Comments on the 'Ozone National Ambient Air Quality Standards: Scope and Methods Plan for Health Risk and Exposure Assessment'

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For
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1.0 Introduction:

Here we address several key technical issues related to EPA's planed Ozone Exposure and Health Risk Analysis for the 2014 Ozone NAAQS review. BP believes that unless these issues are thoroughly addressed, the risk analysis that EPA has proposed to conduct will overstate the health benefits of a revised standard.

1. EPA's planned use of quadratic rollback is not appropriate for the ozone levels under possible consideration for an ozone standard. The quadratic rollback is not supported by broad trends in ozone monitoring data over the past 20 years, and is not consistent with the non-linear nature of ozone chemistry. EPA must use sensitivity simulations of changes in emissions to define the pattern of change in ambient ozone concentrations under proposed standards.

2. EPA's use of averaged background ozone concentrations introduces significant bias in concentration ranges that are extremely important for calculating the health risk benefit of proposed ozone standards. We show that EPA currently underestimates the role of background at higher ozone concentrations, and overestimates the role of background at lower concentrations in all sites examined. EPA should use the highest temporal and spatial estimates of background available, and should account for model underestimates at peak background concentrations.

3. EPA's assumption that 'background' should be based on a zero anthropogenic emission scenario ignores significant public health impacts of eliminating all anthropogenic ozone precursor emissions. Specifically, EPA does not allow for the production of food, shelter, heat or the public health infrastructure. EPA should optimize the health benefits of modern society with the health risks of pollution, and should set emission targets based on best available control technologies rather than simply eliminating all anthropogenic emissions.

2.0 Rollback techniques:

EPA proposes using the quadratic rollback technique, which it has used in previous exposure and health risk assessments, to model the frequency distribution of ambient ozone based on 'just meeting' proposed NAAQS standards. The quadratic rollback method adjusts all concentration levels down, as a function of the magnitude of change necessary to 'just meet' a proposed NAAQS standard. This technique is described in an EPA memorandum titled 'A comparison between different rollback methodologies applied to ambient ozone concentrations' (Rizzo, 2005). **The quadratic rollback technique is not appropriate for 'rolling back' ozone concentrations in the range of proposed future standards.** Rizzo (2005) validates the quadratic rollback technique using data from 2 cities (Los Angeles and St. Louis) from the mid 1990s and early 2000s. The 4th highest MDA8 values tested ranged from 78 ppb to 148 ppb. This range is far higher than most urban environments today, and the response of ozone to changes in emissions is not constant with ozone concentration. The basic assumption of the rollback technique is not consistent with broadly observed patterns of ozone trends over time.

In general, ozone at the highest percentiles has decreased, ozone in the mid-percentiles has remained constant, and ozone in the lowest percentiles has increased due to decreased NOx scavenging (citation). **Rolling back all ozone concentrations is not consistent with the non-linear nature of ozone chemistry**, which is NOx dependent.

Additionally, basing the rollback technique on only a few years of data makes it **impossible to separate the effects of variability in meteorology and emissions**, both of which play a significant role in observed ambient ozone concentration. Because the rollback technique was tuned to a very limited data set, which includes both the effects of differences in meteorology and differences in emissions, the technique is not broadly applicable to predicting the effects of changing only emissions.

As part of the State Implementation Plan (SIP) process, EPA requires modeling the effects of changes in emissions on ambient ozone levels. This modeling has been completed in a wide variety of areas, and is readily available to EPA for parameterizing the locally expected effects of changes in emissions independent of changes in meteorology. We suggest that rather than using a simple rollback technique, EPA analyzes existing SIP modeling sensitivity to changes in ozone to predict ambient ozone concentrations under various scenarios. Additionally, EPA should compare their predictions to observed changes in ambient ozone over the most recent time period possible (i.e. most representative of today's conditions).

