Dear Referee:

Thank you for your thoughtful comments concerning our manuscript entitled "Direct radiative forcing of light-absorbing carbonaceous aerosol and the influencing factors over China". Those comments are all valuable and very helpful for revising and improving our paper. We studied the comments carefully and made corrections which we hope meet with approval. The responses to the referee′s comments are as follows:

Respond to Referee #1:

This is a quite complete paper about the radiative forcing due to carbonaceous aerosols in China. The selected period extended from October 2016 to December 2017. Surface data were obtained from 36 monitoring sites. Although gridded data were also used. The analysis considers a radiative model. Organic carbon is divided in primary and secondary brown carbon, the radiative forcing of both tracers is investigated together with the influence of different atmospheric variables. Since the analysis is quite detailed and focused, only some few minor changes are suggested.

1. **Most of the surface stations are placed at east of the country. The authors should comment the influence of such distribution on the results and if different results could be obtained with a homogeneous distribution of surface stations**

   Response: Thanks for the comments. In our study, the data collected at the monitoring stations were used to validate and evaluate the model performance in simulating the concentrations of light-absorbing carbonaceous aerosols. The 36 monitoring stations included in our manuscript cover most provinces across China. These sites are mainly distributed in central and eastern China, regions characterized by intense human activities, while they are relatively sparse in the less populated western part of China. The sparse distribution of fewer monitoring stations in the western region may limit us to assess the model performance in this region. We added this comment into the latter part of the conclusion section (Sect. 4) in our manuscript as follows:

   "It should be noted that our study had some limitations and uncertainties. First, the sparse distribution of fewer monitoring stations in western China may limit the ability to assess the model performance in this region. …"

2. **Simulation was considered from October 2016 to December 2017. The authors should introduce a comment about the result representativeness since meteorological conditions may be quite different in different years. Perhaps the model is not so sensitive against meteorological conditions, or the weight of weather variables is weak.**

   Response: Thank you for the comments. We agree with your opinion that meteorological conditions may be different in different years, and the model can be affected by meteorological conditions or weather variables. The

monitoring BC concentrations were collected from January to August 2017 in our study, and our simulation was conducted from October 2016 to December 2017 in order to compare with the monitoring data. The initial three months (October to December 2016) simulation was designated as the spin-up period to eliminate the influence of the initial conditions and stabilize the model.

3. **The uncertainty of radiative forcing is quite important. Perhaps, authors could explain the reason for such uncertainty and if they consider procedures to make it smaller or cases where this uncertainty is small.**
Response: Thank you for the suggestions. The uncertainty of the radiative forcing is indeed important. The radiative forcings of light-absorbing carbonaceous aerosols can be affected by the emission inventory. To simulate the radiative forcing of light-absorbing carbonaceous aerosols, anthropogenic emissions over China were updated by the localized emission inventory INTAC with a resolution of 0.1° × 0.1°. However, emissions from biomass burning were derived from the global open biomass burning inventory GFED-4 with a resolution of 0.25° × 0.25°, which may introduce uncertainties in the radiative forcing of light-absorbing carbonaceous aerosols due to its relatively low resolution. Additionally, the physical and optical properties of light-absorbing carbonaceous aerosols vary dynamically in different regions, periods, and pollution conditions. However, the use of default values in the parameterization of these parameters may bring uncertainties into the radiative forcing estimation of light-absorbing carbonaceous aerosols. Future studies are expected to acquire refined local emission inventories and more accurate physical and optical parameters of light-absorbing carbonaceous aerosols, thereby reducing uncertainties in their radiative forcing. The uncertainties associated with the radiative forcing estimates of light-absorbing carbonaceous aerosols were mentioned in the latter part of the conclusion section (Sect. 4) in our manuscript. We modified this part after careful consideration. As follows:

"… Second, the LACs mixing state, aging rate, and AAE values can affect the LACs concentrations and optical properties. Furthermore, the mixing state and aging rate in different regions vary with time and the AAE values mainly depend on the emission sources and burning conditions. Owing to the lack of refined local schemes for these parameters in China, we used the external mixing state, fixed aging time, and empirical AAE values in our simulation, which may introduce uncertainties into the subsequent estimation of LACs DRFs. The refined local emission inventories and more accurate physical and optical parameters of LACs are acquired in the subsequent study to reduce the uncertainties of LACs DRFs. …"