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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Three years of measurements of light-absorbing aerosols in the marine air at Henties Bay, Namibia: seasonality, origin, and transport" *by* Paola Formenti et al.

Anonymous Referee #1

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Review of Formenti et al., Three years of measurements of light-absorbing aerosols in the marine air at Henties Bay, Namibia: seasonality, origin, and transport, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-471, 2017.

This paper describes long-term eBC measurements at a coastal site in Namibia. The authors put the measurements in the context of atmospheric flow using back trajectories and meteorological maps. What I really like about this paper is that it takes the next step – it goes from observations (which are important, but not necessarily exciting on their own) to trying to assess the implications of the observations for radiative forcing using some rough calculations. The calculations are rough due to the limited

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nature of the current data set, but suggest this could be an interesting site to continue measurements with a larger suite of instruments.

Major comments: Line 121-122: “our best-guess estimate for sigma_BC in this work is 4.6 ($\pm$ 0.8) m2 g-1 by extrapolating at 880 nm the mean value of Bond et al. (2013).” I think a little more reasoning of why this is your best guess would be appropriate. The Bond value is so much lower than the other values you cite for biomass burning in the region and in the Amazon. Are you not dealing with biomass aerosol or is it aged and those numbers were for fresh or were there potential limitations in the studies cited (Liousse, Kirchsteter and Martins studies)?

Lines 163-165: did you look at whether the trajectories change during biomass burning season (Aug-Oct) relative to the peak eBC time period (May-Aug)? The manuscript discusses winter and summer differences (although none of the figures show the winter summer differences), but might be interesting to look at side-by-side seasons? And or how the trajectory clusters change as a function of season. Which trajectories are most common in the different seasons? Perhaps you could make a table showing total number of trajectories studied and then how many of each type fit into each season?

Line 278 Equation 2 doesn’t appear to account for hygroscopicity which seems like it would be important at a coastal site (fm=10% seems like a good estimate of absorption to scattering for dry aerosol, corresponding to an SSA of 0.9)

Lines 276-292: Is the AOD of 0.01 comparable to the AOD measured by collocated AERONET measurements during clean periods? Does the discrepancy between the estimate of AOD from the eBC measurements and AOD from AERONET suggest something about aerosol aloft (above the BL) or do you think it’s an artifact of not accounting for hygroscopicity (or some combination of the two). I realize this is meant to be a simplistic calculation, but if the results are different by a factor of 20 (0.01 vs 0.2) some comment should made evaluating the comparison. Perhaps an alternate approach would be to figure out what eBC concentration would correspond to the ob-

served AOD values from AERONET and whether eBC concentrations of that size are seen.

Line 311: Andreae et al (1995) suggest a range of 2-14 cm-3 (ng C m-3)-1 for 'b'. Also Andreae et al used a mass absorption cross section of 10 m2/g for their aethalometer measurements (presumably also at 880 nm for aeths of that time period, although it could've been a broad spectrum instrument). Again, I realize this is a simplistic and speculative calculation (and I think it's great you are doing it!) but a little more description of why you chose 14 rather than 10 or 5 for 'b' would be good as well as some consideration of the potential differences between the eBC from your measurements and Andreae's measurements would be good (since you have that information). Perhaps could move lines 334-341from conclusions into this discussion.

Editorial and minor comments:

Line 68: "..aerosol particles are conducted.." change to "..aerosol particles have been conducted. . ."

Line 71: "The research centre is located on the.." change to "The research centre is located in (or within) the. . ." (I'm not sure if in or within is better.

Line 75: River mouth doesn't need to be capitalized.

Line 81: give diameter and flow rate through inlet pipes?

Line 87: ". . .through the laden filter. . ." change to "through the particle laden filter"

Line 100: Add a sentence between the first and second sentence: "This assumption is supported by measurements of other potentially absorbing aerosol in the region.

Line 100: delete "As a matter of fact,"

Line 105: "..fraction should systematically.." change to "..fraction would need to systematically.."

Line 105-106: cause equivalent absorption to what? How many ug/m3 of black carbon?

Line 121-122: "...4.6 (± 0.8) m2 g-1 by extrapolating at 880..." change to "...4.6 (± 0.8) m2 g-1 obtained by extrapolating at 880..."

