Atmos. Chem. Phys. Discuss., 7, S6348–S6351, 2007
www.atmos-chem-phys-discuss.net/7/S6348/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Weekly periodicities of aerosol optical thickness over Central Europe – evidence of an anthropogenic direct aerosol effect" *by* D. Bäumer et al.

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Received and published: 26 October 2007

We thank the two anonymous referees for many helpful, interesting and encouraging comments. We also appreciate the short comment provided by Olivier Boucher which also has been a great help to us. All three comments suggest some more work to strengthen the paper. We have dealt with these suggestions carefully. In the following, we present the details of how we incorporated the comments in the revised paper.

The grouping of the stations is somehow necessary to limit the number of curves in each of the figures in a reasonable way. We have done that under national categories for comparing stations which are closely situated as e.g. in Greater Paris, and the Referee#2 suggests to make use of that and discuss the conditions there more in detail.

In the case of the German stations, we also aimed for an approximate average for Germany for interpreting our findings on meteorological variables (Bäumer and Vogel, 2007). We agree that it is also possible to carry out an alternative grouping of the station, but we think that our grouping is a practicable compromise. Furthermore, there are no additional stations within the area with a satisfying length of the measured time series and high data quality (level 2.0) at the same time. We want to only apply high quality data to prove these weekly periodicities with appropriate accuracy. We think that it was not useful to apply low quality data. Since the density of the stations is not very high, we agree with the statement that it is difficult to speak e.g. for “all Germany”, and we have modified the text at some passages in this light. There are some further stations at the edge of the investigated area which we have checked now for weekly periodicities. Some stations in Southern France (Toulouse, Toulon, Avignon, Bordeaux, Villefranche) do not display significant weekly cycles. Similarly, close to the western edge of the area, Lille and The Hague also do not show clear weekly AOT cycles. Nevertheless, at some stations a minimum around Sunday is visible (Avignon, The Hague), which is also the case at Modena (Italy) at the southern edge of the area. Referee#2 suggests focusing on the time delay between emissions and AOT. We added some discussion on that in the revised paper including the situation in Greater Paris. The time series at the station Paris is much shorter than the other two time series in Greater Paris, so that we should be careful not to overrate the differences. There is no clear pattern with regard to distances from sources, in general, as both Referees recommend to investigate. This is especially the case since the sources of direct aerosol emissions and precursors are very widespread. The only systematics we can see is that Greater Paris is a more isolated source and agglomeration than other analyzed places as e.g. in Germany. Furthermore, without modeling, it is not possible to completely separate transport and chemistry, of course.

A discussion of how far cloud cover could influence the AOT retrieval is added as suggested by Referee#2. We do not think that this is a problem especially since we solely used level 2.0 AERONET data. We can not see that a weekly cycle in any other

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meteorological time series directly affects the AOT retrieval either.

Referee#1 asks for more tests of the robustness of the observed weekly AOT cycle. Methodology according to Forster and Solomon (2003) is applied and results are given in the revised paper. Similarly, we report on testing whether the weekly cycle is consistent in different parts of the time series and in different seasons. All these tests show that the weekly cycle in sufficiently long time series is robust. Unfortunately, some of the time series are rather short, so that the statistical analysis of a subset comes along with a loss in statistical confidence. Therefore, we do not reorganize the complete paper based on subsets.

Referee#1 suggests analyzing the fine and coarse fraction separately. We report in the revised paper on the strong dominance of fine mode particles that consequently are the dominant agent in generating the weekly AOT cycle. The idea of correlating time series of AOT and temperature is interesting, but a first attempt lead us to the conclusion that this is not helpful in this basic form. The yearly cycle in temperature (higher values in summer) and the yearly cycle in AOT (also higher values in summer) would lead to a wrong conclusion that high aerosol load possibly generates high temperatures. It was at least necessary to subtract the yearly cycle in each time series. Additionally, e.g. increasing temperatures in a high pressure episode in summer usually are accompanied by an increase in AOT by photochemical processes. This also would lead to an opposite conclusion. But we will keep this interesting idea in mind and will try to focus on it in a study in the future, with the help of numerical modeling which offers an access to these questions of causality.

A further short comment on our paper has been provided by Olivier Boucher. We give the requested information about the measurement periods in Table 1 of the paper. He also suggests dealing with the question whether a weekly cycle in cloudiness could negatively influence the AERONET data sampling within a day. In addition to what is stated above with respect to that, we also analyzed the temporal distribution of the single measurements within different weekdays. This also would be able to demonstrate

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negative effects of sun photometers going wrong e.g. during the weekend. We could not find any hint pointing towards an artificial nature of the weekly AOT cycles, caused neither by maintenance nor by cloudiness.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 11545, 2007.