**Author's response to reviews**

**Title:** Estimating BTEX exposure using land use regression in Sarnia, "Chemical Valley", Ontario, Canada

**Authors:**

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**Version:** 2 **Date:** 11 February 2009

**Author's response to reviews:** see over

Thank you and all the reviewers for their comments, suggestions and compliments. We have responded to the reviewers' concerns and suggestions which have definitely improved the revised manuscript.

More specifically, we have addressed the methodological and presentation issues raised by some of the reviewers. We have also revised the introduction and the title of the manuscript as suggested.

Where necessary, we have added additional information and made changes to the text for clarity. Detailed responses to specific comments and suggestions from the reviewers are itemized below.

Please accept our sincere thanks for your consideration.

Sincerely,

D. Odwa Atari

# Response to reviewers' comments

## Response to reviewer # 1

***Reviewer's report***
***Title:*** *Estimating BTEX exposure using land use regression in Sarnia, "Chemical Valley", Ontario, Canada*
***Version:*** *1* ***Date:*** *4 November 2008*
***Reviewer:*** *Godwin Djietror*

***Reviewer's report:***

***Major Compulsory Revisions:***
*NONE*

***Minor Essential Revisions:***

1. *The first sentence in the last paragraph on page 3 should be reworded for clarity: it is suggested that the word "beside" be changed to "besides" and the words "LUR" and "modeled" should be joined with a hyphen.*

   With additional suggestions from the other reviewers the sentence is rephrased and it now reads: "Yielding potentially different health effects than nitrogen oxides and particulate matter, modelling other air pollutants is essential for a better understanding of the link between air pollution and health."

2. *Perhaps the first line on page 3 should be explicit about what the "outdoor exposure" is to: in other words, outdoor exposure to what?*

   The statement is corrected and it now reads: "…outdoor exposure to BTEX…"

3. *On page 10, line 5, the word "were" should be changed to "was"*

   Corrected

*Discretionary Revisions:*

***1.*** *General Comment: There have been many land use regression analyses done on ambient air pollution, but most of these have focused on exposure to particulate matter, sulfur dioxide, and nitrogen dioxide, which are known to impact health adversely. Very little work has been done on BTEX; therefore, the paper should constitute an interesting addition to the environmental health literature. The paper is well written. A comment on how it contributes to the formulation of environmental health policy in Canada and elsewhere would strengthen the conclusion.*

Thank you for your compliments and suggestions. “The modeled ambient air pollution surfaces generated in this study suggest that some residents may be disproportionally exposed to high air pollutants. The results suggest the need for environmental policies that help reduce industrial pollution and assist residents to reduce and cope with daily industrial exposures. The LUR modelling of total BTEX, benzene, toluene, ethylbenzene, (m+p) xylene and o-xylene models are used to estimate personal exposure for a large community health study aimed at examining the determinants of health in a government labelled area of concern.” Depending on the findings attained in the larger health study, we will further pursue and suggest relevant environmental health policies.

## Response to reviewer # 2

***Reviewer's report***
***Title:*** *Estimating BTEX exposure using land use regression in Sarnia, "Chemical Valley", Ontario, Canada*
***Version:*** *1* ***Date:*** *25 November 2008*
***Reviewer:*** *Jason Su*

***Reviewer's report:***
*Land use regression (LUR) models have been used extensively for exposure analysis and improved health outcome studies. The main application of LUR is for modeling long-term average concentrations of nitrogen oxides. This paper used LUR to model volatile organic compounds and thus will add a useful contribution to literature of the feasibility of LUR for modeling other ambient pollutants. After some minor revisions, this paper is suitable for publication in Environmental Health.*

1. *The authors did not specify how AADT was summarized in a selected buffer. Besides, I think the way of using ratio to derive AADT of a road segment within a buffer was inappropriate. It is better to derive VMT (vehicle miles traveled = AADT * length of road segment) for each road segment within a buffer and add up all the VMTs inside that buffer.*

   For clarity, the statement was rephrased and it now reads: "The AADT counts were calculated based on the ratio of the road length within a specified buffer to the total length of the corresponding road segment, multiplied by the total AADT counts of that road segment. Calculated AADT values were then summed as the AADT counts for the monitored station within the specified buffer."

