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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Advances in understanding mineral dust and boundary layer processes over the Sahara from Fennec aircraft observations" *by* C. L. Ryder et al.

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Synopsis: This is an overview paper of the Fennic missions and has two primary objectives a) Give an overview of the Fennic objectives, instrumentation, and research environment; and b) Highlights of interesting measurements and events. By and large I favor papers such as this that can give an overview of a mission. I periodically write papers such as these myself, basically trying to give an overview as to what was done and "Planting a flag" of interesting things ahead of a more substantial paper to be written. This paper by and large meets its objectives. There is great detail on the mission rationale, the research aircraft and the regional environment. Ultimately, I can figure

out what they did-which is the bottom line. Thus, I think the paper is all together appropriate for publication in ACP. This said, there are a few things that require attention. Perhaps they will not take too long to address, but they will have to require some attention to detail. Typically I do not write extensive review for these kinds of papers. The mission is the mission and if the authors want to present it in this way it is their business. But, there are a few things that the authors should consider. It is somewhere between minor and major revisions. This ambiguity is how the authors decide to deal with comments b)-d) where clearly there is something wrong. They do not invalidate the data set, which if analyzed is quite valuable. Regarding e) I can tell you that this will take probably the better part of a week of someones time. a) Title versus conclusions. This paper is titled "Advances in the understanding. . ." However, this is not really what the paper is about. One only needs to look at the conclusions. This is a mission overview paper and spends considerable space laying out the mission and the environment. They do not present too much that I would consider "advances in understanding." This is a very important dataset. But In terms of what we know now, that we did not know earlier, it is fairly thin. There does not even exist a discussion section. Perhaps the conclusions should bulletize the major "New" finding s and backed up by a short discussion section one why these is new.

b) Size distribution: I think issues surrounding the troubles with wing mounted aerosol and cloud probes borders on community wide apocrypha. Or maybe I am just the Rodney Dangerfield of aerosol science. But, as the authors well know because they referenced my 2003 paper, FSSP, CAPS etc probes cannot be used for measuring aerosol particle volume distributions in the coarse mode. This paper, and the work of Maring, as well as my 2006 and 2008 JGR papers lay this out crystal clear. The response function for scattering versus size is degenerate. Period. Consequently, the OPCs slightly enhance the counts of 10 um, which in the third moment, dominates the volume distribution. Additional infection points work their way into larger sizes-which are clearly visible in their size distribution plot. To recognize how big a problem this is, one merely needs to plot size on a linear Y axis (as opposed tothe log scale in

this paper), and one will immediate say “Oh, that is not right. . .” I can tell that the authors know they have a problem, because in their ozone depletion comparison they compare to PCASP surface area concentration, which accounts for maybe 20% of the true surface area. I get the fact that we want a coarse mode size distribution, and we have precious few tools to do that on an airplane. But please explain what is really going on. You can make the same point, by looking at ratios of the giant versus coarse mode counts, or as we showed, the FSSP/CAPS configuration makes a great forward scattering nephelometer. Also, please note in my 2008 dust paper the AERONET inversions verify quite well against measured dust size distributions. Where they have a problem is past 10 um in diameter where the optical cross section is fairly low. While I cannot say the retrievals are accurate to better than 2 um, they are very precise in a single mode environment, like dust.

c) Inlet Cutpoints and its ramification: From the above discussion on dust size I think my feelings regarding the difficulties of measuring dust from aircraft are pretty clear. Most of the results of the paper hinge on this. Along the some lines, the discussion of the inlet cutpoints and its characterization probably would benefit from some clarification. First, I would be shocked if in reality the cuptpoint were really much above 3 um. Although many have tried, I have never seen anyone be really successful. As the verification for the cutpoint is used from an OPC to OPC comparison, as discussed above the final characteristics is likely optimistic. Ultimatley, the derivation of things like AOT are likely underestimated, perhaps grossly at times when there is a large giant mode. If would actually believe the size distributions presented (which I don’t), it would be massively so. But I would not be surprised if the AOTs were underestimated by as much as a quarter to a third on average. Similarly, absorption measurements (perhaps even more than the scattering) take a beating with inlet and plumbing losses as the single scattering albedo goes down fast with larger particle size.

d) Lidar: I am not a lidar guy, but it seems to be that some of the lidar data, such as in Figure 17, is massively attenuated and thus difficult to interpret other than the location

top of the dust layer. It is very tough for me to make sense of it. I showed it to some lidar friends, and their immediate reaction was “Oh, that does not look right.” The LNG lidar data looks ok from what we can tell. It might be worth pinging someone like John Hair at NASA Langley for an independent opinion.

e) Finally on figures: In my last paper to ACP the editor went after me on relatively minor issues of figure layout and clarity, requiring me to essentially redo most of the figures. Given the figures in the present paper are in much worse shape than mine, I thought I would share the love. The figures are inconsistently generated, with very hard to read color bars. Much of the time, the scales are not even listed, and at others there is over scale with lots of fine print font that will not come out well in the next typeset version. Some figures are not even labeled at all. I suggest the authors go through these all again with a fresh view and a copy of adobe illustrator. Keep in mind, ACP tends to take these full page figures and cram them into a quarter page.

Hope this helps, Jeffrey S. Reid, US Naval Research Laboratory.

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