First of all, we appreciate the reviewer's comments and suggestions. In response to the reviewer's comments, we have made relevant revisions to the manuscript. Listed below are our answers and the changes made to the manuscript according to the questions and suggestions given by the reviewer. Each comment of the reviewer (in black) is listed and followed by our responses (in blue).

Review of "Mid-latitude mixed-phase stratocumulus clouds and their interactions with aerosols: how ice processes affect microphysical, dynamic and thermodynamic development in those clouds and interactions?" by Seoung Soo Lee et al.

The authors present LES simulations of a mixed-phase stratocumulus deck over the Korean Peninsula and investigate changes in water path resulting from temporal variations in CCN concentrations. They use a number of sensitivity experiments to investigate the impact of altered CCN and INP concentrations and the presence of ice crystals in these clouds. Alterations in water path between the simulations are largely explained by different efficiencies of condensation and evaporation and the Wegener-Bergeron-Findeisen process.

Overall the simulations and results are well presented. However, I have a few major issues with the scientific interpretation of the results and the hypothesised physical mechanisms, as outlined below. Also in places important details about the diagnostics shown are missing. Therefore I cannot recommend this paper being published before substantial revisions have been carried out by the authors.

Major comments

1. *Wegener-Bergeron-Findeisen process, condensation and evaporation rates*:
   The main hypothesis in the paper to explain lower LWP in mixed-phase compared to warm- phase only simulations is the evaporation cloud droplets and subsequent inefficient deposition of water vapour onto ice in the context of the WBF process. I find that not very convincing or indeed a logical argument.
   For WBF to operate deposition needs to be efficient enough to reduce in-cloud relative humidity below water saturation. All else being equal that would in itself imply an enhanced condensate content in the cloud (assuming we are starting from the same cloud base specific humidity). If deposition onto ice is very inefficient, relative humidity in clouds will remain at (or close to) water saturation and hence no evaporation of cloud droplets would be expected.

   As long as water-vapor pressure (WVP) is greater than water-vapor saturation pressure for ice particles (QIS), deposition occurs whether WVP is lower than the saturation pressure for liquid particles (QWS) or higher than QWS. When WVP is higher than QWS, there is competition between ice and liquid particles for water vapor needed for their growth and depending on how this competition evolves, the amount of deposition or deposition efficiency as the reviewer phrases is determined. Anyway, since QIS < QWS, although WVP is higher than QWS initially, the reduction of WVP due to condensation onto liquid particles and deposition onto ice particles eventually can lead to WVP lower than QWS but higher than QIS and this in turn can lead to a situation where deposition continuously occurs or efficient deposition occurs as the reviewer phrases but condensation stops and evaporation starts.

   Even though WVP is equal to QWS or WVP remains at QWS as the reviewer phrases, that does not mean that there is no evaporation. Even in this situation of WVP=QWS at the initial stage, since QIS < QWS, deposition can occur and this can lower WVP, leading to another situation where WVP < QWS and thus evaporation starts. This is supported by Korolev and Mazin (2003; JAS) showing that although initially WVP=QWS, due to WVP > QIS, deposition occurs, and this lowers WVP and makes WVP becomes "slightly" lower than (or close to) QWS, leading to droplet evaporation and the depletion of droplets.

   Based on the argument above, whether initial WVP = QWS or initial WVP > QWS, deposition can occur as long as WVP > QIS, then eventually WVP can be lower than QWS and evaporation occurs as shown in Figure 3c for the control run. If initially the WBF condition is there which is QIS<WVP<QWS, evaporation and deposition occur simultaneously at the very beginning. This evaporation reduces cloud droplet number concentration as a source of subsequent condensation as shown in Figure 3d. This provides lower cloud droplet number concentration for