2. *The authors stated that they used buffers 50 - 3000m of interval 50m around the monitoring stations. This implies that for each variable there are 60 buffers and therefore 60 statistics. Though the authors mentioned that each predictor variable was screened by a bivariate model to identify variables of the highest correlation with BTEX, they did not mention how a buffer distance of a variable was chosen.*

   "Each of the buffers generated were individually screened through bivariate regression models using SPSS statistical software (SPSS 15.0 for Windows, 2007) to identify the variables that were highly correlated with measured BTEX species. Next, the most relevant univariate relationships were identified and then a stepwise multiple regression was conducted to find the most predictive models for total BTEX (sum of all BTEX species), benzene, toluene, ethylbenzene, m/p-xylene and o-xylene. The final LUR models for BTEX and each species were identified as having a combination of variables with the highest coefficient of determination, $R^2$. Independent variables retained in the models had to have significant *t*-score ($p < 0.05$) and low collinearity with other variables (defined by a variance inflation factor <2.0)."

3. *Two-week sampling period (more often two or three two-week periods) is usually used for LUR models; however it requires that the two-week sampling is representative of the long term average concentrations. The authors have done a good job demonstrating the stability of concentration patterns in the region. However, it would be useful if they could explain in more detail while the neighboring three not four, five or other number of sites were used to compare with the NAPS station.*

   The three sampling sites were the closest to the NAPS station. "The average ambient concentrations of the 3 sampling points closest to the station (Figure 1) were chosen for comparison following Atari et al. (2008) and Miller et al. (forthcoming)."

4. *It would be useful to compare the kriging interpolation results with LUR results to see if the two methods differ significantly.*

   With additional suggestions from the other reviewers, we have added Table 4 to compare the measured, kriged and LUR modeled concentrations at the sampling locations. "When compared to the measured concentrations (Table 4), kriging showed higher correlation coefficients (0.71 – 0.99) compared to the LUR modelled concentrations (0.14 – 0.79). The LUR models showed high correlations with measured concentrations for BTEX (r = 0.61), benzene (r = 0.79), and toluene (r = 0.72) but considerably lower correlation coefficients for ethylbenzene (r = 0.38), (m+p) xylene (0.16) and o-xylene (r = 0.14). When the kriged concentrations were compared to the LUR modelled concentrations at the monitoring sites, BTEX (r = 0.66), benzene (r = 0.83), toluene (r = 0.73), and ethylbenzene (r = 0.51) showed significantly higher correlations compared to (m+p) xylene (r = 0.31) and o-xylene (r = -0.19). The LUR models underestimated o-xylene concentration at the sampling locations compared to kriging. The correlation results suggest that LUR modelling could be an efficient interpolator for benzene, toluene, and ethylbenzene but not for xylenes in a highly polluted area like Sarnia. The effectiveness of kriging in Sarnia may be due to the uniqueness of the area. Sarnia is a relatively small region with about 40% of Canada's chemicals manufactured in the region (Gilbertson et al., 2001).

5. *Some minor grammar issues.*

   a. *Page 2 Results: "Although the correlations between measured BTEX compounds was high...". Change "was" to "were".*

      Corrected

   b. *Page 4 Background: "Chang et al. [9], working in Taiwan, reported that toluene exposure could exacerbate hearing loss in a noisy environment". It might be better to change it to something like "Chang et al. [9] reported that*

*toluene exposure could exacerbate hearing loss in a noisy environment in Taiwan". We do not care if an author works in Taiwan or New York, but we do care where the study was conducted.*

Corrected

c. *Reference: Make sure they are consistent in citing style.*

Thank you for your suggestion. We reviewed all references to comply with the Environmental Health journal style.

