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Interactive comment on "Structural uncertainty in air mass factor calculation for NO_2 and HCHO satellite retrievals" *by* Alba Lorente et al.

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This paper is interesting and should be published after attention to the items below.

Since the structural error is just the 1-sigma variation among the retrievals, I wonder if the fact that so many of them use the Kleipool albedo and fairly coarse models is underestimating the uncertainty due to albedo and profile shape. Thorne et al. (2005) specified that structural uncertainty should be "aggregated over many independent, plausibly constructed datasets. . .." The paper should address whether the uncertainty due to parameters shared among a large percentage of the retrievals used in the study may bias the interpretation to an underestimate of the uncertainty.

Regarding the discussion in the final paragraph of p. 21, the point that validation of the a priori profiles is important is well taken, and I agree that estimating the effect of only the spatial (or temporal) resolution of the chemical transport model on the re-

trieval would require a very specific study. However our understanding of structural uncertainty is that comparing the AMFs calculated by a variety of retrievals allows a characterization of the total error independent of the parametric uncertainty calculations. Given that the highest resolution a priori profiles used here were the 0.5 x 0.667 degree profiles in the POMINO retrieval, and that Valin et al. (2011), Heckel et al. (2011), and Yamaji et al (2014) all show that model resolution < 20 km is necessary to capture the nonlinearity of NOx chemistry; that Russell et al. (2011), McLinden et al. (2014), and Kuhlmann et al. (2015) show profiles at <= 15 km resolution significantly change the AMF, and Vinken et al. (2014) used a sub-grid plume parameterization in their retrieval with 0.5 x 0.667 degree profile resolution to a similar effect, my concern is that the overall uncertainty in the AMF derived from a structural uncertainty that does not include any retrievals using profiles with < 20 km resolution misrepresents the true uncertainty and bias. If adding at least one retrieval with < 20 km resolution a priori profile is impractical at this point, then at a minimum an extended discussion of the likelihood that the AMF uncertainty derived here is underestimated should be developed.

The final statement on p. 21: "It is worth to note that using averaging kernels will reduce the effect of the a priori trace gas profile chosen in the retrieval scheme." requires additional discussion. My understanding of the use of averaging kernels is that they are useful in two ways:

1) When comparing satellite retrieved VCDs against a model, applying the AKs to the model effectively "retrieves" the model trace gas profile, thus the dependence on the a priori profile in the retrieval is the same for both the observed and modeled column, and cancels out (Eskes and Boersma, 2003).

2) Alternately, one could use AKs to implement one's own a priori profiles in the retrieval.

Only in the first case would I say that the dependence on the trace gas profile is reduced, and that only applies when comparing to a model. Work using the satellite columns directly (e.g. Duncan et al. 2010, Beirle et al. 2011, Valin et al. 2013, Mebust and Cohen 2014, Lu et al. 2015, Liu et al. 2016, etc.) would not be able to use AKs in this way.

Technical corrections:

p. 21 l. 476 - PRevious (the R should be lowercase) p. 21 l. 479 - NO2 (the 2 should be subscript) p. 21 l. 480 - (Laughner et al. 2016) âĂŤ> Laughner et al. (2016)

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