condensation when the situation of WVP > QWS is recovered, and subsequently contributes to less condensation; note that unlike in parcel models, air parcels in the model adopted here experience various updraft, downdraft and microphysical conditions and feedbacks among them while those parcels move around three-dimensionally, hence, those parcels can repeatedly come back and forth between WVP>QWS and WVP<QWS. However, aided by the fact that QIS < QWS, deposition is facilitated whether WVP at a grid point and a time step is higher than QWS or not as long as WVP is higher than QIS. This leads to greater deposition than condensation in the control run. The deposition is inefficient due to low CINC as a source of deposition. This inefficient deposition does not mean there is no deposition but mean that deposition is not large enough to make cloud mass in the mixed-phase clouds similar to that in the warm clouds due to the low CINC and the associated insufficient integrated surface area of ice crystals as demonstrated by the INP-10 and INP-100 runs. In the INP-10 and INP-100 runs, with increasing CINC, when WVP > QWS, ice particles can be more dominant in the competition between ice and liquid particles for their growth than in the control run. This enhances deposition and reduces condensation in the INP-10 and INP-100 runs as compared to those in the control run. When WVP ≤ QWS but WVP > QIS, more CINC makes deposition more efficient or significant, which is more favorable for maintaining WVP < QWS and for more efficient evaporation (and thus subsequent less condensation) in the INP-10 and INP-100 runs than in the control run.

If we look at the control run only in Figure 3b, deposition occurs and its rate is generally greater than condensation rate. This means that if we restrict our argument only to the control run for the mixed-phase cloud, deposition occurs significantly as compared to condensation to explain cloud mass more than condensation. This in turn means that deposition enhances condensate content, as the reviewer phrases, in a way that this deposition-enhanced cloud mass is greater than condensation-related cloud mass. This significant deposition is considered inefficient, only when it comes to cloud mass in the control run for the mixed-phase cloud as compared to that in the control-noice run for the warm cloud. Here, it is notable that as seen in Figure 3c, evaporation occurs and this means that overall, the significant deposition involves evaporation in the control run. This in turn means that the statement that deposition is very inefficient, leading to no evaporation, as the reviewer phrases is not true when it comes only to the control run. Here, we see that deposition and evaporation interact with each other to induce the significant deposition in the control run, however, this deposition is not large enough, leading to lower WP in the control run than in the control-noice run.

We may think the sedimentation of ice particles and the PBL-top entrainment play a role in the lower WP in the control run than in the control-noice run. Regarding this, we repeated the control run with sedimentation turned off or by setting fall velocity of ice particles to zero as detailed in Section 4.1.3. In this repeated run, we can exclude the role of sedimentation of ice particles in the WP. Comparisons between the control run and this repeated run show that the qualitative nature of results does not vary with whether there is the ice-particle sedimentation or not. Also, as explained below, the entrainment at the PBL top is greater in the control-noice run than in the control run. Hence, the loss of ice particles and associated cloud mass via ice-particle sedimentation is not the reason why the control run has lower WP than the control-noice run, and entrainment tends to reduce cloud mass in the control-noice run more than in the control run. This means that ice-particle sedimentation and entrainment are not the reason why WP is lower in the control run than in the control-noice run.

2. *Loss of cloud condensate by sedimentation, changes in entrainment and cloud fraction*:
A much more logical explanation (and indeed one that can be found in literature for explaining the behaviour of Arctic / Southern Ocean mixed-phase stratocumulus) is the change in sedimentation rates if ice crystals are present in the stratocumulus clouds. The authors do not consider loss processes due to sedimentation (or indeed altered cloud-top entrainment) in the presented results. This should be remedied in a future version of the manuscript.
The authors also do not discuss changes in cloud fraction between the simulations, which are frequently reported to occurs for super-cooled stratus clouds in the Southern ocean as a function of the INP abundance.

1. We obtained the time series of differences in the average entrainment rate between the control and low-aerosol runs as shown in Figure 9b. This figure shows that during the period between 12:50 and 13:20 LST on January 12^{th}, there is no steady and rapid temporal increase in differences in the rate of entrainment at the PBL tops unlike the situation with CDNC differences between the control and low-aerosol runs. Hence, we believe that it is not likely that the jump in differences in evaporation between the runs is induced by the entrainment rate. However, we believe that entrainment together with the WBF mechanism plays a role in

the reduction in the temporal decrease in evaporation and contributes to the lower temporal reduction in evaporation than that in condensation after 13:30 LST on January 12th in each of the control and low-aerosol runs. Regarding this, the following is added:

(LL869-872 on p29)

For the period between 12:50 and 13:20 LST, there is no steady and rapid temporal increase in differences in the entrainment rate at the PBL tops unlike the situation with CDNC differences between the ice runs (Figure 9b). Hence, the greater jump in differences in evaporation between the ice runs is not likely to be induced by entrainment.

