I have used the first review of the present original version of the manuscript as a ground here in my second review of the current study. Additional comments by me are denoted with Italic font style. For some of the issues below I have included the answers from the authors to my comments in the first review, which are marked with blue colors and an arrow at the begging of the text. The comments by me and answers by the authors below are pointing to updated page and line numbers that correspond to the revised version of the manuscript. I have only included issues from my first review of this manuscript that are still relevant to include here.

Major comment

2. There are issues with the language, which need to be improved. In the section Technical corrections below suggestions are given in an attempt to improve the language and clearness of the manuscript. However, my review and corrections of the manuscript concerning the language has only been carried out for the abstract and Introduction to show that the clearness of the text need to be improved. Therefore, I recommend that the full text needs an English proof-check.

=> This manuscript has been internally reviewed twice in our lab and proofread by another native English speaker. As we replied to the reviewer's technical corrections at the very bottom, most of the corrections the reviewer suggested are incorrect in English or distorted our points, if not irrelevant, in the manuscript. The reviewer raised most of the comments or questions regarding MODIS retrievals, which is not the focus of our study but included only for completeness, we thus wanted to stay focused on our goal and highlights of our 10 work. However, we appreciate different views and tried our best to accommodate the reviewer's comments and reflect them in our manuscript unless we have a specific reason not to.

It is not ok by the authors to ignore many of my suggestions concerning the language, thus, here they have not replied at all (see technical corrections below). My suggestion of an English proof-check remain. However, when now have reading more of particular Sections 4 and 5 I do not think it is much work needed to improve the text in the Sections 3, 4 and 5.

Specific comments

Page 5
Line 17: MODIS is not a satellite and which version is used here, 6.1?

=> We modified "MODIS and GOCI satellites" to "MODIS and GOCI sensors". And yes, version 6.1 was used.

Since I do not find it in the revised manuscript, please include text that describe it is Version 6.1 that is used in the present study.

Line 22. It is not correct to write that AOD measures something. This sentence need to be re-written.

By writing "AOD measures the amount…." then the latter word is a verb and it somewhat odd that a parameter measuring something (an active action), although it might be correct in the English language. By using "AOD is a measure of the amount…." Instead then the latter

word is a substantive, which is a more suitable phrase. Itt is the same as writing "AOD is an estimate of the amount…..".

Page 7

Lines 19-21. "Following Remer et al. (2005), observation errors are specified as the retrieval errors: (0.03 + 0.05 * AOD) over ocean and (0.05 + 0.15 * AOD) over land. They do not include the representativeness error and are slightly smaller than those for GOCI AOD, as described below."

The former part of this sentence sounds better now. However, it is very strange that the authors refer to retrieval errors corresponding to the ocean retrievals, estimated by the MODIS aerosol team (including Lorraine Remer), that are not valid anymore. Please update the retrieval error and corresponding references according to my comment in the first review of the original version of the manuscript.

Page 9

Lines 7 and 8. The word "validation" can be used when comparing satellite derived AOD against ground-based sun-photometer measurements. However, you cannot validate AOD obtained from passive remote sensing against AOD derived from observations with another satellite sensor used in passive remote sensing.

=> We do not want to argue about how others described their work. The term of "validation" was used in Choi et al. (2018) and we just adopted it here. Also, in a broad sense, the terminology of "validation" is commonly used when one data is evaluated against another independent observation in the data assimilation community, so we do not see it problematic. No changes.

You don't need to argue here and instead of just adopt this term and rely on what is commonly used it is better to go to a dictionary. The word validation is a too strong word to describe an inter-comparison of AOD obtained with passive remote sensing from two different satellite platforms (see also comment below corresponding to Figure 2). The word "evaluation", used in the text above by the authors or "comparison" are options that are more suitable.

Lines 18-21. Concerning the sentence "When these different observation errors were applied to GOCI retrievals in the assimilation, the smallest error (ε_2) produced slightly better fits to observations specially for the high values (AOD > 2)……." This statement seems not hold, since ε_2 is not better than ε_1 over land for the situations with lower AOD.

=> We do not understand why our statement doesn't hold due to the case of lower AOD, which we did not even discuss here. We mentioned that the smallest error (ε_2) produced slightly better fits to observations for the high (!) AOD values. We also stated that such a result is not statistically significantly different, so we do not understand why the reviewer is arguing over the statement. No changes.

Remove then "specially" from the original sentence in the manuscript, then your argumentation and statement hold.

