

Interactive comment on “Atmospheric hydrogen variations and traffic emissions at an urban site in Finland” by T. Aalto et al.

Anonymous Referee #1

Received and published: 27 July 2009

The submitted manuscript presents a 1-year dataset of quasi-continuous observations of molecular hydrogen (H₂) in a suburban environment in Helsinki, Finland. The data were used to estimate traffic emissions making use of the observed H₂ to CO ratio during morning rush hours. This approach is not new but nicely complements a series of recent publications using similar approaches in suburban areas in Switzerland, Germany and France. Due to the high Northern latitude of Helsinki, the situation might be different in terms of seasonal variations in contrast to previous studies. The authors should elaborate on the seasonal variations (e.g. nothing is said so far to the annual variation of the experimentally derived H₂/CO emission ratio). Information to the seasonal variations could help to assess the uncertainty of the applied approach. To my mind, most reliable emission ratios should be achieved for morning rush hour episodes in winter when (a) the soil sink is reduced, (b) photochemical processes are negligible, C3325

and (c) convection / entrainment processes are weak. However, the (annually averaged?) results are in good agreement with literature values. Does that mean that the annual variations, i.e. the influence of the above mentioned factors even in summer are small? Nevertheless, the paper is within the scope of ‘Atmospheric Chemistry and Physics’ and is of sufficient originality to merit publication in this journal. The paper is scientifically sound but needs nevertheless some (minor) revisions before publication (see comments below). Language should be checked by a native speaker.

Specific comments:

Page 13921: Did the H₂ and ²²²Rn measurements use the same inlet?

Page 13921: ‘The linearity and reproducibility of the instrument were sufficient for the purposes of this work.’ Does it mean that no non-linearity correction was applied? Be more specific.

Page 13922, equation 2: please incorporate ‘ $j_{\text{EmiCO}} = \frac{\Delta\text{CO}}{\Delta\text{Rn}} \times j_{\text{Rn}} \times C$ ’ in equation 2 to make it clear how the H₂ to CO emission ratio was determined.

Page 13923: Where is the soil exhalation rate of radon coming from?

Page 13923: The determination of the background H₂ and CO mixing ratios is a crucial point for the key analysis of the paper. The authors do explain the selection procedure but it remains unclear why they finally use monthly means as background conditions and no running mean/harmonic fit or similar since they do already apply a harmonic fit to all data for the exclusion of outliers. If the authors stick to the monthly means I recommend adding the monthly means as vertical lines for each month in Figure 2. It wouldn’t add the monthly means in Figure 3 since it is less crucial for CO and it would make Figure 3 hard to read.

Page 13924: The authors mention a notable contribution to the H₂ signal from long-range transport but none for CO. What kind of sources can it be? Please specify / speculate.

Figure 4, Figure caption: 'The value refers to difference between the mean mixing ratio (or H₂/CO ratio) in current sector and minimum of all 10 degree sectors.' Which kind of minimum do you refer to? To the minimum of 1 h averages? To the absolute minimum? To the minimum of the background values? Please elaborate. Why don't you plot the mean H₂ and CO mixing ratios per 10 deg sector? Right panel: It could be more useful to plot the slopes of the H₂ to CO ratios in accordance with the following discussions in Section 3.2.2.

Page 19325: Do Figures 5 and 6 show all data or only weekend data? Nothing is said in the text when referring to the Figures for the first time. Page 13926, lines 14-15 might suggest that the Figures do show only weekday data. Why do the diurnal H₂ cycles for summer and winter and for spring and fall look similar, respectively? The missing morning peak in summer might be most likely explained by reduced traffic (and thermal convection already during the rush hour period?), but the reasons for the missing morning peak in winter remains unclear. The authors should elaborate on the seasonal differences as the situation in terms of annual meteorological conditions i.e. radiation in Helsinki is particular and different to the studies in Switzerland, Germany and France.

Page 13926: Situation in fall: '...At this time of the year, radon activity typically started to decrease after 08:00, suggesting that the slope represents stable nighttime conditions. ...' How does it look like in winter?

Page 13927, lines 10-21: What could be the remote sources that for H₂ and CO?

Page 13929: jEmiCO = 319 ... How does that compare with the numbers from Niemi et al. also used in this publications? Can you upscale jEmiCO? How was the uncertainty (+/- 74 ...) determined?

Chapter 4, first paragraph: The seasonal variations are some of the most interesting results of the study. Please elaborate on that (see also above, General Comments). The authors state that entrainment of non H₂-depleted air from above can bias the

C3327

slope calculation. This can only hold true for summer. Do you think that the winter slopes are more representative than the summer ones? How do they vary?

Page 13930, line 9: where is this number coming from? What's the regression coefficient for the H₂ to CO regression for the morning rush hour data?

References: References are not in alphabetical order (Solomon et al., Tignor et al.)

Figure 2, Figure 3: information in which years the data were measured is missing in the Figures. Add '2007' and '2008' in the graph or in the 'June 2007 to July 2008' in the Figure captions.

Figure 7: why only for 2 months?

Figure 8: quality should be improved. Blue and green colours are not that easy to distinguish.? Avoid duplicating the tick marks of the left y-axis on the right when left and right y-axis are used. Upper most panel: add more tick marks for Excess H₂ and Excess CO. Avoid duplicating the tick marks of the left y-axis on the right hand side. Third panel: Add appropriate ticks marks for wind direction (e.g. 0, 90, 180, 270, 360 deg). Add the units for the visibility.

Please also consider Yver et al, JGR, 2009, in press (available online) for data discussion / comparison with other studies.

Page 13918, line 1: write '... over a one year period ...'

Page 13923, line 1: write '... with the help the radon tracer method ...'

Page 13923, line 13: write '... came from the sector between ...'

Page 13928, line 24: write '... with the help of ...'

Figure 8, caption: Write 'Local time, September 27'

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 13917, 2009.

C3328