The linear stochastic delayed oscillator revisited

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In 1989, Battisti and Hirst [J. Atmos. Sci., 46(12):1687–1712, 1989] introduced a simple linear retarded delay equation $\dot{T}(t) = AT(t) + BT(t-r)$ in order to model the dynamics of the tropical coupled atmosphere/ocean system. The first term on the right-hand side represented the positive feedback (with $A > 0$), the second term (with $B < 0$) the delayed effect of the Kelvin and Rossby wave propagation across the equatorial basin.

In this work we revisit this model and consider stochastic perturbations of the linear delayed oscillator by Gaussian and (heavy-tailed, i.e. stable) non-Gaussian noises. In particular, we solve the first passage problem and determine the intrinsic time scales of this system (Kramers' times).