Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-1084-RC3, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effect of sea breeze circulation on aerosol mixing state and radiative properties in a desert setting" *by* Yevgeny Derimian et al.

Anonymous Referee #2

Received and published: 8 March 2017

This is an interesting and well written article that describes how the composition of aerosols at an inland site can change dramatically on a daily basis because of the influence of sea breezes. The authors point out that this can have a significant impact on the atmospheric radiative effect at the site. I have only a few suggestions for improvement.

Major issues

Page 11, lines 1-24 and Figure 7: Interesting discussion about how the refractive index changes with air mass and water vapor. The authors use standard deviations for the error bars in panels c-f of Figure 7 to understand the differences in the observations during low and high water vapor periods. However, it would be more useful to use the

Printer-friendly version

Discussion paper

standard deviation of the means for this application (i.e., SDOM, or standard errors). This will decrease the contribution of random noise to the size of the errorbars, and it will provide the reader with an understanding of whether these differences are statistically significant at the 1-sigma level (i.e., datasets with overlapping SDOM errorbars are not significantly different). The authors should also indicate how many data points are used to compute the means in panels c-f.

Page 11, lines 18-24: The authors bring up the topic of ssa in this paragraph, but don't really take it anywhere. You could isolate the effect of refractive index on the ssa for Aug 16 w/o much work though. . . that is, compute the ssa of the sea breeze aerosols using the SD of the pre-breeze particles. This will provide a Delta ssa associated with the size change. Similarly, you could compute the ssa of the pre-breeze particles using the refractive index of the sea-breeze particles; this will provide a Delta ssa associated with refractive index. This type of calculation can provide the reader an idea of how much of the ssa change is associated with size and how much is associated with composition, and it will make this paragraph more interesting.

Figures 8 & 9: Is there a discrepancy here?... The coarse mode is dominated by dust before the sea breeze in Figure 8, but Figure 9 indicates that there are more marine particles than dust particles at all radii > 0.5 um.

I really enjoyed the analysis of the effect of core-shell morphology on the AERONET retrievals (Section 7). I have a couple of additional points that I believe are worth including in the manuscript:

+ Water shell thicknesses of 10% and 40% correspond to geometric hygroscopic growth factors of 1.11 and 1.67 (GF = r / r_core). A value of GF = 1.11 seems reasonable, but GF=1.67 is a rather large value to obtain at ambient relative humidities (your figures indicate typical RHs of ∼60% for the sea breezes). These large growth factors are not impossible (especially since you are observing significant fractions of marine aerosols), but it would be worthwhile to discuss these GFs in the context of

TDMA measurements found in the literature. Swietlicki et. al. (Tellus 2008, 60B), for instance, provides a nice overview for measurements at 90% RH.

+ Level 2 AERONET retrievals do not include retrievals with residuals greater than 5-8% (depending upon AOT); thus, the 40% coating cases would not make it through the Level 2 AERONET screening, since the residual for that case is 14%. It is important to point this out to the reader, as it demonstrates that AERONET has the ability to omit cases where the aerosol morphology differs drastically from the morphology assumed in the retrieval. This is a much different conclusion than "the retrieval gets it wrong" for such cases.

Page 17, line 33: "The retrieved refractive indexes significantly exceed those of the core,..." This is somewhat unintuitive, so it would be worthwhile to explain why this happens in a sentence or two.

Minor issues

Page 4: Authors discuss the relationship between the Angstrom exponent and aerosol particle size, without citing the literature. They should provide one or more citations for uninitiated readers.

Page 10, line 24: "Figures 5c and d..." should refer to Figure 6. Page 10, line 34: "Also the maximum of the coarse mode..." should be "Also the maximum radius of the coarse mode..." Page 10, line 34: Replace millimeters (mm) with micrometers (um).

Figure 11, upper right panel: label should be Ca instead of C, right? Page 14 and Figure 12: There is much discussion about the colored arrows in Figure 12, but I do not see any arrows in my copy. Page 15, line 6: What is the wavelength range covered by the SolRad-Net pyranometer? Page 15, line 26: Figures 12c,d should be Figures 13c,d...

Page 16, line 2: The atmospheric radiative effect is related to the SSA, so you could tie this into your earlier discussion of SSA. That is, you could compute the radiative effect

using pre-breeze SD and sea breeze refractive indices to estimate the effect of size on the radiative effect (by comparing to the sea breeze computations that you have already done); likewise, computations utilizing the pre-breeze SD with both pre-breeze and sea-breeze refractive indices can be used to estimate the effect of composition on the radiative effect. I include this item as a "Minor Issue" because it would be a nice addition that will make the paper more interesting, but it is not something that is absolutely necessary for publication.

Page 17, line 27: "Note that the refractive index used in the case of homogeneous particles is the same as that of the core." I think that you should move this sentence to the end of the previous paragraph, as I was looking for this information earlier on.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1084, 2017.

Printer-friendly version

Discussion paper