This document contains the authors' responses to the Editor's comments. The Editor's comments are in black, followed by the author's responses in blue.

The new version is significantly improved in relation to the original.
The authors seem to use the terms OMI aerosol record and OMAERUV interchangeably. For readers unfamiliar with the OMI aerosol products, there may be some confusion, since officially two OMI aerosol records are available. I would suggest the authors to either stick to the 'OMAERUV record' on every instance they refer to it, or include an initial statement stating that the expressions OMAERUV and OMI aerosol record are used Interchangeably throughout in the manuscript.
Thank you for your correction. We have added the *'It is also noted that there are two official OMI aerosol level 2 products though, the OMI measurements in this paper only refers to the OMAERUV product.' (line 255-257)*

A few specific comments on the current version are listed below.
Line 22. Replace 'acceptable' with 'encouraging'
We have changed it accordingly. *'The results are encouraging, though at the current phase, the model tends to overestimate the SSA for relatively absorbing cases and fails to predict SSA for some extreme situations.' (line 21-23)*

Line 34: Just saying that λ_0 denotes the reference wavelength does not provide useful information. It should be stated that this is the longer wavelength in the pair, and it is used to calculate an assumed wavelength-independent-scene-reflectivity, needed for calculation of the of the I_λ Rayleigh term in Equation (1).

We have added more introduction of the wavelength pair of UVAI. *'λ is the wavelength where the radiance difference between a Rayleigh and a measured scene is calculated, and λ_0 is the longer wavelength where a spectrally constant scene reflectivity is assumed for the calculation of I_λ^{Ray}.' (line 34-36)*

Line 42. In addition to the listed aerosol related parameters, the magnitude of the observed UVAI also depends on non-aerosol-related factors such as spectral dependence of land surfaces and ocean color effects, sun-glint effects, and cloud effects. This clarification should be included.
This issue was raised in the earlier review to which the authors reply with the statement
'… the radiance itself is also affected by surface conditions, clouds, atmospheric gases and aerosols. On the other hand, the UVAI only contains the information of aerosol absorption…'.
Their reply reveals a poor understanding of the UVAI concept, since the UVAI is just the measured radiance conveniently packed in a single parameter. It includes any observed spectral dependence other than Rayleigh scattering.
Thank you for your correction. We have modified our presentation accordingly. *'Although non-aerosol factors exist, such as spectral dependence of the surface, ocean color, sun-glint and cloud contamination, the most dominant are aerosol concentration, aerosol vertical distribution and aerosol optical properties (Wang et al., 2012; Buchard et al., 2017).' (line 44-46)*

Line 151. An explanation for the selection criteria UVAI > 1 and CF larger than 0.3 should be added. Is this the MODIS CF? If so, 0.3 represents significant contamination.
Sorry for the confusion. The cloud fraction here is the TROPOMI FRESCO cloud fraction. We may forget to add it from the last version manuscript. We have added its source in the manuscript just after introduction of TROPOMI ALH product. *'At the same band, there is TROPOMI FRESCO cloud support product providing cloud fraction (CF) for mitigating cloud effects as will be explained later (https://scihub.copernicus.eu last access: 19 Sept 2018) (Apituley et al., 2017).' (line 139-141)*

The explanation for the pixel selection criteria has been added also. *'Before implementing radiative transfer calculations, pre-processing excludes pixels with large solar zenith angle (θ_0 > 70°), weak* *aerosol absorption ($UVAI_{354,388}$ < 1), insignificant aerosol amount (AOD550 < 0.5) or cloud contamination (CF > 0.3).' (line 153-155)*

Line 183. Replace 'better' with 'closer to AERONET retrieved SSA'. As stated AERONET SSA does not represent the true SSA value.
We have changed it accordingly. *'Although our retrieved SSA seems closer to AERONET retrieved SSA than that provided in OMAERUV, one should keep in mind that there is only one record for this event, the meteorological conditions, combustion phases and even the aerosol compositions may change during the 3-hour time difference.' (line 186-189)*

