Reply to Anonymous Referee #1

We thank the reviewer for the careful reading of the manuscript and helpful comments. We have revised the manuscript following the suggestion, as described below.

In this paper, the authors have evaluated the contributions of garbage burning (GB) emissions to chloride and $PM_{2.5}$ in the Mexico City Metropolitan Area (MCMA). Their results indicated that GB contributes to > 60% of particulate chloride and represents an important source of $PM_{2.5}$ (about 3–30% simulated $PM_{2.5}$ mass). The manuscript is generally well written on average addresses a potentially important topic on the source of $PM_{2.5}$. I recommend publication of this paper, provided that following issues have been adequately accounted for.

(1) In the SOA module, did the authors consider the contribution of potential heterogeneous reactions to the formation of SOA, including oligomerization of small di-carbonyls (Zhao et al., Environ. Sci. Technol. 40, 7682, 2006; Wang et al., Nature Geosci. 3, 238, 2010) and polymerization of aldehydes (Zhao et al., Geophys. Res. Lett. 32, L09802, 2005). Negligence of those processes may result in substantial under-estimation of SOA mass concentration in their simulations.

In the SOA module, we have included the contribution of glyoxal and methylglyoxal to the SOA formation, but the contribution of polymerization of aldehydes is not considered in the study, considering the acidity in the lower atmosphere. We have clarified in the manuscript in the Section 2: "*Recent studies have shown that small dicarbonyl compounds, such as glyoxal and methylglyoxal, may play a role in the SOA formation via aerosol uptake and cloud processing (e.g., Zhao et al., 2006; Wang et al., 2010). The contributions of glyoxal and methylglyoxal to the SOA formation are also included in the SOA module. The SOA formation from glyoxal and methylglyoxal is parameterized as a first-order irreversible uptake by aerosol particles, with a reactive uptake coefficient of* 3.7×10^{-3} *for glyoxal and methylglyoxal (Zhao et al., 2006; Volkamer et al., 2007). Li et al. (2011a) have shown that glyoxal and methylglyoxal can contribute up to approximately 10% of the observed SOA mass in the urban area of Mexico City. The polymerization of aldehydes also contributes to the SOA formation, depending on the acidity of aerosols in the atmosphere (Zhao et al., 2005). Zhao et al. (2005) have demonstrated that aldol condensation of the aldehydes can be important in the upper troposphere, but may not significantly contribute to secondary organic aerosol formation in the lower troposphere. Therefore, we have not considered the polymerization of aldehydes to the SOA formation in the SOA module, considering that we mainly focus on the SOA formation in the lower troposphere.*"

(2) Also, it is rather unclear how aerosol nucleation was accounted for in their aerosol module. In particular, was the role of organics included in the nucleation schedule (i.e., Zhang et al., Proc. Natl. Acad. Sci. USA, 106, 17650, 2009; Zhang et al., Chem. Rev. 112, 1957, 2012).

We have added a brief description about the nucleation parameterization in the present study as follows: "*The new particle production rate is calculated due to binary nucleation of* H_2SO_4 *and* H_2O *vapor. The nucleation rate is a parameterized function of temperature, relative humidity,*

and the vapor-phase H_2SO_4 concentration, following the work of Kulmala et al. (1998), and the new particles are assumed to be 2.0 nm diameter. However, recent studies have shown that organic vapor is involved in the nucleation process (Zhang et al., 2009; Zhang et al., 2012); further studies need to be performed to consider the contributions of organic vapors to the nucleation process."

(3) Their simulations indicated that GB could account for about 3–30% simulated PM2.5 mass, but it was unclear what categories that mass fraction belonged to. For example, other than PM chloride, that mass fraction contain mainly inorganics, organics, or soot?

We have clarified in the manuscript in the Section 3: "*About 65% of the enhanced $PM_{2.5}$ mass from GB is contributed by OA, in which the contributions from POA and SOA are 30% and 35%, respectively. The particulate chloride constitutes 10% of the enhancement of $PM_{2.5}$ mass from GB, greater than the contributions from black carbon (4%), sulfate (0%), nitrate (0.8%), and ammonium (5%) aerosols.*"