Author's response to reviews

Title: Peak Event Analysis: A Novel Empirical Method for the Evaluation of Elevated Particulate Events

Authors:

Aaron M Orkin (aaron.orkin@mail.utoronto.ca)
Pamela Leece (pamela.leece@mail.utoronto.ca)
Thomas Piggott (thomas.piggott@medportal.ca)
Paul Burt (paul.burt@ontario.ca)
Ray Copes (ray.copes@oahpp.ca)

Version: 3 Date: 11 October 2013

Author's response to reviews: see over
11 October 2013

The Editors
BMC Environmental Health
Submitted online via BioMed Central

Dear Editors and Reviewers,

Re: MS 1243997454948808; "Peak Event Analysis: A Novel Empirical Method for the Evaluation of Elevated Particulate Events"

Thank you for this review and editorial process. We are pleased to submit a second revised version of our manuscript, "Peak Event Analysis: A Novel Empirical Method for the Evaluation of Elevated Particulate Events".

The comments provided by the two reviewers have been helpful and guided this revision. Our responses to the reviewer comments are as follows:

Reviewer 1 (Kaarle Hämeri): Thank you for this review.  
Reviewer 2 (William Faulkner): Thank you for this review. All of the changes recommended in your edited version of the paper have been accepted in the revised version attached.

Please find attached a revised version of the paper.

Thank you for your consideration.

Sincerely,

Aaron Orkin
MD MSc MPH CCFP
Dalla Lana School of Public Health, University of Toronto
Reviewer 1

1) The manuscript lacks detailed information considering the measurements. The authors should explain at the minimum: the instruments used, the experimental set-up (including sampling lines, inlets, sampling height etc.) and calibration of instruments. All of this is now missing and without such information it is impossible to have any idea of the quality of the experimental data.

A real-time aerosol particulate analyzer, (Grimm Technologies Inc., Germany, Model 107) was used for this survey. The monitoring principle for this technology is light-scattering method of particles passing a laser beam at approximately 90 degrees. The instrument has a size-selective particulate matter (PM) 10 head. The numerical designation denotes the aerodynamic diameter of the particle size. The instrument measures PM$_{10}$, PM$_{2.5}$ and PM$_{1}$, then calculates the Total Suspended Particulate (TSP) concentration. Survey design and set-up was based upon complaints received by the Ministry of the Environment. The survey design was to verify the complaints and try to determine the source. Instrument intake consisted of a stainless steel PM$_{10}$ head and inlet located approximately 6 feet off the ground. The instrument had been calibrated before then after the survey.

A brief summary of this information has now been added to the paper's methods section.

2) The location of the measurements needs to be described. The authors mention closeness to a mine with possible specific emissions. How close was this mine and how is it located relative to measurements. Are there any other significant sources nearby?

A mineral extraction and processing company is located approximately 2.5 kilometres from the survey location. The data collected along with particulate samples collected at the survey site showed similar composition to the source products. The mineral is processed at two different locations producing similar products. The second location is more 5.5 kilometres away.

This information has been added to the paper's methods section.

3) The manuscript lacks discussion about uncertainties or errors. This should be included at least in discussion. The results show values with 4 digits and it is not likely that this is the accuracy of the experiments.

The main source of uncertainty and error in the data arises during periods of high relative humidity. Particles above 10 microns can interact with the instrument’s laser and sensor to over-report TSP concentrations under certain conditions. This effect is most likely to occur under high relative humidity conditions because the instrument has a limited capacity to dry the incoming air stream. Under long periods of high humidity conditions this capacity can be exceeded. High humidity conditions can cause unusual TSP readings under certain conditions. This information has been added to the paper’s discussion section.

The results are reported to the nearest thousandth (two decimal places). This is the correct accuracy of the aerosol particulate analyser instrument used. No results have been reported to four decimal places.
4) The links to existing health relevant studies should be discussed more. In the introduction section, the authors speculate on the influence of peak concentrations, but no studies are cited that show the actual knowledge about this.

