The authors have done a great job considering my comments. The manuscript has significantly improved. However, two minor clarification are needed before it can be published:

The authors are thankful to the reviewer for the helpful comments. Our detailed respond to reviewer's minor concerns is listed below (text in black refer to the reviewer's comments while our response is with the blue text).

1. Line 347: "However, due to degradation of the spatial resolution in order to fit the fixed height levels of the OPAC dataset for the ARF simulations, these discrepancies in height were smoothed out." I do not understand this sentence. So you did not use the layer heights derived from model and lidar, but fixed ones from the OPAC data set? Please clarify!

The reviewer is correct. The rephrased sentence (Lines 348-350) is now clearly written as below:

"However, since fixed height levels of the OPAC dataset were finally used in LibRadtran for the ARF simulations of the three Schemes, having significantly lower vertical resolution compared to the intitial lidar profiles, these discrepancies in height were smoothed out".

2. I think the description of SphInX still need improvement:
a. "..to carry out microphysical retrievals from synthetic and real lidar data inputs.."
I guess what you mean is to carry out calculations from lidar data to obtain microphysical aerosol properties? Is this correct, the please write it more precise!

The reviewer is right. There were syntactical errors in this sentence. Now the sentence is updated:

"The SphInX software provides an automated process to carry out calculations from lidar data for obtaining the aerosol microphysical properties and further to statistically evaluate the inversion outcomes".

b. "CRI grid was narrowed down to [1.4, 1.5] for the Real part (RRI), and [0, 0.001, 0.005, 0.01]". What do the values in the brackets mean? Do you only use 2 values for the RRI and 4 for the IRI? Please explain correctly without using mathematic notations which have not been explained.
c. Can you justify, why one can narrow down the CRI to the grid you use? Is this based on the properties of the aerosol type?
d. "…in order to avoid retrieving less realistic size distributions that suggest smoother representations and have undesired systematic behavior. "
What does this sentence mean? And what is an undesired behaviour? It sounds like data manipulation…..please write more precisely.

Answer to the comments 2.b,c,d:

The corresponding lines have now been changed trying to fulfill the Reviewers' questions.

Here, the R_{eff} ranged between 0.01 μm and 2.2 μm and the CRI grid was narrowed down to include only the values 1.4 and 1.5 for the Real part (RRI), and the values 0, 0.001, 0.005, and 0.01 for the Imaginary part (IRI), providing a total of 8 possible combinations for the CRI grid (instead of the initial total of 42 CRI grid). These ranges were used after a careful investigation of the values of the aerosol optical and microphysical properties found in the literature concerning transported Saharan dust events (Dubovik et al., 2006; Weinzierl et al., 2011; Mishra et al., 2014; Benavent-Oltra et al., 2017; Veselovskii et al., 2016; Veselovskii et al., 2020) in order to avoid retrieving less realistic dust-related size distributions and CRI values and to minimize the computational time.

e. “imposed measurement error is reasonably contained”
What does this mean? Please state correctly.
All in all, I still have not really understood what and how you have done the calculations of the aerosol microphysical properties. Please revise this paragraph.

Actually, this sentence was aiming to compare the selection of a narrow CRI grid to a totally fixed CRI value, as described in Samaras (2016), but we now believe that a reference to the “fixed CRI” case is out of the scope of the description that was implemented here, and hence, the total sentence was deleted.

The total updated paragraph is presented below (Lines 194-216):

The SphInX software provides an automated process to carry out calculations from lidar data for obtaining the aerosol microphysical properties and further to statistically evaluate the inversion outcomes. It has been developed at the University of Potsdam (Samaras, 2016) within the Initial Training for atmospheric Remote Sensing (ITaRS) project (2012–2016). SphInX operates with expendable pre-calculated discretization databases based on spline collocation and on look-up tables of scattering efficiencies using T-matrix theory (Rother and Kahnert, 2009). This is to avoid the computational cost which would otherwise limit the microphysical retrieval to an impractical point. The Complex Refractive Index (CRI) is fed to the software separately for the real and imaginary parts which then constitutes a grid combining the following default values: Real part (RRI) $[1.33, 1.4, 1.5, 1.6, 1.7, 1.8]$ and Imaginary part (IRI) $[0, 0.001, 0.005, 0.01, 0.03, 0.05, 0.1]$. A range of values for the effective radius (R_{eff}), which occurs from the ratio of the total volume concentration (u_t) and the total surface-area concentration(a_t), $r_{eff} = 3\,{}^{u_t}/_{a_t}$, is also needed to be predefined. The methodology applied here for spheroid-particle approximation is the same as presented in Soupiona et al. (2019). More specifically, hourly Raman lidar measurements were used as inputs for specific heights within the observed dusty layers and were averaged to produce the 6-point dataset of the so-called $3\beta_{par} + 2\alpha_{par} + 1\delta$ setup. All cases fulfilling this setup were treated in parallel for retrieving their microphysical properties. Here, the R_{eff} ranged between 0.01 μm and 2.2 μm and the CRI grid was narrowed down to include only the values 1.4 and 1.5 for the Real part (RRI), and the values 0, 0.001, 0.005, and 0.01 for the Imaginary part (IRI), providing a total of 8 possible combinations for the CRI grid (instead of the initial total of 42 CRI grid). These ranges were used after a careful investigation of the values of the aerosol optical and microphysical properties found in the literature concerning transported Saharan dust events (Dubovik et al., 2006; Weinzierl et al., 2011; Mishra et al., 2014; Benavent-Oltra et al., 2017; Veselovskii et al., 2016; Veselovskii et al., 2020) in order to avoid retrieving less realistic dust-related size distributions and CRI values and to minimize the computational time. The outputs presented here are the RRI and IRI, the Single Scattering Albedo (SSA) and the R_{eff}.