There are two conditions that must be considered in testing the procedures for verifying just meeting the ozone standard. The first is the regional changes in ozone as peak eposidic concentrations are reduced. Thus, as the peak concentrations for a specific eposide are reduced, what changes in ozone occur over the region for this specific eposide? Weekday and weekend chemistry effects must included in the accuracy testing of any roll back approach. For a specific ozone eposide, areas of lower ozone may increase as a result of non linear chemistry and this effect needs to be factored into the risk assessment. The second condition that needs to be tested is how will ozone regional concentrations respond for non eposidic events as a result of a potential reduction in the standard? In examining the health benefits of a lower ozone standard the accuracy of the roll back techniques must be tested for both conditions.

EPA recognizes 'that the pattern of changes that have occurred in the past may not necessarily reflect the temporal and spatial patterns of changes that would likely result from future efforts to attain the ozone standards; therefore, [they] are considering examining an alternative prospective approach for rollback, as described in section 2.3.3.' Unfortunately, section 2.3.3 was not included in this document.

3.0 Use of background ozone in exposure and risk assessments[1]:

In the current document, there is insufficient detail to reproduce the calculations proposed by EPA for the exposure and health risk assessments. The document states that EPA uses background ozone concentrations in various ways, but the statistical form of background used is not described (i.e. hourly, daily mean, monthly mean, etc…). Because of the importance of how background concentrations are used EPA must provide a detailed description of how background ozone will be use in the risk assessment. In the 2007 Staff Paper, EPA details the use of background ozone in the exposure and risk assessments. It describes using a monthly mean diurnal cycle of background for exposure assessments, and a monthly mean background for risk assessments. We are assuming that EPA plans to use similar calculations in the current draft, and we will focus our comments on the techniques described in the 2007 Staff Paper.

[1] In this context background is considered as Policy Relvant Background (PRB)

As discussed in Fiore et al. (2002, 2003), the concentration of background ozone varies as a function of season, location and total ozone concentration. Fiore et al. (2002, 2003) and Wang et al. (2008) both found that the influence of PRB generally peaked in the 50 to 70 ppb range. They went on to describe that at very high overall ozone levels (i.e. greater than 85 ppb), the concentration of background decreased. EPA has argued that Policy Relevant Background (PRB) in the US is 15-35 ppb (annual mean), and has relied heavily on the observation that the impact of PRB is low for high overall ozone events. The range being considered for the 2011 Ozone NAAQS reconsideration is 60-70 ppb, which lies within the peak concentrations of PRB, and not at the high tail of the frequency distribution, where the influence of PRB is low. This means that the influence of PRB at concentrations relevant for attaining the ozone standard in the 60 to 70 ppb range is underestimated, and that the influence of PRB at concentrations relevant for health effects is also underestimated. It is also important to note that in evaluating the accuracy of modeling of PRB, it was found that models are not capable of capturing the upper end of the PRB frequency distribution. This error should be propagated through the health effects analysis and the effects quantified.

As a result of both of these issues, the health risk benefit calculated by EPA will be an overestimate relative to the risk at PRB. Additionally, because EPA rolls back all ozone concentrations, a large percentage of the health risk benefit comes from levels well below attaining the standard. It is imperative that EPA accurately represents the contribution of background at all concentrations in order to correctly estimate the changes in risk associated with changes in ambient ozone concentrations.

The use of monthly mean diurnal cycles and monthly mean background values introduces another level of uncertainty and bias in the calculation of risk. Over all concentration levels, the net effect of using a mean value will be zero. The question is whether the errors are evenly distributed over all concentration levels, or whether they are not randomly distributed and introduce a bias in the analysis. To test this question, we conducted a simple experiment using the GEOS-Chem nested grid ozone simulation over the United States. We took data from 16 sites for both full emissions and PRB ozone simulations, and compared the use of hourly PRB estimates vs. monthly mean diurnal cycles. We integrated the ppb difference between these estimates for either the entire year (Figure 1) or April to October (Figure 2), and plotted the difference for 10 ppb concentration ranges. We found that the differences are not randomly distributed, and that using monthly mean diurnal cycles of PRB introduces systematic biases at all sites. In addition, these figures indicate that all all of the 16 cities that in the concentration range of 60 to 70 ppb (level of the proposed reconcideration standard) that high PRB events occure simultaneously with cumulative ozone events. It is clear that PRB plays a much larger role in overall ozone concentrations than EPA previously assumed. This new finding will likely substantially influence the ozone risk calculations.