(LL878-883 on p29)

The presence of the WBF mechanism and entrainment facilitates evaporation and this acts against the temporal decrease in evaporation with time over the period in each of the ice runs. This counteraction by the WBF mechanism and entrainment reduces the temporal decrease in evaporation and enables evaporation to reduce temporally to a less extent as compared to condensation in each of the ice runs for the period (Supplementary Figure 1).

2. Regarding the role of entrainment in the noice runs, the following is added:

(LL954-966 on p32)

The average entrainment rate over all grid points at the PBL tops and over the whole simulation period is 0.71 and 0.60 cm s^{-1} in the control-noice and low-aerosol-noice runs, respectively. The average entrainment rate over all grid points at the PBL tops and over the whole simulation period is 0.13 and 0.15 cm s^{-1} in the control and low-aerosol runs. There are aerosol-induced decreases in the average entrainment over the whole simulation period between the ice runs. The boost of evaporation by the WBF mechanism in each of the ice runs leads to greater evaporation efficiency by outweighing the lower entrainment rate in the control run than in the control-noice run and in the low-aerosol run than in the low-aerosol-noice run. Aerosol-induced increases in the boost lead to aerosol-induced greater increases in evaporation efficiency between the ice runs than between the noice runs despite aerosol-induced decreases (increases) in the entrainment rate between the ice (noice) runs for the whole simulation period.

3. Regarding the role of entrainment between the control and control-noice runs, the corresponding text is revised as follows:

(LL543-554 on p18-19)

Associated with the more evaporation and difficulty in droplet activation, droplets disappear more and form less, leading to a situation where cloud droplet number concentration (CDNC) starts to be lower in the control run during the initial stage (Figure 3d). This is despite the higher entrainment rate at the PBL tops and associated more evaporation in the control-noice run than in the control run. The average entrainment rate over all grid points at the PBL tops and over the initial stage is 0.18 and 0.08 cm s_{-1} in the control-noice and control runs, respectively. In this study, the entrainment rate is calculated as follows:

The entrainment rate = $dz_i/dt - w_{sub}$

Here, z_i is the PBL height and w_{sub} is the large-scale subsidence rate at the PBL top.

4. Regarding the role of entrainment between the control and INP-reduced runs, the corresponding text is revised as follows:

(LL1050-1061 on p35)

Also, more entrainment contributes to the more evaporation in the control run (Figure 9b). Between the INP-reduced and control runs, with no increases in the concentration of background aerosols acting as CCN, increases in the surface-to-volume ratio of droplets and the associated enhancement in the WBF-mechanism-related efficiency of evaporation are negligible as compared to those between the control and low-aerosol runs. Note that there are overall larger increases in entrainment and associated evaporation between the control and INP-reduced runs than between the control and low-aerosol runs (Figure 9b). The negligible enhancement in the WBF-mechanism-related efficiency of evaporation overshadows the overall larger increases in entrainment and associated evaporation between the control and INP-reduced runs. This leads to aerosol-induced overall smaller increases in evaporation between the control and INP-reduced runs than between the control and low-aerosol runs (Figures 9a and 9d).

5. Regarding the role of the sedimentation of ice crystals, sensitivity tests are performed. Sections 4.1.3 and 4.2.3 describe those tests and their results.

6. Regarding the cloud fraction, the following is added:

(LL464-467 on p16)

This higher WP in the control-noice run accompanies the higher average cloud fraction over time steps with non-zero cloud fraction. The average cloud fraction is 0.98 and 0.92 in the control-noice and control runs, respectively.

(LL736-738 on p25)

This involves aerosol-induced decreases in the average cloud fraction over time steps with non-zero cloud fraction from 0.93 in the low-aerosol run to 0.92 in the control run.

(LL748-750 on p25)

This involves aerosol-induced increases in the average cloud fraction over time steps with non-zero cloud fraction from 0.96 in the low-aerosol-noice run to 0.98 in the control-noice run.

