Atmos. Chem. Phys. Discuss., 15, C595–C598, 2015
www.atmos-chem-phys-discuss.net/15/C595/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Assessment of crop yield losses in Punjab and Haryana using two years of continuous in-situ ozone measurements" *by* B. Sinha et al.

Anonymous Referee #1

Received and published: 9 March 2015

review of acp-2014-798

The paper covers an important and interesting topic: Assessment of crop yield losses in Punjab and Haryana using two years of in-situ measurements. The study calculates the impact of present-day reductions of crop yield due to the background ozone from the measurements at Mohali and then extrapolates these fields to states of Punjab and Haryana. The most interesting part of the paper is new crop yield exposure relationship for South Asian wheat and rice cultivars which authors tired to develop based on scattered literature from south Asian specific studies. The manuscript is easy to read and the results are important. This paper is definitely a first step in achieving the ob-

jectives the authors have set up to achieve. My overall recommendation is acceptance after careful revision of the text and queries as under:

Specific comments

I have some reservations about the authors finding that new crop yield exposure relationship are a factor of two more sensitive to ozone induced crop losses compared to European and American Indices, and authors have not specified likely explanation for the dissimilarity. Is it because only few OTC (inconsistent) experiments are available over this region and lack of consistent OTC experimental and robust data set could be the prime reason (compared to European and American counterpart)? Or, Asian crops itself are highly sensitive to ozone than European and American crops? Or, crop exposure period for ozone to derive crop specific E-R function is different in SA, European and American (see below comments)?

AOT40 exposure requires accumulation of ozone concentrations over 90 days of crop growing period in order to assess the crop loss. Mills exposure functions are based on consistent 3 months (except for tomato which based on 3.5 months) growing period for wheat, rice, cotton and maize from various literatures. This study derives empirical exposure-yield relationship based on various OTC studied conduced in India and Pakistan for wheat and rice (section 2.5 (last para), 3.2, 3.2.1 and 3.2.2). Here, author failed to mention what time-frame (exposure days, number of days from emergence to maturity) studies in India and Pakistan considered for the yield loss due to ozone (for wheat and rice)? Is it 3 months period? If not, whether the growing period is consistent in all these regional studies? This is important because if the exposure period differs within the various studies for the same crops (eg. wheat) then obviously crop exposed for longer duration (eg 120 days) will show higher yield loss compared to the same crop exposed for shorter duration (eg 90 days), and therefore derived empirical exposure-yield relationship based on different exposure periods will be unrealistic. Author should cite (probably in table) the growing period/exposure period considered in OTC studies in India and Pakistan for different crops.

(Table 6 and sections 3.2, 3.2.1, 3.2.2, 3.3) Mills exposure functions are based on 3 months growing season, therefore while estimating crop yield losses based on Mills functions one generally consider 3 months growing period of exposure regardless of days from emergence to maturity. Here, authors have considered around 4-5 months period for rice and 5-5.5 months for wheat, and 6 months for cotton. Using Mills exposure functions and accumulated ozone above 40 ppb for more than 3 months will therefore provide unreal estimates. Same apply for the exposure functions derived in this study, and therefore author should clearly state that what period of exposure used in deriving the relationship.

Further: how relevant is the AOT40 or M7 observed in an urban/suburban environment for crops which are likely to be produced in a more rural environment (where ozone levels can be much different)? (Table 3)

General:

Page 1, Line 27-28: Authors have not calculated the technological and economic cost for sustainable mitigation of ozone in India. It is therefore unknown to the reader that how much investment would required for mitigating ozone. I would suggest avoiding line from the abstract 'Mitigation of high ..... Incurred presently"

Page 1, Line 13-14: Why wheat loss is a factor of two higher in 2012-13 compared to 13-14?

Section 3.2, 3.2.1 and 3.2.2: Figure 3 and Figure 4: Variation in sowing dates and exposure shows the significant trend of the crop yields as a function of ozone exposure indices. Here, how can one ignore the influence of micro climate suitable for more yields based on sowing dates and year to year variation of crop yield (because crop yield of rice/wheat reported in figure 3 and 4 are for different years) Is this relationship mere a coincidence? Can authors verify whether the yield of rice and wheat is similar during 2007 -2013 for same sowing dates?

Section 3.2.1: East-west gradient in sensitivity of local cultivars to ozone exposure is due to difference in exposure period considered in these various studies? Pl. check.

Table 2: I suggest to normalize these RY calculations by the RY obtained for AOT40 = 0, such that the intercept of the relative yield equals 1. Because the value of "a" in the Mills regressions and also the regression obtained in the present study is not always equal to 1 as would be expected for AOT40 = 0 (particularly for rice and cotton) (for rice it would mean an additional 5

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 2355, 2015.