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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Mineral dust variability in central West Antarctica associated with ozone depletion" *by* M. Cataldo et al.

**M. Cataldo et al.**

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by H. Evangelista/M. Cataldo General remarks of the Referee:

1. "First, the presentation of the material is very poor. Just to give an example: the entire introduction consists of a single paragraph over two pages long! Even an undergraduate knows text needs to be broken down in paragraphs. . . ." Authors: The original text was reduced compared to the present format and some additional text was added because a reviewer asked for complements. These complements consisted in more details on the origin of dust reaching Antarctica mainly from the Patagonia semi-desert and Australia, which we agree completely. The introduction is somewhat long since the work itself deals with a multidisciplinary issue linking a geochemical process that takes place in the stratosphere to the surface deposition of dust in ice cores. There are sev-



eral steps in this understanding and the complete mechanism still requires more data from ice cores and meteorological stations in Antarctica, besides improved models and satellite observations. Looking again the text we see the possibility of maintaining the same content omitting some sentences (probably well known for some readers). In the revised introduction we have changes the text from 1346 words to 1017. In the revised text, paragraphs are accordingly presented.

2. ". . .Here's another example: after discussing Fig 1 presumably the key result of the paper (in Section 3), the authors launch into a two-page long, rambling fusillade of review material about the AAO and many other things, citing a million papers, again without a single paragraph break, and with little coherent train of thought I could detect in the entire discussion. Why is an avalanche of review material placed in the results section? I could cite other examples, but I think this should sufïňĄce. This kind of writing should not appear in a scientiïňĄc journal with even the smallest pretense of self-respect. . .." Authors: We agree in part. We have shortened the section pointing only the key factors associated with the regional climatic changes attributed to the positive phase of AAO. In the revised text, we present a single and concise paragraph.

3. Second: and most importantly. I believe much of the science in this paper is plainly and simply wrong. The main "alleged" ïňĄnding of this manuscript, from what I could gather, is that ozone depletion has caused mineral dust transport into Antarctica to decline in recent decades. The evidence, apparently, comes from comparing Figure 1a (dust) and Figure 1b (ozone). I am sorry for being really thick, but what I see there is ozone going down from 1960 to 2000, while dust goes up and down without any discernible trend: so were is the connection?!? The authors don't even attempt to compute a basic correlation between the two time series... Authors: In this work we do not, necessarily, look for a correlation value between ozone and dust. We investigate whether the abrupt dust increase in ice core sites around Antarctic (in theory caused by the increasingly westerly winds) is also observed at Central Antarctica where comparable wind intensification is not observed. The ozone depletion here is, presumably,

the trigger parameter behind. In Fig. 1 of the manuscript, dust (represented by the sum of Ti, Fe and AlSi) do exhibits a declining trend during ozone depletion area evolution, which is a far different pattern compared to dust records at James Ross Island ice core (McConnell et al., 2007) or Marie Byrd Land (Dixon et al., 2011), for the same period.

FIG. 1

Regression between ozone and dust at Mount Johns, (Fig 2), corresponded to r-Pearson equal to +0.46. Considering the database (n=44) and the t-Student test for r-Pearson significance, the two-sided test as t = {r(n-2)$\frac{1}{2}$/(1-r2)$\frac{1}{2}$}, and considering a significance level of 0.05, we find that the r-Pearson found here is statistically significant.

FIG. 2

We have rewritten the following sentence in “Results and Discussions” section:

Original text: “... Herein, time series for mineral dust were denoted by FAlSi and FFe. (Fig. 1a). In this case insoluble dust microparticles have presented similar trends with respect to ozone depletion mainly after the 80’s decade (Fig. 1b). The observed ozone content at Halley Bay was $\sim$30% lower in the Antarctic spring seasons (October) of 1980–84 than in the springs of 1957–73, (Solomon et al., 1986). ...”

