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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Exposure-plant response of ambient ozone over the tropical Indian region" *by* S. Roy et al.

S. Roy et al.

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2) Specific comments: (i) How site-specific the authors believe the results of the CTM-testing are? For instance, the model was tested for the Pune site - which is quite far south from the Indo-Gangetic plain where the ’hot-spots’ of AOT40 were identified. How confident could one be that results of model performance can be extrapolated to other sites with different emissions and environment? Please, consider that for discussion.

Answer: We greatly appreciate referee’s advice to include a discussion on this important aspect which we missed earlier but now added in the paper as desired. The model has been validated earlier in detail with observed distribution of chemical species including ozone (from where AOT40 is derived) over the geographical region of India during the year 2003 [Roy et al., JGR, 2008]. This reference is now cited in the

revised version. In the cited paper, we have compared model results of ozone with the results of 4 different observational stations spread over India. In addition, the meteorological as well as trace gas data obtained by satellite measurements are compared with model data for whole of the Indian geographical region. We have shown in Roy et al. (2008) that model is able to capture the seasonal and geographical gradient in ozone over India and the higher values of ozone over Indo-Gangetic plain region are clearly distinct wrt the remaining parts of India in model results. The detailed scientific interpretations for such a gradient in IGP region for all the seasons are discussed by us earlier (Beig and Ali, 2006). Although there are quite a few measurements of ozone reported from India, none of them have reported the AOT40 assessment. Such kind of calculation requires data in much more detailed form than reported by them and we do not have access to any of them in such a detail and hence could perform the AOT40 calculations using observations only for Pune. However, we are confident that model performance at Pune wrt AOT40 can be extrapolated to other sites with different meteorological environment and emission scenario like over the Indo-Gangetic plains where the emission hotspots have been identified as model is able to capture the distinct features in ozone distribution as discussed above. However in general, uncertainties can still exist due to the emission inputs and the uncertainty in the simulated (absolute) concentrations due to uncertainties in emissions is difficult to estimate, but is likely to be less then 2–5% [Beig and Brasseur, 2006]. All the above discussion is now added in the revised paper.

(ii) Please, discuss the possible reasons that could cause the observed systematic underestimation in AOT40 (roughly 35%, Figure 1) during the periods of highest ozone concentration (December to March). How important is the model limited ability to capture ozone peaks in this context (Fig 2c)? Similar to the question in item 2i, how would these limitations affect assessments in the other sites?

Answer: Again thanks for advising us to include the discussion of such an important issue in the paper which is now added. The observational site is located at the north-

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western parts of the Pune city (18.54 N, 73.81E) which is a well industrialized semi urban city of India. Most of the industries are situated towards the north eastern and eastern side around 20-25 km away. Since the wind pattern is predominantly north-easterly during the said period so the pollutants emitted from these industries can affect the ozone chemistry at the receptor site. Since the model has been fed with monthly emissions on a 0.5*0.5 degree resolution, these local emission effects have not been incorporated as emission inputs to the model. This may have led to the observed systematic underestimation in AOT40 during the periods of highest ozone concentration (December to March). So there may be an underestimation or over estimation of AOT40 values depending on how much a particular site is affected by local emissions not captured by the model due to coarser resolution. However, we wish to mention here that the ozone distribution over the IGP region, where hotspots are noticed, is largely controlled by the synoptic weather conditions and prevailing dynamics which are very well accounted in the model (Beig and Ali, 2006; Roy et al., 2008) as compared to local emissions and hence uncertainty on these hotspot regions are likely to be much less than Pune region.

(iii) Suggestion: Figure 3 shows three individual months around monsoon but is currently not showing periods with the highest AOT40 sums. Would it not be more illustrative to show maps with selected 3-month AOT40 sums (as used for yield-damage assessment) including months between December to March?

Answer: The maps with selected 3-month AOT40 sums including months between December to March has been added in the paper as advised.

3) Technical corrections/suggestions: (i) In Figure 3 please consider using an identical color palette to all graphs (same color and scale) to facilitate comparison among months.

Answer: As per the reviewer’s suggestion, Figure 3 has been updated with identical color palette to all the graphs with same color and scale.

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(ii) Please, include lat/long coordinates when first referring to the site used for model testing. You may also include it as a point in Figure 3.

Answer: The lat/long coordinates of the chosen site Pune has been included in the paper on first reference to the site.

(iii) When referring to Rabi (line 13; pg 4146) and Kharif (line 6; pg 4148) growing seasons please briefly clarify the meaning (period of the year, e.g. from month x to month y and the type of crops). This short explanation will help the reader to understand the context and importance of referring to these periods.

Answer: As per the referee’s suggestion, a short explanation of the Rabi and Kharif crop growing seasons has been added to the paper in relevant place.

(iv) Figure labels: Change ppb*h for ppb h

Answer: The figure labels have been changed from ppb*h to ppb h according to the reviewer’s suggestion.

(v) In y-axes labels of figures, specify the period for variable calculation, as for example (please check if units are correct): - Fig 1. Monthly AOT40 sum (ppb h) - Fig 2a: Daily AOT40 sum (ppb h) - Fig 2b: Daily average ozone (ppb) - Fig 2c: Daily maximum ozone (ppb) This will help the reader compare graphs with different calculation time steps.

Answer: The y-axes labels of the figures has been changed specifying the period for variable calculation as per the reviewers suggestion.

(vi) Horizontal lines marking thresholds in graph 2 could also include the 40 ppb h for vegetation protection as it was frequently referred in the text.

Answer: The 40 ppb h threshold for vegetation protection which has been frequently referred in the text corresponds to an hour. Since the figures in graph 2 shows daily AOT40 sum, daily 8 h average ozone and daily maximum ozone respectively, so horizontal line for the 40 ppb h threshold cannot be incorporated in these figures.

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Interactive Comment

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 4141, 2009.

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