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Interactive comment on "Extreme haze pollution in Beijing during January 2013: chemical characteristics, formation mechanism and role of fog processing" *by* K. Huang et al.

Anonymous Referee #3

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The manuscript "Extreme haze pollution in Beijing during January 2013: chemical characteristics, formation mechanism and role of fog processing" by K. Huang et al. analyzed a severe pollution episode in Beijing during January 2013, based on Chinese API/AQI data, AERONET data and 15 PM2.5 samples. The monthly averages of pollutants are relatively high compared with those in previous years, which is mainly attributed to the abnormal meteorological conditions. Major aerosol species are found to have an exponential relationship with relative humidity. And aerosol in fog days is found to be more acidic. The topic is interesting. However, there are several major problems:

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1. There have been already a number of papers discussing about the haze in the North China Plain. Compared with the previous works, I see few new findings or insights in this manuscript.

2. The paper aims to investigate the characteristics and formation mechanism of the severe haze pollution event. Actually, without measurements of basic aerosol physical properties (e.g. number size distribution), I think the current data set is insufficient for such a purpose.

3. The information on the QC of the data set is missing in the manuscript. The quality of some data is doubtable. For example, in fig. 4(a), the high-frequency fluctuation in visibility and RH before 10th of January seems to be weird. Something must be wrong with the measurements. I do not think the data in this period can be used. I do not know if such problem also existed in other periods which were used for calculating the average.

4. There is no clear definition of fog and haze in the manuscript. It seems that the author mixed them together. The author even attributed the severe haze pollution to several fog events. According to the Kohler theory, fog clearly differs from haze. In haze, aerosol undergoes only hygroscopic growth; while in fog, aerosol is activated and grows freely. However, the definition of fog in meteorology is only based on RH and visibility. With high aerosol loading and RH, haze can also cause a visibility of hundreds meters, which might be classified as fog in weather reports. In this manuscript, "the role of fog processing" is discussed. I think the fog should be defined according to its microphysical properties rather than RH and visibility. I believe the "fog events" during the study period are mostly haze.

5. It is confusing whether the author wants to discuss one typical severe pollution event or the general condition in January 2013. Section 3.3-3.5 focus on one pollution event in January of 2013, however, the discussion in section 3.1 and 3.2 is based on the average conditions in January. Firstly, a period of one month might only include several

synoptic processes, which is too short for a good representative and to make comparisons between different years. Also, Chinese spring festival is in January in some years, which may cause a change of emissions and influence the monthly average. Secondly, I do not think one can prove a pollution event of 7 days (may be longer but not shown in the manuscript) to be "a historical pollution event" and stem from "abnormal meteorological conditions" based on the average data of the whole month of January. The monthly average mixes lasting time and pollution intensity together. A high average can be yielded from either a long-time light pollution event or a short-time severe pollution event. Concerning the title, I think it makes more sense to focus on one severe pollution event.

6. A lot of discussion is about aerosol hygroscopic growth and the impact of RH on visibility. There are a lot of studies about the relationships between the aerosol hygroscopicity and chemical composition, and the impact of aerosol hygroscopic growth on its optical properties, based on the in-situ measurements of aerosol hygroscopic growth factor (g(RH)) or scattering hygroscopic growth factor (f(RH)) in the North China Plain. The results of these studies are much more clear, specific and in-depth. However, it seems that the author did not notice those papers. Some description and discussion on this issue in the manuscript is therefore unconvincing or inappropriate.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 7517, 2014.

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