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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Effect of regional precursor emission controls on long-range ozone transport – Part 2: steady-state changes in ozone air quality and impacts on human mortality" *by* J. J. West et al.

**Anonymous Referee #2**

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This study rigorously analyses the long-term effects on surface ozone air quality from 9 regional NOx emissions perturbations via impacts on methane. The authors extend the study to combine the short-term ozone responses quantified in a companion paper and then determine the effects on premature ozone-related mortality. Previously, such secondary ozone effects have been quantified in terms of climate forcing but not surface ozone change and in that sense the work is unique. The paper is extremely well written and comprehensive. However, there are weaknesses in the methodology and the application of a global model to examine health effects.



Specific comments are outlined below:

1. Page 7084. Please explain more clearly the use of the scaling described in lines 9-13 and exactly how the surface ozone concentration change is determined form the estimated methane response. Is methane dynamic or prescribed in the model? The Fuglestvedt et al. (1999) method for determining the methane change (and secondary ozone effects) based on the initial change in the methane lifetime is useful for determining the global scale responses i.e. global ozone burden change. It is not clear in the text how the spatial changes to surface ozone are determined from these global methane changes. The surface ozone response to a global methane change will not be spatially homogeneous. It will depend on the local short-lived precursor emissions that may easily change over the lifetime of the methane perturbation. How is this taken into account?

2. Estimates of health effects should not be performed at the current resolution of the model (2.8 x 2.8 degrees) or even at 1 x 1 degree resolution, as concentrations, thus health effects, in urban areas vary significantly across short distances, and such variations cannot be captured by a global model without nesting.

3. An assumption of the paper is that the methane change is globally homogeneous. How true is this assumption? For example, oxidation capacity varies enormously from region to region.

4. Of the multiple health effects of ozone, why was premature mortality selected as the outcome in this study?

5. The actual ozone responses are tiny (ppt) level and are probably dwarfed by inter-annual variability. Please provide a measure of the expected uncertainty range for all the results.

6. What is the physical meaning of a negative 'avoided mortality'?

7. The dose response relationships have been developed based on much higher ob-

served ozone change levels. Is it appropriate to use these relationships for such tiny ozone changes?

8. The model health results are interesting and provocative but may not be meaningful because of the coarse grid resolution. Does it make (common) sense that 10% NOx emissions reductions in North America have substantial impacts on mortality in India and East Asia or the same reductions in Europe have substantial impacts on mortality in Africa? Table 5 seems to strongly reflect regional population density. Does epidemiological/observational evidence exist to support such long-range influences based on tiny changes in surface pollutants? The India and China regions feature huge and increasing loadings of pollution from local emissions sources. Long-range pollution transport health impacts must be negligible compared to health impacts of local pollution in these regions? In the real world, the US has experienced a 20% increase in NOx emissions in the past 10 years and reductions have also occurred in Europe. Is it possible to detect the influence of these real world perturbations on human health in the developing nations and locally? Have avoided mortalities decreased in Europe due to these NOx reductions?

9. I found Figure 2 difficult to read.

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 7079, 2009.