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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.

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This interesting article addresses the effects of surface reflectance and atmosphere radiative transfer model coupling on NO2 retrieval. Two different ways of performing this coupling is proposed, either a full coupling of surface Bidirectional Reflectance Factor (BRF) and atmospheric scattering or assuming that the surface is Lambertian. Three different ways of relating LER surface to BRF values are proposed: - LER is equal to the BRF magnitude corresponding to the illumination and observation geometries; - LER is equal to the to the Directional Hemispheric Reflectance (DHR) or black sky albedo considering the illumination zenith angle at the time of acquisition; - LER is equal to

the BiHemispherical Reflectance (BHR) assuming isotropic illumination or white sky albedo.

The choice of one of these possible definitions (note that more choice are possible offering probably better solutions) impacts the way the radiative coupling between surface and atmosphere is handled. With the first definition, LER = BRF(sza, vza, raa), the single scattering contribution, which is predominant when the scattering optical thickness is low, is correctly estimated while the multiple scattering contribution will be erroneous. With the second definition , LER = DHR(sza), both the estimation of the single scattering and multiple scattering contributions will be erroneous, however the error on the multiple scattering estimation should decrease as the scattering optical thickness increases. Finally, the last definition, LER = BHRiso, is valid only for large optical thickness values, typically above 5. In such situation, sky radiation becomes predominant with respect to collided (direct) illumination, smoothing surface anisotropy effects.

Unfortunately this manuscript uses confusing notation concerning reflectance names and units listed in table 1. I would recommend the authors to follow the well recognized acronyms and definitions established by F. Nicodemus from the US National Bureau of Standard.

When authors refer to BRDF, they actually mean BRF as the quantity they are referring is actually unitless. So the BRDF acronym needs to be replaced by BRF. I acknowledge that this confusion comes from erroneous naming convention in MODIS official NASA product.

Table 1 contains misleading uses of the BRDF and BRF acronyms. BRDF has unit sr-1 while BRF, as albedo, are unitless. So the only difference between BRDF and BRF is the factor pi with BRF = pi * BRDF

The label of the first column is also misleading, as the first line contains the reference cases, ie, full coupling between atmosphere and surface scattering, while the last

three lines proposed three different LER estimation based on the BRF and its angular integral.

I would strongly suggest the authors to clarify Table 1 column labels and to use Nicodemus reflectance naming definition and associated acronym.

F. E. Nicodemus, "Reflectance Nomenclature and Directional Reflectance and Emissivity," Appl. Opt. 9, 1474-1475 (1970) http://www.opticsinfobase.org/ao/abstract.cfm?URI=ao-9-6-1474

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