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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Patterns of Saharan dust transport over the Atlantic: winter vs. summer, based on CALIPSO first year data" *by* B. A. Yuval et al.

Anonymous Referee #2

Received and published: 6 August 2009

General Comments: This paper uses CALIPSO data to characterize the altitude distribution of aerosol transport over the tropical and equatorial Atlantic. It shows a strong contrast between the winter and summer transports. As stated in the paper, while there has been a great deal of research on summer dust events, there is almost nothing about winter transports. The paper finds substantial differences between the winter and summer plume properties – in particular, the height of the aerosol layer top and bottom altitudes. The dynamical causes of these differences and the differences in aerosol source and composition warrant further research.

A shortcoming of this paper is the inability to distinguish between dust and biomass

burning aerosols. This could be a significant problem in boreal winter when biomass burning is prevalent in the equatorial and sub-Saharan regions of Africa. Another problem has to do with the ability of CALIPSO to detect the base of the dust layer and to distinguish it from the MBL.

Finally, as a caveat, I state that although I am familiar with the CALIPSO product at the level of the visual product posted on the web, I have no experience in working with the product at a more sophisticated level. Consequently my comments should be regarded with that in mind.

I find that this paper is worthy of publication after consideration is given to these comments.

Specific Comments: In general I find this paper to be useful, but there are a number of areas that need attention. First of all, the title is not strictly accurate in stating that the focus is "Saharan dust transport". First of all, there is more than dust present in these aerosol events. This is particularly true in winter when biomass burning is very strong in the Soudano region of Africa. In the introduction the authors cite a lot of literature on biomass burning but they essentially ignore it in the body of the paper. Second, not all dust comes from the Sahara and the biomass burning is definitely not from the Sahara which they themselves state in the introduction. Finally in the Introduction (and restated in the Methods) they state: "Therefore, during the winter we describe the transport of plumes of dust-biomass burning aerosol mixture." But that point is not elaborated upon in the body. (With regard to "summer" and "winter", they should qualify, at least for the record, that they are talking about boral seasons.)

The abstract is rather superficial – it is a broad introduction rather than an abstract in the strict sense. They should put more substance in it. Also they lightly pass over profile work prior to CALIPSO. I would certainly agree that CAPLIPSO provides a huge window of vertical profile characterization.

The paper starts with a considerable review of the history of the study of dust out-

breaks. But, as pointed out be another reviewer, the interpretation of their results would benefit from linking more closely to the recent literature from the AMMA and SAMUM campaigns although the latter's focus is a bit too far north to be closely relevant to this work.

In contrast to another reviewer, I have no problem with focusing on a seasonal "plume" region. We are, after all, interested in the altitude distribution of the aerosol in the main transport region for dust-smoke. However I do agree that there should be more of an effort to explain how these differences might arise.

Re: 13183-5: "Based on this MODIS data and taking into account the above field experiments results we decided not to distinguish between the dust and the smoke plumes during the winter. Therefore, for the winter analysis, we study the transport of a joint dust-smoke plumes."

» The authors discuss the use of the depolarization product earlier in the paper (Methods) and then after stating some problems (especially noise) they decline to use it. I can appreciate the problem with this product but it is still useful. In transects of North Africa across the ITCZ into the equatorial regions, one often sees the presence of extremely dense aerosol on both sides of the ITCZ. In the depolarization product, the southern aerosol just disappears. It would seem that they could use this product at least in a qualitative way to elaborate on their results.

Re: 13184: 3 Results 3.1 Dust It seems that the discussion of the altitudes of transport could be improved by linking their results to the literature on both the African side (e.g., AMMA and related studies) and over the western Atlantic (e.g., PRIDE and some of the earlier work in BOMEX, the Carlson and Prospero papers). In particular, a number of the PRIDE papers (e.g., Reid, Maring, etc.) discuss the properties of the Saharan Air Layer (SAL), the distribution of dust, and the relative importance of transport in the SAL and in the MBL. The authors give a rather thorough overview of much of the earlier literature in the introduction but the observations reported in this literature are

never really brought into the interpretation of the results in this paper.

I agree with the general conclusions about the contrasts between the winter and summer transport regarding the overall thickness of the layer and the altitude distribution. A group of us obtain similar results with CALIPSO which we present in a submitted paper which focuses on a broader range of variables associated with these winter-summer transport events. But I am less confident of the lower boundary results in CALIPSO for a number of reasons. One problem is the ability to discriminate between dust and sea-salt in the MBL. The other has to do with the attenuation of the incident and backscattered lidar beam; this would vary with the total column aerosol loading. This is particularly evident in Fig. 5 which shows the base of the summer SAL along the coast of Africa at about 1.5 km altitude. This is considerably higher than that obtained in earlier work (e.g., Karyampudi, Carlson, Westphal). Soundings along the coast and in the Cape Verde Islands suggest much lower altitudes for the base of the SAL layer. In addition there is much evidence of low-level transport along the coast as well which is not seen in this figure. Thus the authors err in relating the height of the base of the SAL as they depict it, linked with the depth of the MBL.

Re Fig. 2. Aerosol optical properties over the Atlantic Ocean, for the 2006 summer (upper row) and 2006–2007 winter (lower row), from the MODIS instrument onboared Terra. Left column: the aerosol optical depth (at 550 nm). Right column: the aerosol fine mode fraction. The contours mark the center of the seasonal plume.

» I don't understand how the center of the ROI (plume) was defined in right column bottom (winter).

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 13177, 2009.