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Interactive comment on "Improving air quality forecasting with the assimilation of GOCI AOD retrievals during the KORUS-AQ period" *by* Soyoung Ha et al.

Anonymous Referee #2

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The manuscript presents a study assimilating ground-based observations and satellite based retrievals to improve PM2.5 forecasts. The topic is relevant and in the scope of the Journal. There have been several previous studies about assimilating geostationary satellite retrievals, especially those from GOCI. This study builds over them and, in my mind, has a few additional contributions: The first and most important is that assimilating GOCI by itself doesn't seem to improve the forecasts for the study period, sometimes even making it worse. The authors only find improvements when they assimilate both surface and satellite data. Other contributions include separating assimilation performance by pollution regimes, and showing sensitivity studies on how to represent the error on the observations and how to aggregate them to speed

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Discussion paper

up the assimilation algorithm without worsening performance. These represent good contributions to the field and would grant publishing in ACP.

However, I think the paper needs a lot more work before it's ready for publication. In terms of the science, I think they need to do more work on understanding why GOCI makes the assimilation worse and why does it get better when including the surface observation. The study period coincides with a major field campaign where additional airborne and ground-based observation were made to try to tackle these questions. The authors also talk about the operational forecasts, so it would be good if they could include the performance of this system to understand if the assimilation efforts can help improve the current system. Also, it needs major improvements in the English. I suggest the authors to find support by a native English speaker. A few major and minor comments below.

Comments by line (<page> <lines>):

2 3-8. Provide references to these statements

5 21-22. But you mention above that Saide et al. (2014) used MOSAIC within GSI. For for Page 15, lines 1-5.

6 6. By doing cycles every 6 hours you are not taking advantage of the $\sim$hourly time resolution of GOCI data

Figure 1. Why show observations for a given time? Why not show maybe an average of the period analized?

Eqns 3-6. Please explain why there are more than one error equation and when would you use which

Figure 5 does not contributes to much information so I would drop it along with the discussion about it

Figures 8 nd 7. You could model vertical distribution and impact after assimilation using

C2

airborne data and surface lidars deployed as part of KORUS-AQ

14 4-9. Be more specific here, mention the approached that you used of smoothing observations instead of thinning

15 6-11. I don't agree with these statements. There were a couple of flights during the hazy period you study that could be useful. You are showing that GOCI only degrades performance while including surface improves, so you should be changing the vertical resolution through the data assimilation. KORUS-AQ had airborne and ground based lidars that you can evaluate against to assess this. You can also evaluate the model ability to represent aerosol composition, both from supersites observations and aircrafts. You could also be including the ground based (AERONET-DRAGON) and airborne (4STAR) AOD data. There were even PM monitors in different ships that you could also use for evaluation.

Minor Edits (<page> <lines>): A few corrections but in general the manuscript doesn't read well for English

1 2: ". . . every day for the last decade, providing . . ."

1 4: "assimilated to make systematic improvements on air quality forecasting in South"

1 19: I would change "complications" by "uncertainties"

8 2-4: This sentence is very confusion, I would just erase it and keep the last sentence of the paragraph

9 14: ". . . account for representativeness error, we also tested with . . ."

9 24: "particularly for pollution events"

9 32: "the two observations types. . .."

13 27. This sentence is not clear, why do you mean by power instability?

13 33-34: . . ., but higher levels of pollution in SMA are not simulated either.

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