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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impacts of precursor reduction and meteorology on ground-level ozone in the Greater Toronto Area" *by* S. C. Pugliese et al.

Anonymous Referee #2

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Summary:

The authors present a description of how mean daily summertime maximum ozone and Ox (O3 +NO2) concentrations in the Greater Toronto Area (GTA) have changed over a 13 year (2000-2012) period using observed ozone, NO2 and VOC concentrations along with a few meteorological datasets. They find mean summer time VOC reactivity and mean NO2 concentrations have decreased, likely due to local air quality management efforts. Local summertime Ox concentrations have responded to these emission changes although the authors find meteorological variability also plays a role in determining local Ox concentrations. Mean summertime daily maximum ozone con-

centrations have not showed the same decline as the VOC, NO2 and Ox concentrations.

General Comments:

The title refers to the impacts of precursor reductions on ground-level ozone but much of the analysis deals with Ox. While looking at the odd-oxygen budget might be the proper reference frame for a chemistry point of view, the health based standards referred to in the text are all based on ozone levels. Additionally, the Ox trends are likely being driven by the NO2 trends, thus masking the important ozone trends. Either the title of the article should be changed to reflect the central role of Ox in the present analysis or the analysis should emphasize ozone and its trends to a greater extent.

Would the analysis be different if instead of looking at trends in mean summertime daily maximum concentrations, trends in annual maximum (or 99th, 95th, etc. percentiles) daily maximum values were used? Such an analysis would be more in line with the Canada Wide Standard.

Is there any sense that the airmass around the GTA region switches from VOC- to NOx-sensitive as one moves away from the heavily urbanized downtown core? Such a switch, while potentially occurring only on days most conducive to ozone formation, might alter the interpretation of the trends.

Oltmans et al. (2013) show that background ozone concentrations as measured at Whiteface Mountain show a small decreasing trend between 2000-2010. Could changing eastern North American background concentrations be influencing the reported trends, especially since trends reported here are based on annual summertime mean concentrations?

Specific Comments:

Page 10211 Line 18: Aren't NOx emissions from transportation also a result of fossil fuel combustion?

Page 10211 Line 26-27. The Wolff and Lioy (1978) and Jacob et al. (1993) references are very dated and a lot of research has been more recently done on empirical relationships between ozone and meteorological variables.

Page 10215 Line 3: "... increasingly larger amount ...". Is the increase over time or increase with respect to the larger inventory?

Page 10215 Line 8: Has smog been defined? Is this meant to be photochemical smog? Many definitions of smog include PM25, and I wonder if the authors mean to introduce PM25 trends into the discussion.

Page 10215 Line 15: How complete were the datasets? How were missing data treated?

Page 10216 Line 1: List the 5 sampling dates.

Page 10216 Line 5: How were 8hr averages calculated – were the 24 such averages in a day? Was the date of the starting hour used to assign the 8-hour average to a specific day? How was missing data treated in calculating the averages?

Page 10261 Line 15: The authors should be aware that only isoprene was measured in NAPS canister prior to 2003, with isoprene and terpenes being analyzed post-2003 (Daniel Wang, personal communication). Thus "biogenic" concentrations can potentially show increasing trends over time.

Page 10217 Line 1: The description of the meteorological datasets should be moved to section 2.1 (Study region and data collection).

Page 10217 Line 20: Why is 11:00 to 15:00 defined as midday - is the average summer time of solar noon in Toronto at 13:00? Are the times Local Standard or Local Daylight Savings time?

Page 10220 Line 10: Fugitive anthropogenic VOC emissions should also increase with higher temperatures.

Page 10220 Line 11: How were the number of exceedance days calculated? If multiple stations exceeded the 65 ppb (8-hour averaged) ozone concentration, was this day counted multiple times (once for each of the exceeding stations) or just once? How would the change in number of stations reporting ozone influence this exceedance total?

Page 10221 Line 6: Is the proportion of days in 2012 with W-NE, W-SE or stagnant days statistically significantly different from the other years?

Page 10221 Line 13: Why was The Toronto North station singled out for this analysis? Are the conclusions the same if the other stations are used?

Page 10221 Line 15: Figure 5 only tells us that the W-SE direction is associated with the highest average summertime levels, not the highest or exceedance levels.

Page 10221 Line 15+: Figure 5 also shows that in 2010, W-NE airmasses were associated with lower average Ox temporal profiles, but the text says all years had consistent profiles.

Page 10222 Line 3+: Why were only the midday hours considered in the radiometer data? Would total cumulative radiation be more relevant? Aren't ozone and HONO photolysis important morning sources of radical initiation?

Page 10222 Line 10+: Could figure 6b be redone so that the number of summer days when a certain radiation threshold is reached be read directly from the x-axis?

Page 10223 Line 17: I thought the NAPS data are analyzed for 176 VOC compounds, not 40?

Page 10224 Section 3.5: Do each of the VOC pairs have similar ozonolysis rates? If they don't, then changes in daily ozone concentrations would potentially confound this analysis. This problem would be most severe for the butene pair.

Page 10266 Line1+: Should state that the results are for summertime mean daily con-

centrations of ozone precursors.

Page 10226 Line 22: It should state mid-day levels incoming solar radiation . . .

References: Oltmans, S. J.; Lefohn, A. S.; Shadwick, D.; Harris, J. M.; Scheel, H. E.; Galbally, I.; Tarasick, D. W.; Johnson, B. J.; Brunke, E.-G.; Claude, H.; Zeng, G.; Nichol, S.; Schmidlin, F.; Davies, J.; Cuevas, E.; Redondas, A.; Naoe, H.; Nakano, T.; Kawasato, T. (2013). Recent tropospheric ozone changes - A pattern dominated by slow or no growth. Atmospheric Environment, 67, p. 331-351.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 10209, 2014.