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A Hidden Markov Model Perspective on Regimes in Atmospheric Flows

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A controversial topic in the recent climate modeling literature is the fashion in which persistent circulation regimes in the atmosphere occur despite nearly Gaussian statistics of the large-scale planetary waves. In my presentation I will introduce a hierarchy of circulation models and examine their regime behavior through hidden Markov model (HMM) analysis of the time series of suitable low-frequency planetary waves. This analysis elucidates how statistically significant regime transitions occur despite nearly Gaussian behavior in the associated probability distribution function and without a significant role for the low-order truncated nonlinear dynamics alone. I will show that in a batrotropic model the turbulent backscatter onto a three-dimensional subspace of low-frequency modes is responsible for these effects and not fixed points of the corresponding truncated low-order system. Furthermore, I will discuss the predictability of regime transitions and the interannual variability of the frequency of occurence of circulation regimes in reanalysis data.