Atmos. Chem. Phys. Discuss., 8, S693–S696, 2008
www.atmos-chem-phys-discuss.net/8/S693/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The role of climate and emission changes in future air quality over southern Canada and northern Mexico" *by* E. Tagaris et al.

Anonymous Referee #2

Received and published: 12 March 2008

Title: The role of climate and emission changes in future air quality over southern Canada and northern Mexico

In general, I believe this paper is well written and covers important work. There was clearly a substantial amount of work that went into this paper, and it could potentially be an important contribution. There are, however, some major issues that would have to be addressed before this work is published.

General comments:

1. The authors have not established that this model predicts meteorology, ozone, or

PM accurately over Canada or Mexico. While Tagaris et al. (2007) evaluated the model over the US, there has been no evaluation over the areas that are discussed in this paper. It is difficult to put any stock in the conclusions of this study when we have no idea of the quality of predictions in the regions being studied. Data should be available for comparison (for example, http://www.statcan.ca/english/freepub/16-251-XIE/2007000/maps/map2-en.htm). I believe the lack of model evaluation is a major flaw of the work in its present form.

2. This work uses the IPCC A1B scenario to represent future climate and emissions. This is simply one of a set of many (infinitely many, actually) futures that are within the realm of possibility. The authors frequently use the future tense (i.e. from the abstract – "Global climate change combined with the projected emissions will decrease M8hO3..."); this implies that the A1B scenario is THE future, not just one possible future scenario. The authors should stress that this is one of many possible scenarios and that predictions are for the 2050s under the A1B scenario, not just for the 2050s.

3. It is uncertain whether three present years and three future years are representative of "the present" and "the future". For example, one unusually hot year, such as 2002, could have a large influence when only three years are simulated. Interannual variability is a very important issue when trying to predict these long-term effects, but they are barely discussed in this paper.

Specific comments:

Introduction 1. The authors assert that the cited studies lead to the conclusion that "climate change alone seems to play a minor role" in determining future ozone concentrations. Some of the studies, especially Hogrefe et al. (2004), show climate changes to have an important effect on ozone. The authors imply that there is a consensus that climate effects on ozone are expected to be small, when this is not the case.

Methods 2. Another importance difference between Tagaris et al. (2007) and the present work is the model evaluation in the 2007 paper that is not in this paper.

ACPD
8, S693–S696, 2008

3. Given that there is no data assimilation, are your present-day summers actually representative of 2000-2002, or are they really theoretical generic present-day summers? The impression the paper gives is that the work is actually reproducing the meteorology and air quality from 2000-2002, though without any meteorological assimilation, which seems quite difficult. Was there any assimilation done at the global (GCM) scale? If the "historical" years are actually generic present-day years, it may be clearer to label them as such.

Results and discussion Meteorology 4. It is difficult to have faith in the predicted meteorological changes when no comparison to measurements has been made for the present day.

5. Table 1 – Four significant digits seems like overkill for temperature, mixing height, and insolation. These should probably just be rounded to the nearest integer.

6. Figure 2b – Is this (total number of rainy days in three future summers) - (total number of rainy days in three present summers), or is this the difference in the average number of rainy days per summer? Either way, it should be clarified. It is probably more meaningful to the reader when expressed as a per summer average. If this already is shown as a per summer average, the change in the number of rainy days is enormous, especially around Vancouver – up to 60 out of a total of 90 days in the entire summer. This would be a very important, noteworthy result. Also, it may be more meaningful to show the number of days with rain over a certain threshold amount rather than just any amount of rain greater than 0.

Emissions 7. Are the changes in emissions in Table 2 the average per grid cell? Whether this is the average per grid cell or the total for the entire region, it should be stated explicitly. The impression given in Figure S1 is that these are per grid cell.

8. For the case where only climatic changes are considered, is there a dependence of NOx emissions on lightning? If so, climate could increase NOx if more convective systems are expected.

ACPD
8, S693–S696, 2008

9. Does industrial growth explain the increase in ammonia emissions? Wouldn't most of this be due to livestock and agriculture?

Air quality Ozone 10. p. 3412, line 25 – "while it is expected an increase" should probably be "while it is expected to increase".

Particulate matter 11. Figure 3b – These average concentrations seem rather low, but there is a lot of remote area in the domain, so it is possible that they are correct. It is difficult to know when there has been no model evaluation.

12. The main meteorological effects are asserted to be due to temperature and precipitation. Do the authors think that PBL changes are also important?

13. Table 4 – Given that the relative compositions of PM under historic and futurenp scenarios are nearly identical, it seems that processes that affect all PM species equally may have the largest effects. This could mean things like precipitation, PBL height, and wind speed may be the most important.

14. Figure 8 – The color scale chosen shows changes in the US quite well, but obscures the (smaller) changes in Canada and Mexico – the actual regions of study in this paper. Perhaps the color scale should have finer resolution so the changes in Canada and Mexico are more apparent.

15. p. 3414, line 24 – "lower compared to" should probably be changed to "smaller than" for clarity.

Conclusions 16. The second-to-last sentence is not worded clearly.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 3405, 2008.