

Interactive comment on “Observations of high rates of NO₂ – HONO conversion in the nocturnal atmospheric boundary layer in Kathmandu, Nepal” by Y. Yu et al.

Anonymous Referee #2

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This paper presents very interesting results on the inter-relationships between HONO, NO_x, and particulates in Kathmandu. The very high values of HONO/NO₂ observed are inferred to be the result of NO₂ reactions on surfaces (ground and aerosol), facilitated by the shallow nocturnal boundary layer and modulated by RH at times.

The discussion is hard to follow at times, perhaps because a series of hypotheses are examined in turn, but not ever really synthesized. Perhaps the best example of this is given by the juxtaposition of sections 3.3 and 3.4. In the first section attention is focused on relatively fast variations in HONO/NO₂, perhaps linked to even shorter spikes in aerosol mass (measured in-situ as PM₁₀) presumed to reflect increasing S/V

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of aerosol (Figure 5). In the final paragraph of 3.3 it is suggested that soot in the nocturnal aerosol plumes may be an important HONO source. Then the discussion of Figure 6 largely ignores similar linked variations in HONO/NO₂ and S/V aerosol (estimated from the DOAS retrievals) on short time scales, focusing instead on the correlation between HONO/NO₂ and S/V ground, which is driven by larger changes occurring over several hours. And section 3.4.1. ends by suggesting that production on ground surfaces "was a major source of HONO in Kathmandu atmosphere." While not clearly stated, the implication appears to be that the ground source overwhelms any contribution from the aerosol plumes discussed in the previous section. However, the next section takes up the effect of RH and focuses on aerosol reactions as much, if not more, than ground surfaces.

My opinion is that these several processes need to be considered together in the text, not as a series of "either/or" hypotheses. At the very least, a paragraph or two discussing the possible combination of multiple sources would tie the different subsections together. I realize that reviewer #1 discounts any significant production of HONO on aerosols (apparently globally), but the fine scale variations in Figures 5 and 6 are intriguing. It should be noted that the particulate loading in Kathmandu is extremely high, and is quite likely to have qualitatively different composition than aerosol in European cities. In addition to the brick kilns mentioned in the manuscript, the vehicle fleet in Kathmandu has a large number of old and poorly maintained diesels. Adding these local sources onto the regional "brown cloud" makes for impressively poor air quality in the valley.

I urge the authors to explore the relationships between HONO/NO₂, S/V aerosol and boundary layer height (controlling S/V ground) more thoroughly and simultaneously. This might involve multiple regression, or, based on Figure 6, it would seem possible to estimate HONO/NO₂ linked to production on ground surfaces, and then examine "residual" variations of HONO/NO₂ as a function of S/V aerosol. Alternatively, if 21-22 January is truly illustrative, it would seem that the impact of changing S/V aerosol

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could be investigated by focusing on the full set of early morning observations (~ mid-night to ~4:00) when boundary layer height is stable but HONO/NO₂ varies in response to something. Figures 5 and 6 strongly suggest that at times there was significant production of HONO when particle loading was elevated. This does not prove that the HONO was produced on the particles, but if other sources can be shown incapable of driving the observed short term variations observed, heterogeneous production on aerosols would have to be considered a possibility.

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