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Non-Gaussian signatures in the PDF of planetary waves

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Although there is no doubt that many features of atmospheric planetary wave behaviour have been successfully described in linear terms, there is increasing agreement that a full description needs to include nonlinearities. These nonlinearities are expected to lead to non-Gaussian features and possibly multiple modes in the probability density distribution of atmospheric states.

We extend on previous studied by searching for statistically significant non-Gaussian features in an extremely long GCM integration with fixed boundary conditions. This allows a quantitative and qualitative description of the non-Gaussian features and possible multimodality in up to four dimensions.

We address which ways the density function points to the existence of preferred atmospheric patterns and to which degree it is consistent with the notion of preferred states. For this purpose and to link the non-Gaussian features to the nonlinearities in the mean planetary wave behaviour, we determine to which degree the PDF can be described in terms of a multiple-well potential and by a low-dimensional nonlinear stochastic model.

Interestingly we find that regions of enhanced probability correspond to a Pacific blocked and to a Pacific zonal state; these are the same states which our earlier work had found to be stagnation points when mean phase space tendency distributions for the system were constructed.