

**Reviewer:** *This manuscript investigated the regional haze occurred over the North China Plain, provided the reliable data and revealed the formation mechanism of this episode. I do think that this manuscript can be published in ACP with the minor revision.*

**Response:** Thanks a lot for Prof. Zhuang's confirmation of this job.

Some revisions are suggested as below:

**Reviewer:1)** *How the site of SDZ can be the background site? This needs to be clarified.*

Response: The SDZ station is one of GAW Regional Stations (Global Atmosphere Watch programme of the World Meteorological Organization) in China that has been authenticated by WMO (<http://gaw.empa.ch/gawsis/reports.asp?StationID=223>). There are no densely populated and industrial areas within a distance of 30 km around the station, so the atmospheric pollution level at SDZ station represents the background concentration of atmospheric pollutants in the economic developed regions of North China. The detailed information of this station was introduced in our previous study as following (Zhao et al., 2009):

Shangdianzi (SDZ) station is one of the regional Global Atmosphere Watch (GAW) stations in China. The station is located in the northern part of the North China Plain and in the Miyun County of Beijing, about 100 km and 55 km northeast of the urban area and the Miyun Township of Beijing, respectively (Fig. 1). Only sparsely populated small villages, and thus insignificant anthropogenic emission sources, lie within 30 km of the site. The station's instrument building is situated on the south slope of a hill surrounded by mountains in every direction except the southwest. Due to the valley topography, the prevailing winds at SDZ are from the east-northeast and the west-southwest. Polluted air masses from urban areas and satellite towns of Beijing can therefore be easily transported to SDZ by southwesterly winds, while relatively clean air masses arrive from other wind directions.

**Reviewer:2)** *At SDZ, the photochemical reaction, regional transport and heterogeneous reaction process probably together caused the increase of sulfate and nitrate." At this so-called background site, it seems there were no sufficient data to*

*support this conclusion. I do not think that it is needed to discuss this background site, if it can really be considered to be a “background site”.*

**Response:** As we mentioned in the response for question 1, SDZ is a regional background station and easily influenced by the pollutants transported from south urban area by southerly winds (Lin, et al., 2008; Zhao, et al, 2009; Meng, et al., 2009). The variation of NO<sub>2</sub> and O<sub>3</sub> showed the typical characteristic of photochemical process in the earlier stage of this haze. The sharply increase of pollutants (PM<sub>2.5</sub>, NO<sub>2</sub> and CO) and enhanced southerly winds (Fig.1) in the later stage indicated the role of regional transport. The increased NOR in this haze and similar variation characteristics of NO<sub>2</sub> and O<sub>3</sub> with that in BJ in the later period probably indicated the role of heterogeneous reaction process to some extent. However, it is need more data to demonstrate the impact of heterogeneous reaction process.

**Reviewer:** 3) *The weighing of filter does not indicate the condition of weighing, which required constant temperature and humidity, and this is tremendous important for the reliability of those data provided.*

**Response:** All of the filters were weighed with an analytical balance (Mettler XS105DU, reading precision 0.01mg). Before and after sampling, the filters were weighed after equilibrated for 24h in a desiccator. All the samples were stored in a refrigerator under 3 °C and analyzed for chemical species in less than a month.

**Reviewer:** 4) *Page 913, Line 17-19 , “Organic material (OM) was obtained by multiplying OC concentrations by a factor of 1.2, accounting for hydrogen and oxygen in the organic compounds: : .” The factor of 1.2 here seems lower than the real situation. If this can be corrected to be a more reliable number, the role of the OM in the formation of the haze can be seen more significantly.*

**Response:** As the real chemical composition of organic compounds in aerosols has been poorly identified, the factor used in this calculation is controversial, although the conversion factors of 1.2 or 1.4 are used in Beijing in the literature (sun et al., 2004; Duan et al., 2006). In our case if a factor of 1.4 is used, it will lead to the total mass balance to be over 100% for some samples. However, the role of OM in the formation of this haze was still evident with the factor of 1.2.

**Reviewer :** 5) *In general, the writing should focus on the “3.3 Chemical characteristics and secondary formation of this episode”, and section 3.1 can be combined in 3.4 section.*

**Response:** As Prof. Zhuang's said, section 3.3 is the most important part of this paper. We have given full analysis on the chemical characteristics and secondary formation of this episode in this section. In section 3.1, we introduced the meteorological background of this haze and the general variation of pollutants before, during and after this haze episode. This part gave the background information of this haze episode, and we think it would be better to introduce it in the first section of the results and discussion. The section 3.4 focused on the mechanism of accumulation and transport with analysis of vertical variations of meteorological elements and aerosols. This part is different from section 3.1. Thus, we think the original structure of this paper is better for reading.

**Reviewer:** 6) *The abstract seems too long and it can be shorten by one third. I tried to revised as below:*

*A regional haze episode occurred in the Beijing, Tianjin and Hebei province (BTH) area in the North China Plain (NCP) was investigated. The increase of secondary inorganic pollutants ( $SO_4^{2-}$ ,  $NO_3^-$ ,  $NH_4^+$ ) was observed simultaneously at four sites, especially in the plain area of BTH, which could be identified as a common characteristic of pollution haze in east China. The sulfate and nitrate in  $PM_{2.5}$  were mainly formed through the heterogeneous reaction process in the urban area. The fact of the organic matter (OM) increased more significantly at Chengde (CD) site than the other three sites in plain area suggested the greater regional impact during haze episode. The secondary formation of aerosol was one important formation mechanism of haze. The strong temperature inversion and descending air motions in the planetary boundary layer (PBL) allowed pollutants to accumulate in a shallow layer. The weak surface wind speed produced high pollutants concentration within these source regions. The accumulation of pollutants was one main factor in the haze formation. The enhanced southwest wind in the last period of this episode transported pollutants to the downwind area and expanded the regional scope of the haze.*

**Response:** Thanks a lot for Prof Zhuang's revision. The abstract will be rewritten as his suggestion in the revised version.

**Reviewer:** 7) *The saying in page 1 Line23 "The organic matter (OM) was different from secondary inorganic pollutants, which increased more significantly at Chengde (CD) site than the other three sites in plain area." can be revised as "The fact of the organic matter (OM) increased more significantly at Chengde (CD) site than the other three sites in plain area suggested the greater regional impact during haze episode".*

**Response:** We accepted this suggestion and will modify this sentence in the new version.

**Reviewer:** *Minor corrections: 1. Page 2. Page 08, Line 14 An Aerosol lidar (ALS300, EZ manufactured by Leosphere) has (here "has" should be deleted) was employed in this field campaign at SDZ.*

**Response:** The "has" will be deleted in the revise version.

*3. Page 14, Line 7 "However, the percentages were comparable at threes sites" Page 918, Line 13, "was comparable at threes sites", The word "threes", should be corrected to be "three".*

**Response:** The "threes" will be corrected to "three" in the revise version.