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Interactive Comment

Interactive comment on "A study of the impact of synoptic weather conditions and water vapor on aerosol-cloud relationships over major urban clusters of China" *by* K. Kourtidis et al.

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We thank the referee for the positive comments and the careful remarks.

Concerns

See the Tables S1 and S2 in the Supplement, containing detailed statistics of the AOD-CC relationship over each of the three urban clusters studied. ÎŚ detailed seasonal analysis is underway, but the involved amount of work is such that the results, once finished, will be the subject of another manuscript. We can only state here, if the sample size within each urban cluster is of concern to the referee, that there are no

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large differences in the sample size. Further, as we state in the manuscript, the SLP classification results to some degree to a seasonal classification, as most SLP values less than 1008 mb are encountered during the warm period May-August, while most SLP values greater than 1017 are encountered during the cold period October-March. See also the now included in the revised version Figs. S7 and S8 of the Supplement, with the requency distribution of the AOD-CC values for different SLP levels and for different WV levels (AOD<0.6). A reference to Wang et al. (2015) has now also been added to the manuscript.

Specific comments

1 P14013 lines 13-14: This is a very interesting remark, but cannot be clarified within the present work as it involves very substantial amounts of work, that would go far beyond the scope of the present paper. As the referee correctly points out, to get an insight into this a classification of aerosols and the cloud layering pattern would be needed. This would require data from other sensors than MODIS, as MODIS does not provide information on the vertical aerosol-cloud layering pattern, nor it is possible to use MODIS for aerosol classification over land. The latter is due to the fact that for a classification (e.g. (e.g. according to Barnaba and Gobbi, 2004 or Pace et al., 2006), the Fine mode ratio (FMR) or the Angstrom Exponent would be needed, which, although provided by MODIS are not accurate over land. As we note in the manuscript, personal communication with L. Remer, NASA GSFC: "Angstrom over land is not reliable and we recommend strongly not to use it". The same exactly stands for the FMR product which gives only an indication of the existence of dust/non-dust aerosols being more a crude qualitative measure (see also Georgoulias and Kourtidis, 2011). Even if the above considerations were not valid, further classification of the dataset would result in much fewer data points within each subclass and this would deteriorate the statistics considerably. See also the now introduced Table S5 of the revised Supplement, for detailed statistics of the AOD-CC relationship for different WV classes over PRD.

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2 and 3, on the use of daily SLP instead of hourly (or 6 hourly) close to overpass time: The reason for this was that firstly the amount of work would increase and secondly (and most importantly) this would not lead to any substantial improvement in the calculations or a more accurate partitioning into the SLP classes. This is because, we report here only for the two classes that correspond to the core of high and low pressure systems. Even if such a system moves quickly it would take days to pass over the area, not hours.

4 P14011 lines 12-15: More details are now provided in the revised manuscript, as follows: "This was done as follows, for each of the three urban clusters studied: Concurrent MODIS AOD, WV, CC and CTP values were assigned to one of the three SLP classes according to the concurrent NCAR/NCEP Sea Level Pressure. Then, within each of the three SLP subsets, containing each timeseries of concurrent AOD, WV, CC and CTP values, the data were bined in equally sized bins (thus not equal sample size bins, as this would make comparison between the three clusters difficult) according to AOD and WV. This resulted in 100 bins (10 AOD bins for AOD between 0 and 1, bin step 0.1 X 10 WV bins for WV between 0 and 10 cm, bin step 1). The mean of the CC and CTP values corresponding to AOD and WV within each bin was then calculated (in case there were more than six values of the respective variable within the studied bin). The same was repeated once more using AOD and CC equally sized bins. This resulted in 100 bins (10 AOD bins for AOD between 0 and 1, bin step 0.1 X 10 CC bins for CC between 0 and 1, bin step 0.1). The mean of the WV values corresponding to AOD and CC within each bin was then calculated (in case there were more than six values of WV within the studied bin)".

