

Interactive comment on “Biogenic isoprene and implications for oxidant levels in Beijing during the 2008 Olympic Games” by C.-C. Chang et al.

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Interactive comment on “Biogenic isoprene and implications for oxidant levels in Beijing during the 2008 Olympic Games” et al. Anonymous Referee #2

Overall Comments: I recommend rejecting this paper for publication in ACP because it does not provide any new insights into ozone production in Beijing. The paper provides an overview of NMHCs during the CAREBeijing-2008 campaign, but the subsequent analysis is very weak. I suggest that the authors attempt to reproduce the observations, i.e. the difference in ozone in summer 2006 versus summer 2008, using a regional photochemical model. This may offer them the opportunity to test their proposed mechanisms. As written, the paper only provides a summary of possible mechanisms

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for the observations. No effort is made to rule out various hypotheses. It would also be interesting to look at the observations from 2006 and 2008 in the context of any longer term measurements of ozone from PKU.

Reply:

We thank the referee for offering his/her viewpoints. However, we disagree that this study provides no new insights into ozone production in Beijing. We hope that the referee can compare the existing papers in the literature with our manuscript to find the novelties in this study. Possible impacts that can be brought upon by our work include impact of isoprene on OH reactivity, secondary pollutant formation, validation and modification of isoprene inventory in the regional photochemical models, etc. This work is meant to accentuate the role of biogenic isoprene in a megacity such as Beijing at the time when anthropogenic VOC sources are largely curbed during the Olympic period. The novelties and new insights of this study are as follows:

1. This study is aimed at providing a clearer understanding of the role of biogenic isoprene among numerous NMHCs, which are mostly anthropogenic, in affecting oxidant levels during the Olympic period when emissions of anthropogenic sources were strictly controlled. We analyzed over 700 hourly data points for 65 speciated NMHCs, CO, NO, NO₂, NO_y and O₃, as well as the meteorological parameters for the period from August 1- August 30, 2008 when the anthropogenic precursors of ozone were stringently controlled (the CAREBeijing-2008 campaign). To draw a contrast, the data (over 600 hourly data points) observed at the same site during the CAREBeijing-2006 summer campaign when there were no control measures are compared.

2. In the study we describe the diurnal characteristics of both biogenic and anthropogenic sources contributing to atmospheric isoprene and also analyze the differences between the controlled and non-controlled periods for anthropogenic sources (Fig. 3). One remarkable finding is that the biogenic isoprene overwhelmed the anthropogenic isoprene during the midday hours. The midday surge of biogenic isoprene could incur

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a much larger loss and more effective production of midday ozone and secondary pollutants than other time periods of a day due to the concurrence of the midday peak of isoprene with the peak of OH radical formation. The diurnal characteristics and sources of isoprene are pivotal for assessing potential impacts on atmospheric chemistry, OH reactivities and secondary pollutant formation, and for validating and modifying isoprene's inventory in regional photochemical modeling.

3. By comparing the sources of isoprene for the CAREBeijing-2008 campaign with those for the CAREBeijing-2006 campaign, we found that the contribution of anthropogenic sources during the period of CAREBeijing-2008 was much lower than that during CAREBeijing-2006 as expected, due to strict emission controls on anthropogenic sources occurred during the period of CAREBeijing-2008. In contrast to the anthropogenic isoprene, the biogenic isoprene was not affected by control measures during CAREBeijing-2008. The role of biogenic isoprene was accentuated as a result. During this period, isoprene accounted for 33% the total 65 VOCs' reactivity during the daytime and reached as much as 40-50% of the total reactivity during midday and early afternoon, which is remarkably large and poses a great challenge from the control point of view.

4. In addition to integrating possible interpretations proposed by other research groups for the discrepancy between decreased precursor levels and the observed high ozone in Beijing during the Olympics period, we intent to draw attention to the role of biogenic isoprene which has never been thoroughly discussed and quantitatively assessed for the period of 2008 Olympics in the literature. Although anthropogenic precursors were greatly reduced during the Olympic Games, the presence of sufficient biogenic isoprene and moderate levels of NO_x in conditions of high radiation flux and temperatures during midday hours can still have a significant contribution to midday and early afternoon O₃. The results indicate that the influence of biogenic isoprene and the non-linearity of O₃-VOC-NO_x chemistry (details described in the Section 3.3) should be other significant concerns in terms of ozone abatement strategy.

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Specific Comments (Mainly Grammatical Comments): There are a number of poorly written sentences in the manuscript. Page 25941, lines 19-25: “up to” is confusing when no timescale is given for the comparison Reply: We have revised it.

Page 25942, lines 6: replace “proposals” with “hypotheses” Reply: We have corrected it.

Page 25942, line 7: replace “were published” with “have been published” Reply: We have corrected it.

Page 25942, lines 18-20: error in sentence, perhaps remove “large amounts of” from sentence Reply: We have corrected it.

Page 25945, second 2.1.3: Brief description of ozone and CO measurements is needed or it would also be OK to add an appropriate reference. Reply: We have revised it and added references. Thanks for the comment.

Page 25946, line 25: Replace “In the study” with a specific reference to Wang et al, (2013) if this is appropriate. Reply: “In the study” denotes the study in Beijing, not the study of Wang et al (2013). We have revised it to avoid confusion.

Page 25947, lines 14-15: Discuss this earlier in the manuscript. Reply: We have moved it to “Methodology” section. Thanks for the comment.

Page 25950, lines 10-12: Sentence is missing a word – grammar is strange. Reply: We have corrected it.

Page 25951, lines 21-24: Why is this surprising? Reply: It is not an appropriate word. We have corrected it.

Page 25954, lines 26-28: The concept here is confusing and I don’t understand the logic. Reply: We have revised it to avoid confusion and also to make our point clearer. Thanks for the comment.

Page 25955, lines 13-14: Grammar issue in this sentence. Reply: We have revised it.

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Figure 4: This figure could be improved by using a log scale on the y-axis. Effort should also be made to make this figure as large as possible to improve readability.
Reply: This figure aims to show which species are the most abundant species and the difference in their concentrations between daytime and nighttime. It would be less effective in the purpose if we use a log scale instead.

Figure 5: Effort should be made to compare this data to 2006 in another set of panels.
Reply: We will consider adding new panels in Figure 5. Thanks for the comment.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 25939, 2013.

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