Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 9, 4537-4544, 2009
www.atmos-chem-phys.net/9/4537/2009/

Discriminating low frequency components from long range persistent fluctuations in daily atmospheric temperature variability

M. Lanfredi[1,2], T. Simoniello[1,2], V. Cuomo[1], and M. Macchiato[2,3]
[1]Istituto di Metodologie per l'Analisi Ambientale-CNR,Tito (PZ), Italy
[2]Consorzio Interuniversitario per la Fisica della Materia, Napoli, Italy
[3]Dipartimento di Scienze Fisiche Università "Federico II", Napoli, Italy

Abstract. This study originated from recent results reported in literature, which support the existence of long-range (power-law) persistence in atmospheric temperature fluctuations on monthly and inter-annual scales. We investigated the results of Detrended Fluctuation Analysis (DFA) carried out on twenty-two historical daily time series recorded in Europe in order to evaluate the reliability of such findings in depth. More detailed inspections emphasized systematic deviations from power-law and high statistical confidence for functional form misspecification. Rigorous analyses did not support scale-free correlation as an operative concept for Climate modelling, as instead suggested in literature. In order to understand the physical implications of our results better, we designed a bivariate Markov process, parameterised on the basis of the atmospheric observational data by introducing a slow dummy variable. The time series generated by this model, analysed both in time and frequency domains, tallied with the real ones very well. They accounted for both the deceptive scaling found in literature and the correlation details enhanced by our analysis. Our results seem to evidence the presence of slow fluctuations from another climatic sub-system such as ocean, which inflates temperature variance up to several months. They advise more precise re-analyses of temperature time series before suggesting dynamical paradigms useful for Climate modelling and for the assessment of Climate Change.

Final Revised Paper (PDF, 2297 KB) Discussion Paper (ACPD)

Citation: Lanfredi, M., Simoniello, T., Cuomo, V., and Macchiato, M.: Discriminating low frequency components from long range persistent fluctuations in daily atmospheric temperature variability, Atmos. Chem. Phys., 9, 4537-4544, 2009. Bibtex EndNote Reference Manager