(LL1092-1096 on p36)

This greater increase in IWP dominates over the smaller decrease in LWP between the control and INP-reduced runs, leading to an increase in WP in the control run as compared to that in the INP-reduced run with an increase in the average cloud fraction over time steps with non-zero cloud fraction from 0.89 in the INP-reduced run to 0.92 in the control run.

Specific comments

1. In the introduction (l. 104 ff.) the WBF process is introduced. The discussion is relatively superficial and for example ignores that the occurrence of WBF dependence on the balance in timescales between supersaturation generation and its depletion by condensation and deposition on the existing cloud particle population. As so much of the paper rests on the WBF process are more detailed discussion is required here (if the focus on WBF is to remain in future versions of the manuscript).

The following is added:

(LL121-128 on p5)

The occurrence of the WBF mechanism depends on updrafts, humidity, associated supersaturation and microphysical factors such as cloud-particle concentrations and sizes (Korolev, 2007). Also, it needs to be pointed out that when the WBF mechanism starts and how long it lasts depend on how a timescale for updrafts and associated supersaturation is compared to that for phase-transition processes as a part of microphysical processes (Pruppacher and Klett, 1978). Korolev (2007) have utilized a parcel-model concept to come up with conditions of updrafts and microphysical factors where the WBF mechanism is operative.

To give more detailed explanation of the methodology to examine the interplay between ice and liquid particles including the WBF mechanism, the following is added:

(LL160-179 on p6-7)

To fulfill the aim, this study focuses on effects of the interplay between ice crystals and droplets on those clouds, and interactions of these effects with aerosols using a large-eddy simulation (LES) Eulerian framework. The LES framework reasonably resolves microphysical and dynamic processes at turbulence scales and thus we can obtain process-level understanding of those effects and interactions. Note that with the Eulerian framework, instead of tracking down individual air parcels, which can be pursued with the Lagrangian framework, this study looks at updrafts, microphysical factors, phase-transition processes and their evolution, which are averaged over grid points in a domain, to examine the overall interplay between ice and liquid particles over the whole domain. Also, in the LES framework, air parcels go through various updrafts, microphysical factors and feedbacks between them. Thus, unlike in Korolev (2007), an air parcel in the LES framework can repeatedly experience conditions where the WBF mechanism does not work and those where the mechanism works as it moves around three-dimensionally. Hence, chasing down air parcels in terms of conditions (e.g., updrafts and microphysical factors) for processes such as the WBF mechanism is enormous task and not that viable. This motivates us to embrace the approach that adopts the averaged updrafts, microphysical factors and phase-transition processes to examine the overall interplay between ice and liquid particles which includes the WBF mechanism. To help this approach to identify the overall interplay between ice and liquid particles clearly, this study utilizes sensitivity simulations.

2. Figure 2: It is unclear what the data shown is. Observations somehow regridded? Some model output? You need to state this in the text and the caption.

Observed and measured PM data by ground stations are shown in Figures 2a, 2b and 2c. For Figures 2b and 2c, observed and measured PM data are interpolated into grid points in the domain. To make this point clear, corresponding text and caption are revised and the following is added:

(LL201-202 on p7)

These stations observe and measure PM10 and PM2.5 using the beta-ray attenuation method (Eun et al., 2016; Ha et al., 2019).

(LL215-217 on p8)

To construct Figures 2b and 2c, observed and measured aerosol mass concentrations by the ground stations are interpolated into equidistant points in the rectangle.

(In caption for Figure 2)

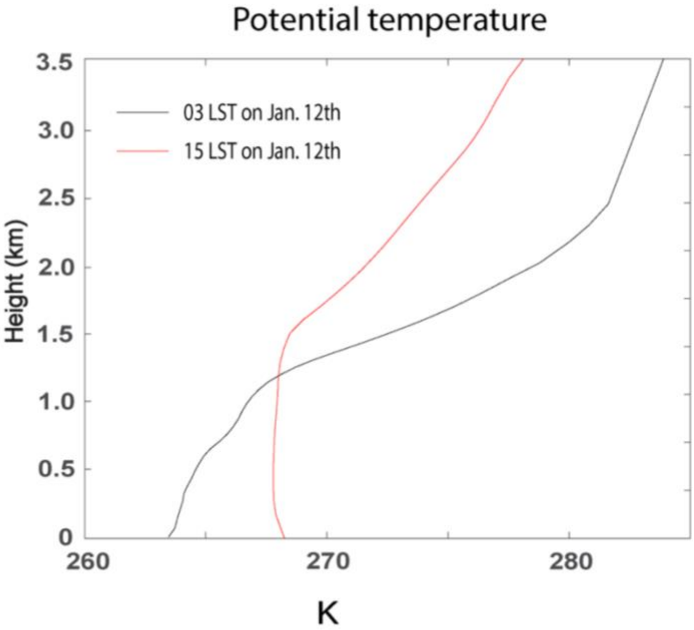
The spatial distribution of PM2.5, which is observed and measured by the ground stations and interpolated into grid point over the rectangle in Figure 1, at (b) 05:00 LST and (c) 18:00 LST on January 12th in 2013.

