

Interactive comment on “Aerosol optical properties in a rural environment near the mega-city Guangzhou, China: implications for regional air pollution and radiative forcing” by R. M. Garland et al.

R. M. Garland et al.

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We would like to thank Referee 2 for their careful reading of the manuscript and for their thoughtful comments. We have addressed their comments below; their original reviews are in italics with our responses following.

1) *Strong justification on how and why only one rural site can be representative of PRD regional scale aerosol optical properties is needed. Apparently, even in the summer time when the aerosol loading is relatively low, contributions from local biomass burning source and diesel soot from truck traffic were significant. Was there any additional to support the claim that measurement from this site would be suitable site for a re-*

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gional background site? What exactly is the zone of representation of this regional background site?

In this campaign, the Backgarden site was chosen by local organizers as the non-urban background site as opposed to the urban downtown site in Guangzhou city. The purpose of this campaign was to measure the air masses as they came off of the South China Sea, over Guangzhou and the PRD region in general, and finally measured at Backgarden. During the summer, when this campaign was held, the winds were generally from the south/southeast. Thus, the Backgarden site, which was NW of Guangzhou, was geographically ideally situated as a receptor site and, as a rural farming town, was ideal due to its minimal local sources. As described in the manuscript, we did have an episode of intense local biomass burning, but this has been treated separately.

PRIDE-PRD2006 was a complementary study to PRIDE-PRD2004. The latter study was held in October 2004. During the autumn, the PRD has mostly north/northeasterly winds which transport in continental pollution to the region. Thus, as seen in Table 2 of the manuscript, the aerosol optical properties were different for these two seasons. Together, these campaigns help to characterize the air pollution in the Pearl River Delta, an area that is ever-growing economically as well as in industrialization and population and on its negative impact to the environment.

This and further information is included in the revised Introduction, Methods and throughout the Results and Discussion section (Specifically, Sections 1, 2.1, 3.1.3 and 3.3).

Additionally, we did not mean to imply that this site is truly representative of the full region. To avoid any further confusion we will replace the term “regional background site” by the term “rural site” throughout the revised manuscript.

2) *As this paper also recommends daytime average single scattering albedo value (0.87) for climate modeling purposes, it may be an indicative value for summer when*

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the aerosol loading is typically low. Nevertheless, the question is how representative are the optical properties measurement at this site, including the single scattering albedo value, if winter high aerosol loading effect and seasonal effects were not included or determined. In other words, why pick summer to perform optical properties measurement instead of winter when typically more serious air pollution problem would occur.

We think that the summer is a good time to measure the evolution of PRD regional pollution as the air masses generally come from over the sea and then move over the PRD region to the measurement site. Additionally, one of the goals of this study was to complement the 2004 study when the PRD region had mostly north/northeast winds. This is discussed now at the end of the Introduction and in the Methods Section (Sections 1 & 2.1). Additionally, no other detailed study of this region has been performed at this time of year. And, while aerosol loadings may be lower in the PRD in summer, they are still comparable to urban areas elsewhere.

3) Despite the comments presented above, the paper does address relevant scientific questions within the scope of ACP and the paper also present novel concepts in illustrating aerosol properties and its relationship with common air pollutants.

4) The data, without strong support in terms of regional representation, are relatively weak to support rigorous interpretations and conclusions. Specifically, the discussions and analyses on implications for regional air pollution need significant elaboration in order to reflect the title of the manuscript.

We did not intend to fully characterize the regional pollution of the PRD, which is obviously not possible by a single one-month field campaign at one measurement site. Nevertheless, we are confident that our measurements do provide insight into the nature and sources of regional air pollution in the PRD during the measurement period and season as explained in the following sections:

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- Sections 1 and 2.1; The air masses that were measured generally passed over the PRD region before arriving at the measurement site
- Section 3.1; The extensive and intensive optical properties are similar to urban areas even though the measurement site was rural.
- Section 3.2; The diurnal cycle is consistent with strong regional nighttime emissions of absorbing aerosol particles
- Section 3.3; The pollution level is not related to local wind direction, thus the measurements are not dominated by local sources.
- Section 3.4.1; The mass scattering efficiency is similar to urban areas elsewhere

Typos/clarification

1. *Line 12, page 6865, Bergin et al reported a value 2.3-3.6 m² g⁻¹ (PM₁₀) for Beijing aerosol; however, in Table 2, the inlet cited is TSP for the Beijing aerosol. The Bergin et al 2001 paper again was cited. Please clarify if the aerosol is PM₁₀ or TSP.*

In the Bergin et al. (2001) the size cut-off for the scattering is not specified; there is no mention of an impactor, so we assumed that the inlet was TSP. However, the paper clearly states that the mass scattering efficiency was for PM₁₀. Table 2 in our manuscript will be changed accordingly.

2. *Lines 18 & 19, page 6872, Most of the parameters measured and calculated for this site are similar to those of urban areas, confirming . . . ; As indicated in the title and the main text, the measurement for the present study was conducted in a rural regional background site, how come the parameters measured and calculated for this rural site are similar to those of urban areas. Clarification is needed.*

We did not mean to imply that the measurement site would be a “clean background site”, and to avoid any further confusion, we will remove the term “background site” from

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the revised manuscript. The site itself was very rural (farming environment); however, as seen in Figure 1 of the manuscript, it was on the edge of the highly populated and industrialized PRD region.

We also find it a very interesting result that a rural site could have such high pollution levels, and we believe this demonstrates the regional nature of air pollution in the PRD. A better description of the site and motivation has been added in the Introduction and Methods sections (Sections 1 and 2.1).

Reference

Bergin, M. H., Cass, G. R., Xu, J., Fang, C., Zeng, L. M., Yu, T., Salmon, L. G., Kiang, C. S., Tang, X. Y., Zhang, Y. H. and Chameides, W. L.: Aerosol radiative, physical, and chemical properties in Beijing during June 1999, *Journal of Geophysical Research-Atmospheres* 106, 17969-17980 (2001).

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