## Response to reviewer # 3

***Reviewer's report***
***Title:*** *Estimating BTEX exposure using land use regression in Sarnia, "Chemical Valley", Ontario, Canada*
***Version:*** *1* ***Date:*** *1 December 2008*
***Reviewer:*** *Talar Sahsuvaroglu*

***Reviewer's report:***
*Minor Essential Revisions*

1. *Title is about assessing exposure, although I would suggest that the model estimates the distribution of the pollutants, so I would suggest adjusting the title to reflect this.*

   With inputs from the other reviewers, the title has been revised and it now reads "Assessing the distribution of volatile organic compounds using land use regression in Sarnia, "Chemical Valley", Ontario, Canada"

2. *p5, last sentence of first paragraph. More clarification is required to link the two statements in this sentence. The lead in to concluding "… vicinities of noxious facilities" needs more information. The statement has to be backed up better.*

   For clarity, the statement was rephrased and it now reads: "…the variability of air pollution for health studies in high polluted environments like Sarnia…"

3. *p7. Last sentence of first paragraph. Hence is not the right word to start this sentence. This sentence should also be linked in better to the rest of the paragraph.*

   With additional inputs from the other reviewers, the paragraph was removed.

4. *p7, last full sentence of the page. Vidal Street is introduced for the first time – but no details are given as to the importance of this street in Sarnia. It is also not any of the Figures. It should be in at least Figure 1. More information is necessary to readers who are not familiar with the area as to the relevance.*

   For clarity, the statement was rephrased and it now reads: "…only 2 samplers were located within Vidal Street, the main traffic route through the industrial core which served as the point of origin for the measures for this study to capture pollution near service areas. Vidal Street is called the industrial core because it is the major traffic feeder to industries in Sarnia (Figure 1)."

5. *p16. first paragraph. This discussion regards seasonal variability – what is the importance of seasonal variability for health effects?*

   "although seasonal variations might affect the temporal trend of modelled air pollution concentration, seasonality would have little influence on the spatial and

geographic patterns of pollution because of the numerous petrochemical facilities in the region (Sahsuvaroglu et al., 2006; Atari et al., 2008; Ross et al., 2006; Lebret et al., 2000). Subsequently, seasonal variation may not greatly influence chronic health outcomes because, as observed in this research, the 2-week concentrations adequately represent mean annual concentration in Sarnia (see also Lebret et al., 2000)"

6. *All figures are numbered #1. I expect these would be adjusted in the final version.*

   The numberings are corrected.

*Discretionary revisions*

1. *Generally, some minor comments:*
   a) *I would like to see some details regarding the ultimate use of this study – how is it going to be integrated into the community health study?*

      The models generated in this study will be used to generate exposure estimates for surveyed respondents based on their 6-digit postal codes.

   b) *Was there any other reason that October was chosen for the field work?*

      "Thirty-nine samplers were deployed in Sarnia for 2 weeks in October 2005 to coincide with a community health survey. The month of October best represents the average annual weather condition in Sarnia."

   c) *Were numerical comparisons conducted between the kriged model to the LUR model? This would be a welcome addition to assessing the modeling capabilities of the LUR, although not necessary.*

      Point addressed above with response to reviewer #2 (response number 4)

## Response to reviewer #4

***Reviewer's report***
***Title:*** *Estimating BTEX exposure using land use regression in Sarnia, "Chemical Valley", Ontario, Canada*
***Version:*** *1* ***Date:*** *24 December 2008*
***Reviewer:*** *Michael Jerrett*

***Reviewer's report:***
*Major Compulsory Revisions (which the author must respond to before a decision on publication can be reached)*

