

Interactive comment on “The use of tunnel concentration profile data to determine the ratio of NO₂/NO_x directly emitted from vehicles” by X. Yao et al.

X. Yao et al.

Received and published: 1 March 2006

This paper reports measurements on NO and NO₂ concentrations from two different tunnels in Hong Kong. The potential of the work is excellent. Very little data exists in the open literature on NO:NO₂ vehicular emissions, but the subject is of immense importance in understanding ambient NO₂ concentrations. Even slight changes in primary NO₂ emissions would have the potential to jeopardise air quality compliance in many cities. As the authors mention, tunnel measurements can provide complementary information to rolling road or instrumented vehicle measurements. The later focus on a limited sub-set of the fleet, whereas tunnel measurements are generally more representative of the whole vehicular fleet in one area. The differing results from the

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north and south tunnels emphasise that emissions can be fuel and fleet dependent and therefore that tunnel measurements are required in many different locations. Conversely, it also means that the reader requires detailed information on the fleet and fuel characteristics to compare the data from this study with other work. Despite the excellent potential of the work, I have serious concerns about the paper in its current state. Many of these may be straight forwardly addressed by the authors, but other issues may require further consideration.

1. More experimental detail is required. Methodology (presumably standard NO_x and O₃ boxes), position of sampling inlet. Response times of the instruments and calibration methods should be given. How many measurements were taken in the tunnels. The text mentions an average of 5 runs; 5 runs on the same day or different days? How reproducible are the profiles and concentrations from day to day?

Response: The manuscript has been revised to clarify the points raised. Additional information on the monitoring platform can be found the cited reference (Yao et al., AST, 2005). As presented in the paper, 5 runs in different days were carried out and the measurements were used for estimating the upper limits of the vehicle primary NO₂/NO_x ratio. The results are reproducible.

2. The effects of the tunnel ventilation should be described in much greater detail and incorporated into the analysis. It surprises me to see that the authors were able to observe significant O₃ concentrations in the tunnel, when it's lifetime in the presence of even 1 ppm of NO is only 2 seconds. Would it be possible to measure the ambient NO, NO₂ and O₃ concentrations at some of the ventilation inlets?

Response: More details on the tunnels and traffic have been included in the revision.

We did not measure ambient NO, NO₂ and O₃ concentrations at the ventilation inlets. We have practical difficulty in Hong Kong in that the tunnel operators are reluctant to allow us to do any stationary measurements because we would interrupt their normal operations (which means income). Furthermore, we do not have the resources to

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simultaneously perform stationary and mobile measurements. Tunnels in Hong Kong are open systems with forced ventilation. It is highly conceivable that some species such as ozone can be brought into the tunnel (even the mid-section). In a close system, the reviewer is correct that highly-concentrated NO cannot coexist with O₃. However, this may be not case for an open system. The important thing is that tunnel is just about only place that we could think to measure vehicle emitted NO₂ where ozone is at a minimum. To the best of our knowledge, we are the first to report such concentration profile data in tunnels. Without concentration profiles, one can only guess the dynamics of these air pollutants inside tunnels.

3. The potential for the generation of NO₂ from the 3rd order 2NO + O₂ reaction should be considered more quantitatively.

Response: See our response to Comment 5, Reviewer 2.

4. More details should be given regarding the fleet using the tunnels (e.g. distribution of ages, % with catalysts, fuel types, speeds, fuel composition etc).

Response: Done.

5. It would seem sensible to present the CO and SO₂ data mentioned briefly in the same paper.

Response: The concentration profiles of CO and SO₂ are reported in Yao et al. (AST, 2005). The reference is cited. Since these gases are not discussed in this paper, we have opted to refer interested readers to Yao et al. (2005).

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 12723, 2005.

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