Atmos. Chem. Phys. Discuss., 12, C9273–C9275, 2012
www.atmos-chem-phys-discuss.net/12/C9273/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of a future H_2-based road transportation sector on the composition and chemistry of the atmosphere – Part 1: Tropospheric composition and air quality" *by* D. Wang et al.

D. Wang et al.

dong.wang@cmcc.it

Received and published: 13 November 2012

General response: It seems that this reviewer judged the value of this study based on whether a H2 economy is likely to be realized and, not on the value of the science study with the assumption that such a use of H2 could possibly occur. We would argue that the atmospheric impacts are worth looking at whether an individual thinks such an economy would develop or not.

C: The possibility of a H2 based transport sector has lost some steam in recent years

with wider acceptance of electric and battery powered transportation and thus diminishing the value of this study on a purely impact basis. R: We believe that the true value of a study does not fluctuate as fashion does. This study is an evaluation of impact of an assumed H2 economy. The debate on whether H2 economy will realize is beyond the scope of this study. We are sorry that this reviewer judged this study from this point of view.

C: It would probably be more useful if some of these were presented as ratios, molecule of H2 emissions to delta change in ozone under scenario xyz, as an example. R: It is the change in the fossil fuel related emissions that results in a change in ozone. Such metrics are not appropriate because of the nonlinear tropospheric ozone chemistry. Therefore, it makes little sense to use the metrics suggested by the reviewer.

Specific Questions: a) was H2 lower boundary condition in the models set as a mixing ratio BC or a flux boundary condition? R: It was flux boundary condition.

b) Section 4.2 Ozone, line 14; in figure 3b and 3e what is going on at the tip of Africa? The ozone here shows an increase. R: Ozone formation in the southern tip of Africa is VOC-limited. That is, when both NOx and VOC emissions are decreased as in the H2-FC scenarios, ozone concentration increases. Whereas when only VOC emission is decreased, ozone concentration decreases as shown in Figs. 3c and 3f.

c) Section 4.2, line 15: "these regions ozone production is VOC limited. . .', if VOC goes down shouldn't you see a decrease in ozone under these conditions? R: The whole sentence we wrote is 'In these regions ozone production is VOC-limited, hence decreasing both NOx and VOC emissions, as in this H2 fuel cell case, does not effectively decrease ozone.' Note in the H2 fuel cell scenarios, NOx emissions decrease as well as VOC in these regions.

d) In section 3 Model Description, line 25: How many years was the model used to simulate the same year? It is said that the lifetime of H2 is between 1 and 2 years. Did the model simulations last long enough to reach steady state? R: The model was

ACPD

12, C9273–C9275, 2012

run for eight years to simulate the same year. The simulation period is long enough for tropospheric chemistry to reach steady state. As stated in the paper, inter-annual changes of key species is less than 1%.

e) What is the lifetime of H2 in your calculations? R: The lifetime of atmospheric H2 is discussed in the paper.

f) It is seems odd that CMAQ used MM5 and not the CAM dynamics for the simulations? R: We used MM5 meteorology because it is more suitable for driving the CMAQ model. CAM is a global model whereas MM5 is a higher resolution regional model

g) Were the CMAQ BC's for gases comes from CAM-CHEM? R: Yes.

h) How are the CMAQ simulations performed? Are these simulations for a full year? repeat the same year for a steady state? R: The CMAQ simulations were performed for a full year.

i) The CMAQ results are presented as 8-hr averages and peak values, where as the CAM-CHEM results are presented as annual averages. It is hard to compare these two analysis. It would be useful if the CAM-CHEM results are also plotted as 8-hr averages and peak values. R: Which statistics to use depends on what can be drawn from modeling studies. The results in which we are interested are different for global models and regional models. For the global model, we are more interested in how background concentrations of key species change; whereas for the regional model (CMAQ in this case, which is often used in air quality analyses) key air quality standard criterion statistics are evaluated.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 19371, 2012.