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.
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.

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).
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.
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?
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?

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.

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.
- l. 57: interactions with what?
- l. 62: I do not understand what you want to say with the sub-sentence starting with “whose“
- 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.
- l. 104: “The ~~level of~~ water-vapour equilibrium saturation **pressure** is lower …“
- l. 111: “… differences in water-vapour equilibrium saturation **pressure over** ice and liquid …“
- 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.
- l. 177: Please indicate the location of these stations (also the Seoul one) on Figure 1.
- l. 179: Not sure I would agree with 03 LST based on the plot. It more looks like 10 LST.
- l. 227: Please rephrase this sentence. It sounds very strange. Also state whether you use equi-distant vertical levels or a stretched coordinate system.
- l. 280: “… aerosols **acting** as IN …“ (missing also at various other instances throughout the text, please carefully review)
- l. 338: Interplay between what?
- l. 388: Is this refering to MTSAT or ground based observations? How is averaging done?
- l. 621 ff: I do not get this sentence, please rephrase.
- Fig. 2a: Make clear the x-axis is in 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.