***Overview Comments***
*This paper develops a land use regression model for predicting VOC species in the ambient atmosphere in Sarnia, Ontario, an industrial city with a heavy concentration of petrochemical plants. There have been only a few attempts to predict VOCs. Given the paucity of models on VOCs and the biological plausibility of VOCs as a putative agent behind the observed health effects from air pollution, the paper is of interest to the environmental health community. VOCs may also be a more specific marker of traffic than more commonly used pollutants such as NO2 (a point the authors would do well to including in their paper). Overall the analysis is well executed. The presentation and diagnostics, however, are somewhat uneven, and attention will have to be paid to a number of methodological and presentation issues.*

*The authors will also have to strive to interpret their results for the broader environmental health audience by conjecturing about the generalizability of their results to other locations, based on the results from the few published studies and on their own understanding of the similarities and differences of Sarnia compared to other urban locations. The city seems small and unduly influenced by the petrochemical contribution – what does this mean for their findings and their generalizability to other locales? My sense is that their study has fairly restricted generalizability, but could make a contribution by noting that point sources are an important source of ambient VOCs (much of the current literature focuses on traffic). Special attention to the buffer sizes in their study compared to others will be needed in the Discussion. More on this point below.*

Thank you for your compliments and suggestions. We have responded to your concerns and suggestions which have definitely improved the revised manuscript.

1. *Title*
   *The title suggests only BTEX will be modeled, but in fact all the individual constituents are also modeled. Possibly a change from BTEX to VOCs or HAPs would be appropriate.*

With inputs from the other reviewers, the title has been revised and it now reads: "Assessing the distribution of volatile organic compounds using land use regression in Sarnia, "Chemical Valley", Ontario, Canada"

2. *Abstract*
   *Acceptable, but with a few clarifications needed: (1) line 1 in the abstract, "alternative" to what? needs clarification; (2) conclusions, traditional LUR modeled pollutants, do you mean NO2? Be specific.*

   For clarity, the work "alternative" was removed and the statement now reads: "… proposed as a promising approach to meet some of the challenges..."

   With additional inputs from the other reviewers the word "traditional" was also removed and the sentence rephrased for clarity. The statement now reads: "Yielding potentially different health effects than nitrogen oxides and particulate matter, modelling other air pollutants is essential for a better understanding of the link between air pollution and health."

3. *Introduction*
   *This was the most problematic part of the paper. While it is clear that care was taken with the modeling procedure, the literature review is at times inaccurate, and this will require revision and possibly further interpretation of relevant articles. Some of the articles cited in the first line of the paper do not actually deal with health effects as suggested, but with exposure.*

   The introduction has been revised to reflect the concerns raised.

4. *There is a need for a footnote or additional line citing what a "number 1 human carcinogen actually means". More accurately this is "Group 1 – carcinogenic to humans."*

   The statement was rephrased for clarity and it now reads: "…classified benzene as a known human carcinogen…"

5. *Did the US DHHS actually say this was a "strong causal" relationship. This is the type of wording that government agencies rarely use – so you need to be certain. I'm not suggesting this is incorrect, but double check because it could reduce the credibility of the article if it is not accurate.*

   The statement was revised and it now reads: "the US Department of Health and Human Services (2007) reported an association between occupational exposure to benzene and the occurrence of acute myelogenous leukemia."

6. *What is meant by "intensities that were considerably low"? Low compared to what? Normal ambient conditions? Lab data? Occupational exposures? Clarification needed.*

The statement was revised for clarity and it now reads: "In Australia, Glass et al. (2003) found an association between leukemia and cumulative benzene exposures that were considerably lower than the accepted level."

