

***Interactive comment on “Process analysis and sensitivity study of regional ozone formation over the Pearl River Delta, China, during the PRIDE-PRD2004 campaign using the CMAQ model” by X. Wang et al.***

**Anonymous Referee #1**

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The article investigates, with a 3-D air quality modeling system, ozone pollution events in the Pearl River Delta region. Data of a one-month field campaign are used either for initializing the model for the meteorological fields or for evaluation of the modeling system's performance. Three evolution patterns of elevated ozone are distinguished depending on differing near-ground flow conditions. An integrated process rate analysis is applied to determine the main contributors to the elevated ozone levels. The article investigates the interactions between precursor emissions, transport and ozone photochemical production. In addition, sensitivity studies reveal areas within the Pearl

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River Delta, which are either VOC- or NO<sub>x</sub>-limited.

This paper fits into the scope of ACP. It deals with the modeling of tropospheric ozone pollution, including precursor emissions, transport, gas-phase chemistry, and the meteorological conditions over the greater region of the Pearl River Delta, one of the regions in south-east Asia with very bad air quality. Investigating in detail the underlying mechanisms is not only of regional, but also of general interest. The integrated process analysis and the sensitivity study with either reduced VOC or NO<sub>x</sub> are the strong points of the paper, together with the use of observational data of a comprehensive one-month field campaign. The results are presented in a clear and well structured way. I recommend publication in Atmospheric Chemistry and Physics after consideration of the following comments.

Specific comments

In the introduction I am missing some references to studies for comparable Mega-cities or regions. Are there comparable studies, what was investigated and found?

In section 2.1, model setup and inputs, the authors mention that observations in the ABL during PRIDE-PRD2004 were used to prepare the initial and boundary conditions for the MM5 meteorological simulations. Later on, in section 3.1, evaluation of model performance, it is stated that simulated surface meteorological fields are examined against surface hourly observations made during the field campaign. Could the authors clarify which observations were used as model input, which ones for evaluation?

In section 2.2, model evaluation protocol, the monitoring network is described, and in particular the measurement techniques for NMHC. However, I am missing some description or reference for the NO<sub>2</sub> observations, which are discussed in section 3.1 and in Figure 4.

In section 2.5, ozone sensitivity testing, it is described that the emissions of VOCs and NO<sub>x</sub>, respectively, were reduced by 25%. Are these reductions linear over all emission

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sources, or have some been more reduced, some less?

In section 3.1, evaluation of model performance, the authors describe the evaluation statistics for simulated ozone concentrations. Is it possible to give similar statistics for NO<sub>x</sub> and NMHCs or to include them in Table 3?

In section 3.3, process analysis of ozone formation, the authors explain that their process analysis focuses mainly on the ABL. However, it would be interesting if there are also informations about possible impacts of entrainment of precursors (or even ozone) from the free troposphere, or long-range transport of precursor emissions during the measurement campaign in October 2004.

At the end of section 3.4, ozone production efficiency, the values found for OPE over the PRD are also compared to values found for Beijing, US cities and the Mexico City Metropolitan Area. However, for the latter two no values are given, only for Beijing. Numbers for the other two cases would be interesting.

Technical corrections

Page 26837, line 13: '... modeling studies have rarely been performed ...' Are there or not? If yes, then please cite at least one.

Page 26839, line 18: Please give a reference for BEIS 3.09

Page 26842, line 5: 'chemical process'. This term appears in the following several times (also in Figure captions), however, I find it a bit confusing as it sounds like a specific chemical process (however, not nearer specified). I suppose the authors refer to the gas-phase chemistry (CHEM) of their integrated process analysis. It would read better to replace 'chemical process' by 'gas-phase chemistry'.

Page 26847, lines 1-2: Would read better written as: At the rural Xinken site, vertical transport contributed mainly to the ozone levels and was then decreased on a similar magnitude by horizontal transport during the daytime (Fig. 8b).

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Page 26848, line 24: '... busy harbors are located ...'

Page 26849, line 26: '... on the other two days.' From the text alone, it is not clear which days (21/22, or 15/16 October)?

Page 26852, lines 14/15: The description of Figure 16 is a bit confusing when reading the graph from the perspective 'as a function of the NO<sub>x</sub>/NO<sub>y</sub> ratio'. It would read better like: '... the percentage change in P(O<sub>x</sub>) tends to decrease from about 30% to -30% with increasing NO<sub>x</sub>/NO<sub>y</sub> ratio, whereas an increasing tendency ...'

Page 26853, line 14: new sentence after '... horizontal outflow.'

Page 26862, caption Table 3: Please include a brief explanation what NMB and NME stand for.

Page 26863, caption Table 4: Could the three evolution pattern categories named? Or include anything like 'refer to text for category explanation' in the caption.

Page 26867, Figure 3: Is it possible to enlarge the figure for better readability?

Page 26875, Figure 11: Is it possible to enlarge the legend text for better readability?

Page 26876, Figure 12: Is it possible to enlarge the legend text and titles of the figures for better readability?

Page 26878, caption Figure 14: There should be a reference to the corresponding text to explain what the ellipses are marking.

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