This study examined the sensitivity of microphysical property of cirrus clouds and radiation changes induced by aircraft soot. This manuscript was written very well and reviewed comprehensively. Lots of sensitivity experiments for ice nucleation ability, vertical velocity and nudging were conducted. However, I still have some suggestion to improve this study and make the conclusion clearer. The description of the model setup is not detail enough. For example, the method to determine the homogeneous freezing and its critical condition should be added. In addition, I suggest showing the ICNC from homogeneous nucleation, which is important to determine the RF of aircraft soot and its sensitivity. Else, what's the mechanism of the growth of aircraft soot? Is coating on aircraft soot considered? Will coating influence the ice nucleation ability of aircraft soot?

Figure 5 summarized the results of series of sensitivity experiments. However, the reason and mechanism leading to those results is not clearly explained, so that we still can not address exact conclusions and mechanisms from these experimental results. I suggest pay more attention to the mechanism explaining the sensitivities, especially those non-monotonous variations.

Although this study does not mean to provide an updated estimate on the aviation soot-cirrus effect. I would still suggest adding some comparison between observations (ICNC, radiation, IWC) and simulations, so that we can evaluate which sensitivity may be closer to actual conditions. Otherwise, we can not find any reference to determine the sensitivity parameters. If the simulated conditions are far away from real conditions, the sensitivity experiments would make no sense to address a general conclusion and help modeler to work further.

Specific comments:

1. Line 70: Zhu and Penner have published a corrigendum in Atmospheric Chemistry and Physics which changed the S_{crit} to 1.35
2. Line 98: It is not clear that what are "such methods" did you mean here? Parameterization of vertical updraft?
3. Line 142: Actually, all models using the ice nucleation parameterization of Liu and Penner (2005) have temperature dependence, although not very exact.
4. The section 2 is like an introduction, which is some similar with the Section 1. I suggestion merging section 2 into Introduction secton.
5. Line 178: Why did you change the minimum CDNC to 50cm-3? Did you have any reference?
6. Line 183: Was the ERF here attributed by the changes only in warm clouds? Or combined with ERF on cirrus clouds?
7. Line 195: BCtag tracer refers to BC. So did you use the emission inventory of aircraft BC or aircraft soot? Do aircraft BC and soot have same ice nucleation ability and size distribution?

8. Table 1: The background soot is not very important for the ice nucleation and RF of aircraft soot since the number of INPs from background soot should be very small. Instead, I think dust could be mor important to influence heterogeneous nucleation since the number of INPs from dust are usually larger than soot. I would suggest adding some sensitivity experiment with different treatment to dust in addition to the sensitivity experiments of Scrit for background soot.
9. Line 265: As I saw, the connections between North America and East Asia are also marked.
10. Figure 3 c&e: I saw the mass concentration is high around 200hPa over the Antarctic, while that is low over the Southern tropics. However, the number concentration is opposite. In addition, the mass concentration is some high above 200hPa, but the number concentration is very low there. Could you please explain the mechanism of aircraft soot growing and the way to determine the number concentration? What are the size distributions of aircraft soot over tropics and polar area? Why are they largely different?
11. Line 287: Why the RF is positive when the critical saturation is high? Even though the nucleation efficiencies is low, INPs from aircraft soot also suppresses the homogeneous nucleation leading to small negative RF. Figure 5h indicates that the cloud frequency increases when Scrit is median and high, which was used to explain the enhanced cloud lifetime and positive RF. However, the cloud frequency increase only when fact=0.1% and the RF when fact=0.1% is much less positive than the cases with fact=1% and 10% (Scrit=1.4). In addition, the total ICNC increases but ICNC from homogeneous freezing decreases when fact=0.1, although the change in the ICNC from heterogenous nucleation did not show. Why do ICNC from homogeneous freezing only increase when fact=1% and Scrit=1.2&1.3(Figure 5e)?
12. Line 328: As you explained, the additional aircraft soot in the Southern Hemisphere could lead to enhanced heterogeneous nucleation thus positive RF. Why the ICNC did not increase when much more INPs added when Scrit=1.2? What's the different mechanism?
13. Line 345: Could you please show the changes in low-level clouds maybe in SI? So that we can know how much influence on the low-level clouds and contribution to the changes in shortwave.
14. Line 385: I don't understand why the RF of aviation soot is more negative and significant when the impact of aviation soot is reduced?
15. Line 420: Why does the longwave RF switch from cooling to warming?