The paper discusses the remote sensing of dust aerosols over the Arctic and the question of the possible misinterpretation of dust identification when using the brightness-temperature differences at 11 and 12 μm as parameter. In particular the possible bias induced by clouds in is investigated. The paper provides an interesting discussion against recent literature and provides illustration based on specific cases. The paper topic is well suited for ACP and surely of relevance for the dust and remote sensing community. However, the presentation quality should be improved before publication. As general comment, in fact, the paper is quite hard to read as the presentation and the discussion is based on many references to other papers, including mention to literature figures, and reference to Appendix and Supplementary material of the paper itself. Several footnotes are also present in the text and could be avoided. Despite it is appreciable to have a concise manuscript, the many references to literature and additional material in the paper make the reading often difficult. The reviewer suggests to revise the presentation to make it more self-consistent.

General comment to the reviewer: *the answers to your specific comments are immediately below. We would also point out that we made other changes that we thought would help to clarify the text (as well as the correction of few technical errors and/or typos that we missed in our proofreading before the original submission)*

We made a concerted effort to respond to the general notion of our paper "making reading often difficult". This included the elimination of excessively detailed text that wasn't essential to the narrative of the paper:

- *The paragraph in the main text that dealt with the "correction" of KA's (Kawai et al., 2023) simulations (involving the comparison with CALIOP estimates of local dust DOD). These are details that go beyond the (not very demanding) reasons for including a discussion of local dust simulation in the paper*
- *everything related to local vs Asian dust* DOD_m *comparisons*
- *the appendix table with its admittedly outdated estimates of dust refractive index (i.e. the table that was entitled "Survey of dust refractive indices (11 and 12 μm)"). We replaced that table by simple refractive index + derived emissivity spectra (Figure B2 in Appendix B.2) that explicitly show and contextualize the refractive indices employed for all of our MODTRAN simulations of* $BTD_{11\text{-}12}$

We also added a graph in Appendix A showing a comparison of the AERONET CM AOD (for the AERONET sites in or near the CAA) with DODs from the KA simulations: we believe that this lends support to the variety of arguments we make for the weakness of DODs in the Arctic (the main text was also clarified to underscore that point)

And we added other clarifying material:

- *the addition of North American wide map in the main text as suggested by the referee.*
- *what we believe is a significantly clearer discussion related to the main text figure showing the radar profiles and the* $BTD_{11\text{-}12}$ *and* BT_{11} *temporal series of Mar. 22, 2015 (that figure is now Figure 2 after the addition of the map as Figure 1)*

We chose not to remove citations or footnotes: the referee will surely be open to the argument that as cumbersome as citations can sometimes be, they are endemic to a comprehensive scientific text. With

respect to footnotes, we believe that they actually make the text more readable and easier to understand: the reader is free to ignore footnotes in order to understand the higher level narrative of a given text (and free to consult the footnotes if he or she feels the need to dig deeper into the technical details)

Other specific comments:

Section 2 is quite short and not fully clear in particular since, as the introductory part, it relies on the reference to literature and supplementary material

> *We replaced our single sentence of (admittedly oversimplified) contextual text by a more substantive supporting narrative. The first paragraph is now about climatological scale detection of Arctic aerosols while the 2nd paragraph is about our claims concerning the event level mis-interpretation by VCT*

Introduction and following sections: many literature measurements from diverse sites in the Arctic are discussed. It would be good to have the localisation of these sites either in the form of latitude and longitude (in Table or main text; these are mentioned for some sites in the Appendix section only) or as a map. A map could be useful to provide some contextualisation of the discussion for a non-Arctic specialized reader.

> As stated above, w*e added a map (new Figure 1) : we think that the reviewer is correct and that it does indeed give contextual colour (breathing space) to our short but technically dense main text*

Appendix A, line 293: the value of $reff$ of 2.7 µm is referring to a transported or locally emitted dust? As the dust diameter changes over transport time due to gravitational settling, is this assumed Reff value representative of source or long range transported dust? Please clarify in the text.

> *Text line was clarified (the Kok distribution, of r_{eff} = 2.7 µm, refers to locally emitted dust). Kawai-derived estimates of DODs that would, at a distance from the emissions, be smaller due to smaller-sized dust particles, will not impact our order-of-magnitude claim that the Kawai-based DODs are substantially smaller than the AeF estimates.*

Footnote number 7 and Appendix B1: the OPAC database is quite outdated to represent dust infrared refractive index and the survey in Table B1 is missing several key works in the literature that investigated the infrared refractive index of dust aerosols. For this reason, I would either change the title of this section to clarify that this is not an exhaustive survey, or to extend the survey and take the variability of the refractive index of dust into account.

> *As stated above, we deleted that largely irrelevant refractive index survey table in favour of graphical refractive index and emission spectra which showed and contextualized the explicit refractive indices employed in our MODTRAN simulations of $BTD_{11\text{-}12}$.*

Final note to the referee

> *In response to the 2nd referee, we provided a more comprehensive explanation of the parameterizations employed to generate the $BTD_{11\text{-}12}$ vs BT_{11} patterns for ice, water and dust clouds (and moved that figure + its discussion from the supplementary material to a new Appendix B.1 [supported by the new Appendix B.2 where the choice of refractive index is justified])*

We also rearranged Appendix A in general to render its opto-physical development more "bottom up" (with more clarifying titles to accommodate this re-rearrangement as well as the transformation of old Appendices A.5 and A.6 into, respectively, new Appendices A.3 and A.4: a Word sample of the new Appendices TOC is below). Appendix A.3 includes a new graph (Figure A1) which more explicitly (and clearly, we would argue) compares the AeF CM AODs with the KA DODs for the four AeF AERONET sites in the CAA (Canadian Arctic Archipelago). There are still three tables labelled A1, A2 and A3: they have been revised to eliminate everything related to our misguided (unnecessarily complicating) attempt to compare $[DOD]_m$ values of local and Asian dust.

We provide below the new TOC of the Appendices so that the reviewer can better appreciate their re-arrangement (the TOC of the main text did not change)