Interactive comment on “The importance of surface reflectance anisotropy for cloud and NO$_2$ retrievals from GOME-2 and OMI” by Alba Lorente et al.

Anonymous Referee #1

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This is an interesting and well-written paper that describes how surface reflectance anisotropy affects cloud and NO$_2$ retrievals from satellite instruments. It is suitable for publication in AMT. I have a few suggestions below.

This is basically a theoretical sensitivity study focusing on surface reflectance. Some additional analysis of what to expect in a real retrieval (e.g., Zhou et al., 2010; Lin et al., 2015) and applications (which combine pixels with forward reflecting and pixels with backward reflecting) would be nice. I expect that adding forward and backward scenes together reduces the net effect of surface reflectance on both cloud and NO$_2$.

Whether (and how) the effects on C$_{eff}$ and M$_{cr}$ act together or compensate each other to affect NO$_2$ AMF is dependent on cloud pressure (CP). In this study, CP is assumed at 850 hPa, which for polluted situations means that most NO$_2$ is below cloud, that M$_{cd}$ is much smaller than M$_{cr}$, and thus that the effects through C$_{eff}$ and M$_{cr}$ are complementing each other. A higher CP could lead to M$_{cd}$ larger than M$_{cr}$ and thus compensating effects (on NO$_2$ AMF) through C$_{eff}$ and M$_{cr}$. Please comment.

Sects. 4 and 5 – Do you assume Henyey-Greenstein clouds in the forward model (Eq. 8) and then assume Lambertian clouds in the reverse model (i.e., in the cloud and NO$_2$ retrievals)? What else are different between the forward and reverse models? Is cloud pressure the same between forward and reverse models? It is not clear how the difference between C$_{eff}$ and C$_{geo}$ is derived. Also, where is the C$_{geo}$ from (e.g., in Fig. 8)?

P3, L20 – clarify “clear-sky” P12, L7 – could you comment on the large difference near the hot-spot region between LIDORT and DAK/SCIATRAN? Sect. 5.1 – why not use the retrieved C$_{eff}$ BRDF, rather than assuming C$_{eff}$ BRDF $= 0.1 \pm 0.05$? Table 2 – please provide a complete set of ancillary parameters such Ps, T profile, etc.