Reply to Associate Editor:

We thank the associate editor for the constructive and positive review.

1. *Your choice of the snow spectrum A(lambda) is not clear. From my point of view, the best choice is given by Eq. (2) in the paper listed below. The parameter L in Eq. (2) can be included in the retrieval parameters list. For the case of polluted snow, the modification is needed (A. Kokhanovsky, Snow Optics book).*
   Kokhanovsky, A.A.; Brell, M.; Segl, K.; Bianchini, G.; Lanconelli, C.; Lupi, A.; Petkov, B.; Picard, G.; Arnaud, L.; Stone, R.S.; et al. First Retrievals of Surface and Atmospheric Properties Using EnMAP Measurements over Antarctica. Remote Sens. 2023, 15, 3042.
   https://doi.org/10.3390/rs15123042
   Response:
   The formula $A(\lambda) = c_{veg}A_{veg}(\lambda) + c_{soil}A_{soil}(\lambda) + c_{snow}A_{snow}(\lambda)$ is only used to generate synthetic measurements based on land cover fraction. When generating the synthetic truth, the choice of $A_{soil}(\lambda)$, $A_{veg}(\lambda)$ and $A_{snow}(\lambda)$ is given in detail at the caption of Figure 1, and these 3 spectra are all based on real measurements for vegetation, soil, and snow. We believe that these spectra are sufficient for use given the limited scope of the synthetic study.

'Figure 1: Reference reflectance for vegetation, soil and snow. The snow data are downloaded from National Snow and Ice Data Center (NSIDC) (https://nsidc.org/data/hma_sbrf/versions/1) and the soil and vegetation data are downloaded from ASTER spectral library (https://speclib.jpl.nasa.gov/).'

When we conduct the retrieval with real measurement data, the $A(\lambda)$ refers to the isotropic reflectance for the land cover, which includes the contribution of all the land cover types, and instead of giving a formula of $A(\lambda)$ and fit the formula parameters, we fit $A(\lambda)$ directly for each wavelength separately which gives full flexibility to represent any spectral shape of the snow albedo. In the revised version, we include a reference to Kokhanovsky et al. (2023) to discuss an alternative method of retrieval where the spectral dependence of $A(\lambda)$ is parameterized. We have include it in '2.1 Forward model':

'In our algorithm, $A(\lambda)$ is fit separately for each wavelength which provides full flexibility to represent any spectral shape of the snow albedo. An alternative method to deal with the spectral dependence is discussed by Kokhanovsky et al. (2023) where $A(\lambda)$ is parameterized with effective absorption length L which is valid for snow with different microstructure and pollution level.'

2. *To my understanding your snow spectrum is valid for a given snow microstructure (parameter L in Eq.2 in the paper given below) and some level of pollution. Indeed, the decrease of reflectance towards shorter wavelengths is a clear indication of the fact that snow is loaded by dust. Actually, the dust in air will produce the same effect (decrease of reflectance towards UV). How do you distinguish these two cases (dust in snow and dust in air) in your retrieval technique?*
   Response:
   We agree for the case of single-view radiometric remote sensing. However, since we are using multi-angle measurements of radiance and polarization, our retrieval has better capability to distinguish dust in snow and dust in the air. For example, through interaction with Rayleigh scattering, absorption by aerosols in the atmosphere has a characteristic effect on polarization measurements near 90° scattering angle. In our synthetic study we did not encounter specific difficulties for cases with strong dust loading.

Reference:

Kokhanovsky, A. A., Brell, M., Segl, K., Bianchini, G., Lanconelli, C., Lupi, A., Petkov, B., Picard, G., Arnaud, L., Stone, R. S., and Chabrillat, S.: First Retrievals of Surface and Atmospheric Properties Using EnMAP Measurements over Antarctica, Remote Sensing, 15, 3042, 2023.