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Interactive comment on "Chemically aged and mixed aerosols over the Central Atlantic Ocean – potential impacts" *by* M. Astitha et al.

Anonymous Referee #3

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This paper presents the results of a chemical aerosol transport model and it compares these results with satellite and in situ measurements. The study focuses on August 2005, a period when there was intense hurricane and tropical storm activity over the Atlantic Ocean.

I am not qualified to comment on the technical aspects of the model. I restrict my comments to the generalized nature of the results in the context of my research in this general region. I refer readers to another reviewer, Zev Levin, who presents a more comprehensive review that touches on the issues of the model and the cloud-process related aspects of the results. In general, the study presents some interesting results. However certain aspects of the paper could be improved by a more focused analysis.

My major comment is that the title of the paper does not capture the coverage of the

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paper. The results focus on the eastern Tropical North Atlantic Ocean.

The model focuses on three aerosol mass fractions: Total PM2.5, Total PM10 and Sulfate PM10. Also three size ranges: 0.03–0.1 μm (Aitken mode) and 0.1–2.5 μm ("accumulation mode") and PM10. I would argue that the particle size range used for the "accumulation" mode, 0.1 to 2.5 μm diameter is too broad. The extension to 2.5 μm includes a great deal of the dust mass. The mass median diameter of dust over the eastern Atlantic to the Caribbean is about 3 μm. I assume that this was done because of the desire to compare with the PM 2.5 measurements made at air quality stations. However many of the European and Mediterranean basin sites are impacted by pollution sources (which do, indeed, contain substantial mass in the accumulation mode as usually defined, 0.1 – 1.0 μm diameter) whereas, in contrast, the stations along the west coast of North Africa will be heavily impacted by dust much of which will fall into the "accumulation" size mode as defined in this paper. Thus the testing of the model against the European sites may not be ideal for the intended purpose of the model.

As acknowledged by the authors, the model tends to substantially underestimate the measured concentrations as shown in Figure 2 where the regression slopes range from 0.37 to 0.6 for the three classes of aerosols. The authors state that this result "is expected, since the model simulation did not include organic aerosols. . .." While this is a reasonable assumption for some stations, it is not necessarily generally applicable. The underestimation of the model is particularly evident in panel Figure 2a, Total PM10; there is a heavy clustering of points where the model yields consistently low values compared to the measured values. One would not think that organic aerosols would contributed in a major way to PM10 concentrations. These data are obtained from very different environments, some dominated by pollution, some by dust, and some dust-marine.

Rather than grouping all these data together as was done in this paper, it might be more meaningful to use data grouped by environment or region based on the very brief

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description beginning at line 5193/17. This might resolve some of the problems seen in Figure 2. The separation of the station data on this basis would allow us to better assess the model results. It is notable, for example that the regression in Fig. 2c, PM10 sulfate daily average values, is driven by a few very high values which I would suspect come from the Mediterranean stations. I suspect that if these were removed, the regressions would change substantially with a slope closer to 1. Also I suspect that the intercept would be closer to zero. As it now stands there is a very substantial Y intercept in the model estimate (1.87)

Figure 3 is a multi-panel graphic presentation of the comparison between modeled and measured number concentrations for four stations, all European. The data from two stations, Jungfraujoch and Puy de Dom are plotted in one panel, 3a; a single regression line is calculated. (What is the particle size range for Fig. 3a?) It is my impression that while the two distributions are similar, there may be some significant differences. Perhaps the regression lines should be plotted separately. In the cases of panel 3a and 3b, the regressions are largely driven by relatively few high values. The large mass of the data at relatively low concentrations (which are nonetheless rather high which suggests pollution impacts) are essentially uncorrelated, especially in 3b. Furthermore the model results in all three panels (i.e., all four stations) show that the model estimates are biased high at lower measured concentrations. All three panels yield Y intercepts that range from 616 to 845 cm-3. These intercept values are comparable in magnitude to some of the highest values estimated for the eastern Atlantic sites later in the paper. The use of data from mountain stations complicates the interpretation of the model performance. Mountains, especially these which are located on massive ranges (and contrasted, for example, to Izaña or Mauna Loa which have problems of their own) generate complex meteorology and circulation patterns that are difficult for models to resolve. There are also relatively local effects (upslope/downslope winds driven by local heating and cooling) which the model could not resolve.

In testing the model product the authors compare the model AOD against satellite AOD.

While this is interesting, a more stringent test would be to compare against AERONET data which would also provide an estimate of fine/coarse aerosol fractions. A quick check of the AERONET site shows some data for the days of interest at a number of sites in the modeling domain including some island stations in the Cape Verde Islands and Canary Islands.

Fig. 9 to 14: These figures have some interesting aspects to them. But it is difficult to extract much information from them. There are so many.

The paper reports (ca. 5201/13) that the desert dust maximum is 255 μg cm-2 on the 16th and 301 μg/cm2 on the 27 August. These column loadings are reasonable. If one assumes that the dust is carried in a layer several km thick, these loadings convert to dust concentrations of a few hundred μg m-3, values which are commonly measured on Izaña, Tenerife, during dust outbreaks.

I am not qualified to comment on the portions of the paper dealing with cloud-aerosol processes.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 5185, 2010.

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