

***Interactive comment on “The impact of a future
H₂-based road transportation sector on the
composition and chemistry of the atmosphere –
Part 1: Tropospheric composition and air quality”
by D. Wang et al.***

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C: At several places in the introduction and sections 3 and 4 the soil sink for hydrogen is mentioned but it is not described how it is implemented. Is it a uniform deposition velocity over land surfaces or is it dependent on vegetation type? This should be critical for the regional model.

R: As discussed in the Introduction Section (last paragraph on page 19374), field studies suggested a correlation between the deposition velocities of H₂ and CO. The factor

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is around 2. So we modeled that the deposition velocity is twice that of CO, that is, $V_d[H_2]=2 \cdot V_d[CO]$, as stated in the last sentence of the first paragraph in the Model Description Section (first paragraph on page 19381).

C: Are the emissions available for the fine grid of the regional model? Even if more information is in the (difficult to get) reference a little bit more should be said in the text.

R: The CMAQ emissions distribution was based on emissions from the SMOKE model for the CMAQ chemical mechanism and developed at the native CMAQ grid resolution. For the future scenarios these emissions were scaled using scaling values as in the CAM-Chem simulations.

C: Page 19376: I suppose the annual tropospheric average of OH concentration is meant without any weighting for reaction constants with CH₄ or CO as sometimes in the literature. R: The average of OH concentration is meant without any weighting for reaction rate constants with CH₄ or CO in this paragraph.

C: Page 19379: The hydrogen demand is assumed to be the same for FC and ICE. I would expect that the efficiency of both techniques is different. Is the percentage of leakage larger in densely populated regions? Please clarify.

R: The efficiency of the two techniques can be different, but it is difficult to specify which one is higher than the other and how much larger. In this study, we assumed them to be equal. The percentage of leakage is the same, regardless of the leakage location.

C: Page 19385: What is average tropospheric ozone? Ozone in the boundary layer or in the whole troposphere including stratospheric influences? Please expand, the given number alone is not useful. The word 'summertime' is misleading here and in the figure caption since for the southern hemisphere winter is shown.

R: Averaged in the whole troposphere. 'Summertime' is modified in the revised paper.

C: Page 19387, last paragraph: I'm surprised not to see the reference to the Spivakovsky climatology here R: We don't think it is necessary to do so.

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C: Page 19390: What is average NO_x? Mention also peak values and their changes and/or probability density functions. 80% of what? R: Modified in the revised paper.

C: Page 19393, third para.: mention nitrate explicitly, I suppose this is meant here. R: We actually meant PM_{2.5} here.

C: Page 19396: I don't understand the different results in section 4.6.2 for the northern midlatitudes. Please explain better. R: Modified in the revised paper.

C: Page 19397: Please expand the explanation of nitrate changes slightly. R: Modified in the revised paper.

Technical corrections: C: Page 19388, line 19: 'which would reduce'. R: Modified in the revised paper.

C: Page 19401, line 17: typo. R: Modified in the revised paper.

C: Page 19404 and 19405: Don't use 'burden' (usually an integral) for mean mixing ratios and concentrations. R: Modified in the revised paper.

C: Figures 2, 3, 4, 8, 10, 12, 14, 15, 16: The different blue colors are difficult to distinguish. Please modify the color palette. R: This color palette has been tested to show best key features of the pattern, and has been adopted many publications. The color in the discussion papers is a bit off the original.

C: Figure 3 and 4: Replace in caption 'summertime' by 'NH summer'. R: Modified in the revised paper.

C: Figure 5, 9, 11, 13: The color scheme for the changes is confusing because in most publications the strongest decrease is blue or violet. It is also inconsistent to the results of the global model. R: It was chosen to highlight the most benign changes. We don't think this is a problem as long as the accompanying color bar is correct.

C: Figure 12, caption: Without dust and sea salt? Be consistent with text. R: In fact, the PM_{2.5} concentrations calculated by CAM-Chem include dust and sea salt with

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diameters no greater than 2.5 μm , so the panels for the baseline scenarios in Figure 12 did include the dust and sea salt with diameters no greater than 2.5 μm . What we meant in the text was that the changes in PM_{2.5} concentrations were not from changes in dust and sea salt.

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