



EARTH SYSTEM SCIENCES, LLC

From: Nicole Downey, Ph.D. (nicole.downey@earthsystemsciences.com)
To: CASAC
Date: October 29, 2012
Subject: Background Ozone in the Risk and Exposure Assessments

There continues to be a significant level of confusion with respect to background ozone, the risk ‘in excess of background’ and how background ozone is taken into account in the risk assessments.

EPA argues that ‘the risk attributable down to the lower levels or down to background basically subtract[s] out.’¹ This idea reflects a deep misunderstanding of the fundamentals of ozone chemistry and the response of ambient ozone concentrations to emissions controls. Ozone is produced by a reaction between NO_x and VOCs, but it is also destroyed by NO_x. This non-linear response to changes in NO_x emissions makes ozone unique among the criteria pollutants, and requires careful consideration. In order to reduce peak ozone levels, you must reduce NO_x and/or VOC emissions. If you reduce NO_x emissions, you will not only decrease ozone at some times, but increase it at others (Figure 1). Under EPA’s current approach using the quadratic rollback technique, ozone increases in response to NO_x emissions changes are not accounted for, and only decreases in high ozone levels are taken into account. Furthermore, anthropogenic NO_x emissions, which produce ozone in excess of background, also destroy background ozone. This means that the only way to evaluate the risk at background is to calculate that risk in a zero emissions scenario. It is not correct to simply difference two scenarios, and argue that background cancels out, because background is not constant between two different anthropogenic emissions scenarios.

With the planned replacement of the quadratic rollback with HDDM, EPA has stated that background is implicitly included in the HDDM runs, and that background will be taken into account. An HDDM simulation that includes anthropogenic emissions does not give you the risk at background (Figure 2), but rather the total risk that is due in part to background and in part to anthropogenic emissions. The component of risk due to background in a scenario that includes anthropogenic emissions is different than the risk at background due to the interaction of anthropogenic emissions with background ozone. Once HDDM is implemented, EPA must still calculate the risk of a ‘zero emissions scenario’ and use this scenario as the true risk at background levels. All changes in risk between possible standards should take this into account as the baseline level of risk.

¹ Karen Martin (EPA) presentation during September 13, 2012 CASAC meeting. Quote taken from meeting transcript (0913EPA.PDF) page 22, Lines 4-7

In the first draft Risk and Exposure Assessment and first draft Policy Assessment, EPA calculates the risk of ozone exposure down to zero, and maintains that there is a linear mortality concentration function that extends down to zero ozone. This focus on mortality at low ozone concentrations (i.e. < 60 ppb) makes it imperative that the risk at background levels is properly taken into account. CASAC should recommend strongly in the letter to the administrator that the proper way to take background into account in a risk analysis is to explicitly calculate the risk at background, and present this risk to the EPA administrator.

