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Stratosphere-troposphere coupling: use of the Fluctuation-Dissipation Theorem as a quantifier of tropospheric response.

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Some aspects of the coupling between stratosphere and troposphere can be understood as tropospheric response to stratospheric forcing, with the tropospheric circulation acting, through the coupled effects of eddies and mean flow, as an amplifier. The Fluctuation-Dissipation Theorem (FDT) is one theoretical tool available to predict the tropospheric response to forcing. The FDT provides an estimate of the linear operator relating forcing to response, based only on the statistics of the unforced tropospheric circulation, calculated from a suitable time series. The simplest prediction of the FDT, already exploited in the context of response to stratospheric forcing, is that response to forcing will be proportional to the longest correlation timescale in the unforced circulation. Potentially the FDT can provide more precise information on the structure and magnitude of the response to an arbitrary forcing. However the usefulness is limited by (a) sampling issues (i.e. the accuracy of the prediction) is limited by the length of the time series of the unforced circulation and (b) the gaussianity assumption in the traditional form of the FDT. This presentation will provide quantitative analysis of (a), present a non-Gaussian extension of the traditional FDT -- we refer to the extension as a 'non-parametric FDT' and discuss its usefulness as a predictor of changes in the tropospheric circulation.