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Earth System Dynamics
Discussions

Interactive comment on "Long-range memory in millennium-long ESM and AOGCM experiments" *by* L: Østvand et al.

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Hello!

The study at hand investigates long-term memory in global temperatures through power-law scaling. The topic is important for understanding climate variability and the role of internal dynamics and external forcing in generating the variability. The authors use an impressive selection of model and reconstruction data for their studies. I'd like to comment on a couple of issues that might lead to increased understanding.

In our recent article in Theoretical and Applied Climatology, we got a result that superficially seems to contradict the result of the similar exponents obtained for forced and unforced COSMOS model runs. In our results, long-range memory was found

for both as in the article under discussion, but for clearly different exponents. For the power spectrum ($S(f) \propto f^{-\beta}$) we obtained $\beta > 0.7$ for a forced and $\beta \sim 0.35$ for an unforced run. Might this have to do with the range of frequencies covered in the fit? We concluded that the frequency range chosen plays a very major role, especially since the larger number of points for higher frequencies, if included, can dominate a least squares fit.

Anonymous Referee #2 of this article thought it would be interesting to see the exponents estimated from the power spectrum, which is familiar also to less mathematically inclined readers. I agree, as our results varied somewhat depending on whether detrended fluctuation analysis or the power spectrum was used. We did not track down the reasons for the differences as the case of our article, the DFA sensitivity calculations were included last minute in reaction to a reviewer comment, but in principle it would be interesting to understand why identities such as $\beta = 2\alpha - 1$ do not hold as universally as one might think. Perhaps it also has to do with different scaling in different frequency ranges?

Sincerely yours,

Svante Henriksson

Henriksson, S. V., Räisänen, P., Silen, J., Järvinen, H., and Laaksonen, A.: Improved power-law estimates from multiple samples provided by millennium climate simulations, Theoretical and Applied Climatology, online first, DOI 10.1007/s00704-014-1132-0.

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