Atmos. Chem. Phys. Discuss., 6, S4966–S4968, 2006
www.atmos-chem-phys-discuss.net/6/S4966/2006/

Atmospheric Chemistry and Physics Discussions

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

I. Janosi

janosi@lecso.elte.hu

Received and published: 30 November 2006

This manuscript reminds me of the golden age of box counting, when people enthusiastically reported on fractal dimensions of anything they could evaluate by simple algorithms. Such publications were especially perplexing when obvious technical flaws could be easily identified.

Two deficiencies are immediately apparent in this work. Firstly, the term "deseasonalized" pops up in Section 3 (page 11962, line 21) without giving any details. Secondly, DFA exponent values are mentioned in the text from DFA-1 to DFA-5 local detrending (values between 0.98 and 1.08), but only the curve for DFA-1 analysis is shown in Fig. 2. Since the Mauna Loa monthly CO2 data is easily available in the net (see e.g., http://cdiac.esd.ornl.gov/ftp/trends/co2/maunaloa.co2), I repeated the DFA analysis, just for curiosity.

My main result is that I could not reproduce neither Figure 2, nor the exponent values reported in the text, however I tested three methods (see below) to remove the strong seasonal periodicities.

The above record consists of monthly averages from 1958 to the end of 2004. I dropped the first year because 4 months are missing. The rest of the data contains 3 remaining holes in 1964, where I used linear interpolation to fill the gap. The result is a record of 46 full years, altogether 552 data points (shockingly short for any kind of fluctuation analysis). The plot of data is almost identical to Fig. 1, with the extra year for 2004 and the missing first 8 points. It is obvious that the strong seasonality obscures any long-range correlation in the assumed fluctuations around the trend, therefore it is vital to remove it.

The first method I tested works well for e.g., daily temperature data, and it is the simplest. One can compute the 46-year average of January, February, etc. data separately, and subtract these averages from the raw data. Note that this method can not remove the strong overall increasing trend. The DFA-1 curve is similar to Fig. 2, however with different fluctuation amplitudes and a slope of 1.75. The DFA-2 ... DFA-5 curves exhibit a strong kink indicating that seasonality is not entirely removed, the "asymptotic" slopes for the last 8-10 points are 1.13, 1.11, 1.15, and 1.10, respectively.

My second attempt was similar to the first one, except that I removed the global trend by fitting a polynomial of order 10 to the whole data set. The residuals were treated as above. The DFA curves are very different, the "scaling" seems to break down at around 8 years. "Asymptotic" slopes are 1.24, 1.44, 1.53, 1.60, and 1.62 for DFA-1 ... DFA-5 curves. Actually, the overall CO_2 trend can be satisfactorily removed by a third order polynomial, with the resulting DFA slopes: 1.19, 1.31, 1.43, 1.62, and 1.68. Kinks at 2-3 years are always present for higher order DFAs.

Finally I tested the classical Wiener filtering method to remove annual periodicity, I

ACPD

6, S4966–S4968, 2006

cutted out the spectral peaks at 6 and 12 months. The result is similar to the previous one, "asymptotic" slopes are not saturating (1.24, 1.49, 1.60, 1.69, 1.67), and kinks are present for higher order DFA curves.

The anomalous large slopes indicate that what we see is not long-range correlation in the fluctuations but a very strong trend apparent already in the record. The sensitivity of slope values to the method of removing seasonalities suggests that DFA is not a proper tool to evaluate such smooth records of monthly averages.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 11957, 2006.