

Interactive comment on “H₂ vertical profiles in the continental boundary layer: measurements at the Cabauw tall tower in the Netherlands” by M. E. Popa et al.

Anonymous Referee #1

Received and published: 9 March 2011

review of acp-2010-925

Title: H₂ vertical profiles in the continental boundary layer: measurements at the Cabauw tall tower in the Netherlands

Authors: M. E. Popa et al.

The submitted manuscript presents 3 years of continuous molecular hydrogen (H₂) measurements at a tall tower in the Netherlands. The H₂ mixing ratios are alternately monitored at four heights from 20m to 200m above ground. This is a very interesting and rather unique dataset that allows to gain insight into various source and sink processes determining the local H₂ concentrations at the sampling site. Hence, the

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paper is within the scope of ‘Atmospheric Chemistry and Physics’ and is of sufficient originality to merit publication in this journal. However, the manuscript is a bit wordy, too detailed in some parts but also misses some (mainly technical) information. I think the papers could become more attractive when being shortened. Some suggestions for shortening are listed below (see the specific comments).

According to the authors, the flux estimates are pretty uncertain, partly due to lack of reliable Radon fluxes. The measurements in different heights above ground should allow determining fluxes without Radon flux information, only based on H₂ gradients and meteorological information. I would be curious to see if the results would match the H₂ fluxes determined with the Radon technique.

Finally, some conclusions to the representativeness of the data/results should be included.

Specific comments:

Abstract:

the abstract is way too long and too detailed. It has a bout 450 words (e.g. some journals restrict the abstract to 250 words).

Suggestions to shorten the abstract are:

Remove page 5590, lines 8 – 11 ‘From the three-year ...determine multi-annual trends’.

Remove page 5590, line 17 ‘which differentiates ... measured’

Remove page 5590, lines 18 – 23 ‘that is, ... of the soil uptake’.

Remove page 5590, lines 25 – 28 ‘Local soil and weather ... in our study domain’.

Remove page 5591, line 4 ‘In contrast’

Remove page 5591, lines 5 – 6 ‘are very similar to results of previous studies’.

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Other suggested abstract changes:

page 5590, line 3: add 'October' after 'since'

page 5590, line 7: add 'long-term' after 'quasi-continuous'

page 5590, line 11: 'Seasonal H₂ cycles are observed [at all heights] or [with decreasing? amplitude with sampling height]'.

page 5590, line 11: add 'unique' in front of 'behaviour'.

Page 5591, line 2: what do you want to say with 'scattered'? H₂/CO ratios are more variable than estimated?

Page 5591, line 3 - 4: replace 'a different driving regime due to frequent traffic jams' with 'frequently occurring congested traffic'.

Main text:

Page 5596, lines 12 – 15: details about the GHG measurements are not needed.

Page 5597, lines 8 – 14: what's the loop size? Is the loop temperature-stabilized? How does the temperature vary in the lab? Temperature and pressure changes are linearly influencing your amount of H₂ molecules in the loop and thus your result, right? Did you correct for that? You performed the calibration daily. Always at the same time of the day? How often did you measure the working and the target tank? Later (page 5599) you mention that WT measurements are used for correcting for short term sensitivity changes. What do you mean with short term?

Page 5597, lines 15 – 22: aluminium cylinders are often subject to H₂ drifts. Did you check for drifts?

Page 5598, lines 10 – 11: 'the only difference ... T1 and T2' could be removed.

Page 5598, lines 18 – 21: Radon monitor: add some information such as: manufacturer; how is the calibration done, where is the Rn monitor on Fig. 2, does it have

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separate inlet lines?

Page 5600: sections 'Precision' and 'Accuracy' could be merged into one.

Page 5601, Cabauw MPI-BGC difference in CO. Did you do the CO comparison also with your GC-FID measuring CO? If so, how did the offset look like?

Page 5602, equation 1: how does it look like when you include the linear term? I don't really see the point to exclude the linear term. When the time series is short and the trend is small, the linear term will be simply insignificant.

Page 5602, line 19 – 21: calculation of the baseline: '... averages of the 5th percentile of the weekly afternoon data...' I don't get it. You take all afternoon data within one week and calculate the 20% percentile? But what do you average? Please clarify. How is afternoon defined? What is your averaging interval? 5th percentile is the 20% percentile? Do you apply running averages? Same for CO.

Page 5606: reword 'High altitude pollution signal'. 200m isn't a high altitude.

Page 5606, line 9: do you have any information on H₂ emissions from airplanes? Please add a reference.

Page 5607, line 10: 'We initially suspected a contamination ...' Why? Because stronger gradients were expected? If so, which kind of?

Page 5610, lines 17 – 20: move this paragraph up (e.g. to the very end of Section 2.1?)

Page 5611, lines 11 – 20, equations 2 and 3: to my mind, this part is not necessary as the radon tracer method isn't new and is already described in various publications (that are already cited).

Section 4.5 Soil sink: you mention that your flux estimate is rather uncertain because there are no radon flux estimates/data available. As you measure in several heights above ground, did you try to apply the gradient method to determine the H₂ fluxes?

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(see e.g. Fick's first law, gradient transport theory or K-theory) It would be interesting to see if the results of the different approach are similar.

Conclusions: the conclusions are so far just summarizing what was already said before. Can you generalize/upscale the results or look at it from a broader perspective? It should be possible since you highlight the large footprint at Cabauw on page 5596, lines 3 – 6. Are the results supposed to be characteristic for Dutch conditions?

Acknowledgements: which CO analyzer from MPI Mainz you refer to? The CO data shown in the paper are measured with the RGA?

Minor comments

Page 5616, line 18: 'Gif-sur-Yvette' is misspelled.

Page 5621, line 16: change 'the introduction on larger scale' to 'a large scale introduction'

References

Bond et al. (second one) ... was published in 2011

Fabian et al., use subscripts for all species

King, remove symbol after 'Mycobacteria'

Liebl et al., check author names

Neubert et al., affiliations became part of author names, right?

Rockmann et al., check author names (who is T.S.?)

Szegvary et al., check superscripts (^{222}Rn , for both references)

Tromp et al., complete page numbers

Figures

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Fig. 4: why do you only show two years of data?

Fig. 5, caption: replace 'high altitude pollution events' with 'top level pollution events'?

Fig. 6: why don't you show all 5 events according to Fig. 5. It would make it easier for the reader.

Figs. 8 – 10: what do the error bars show?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 5589, 2011.

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