Application of the Fluctuation Dissipation Theorem in a non-Gaussian regime.

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The time mean response of many chaotic systems, including potentially the tropospheric circulation, to a small forcing may be calculated from the statistics of the unforced system using the Fluctuation Dissipation Theorem (FDT). The standard form of the FDT requires the PDF of the unforced system to be Gaussian. However the tropospheric circulation as simulated in simple numerical models for example, is clearly non-Gaussian which leads to significant systematic errors in the application of the FDT.

Here we consider whether the FDT calculation can be improved without making the assumption of a Gaussian PDF. This is challenging for the tropospheric circulation, even in a simple model, because of the high dimensionality. We therefore test the approach using a strongly non-Gaussian three dimensional forced Lorenz model, in particular considering the pay-off between accuracy and the required length of the time series of the unforced system. We consider the implications of the results for higher dimensional systems.