Response to Reviewer #2

We thank Reviewer 2 for their careful reading of the manuscript. Most of the comments relate to clarifying aspects of the original version; we have addressed all of these in the revised version. The substantive comment regarding seasonal differences in meteorological factors which may impact the measured ozone gradients. Following the suggestions of Reviewer #1, we have made significant changes to the discussion; it now explicitly includes some analysis of boundary layer height changes perpendicular to the shoreline, as well as lake breeze effects.

Our specific responses to the comments of Reviewer 2 are given below.

Line 53: Put a "The" before "Average" or make concentrations plural

- Edited

Line 131: Why were measurements only made during the afternoon? Please clarify.

- Measurements were made in mid day to afternoon, when ozone levels peak, in an attempt to reduce the influence of diurnal ozone trends on observations. Lake-and sea-breeze circulations tend to establish around noon and after as well, and ozone gradients would be strongest. This explanation has been added to the revised text.

Line 145-146: Change "was" to "were", data is considered plural. Check manuscript for other instances.

- Edited

Line 159: For the hourly O3 and NO2 from the provincial stations, are these data only encompassing the hours of 12:00-21:00 EDT, similarly to the Aeroqual 500? It should be noted specifically how the monitoring station data is averaged

- Monitoring data was an arithmetic mean from daily hourly values from 01:00 to 24:00 EDT of a single day. We changed the average to encompassing sampling hours 12:00-21:00 EDT.

Line 265-266: The authors do not mention the shallower mixed layers, decreased photolysis rates of NO2 and overall decreased ozone production rates during winter time. These are possible contributions to the lack of a relationship between wind speed and ozone concentration. Ozone gradients may be more impacted by meteorology during summer, while during winter the regional background and local sources may contribute more. The authors should explore and describe how during winter there is less dynamic variability in ozone due to the possible reasons mentioned above.

- We are adding the boundary layer height changes in Toronto as modelled by Stroud et al., (2020).
    - At around 5:00 PM local time, the mixing length at the surface increases from around 1-3 m on the lake to 70-100 m in around 1 km distance in downtown Toronto. After this point, the model shows a uniformly well-mixed convection up to 2.3 km altitude. This suggests the origin of the steeper gradient or lake-edge removal is largely influenced by this growth in boundary layer height.

    - However, assuming the boundary layer height changes uniformly along the lake, this does not account for the differences between cities.

- An overall shallower mixed layer would result in decreased gradients in both Toronto and Oshawa, but Toronto displayed no difference between the seasons. Decreased ozone production and background levels are somewhat observed in our observations, however, would once again decrease ozone gradients overall but Toronto is not affected.
- We are adding assessment of lake breeze in Toronto summer following criteria by (Laird et al., 2001) that has also been used by (Wentworth et al., 2015) to identify lake-breeze circulation in Toronto.
    - All days in Toronto from this test showed lake-breeze except for August 2, 2023. This is incidentally also the day when the slope was the lowest, -0.0086 ppb/m, and our own measured wind directions were sporadic with no trend.
    - A z-score of + 0.928 and Grubbs' outlier test (a = 0.050), however, does not show that this is a significantly lower value.
    - The same program was also run on Toronto winter values that resulted in one positive for February 12, 2023. The slope was on the steeper end but not the highest recorded.
    - In Oshawa, all summer days showed lake-breeze except for June 10th, 2022. The slope on this day was below the mean but not the minimum. Winter had no positives.
- From this we hypothesize that the base nearshore ozone gradient is the result of the growth of the boundary layer height moving from lake to land and extends around 1 km inland. Lake-breeze meteorology and seasonal production rates impact the absolute values of ozone measured. Seasonal differences in ozone gradient appear to be impacted more by regional geographic factor.

Stroud, C., Ren, S., Zhang, J., Moran, M., Akingunola, A., Makar, P., Munoz-Alpizar, R., Leroyer, S., Bélair, S., Sills, D., & Brook, J. (2020). Chemical Analysis of Surface-Level Ozone Exceedances during the 2015 Pan American Games. Atmosphere, 11(6), 572. https://doi.org/10.3390/atmos11060572