

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

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The present paper "Exposure-plant response of ambient ozone over the tropical Indian region" by Roy et al., presents the study related to the distribution of the exposure plant response index AOT40 over the Indian tropical region.

The idea behind the paper is very innovative and discusses the one of the major issue over India whose economy depends on agriculture. However the work presented in this paper is not clear in many contexts.

I do not have many comments as the former reviewers have already addressed them. I would like to add some more comments.

Comment related to the calculation of AOT40.

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The European CLs to protect vegetation against the adverse effects of O₃ are expressed as an Accumulated exposure Over a Threshold of 40 ppb (AOT40). This index is calculated as the sum of differences between the hourly O₃ concentrations >40 and 40 ppb, for each daylight hour with global radiation $\geq 50 \text{ Wm}^{-2}$ during the growing season which is three months for Europe (Keller et al 2006, Grünhage et al 1999) while in the present study the authors have calculated AOT40 during the daylight hours between 7 a.m. and 7 p.m.

Authors have not considered the global radiations ($\geq 50 \text{ Wm}^{-2}$) while calculating the AOT40.

50 Wm⁻² can be observed one hour after sunrise and one hour before sunset, eventually reducing the length of daylight hours by approximately two hours.

Considering the geographical immenseness of India (65 E-95 E) the local time difference of 2 Hours from east to west can majorly influence any sort of calculations engrossing day light timings. Authors have not considered this difference and simply calculated between 7 a.m. and 7 p.m. (especially over Gangetic plane, the sun sets around 6 PM in winter with global solar radiation reaching below 50 Wm⁻² around 5PM)

The duration of the daylight time is different for different seasons, especially over the northern India. The daylight duration (global radiations 50 Wm⁻²) could vary between 8 hours in winter to 12 Hours in summer.

Calculation of AOT40 considering the above said facts may result in different picture of AOT over India, mainly reduced AOT40 values during winter growing seasons.

Daily or monthly AOT40 has no definition or meaning.

Appropriate discussion of AOT40 during growing season is missing.

Since AOT40 is an accumulative index, missing data can affect the AOT40 calculations, as lot of missing data can be seen in the ozone time series. Authors have not properly judged upshot about the calculation of AOT40 for the period of missing days/hours.

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In India, and especially in northern India, there are two distinct seasons, kharif (June to October), and rabi (October to March) as mentioned by authros. However the crop seasons are different for different part of India.

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AOT40 values are higher than the critical level in some parts of western India during the month October, which is a "Kharif" crop growing season in India.

The month of October is harvesting month of Kharif crop, thus this statement has no meaning.

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Daily AOT40 values were found to be almost zero during most of the time in the monsoon (June to September).

Jul-Sep is growing season for Karif crops; mainly rice in Northern India, Low values of AOT 40 indicates no threat to crop production. Authors should indicate this in the paper.

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Figure 1 shows the comparison between monthly AOT40 values calculated from the model and from the point observation at Pune for the year 2003. It is found that observed monthly AOT40 values lying reasonably in the same range as the modeled values at Pune indicating that our model is capable of reproducing the monthly AOT40 values.

Looking at figure 1, 2a-c, it can be seen that the model simulation underestimates the ozone concentrations. It is advisable to show some more statistics like correlation, MAE or RMSE in order to have the clear picture of simulated results.

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Although the model qualitatively reproduces a similar phenomena, a reasonable quantitative agreement was not obtained in this regard possibly due to the inability of the regional model with 0.5° degree resolution, to capture any sudden, localized excess rainfall event which has happened during the monsoon months of the year 2003 as per the rainfall records (IMD-report, 2003) which is discussed in detail by us elsewhere (Roy et al., 2008).

REMO-CTM had been validated with precipitation data over India (Roy et al 2008). It has been mentioned in Roy et al., that "The model is able to capture the variability in the precipitation pattern over India to a reasonable extent which is an essential factor for simulating such key species in the atmosphere" but in the present study inability of the model to capture the precipitation is discussed. Please elucidate this contradictory statement.

Figure 3, two color bars for three panels, one is missing?? Two color scales for the figures are confusing. Is it possible to show AOT40 for all months or at least for the growing season of kharif (July, Aug, Sep) and rabi (Dec, Jan, Feb)

As far as I understood, Authors have simulated the Ozone concentration from REMO-CTM and recalculated AOT40. Authors also mention "observed AOT40". Since AOT40 is calculated from simulated and observed concentrations. Please specify these facts in the paper.

AOT40 calculations have been reported by Mittal et al, 2007, considering more number of measurements over India which has been refereed by the authors.

Ahammed et al 2005, Pulikesi et al 2006, Gupta et al 2007 and Debaje et al 2008 reports the lower concentrations as compared to discussed in this paper. Paper from Debaje et al gives more detailed information about ozone concentration in rural and suburban area in western Maharashtra which also included Pune. I hope there are more papers available on ozone measurement over India.

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Although the data available at different location referred in this paper is not for year 2003, but can be used for comparison purpose in the absence of data.

References:

Ahammed et al 2005, Seasonal variation of the surface ozone and its precursor gases during 2001–2003, measured at Anantapur (14.62°N), a semi-arid site in India

Debaje et al, 2008, Surface ozone variability over western Maharashtra, India

Gupta et al 2007, Variability in the vertical distribution of ozone over a subtropical site in India during a winter month

Grünhagea et al 2009 The European critical levels for ozone: improving their usage

Keller et al 1999 High-resolution modelling of AOT40 and stomatal ozone uptake in wheat and grassland: A comparison between 2000 and the hot summer of 2003 in Switzerland

Pulikesi et al 2006, Surface ozone measurements at urban coastal site Chennai, in India.

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