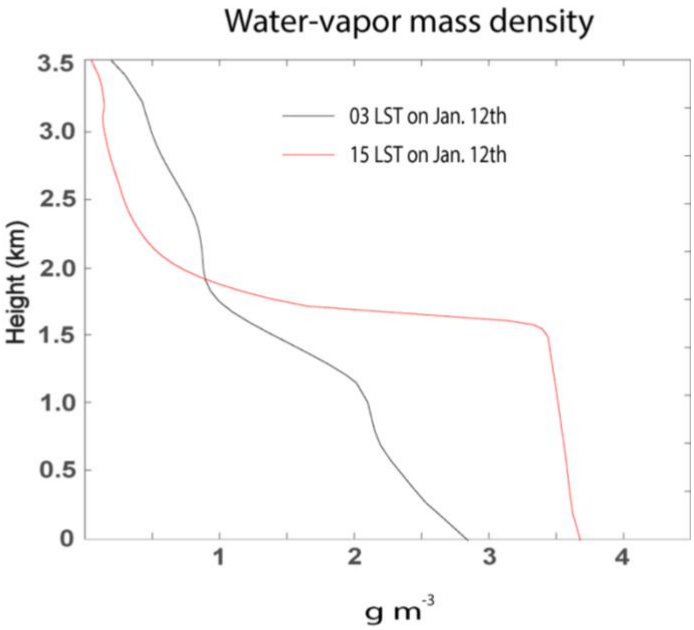
3. Section 2: You discuss changes in ambient aerosol concentrations in this section due to advection. Changes in airmass as implied by the large increase in aerosol concentrations shown in the timeseries likely also imply changes in meteorology (e.g. moisture content or vertical temperature structure). Are there any data available to check how large these changes are and what the impact of these changes on the cloud deck would be?

Yes, there are changes in meteorology accompanying changes in aerosol concentrations in the domain.

This paper focuses only on impacts of advected aerosols on clouds and does not focus on impacts of advected meteorological conditions on those clouds. Hence, impacts of advected meteorological conditions are out of scope of this study. That's why we repeated the control run only by changing aerosol concentrations but not by changing meteorological conditions. Then, we compared the control run to the repeated run (i.e., the low-aerosol run) to isolate impacts of advected aerosols.

Although impacts of advected meteorological conditions are out of scope, we obtained the vertical distribution of the radiosonde-observed potential temperature and humidity at 03:00 and 15:00 LST on Jan. 12th as shown in the following figure. At 03:00 LST on Jan. 12th just before when aerosol concentrations start to increase due to the aerosol advection in the Seoul area, there is a stable layer in the PBL whose top is around 1.0 km. This stable layer is not favorable for the formation of a deck of stratiform clouds. However, after 03:00 LST, the PBL becomes a well-mixed layer and its top height increases to 1.5 km as seen in comparisons between 03:00 and 15:00 LST in the figure. Hence, with advection-induced increases in aerosol concentrations in the Seoul area, meteorological conditions become favorable for the formation of a deck of stratocumulus clouds. Regarding this, if we had repeated the control run with an assumption that meteorological conditions after 03 LST on January 12th do not evolve and are fixed at 03 LST on January 12th, there would have been no or nearly no formation of stratocumulus clouds in the repeated run.





4. Section 3.2 (l. 247): Are observations at this spatial resolution also available over the ocean area of your domain? How is the horizontal interpolation done and how potential domain-filling required in areas with fewer stations? Also could you use the AERONET data to justify your assumption about constant modal radius and standard deviation?