Line 245. Although the same wavelength pair (354, 388) is used in the OMAERUV UVAI definition, the way the observed radiances are calculated have changed [Torres et al., 2018]. The new definition handles the effect of clouds using of Mie Theory (instead of the Lambertian approximation), and reduces significantly the across-track angular dependence. It also accounts for wavelength dependence of surface reflectance as well as sun glint over the oceans. For cloud-free conditions, the Mie-UVAI is slightly larger than LER-UVAI (~0.3) for nadir-viewing conditions. The original definition (consistent with that in TROPOMI) is still reported in the OMAERUV as a parameter labeled 'RESIDUE'. Thus, the original definition should be used for algorithm training purposes. This is important because the difference between the LER and Mie definitions increases with viewing sensor solar zenith angle.
Thank you for your correction. We have re-collected the OMAERUV (as we did not extract the residue from the original files at the first place) and re-collocated it to the AERONET data set using the same criteria.

We have added explanations in the manuscript. *'Note that the UVAI used here is the 'residue' field in the original OMAERUV product, where the simulated radiance (I_λ^{Ray} in Eq.(1)) is calculated by a simple Lambertian approximation that is consistent with TROPOMI UVAI (Torres et al., 2018).' (line 272-274)*

The following heatmap gives a quick view of how the UVAI and residue correlates with other parameters. The correlation between the residue and AOD, AAOD and ALH is relatively higher compared with other parameters, but not significantly high (at or less than the level of 0.5) compared with UVAI. As a result, we use a stricter criterion that only keeping OMAERUV pixels with cloud fraction smaller than 0.1. This enhance the correlation between UVAI and AOD, AAOD and ALH (r = 0.66, 0.66 and 0.4, respectively). There is total 5679 samples in the training data set. We have the following changes in the manuscript:

'OMI pixels with θ_0 larger than 70° or cloud fraction larger than 0.1 are excluded.' (line 260-261)

'In total 5679 samples are obtained.' (line 266)

'The empirical ratio between a training and testing data set is 70% versus 30%, thus there are 3975 samples in the training data set and 1704 samples in the testing data set.' (line 289-290)

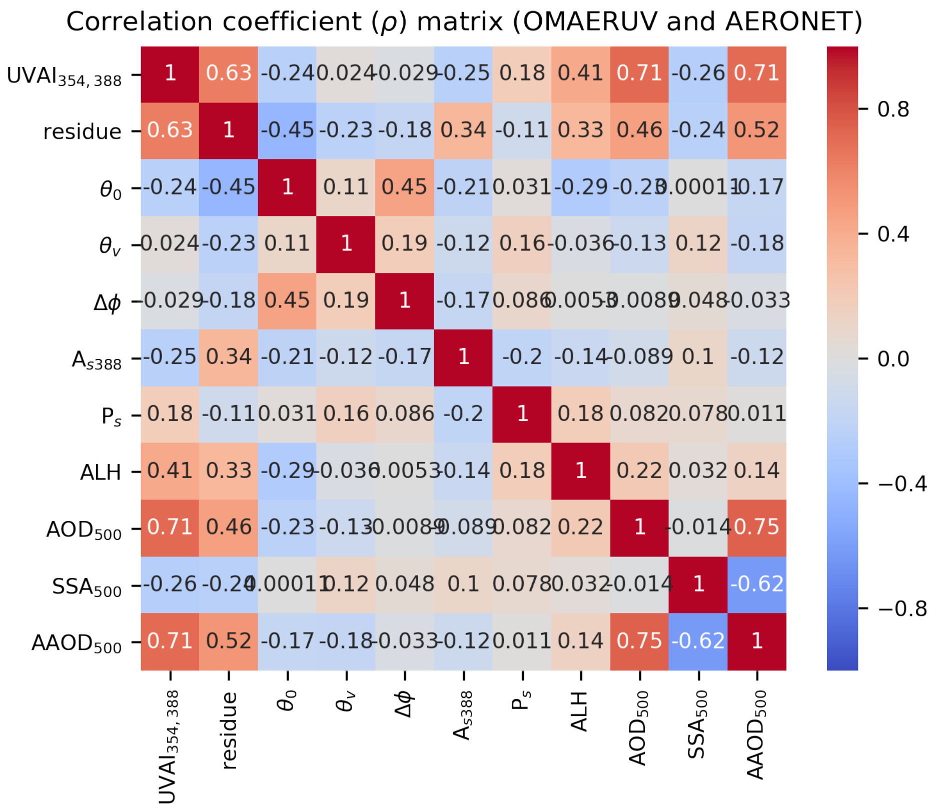
But be noted that in the case applications the input TROPOMI data is still using CF < 0.3 to ensure there is collocated pixels with AERONET sites. In the heatmap, the residue seems has a higher dependence on the solar zenith angle and the surface albedo, too. But we may only focus on the aerosol related features. We have the following changes in the manuscript:

