

## ***Interactive comment on “Structural uncertainty in air mass factor calculation for NO<sub>2</sub> and HCHO satellite retrievals” by Alba Lorente et al.***

**Anonymous Referee #1**

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This paper does a good job breaking down sources of uncertainty in AMF calculations, and will be useful to the satellite retrieval community. I have a few minor comments that need addressing before publication:

Line 132: “It is desirable to use as much information as possible retrieved from the satellite instrument itself.” I didn’t see much in the model descriptions with regards to this statement. What information from the satellite is used, is it the same for all the models, etc.

Line 275: “The agreement in this study is better than previous RTM comparisons...” Any idea why?

Line 357: The differences between online and LUT AMFs would depend on the resolution of the LUT. Since the Castellanos et al (2015) study indicated an 8% error (which is

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larger than the error due to RTM treatments you found), it would be worthwhile to have a brief discussion on the LUTs used in the different models and possible differences that may arise.

Section 3.3.2: Which model is used to evaluate the cloud corrections?

Line 467-470: Characterization of the sensitivity of AMF to albedo and to a priori profiles is inconsistent. Surface albedo is said to “explain some” of the difference, while the AMFs are “highly sensitive” to the a priori, even though their correlations in Table S3 are very similar (0.21 & 0.50 compared to 0.19 & 0.55). Also, line 492 calls the a priori profiles the “main cause” of the differences. From the information given, AMFs seem equally sensitive to both a priori and albedo, however the text suggests otherwise and should be rephrased.

Line 490: It’s not clear how the use of an averaging kernel will reduce the effect of the a priori. Averaging kernels are most frequently used for making comparisons between two models, or between a model and a retrieved observation, in order to reduce errors that may arise when two models are based on different a priori profiles. From my understanding this does not reduce the retrieval’s sensitivity to the a priori itself. This statement needs further explanation.

Technical notes:

Line 43: “20-50% from typical VCDs uncertainties of 40-60%” is ambiguous. Is it 20-50% of the typical uncertainty, or is it 20-50 percentage points. Consider rewording.

Figure 4: The green and red lines are hard to distinguish from the others in parts b-f. I realize that this is because they are overlapping, but (for example) in 4b are the green and red lines under the blue one, or under the pink one? It would be good to find a way to make this clearer.

Line 426: “...when cloud fraction is less than 0.1...” Should this be “greater than 0.1”? “Less than” seems to contradict the discussion in Section 3.3.2.

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Lines 390-405/Figure 7: The text discusses relative differences in AMFs, and mentions that differences are small in unpolluted situations with larger differences in polluted areas. Figure 7 shows absolute differences in AMF, and the polluted and unpolluted plots have a similar vertical range. I would suggest including a plot of the relative differences to better illustrate the conclusions made in the text.

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