5 unequally sized bins: Correct, each bin of meteorological factor and AOD does not have equal sample size. Using equal sample sizes would result in different bins in the three different urban clusters studied and would make any comparison difficult. The statistical analyses performed (see Tables S1 to S5 of the revised Supplement) show that this has not affected the conclusions or introduce a bias.

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6 P14012 second paragraph: Paragraph moved to Section 2 as suggested.

7 P14016: Fig. 5 does suggests clearly that there is no large increase in WV as AOD increases, hence we maintain that it does also suggest, viewed from a different perspective, that there is no large increase in AOD as WV increases, as where WV values are largest AOD values are not. We rephrased slightly the relevant parts of the text, though, from “there is no large systematic AOD retrieval bias due to aerosol swelling at increased WV” to “there is no large systematic AOD increase at increased WV”.

References:

Barnaba, F. and Gobbi, G. P.: Aerosol seasonal variability over the Mediterranean region and relative impact of maritime, continental and Saharan dust particles over the basin from MODIS data in the year 2001, Atmos. Chem. Phys., 4, 2367-2391, doi:10.5194/acp-4-2367-2004, 2004.

Georgoulias, A. K. and Kourtidis, K. A.: On the aerosol weekly cycle spatiotemporal variability over Europe, Atmos. Chem. Phys., 11, 4611-4632, doi:10.5194/acp-11-4611-2011, 2011.

Pace, G., di Sarra, A., Meloni, D., Piacentino, S., and Chamard, P.: Aerosol optical properties at Lampedusa (Central Mediterranean). 1. Influence of transport and identification of different aerosol types, Atmos. Chem. Phys., 6, 697-713, doi:10.5194/acp-6-697-2006, 2006.

Annex: Newly introduced Figs. in the revised Supplement

Fig. S7: Frequency distribution of the AOD-CC values for different SLP levels (AOD<0.6). Left: AQUA, right: TERRA.

Fig. S8: Frequency distribution of the AOD-CC values for different WV levels (AOD<0.6). Left: AQUA, right: TERRA.

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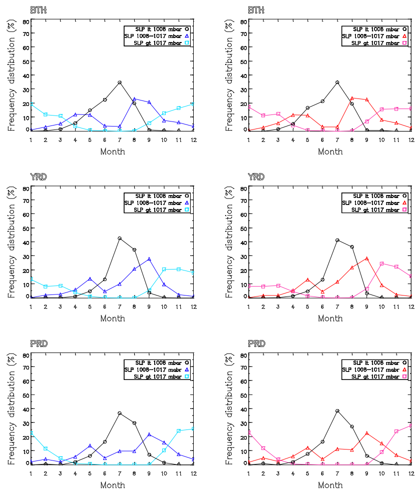

Fig. S7: Frequency distribution of the AOD-CC values for different SLP levels (AOD<0.6). Left: AQUA, right: TERRA.

Fig. 1. Fig. S7: Frequency distribution of the AOD-CC values for different SLP levels (AOD<0.6). Left: AQUA, right: TERRA.

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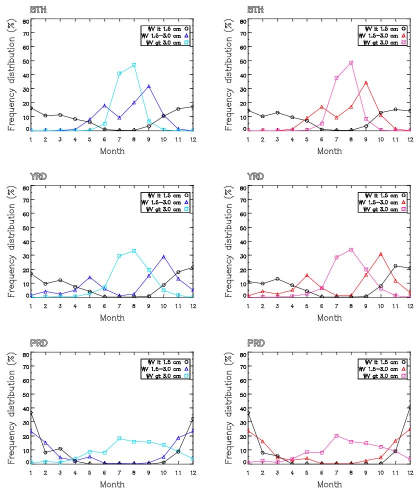

Fig. S8: Frequency distribution of the AOD-CC values for different WV levels (AOD<0.6). Left: AQUA, right: TERRA.

Fig. 2. Fig. S8: Frequency distribution of the AOD-CC values for different WV levels (AOD<0.6). Left: AQUA, right: TERRA.

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