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Comment on acp-2022-654

Anonymous Referee #2

Referee comment on "Measurement report: Aerosol vertical profiles over the western North Atlantic Ocean during the North Atlantic Aerosols and Marine Ecosystems Study (NAAMES)" by Francesca Gallo et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-654-RC2>, 2022

This study presents and discusses a compilation of datasets of airborne aerosol measurements performed during three observation programs in the Western North Atlantic Ocean (WNAO). Aircraft campaigns provide unique information about the three-dimensional structure of the atmosphere. However, they typically provide only "snapshots" of the atmospheric composition in a given area. Here the Authors make an attempt to overcome this limitation by combining the datasets from 37 spirals performed in a similar altitude range and by lumping them into three sets representative of different seasons: winter, spring and summer. The results provide a clear picture of several relevant patterns in aerosol properties and chemical tracers in the marine boundary layer and in the free troposphere in the WNAO, as well as information about the processes driving the variability of such parameters as a function of the seasonal variations in the meteorological conditions, biological activity in surface ocean and atmospheric dynamics. The discussion is clear and concise, supported by good graphics. The paper misses a table summarizing the main statistics of meteorological variables and of the concentrations of carbon monoxide, DMS and aerosol parameters in the MBL and FT in the three seasons. A figure with the average vertical profiles of the main aerosol parameters in the three seasons would of help, too. Having said that, in this reviewer's opinion, describing the great variability in the individual vertical profiles just focusing on the seasonal difference is an oversimplification: Fig. 6 (especially panels d, e, g, h) suggests that very different events with contrasting compositions were lumped together. It would be important, therefore, to take the correlations in Fig. 6 with a grain of salt, because in several cases the datasets do not look homogeneous at all. At the same time, it would be important to add a sentence in the Abstract to acknowledge the intra-seasonal variability.

Specific comments:

Section 3.2 NAAMES-1. Fig. 6b shows that most of the data belong to a cluster showing a

positive correlation between sulfate and BC, at least for sulfate concentrations greater than 0.05 ug m^{-3} . The three flights performed on 11/12 and 11/14 are characterized by FT levels of BC and sulfate somewhat higher than the background.

Section 3.2 NAAMES-2. There is a lot of variability between days. The flight of 5/20 is characterized by very high FT concentrations of carbonaceous aerosols. By contrast, on 5/26, the air column was depleted of carbonaceous aerosols while sulfate exhibited moderate concentrations in the FT. The following days showed relatively high concentrations of all aerosol compounds in the lower FT. The discussion does not acknowledge such intra-seasonal variability, nor it takes into account possible source regions for the air masses.

Section 3.2 NAAMES-3. The compositions observed in this period encompass at least three different conditions. The main difference is between the profiles recorded on 09/08 and 09/08 which were characterized by low carbonaceous aerosol concentrations and high sulfate concentrations and the days before (09/04 and 09/06) or the following ones (09/12 to 09/17) when a multi-layer structure was observed.

Fig. 1c. Do the three flights done on 05/26 exactly share the same RH profile?

Fig. 3. The units for BC should be ng m^{-3} not ug m^{-3} .