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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of HONO on global atmospheric chemistry calculated with an empirical parameterization in the EMAC model" *by* Y. F. Elshorbany et al.

Anonymous Referee #2

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In this manuscript, the authors examine the impact of HONO on global atmospheric chemistry with a simple parameterization for HONO, i.e., taking a HONO/NOx ratio of 0.02, in the EMAC model. The agreement is surprisingly good between the predicted and the measured HONO concentrations with this simple parameterization, especially in the urban environments. The predicted effects on atmospheric chemistry (OH and O3) are reasonable in the urban regions. I consider this work to be a good modeling effort to understand the potential effects of HONO on a large scale, with interesting results, and thus recommend it for publication after addressing the concerns that I have below:

1. The analysis of field data for HONO parameterization seems very thorough. However, the data sources were bias, mostly from urban campaigns. If the parameterization is to be applied to a global model, data from rural and remote regions should be included; this is important since majority of earth surface can be classified as rural and remote (including oceanic). In the low NOx environments over the continents, HONO/NOx ratio can be significantly higher. For example, the daytime average HONO/NO2 ratio was $\sim$0.09 at Meteorological Observatory Hohenpeissenberg; it could be as high as 0.3 during the low NO2 (<1 ppb) periods (Acker et al., 2006). In rural New York State (average NOx <1 ppb), the HONO/NOx ratio was between 0.07 and 0.3 (Zhou et al., 2002, 2007). At the mountain top research station Jungfraujoch (NOx < 1ppb), the daytime HONO/NOx ratio ranged from 0.04 to 0.27 (Kleffmann and Wiesen, 2008). Over the ocean surface, however, the HONO concentration and thus the HONO/NOx ratio are expected to be very low, due to the lack of heterogeneous sources from solid surfaces and to the effective deposition onto sea surface (seawater pH $\sim$8), although no much information is available in the literature. If the authors want to have a true global picture of HONO distribution and its effects on atmospheric chemistry, they need to take these factors into consideration. Otherwise, they would do better by focusing their efforts on regional modeling.

2. The significant HONO concentrations over North Pacific and North Atlantic Oceans in Figure 11 are not realistic, and the enhancements on OH and O3 in Figures 14 and 15 should not exist, due to the expected low HONO level and low HONO/NOx ratio, as stated above.

3. What is the height in the first layer of the vertical grid in the model? If the ground surface HONO source is important, the predicted HONO concentration (averaged over the layer) can be significantly affected height of the first layer. If the first layer height is significantly greater that the measurement heights in the field campaigns, then the comparisons of the predicted and the measured concentrations are not very meaningful. It would be interesting to see the HONO concentration values in the second and

upper layers away from ground surface.

4. What are the bases to use different equations (Eqs (5) and (6)) for sectors B and C during the day? If photochemical processes become important, there should be a sector centered on the noontime, say 9:00 - 15:00, to fully reflect the effect.

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