response:

It is true that the NWP model errors on cloud and precipitation forecasts should be considered in the DA processes for the real FY-4A visible radiance DA. On one hand, the parameterization (such as the subgrid-scale cloud fraction parameterization in this study) is closely related to the calculation of synthetic visible radiance by a forward operator. On the other hand, the formation and dissipation of cloud and precipitation highly depend on the model parameterization. Suboptimal parameterization may introduce large model bias in some cases due to unsolved scales and processes (Janjić et al., 2021). The model bias could introduce negative impact on cloud and precipitation forecasts. Therefore, the NWP model should be tuned to properly represent the scale-dependent microphysical processes in order to fully realize the effects of the FY-4A visible radiance DA. (L648-655)

Other changed not explicitly mentioned are marked in red.