Response to Referee #3

We greatly appreciate the helpful comments from the reviewer, which have helped us improve the paper. We have addressed the comments carefully, as detailed below.

General Comments

Aerosol is very important to impact atmospheric cycle and climate system by direct and indirect effects, a hot issue of scientific researches internationally. The paper summarizes the recent published on Chinese PM2.5 and reviews the tempo-spatial distribution of PM2.5, chemical composition, aerosol optical properties, and reveals their relation across the whole country, based on ground-based filter measurements of particles, gases (e.g. SO2, NO2, CO). In fact, high aerosol burden regions such as areas in Asia are still not well characterized in terms of particle chemical and microphysical properties and long-term variation trend. The topic of this paper is of common interest within the scientific community. Although the manuscript includes some important data, however, the quality is not sufficient in the current state to be directly published. The authors should take the suggestions made here into consideration for revision.

Specific suggestions

1. The paper mainly presents the $PM_{2.5}$ measurements in urban sites, especially in eastern areas and other areas with relatively strong human activities (Figure 1). In addition, the variation of $PM_{2.5}$ is very different in the North, the Middle and the South, so the authors should address it clearly (Figure 3). This paper somewhat provides more efforts to give a long-term trend of $PM_{2.5}$. However, it lacks some remote sites such as in northeastern, Xinjiang, Yunnan areas etc, maybe it is better to select one typical year to focus on these sites and compare with the sites in the paper.

Response: As explained at the beginning of section 2, the purpose of the study is to summarize chemically-resolved $PM_{2.5}$ data across China. Thus, only data sets have synchronous measurements of $PM_{2.5}$ and its major chemical components (inorganic ions, OC and EC) are included in this review. We are aware that they are many other studies concerning $PM_{2.5}$ pollution in many regions of China, however, most of these studies do not have information on $PM_{2.5}$ chemical composition and thus cannot be included in this review. We have gone through a more careful literature survey and found a few additional studies conducted in medium-sized cities and remote sites. These studies have been added in the SI tables and numbers in the paper due to the addition of these studies have been updated.

2. In lines of 620-624, AOD can reflect the column amount of aerosol in the whole atmosphere, while $PM_{2.5}$ is only the mass of particles at the surface. The differences in fine structures of $PM_{2.5}$ and AOD are related to $PM_{2.5}$-AOD comparison and spatial variations of chemical composition, the size, number, vertical distribution and transport of aerosol are also responsible for these differences. The authors should

address them clearly.

Response: We have added some materials and relevant references explaining the relationship between AOD and $PM_{2.5}$ in section 3, which reads: “Satellite retrievals of AOD have been widely applied to estimate surface $PM_{2.5}$ concentrations using statistical models (Liu et al., 2005; Hu et al., 2013; Ma et al., 2014; Wang and Christopher, 2003). Although the correlation between AOD and $PM_{2.5}$ mass concentration depends on many factors, such as aerosol size distribution, refractive index, single-scattering albedo, and meteorological factors (Che et al., 2009; Guo et al., 2009b; Guo et al., 2017), the predicted $PM_{2.5}$ mass from satellite AOD data compared well with ground-level measurements (Ma et al., 2014; Xie et al., 2015b). Moreover, the spatial distributions of AOD measured using sun photometers mostly agreed with those retrieved from satellite data (Che et al., 2014; Che et al., 2015; Liu et al., 2016b; Pan et al., 2010).”