

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

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The referee's comments regarding this paper are very helpful. In particular, the referee's concern regarding the interpretation of the curvature in a time series (page 5, line 14) is well founded. The curvature indeed does not automatically imply that there exists a meaningful or significant trend onward. And it is certainly true that extrapolating the fitted curve to an unobserved future based on a second order polynomial (or any other polynomial fit) is not only potentially, but almost certainly, misleading as polynomials generally diverge to large negative or positive values outside the data range used to derive the polynomial itself. As the referee notes, we do discuss this concern

C1

in the Discussion and Conclusions Section. In the revised paper, we also now discuss this concern in the Analysis Approach Section as well; the original paragraph on page 5, lines 13-20 has been replaced with the following paragraph:

"The long-term fit to the Mace Head data finds a statistically significant, negative value for c , with ozone concentrations increasing early in the data record. The polynomial fit reaches a maximum, and then decreases later in the record. When three terms are included, Equation 2 allows the calculation of the year that the maximum of the fit was reached, year_{max} :

$$\text{year}_{max} = -b/2c + 2000. \quad (2)$$

The year_{max} calculated from Eq. 2 is included in Table 1, which is within the time period of the observational record. The physical interpretation of the maximum derived from the fit, and any extrapolation to a maximum year outside the observational time period, would depend on the scientific understanding of the factors driving the concentration changes. As discussed later, the apparent decrease after the derived maximum of the fit in Figure 1 is not statistically significant, and the existence of a physical maximum of Mace Head ozone concentrations remains an open question. Extrapolation of fits derived from Equation (1) is likely misleading, since polynomials generally diverge to large negative or positive values when extended outside the data range used to derive the polynomial itself."

Minor comments by referee (in italics) and our response (in plain text):

1) P3. L30.: This statement only holds true if temporal sampling scheme does not introduce any bias to the monthly means. For example in the historical period some of the monthly means from ozonesonde might have only averaged from a very few profiles, it is then hardly be representative to the monthly means if there was an over- or under-sampling issue. The authors should clarify this point or be conservative to the statement.

C2

A qualifying phrase has been added to the statement in question; it has been revised to read: "As long as the temporal sampling scheme does not introduce any bias to monthly means (e.g., through sparse sampling such that the data are not fully representative of the actual monthly means), restricting the analysis to monthly mean data rather than working with higher frequency data does not reduce the statistically significant information regarding the average long-term trends or seasonal cycles."

2) P10. L21.: The term "robust" has a very specific meaning for the median or quantile regression in the statistics. The power series fit is still depended on the mean value and the ordinary least square, it is not allowed any breakdown point in the data, so it should not consider to be a robust approach.

Thank you for this correction. The term "robust" has been removed from this sentence.

3) Figs 7 8: The plot legends have labeled "tau" and "correlation factor", but these terms are not defined or mentioned in the main text.

The main text did define "tau" (page 9, line 1). The plot legends have labeled a "correction factor" that was not explicitly defined. In the revised paper, this factor is now defined in Section 3.6: "Thus for the two example data sets discussed here, the confidence limits annotated in Figures 1 and 4-6 and included in Table 1 must be increased by a "correction factor" of 1.4 and 2.9 for ozone and N₂O (for cubic long-term change fit), respectively; Table 2 gives the corrected confidence limits for the final values derived for the seven or eight parameters."

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