Reviewer's report

Title: Measurement error in time-series analysis: a simulation study

Version: 1 Date: 24 June 2013

Reviewer: Matthew Strickland

Reviewer's report:

This is a clearly written description of a simulation study to investigate the effects of measurement error in a time-series study. The bottom line result from this paper is "when regional averages were based on 5 or 10 monitors per region, health effect estimates were virtually unbiased. However, with only 1 monitor per region, the regression coefficient was attenuated." This is an important result that helps to inform the practice of epidemiology.

Major Revision

Overall I see one major weakness of the study (something the authors readily acknowledge). Namely, there is no meaningful spatial pattern in the simulated mean pollutant concentrations, i.e., the grid-specific means mu(i) are normally distributed around an overall mean mu, and the only input to the correlation matrix (D) is distance between monitors. For many pollutants in a real-world setting the concentrations tend to be highest near the urban core and then decrease with increasing distance from the core (sometimes isotropically, but often not). In such a setting it might require averaging more monitors to get to the point where the health effects are virtually unbiased. And so this is the major concern that I have with the interpretation of the Results - that people will look at Tables 2 and 3 and think they are in pretty good shape with respect to their own study if they only have 2 or 3 monitors (which is a very typical real-world situation to be in) whereas in reality things might not be as rosy as suggested by the Results. I think that the authors should give consideration to these caveats and be sure they are well-conveyed in the paper.

Minor revisions:

1) The authors' focus is predominantly on additive error, which is reasonable for a spatially homogeneous secondary pollutant like ozone but less so for pollutants with major primary sources like NO2. I think that the inclusion of the proportional measurement error results are important part of this paper, and I would encourage the authors to mention that they do this in their abstract and/or background, as I was somewhat surprised when it finally came up at the end of the Methods section.

2) In the background on page 1: In a Poisson model Berkson error can cause bias away from the null if the variance of the Berkson error is not constant (across levels of Z), even if Z is measured without error. See Steenland et al Scand J Work Environ Health 2000, 26: 37-43.
3) This is a very small edit, but I would suggest the authors do not mention "adjustment for grid as a fixed effect" in the Background, as I spent time wondering what the purpose of this would be (control for confounding? lack of an offset?), and it wasn't until several pages later that the reason for its inclusion was addressed.

**Level of interest:** An article whose findings are important to those with closely related research interests

**Quality of written English:** Acceptable

**Statistical review:** Yes, and I have assessed the statistics in my report.

**Declaration of competing interests:**

I declare that I have no competing interests