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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol optical depth trend over the Middle East" *by* K. Klingmüller et al.

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We thank the referee for reviewing the manuscript, the positive comments and the valuable remark on the autocorrelation.

Regarding the time lag considered in the autoregressive model, for consistency with previous studies we follow the approach of de Meij et al. (2012), Hsu et al. (2012) and Pozzer et al. (2015), who employ the method described by Weatherhead et al. (1998) and the references therein (Tiao 1990), and use a first order autoregressive (AR(1)) model for monthly data.

We propose to add the supplement of this comment to the supplement of the article. For all time series plots in the manuscript (Figs. 3 to 6) it includes plots of the partial autocorrelation functions (Figs. S31, S33, S35, S37) showing that only the first order (1 month lag) term is significant. Additionally, Figs. S32, S34, S36 and S38 display

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the correlograms of the residuals of the corresponding AR(1) models, revealing that the residuals are well approximated by white noise and providing further evidence that using the first order model sufficiently accounts for the autocorrelation structure.

In the main text we propose the following additions:

PAGE 5, LINE 15

Extending

"The trend of the deseasonalised AOD ist calculated by fitting a linear model using generalised least squares taking into account the time series auto correlation with a time lag of one month (Pinheiro et al., 2015)."

to

"The trend of the deseasonalised AOD has been calculated by fitting a linear model using generalised least squares (Pinheiro et al., 2015). Consistent with Weatherhead et al. (1998), de Meij et al. (2012), Hsu et al. (2012) and Pozzer et al. (2015), the one-month-lag autocorrelation was used to account for the autocorrelation structure of the time series, see Figs. S31 to S38 in the Supplement."

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New reference item

Weatherhead, E. C., et al. (1998), Factors affecting the detection of trends: Statistical considerations and applications to environmental data, J. Geophys. Res., 103(D14), 17149–17161, doi:10.1029/98JD00995.

PAGE 24, CAPTION FIGURE 3

Adding

"The autocorrelation structure of the time series is studied in Figs. S31 and S32 in the Supplement."

PAGE 25, CAPTION FIGURE 4

Adding "; see also Figs. S33 and S34 in the Supplement"

PAGE 26, CAPTION FIGURE 5

Adding "; see also Figs. S35 and S36 in the Supplement"

PAGE 27, CAPTION FIGURE 6

Adding "; see also Figs. S37 and S38 in the Supplement"

References:

A. de Meij, A. Pozzer, J. Lelieveld, Trend analysis in aerosol optical depths and pollutant emission estimates between 2000 and 2009, Atmospheric Environment, Volume 51, May 2012, Pages 75-85, ISSN 1352-2310, http://dx.doi.org/10.1016/j.atmosenv.2012.01.059.

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Pozzer, A., de Meij, A., Yoon, J., Tost, H., Georgoulias, A. K., and Astitha, M.: AOD trends during 2001–2010 from observations and model simulations, Atmos. Chem. Phys., 15, 5521-5535, doi:10.5194/acp-15-5521-2015, 2015.

Tiao, G. C., G. C. Reinsel, D. Xu, J. H. Pedrick, X. Zhu, A. J. Miller, J. J. DeLuisi, C. L. Mateer, and D. J. Wuebbles (1990), Effects of autocorrelation and temporal sampling schemes on estimates of trend and spatial correlation, J. Geophys. Res., 95(D12), 20507–20517, doi:10.1029/JD095iD12p20507.

Weatherhead, E. C., et al. (1998), Factors affecting the detection of trends: Statistical considerations and applications to environmental data, J. Geophys. Res., 103(D14),

17149–17161, doi:10.1029/98JD00995.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/acp-2015-839/acp-2015-839-AC2-supplement.pdf

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