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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the scaling effect in global surface air temperature anomalies" *by* C. A. Varotsos and M. N. Efstathiou

Anonymous Referee #2

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I recommend to reject this paper for the following reasons:

1. Application of the DFA method

One of the main messages of the paper is compromised by a major short coming of many DFA studies. The inference of long term memory from observational data means that (1) power law scaling needs to be established and (2) a simple exponential decay of the autocorrelation function has to be rejected. For DFA this means that a straight line in the log-log plot of the fluctuation function vs. the time lag has to be established and any (in the DFA language) "cross overs" have to be excluded. One way of doing so is the analysis of local slopes. What puzzles me is that the authors discuss this problem in the introduction ("power law scaling of the fluctuation function (and thus long-memory) may not be assumed a priori but have (sic) to be established by the investigation of the local slopes.", p 14730, line 3f) and cite the relevant literature, but completely ignore this point in their analysis. In their analysis of monthly global and NH data (fig 5), cross overs can be clearly seen at log(tau/months) $\sim$ 1.7, i.e., tau $\sim$ 6 months, i.e., the fluctuation behaviour above 6 months is much lower than that below 6 months. Fitting a straight line across the whole investigated scale range of course yields a single value for the slope of the line, but this slope (giving a power law scaling exponent) does not describe the underlying process, as the latter obviously cannot be described by a straight line. There is no scaling behaviour in the investigated range, and for "larger" scales the scaling is weaker than for short scales. In fact, the longest scales investigated are exp(3) $\sim$ 20 months, i.e., less than 2 years. Talking about long range memory on scales which are low compared to typical interannual variability is slightly off the point. For annual data, I completely agree with the other referee: the data in the DFA plots (figs 3 and 4) are so scattered that - without any confidence intervals, nothing can be said about whether the straight line is an appropriate model, and whether the slope for large scales is different from 0.5. To summarise: the authors have not inferred any long range correlations.

2. Significance of the results

One can of course interpret the DFA exponent as a simple measure of the strength of the memory without claiming that any real scaling exists - in that sense it carries similar information than, e.g., a decorrelation time. But even in the presence of scaling in the observed range, the main message of the paper would boil down to the following:

-global, NH and SH land surface temperature data are correlated on time scales up to 2 years;

-the correlation behaviour over NH land and SH land is roughly equally strong;

-with reference to an earlier paper (that total SH correlations are stronger than total NH correlations) the authors conclude that SH sea surface temperature (SST) correlations are stronger than NH sea surface temperature correlations.

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The first two findings are obviously well known and trivial. The third conclusion is probably even wrong: the authors analyse temperatures averaged across hemispheres over land and oceans separately, and the total hemisphere. To my knowledge, the NH land mass is much larger than the SH land mass, implying that SH average temperature fluctuations are more dominated by SST fluctuations than NH average temperature fluctuations. Thus, even in case of identical correlation behaviour of NH and SH SST, the correlation of the overall SH temperature should be stronger correlated than NH temperature. The authors may have checked this simply by considering SST only correlations for the NH and the SH. If my reasoning is right, also the third finding would be trivial: SH temperature fluctuations have stronger memory, because there is less land area than on the NH.

3. Sloppiness.

In the following I will list several points where concepts have been wrongly explained, specific technical terms have been used in a sloppy or wrong way, or a very loose language has been used to describe precisely defined concepts.

p14729, l 5: in what sense is the land-surface temperature driving the greenhouse effect? It is a variable in the water vapour feedback, but the driving factors are radiative forcing and the composition of the atmosphere.

p14729, l9: land-surface temperature is not a climate sub-system. It is a climate variable.

p14730, l20ff: a "value distribution" is correctly called marginal distribution. In fact, auto-correlations are defined as cor(tau) = E[(x(t)-mu)(x(t-tau)-mu)], i.e. as expected values of the joint probability distributions at different time lags. Thus they always result from the time behaviour. This critique also applies to all following discussion of the same point.

p14732, l11f: long-range correlations are an asymptotic concept for large scales (see

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Beran, 1994, or the discussion of the authors in the introduction: "the correlation sum is divergent", p. 14730, line 2). There are no long-range correlations for "certain ranges".

p14732, l18ff: as the other reviewer pointed out, confidence bands around the points in the DFA plot might help to show whether scaling exists! If one aims to establish long term memory, one is obviously interested in long time scales spanning several orders of magnitude. Including data on short time scales (i.e., monthly instead of yearly) is of course of little help: one would like to (1) extend the DFA plots to the right and (2) decrease the noise on the large scales. Both can only be obtained by longer time series.

p14734, l20ff: Varotsos et al (2009) do not consider NH and SH LSST correlations separately, as claimed by the authors. In fact, the authors analyse global mean LSST, NH tropopause height and SH tropopause height.

p14734, l24f: see above for a very simple explanation.

p14735, l10f: the reasons why the ocean shows greater persistence than the atmosphere are text book knowledge.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 14727, 2012.