

Interactive comment on “Exploiting the weekly cycle as observed over Europe to analyse aerosol indirect effects in two climate models” by J. Quaas et al.

Anonymous Referee #2

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This manuscript has significant problems and should not be published in its current form. The statistical significance is assessed incorrectly and the widely varying time periods and spatial distributions of the different data sources make comparisons impossible.

Statistical significance is at the heart of any paper on weekly cycles. Any non-trivial time series has different averages on different days, and hence always has some weekly cycle. The key is whether or not the differences are statistically significant. This manuscript uses a t-test to assess statistical significance, which has been shown to be invalid for this purpose (Barnet et al., 2009). There are three problems with a

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t-test. First, it is intended for calculating the significance of a single threshold, not the 7 different possible weekly maxima. Second, the t-test assumes independent data points. Atmospheric data are strongly autocorrelated in time and space so the number of independent data points is less than the total number of points. Finally, the t-test assumes normal distributions, and most atmospheric data are not normally distributed.

A full description of a proper way to assess statistical significance has not been published to my knowledge, but one method is a block bootstrap approach whereby weekly cycles are calculated for data randomly moved around in blocks and compared to the weekly cycle from the real time series. Calculating 6 and 8-day cycles is also helpful.

The second major problem is the wide variation in the years covered by the data. Much of the satellite data cover 4 to 6 years starting in 2000. Yet the meteorological data cover up to 130 years. This leads to invalid comparisons. Weekly cycles are generated by technological practices such as whether coal is burned in baseline generating stations used 7 days a week, as is now common in the US, or is used in light industry and home heating, as was common before about 1960. Surely any weekly cycle was changed by major events such as the introduction of air pollution controls in Western Europe in the 1970s or the cleanup of emissions from Eastern Europe in later decades. Cultural practices also matter. The percentage of people not working on Sundays must be different now than 100 years ago. The meteorological and satellite data need to be for similar time periods and limited to an interval with consistent technology and culture.

In addition, the meteorological data are for 41 German stations whereas the satellite data are averaged over continental Europe.

The large collection of data sets in this work could be very useful when properly analyzed.

Barnet, P., T. Kuster, A. Muhlbauer, and U. Lohmann (2009), Weekly cycle in particulate matter versus weekly cycle in precipitation over Switzerland, *J. Geophys. Res.*,

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