Lines 29-31. *Suggestion, change the sentence "This is partly because AOD is not directly associated with surface PM2.5 ……" to "This is partly because AOD is not directly related to surface PM2.5 ……2, since "related" is a more correct word to use.*

Section 5 and page 14

Line 26 and first sentence in this section. I think it is too strong positive words are used here when describing the GOCI AOD retrievals.

I am sorry about this comment since I refer to the sentence on page 15 instead of the correct page 14: "GOCI AOD retrievals provide reliable and consistent aerosol information, monitoring air pollutants flowing over to the Korean peninsula at high resolution every day." Thus, I think it is too strong positive words used in the first part of the sentence when describing the GOCI AOD satellite retrievals on the accuracy of air quality forecasting This is what the authors write in the abstract "During the Korea-United States Air Quality (KORUS-AQ) period (May 2016), the impact of GOCI AOD on the accuracy of air quality forecasting is examined by comparing with other observations including Moderate Resolution Imaging Spectroradiometer (MODIS) sensors and fine 10 particulate matter (PM2:5) observations at the surface." Concerning the latter parameter the result presented in Figure 5 is not impressive. In addition, you cannot rely the statement on an inter-comparison with AOD derived from observations carried out from another satellite platform.
The first and second parts of the sentence is not synchronized and this is an odd phrase "air pollution flowing over…."
Therefore, here is a suggestion: "GOCI provide daily AODs with high spatial resolution and frequently detect air pollutants over to the Korean peninsula."

Figures

Figure 2 It is not correct to write that AOD is retrieved at this time, since it is the observations that is carried out at this time and it is a very long way to come up with an estimate of AOD, for example you have to introduce a model that describe radiation transfer in the atmosphere. Change "retrieved" to "corresponding" in the first sentence of the figure caption to Figure 2. Describe in the figure caption the solid black box introduced.
=> This study is not meant for describing the retrieval process, but how the data is used in the assimilation cycle. The data was processed at the time and that's how they are described and presented in Figure 2. Even in-situ measurements such as radiosonde do not report the values at the exact time (depending on the vertical levels as it goes up), but in the data assimilation context, that's how they are all described. Please note that we already illustrated the temporal distribution of the data in the last paragraph of page 7 ("In terms of temporal distribution,). In response to your last comment, though, we added one paragraph
25 "Domain 2 is marked as a black box in each panel." at the end of the caption.
It has nothing to do with reporting the values at the exact time, instead you have to separate "retrieved" and "observed", thus, the TOA radiance was measured/observed at the current time. It is just simply to write it more correctly so you don't hide that AOD derived from satellite measurements is not a direct observation, instead it need to be related to measured radiance scattered only by aerosols. The latter means that the contributions of Rayleigh scattering and surface reflection have to be reduced for. In addition, to relate AOD with TOA radiance associated with purely aerosols you have to introduce radiative transfer calculations. I present here a new suggestion: "Field of GOCI AOD at 550 nm derived/retrieved from observations carried out at 2016-05-01_06:00:00 UTC……."

Figure 3. You have to include information that the right y-axis goes down to 2000 (the latter value I picked up in the file with the author's response in the review process), since it is otherwise hard for the readers to understand part of the figure. You need to use different symbols for each cycle or at least each pair of cycles. The half-last part of the last sentence in the figure caption need to be re-written.

Figure 4
In the figure caption you have to refer to the body text about the three different types of observation errors. Take the color blind persons in consideration and use the three colors in combination with solid, dashed and dotted lines and separate land and ocean with heavy and normal lines, respectively.
=> This draft uses a lot of colors throughout the figures, and is not meant for color-blinded readers, unfortunately. But based on your comment, we added "The first two errors (1 and _2)) are described in equations (3) - (6) and the third error (_3) increases by 20% everywhere." in the caption.
I agree on "a lot of colors", but why not make it easier, particularly for the colorblind person, by improving those figures for which it possible to do that for? You do not use colors in Figure 3 and it seems to work relatively well (see comments concerning Figure 3 above).

Figure 7
It is a lot of space in the figure and therefore write the names of the species in all figures.
=> We decided to put the species name in the main title because the first panel does not have room for it due to the legend. As this figure has to take up the whole page (height-wise) anyway, we decided to keep the main title. No changes.
I guess the journal will not accept the presentation of these figure and then it could be worthwhile to wait with the changes. You could in any case already now try to improve the presentation of the figures by using the free spaces on the right and left sides of the figures. Thus, make three rows, 3, 3 and 4, instead and remove "Model levels" and values on the y-axis corresponding to the figures presented at the middle and right positions. This means that you can move the figures closer to each other. The results of it will be that you get somewhat larger figures, thus, it will be possible to remove the titles and put all species names in the figures. In addition, you have to explain the species name in the figure caption or at least write in the figure caption that this information can be found in Section 4.2.