Of particular importance is the overestimate of the role of PRB at low concentrations, and underestimate of the role of PRB at higher concentrations at all sites. Based on this analysis, we encourage EPA to use the highest temporal and spatial resolution background ozone data available. EPA currently has hourly North American, United States and Natural background estimates for 2006, 2007 and 2008 provided by Harvard University (Zhang et al. *submitted*). **It is of utmost importance in both the**

exposure and risk assessment modeling that EPA uses background concentrations that are appropriate for the ozone concentration level it is considering.

Based on the results of Figures 1 and 2, it is recommended that EPA use estimates of PRB in the following manner.

1) Risk assessments should define background ozone for a selected city using all hourly model estimates of PRB (i.e., 8760 hours per year of modeling)
2) Ambient ozone concentrations and concentrations for just meeting different levels of the standard must be for the same year as the PRB modeling
3) All monitors in the in the urban area should be utilized in the analysis.
4) The concentration benefit for different levels of the standards must be considered by subtracting the hourly ambient levels with the concurrent hourly PRB modeling results.
5) The change in risk should incoperate all of the hourly results in describing the overall regional ozone reduction.

Further, EPA has stated that they plan to use background modeled for the years 2006-2008, but observational data from 2008-2010. The disconnect between the modeled background years and observations introduces significant bias. EPA must either restrict its analysis to 2006-2008, or conduct modeling of background ozone for 2008-2010 and risk calculations should utilize the methodology outlined above.

In the health risk assessment portion of the document, EPA states that they do not calculate the health risk at background levels. In order for them to accurately characterize the changes in risk with changes in ambient ozone, they cannot consider the risk at background levels to be zero. This would artificially inflate the health risk benefit, if, once background levels are reached, the risk goes to zero. Instead, EPA should calculate the relative changes for all cases.

4.0 Assumptions underlying background ozone

For the 2014 NAAQS assessment, EPA is considering three cases of background. These include all anthropogenic emissions in North America eliminated, all anthropogenic emissions in the United States eliminated, and all anthropogenic emissions globally eliminated. The goal of the NAAQS process is to protect human health, but by setting an ozone standard that eliminates all anthropogenic emissions nationally (or globally), EPA is ignoring the health effects that would occur in this scenario. No allowance is included for agriculture and food production. No allowance is included for providing shelter or heat, and no allowance is included for maintaining the public health infrastructure. This scenario itself would have significant negative public health impacts. EPA should recognize that the NAAQS process should optimize the benefit of providing for the basic needs of human society with protection from negative health effects of air pollution. Scenarios simulating air quality using best available control technologies (BACT) or reasonable avalible control technologies (RACT) should be used, rather than assuming that all anthropogenic emissions can be eliminated. The NAAQS process requires that air quality standards be reviewed every 5-years, which would allow for incorporating new technologies into the risk assessments. Simply assuming that all anthropogenic emissions can be eliminated is overly simplistic and unrealistic, and as stated earlier, disregards the significant public health benefits modern society brings.

EPA should thoroughly reconsider and critically evaluate the basic assumptions of their health risk benefit calculations, and should develop a more sophisticated approach to this problem.