7. *Somewhere in the Introduction, you need to emphasize that there is a discordance between the evidence from toxicology, occupational epidemiology and environmental epidemiology. The exposures in the ambient are often very low compared to indoor and environmental exposures – so although there is biological plausibility for a link between VOCs in the ambient environment and health effects, the evidence to date is formative to say the least. See for example:*
   *Sexton, K., Adgate, J.L., Ramachandran, G., Pratt, G.C., Mongin, S.J., Stock, T.H., Morandi, M.T., 2004. Comparison of personal, indoor, and outdoor exposures to hazardous air pollutants in three urban communities. Environ. Sci. Technol., 38: 423–430.*
   *Also see an excellent review by G. Leikauf in EHP for the biologic aspects of VOC exposure.*

   Thank you for the references. Where appropriate, information from the references is incorporated into the revised manuscript. For example, "Although there is a biological plausibility for a link between hazardous pollutants in the ambient environment and health effects, there are discordances between the evidence from toxicology, occupational and environmental epidemiology. This is partly because the threshold concentrations observed in clinical studies are frequently above those in epidemiologic studies (Leikauf, 2002). Researchers have also documented that ambient (outdoor) air pollution might underestimate personal exposure because people spend most of their time indoors (Aguilera et al., 2008; Sexton et al., 2004; Adgate et al., 2004). However, with the consistent pattern of outdoor air pollution measuring lower than indoor air pollution (Sexton et al., 2004; Adgate et al., 2004), outdoor exposure should not be considered obsolete. Rather, outdoor air pollution can be used as an estimate of overall pollution pattern, especially in high polluted areas where the correlation between indoor and outdoor air pollution might be high. Overall, in Sarnia, outdoor traffic and industry-related air pollution would highly influence indoor levels because of the numerous petrochemical industries (see also Lee, 1997). Hence, in the absence of indoor air pollution estimates, outdoor exposure patterns are sufficient for health studies (Rava et al., 2007)."

8. *A major point that's missing is that the very low levels in the ambient environment have not been observed to generate health effects in toxicological studies – or at least very minor ones. So the picture linking ambient VOCs to health is not as clear as suggested, but there is no doubt further investigation is needed, which is part of the rationale for this paper.*

   The "background" section of the manuscript was revised to reflect suggestions and additional references provided by the reviewers.

9. *On the review and critique of various methods for predicting exposure, dispersion models are not only costly, but more importantly they often lack precision in the requisite meteorological or emissions data to predict accurately.*

   Statement revised to reflect the inaccuracy of dispersion models.

10. *Methods*
    *Not clear what the statement about highest levels of VOCs refers to; the plants or the ambient environment of Sarnia?*

    The statement was revised and it now reads: "These point sources in Sarnia are amongst the largest industrial polluters in Canada with the highest levels for some VOCs, such as 1-3 butadiene, compared to other polluters across the country (Curren et al., 2006)"

11. *I would recommend cutting the first para of p.7 entirely. Doesn't add much and takes away from the main points.*

    The paragraph is removed.

12. *If you do choose to retain, change the following:*

    The paragraph is removed.

13. *Top of p.7 change show to shows.*

    The paragraph is removed.

14. *Need to indicate that London and Windsor are nearby Canadian Cities.*

    The suggestion is implemented and the statement now reads: "The City of Sarnia (42º 58' N, 82º 22' W) is located in southwestern Ontario, Canada, on the border just east of Port Huron, Michigan, USA (Figure 1). Neighbouring Canadian cities include London and Windsor."

15. *It's unclear what the kriging analysis adds and the authors should consider removing this from their paper. The kriging models look so similar to the LUR that readers may wonder why you have gone to the extra trouble. If you do choose to retain, some explicit comparisons of the predictions at control points between LUR and kriging would strengthen the paper. Possibly in industrial locations with one overwhelming emission source, kriging can supply a defensible exposure model – which would be good to know because the LUR is much more laborious.*