'The UVAI also has a dependence on θ_0, but in this study we only focus on the aerosol related features.' (line 281-282)

‘Note that the data includes pixels with CF larger than 0.1 in order to ensure there is satellite measurements collocated with the AERONET sites (though CF is no larger than 0.3).’ (line 354-356)

‘The input features are selected by the Spearman’s rank correlation coefficients and a priori knowledge on relationship between UVAI and only aerosol related features.’ (line 439-440)

‘Other non-aerosol features affecting UVAI should be also taken into consideration.’ (line 445-446)



The new training data set leads to small changes in the SVR model hyper-parameter C, which is 0.08 (used to be 0.11). The accuracy of the updated SVR is slightly lower than that of the previous one (with UVAI in the training data set). The updated SVR tends to predict higher SSA than the previous one, which is as expected, because the Mie-UVAI is overall 0.3 larger than the residue. The higher UVAI (if the ALH and AOD keep the same), the lower predicted SSA as we described in the sensitivity study in Section 3.5. From the case applications, 5 out of 9 of the predicted SSA records is within +/- 0.03 difference compared with the AERONET records (used to be 66%), and not all predictions are within +/- 0.05 difference (88%).

We also have updated the Figure.6-15 and figures in Appendix B, and results in Table 3 and 4 accordingly.

Line 246. In the description of the OMAERUV record, it should be stated that AOD retrievals have been validated using the multi-year AERONET aerosol record [Ahn et al., 2014], and, similarly, the SSA parameter have been evaluated with AERONET Almucantar retrievals [Jethva, et al., 2014].

We have added them accordingly. *‘Its AOD was validated by the multi-year AERONET record (Ahn et al., 2014) and its SSA was evaluated by AERONET Almucantar retrievals (Jethva et al., 2014).’ (line 252-254)*

Line 426 'Acceptable' is a subjective interpretation. Replace 'acceptable (+/- 0.02)' with ' +/- 0.02'
We have changed it accordingly. *'The accuracy of SVR-predicted SSA is ±0.02, with higher tendency to overestimate the SSA for relatively absorbing cases.' (line 441-442)*

Cited References

https://doi.org/10.5194/amt-11-2701-2018Torres, O., Bhartia, P. K., Jethva, H., and Ahn, C.: Impact of the ozone monitoring instrument row anomaly on the long-term record of aerosol products, Atmos. Meas. Tech., 11, 2701-2715, , 2018.

Jethva, H., O. Torres, and C. Ahn (2014), Global assessment of OMI aerosol single-scattering albedo using ground-based AERONET inversion, J. Geophys. Res. Atmos., 119, doi:10.1002/2014JD021672.

10.1002/2013JD020188Ahn, C., O. Torres, and H. Jethva (2014), Assessment of OMI near-UV aerosol optical depth over land, J. Geophys. Res. Atmos., 119, 2457–2473, doi:.