5.0 General comments:

In the document, EPA states that it will use 'three or more' of several urban areas in the United States for it's exposure and risk analysis. Given the issues detailed above with respect to the use of background ozone, it is necessary for EPA to re-do the entire exposure and risk analysis for all cities, and not re-use analyses from the 2008/2011 NAAQS cycle. For all sites, EPA should use hourly estimates of background, and should include an estimate of the error associated with underestimates of modeled peak background concentrations (i.e. Rastiv…). If ozone monitoring data is available, EPA should consider all months of the year, rather than just the ozone season, to accurately describe the integrated differences in health risk benefits.

EPA plans to use data from the 2000 Census as input to the APEX model. By the time this NAAQS cycle is completed, that data will be 14 years old. Instead, EPA should use the most recent 2010 census data, as there have been significant shifts in population over the past decade.

Finally, EPA has adopted regulations that will impact ambient air quality over the next 3-5 years. These regulations will decrease emissions of ozone precursors, and are independent of changes in the ozone standard. EPA should quantify the expected health benefit of regulations that are set to take effect. EPA cannot claim this benefit as a benefit of the 2014 ozone NAAQS, as this health benefit would already occur regardless of a change in the ozone standard.

6.0 Summary and conclusions:

Here we have argued that EPA's planned exposure and risk assessment for the 2014 NAAQS should be revised to reduce bias and uncertainty in their analysis. First, their use of quadratic rollback introduces significant bias, which will overpredict the reductions in ozone concentrations at mid to low levels, and therefore overpredict the health risk benefit of reducing the ozone NAAQS. Ozone does not respond linearly to changes in precursor concentrations. It is widely observed that the lowest percentile ambient ozone concentrations have increased over the past 20 years due to emissions controls and decreased NOx scavenging. This chemistry is well known and widely accepted. EPA must ensure that their rollback technique is valid over the ozone concentration range that they are considering for a standard, and that it is consistent with the fundamentals of ozone chemistry. We recommend that EPA uses sensitivity runs from already completed SIP modeling to parameterize the response of ambient ozone to changes in emissions.

EPA has consistently used mean background concentrations, rather than higher time resolution estimates of background. As shown here, this introduces a significant bias over different concentration ranges. At low levels, EPA is overestimating the role of background ozone. At high levels, EPA is underestimating the role of background ozone. The peak ranges of the bias are different for different locations, but in all cases, they are at levels that are extremely relevant to the standard setting process. We suggest that EPA simply use the highest temporal resolution (i.e. hourly) estimates of background ozone to eliminate this source of bias.

EPA defines various types of background assuming a complete elimination of anthropogenic ozone precursor emissions. This approach is overly simplistic, and ignores the public health benefit derived from activities that produce ozone precursors. EPA must develop a more sophisticated analysis of ozone risk, and include emissions necessary to achieve a basic quality of life, including food, shelter, heat and the public health infrastructure. We suggest that EPA uses estimates of best available control technologies (BACT) to optimize the benefits between emissions reductions and health benefits derived from emission generating technologies.

We strongly feel that the issues presented here introduce significant error and bias to EPA's analysis of the exposure and risk assessment for NAAQS standard setting, and we earnestly hope that EPA will consider improving their approach.

Figure 1

These figures show the integrated effect of using the difference between observations and monthly mean PRB, vs. the difference between observations and hourly estimates of PRB. Positive indicates that the influence of PRB is underestimated in this concentration range, while negative indicates that the influence of PRB is overestimated. By moving to an hourly approach, more exposure in excess of PRB will occur at lower concentrations, and less exposure in excess of PRB will occur at higher concentrations. These are preliminary data - Do not cite or quote.