This study refers less to disease-related health effects (such as heart disease, chronic obstructive pulmonary disease, silicosis etc.) than to widely understood nuisance effects arising from even extremely brief particulate events. Anyone who has sat next to a campfire when the smoke blows toward them, worked with a masonry saw, or stood next to a dirt road with intermittent traffic, knows that brief but very elevated particulate levels can be uncomfortable. In general, there is little data to show that these brief discomforts produce chronic or population-level health effects, but there is nevertheless little doubt that it would be a nuisance to live in a setting where extremely elevated brief peak events occur on a regular basis.

Brief exposure dust, fumes, or vapours in patients with no prior history of respiratory disease has, however, been described as the causative agent in reactive airways dysfunction syndrome (RADS), resulting in persistent symptoms of airway inflammation and bronchial reactivity. Therefore, brief exposures to elevated particulates can have lasting health effects.

This section in the introduction has been enhanced with further references.

5) Third paragraph in results section presents very high values. It would be interesting to get some more information where does this pollution come from. These values seem to be much higher than typical atmospheric levels even during peak events. The authors should also discuss the TSP results. It is widely known that the measurements of TSP are difficult to perform and usually considered inaccurate due to difficulties to sample the largest particles. Therefore in most of the air quality studies TSP is not considered any longer, but replaced by PM10, PM2.5 etc.

We acknowledge that these values are higher than typical atmospheric levels even during peak events. We emphasize that these are the maximum values reported, not the 98th or 99th percentile values as generally reported as peak values in other studies. The extremely elevated TSP value in August could be due to the humidity conditions causing unusual TSP values. This value is, however, within the accurate range of the measurement instrument.

We acknowledge that TSP is considered less commonly than PM10 and PM2.5 in most air quality studies. However, most air quality studies focus on combustion particulates, composed chiefly of smaller particles. Although we agree that there are important technical challenges involved in measuring TSP, we believe that TSP measurement still has an important place in occupational and general “nuisance dust” studies, with sources such as dirt roads, grain and wood dust, or sand. Where a substantial portion of particulates exceed 10 microns diameter, TSP measurements still have a role in providing a comprehensive quantification of particulates.

Finally, we agree that that it would be interesting to study where the observed particulate was coming from. However, the goal of this study was not to investigate or conclusively attribute the measured
particulate to a given source. Instead, the goal of the study was to determine if the available particulate data could explain why locals might have lodged complaints regarding brief but uncomfortable dusty conditions. A separate study conducted by the Ontario Ministry of the Environment in May 2012 revealed similarities between the dust and the mineral composition of nearby mining products. These results, however, are beyond the scope of this study.

Minor Essential Revisions

1) The lines 6-8 in results section repeats the previous sentence.

Thank you for this observation. The repeated sentence has been deleted.
Reviewer 2

1) The conclusion in abstract should address the analysis results in this study.

The abstract conclusion has been modified to attend more closely to the analysis results in the study.

2) In background section, authors should give a general review on the PM data evaluation methods to highlight the purpose of this study.

A real-time aerosol particulate analyzer, (Grimm Technologies Inc., Germany, Model 107) was used for this survey. The monitoring principle for this technology is light-scattering method of particles passing a laser beam at approximately 90 degrees. The instrument has a size-selective particulate matter (PM) 10 head. The numerical designation denotes the aerodynamic diameter of the particle size. The instrument measures PM$_{10}$, PM$_{2.5}$ and PM$_{1}$, then calculates the Total Suspended Particulate (TSP) concentration. Survey design and set-up was based upon complaints received by the Ministry of the Environment. The survey design was to verify the complaints and try to determine the source. Instrument intake consisted of a stainless steel PM$_{10}$ head and inlet located approximately 6 feet off the ground. The instrument had been calibrated before then after the survey.

The authors believe that this information would be best suited to the methods section. A brief summary of this information has now been added.

3) Figure 2 about variation of TSP and PM10 in August 2012 was confused. The left Y-axis (log) and right Y-axis (normal) showed the different scales, but how to identify which one is TSP or PM10.

Figure 2 includes a legend located to the right of the May 2012 graph. TSP is represented as the blue line and PM$_{10}$ is represented as the red line in both the May 2012 and August 2012 graphs.

