The authors greatly appreciate the constructive comments from the reviewer #1.
The reviewer maintains that the manuscript demonstrates the importance of mixing states of dust and BC particles on their optical properties. The reviewer underlines that the topic is important to the atmospheric science community, although further understanding of the abundance of mineral dust particles with black carbon in the atmosphere is needed, as the authors also emphasize in the manuscript.

We revised our manuscript with a number of changes in response to the reviewer's comments. The specifics are listed below.

Rev. 1: General comments: I suggest having a brief discussion regarding why and how optical properties of mineral dust mixed with black carbon differ from those of bare mineral dust/black carbon. I assume that microphysical configuration such as lens effect (Bond et al., 2006) and shadowing of mineral dust particles to black carbon may contribute to the optical properties of mineral dust/black carbon mixed particles. This discussion will be useful to have a general conclusion since this paper discuss a limited number of modeled particles. Example is Page 2504 Line 27-28: While DDSCAT predicts for internally mixed particles larger than 500nm (BL2S3–BL2S5) an increase of SSA at all wavelengths compared to bare dust particles (S3–S4–S5). Please discuss the reason.

Commenting on the *relevance of selected number of simulations* in a computational intensive spectral range.

The paper addresses how optical properties of polluted mineral dust aerosols might vary depending on the details of the mixing with black carbon particles and the mineral dust size. Internal mixtures of BC and dust have been found in many geographical locations. The strongest impact of polluted dust, discussed in literature, has been found in Asia, due to the high load of absorbing aerosols (black carbon, mineral dust and mixtures). It has been demonstrated that these aerosols have an impact on both the spatial and temporal distribution of high precipitation events. The simulations performed in our study *are computationally* intensive, due to the aerosol *sizes* and the (short) wavelengths selected. The spectral signature of the aerosol ensemble has been characterized in the UV-VIS-NIR, spectral range that has not been explored from other authors yet, despite the significance for remote sensing retrieval and climate modeling.

Commenting on the *effect of mixing on optical properties of BC and mineral dust.*

The configurations studied in this manuscript have been observationally constrained and *do not include embedding*. The *BC* particle is *laying on the surface of mineral dust*. So, there is no "traditional lens effect", where incident light is focused on the core of the particle. When simulating internal mixtures, the size of the BC aggregate is kept the same, while we increase the dust particle size. Regarding optical properties and differences between bare BC, mineral dust and internal mixtures:

1. Internal mixture vs. bare BC: With the increase in size of mineral dust increases absorption, but also largely the scattering of the internal mixture, leading to larger SSA values for internal mixtures compared to bare BC (in all cases BL2S1 – BL2S5). The increase in the absorption in the internal mixture compared to bare BC, despite no embedding (and therefore no lens effect, see also Scarnato et al., 2013) is due to absorption properties of mineral dust.
2. Internal mixture vs. bare mineral dust: Interestingly, when comparing the internal mixtures cases BL2S1 – BL2S5 with bare mineral dust optical properties, we found a "cut off' in the SSA values, depending on the size of the 2 internally mixed aerosols: 1. Simulations predict for small internally mixed particles (cases BL2S1 and BL2S2), where dust particles are small in size, a steep increase in the absorption and no significant variation in the scattering properties compared to bare

mineral dust. The latter leads to smaller SSA values of internal mixtures compared to bare mineral dust particles. 2. When mineral dust particles are larger and therefore the BC mass is comparably much smaller than the mass of mineral dust (cases BL2S3-BL2S5), simulations predict a steep increase in the scattering, but less in the absorption, therefore prevails scattering vs. absorption, leading to the larger SSA.

The authors added after the sentence "While DDSCAT predicts [ ]…. bare dust particles (S3-S4-S5)." the following text:

Such a "cut off" in SSA values is due to the fact that simulations predict for small internally mixed particles (cases BL2S1 and BL2S2), where dust particles are small in size, a steep increase in the absorption and no significant variation in the scattering properties compared to bare mineral dust (S1-S2). The latter leads to smaller SSA values of internal mixtures compared to bare mineral dust particles. Further, when mineral dust particles are large (cases S3-S5), and therefore the BC mass (case BL2) results comparatively much smaller than the mass of case S3 and S5), DDSCAT simulations predict a steep increase in the scattering, but less in the absorption, therefore prevailing scattering vs. absorption, for those cases are associated with larger SSA values compared to bare mineral dust.

In an attempt to synthesize the differences between the above discussed optical properties of bare BC and internal mixtures, we found that:
With the increase in size of mineral dust the absorption increases; however, also the scattering of the internal mixture (cases BL2S1 – BL2S5) increases leading to larger SSA values for internal mixtures compared to bare BC (case BL2) (not shown here, as we provide MAC normalized by the total mass of the particle, not just BC mass). The increase in the absorption, despite no embedding (no "lens effect"), see also Scarnato et al., 2013, is due to absorption properties of mineral dust.

Specific comments

1. **P2488L14-16 The meaning of "the opposites" is not clear here.**

We modified the sentence in the following way:

"Predicted values of mass absorption, scattering and extinction coefficients (MAC, MSC, MEC) for bare BC show a weak dependence on the BC aggregate size, while the asymmetry parameter (g) shows an opposite behavior."

1. **P2489 L18: Semicolon (;) may be comma.**

We modified the text adding a period.

2. **P2493 L9: Take out parenthesis.**

We removed the parenthesis, thanks for noticing.

3. **P2494: L4 and 7: Some words are italic. Is there any intention?**

We just wanted to underline that was just a minor aspect discussed in the paper.

4. **P2496 L7: In this study, we modeled dust aerosols as spheroids and rectangular prisms with an intermediate aspect ratio of 1.75. . . (see Table 3). The aspect ratio of 1.75 is not intermediate but the maximum value (Table 3).**

We modified the text for clarification in the following way:
"In this study, we modeled dust aerosols as spheroids and rectangular prisms with an intermediate aspect ratio (compared to the literature) of 1.75, ⋯ []"

5. **P2498 L18 For synthetic aggregates presented in Fig. 2, . . . I am not sure why the number of each particle has standard deviation (SD). Is this an averaged number? Please explain the meaning.**

Yes, they are averages. The number estimates is sensitive to orientation, therefore the SD is calculated from 50 random orientations.

6. **P2500 L27: Table 4 should be Table 5.**

Thanks for noticing it. We modified the text accordingly.

7. **Table 2: Table 2 is not useful unless the refractive indices values are shown. Also Wagner et al. (2012) showed a range of refractive index for mineral dust. Which values did the authors use?**

As the referee commented, Wagner et al. 2012 provided a range of values for Sahara dust. We used the upper range of values for the imaginary part of the mineral dust refractive indexes.

The comment of the referee on the utility of Table 2 is justified. Despite that, the choice to keep Table 2 is motived by the fact that, in this way, a quick reader does not have to scan all the paper to find the reference refractive indexes.

8. **Table 3: Please indicate how many particles were analyzed to obtain these values.**

The values in Table 3 provide morphological descriptors for the images shown in Fig. 1

9. **Figure 1: It will be useful to have arrows to indicate black carbon on the mineral dust particles.**

We modified the images adding red circles around the BC aggregates on the surface of the mineral dust particles.