

## ***Interactive comment on “Flexible approach for quantifying average long-term changes and seasonal cycles of tropospheric trace species” by David D. Parrish et al.***

### **Anonymous Referee #2**

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#### Comments

Parrish et al. developed a useful approach to quantify the minimum set of parameters that mathematically describes the mean long-term evolution and seasonal cycle of an atmospheric trace species' concentrations. This is a continuous effort of the subjects to characterize the trend of the atmospheric trace compounds in the troposphere so that human response may be warned at appropriate moment. The major statistical tools implemented in this study is the power series fit for the annual trend and the Frouier Transform for the monthly change. The paper is within the scope of AMT and I have the following comments for the authors to consider before publication.

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1. The power series fit as denoted by Equation 1 is certainly more useful compared with the normally used linear fit method. Nevertheless, could the authors describe the possible physical meaning of the changes subjected to  $t^2$ ,  $t^3$ ,  $t^4$ , ...? In short, why power series fit? To fit the nonlinear trend, we could also try other function forms to describe the atmospheric oscillation. For example, if we think the ozone change may partly or largely be driven by the temperature, we may think a form of equation to describe the temperature change with the time.

2. The information of Figure 2 is quite limited which I think can be removed from the main text.

3. The Frouier Transform for the detrended monthly change of ozone concentrations shown in Figure 3 is very interesting but the information from Figure 4 is basically the same with a different view angle. I suggest to merge the two figures as one figure and assigned with two panels.

4. The section - 'The rate of change of the concentrations' is certainly very interesting, as the rate of change can be derived consequently as a differentiate of equation 4. Nevertheless, as long as the physical meaning is not clear, I suggest to remove this part or to add more discussions on this part to abstract the possible meanings of the phenomenological analysis with its theoretical background.

Technical comments: The time axis 1/1/99, 1/1/00, 1/1/10 better changed to be 1/1/1999, 1/1/2000, and 1/1/2010 or 1999, 2000, and 2010

The legend of Figure 1.: the unit of parameter  $c$ , should it be  $\text{ppb yr}^{-2}$  Figure 5: it would be helpful to add a description of the violet line in the figure legend

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