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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mesoscale temperature fluctuations in the stratosphere" *by* B. L. Gary

B. L. Gary

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Anonymous referee #1 correctly points out that fractal analysis could have been used to investigate the amplitude of mesoscale variations of isentrope altitude derived from MTP data. I will add a paragraph about this in Section 7 (see below). The fractal Hurst exponent contains information about the relative importance of long spatial frequencies to short ones. This additional information is unlikely to change the conclusions reached using my simpler Gaussian width parameter. I believe this is the case because every time I computed a power density spectrum for a long isentrope segment I measured the same spectral index, -5/3 (not reported in the manuscript). This suggests that Hurst exponent solutions would also have been the same for all long flight segments. Hence, I believe that fractal analysis of MTP isentrope altitudes would show the same correlation with the four independent variables that I found using an alternative analysis.

Two of the fractal articles cited by the reviewer pertain to ER-2 flights near jet streams. My treatment of jet streams in Section 5 showed them to be sites where the synoptic scale temperature field was especially flawed, and where a much greater component of mesoscale structure was present than elsewhere. In the second part of the manuscript, which dealt with the correlation of an ever-present background of mesoscale structures with independent variables, I specifically avoided including jet stream and mountain wave data in my analysis because I believed that additional physics was involved in their origins. This belief is supported by the presence of "outliers" that appeared in my correlation plots and which I later identified as being associated with either a mid-latitude jet stream or mountain wave. My goal does not include a study of jet streams or mountain waves, so the two journal citations describing a fractal analysis of jet stream measurements is not relevant to this manuscript.

The Murphy publication deserves to be included in my introductory section as an example of the need for using realistic temperature fluctuations for models of ice cloud evolution. This paper explicitly states that for a simulation of ice cloud evolution a fractal model was used to create mesoscale temperature fluctuations that were superimposed upon synoptic temperatures, using a Hurst exponent of ˜0.6. I will amend my Section 7.4 and Section 9 (see below) to include a fractal model as an option for simulating mesoscale temperature fluctuations. I want to thank the reviewer for calling this article to my attention.

These are the specific change I intend to make at the end of the 8-week discussion period:

Pg 4, ln 26, insert before ")": "Murphy, 2003; Karcher and Strom, 2003"

Pg 5, ln 2, insert paragraph: "Murphy (2003) has shown the importance of superimposing realistic mesoscale temperature fluctuations upon synoptic temperature variations in a model for ice cloud evolution that involves the conversion of metastable cubic ice crystals to normal hexagonal ice crystals. This leads to a smaller number of ice crystals which then grow large enough for their faster fall velocities to dehydrate the cloud layer."

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EGU

Pg 14, ln 7, insert paragraph: “Fractal analysis could be used to assess the amplitude of mesoscale temperature fluctuations, as pointed out by a reviewer of this article (e.g., Tuck, Hovde and Bui, 2004; Lovejoy, Schertzer and Tuck, 2004; Mandelbrot, 1998). A fractal analysis solution for a flight segment would yield as a bonus the Hurst exponent, which contains information about the relative importance of long versus short spatial frequencies. For several long flight segments I performed power density spectral analyses and found that in every instance the spectral index was about -5/3. I don’t think the additional information provided by the Hurst exponent would be useful for the purposes of this investigation. This also means that the fractal solution “prefactor” should correlate with my chosen independent variables in the same manner as the MFA parameter that I have chosen to use.”

Pg 20, ln 10, replace “two” with “several”

Pg 20, ln 14, replace “The other” with “Another”

Pg 20, ln 16, insert the sentence (before “If a specificĚ”): “A third way to superimpose mesoscale temperature fluctuations upon a synoptic scale back trajectory is to employ a fractal model using a chosen prefactor and Hurst exponent of ˜0.6, as was done by Murphy (2003).”

Pg 20, ln 22, change the opening sentence to: “The MFA values in Table I are based on Ě”

Pg 21, ln 17, replace “The MFA sequence is needed” with “This MFA value may be used with Eq. (7) to calculate a probability density function for mesoscale departures to a synoptic record. As an alternative, this MFA value may be used to calculate a fractal sequence (Murphy, 2003). Finally, this MFA value can be used”

Pg 24, ln 9, insert the following reference: “Lovejoy, S., Schertzer, D. and Tuck, A., Fractal aircraft trajectories and nonclassical turbulent exponents, Phs. Rev. E, 70, 036306, 2004.”

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Pg 20, ln 9, insert reference: “Mandelbrot, B. B., Fractals and 1/f Noise, Berlin: Springer, 1998.”

Pg 20, ln 11, insert reference: “Murphy, D. M., Dehydration in cold clouds is enhanced by a transition from cubic to hexagonal ice, Geophys. Res. Lett., 30, Art. 2230, 2004.”

Pg 20, ln 22, insert reference: “Tuck, A. F., Hovde, S. J. and Bui, T. P., “Scale invariance in jet streams: ER-2 data around the lower-stratosphere polar night vortex,” Q. J. . Meteorol. Soc., 130, 2423-2444, 2004.”

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 7369, 2006.

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