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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of high rates of NO_2 – HONO conversion in the nocturnal atmospheric boundary layer in Kathmandu, Nepal" *by* Y. Yu et al.

Y. Yu et al.

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We appreciate the referee's comments and suggestion. We clarify questions raised by the referee here.

Comment 1: In page 190, line 13-16, It says, "Nevertheless, the retrieval results of aerosol surface and volume8230;. agree well with the trends seen in our PM10 data (Fig. 2)". However, if we look carefully at Figure 2, we can find their trends actually did not agree. The aerosol surface and volume had sharp peaks, while PM10 mass concentration had much broader peaks, and their maximum values appeared at different time. Table 2 lists HONO measurements in Asia. This information does not relate to the section 3.1, and it better fits in introduction section.

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Response 1: It might be misunderstanding of Figure 2. As we mentioned in this paper (Page 191, line 7) and former paper (Yu, 2008a), there were no the long path DOAS data due to the heavy fog and smog every morning and some evening. We accepted the suggestion from referee, and moved the Table 2 to the introduction section in the revised paper.

Comment 2:Section 3.2, page 192-193, NO2 in the ambient is mainly from the conversion of NO, so the correlation between HONO and NO2 should not be used as an indication of direct emission from the same source.

Response 2:In our paper, we had clarified the direct emission was NOT the major source of HONO in the Kathmandu atmosphere. As we mentioned in the beginning of Section 3.2, in many field studies, the value of [HONO]/[NO2] is used as an index to estimate the efficiency of heterogeneous NO2-HONO conversion. In the introduction section, we have discussed the NO was NOT the major source of HONO formation in the atmosphere. Furthermore, the NO concentration was relative lower compared to NO2 (see table 1). The highest recent report of [HONO] to [NOx] emission ratio was 0.008, our minimum observation of [HONO]/[NO2] is around 0.008, if we consider of [NOx]=[NO]+[NO2], the value of [HONO]/[NOx] should be lower than 0.008, which agrees with our inclusion.

Comment 3:Section 3.3, page 193-194, and Fig. 5, a close look at figure 5, one can see that PM 10 had sharp peaks and lasted less than five minutes while HONO had broad peaks and lasted more than 15 peaks. These shows HONO and PM10 might come from different plume. The DOAS observation has 1 km distance between DOAS and the mirror, a sharp peak of PM10 suggest a narrow plum passed through the light path, which passed through low buildings, roads, and some bare fields. In Fig 5, NO had similar sharp peaks as those of PM10, suggesting that the sharp increase of PM10 and NO was caused by a narrow plume from a combustion source. Therefore, this observation should not be used as an evidence for the heterogeneous formation of HONO on PM surface.

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Response 3: The time resolutions of instruments (DOAS, NO and PM10) are different, DOAS had the time resolution of 5-10 minutes, while NO and PM10 monitor had 10 seconds time resolution. We had set the same clock before the field campaign to minimum the time difference between three instruments. We believe our observation is real and valuable to HONO heterogeneous formation.

Comment 4: Page 196, line 14- page 197, here the authors concluded that "the NO2 heterogeneous reaction on the ground reactive surface was a major source of HONO in Kathmandu atmosphere". This is contradicting to the discussion in section 3.3. The ground surface may correlated well with HONO concentrations, but this does not necessary mean ground surface was the major source of HONO, because they may be controlled by different process and coincidently have similar diurnal trends. It is interesting to see from Fig 6, that [HONO]/[NO2] correlated well with the total surface of aerosol and ground, while the aerosol and ground surface were at similar levels. This suggests that both aerosol and ground may contribute to the HONO formation with similar importance. More discussion is needed.

Response 4: There is no any contradicting of active ground surface and aerosol surface contribution of HONO formation in the Kathmandu atmosphere. Section 3.4 indicated the good correlation of active ground surface with [HONO]/[NO2], which suggested the active ground surface was the major source of HONO formation. Section 3.3 showed the additional HONO formation through the aerosol surface (it might have influence to HONO formation, however it was NOT major source of HONO due to 1) quick inactive of soot surface; 2) relatively short contact time of soot with NO2). We didn't see any contradicting between these two sections.

Comment 5: Page 196, line 22-24, the constant value of ground surface at 3 am-6am is due the way how boundary height was calculated.

Response 5: Yes. The constant value of ground surface at 3 am-6 am is due to the stable boundary height (it had also reported as reference Kondo et al. 2002).

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Comment 6:Page 198, line 12-35, here the authors used the results to discuss the production and destruction reaction probabilities of HONO on ammonium sulfate, this is contradicting to the section 3.3 where the authors suggest the reaction of NO2 on the surface of soot may be the major source of HONO.

Response 6:We had discussed the heterogeneous of HONO formation through NO2 on the particles surface. The mechanism of HONO formation is not clear so far. We assume the reaction mechanism is NO2 hydrolysis regardless of the aerosol chemical composition. We didn't suggest the NO2 heterogeneous reaction on the soot surface may be the major source of HONO. We suggested the reaction of NO2 on the soot surface may be a source (actual not the major source) of NO2-HONO conversion in the Kathmandu atmosphere.

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