Figure 8
Write "Model levels" connected to the y-axis.
=> The caption already stated that it 5 is the same as Figure 7. We tried to reserve more x-axis space to zoom in differences between the experiments here, dropping y-axis title intentionally. No changes made.
It is not acceptable to refer to the previous figure concerning text belong to the y-axis. You will neither reduce the size of the figures by including this text. Thus, you have free space available on the left side of the figures and you need only to include "Model levels" (once) at this place. You could also exclude the values on the y-axis corresponding to the right figure.

Figure 11
Suggestion "Figure 11. Same as Fig. 10, while here the results of forecast accuracy (%) for categorical forecasts are presented, subdivided according to classification of air quality in Tables 2 and 3."
Include "Model level" on the y-axis.
=> Figure 11 shows different statistics, not the model level, as shown in the main title. No changes made.
The authors are of course right in the comment above, but the figure caption is once again not clear. For example you have to write "with the exception for" instead of just "except" and

"Tables 2 and 3" instead of "Table 2 and 3". However, even with these changes suggested the sentence is not clear and complete.

Technical corrections

It was very hard to read through all the comments because they are mostly incomplete and are not separated by lines. In many cases, the modifications that the reviewer suggested either do not flow well in our manuscript, or misrepresent our points, or are simply wrong in grammar. The reviewer 5 tries to change our manuscript line by line in his/her way, but we should ask for being respectful for the authors' work. But here are our responses to the questions:
It seems that in the creation of the pdf-file, when my review was uploaded into the reviewing system, the space between two comments disappeared. It is pity that I did not notice that. Even so, all the comments are clearly separated in the way that every new comment start with a new line, for example "Line 2" and "Line 3" corresponding to the abstract. My comments are either incomplete. With an example I explain here how to handle the comments. This text "……. underestimates predicted surface $PM_{2..5}$……" on Line 11 in the abstract means that it is only these words in the sentence that the authors need to put attention on. The following comments presented below remain for the authors to take in consideration, and for some of these I have included a motivation.

Abstract

Line 2. Suggestion "The Korean Geostationary Ocean Color Imager (GOCI) provides, based on daily high temporal and spatial resolution data, unprecedented information on air pollutants over the upstream region of the Korean peninsula for the last decade."
Note that GOCI is not a satellite and the phrase "…..has monitored the East Asian region in high temporal and spatial resolution every day for the last decade……" need to be rewritten.

Line 3. "the GOCI aerosol optical depth (AOD)" instead of "the GOCI Aerosol optical depth (AOD)."

Line 6. "……assimilated with three-dimensional…..technique in the Weather….."

Line 9. "Sensors" are not observations and therefore change to "….(MODIS) AOD…….", but this is a better suggestion "…… (MODIS) AOD and in-situ ground-based fine particle matter ($PM_{2,5}$).", since then you don't need to include "observations" again in the sentence.

Line 11."……. underestimates predicted surface $PM_{2..5}$……" You have to be more clear what you mean with the second time you write "surface $PM_{2..5}$" in the sentence. Is it "predicted" or "estimated" or something else?

Line 13. The last part beginning with "with the most…" of this sentence is not clear.
=>We clearly demonstrated the most significant contributions to the prediction of heavy pollution events in Figure 11 where the assimilation of GOCI data produced the biggest improvement in b) high pollution accuracy.

Make then a new sentence of it "This resulted in the most significant contributions to the prediction of heavy pollution events over South Korea."

Introduction

Page 1

Line 21. "Surface concentrations" of what ?
=> of chemical species. We believe this should be clear as the previous paragraph is immediately followed by this one.
You have to make the current sentence clear and not rely on the information in the previous paragraph, particularly not in this case when you also describe aerosols in the previous paragraph.

Line 23. "The latter is highly dependent on……" The word "relies" don't suit here.

Page 2

Line 3. "….performs chemical simulations according to 3-km horizontal resolution at present day." *Please accept this change or make the original text more clear.*

Line 4. What is meant by "these fast-varying complex mechanisms" or what is it pointed to?
=> All the mechanisms described in the previous paragraph, particularly the aerosol-meteorology interaction at short time scales. Again, this sentence is also connected with the paragraph right ahead.
To improve the text the best solution is to include the information you touch on in the answer above. Another but not the best solution could be to write it like this : "For such a high-resolution application and for situations with very high aerosol concentrations, the fast-varying complex mechanisms described above might be better represented through online coupling between chemical and meteorological components."