Line 135: "in the following SAWS, 2016..." change to "...hereafter referred to as SAWS, 2016..."

Line 143: We define "..excess eBC mass concentrations" the occurrences.." change to ""..excess eBC mass concentrations" as the occurrences.."

Line 149-150: these sentences are a little confusing – is the agreement remarkable because the amount of eBC was similar (50-150 ug/m3)? Since Andreae's sigma_BC was ∼2x larger than the sigma_BC assumed for your data set the agreement seems potentially coincidental rather than remarkable. Or did you mean that it's remarkable that this manuscript and Andreae's paper both indicated a strong continental influence in pristine locations?

Line 155: delete "On the other hand,"

Line 162: "..May to September.." later you say "..May to August.."

Line 182: define the winter and summer months - is winter JJA and summer DFJ?

Line 199 and 204: I don't think West Coast needs to be capitalized

Line 202: I don't think Westerly Wave needs to be capitalized

Line 212-214: "..the seasonal difference of the boundary layer height, also associated with the changes in synoptic regimes, is opposite to the seasonal cycle of the BC concentrations. This is confusing. Figure 2 shows the highest concentrations of eBC in austral winter JJA and lowest in austral summer. Lines 211-212 says the BL is 1000 m in winter and and 500 m in summer. That suggests the BL is high when the eBC is high and vice versa and thus has the same seasonal cycle as eBC.

Line 219: say how many trajectories this ended up being.

Lines 269-275: Seems like you could also look at the AAOD using an equation similar to equation 2 without the fm factor and using the assumed value for sigma_BC. For AAOD you could ignore hygroscopicity (well, it's commonly done to ignore hygroscopicity of absorbing aerosol – whether it's a good idea to do so is another question!).

Line 287: you used 700 m as delta z – but earlier you discuss boundary layer heights of 500 m in summer and 1000 m in winter. Why not use one of those values (or both) to get a range?

Line 292: start a new paragraph.

Line 292: "However, that the long-range. . ." rewrite "While estimates of AOD from eBC suggest little radiative effect, the long-range. . ."

Line 294: ". . .consistent to measurements. . ." change to ". . .consistent with measurements. . ."

Line 315: "..therefore exceeding by.." change to ". . .exceed by. . ."

Line 332: "Indeed, as the specific attenuation used in calculating the concentrations of black carbon from optical attenuation measurements are different, comparisons have to be considered as indicative." Change to "However, because the specific attenuation used in calculating the concentrations of black carbon from optical attenuation measurements are different in Andreae et al (1995) and the current study, such comparisons have to be considered very rough.

Lines 345-353 should go in the main body of the manuscript. (Much of the time I was reading I was wondering what the aerosol particles were if they weren't biomass burning during the dry season). Probably the best place for these lines is a new paragraph at the end of section 3.1. You might have to add some text referring to the next section about circulation, something along the lines of: "The existence of two major transport patterns (anticyclonic recirculation and along-the-coast streamlines) as described in

section 3.2 below suggests. . .”

Lines 355-356: “Their direct radiative effect should be insignificant.” Rewrite to “This low AOD value suggests their radiative impact should be insignificant.”

Lines 358-363: I would move these lines to line 295 after the (Junkermann and Hacker, 2015) reference. Then I would start a new paragraph with the sentence ‘This evaluation. . .”

Line 363: I would start a new bullet point with “Using an empirical relationship. . .”

Figure 2: I think it would be useful to have a second plot or an inset plot that shows the overall seasonality. See for example, figure 6c in http://aaqr.org/files/article/320/31_AAQR-15-05-SIMtS-0358_855-872.pdf which shows both the time series and the seasonality of eBC.

Figure 2 – could you change the tickmarks so there are 12 sections in each year? Right now there are 11 so it’s hard to figure out months.

Figure 5 and figure 4.S could be combined – you could put the box whisker from figure 5 (oriented horizontally) above the trajectory distribution in figure 4.S. You would need to use the same x-axis range for MBC. Note: should label eBC rather than MBC for consistency with rest of paper. The paragraph (lines 250-263) discusses figure 4.S enough that I think it should be included in the main text.

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