Revised text: “... Time series for mineral dust were denoted by FAlSi+Fe+Ti (Fig. 1a), where the insoluble dust microparticles have presented similar trends with respect to ozone depletion mainly after the 80’s decade (Fig. 1b). The regression between ozone and dust at Mount Johns corresponded to r-Pearson equal to +0.46, which is statistically significant at 95% confidence level, considering the two-sided t-Student significance test, as t = {r(n-2)$\frac{1}{2}$/(1-r2)$\frac{1}{2}$} and n=44.”

4. Yet they construct "dendrograms" with "single linkage as the amalgamation algorithm": I have no idea what in the world that means! In any case, most of the methods in this paper are complicated beyond necessity and, in the end, obscure the simple



fact that the ozone and dust time series have little to do with each other. Authors: The techniques employed here do not obscure the ozone-mineral dust association. Contrary to the reviewer opinion, it corroborated all the discussion on the topic presented in the manuscript and in the current literature. The hierarchical analysis is widely used in aerosol science (we just give some few examples bellow to those not familiar with, but the literature has vast examples). To look only on the correlation level as it would resolve everything in the understanding the association among parameters is just old-fashioned science. It is very surprising that a reviewer (or a reader of ACPD) do not know what it means !

Some few recommended texts on cluster analysis applied to aerosol science:

1. Koppe M, Hermann M, Brenninkmeijer CAM, Heintzenberg J, Schlager H, Schuck T, Slemr T, Sprung D, van Velthoven PFJ, Wiedensohler A, Zahn A, Ziereis H. 2009. Atmospheric Chemistry and Physics Origin of aerosol particles in the mid-latitude and subtropical upper troposphere and lowermost stratosphere from cluster analysis of CARIBIC data. Atmos. Chem. Phys. 9 : 8413-8430.

2. Treffeisen R, Herber A, Strom J, Shiobara M, Yamanouchi T, Yamagata S, Holmed K, Kriew M, Schrems O. 2004. Interpretation of Arctic aerosol properties using cluster analysis applied to observations in the Svalbard area. Tellus 56B : 457-476.

3. Scalabrin E, Zangrando R, Barbaro E, Kehrwald NM, Gabrieli J, Barbante C, Gambaro A. 2012. Amino acids in Arctic aerosols. Atmos. Chem. Phys. Discuss.

5. Finally (and perhaps most disturbingly) this paper contradicts previous studies, surely a red ïňĆag that something is ïňĄshy. As an explanation for the discrepancy, we are offered some really farcical speculations such as the hypothesis in which the polar vortex may act like an “atmospheric barrier”, preventing warmer, coastal air from moving in to the continent’s interior How can a polar vortex in the stratosphere be a barrier to anything near the surface? There is no polar vortex in the troposphere, so this explanation is total nonsense. This betrays profound misunderstand of the most elementary

atmospheric science. Authors: First, our work do not contradicts any other study since no work before has used geochemical records (dust material) to infer the action of the increasingly westerly winds at sites around Antarctica and at Central Antarctica for the same time basis. In the current literature, this issue is mostly referred to changes in climatology or described by model experiments. Second, a well accepted definition for the Polar Vortex is : "A quasi-persistent, large-scale cyclone established in the middle-to-upper troposphere and the stratosphere". Third, we agree that the sentence in the manuscript was somewhat exaggerated with respect to the polar vortex intensification consequences. We have rewritten the following text :

Original text: "... According to Thompson and Solomon (2002) recent significant tropospheric trends in Antarctica are related to trends in the lower stratospheric polar vortex that may contribute substantially to the observed cooling over eastern Antarctica and the Antarctic plateau. An example of that is the temperature decline over Central and East Antarctica inferred from the Advanced Very High Resolution Radiometer (AVHRR) sensors (using the thermal infrared channel) from 1982 to 2004. Therefore a hypothesis in which the 'polar vortex may act like an atmospheric barrier, preventing warmer, coastal air from moving in to the continent's interior (Kerr, 2002; http://earthobservatory.nasa.gov/IOTD/, 2006), based purely in the climatological approach, is also confirmed by the dust geochemical composition retrieved from our ice core that contrasts to trends observed at Western/Northern Antarctica."