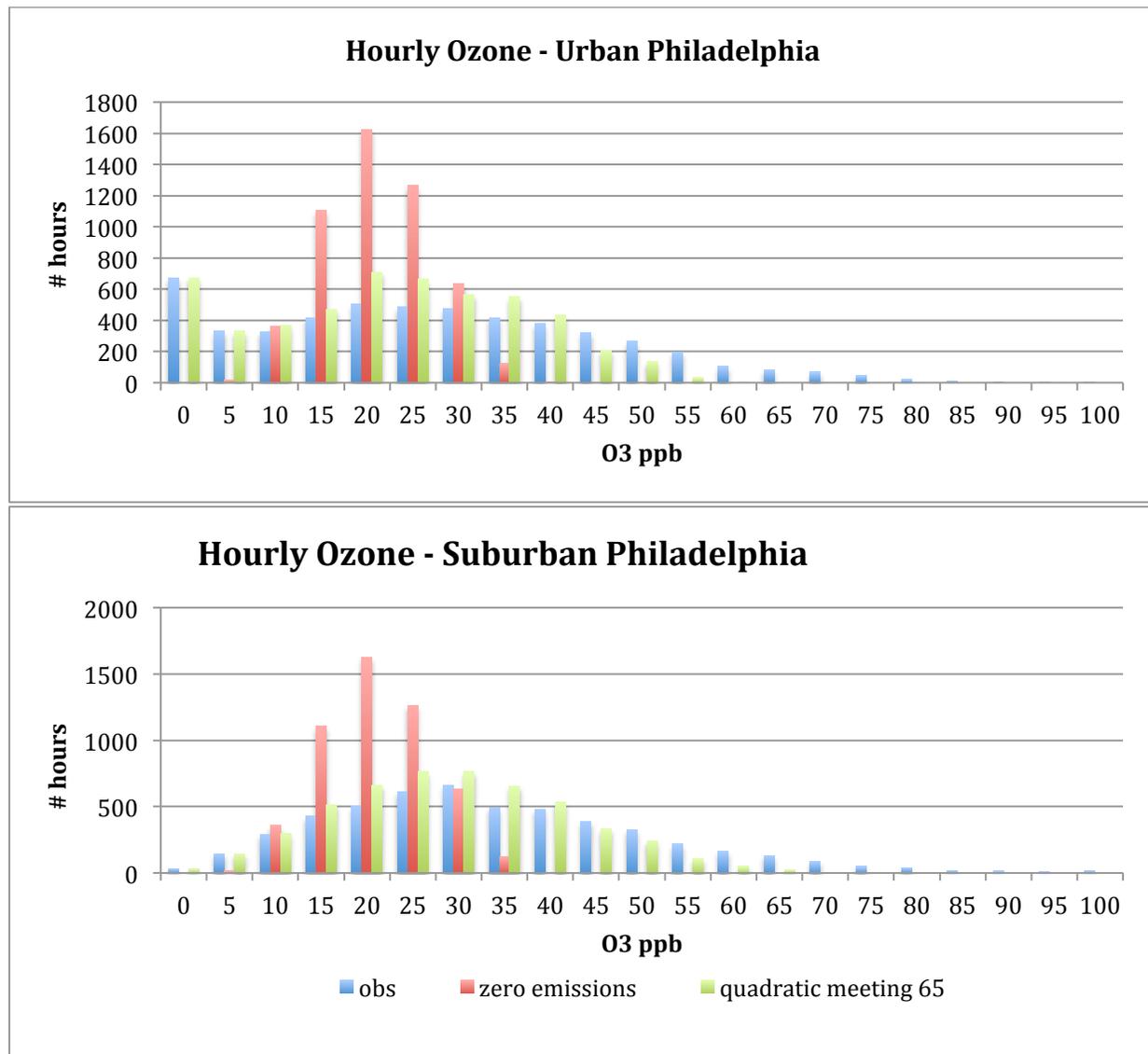


Figure 1. Hourly frequency distributions for ozone at an urban (Lums Pond) and suburban (Cecil Fair) site in Philadelphia. Monitor observations for the ozone season (April-October) are in blue, the quadratic rollback estimate for a distribution meeting a standard of 4th highest 3-year average MDA8 of 65 ppb is in green, and a zero emission scenario from the CAMx model (Emery et al. 2012) is in red. Notice that the zero emissions scenario does not lead to decreases in ozone at all levels. Instead, ozone at low levels increases whereas ozone at high levels decreases. This is due to the non-linear response of ozone to changes in NOx emissions.

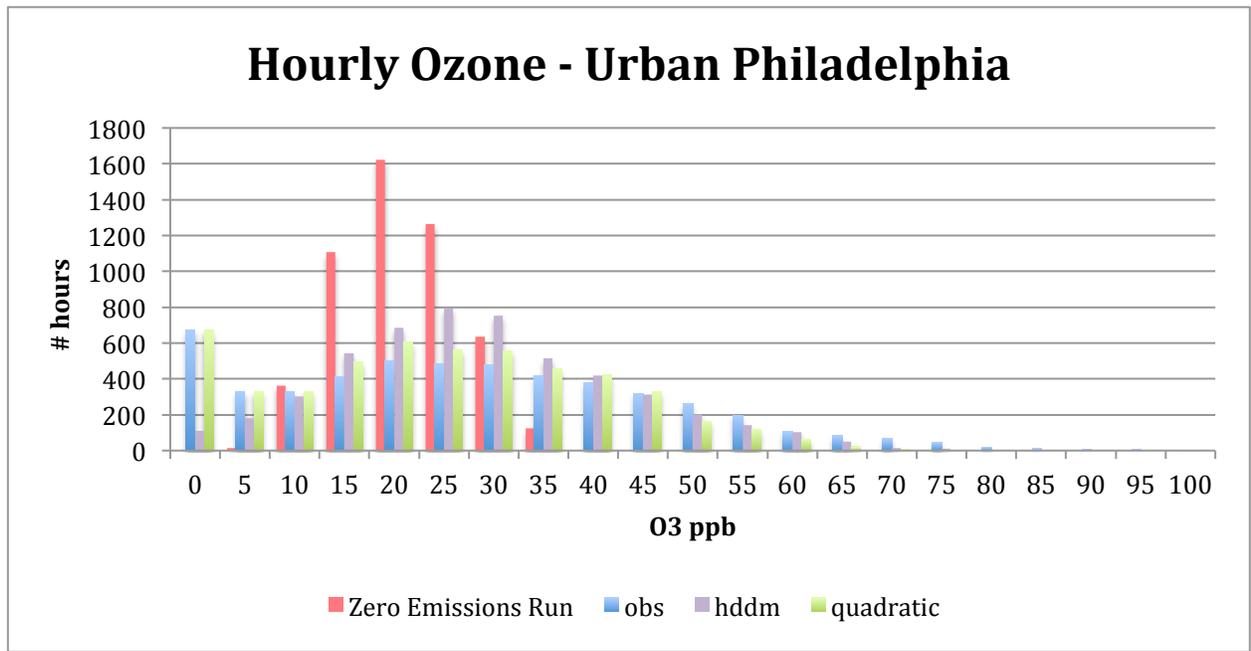


Figure 2. Hourly frequency distributions for ozone at an urban (Lums Pond) site in Philadelphia. Monitor observations for the ozone season (April-October) are in blue, the quadratic rollback estimate for a distribution meeting a standard of 4th highest 3-year average MDA8 of 80 ppb is in green, the HDDM estimate for a distribution meeting a standard of 4th highest 3-year average MDA8 of 80 ppb is in purple, and a zero emission scenario from the CAMx model (Emery et al. 2012) is in red.