Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-300-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Long term dynamics of OH temperatures over Middle Europe: Trends and solar correlations" *by* C. Kalicinsky et al.

Anonymous Referee #2

Received and published: 22 June 2016

The paper seeks to explore an alternative explanation for the change in slope of the OH temperature time series previously reported in earlier publications using a shorter time series. While the results are promising, I believe there is an overall shortcoming in the analysis technique. While this may not substantially change the overall results, it does put into question their statistical significance.

When fitting data using an orthogonal basis set, one can fit the functions simultaneously or sequentially, where the first function is subtracted from the data and the next fit to the residuals. However, in this paper there is a combination orthogonal functions (sinusoids in the case of the periodogram) and non-orthogonal functions (solar cycles and trends) fitted to the data sequentially. For example in Section 4.1, the solar 10.7 cm flux and a trend first are correctly fitted simultaneously as they are non-orthogonal. However, on page 7, lines 1-13, a periodogram, which fits a set of orthogonal sinu-

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Discussion paper

soids, is performed on the data that has had the solar and trend subtracted. It is not technically valid to perform the LSP of the residuals since functions non-orthogonal to the resulting periodogram sine waves have been removed. In particular, on line 5, it is stated that the LSP shows a peak with a period of 20 years remains after subtraction of the solar cycle and trend. However, the subtraction of a linear trend will act as a low pass filter (Kennedy, JGR 85, p219, 1980). Thus, the "peak" at 20 years is likely an artifact of passing the original data with its red-noise through this low pass filter.

Though the paper tries to justify this referring to Horne et al., 1986, it should be noted that Hornes's analysis removed a function orthogonal to the other periodogram components. That is not the case here. Additionally, in Horne's analysis, the estimate of variance after removal of the orthogonal function must be used to re-normalize the periodogram. That estimate of variance must be adjusted to the reduction in the number of degrees of freedom associated with the removal of these "correct" functions in much the same way that the total variance of the raw data set was estimated using N-1 to account for the removal of the mean. Here, a mean, a trend, and a solar cycle (itself a combination of several orthogonal sinusoids) have been removed, and the variance must be estimated appropriately.

In section 4.2, the solar F10.7 cycle is not an orthogonal function to the two linear trends. Hence, its removal before fitting the two trends will influence the trends. All of these non-orthogonal components should be fit simultaneously.

Similarly, in section 4.2, a sinusoid is fitted to the residual after removal on non-orthogonal components. It should be fit simultaneously with the other terms as in Equation 8. Page 9, line 10, it is not mentioned whether this procedure explains more of the variance than the trend-break (assuming the trend break analysis is done correctly).

Page 9, line 13. As previous comments, one has not removed orthogonal functions nor adjusted the estimate of variance to account for the removal of these functions.

Thus the LSP of the residual cannot be interpreted as periodic components remaining in the data. These may well have been created by the removal of the non-orthogonal functions.

Page 9, line 20. Again, the peak at 24 years in the periodogram could well be the result of the non-orthogonal functions being used to fit the data, and does not justify fixing the period to be fixed at 24 years in the fitting procedure. Thus, the period should also be allowed to vary in the fit in equation 9. Otherwise, there is no unambiguous evidence from the periodogram that it is exactly 24 years.

In Section 4.4, , the LSP of the residuals is again not valid (as stated above), and these periods should not be fixed. One could fit a series of sinusoids simultaneously with the solar cycle, where the periods are also treated as free parameters. Using a non-linear least squares fit, the periodogram of the residuals may be used to estimate the initial values of these parameters. However, it is unclear whether there are enough degrees of freedom in the 25 data points to accommodate this analysis.

I would advise that the fitting be performed simultaneously rather than sequentially to avoid the problems associated with the non-orthogonal basis set. In this way, the statistical significance of the periods, and the values of the periods themselves may be assessed. If indeed the results are substantially the same, then the interpretation will hold.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-300, 2016.