Response to Reviewer #2

General comments:

The paper, although a little too long, presents interesting analysis of two dust event periods and the presence of bio-aerosols, one over Puerto Rico, and one over Leon (Spain). The first part of the paper, which describes measurements method, is probably the best part of the paper.

The second part, the analysis of the two dust event periods, is the main limitation of the paper: Why these two events only, which do not occur at the same year and period? We cannot speak of a comparison just from two episodes that have no reason to be similar or different. At least, it is just two cases studies, which are interesting by themselves. The authors must explain why they have considered only these events, how they can be compared or not, and how they can be representative of not of dust events in two different regions of the world.

Response: We respectfully disagree with the reviewer that two events or dust episodes cannot be compared and they are just two case studies. What the two events that we are comparing have in common is that the source of the dust is from the same regions of Northern Africa. We acknowledge that they are from different seasons, but this should not impact significantly the characteristics of the dust itself that is being lifted from the surface by strong winds. Those two events were chosen because of their historical significance. The June 2020 dust event over Puerto Rico was the highest dust event observed in the last 26 years based on the ground data available, in terms of the amount of dust transported and its geographical extent (Yu et al., 2021). Whereas Leon recorded the highest dust event in the 22 years (García Valero, Juan Andrés. "Report on the intrusion of dust of Saharan origin over the Spanish peninsular territory between March 14 and 16, 2022." (2022)) based on the air quality data available at that location. Although these two events did not occur at the same time, the magnitude of dust they carried from Northwest Africa to two different locations of different geography enabled numerous opportunities to study the properties of these aerosols. For example, a better understanding of dust transport from Africa to the Caribbean and the Iberian Peninsula, the influence of meteorology over dust transport, dust-bioaerosols link, dust-cloud interactions, validate the outcome of the dust forecasting models, etc.

Reference:

García Valero, Juan Andrés. "Report on the intrusion of dust of Saharan origin over the Spanish peninsular territory between March 14 and 16, 2022." (2022).

Yu, H., Tan, Q., Zhou, L., Zhou, Y., Bian, H., Chin, M., Ryder, C. L., Levy, R. C., Pradhan, Y., Shi, Y., Song, Q., Zhang, Z., Colarco, P. R., Kim, D., Remer, L. A., Yuan, T., Mayol-Bracero, O., and Holben, B. N.: Observation and modeling of the historic "Godzilla" African dust intrusion into the Caribbean Basin and the southern US in June 2020, Atmos. Chem. Phys., 21, 12359–12383, https://doi.org/10.5194/acp-21-12359-2021, 2021.

The title must be changed to specify that only two events are considered.

Response: We have changed the title in the revised manuscript.

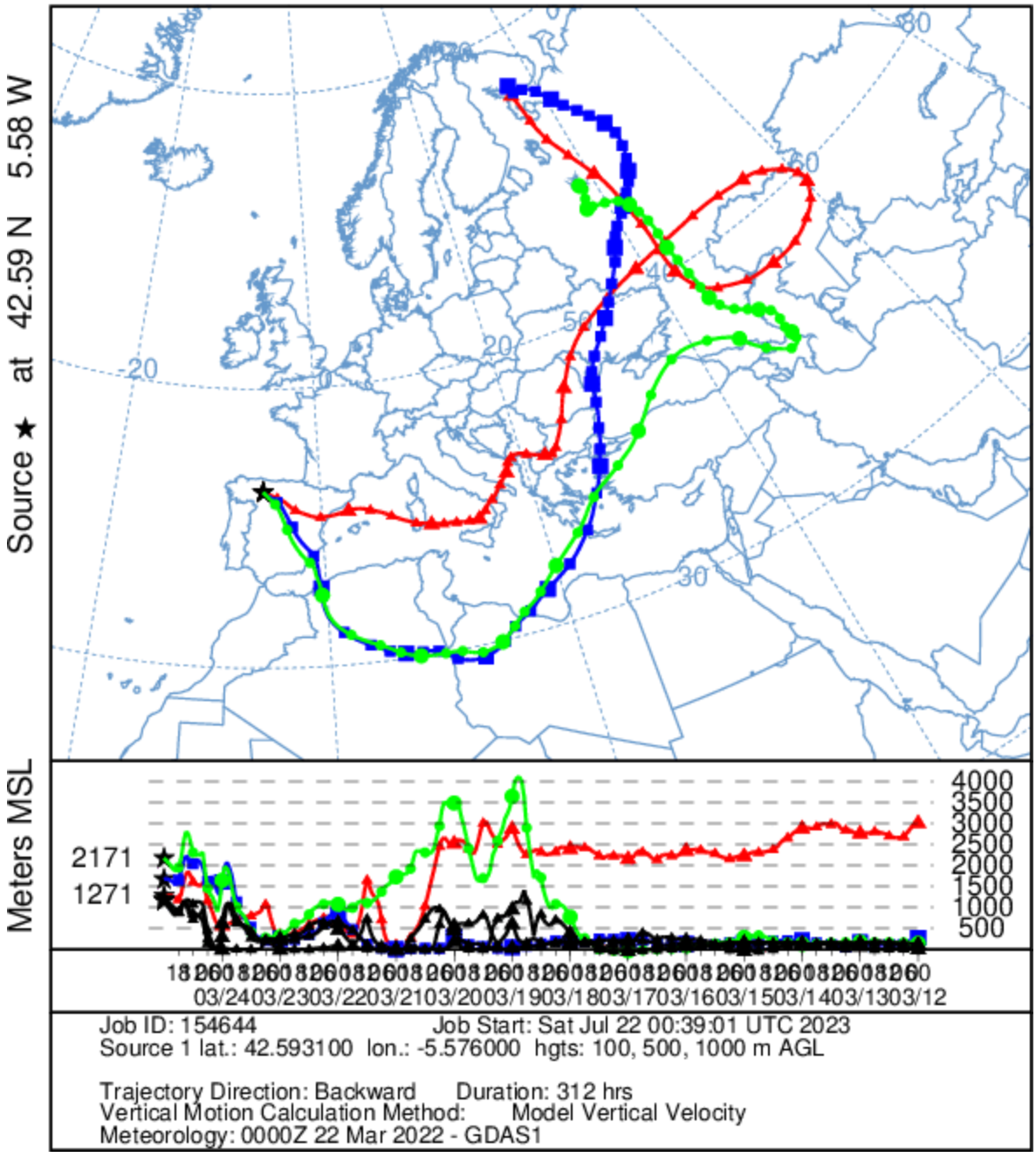
"A Comparative Analysis of an Intensive Incursion of Fluorescing African Dust Particles over Puerto Rico and Another Over Spain.