4) The characteristics of the novel method mentioned in this paper should be addressed more clearly.

The methods section of the paper has been enhanced to provide a clearer description of the elements of our novel approach to peak event analysis.
Reviewer 3

Methods
Page 3

How were measurements made? Where was the sampling location relative to the source? Relative to the location from which complaints originated? What was the wind direction?

A real-time aerosol particulate analyzer, (Grimm Technologies Inc., Germany, Model 107) was used for this survey. The monitoring principle for this technology is light-scattering method of particles passing a laser beam at approximately 90 degrees. The instrument has a size-selective particulate matter (PM) 10 head. The numerical designation denotes the aerodynamic diameter of the particle size. The instrument measures PM$_{10}$, PM$_{2.5}$ and PM$_{1}$, then calculates the Total Suspended Particulate (TSP) concentration. Survey design and set-up was based upon complaints received by the Ministry of the Environment. The survey design was to verify the complaints and try to determine the source. Instrument intake consisted of a stainless steel PM$_{10}$ head and inlet located approximately 6 feet off the ground. The instrument had been calibrated before then after the survey.

A mineral extraction and processing company is located approximately 2.5 kilometres from the survey location. The data collected along with particulate samples collected at the survey site showed similar composition to the source products. The mineral is processed at two different locations producing similar products. The second location is more 5.5 kilometres away.

It would be interesting to study where the observed particulate was coming from, by examining wind direction, other meteorological variables, and the dust’s chemical composition. However, the goal of this study was not to investigate or conclusively attribute the measured particulate to a given source. Instead, the goal of the study was to determine the source. Instrument intake consisted of a stainless steel PM$_{10}$ head and inlet located approximately 6 feet off the ground. The instrument had been calibrated before then after the survey.

A brief summary of this information has now been added to the paper’s methods section.

Analyses Performed
Page 3

How could they have no effects on the mean? They may have small effects, but they must have effects unless these data are excluded. What "other changes"?

This point is well taken. Even brief peaks should have some minimal effect on mean levels. However, brief peak events could have minimal perceptible effect on monthly mean particulate levels over the course of several months if they occur in concert with other seasonal changes to the baseline level of particulates in the ambient air, such as pollen levels, local vehicular traffic variations, or changes in activity levels at the mining source. The sentence in question has been changed to “Depending on other concurrent changes and sources of environmental particulates, these brief peak events may have minimal effect on calculated monthly means.”
Analysis of meteorological data would make the paper much more informative. What was occurring meteorologically when the peak events occurred? Similar observations have been made in rural areas in the US when an inversion layer is present near a feedyard or harvesting operation.

We agree that analysis of meteorological data would be informative. However, analysis of meteorological data would contribute to addressing a different research question than that which motivated this study. As discussed in the paper’s background section, our study was driven by efforts to identify if the local complaints regarding dusty conditions could be confirmed with an analysis of local particulate levels. To answer this specific question, we restricted our analysis to an examination of peak particulate events.

An analysis of meteorological data would add to our analysis by helping to identify possible particulate sources based on the location of the sensor and the associated sources. Alternatively, an analysis of meteorological data might connect peak events with certain wind, humidity or temperature conditions. Since these were not the aims of our study, meteorological analysis was not performed.

In short, our study concerns analytical techniques to identify the presence of peak particulate events rather than analytical techniques used to attribute those events to specific sources. For this reason, meteorological data has a limited role in addressing our research question and has not been included.

**Results**

Is this value within the detection range of the instrument used for measurement? If these values were measured using TEOMs, did such heavy loading effect subsequent measurements?

As discussed above, the values were not measured using TEOMs.

We acknowledge that some of the reported values are higher than typical atmospheric levels even during peak events. All values are, however, within the accurate range of the measurement instrument.

**Conclusions**

Are these events predictable? Analysis of the meteorological data would be helpful to answer this.

Our reasons for not conducting meteorological analyses are discussed above. We concur that meteorological analyses would provide interesting additional perspectives, but would not contribute to addressing our specific research question, which is restricted to analytical techniques for the identification of peak events.