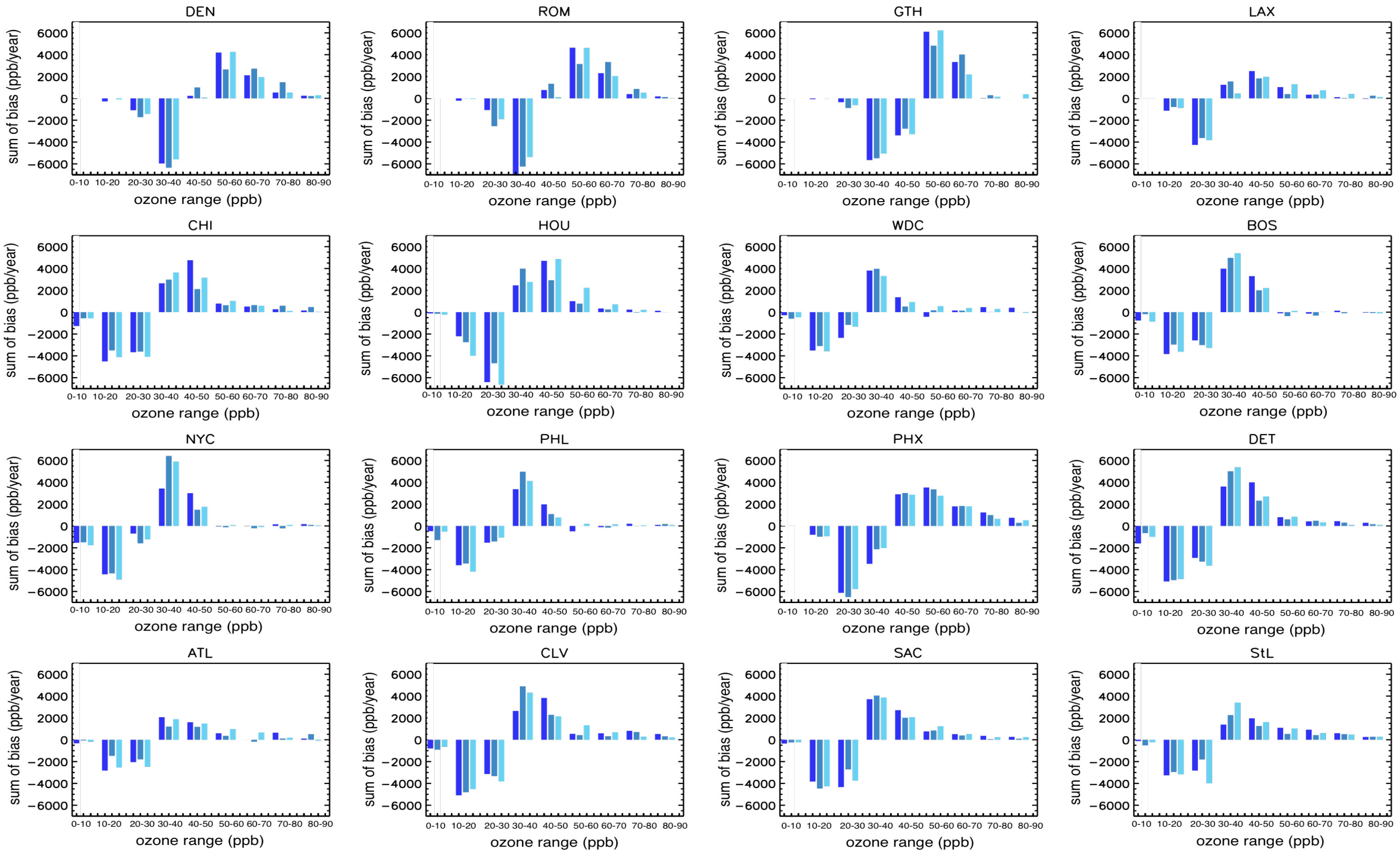

Figure 2

April - October ONLY

2006 2007 2008

These figures show the integrated effect of using the difference between observations and monthly mean PRB, vs. the difference between observations and hourly estimates of PRB. Positive indicates that the influence of PRB is underestimated in this concentration range, while negative indicates that the influence of PRB is overestimated. By moving to an hourly approach, more exposure in excess of PRB will occur at lower concentrations, and less exposure in excess of PRB will occur at higher concentrations. These are preliminary data - Do not cite or quote.