Also, one important information is missing: the altitude of the dust plume. Do all the particles of the plumes have fallen on the ground, or do they mainly travelled above the ground, or do only the lower part of the plume have touched the ground? The ground-based meteorological parameters could be not representative of the meteorological conditions a few km above the ground.

Response: We have added a dust plume height for PR and Leon in the revised manuscript.

The figures below show the height of the air mass back trajectories drawn at three different altitudes (e.g., 100 m, 500m, and 1000 m) on the peak days of the dust event observed in PR and Leon. The air mass height reduced when it moved from Northwest Africa to Puerto Rico and Leon. It shows significant dust deposition at the locations under study (Record amount of PM_{10} observed at both the sites). As for the Caribbean (Puerto Rico), the historic African dust plume in the Caribbean was modulated by meteorology. The MEERA-2 meteorology associated with the dust episode, which focuses on geopotential height and wind vectors in **detail, is discussed in Yu et al., 2021.**

NOAA HYSPLIT MODEL
Backward trajectories ending at 0000 UTC 25 Mar 22
GDAS Meteorological Data



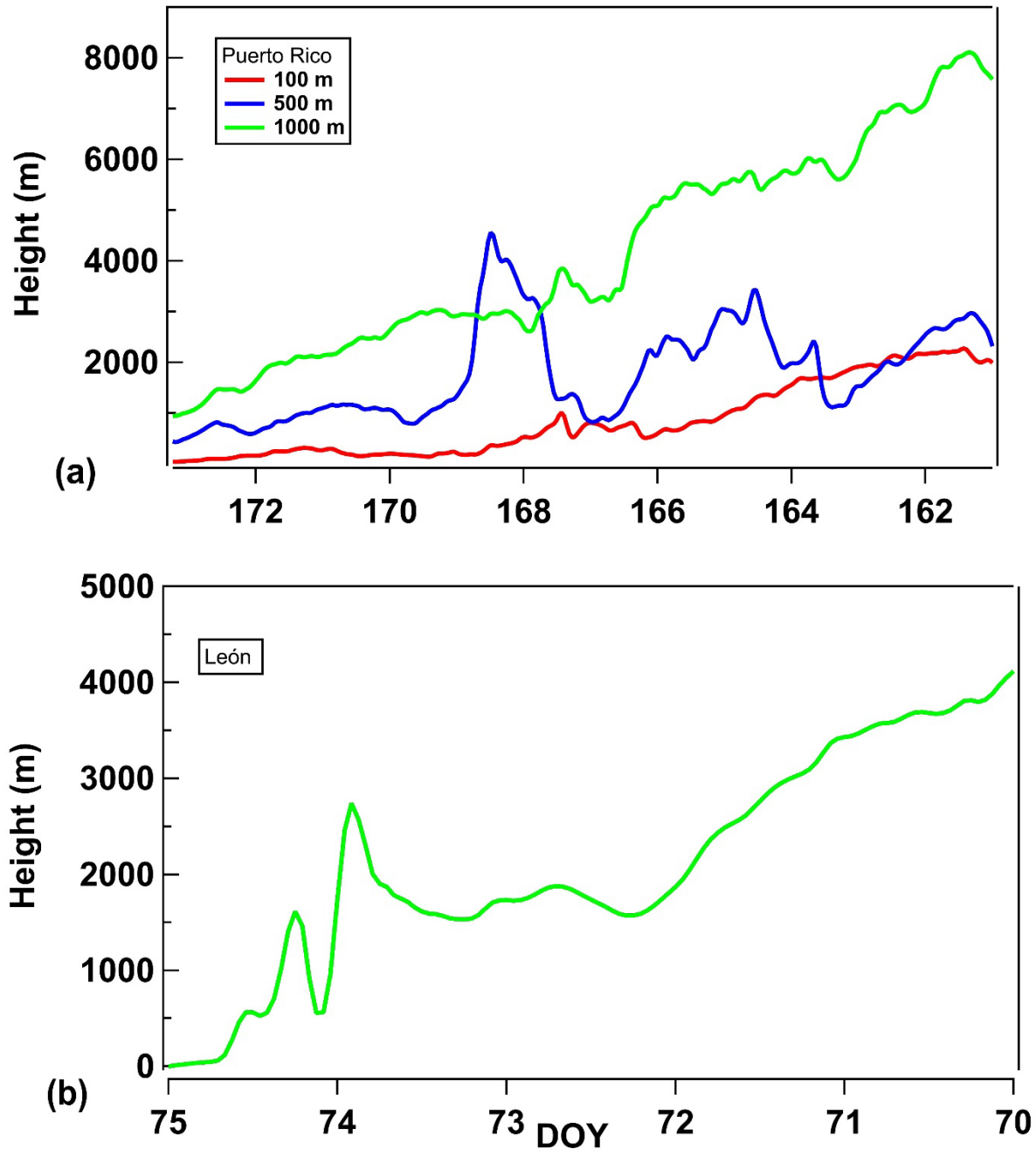


Figure: HYSPLIT air mass back trajectories height drawn for thirteen days over PR (a) and five days over Leon (b) on DOY 175 and 75, respectively.

Tables and legends of the Figure (and in particular for Figure 9) are often too small and thus difficult to read.

Response: We acknowledge the reviewer's concern and have added an additional, larger legend on Figures 8 & 9 for clarity. We also draw the reviewer's attention to the figure captions that also describe the nature of the lines, i.e. color and dashed/solid.

Thus, the paper needs a serious revision concerning its objectives and conclusions. Nevertheless the analysis is interesting and deserves publication after the revision.

Specific comments:

Figure 1 : It seems that that dots that are present in Figure 1b for AB type are missing in Figure 1a.

Response: We appreciate the reviewer comments concerning the error on Figure1a. This Figure has been corrected in the revised manuscript. The label for the AB types was inadvertently covering the squares that are mentioned by the reviewer.