    With additional suggestions from the other reviewers, we have added Table 4 to compare the measured, kriged and LUR modeled concentrations at the sampling locations. "When compared to the measured concentrations (Table 4), kriging showed

higher correlation coefficients (0.71 – 0.99) compared to the LUR modelled concentrations (0.14 – 0.79). The LUR models showed high correlations with measured concentrations for BTEX (r = 0.61), benzene (r = 0.79), and toluene (r = 0.72) but considerably lower correlation coefficients for ethylbenzene (r = 0.38), (m+p) xylene (0.16) and o-xylene (r = 0.14). When the kriged concentrations were compared to the LUR modelled concentrations at the monitoring sites, BTEX (r = 0.66), benzene (r = 0.83), toluene (r = 0.73), and ethylbenzene (r = 0.51) showed significantly higher correlations compared to (m+p) xylene (r = 0.31) and o-xylene (r = -0.19). The LUR models underestimated o-xylene concentration at the sampling locations compared to kriging. The correlation results suggest that LUR modelling could be an efficient interpolator for benzene, toluene, and ethylbenzene but not for xylenes in a highly polluted area like Sarnia. The effectiveness of kriging in Sarnia may be due to the uniqueness of the area. Sarnia is a relatively small region with about 40% of Canada's chemicals manufactured in the region (Gilbertson et al., 2001).

16. *In the section on variable generation, the authors need to report the specific data sources for each variable with citations to the literature or companies that have supplied the data used in their analysis (e.g., DMTI).*

    We have added additional information on the specific data sources and the appropriate citation to the literature or companies that have supplied the data used in this study. The additional information reads: "The traffic counts were annual average daily traffic (AADT) volumes collected in 2004 and compiled for major and minor roads by the City of Sarnia, Administration and Engineering Department, and for highways by the Ontario Ministry of Transportation. Both the city and provincial traffic data were then combined in GIS to establish a comprehensive dataset for traffic counts based on road segments. Population and dwelling counts at the dissemination area (DA) level were generated from 2001 census data (Statistics Canada, 2006). The street network and land use 2006 datasets were obtained from Desktop Mapping Technologies Inc (DMTI) via the Data Liberation System from the University of Western Ontario. The street network file had information on all three types of roads (minor, major, highway) segment–by–segment. Digital elevation data were used to generate the elevation for each sampled station at a 25 x 25 m grid resolution (DMTI)."

17. *The authors need to find a better term than "best" model – or if they do want to use some term such as this, don't use "best" so frequently in such a short space. Possibly "most predictive" or "optimized" would be better.*

    The word "best" have been replaced with "most predictive".

18. *Results*
    *There is a problem here with the way the tables are organized. It would be more useful to have each land use variable down the rows (every one that is significant in any model) and the specific VOC models their coefficients down the columns. Then*

*report R2 and other summary statistics down at the bottom of each column (condition index, cooks' distance maximum, etc). This will allow readers to inspect the various coefficients and the statistics directly between the models. I could send a sample table if clarification is needed.*

The LUR tables were reorganized to incorporate some of the suggestions.

19. *All the figures are mislabeled as Figure 1 in my copy – need to carefully check this after web conversion. In general the figures are too small. The attempt to jam in all 6 figures into one figure does not work – needs to be enlarged on each figure. Possibly include just one or two surfaces that are zoomed in and note the similarity between others surfaces. Most of the VOC species are highly correlated, so this is reasonable.*

    The mislabeling was due to web conversion. We have made sure that all web conversions are correct this time.

    "The measured BTEX species are highly correlated to each other (Table 3). The kriged surfaces of measured BTEX concentrations showed similar patterns with high concentrations along the industrial core. Because of the high correlation between BTEX species and their similar patterns in the kriged surfaces, only two surfaces are shown (Figure 2). The benzene surface has a slightly more localized pattern when compared to the other BTEX species."

20. *On the topic of correlations between the VOCs, how do these correlations compare to other studies. They seem higher than what I have seen before, and this may be a reflection of the dominant industrial source. Some analysis and comparison to other studies would improve the paper.*

    "The correlations between BTEX species in this study showed slightly different coefficient ranges compared to other studies in Canada and the US (Pankow et al., 2003; Beckerman et al., 2008). This research has slightly narrow coefficient ranges (0.76 – 0.99) (Table 3) compared to the coefficient ranges (0.53 – 0.89) reported in Toronto, Canada (Beckerman et al., 2008). The difference could be due to the numerous petrochemical industries in the region. While examining the concentration and co-occurrence of VOCs in the US, Pankow et al. (2003) reported comparable correlation ranges (0.78 – 0.99) between BTEX species. The high correlation coefficients in this study suggest that BTEX species are emitted by similar sources and it might be possible to monitor only one or two of BTEX species in Sarnia (also Miller et al., forthcoming).