Aerosol data are not available over the ocean area. Using the inverse distance weighting (IDW) method for interpolation or extrapolation, aerosol observed data on the land are extrapolated to the ocean area. Simply speaking, distances between a grid point of interest over the ocean and grid points over the land are obtained and based on these distances, an aerosol concentration for the grid point over the ocean is obtained. Here, IDW adopts an assumption that things that are close to one another or have shorter distances among them are more alike than those that are farther apart or have longer distances among them.

Only ~20% of the simulation domain is occupied by the ocean area and thus, we believe that the ocean area does not occupy a significant portion of the domain. So, we think that ocean does not affect the conclusions in this study. As a way of testing this thought and a way of removing the uncertainty associated with the ocean, we performed analyses of observation and simulation results here only over the land area (without the extrapolation of observation in the land area to the ocean area). These analyses give us the same conclusions that are already given in the old manuscript. Hence, whether we include the ocean and associated uncertainty in analyses or not does not affect the qualitative nature of conclusions in this study.

According to the AERONET data, the shape of aerosol size distribution and aerosol composition do not show a significant variation during the simulation period. Hence, we assume that the shape and composition do not vary during the period. The shape and composition described in the old manuscript are the average shape and composition over the simulation period.

To indicate the shape of aerosol size distribution and aerosol composition in the AERONET data do not show a significant variation during the simulation period, the following is added:

(LL299-302 on p10-11)

Aerosol chemical composition in this study is assumed to be represented by this mixture in all parts of the domain during the whole simulation period, based on the fact that aerosol composition does not vary significantly over the domain during the whole period with the observed clouds.

(LL315-317 on p11)

Since the AERONET observation shows that the shape of the size distribution does not vary significantly over the domain during the simulation period, we believe that this assumption is reasonable.

5. Figure 3 (and several other figures): It is unclear whether the averages shown are average over the entire domain or in-cloud areas only. The former would / could potentially include a large number of small values in cloud-free areas and include potential changes in cloud cover into the shown metrics / diagnostics.

By “definition”, the domain average means that all grid points are used for the average whether they have non-zero values of a variable of interest or not. For example, the domain-averaged condensation rate is “the sum of condensation rate over all grid points in the domain whether they have the zero value of condensation rate or not” divided by “the number of all grid points in the domain”. When “the domain average” is used, that is indicated in figure captions and text.

When the average is performed over grid points only with non-zero values of a variable of interest but not with zero values, that is indicated in figure captions and text. For example, CDNC averaged over grid points only with non-zero values of CDNC for the whole domain is “the sum of CDNC over grid points with non-zero CDNC excluding those with zero CDNC in the domain” divided by “the number of grid points with non-zero CDNC excluding those with zero CDNC in the domain”

Most of variables in this paper are averaged with “the domain average”. However, it is conventional to show the values of variables, such as CINC, CDNC, cloud-particle radius, and cloud-top and -bottom heights, averaged over grid points with the non-zero values of those variables, since in this way, readers can make comparisons of those variables between different studies most of which perform the average of those variables over grid points with the non-zero values of those variables but not over all grid points including both the non-zero and zero values. In the case of cloud-particle radius, it is conventional that it can also be averaged over grid points with non-zero cloud-particle concentration.

In this study, we are interested in how the total amount of cloud variables (e.g., LWP, IWP, WP, condensation, evaporation and deposition) vary over the whole domain with varying aerosol conditions or cloud conditions (e.g., mixed-phase or warm clouds). Based on the interest, we summed up each of those variables over the whole grid points whether they have the non-zero values of each of those variables or not. Then, following the convention which shows the normalized sum of each of those cloud variables as a way of showing the total amount of each of those cloud variables, we normalized the sum by dividing it by the total number of all grid points over the whole domain in all of simulations, which is equivalent to “the domain average”, so that readers can compare the normalized sum to that in other studies most of which also perform “the domain average” for those cloud variables.