The authors have not given any respond to the comments below and again this is not ok.

Lines 9-10. This sentence need to be re-written.
Suggestion: "Chemical modeling are associated with large uncertainties, particularly concerning emission data and to simulate meteorology process. One of the most effective ways of utilizing aerosols is instead to assimilate aerosol observations into the forecast model and improve the initialization of aerosol simulations."

Line 12. Not clear written: "(usually in the optical properties)"
Suggestion: "(usually the optical properties)"

Line 12. Change “observed information” to “information” or “results”

Line 15. Change “for” to “of”

Line 16. “….conducted in Korea between 1 and 12 June 2016…….”

Line 17. Remove “a field campaign”
The original sentence “An international cooperative air quality field study conducted in Korea between 1 and 12 June 2016, named as the Korea-United States Air Quality (KORUS-AQ), was a field campaign jointly developed by air quality researchers in the United States and South Korea to improve our understanding of major contributors to poor air quality in Korea for May 1-June 12, 2016.” need to be improved. Note that this sentence include the word “field” twice and this is redundant. I think also that it is possible and more suitable to make the sentence shorter.
Suggestion: The Korea-United States Air Quality (KORUS-AQ) field campaign conducted in Korea between 1 and 12 June 2016 was developed by researchers in the United States and South Korea to improve our understanding of the major contributors to the poor air quality in Korea.”

Line 21. “….occurred due to long-range……”

Lines 25-27. Based on the Korean Geostationary Ocean Color Imager (GOCI) onboard the Communication, Ocean, and Meteorology Satellite (COMS) retrievals of hourly AOD scenes, for multiple spectral bands, are centred with respect to the Korean peninsula during daytime (Kim et al., 2017). AOD scenes with high spatial and temporal resolutions are available since 2010.”
The sentence in the original manuscript lose connection at “….spectral bands monitoring….”. This is a new suggestion to uses two sentences instead of the original one: “The Korean Geostationary Ocean Color Imager (GOCI) onboard the Communication, Ocean, and Meteorology Satellite (COMS) provides hourly AOD retrievals at multiple spectral bands. GOCI monitoring the East Asian region centered on the Korean peninsula during daytime (Kim et al., 2017). AOD scenes with high spatial and temporal resolutions are available since 2010.”

Line 28. “It has been demonstrated”
The original sentence need to be re-written. Here is a new suggestion:
“It has been demonstrated that GOCI data are associated with high accuracy compared to the low-orbiting Moderate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite 30 (VIIRS) products (Lee et al. (2010); Wang et al. (2013); Xiao et al. (2016); Choi et al. (2018)”

Line 31. “assimilating AOD derived from MODIS observations (Remer et al., 2005)”
Should it be like this: “Liu et al. (2011) were the first to implement assimilation of Aerosol Optical Depth (AOD) retrieved from the MODIS sensors (Remer et al., 2005) into the

National Centers for Environmental Prediction (NCEP) Gridpoint Statistical Interpolation (GSI; Wu et al. (2002); Kleist et al. (2009)) system."

Line 34. "forecasts of a dust storm"

Line 35. "..widely used for air quality forecasting. The system has been extended for….."
Please make two sentences of this relatively long original sentence.

Page 3
Line 5. "MOdel….."

Line 8. "….assimilation **of** AOD improved…"

Line 9. "In the present study, the assimilation.....system has been extended to be better used in the GOCI AOD retrievals during the current investigation period…"
Line 10. Not clear what is meant by this "careful investigation of data characteristics."
The change suggested here by me don't hold and I am sorry for that. However, this sentence on line 9, page 3, in the original version of the manuscript need in any case to be improved. Here is a new suggestion: "In the present study, the assimilation capabilities in the GSI 3DVAR system has been further extended to optimize the use of GOCI AOD retrievals during the KORUS-AQ period. (with careful investigation of data characteristics) I suggest to excluding the last part of this sentence, in the brackets, or improve it.

Lines 10-13. The last part of this sentence is not clear: "……compared to that of other observations."
I suggest creating two sentences of this long original sentence.

Line 13. "data and examine"
Sorry, I referred to the wrong line here, thus, it should be Line 12 instead. Here you should remove the redundant word "then" in the original manuscript.

Line 18. "conclusions are presented"
This is one of several examples showing that the manuscript needs an English proof-check. Thus, the phrase "conclusions are made in Section 5" is not grammatical correct.