Atmos. Chem. Phys. Discuss., 15, C22–C27, 2015
www.atmos-chem-phys-discuss.net/15/C22/2015/

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.

D. A. Ridley (Referee)

daridley@mit.edu

Received and published: 23 January 2015

"Advances in understanding mineral dust and boundary layer processes over the Sahara from Fennec observations" is a comprehensive review of the Fennec field campaign observations and the findings thus far. The manuscript is well-written and detailed, serving as a technical document that also includes a summary of current results and future work involving the Fennec campaign data. Several interesting areas of research are highlighted, including measurements of very large dust aerosol, dust uplift during nocturnal LLJ breakdown, potential ozone depletion via dust uptake, vertical structure and mixing within the SABL, and dust acting as CCN and IN (at relatively

warmer than expected temperatures). The manuscript details a wealth of exciting data that has been collected during the Fennec campaign that will greatly aid in our understanding of meteorological processes driving dust emission and transport, and the resulting radiative impacts in this important region. I therefore recommend this article for publication after addressing the comments below.

Major points

Beyond a reference point for future Fennec research articles, I believe the major benefit of this manuscript to the wider community comes from (1) the summary of findings based on the campaign and (2) the individual flight and observation details that will direct researchers to specific data of interest to them.

To better address these points I would like to see a summary table of the findings and the associated references rather than the current conclusion section that, while concise, is largely a repetition of the preceding sections. Something akin to the tables within Ansmann et al. (2011) summarizing the SAMUM campaign findings would be very helpful to the reader. The conclusions could then be limited to an extension of the general summary detailed on pg 252 lines 1-11, reducing the text in the conclusions of this lengthy manuscript.

To address the second point, I think some effort should be made to detail where the data is available to the wider scientific community. Are their plans to store the data in a public repository? For example, in the same way the NASA Discover-AQ campaigns have been. The comprehensive information on flights, instrumentation and meteorology in this manuscript can then be used to help the community make best use of specific flights within the wealth of data collected.

The remaining smaller points are concerned with errata, brevity, and clarity in the text and figures.

Minor Points

pg 204 - Consider dropping lines 1-26 altogether. The paper is long and some of this comes across unnecessary and repetitive. If so, the last paragraph on pg 203 can be merged with the following text.

pg 205, line 17 - reword to "Finally, the Sunphotometer Airborne Validation EXperiment (SAVEX) was designed to use the island of Fuerteventura as an operating base by conducting an intercomparison of...

pg 205 line 27 - "insight"

pg 207 - can you quote what the uncertainty decreases to above 2 km?

pg 209 line 20 - Ryder et al. (2013c) appears to be the same reference as Ryder et al. (2013b) in the references section.

pg 209 line 26 - "Interestingly, "

pg 210 line 1 - replace ": clearly" with ". Hence, "

pg 210 line 9 - replace "are" with "is"

pg 211 line 25 - "post-processing"

pg 212 line 5 - should this be "pitch, roll and heading."?

pg 214 line 19 - 2102 should be 2012

pg 216 line 20 - "Such..." it is not clear what is being referred to here. Both of the preceding dust generating processes? Consider rewording.

pg 218 lines 7-12 - A long sentence! Consider changing to "...Fennec flight domain: a northern extension of..."

pg 220 line 15 - typo: "sampling"

pg 223 line 19 - "Interestingly, "

pg 224 line 26 - is a unit of volume missing from the "10 ug"?

pg 227 line 13 - should this read "(GCCN)"?

pg 228 line 28 - is the fact the PCASP does not represent the full CCN size range problematic at all?

pg 229 line 9 - remove the first "further"

pg 230 lines 7-12 - Four instances of "could" in this section! Is there any plan/way to test this hypothesis?

pg 230 lines 20-22 - Fragment. Please revise the sentence.

pg 231 - This is interesting but the inability to separate out air mass effects from dust-ozone effects is a pain and always crops up... I suppose some kind of Lagrangian study is needed.

pg 235 line 1 - typo: "complicated"

pg 236 - repetition between lines 3-5 and 10-12, please revise.

pg 237 line 7 - delete open bracket

pg 237 - Recent work by Kok et al. (2014) has shown that the dust uplift is likely non-linear with threshold velocity. This may not affect the broad results here but a caveat that the DUP is a simplification should probably be inserted.

pg 243 line 16 - Reorder so that :up to about 2.8 km above MSL" follows "grew".

pg 245 line 14 - change "from heating" to "in heating"

pg 246 - This is a little confusing. The albedo on Figure 18 shows no decrease at 21.6N (possibly because it is off the flight track) but this makes relating the CBL depth and albedo difficult - the figure doesn't seem to back up the text well. Is there a way to improve this?

pg 250 line 15 - Here it says the SEVIRI comparison is good, but there appears to be a high bias relative to MODIS and the LIDAR in the case show.

pg 262 - Ryder 2013b and 2013c appear to be duplicated.

pg 263 - Sodemann reference is "in preparation" in references but says "submitted" in the main text.

pg 263 line 23 - remove "last access..."

Table 4 - retain brackets for mount location abbreviation as in Table 3

Figure 5 - no legend entry for the data points from previous campaigns (black dots).

Figure 7 - please be consistent with the panel labelling throughout the figures - the (a,b,c) format in Figure 5 is preferable.

Figure 8 - Write out "Potential temperature" before the symbol in the caption. - Make the "large circles" larger and more visible.

Figure 10 - Again, please use the (a,b,c) labelling format for clarity and consistency.

Figure 12 - Colour bar label should read "uplift", not "uptake".

Figure 13 - BAe146 flight track is barely visible, please thicken the line

Figure 15(b) - should the top axis units be Mm-1?

Figure 17 - define CBL and SRL in the caption (unless ACP guidelines state otherwise) - the mauve line at the bottom does not appear to be defined in the caption

Figure 18 - are the k/kg units meant to be g/kg?

References ANSMANN, A., PETZOLD, A., KANDLER, K., TEGEN, I., WENDISCH, M., MÜLLER, D., WEINZIERL, B., MÜLLER, T. and HEINTZENBERG, J. (2011), Saharan Mineral Dust Experiments SAMUM–1 and SAMUM–2: what have we learned?. Tellus B, 63: 403–429. doi: 10.1111/j.1600-0889.2011.00555.x

Kok, J. F., Mahowald, N. M., Fratini, G., Gillies, J. A., Ishizuka, M., Leys, J. F., Mikami, M., Park, M.-S., Park, S.-U., Van Pelt, R. S., and Zobeck, T. M.: An improved dust

emission model – Part 1: Model description and comparison against measurements, Atmos. Chem. Phys., 14, 13023-13041, doi:10.5194/acp-14-13023-2014, 2014

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 199, 2015.