We find that whether we perform the domain average for each of variables, such as CINC, CDNC, cloud-particle radius, cloud-top and -bottom heights, and compare each of these domain averages to each of the domain-averaged cloud variables (e.g., LWP, IWP, WP, condensation, evaporation and deposition) or we perform the average of each of those cloud variables (e.g., LWP, IWP, WP, condensation, evaporation and deposition) only over grid points where it has non-zero values and compare each of these averages to the average of each of variables, such as CINC, CDNC, cloud-particle radius, cloud-top and -bottom heights, only over grid points where it has non-zero values, the qualitative nature of conclusions in this study does not vary.

Technical corrections

- Throughout the text IN is used to refer to aerosols able to initiate ice. In recent literature this term is not standard anymore, instead “ice nucleating particles“ (INP) is used. The authors should consider switching to this nomenclature.

Done.

- l. 57: interactions with what?

Replaced with the following:

(LL58-59 on p3)

This study examines the roles of ice processes in those clouds and their interactions with aerosols using a large-eddy simulation (LES) framework.

- l. 62: I do not understand what you want to say with the sub-sentence starting with “whose“

The sub-sentence is removed.

- l. 102: Make sure you make clear that “level“ refers to an altitude, at which homogeneous freezing would be expected based on an average temperature profile. The current formulation is somewhat confusing.

The word “level” pointed out here is replaced with “altitude”

- l. 104: “The ~~level of~~ water-vapour equilibrium saturation **pressure** is lower …“

Done.

- l. 111: “… differences in water-vapour equilibrium saturation **pressure over** ice and liquid …“

We put “pressure” in the corresponding sentence. However, we believe that “between” is a better word than “over”, since the corresponding sentence wants to express that the saturation pressure is “different” between ice and liquid particles.

- l. 118 ff: I am not sure the sentence starting with “hence“ is logical or I do not understand what you are trying to say. Please rephrase.

The corresponding sentences are replaced with the following:

(LL129-135 on p5)

The evolution of cloud particles as well as their interactions with aerosols is strongly dependent on thermodynamic and dynamic conditions such as humidity, temperature and updraft intensity (Pruppacher and Klett, 1978; Khain et al., 2008). Interactions between ice and liquid particles in mixed-phase clouds, which include the WBF mechanism, change thermodynamic and dynamic conditions where cloud particles grow. Impacts of these changes on the development of mixed-phase clouds and their interactions with aerosols have not been understood well.

- l. 177: Please indicate the location of these stations (also the Seoul one) on Figure 1.

Done.

- l. 179: Not sure I would agree with 03 LST based on the plot. It more looks like 10 LST.

We looked at data and it is 05 LST. We marked the time points with arrows and the following is added to the corresponding caption, accordingly:

The blue (red) arrow marks time when aerosol mass starts to increase in BN (SL) due to the advection of aerosols from East Asia to the Seoul area.

- l. 227: Please rephrase this sentence. It sounds very strange. Also state whether you use equi-distant vertical levels or a stretched coordinate system.

Replaced with the following:

(LL261-263 on p9)

In the vertical domain, the resolution coarsens with height. The resolution in the vertical domain is 20 m just above the surface and 100 m at the model top that is at ~ 5 km in altitude.

- l. 280: “… aerosols **acting** as IN …“ (missing also at various other instances throughout the text, please carefully review)

Done.

- l. 338: Interplay between what?

The corresponding text is revised as follows:

(LL431-437 on p15)

Via comparisons between the control and control-noice runs, we aim to identify effects of the interplay between ice crystals and droplets on the adopted system. Via comparisons between a pair of the control and low-aerosol runs and that of the control-noice and low-aerosol-noice runs, we aim to identify effects of the interplay between ice crystals and droplets on interactions between the system and aerosols. Henceforth, the pair of the control and low-aerosol runs is referred to as the ice runs, while the pair of the control-noice and low-aerosol-noice runs is referred to as the noice runs.

- l. 388: Is this refering to MTSAT or ground based observations? How is averaging done?

