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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Introduction to Special Issue – In-depth study of air pollution sources and processes within Beijing and its surrounding region (APHH-Beijing)" *by* Zongbo Shi et al.

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Response to reviewer comments:

General response:

We thank both reviewers for providing constructive comments.

We have carefully considered every single comment and revised the manuscript accordingly. We also provided a point by point response to all the comments made below.

One point we would like to make is that this is an Introduction to special issue paper, not an overview or research paper. ACP editorial policy states that "Special issues may

include an introduction article or an overview article or both. Introduction articles outline the motivation and background, and overview articles synthesize and summarize the findings of the special issue papers. The manuscript title must clearly reflect the relation to the special issue and should start with "Introduction:" or "Overview".

To make this clearer, we have added a paragraph at the end of the introduction.

"This introduction paper describes the motivation and background of APHH-Beijing programme, and presents some of the background air quality and meteorology observations that lay the basis of data interpretation for the whole programme, particularly during the two intensive field campaigns. These campaigns form one of the core research activities within APHH-Beijing integrating the different themes / projects. We did not intend to present the key scientific results of APHH-Beijing here as much of the research activities are still ongoing and unpublished. Such information is more suitable to go to an overview paper."

We also would like to emphasize that scientific work on the impact of synoptic scale meteorology on air quality and the air quality climatology add significant knowledge to our understanding of air pollution events in Beijing. Therefore, this introduction paper not only provides the motivation and background of the APHH-Beijing programme but also new science.

Many of the ACP special issues have introduction papers, such as:

Kulmala, M. et al., 2009. Introduction: European Integrated Project on Aerosol Cloud Climate and Air Quality interactions (EUCAARI) – integrating aerosol research from nano to global scales. Atmos. Chem. Phys., 9, 2825–2841. Cairo, F., et al., 2010. An introduction to the SCOUT-AMMA stratospheric aircraft, balloons and sondes campaign inWest Africa, August 2006: rationale and roadmap. Atmos. Chem. Phys., 10, 2237–2256 Kruger, K and Quack, B., 2013. Introduction to special issue: the TransBrom Sonne expedition in the tropical West Pacific. Atmos. Chem. Phys., 13, 9439–9446 Kulmala, M. et al., 2015. Introduction: The Pan-Eurasian Experiment (PEEX) –

multidisciplinary, multiscale and multicomponent research and capacity-building initiative. Atmos. Chem. Phys., 15, 13085–13096 Martin, S.T. et al., 2016. Introduction: Observations and Modeling of the Green Ocean Amazon (GoAmazon2014/5). Atmos. Chem. Phys., 16, 4785–4797.

Reviewer 2:

Comment 1: However, to be qualiïňĄed as an ACP research article, the authors need to provide more sciences in the manuscript, as suggested below.

Response: This is not a research article but an introduction paper. Please see the general response above.

Comment 2: There have been many ïňĄeld campaigns, e.g., CAREBeijing, organized in the past 10 years targeted on investigating the air pollution and its health impact in Beijing. Compared with all those previous studies, what is unique about the current project? What are the scientiïňĄc challenges this project aims to solve? Response: Please see response to comment 1 by reviewer 1. APHH-Beijing is unique in that it is an integrated programme quantifying emissions of air pollutants using bottom-up, tower-based flux and satellite measurements, apportioning sources of particulate matter by multiple receptor models and hybrid receptor-chemical transport models, understanding atmospheric processes leading to pollution events via a coordinated measurements of physics and chemistry, and quantifying the health effects to individuals through personal exposure and health indicator / novel metabolomics measurements. APHH-Beijing integrates strengths in atmospheric sciences the UK with emerging research capabilities in China. In the newly added summary, we also highlighted the novel aspects of APHH-Beijing programme. Please also see response to reviewer comment 1.

Comment 3: There are four research themes presented: sources and emissions, atmospheric processes, health effects, and solutions. The last two only appeared in the very ïňĄrst part of the manuscript, no scientiïňĄc output can be found later on. To

make this manuscript completer and more consistent, primary results related to the health impacts need to be given.

Response: This is an introductory paper designed to set the scene rather than to give the conclusions of the study. Consequently, we feel that it would be inappropriate to report results from the health impacts studies which have yet to be subjected to peer review of their findings. It is our intention to write an overview paper towards the end of the APHH-Beijing programme where we will summerize the outcomes of the whole programme.

Comment 4: One focus of this manuscript is the overview of two joint ïňĄeld campaigns. Indeed, there are lots of discussions regarding the site information and type of instruments, but these discussions are not necessarily useful, as any future publications related to these two campaigns would have to give similar descriptions in their methods section anyway. Instead, this manuscript could be a nice platform for a detailed instrument calibration and comparison, data analysis and uncertainty quantiïňĄcation, and so on.

Response: One of the reasons why we have provided detailed site information is exactly to avoid every single paper to have a long paragraph describing exactly the same information. All further papers can refer to this paper for site information.

The list of instruments are very important part of the introduction paper as this gives readers an overview (big picture) of what is being measured within APHH-Beijing and see immediately if they might be able to find a particular type of data that they are interested in. Most single projects will make some particular type of measurements, but the APHH-Beijing programme made many complementary measurements.

We feel that instrument calibration is a routine work by each research group and this is too detailed for an introduction paper. Instead, such information should go to individual papers.

We take intercomparison extremely seriously within APHH-Beijing, particularly for those species that are still hard to measure, such as HONO. It is our intention that such highly specialized subjects will be published in individual papers rather than in this introduction paper. For example, an intercomparison HONO dataset has been generated for the whole APHH-Beijing programme to use, including both modelling and measurement scientists.

Data analysis and uncertainty quantification are highly complex in particularly when we are considering hundreds of species are being made. It is impractical to include such detailed information within an introduction paper.

Comment 5: The last two sections describe the air quality, e.g., the average concentrations and diurnal patterns of common air pollutants like NOx, O3, PM2.5, and etc., during the two ïňĄeld campaigns. As the authors highlighted earlier that regional modeling is an essential part of the campaigns, a modeling vs. observation comparison in terms of temporal proïňĄles of these common pollutants need to be provided. Response: We highly value this constructive comment and have added section 7 to address this comment. We also added two paragraphs:

“Air quality modelling is a key aspect of APHH-Beijing. This involves multiple models from regional (e.g., WRF-Chem, UKCA, NAQPMS) to urban (e.g., CMAQ) and to street scales (ADMS). This section aims to provide an example comparison of model simulated pollutant concentrations against APHH-Beijing measurements made at IAP (Figure 16) to demonstrate model capabilities. Specific modelling work will be published in the special issue.

Figure 16 shows that the magnitude and variation of wintertime PM2.5 concentrations are reproduced very well by NAQPMS during November, although there are some weakness in capturing the highest PM2.5 levels during the haze events at the end of November and start of December. This is partly due to the representation of local meteorological features during this period, and PM2.5 concentrations during the major

haze episode on 4 December are much more similar to those measured at Pinggu than at IAP (see Figure 2). The diurnal variations in O3 during the summertime are reproduced relatively well by UKCA, which captures the rapid daytime formation of O3 and strong nighttime removal. The very highest levels of daytime O3 are underestimated with the model, particularly during the episode at the end of May. However, there is a strong local contribution to this as evident from the lower concentrations measured at Pinggu, and these local differences are not fully resolved with the model. Despite this, the day-on-day build-up of daytime O3 during the periods of 22-27 May and 11-16 June is captured well, and demonstrates that the model reproduces the synoptic drivers of local O3 formation well.”

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