21. *The benzene plot indicates some model problems with some "sag" below the line in the middle of the distribution. Seems heteroskewdastic. Would the model pass a White's test? Some further investigation of this model and fine tuning seems warranted. As it stands the plot looks problematic and raises questions about the reliability of the model.*

In response to the concerns, we carefully re-examined the individual sampling points for their influence in the overall model. All highly influential cases based on their calculated Cook's distance were removed. After the outliers were excluded, the $R^2$ for the benzene model change from 0.69 to 0.78 with industrial land use within 1600m, dwelling counts within 1200m and length of highway within 800m showing significance. The manuscript was revised to reflect the calculated coefficient and new benzene plot is presented.

22. *Make the statement about the missing samples not being influential to "probably" not influential – you really don't know the impact with certainty.*

    Corrected

23. *Move reference to Table 1 to above the actual results reporting – need the reader to focus on the table before narration.*

    Corrected

24. *Discussion*

    *Most of the buffers used here are very large compared to other studies – this needs to be noted in the Discussion and needs to be compared to the other studies that have published VOC results. This gets back to my earlier concern about generalizability. If most of the influence in Sarnia is coming from an unusually large industrial area, then the large buffers are reasonable, but they do not seem to agree with the other published studies and are therefore not very generalizable to other places without such a large industrial influence. The models in general produce surfaces that are very similar to the kriging models, and this probably results from the very large buffer areas. What physical processes would generate such large buffers? At 2.8 km it seems that almost half the study area is covered by some of the large buffers – which would basically indicate little small area variation and a generally high level across the study domain. This is a concern given the relatively small study area and the dominant source.*

    "When compared to other LUR models developed in Munich (Carr et al., 2002), El Paso (Smith et al., 2006), Sabadell (Aguilera et al., 2007) and Windsor, Ontario (Wheeler et al., 2008), the significant variables in the present study showed considerably larger buffer radii. For example, Wheeler et al. (2008) reported significant highway buffer radii of 50m and 100m for benzene and toluene models, respectively. However, in this study, we found significant highway buffer radii of 800m for both benzene and toluene models (Table 5). The later result was also larger than the 300m buffer radius reported by Beckerman et al. (2008) when examining the variability of traffic-related pollutants around an expressway in Toronto, Ontario. The differences could be due to the unusually large number of petrochemical facilities in Chemical Valley, hence the broader distribution of ambient air pollutants in the area. The larger buffer radii found in this study potentially limits the generalizablility and

transferability of the developed LUR models to areas of similar contextual and compositional characteristics (Hoek et al., 2008)."

25. *Although the predictions generally look high, I would like the authors to consider the following questions.*
    a. *Why would these be so different than other places?*

       Sarnia is different from many places because of the numerous petrochemical industries in the region.

    b. *Was the search for high R2 at the expense of physically plausible predictor variables?*

       The search was not for high R2 but rather for the variables that "best" explains the spatial distribution of the modeled pollution concentrations.

26. *What would be the sensitivity of the prediction surfaces and model output to the use of smaller buffers that are similar to what we have seen in other LUR VOC models or in distance decay studies such as Beckerman (2008) in AE that show a maximum influence zone away from one of the world's largest highways of about 300 m? You could test this directly and it is worth some further investigation as a sensitivity analysis.*

    Addressed above

***Minor points:***

a) *Avoid the words "noxious" and "cheap"*

   Corrected

b) *Some other references that might be useful are included below:*

   Thank you for the references. Where appropriate, information from the references is incorporated into the revised manuscript.