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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Study on the atmospheric boundary layer and its influence on regional air quality over the Pearl River delta" *by* M. Wu et al.

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We would like to thank Referee 2 for your careful reading of our manuscript and for your valuable and constructive comments. We have addressed the comments below.

Comment:

Boundary layer meteorology plays very important roles on air quality. In the Pearl River delta, many previous studies already reported the linkage between PBL meteorology and air pollution. However, most of these works are based on numerical modeling and limited surface measurement. There is a still a knowledge gap in

the vertical structure of the PBL for typical air pollution episodes in this region. This study presents some results from two intensive campaigns carried out during PRIDE-PRD2004/2006.Generally speaking, the measurement results are very valuable for the community. However, an in-depth analysis and a significant improvement of presentation are needed before it can be accepted for publication on Atmos. Chem. Phys.

Response:

From the data analysis of PRIDE-PRD 2004 and PRIDE-PRD 2006, respectively, it is found that the high-level concentrations of air pollutants usually occur in autumn and winter over PRD, the surface high-pressure system (anti-cyclone), descent motion outside of hurricane and sea breeze would result in the high-level concentrations (Fan et al.2008, Fan et al.2011).

In this paper, we tried to make full use of the observation data from PRIDE-PRD2004/2006, analyzed all the measurements data of 2004 and 2006 comprehensively, focused on the influence of boundary layer meteorology (BLM) on regional air quality. In addition to the traditional analysis method, we introduce three new BLM analysis tools as balloon trajectory distribution(BTD), Recirculation factor (RF) and Ventilation index(VI) to detail analysis two typical polluted cases (affected by the warmed period before cold front (WPBCF) and the subsidence period controlled by tropical cyclone (SPCTC), respectively) and one clean case (not-polluted). It were found that BTD, RF, VI were quite different between polluted cases and the clean case. RF and VI are good reference index for pollution judgment. At the end, we summarize the typical structure of BLM causing high air pollution over PRD in different weather conditions.

PRIDE-PRD2004/2006 intensive campaign had spent a lot amount of manpower and resources. We tried to make full use of these observation data, although it still having many unclear places about the ABL vertical structure of typical air pollution episodes in PRD, the results present in this paper is valuable.

Comment:

ACPD

13, C3786–C3790, 2013

1) The experiments were conducted for the two months in 2004 and 2006, but the authors mainly focused on three typical 1-day cases. Of course, it is important to compare the meteorology for three days. However, it is also important to discuss the evolution of each case, i.e. pre-episode, episode, and/or post-episode days. That kind of comparative study will provide more solid conclusion for the control mechanisms and processes for these pollution episodes.

Response:

We agree with you.

From the data analysis of PRIDE-PRD 2004 and PRIDE-PRD 2006, respectively, it was found that the surface high-pressure system (anti-cyclone), descent motion outside of hurricane and sea breeze would result in the high-level concentrations (Fan et al.2008, Fan et al.2011).

During this study, we had divided PRIDE-PRD 2004/2006 observation sessions into several cases, and summarized the weather conditions into different kinds, chosen three typical cases to detail analysis. Each case includes several pollution days and clean days. We have analyzed the evolution of each case (pre-episode, episode, post-episode days), but only showed three days data in our paper. We have revised and improved the statements in revision paper, and added the description of each case's evolution.

Comment:

2) Section 4 is supposed to present "results and discussion". We do see a lot of description of "results", but less "discussions". Discussions should be made to compare with other researchers founding from both modeling and measurement works. Unfortunate, we almost cannot find a reference cited in the entire section 4.The"discussion" part needs to be significantly strengthened by linking the findings with previous findings and discussing any agreed/disagreed conclusions.

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13, C3786–C3790, 2013

Response:

Thanks for your advice. We had added some relevant discussions in the section 4 in revision paper.

Comment:

3) The schematic charts in Fig.9 are far beyond what the data showed and what the analysis presented. For example, Fig.2 clearly shows that the two periods were under totally different synoptic background wind i.e. south vs. north. How the synoptic wind can affect the diurnal cycle of PBL and air pollution dispersion? Were there any evidences showing strong subsidence of the second case?

Response:

Based on the geographical circumstance, climate and the boundary layer meteorology features of PRD, Fan had built a boundary layer concept model of PRD (Fan et al, 2007).

The schematic charts in Fig.9 is the improved of the PRD boundary layer concept model, and showed the total results about the boundary layer vertical condition comprehensively. In Fig.9a, the "warm air" and "cold air" were just used to express the background weather condition: the warmed period before cold front (WPBCF). Fig.9b expressed the subsidence background weather condition: the subsidence period controlled by tropical cyclone (SPCTC). And the subsidence was inferred from weather chart and theory of tropical cyclone. The influence of background weather condition to local circulation didn't be showed in these figures. We had added some discussion in this paragraph in revision paper.

Minor comments:

1) The markers of wind vector in up left hand of Figure 2 and Figure 4(N 5m/s): should them be in south direction(S 5m/s)?

ACPD

13, C3786–C3790, 2013

Response:

These marker of wind vector showed the arrow pointed north.

Minor comments:

2) Figure 3: What is the data source of wind field? Observation or modeling?

Response:

Figure 3 was plotted by interpolated from 27 automatic meteorological stations observation data of PRD. Some sentences have been added in P9 to state the source of data.

Minor comments:

3) Figure 1: please show the urban area as the authors tried to discuss the urban heat-island circulation.

Response

Another figure which showed urban area has been added in Figure 1.

References:

1. Fan S. J., et al., Atmospheric boundary layer characteristics over the Pearl River Delta, China, during the summer of 2006: measurement and model results, Atmos. Chem. Phys., 2011, 11(13), 6297–6310

2. Fan S. J., et al., Meteorological conditions and structures of atmospheric boundary layer in October 2004 over Pearl River Delta area, Atmospheric Environment, 2008, 42(25), 6174-6186

3. Fan S. J., et al., Atmospheric boundary layer concept model of the Pearl River Delta and its application, Journal of Tropical Meteorology,2007 ,143(1):8-13

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