

Interactive comment on “Impacts of black carbon on the formation of advection-radiation fog during a haze pollution episode in eastern China” by Qiuji Ding et al.

Anonymous Referee #2

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This study investigates the impact of aerosol-cloud interactions (ACI) and aerosol-radiation interactions (ARI) on fog formation. The important roles of changing of advection and PBL dynamics in fog formations are revealed. It highlights the role of BC in the formation and maintenance of fog. In general, the manuscript is well organized. Thus, I suggest a minor revision before publication. The suggestions and comments are lists as following:

1. Introductions, Line 30, Page 2: I think it is not appropriated to claims “the impact of BC on fog has been rarely investigated by existing studies” after listing two references of “the impact of absorbing aerosols on fog formations”. Since BC is one of the most

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important absorbing aerosols.

2. Could you describe whether nudging is employed and the detailed method of nudging? Because nudging can affect the estimation of ARI.

3. As mentioned in Aerosol-Radiation-Microphysics Interactions (https://ruc.noaa.gov/wrf/wrf-chem/wrf_tutorial_2018/AerosolInteractions.pdf, page 42), “Comparing runs with chem_opt = 8 (without cloud-borne aerosols) with chem_opt = 10 (with cloud-borne aerosols) for MOSAIC coupled to Lin microphysics does not quantify the indirect effect, since the autoconversion scheme used in the Lin microphysics scheme will be different”. I’m not sure if it is the same for Morrison module? Could you describe the prescribed aerosol used in EXP_NOAER scenario?

4. Mentioned in Line 15, page 11, “Comparison between ARI and ACI shows that the effect of ARI was dominant over the effect of ACI. The reason may be that during this haze pollution episode there was little cloud and ACI was very weak.” However, the role of ACI is not limited as the change of solar radiation and PBL dynamics. One of the most important ways is acting as CCN during fog formations. I’m curious if the number and radius of fog droplet are changed. Could you show some results?

5. I think some statements in abstract and conclusion are too strong as a case study, like “We find that the ARI dominates this fog-haze episode while the effects of ACI are negligible.” It would be more appropriate if the statement could be limited as for specific scenarios. Further, it would be interesting to investigate under which conditions ARI is more important and under which conditions, ACI is more important in future studies. Maybe it is beyond the scope of this study.

6. I’m not sure whether the sharp decrease of PM_{2.5} and BC on Dec 7 in Figure 4 is due to wet removal or not. I guess the sharp decrease and rapid increase may be caused by the activation of the interstitial aerosol to the cloud-borne aerosol, and resuspension from the cloud-borne aerosol to the interstitial aerosol. And cloud-borne aerosol is not counted in CTL_EXP scenario. If so, could you check if the cloud-borne

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aerosol is calculated in the optical module and discuss whether ARI is underestimated during fog episode?

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