The corresponding text is revised as follows:

(LL485-500 on p17)

Multifunctional Transport Satellites (MTSAT), which are geostationary satellites and available in the East Asia, do not provide reliable data of LWP and IWP, although they provide comparatively reliable data of cloud fraction and cloud-top height throughout the whole simulation period (Faller, 2005). Ground observations provide data of cloud fraction and cloud-bottom height throughout the whole simulation period. Here, the simulated cloud fraction and cloud-bottom height are compared to those from ground observations, while the simulated cloud-top height is compared to that from the MTSAT. The average cloud fraction over time steps with non-zero cloud fraction is 0.92 and 0.86 in the control run and observation, respectively. The average cloud-bottom height over grid columns and time steps with non-zero cloud-bottom height is 230 (250) m in the control run (observation). The average cloud-top height over grid columns and time steps with non-zero cloud-top height is 2.2 (2.0) km in the control run (observation). For this comparison between the control run and observation, observation data are interpolated into grid points and time steps in the control run. The percentage difference in each of cloud fraction, cloud-bottom and -top heights between the control run and observations is ~ 10% and thus the control run is considered performed reasonably well for these variables.

- l. 621 ff: I do not get this sentence, please rephrase.

As seen in supplementary Figure 1 and described in text, evaporation and condensation jump in each of the ice runs (i.e., the control and low-aerosol runs) in a time period between 12:50 and 13:20 LST. As seen in supplementary Figure 1 and described in text, the jump (or the surge or the rapid increase) in evaporation is higher than that in condensation in each of the ice runs. This accompanies a situation where the jump in differences in condensation between the ice runs is not as high as that in differences in evaporation between the ice runs as seen in supplementary Figure 1 and described in text. As seen in supplementary Figure 1 and described in text, associated with this, differences in the jump between evaporation and condensation are greater in the control run than in the low-aerosol run.

It is well-known that evaporation tends to make droplets disappear and condensation counteracts this disappearance of droplets. Hence, more evaporation tends to make more droplet disappear, while more condensation counteracts the disappearance of droplets more as described in text. The jump (or the surge or the rapid increase) in evaporation leads to the jump (or the surge or the rapid increase) in the disappearance of droplets, while the jump in condensation leads to the jump in the counteraction against the disappearance of droplets. Since the jump in evaporation is higher than that in condensation in each of the ice runs, evaporation-induced disappearance of droplets outweighs condensation-induced counteraction against the disappearance of droplets. Hence, for each of the ice runs, this induces the decreasing trend of cloud droplet number concentration (CDNC) starting at 13:30 LST. If the rate of this decrease in CDNC with time is equal between the runs, there won't be any decreasing trend in "differences" in CDNC between the runs. However, remember that differences in the jump between evaporation and condensation are greater in the control run than in the low-aerosol run. Hence, evaporation-induced disappearance of droplets is counteracted by condensation "less" in the control run than in the low-aerosol run. This induces the rate of the decrease in CDNC with time to be greater in the control run than in the low-aerosol run, which in turn induces differences in CDNC between the runs to reduce with time starting at 13:30 LST.

The corresponding paragraph is revised as follows:

(LL801-817 on p27)

The jump in differences in condensation between the ice runs is not as high as that in differences in evaporation between the ice runs (Figure 9a). This situation accompanies the fact that in each of the ice runs, the jump in evaporation is higher than that in condensation (Supplementary Figure 1). This means that differences in the jump between evaporation and condensation are greater in the control run than in the low-aerosol run (Supplementary Figure 1). Hence, evaporation-driven jump in the disappearance of droplets outweighs condensation-driven jump in counteraction against the disappearance in each of the ice runs. Due to this, the increasing temporal trend of CDNC turns to its decreasing trend in each of the ice runs around 13:30 LST on January 12th. If the rate of this decrease in CDNC with time is equal between the ice runs, there is no decreasing trend in differences in CDNC between the runs. However, remember that differences in the jump between evaporation and condensation are greater in the control run than in the low-aerosol run. Hence, when the jumps occur, evaporation-induced disappearance of droplets is counteracted by condensation "less" in the control run than in the low-aerosol run. This induces the rate of the CDNC decrease to be greater in the control run than in the low-aerosol run. This in turn turns the increasing temporal trend of the CDNC differences between the ice runs to their decreasing trend around 13:30 LST on January 12th (Figure 9a).

- Fig. 2a: Make clear the x-axis is in days!

Done by adding "January" and replacing "dates" with "days"

- Fig. 9a, 9c: Consider changing the scaling. The temporal evolution of most variables is very hard to discern in the current versions of these plots.

Done.