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Atmospheric Measurement Techniques Discussions

Interactive comment on "Effect of surface BRDF of various land cover types on the geostationary observations of tropospheric NO₂" *by* K. Noguchi et al.

Anonymous Referee #3

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With the purpose of obtaining an improved understanding of surface reflectance effects on tropospheric NO2 retrievals from a geostationary satellite instrument (GMAP-Asia, 10x10 km2 spatial resolution), the authors investigate the effect of BRDF on radiative transfer above specific land types. They build on existing MODIS products at very high spatial resolution to construct a BRDF-function. Then they use a very high-resolution land cover classification data from ALOS/AVNIR-2 to determine the most probable BRDF for a range of MODIS 1x1 km2 scenes in the wider Tokyo area. This is all sound and straightforward. But then Noguchi et al. proceed to investigate the effect of the BRDF-variability introduced by land cover differences on virtual (1x1 km2) NO2

tropospheric air mass factors, and report strong effects (differences up to a factor 2). While I think that these numbers are useful in themselves, they are probably an exaggeration of what may be expected in terms of AMF variability for a real GMAP-Asia (or TROPOMI) pixel that will cover a 100 km2 area with considerable land cover type heterogeneity. Therefore my main concern is that the AMF differences brought about by different land types at the scale of a relevant satellite pixel have not been reported yet, but it is easy for the authors to do so in a revised version of this study.

To evaluate the effect of incomplete descriptions of surface reflectance, the authors also use the MODIS product to construct the Bidirectional Reflectance Factors, the Black Sky Albedo, and the White Sky Albedo, and they investigate the effects of these descriptions of surface reflectance, as well as aerosol scattering on the 1x1 km2 AMFs. The approach and findings appear useful, but, again, would gain in value when applied to the more relevant scale of a satellite pixel. Below, find a list of specific concerns that should also be addressed in a revision of this manuscript.

Specific comments:

Abstract, line 5: 'the East Asia' should read 'East Asia' or 'eastern Asia'.

P3445, L11-12: that surface parameters need to be known with high spatial resolution was discussed also in Zhou et al. [2009], and Boersma et al. [2011]. It would be appropriate to also cite these papers.

P3445, L18: please be specific for what instrument (i.e. overpass time, viewing geometry) the findings of Zhou et al. [2010] hold.

P3445, L25: what is meant with 'OMI-based LER version 3'? This should be clarified.

In section 2.1, it would be appropriate to discuss the quality of the MODIS albedo products. Have they been evaluated against other albedo datasets or against independent parameters?

P3446; are there any differences in the construction of the BRDF between this work

and the work by Zhou et al. [2010]?

P3447, L15-16: It's unclear what this sentence tries to convey. I think the authors intend to say that the BRF, WSA, and BSA are all treated as LER values when the AMF and BAMFs are calculated with the radiative transfer. Please rephrase.

P3448, L22-23: The details of the aerosol types assumed should be somewhere in this paper, not just by referring to an earlier paper.

P3449, L25-26: How is the 100% urban or rice paddy result different from the 90%-95% threshold? Is it relevant?

P3450, L10-12 and Figure 5: why does the deciduous forest type have the highest kernel values in winter? When trees lose their foliage in fall, I would expect the forest to appear darker as seen from space.

In section 3.3 and 3.4, I suggest to repeat that one constant NO2 profile has been assumed.

P3452, L3: 'whenever'?

P3452, L10: this sentence is not very clear. Since a vertical column is retrieved, an altitude-dependent error appears odd. I think the authors mean an error that depends on the assumed vertical distribution of NO2 (in the AMF calculation).

References:

Boersma, K. F., H. J. Eskes, R. J. Dirksen, R. J. van der A, J. P. Veefkind, et al., An improved tropospheric NO2 column retrieval algorithm for the Ozone Monitoring Instrument, Atmos. Meas. Tech., 4, 1905-1928, doi:10.5194/amt-4-1905-2011, 2011

Zhou, Y., D. Brunner, K. F. Boersma, R. Dirksen, and P. Wang, An improved tropospheric NO2 retrieval for satellite observations in the vicinity of mountainous terrain, Atmos. Meas. Tech., 2, 401-416, 2009.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 3443, 2014.