

Interactive comment on “Vertical profiles of nitrous acid in the nocturnal urban atmosphere of Houston, TX” by K. W. Wong et al.

Anonymous Referee #2

Received and published: 28 January 2011

Wong et al. acquired DOAS measurements of O₃, NO₂, and HONO in Houston, Texas. The DOAS instrument was located at a height of 70 m, with retroreflectors at 20 m, 130 m, and 300 m. This allows the authors to calculate O₃, NO₂, and HONO profiles with three levels of vertical resolution. These measured profiles are compared with vertical profiles calculated using a 1-D chemistry model. HONO / NO emission ratios are taken from the literature. NO_x emissions and vertical mixing are adjusted in the model to match observed NO₂ and O₃ profiles. The model is then used to predict HONO production and loss at different vertical levels.

The vertical distribution of HONO is an important topic, and few papers have presented vertical profiles. The scientific approach is valid and the conclusions reached in the paper are interesting.

C12936

Major comments:

1. The authors do not describe the assumed aerosol profile that is included in the model. How was the vertical aerosol profile determined? Are there any measurements that could be used to constrain the profile?
2. Page 30148 lines 12 - 15: "HONO mixing ratios below 20 m, which were not observed by the LP-DOAS, showed that..." This is unclear. Was there an additional, in situ HONO measurement that was not described in the experimental section? If so, why was it not used to constrain the model?
3. Page 30135, line 22: The authors select three nights with distinct vertical gradients, and use these examples to conclude that HONO production at the surface is greater than HONO production on aerosols. I assume that the authors selected nights with strong vertical gradients because this indicates a stable nocturnal boundary layer. If so, that should be explained in the text. Also, I assume that they used O₃ and NO₂ (not HONO itself) to select nights with strong vertical gradients. If so, that should also be explained in the text. Unless these two points are clarified, it seems as if the selection of nights influences the conclusion – by selecting only nights with strong vertical gradients in HONO, one would logically reach the conclusion that HONO comes from the surface. Are other days (particularly days without strong vertical gradients) not well-represented by the 1-D model? What about comparing the diurnal average for the entire period to the model?
4. On page 30137, line 5-6, the authors state that they believe "that the upper height interval was in the residual layer during both nights." In the conclusions, they state that HONO was often below 100 ppt in the upper height interval and care must be taken to interpret surface observations of HONO because they are not representative of the entire boundary layer. But the upper height interval arguably wasn't in the boundary layer. This inconsistency is confusing, and should be fixed throughout.
5. The authors adjust the NO_x emission rate and vertical transport in the model to

C12937

match the observations. What is the sensitivity of the model to HONO / NO emission ratio? Could the HONO / NO emission ratio change during the night, with changes in vehicle fleet (more cars, fewer trucks)?

6. Page 30140 line 12 What are the VOC concentrations that are included in the model?

7. Was the friction velocity measured? How does it compare to the values assumed for the model? What are the time scales for vertical and horizontal mixing (described on pg 30141 line 22)?

8. I don't understand the statement on pg 30151 line 7-8 "Therefore addition of HONO by direction emission leads to a larger net HONO formation at the ground when vertical mixing is constant." Why would HONO production be related to HONO emission?

9. How does the surface area of buildings compare to the surface area of the ground and aerosol?

Other comments: Page 30131 line 2 NBL not defined in introduction.

Page 30131 lines 6 - 10 Add references for these two sentences.

Page 30132 line 1 Remove "[i]n the nocturnal boundary layer" because HONO can be formed during the daytime as well.

Fix "relative humidity" throughout

Table 1 - Give acquisition time for detection limits

Figures 4, 5, 6 - Add panel indicating the error between the refined model and the observations.

Figure 9 - Simplify the figure. It is very difficult to distinguish the colors.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 30129, 2010.