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Interactive comment on "Technical Note: Long-term memory effect in the atmospheric CO_2 concentration at Mauna Loa" *by* C. Varotsos et al.

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Title: Continuation in Illusion in 'apparent flaws in the analysis'

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Here, we proceed to additional clarifications in continuation to our previous comment (Sarlis and Skordas 2006) related to the points raised by Janosi (2006a) on the ability

of the detrended fluctuation analysis (DFA) to reveal (Varotsos, Assimakopoulos and Efstathiou, 2006) long-range correlations in the CO_2 time-series of Mauna-Loa:

1) It is encouraging that Janosi(2006b) didn't come back to his first (simple) method to remove seasonality, the application of which led(Sarlis and Skordas, 2006) to α-values with a mean 0.99 (and standard deviation 0.05), thus providing additional support to the findings of Varotsos, Assimakopoulos and Efstathiou (2006).

2) Concerning the second method proposed in Janosi(2006a), Janosi(2006b) did not proceed to fit the resulted DFA-l with a linear least squares fit. The relevant curves along with the corresponding linear least squares fits are shown in Fig.1.

FIGURE 1 available online at

`http://www.cc.uoa.gr/~nsarlis/DFACO2/nFig1.pdf`

An inspection of this figure shows that the resulting α-values have a mean 1.20 (and standard deviation 0.03) pointing to a very strongly correlated signal (Xu et al. 2005), in essential agreement with the conclusions of Varotsos, Assimakopoulos and Efstathiou (2006).

3) Concerning the third method proposed in Janosi(2006a), Janosi(2006b) again missed to fit the resulted DFA-l with a linear least squares fit. Thus, we followed the same procedure using the TISEAN package(Hegger, Kantz and Schreiber, 1999) routine for Wiener filtering and Fig.2 depicts the DFA-l along with the corresponding linear least squares fits.

FIGURE 2 available online at

`http://www.cc.uoa.gr/~nsarlis/DFACO2/nFig2.pdf`

An inspection of this figure shows that the resulting α-values have a mean 1.13 (and

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standard deviation 0.02), which supports the findings of Varotsos, Assimakopoulos and Efstathiou (2006).

4) The origin of the unusual high (in the 2nd and 3rd method) "asymptotic exponents" reported by Janosi(2006a), might be due to deviations from the superposition rule of Hu et al.(2001), who stated (verbatim): 'We show that the DFA result of noise with a trend can be exactly determined by the superposition of the separate results of the DFA on the noise and on the trend, assuming that the noise and the trend are not correlated. If this superposition rule is not followed, this is an indication that the noise and the superposed trend are not independent, so that removing the trend could lead to changes in the correlation properties of the noise.'

FIGURE 3 available online at

`http://www.cc.uoa.gr/~nsarlis/DFACO2/nFig3.pdf`

Figure 3, depicts the relative change of F_d when decomposing the Mauna-Loa CO_2 time-series into the following three components: 10th order polynomial trend, seasonal variation and correlated noise, as suggested in the second method of Janosi(2006a). Disregarding the large deviations at 6 and 12 months, we observe that for the time scales larger than ≈ 40 months there appear stronger deviations than those observed for smaller time scales.

5) Concerning the point of Janosi (2006b) that DFA scaling cannot be established for a time series consisting of 552 points, we forward the following clarification (Anonymous Referee no.3, 2006): Audit et al.(2002) showed that for time-series consisting of $\approx 10^2$ data points, DFA leads to smaller mean square errors compared to the Wavelet Transform Modulus Maxima method. In other words, for time series comparable to the one under discussion, the DFA method provides the best estimator for the scaling exponent.

In summary, a correct application of the three methods of removing seasonalities sug-

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gested by Janosi (2006a) led to α-values in the range [0.91,1.21], which essentially confirms Varotsos, Assimakopoulos, and Efstathiou (2006) who found 1.05$\pm$0.04 for DFA-1 for their deseasonalized and detrended CO_2 time-series. These facts indicate the presence of 1/f-type noise in the CO_2 time-series of Mauna-Loa as originally suggested by Varotsos, Assimakopoulos, and Efstathiou (2006).

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