Revised text: "... According to Thompson and Solomon (2002) recent significant tropospheric trends in Antarctica are related to trends in the lower stratospheric polar vortex that may contribute substantially to the observed cooling over eastern Antarctica and the Antarctic plateau. An example of that is the temperature decline over Central and East Antarctica inferred from the Advanced Very High Resolution Radiometer (AVHRR) sensors (using the thermal infrared channel) from 1982 to 2004 and herein corroborated by the dust geochemical composition retrieved from our ice core that contrasts to trends observed at Western/Northern Antarctica."



Interactive comment on Atmos. Chem. Phys. Discuss., 12, 12685, 2012.

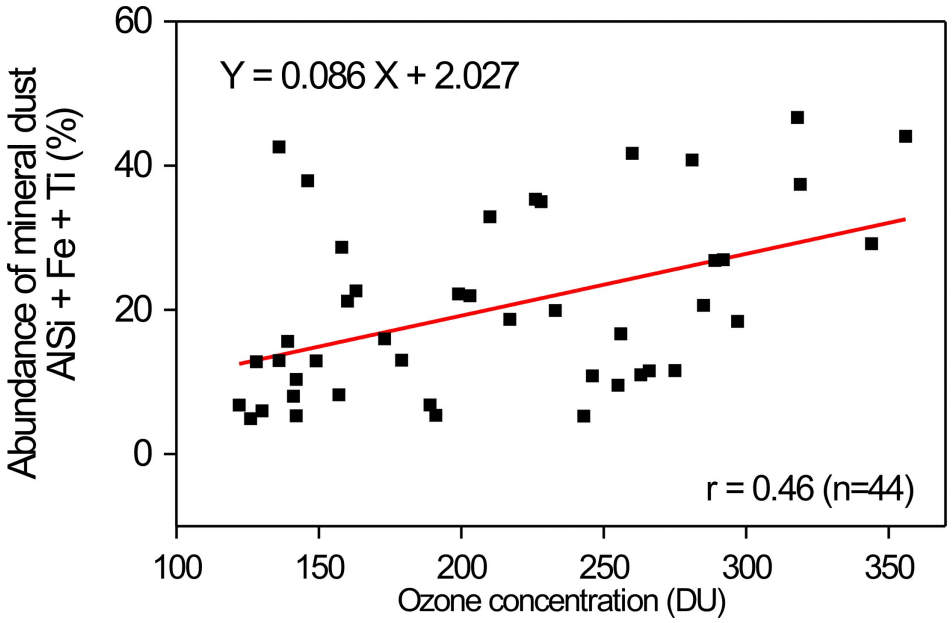


**Fig. 1.** Regression between mineral dust abundance (Ti+Fe+AlSi) and ozone concentrations (October data at South Pole Station).



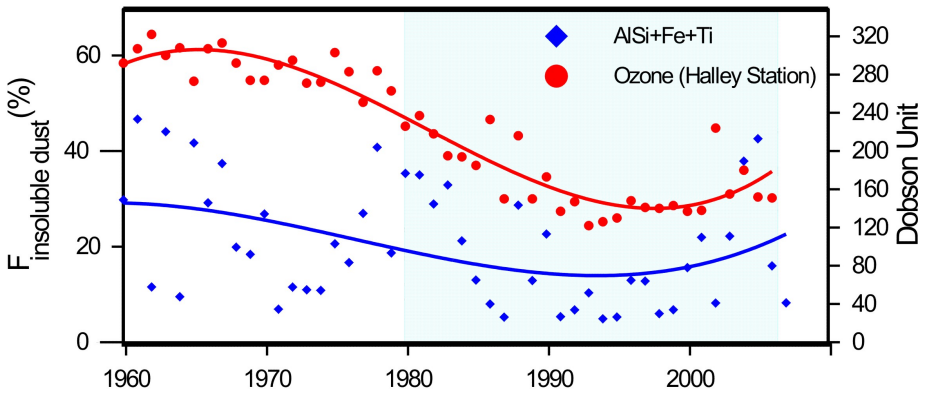


**Fig. 2.** Time series, and polynomial fit, of insoluble mineral dust in Mount Johns and ozone concentrations in the manuscript.