Line 359: Most of the optical counter assume a given value for the refractive index. Obviously, the fog monitor considers the refractive index of water (with no imaginary part) to provide the size distribution of the particles. Obviously, the refractive index of dust particle is totally different and have an imaginary part. Thus the retrieved size distribution will be erroneous due to this calibration procedure. In fact, the dust particles at a given size will be less luminous than water droplets. Thus, the real size of the dust particles will be underestimated.

Response: We appreciate the reviewer's comment. We agree that FM-120 may underestimate the real size of the dust particles. In this study, the primary instrument used was WIBS, which was tested and calibrated using a standard polystyrene Latex sphere and is more accurate than FM-120 as far as the measurement of particle size distribution of dust is concerned. We have edited the manuscript now to read:

"The FM-120 was originally developed to measure fog droplet properties; however, the measurements are not specific to fog and in the presence of dust particles it will measure their size distributions but with a larger uncertainty because these particles will not be spherical. nor will they have a refractive index of water (1.33). The estimated uncertainty due to shape and refractive index uncertainty is approximately ±30%."

Line 625: Nothing is highlighted in blue in red in Table II, and the cells are no shaded.

Response: We thank the reviewer for catching this formatting error. However, color shading

is not allowed by the EGU journals. We are now using gray and black shades in table II the revised manuscript

Figure 14: The shaded regions are more in orange than in yellow.

Response: We thank the reviewer for noticing this. We have changed "yellow" to "orange in the caption.

Figure 15: What mean "DOY" preceded by a number?

Response: We apologize for the confusion of preceding "DOY" with the number instead of placing the number after DOY, i.e. DOY75 rather than 75 DOY. This has now been changed.

Figure 17: To what correspond the black vertical line in panel (b)?

Response: We thank the reviewer for identifying this error in Figure 17 (panel b). We have corrected it in the revised manuscript.

Figure S8 is unnecessary.

Response: Given reviewer comment, We have removed FigS8 in the revised manuscript.

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