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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol arriving on the Caribbean island of Barbados: Physical properties and origin" *by* Heike Wex et al.

Anonymous Referee #1

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This manuscript investigated the aerosol arriving at Barbados and found 3 typical number size distributions (NSD), classified as marine-type, Aitken-type and accumulation-type. Size distributions on ground where compared with airborne measurements. Hygroscopicty and CCN number concentrations were investigated, also in regards of their origin. Sea spray was found to be a minor source of CCN. The manuscript is well written and structured. Measurement uncertainties and data quality are well documented and possible limitations and alternative interpretations are discussed. I recommend publication, after minor revision.

General Comments:

1. The reader would strongly benefit, if all Figures had a legend. Figures 2, 5, 6, 7, 8 do not have a legend, while others have.

2. The discussion of the particle hygroscopicity is very informative, however, I did not find a comparison of the different kappa values for the different NSD types. Did the different types show different or similar kappa-values? Did all Aitken/Nucleation mode types show a similarly high kappa, or was there a variation indicating different nucleation precursor? Also how representative is the kappa value for these Aitken mode types, as the maximum in the NSD is below the critical diameter. Can these kappa values be used to get an indication how these particles were formed, in terms of aerosol precursors.

Specific Comments:

Page 3 Lines 17ff.: It is noted that nucleation in the free troposphere is derived from DMS-derived H_2SO_4. Kirkby et al. showed that pure binary H_2SO_4-H_2O nucleation cannot explain ambient formation rates and that it requires ternary NH_3-H_2SO_4-H_2O nucleation even in the free troposphere. This is nowhere mentioned or discussed. These findings should at least be mentioned.

Page 5 Line 8: How long were the filters stored and at which temperature before measurement. Could this influence the results?

Page 5 Line 19: What is the absolute (wet) cut-off of the cyclone, were all droplets removed?

Page 5 Line 29: Which neutralizer was used, Krypton, X-ray? Which charging efficiency was applied?

Page 10 Lines 26ff.: During Aitken-type events N_{total} is often twice as high as N_{CCN}. What does this imply on the importance of new particle formation to CCN production? Previous modelling studies (e.g. Merikanto et al., 2009) suggested that up to 45

Page 11 Section 3.3.2: The authors suggest that Aitken-mode NSD might have entrained from the free troposphere, as also previously suggested by several studies. Did you find any indication of this in FLEXTRA? Additionally, FLEXPART dispersion mod-

elling (https://www.flexpart.eu/) would have been my choice instead of its predecessor FLEXTRA. Why was it not used?

Page 27 Table 3 and Table 4. I find these two tables somewhat confusing. Why not explicitly write out all the percentages, e.g.

From Africa

xx% in total (xx% Accumulation, xx% Aitken, xx% marine)

Alternatively explain, why you combined the Aitken and marine types. However, I find stating all percentages is the best way. Also can't be table 3 and 4 combined?

Page 32: Figure 8 shows the wind speed vs N_{total}, showing no or weak correlation. How does the wind direction correlate with N_{total}.

Page 33: The Wind speed panel in Figure 9 shows a quite different trend between 2010 and 2011. How can this be explained.

References:

Kirkby, J., et al. "Role of sulphuric acid, ammonia and galactic cosmic rays in atmospheric aerosol nucleation." Nature 476.7361 (2011): 429-433.

Merikanto, J., et al. "Impact of nucleation on global CCN." Atmospheric Chemistry and Physics 9.21 (2009): 8601-8616.

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