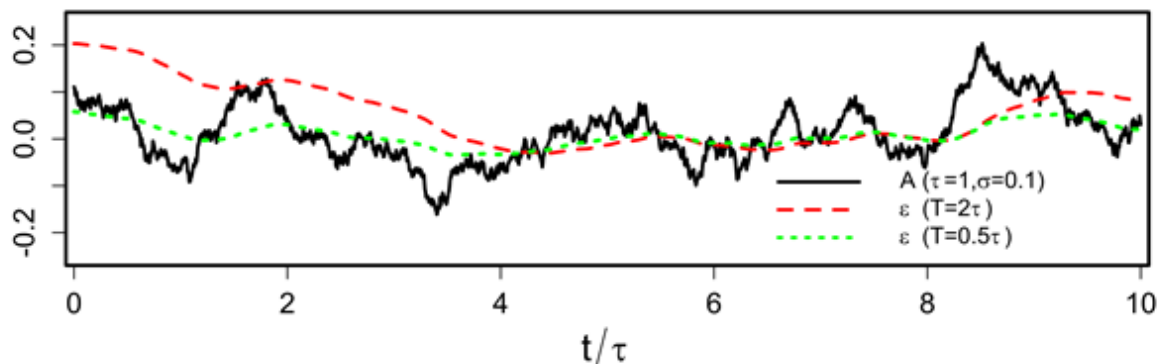# Predictability of population fluctuations

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Population dynamics is affected by environmental fluctuations (such as climate variations), which have a characteristic correlation time. Strikingly, the time scale of predictability can be larger for the population dynamics than for the underlying environmental fluctuations. Here, we present a general mechanism leading to this increase in predictability. We considered colored environmental fluctuation acting on a population close to equilibrium. In this framework, we derived the temporal auto and cross-correlation functions for the environmental and population fluctuations. We found a general correlation time hierarchy led by the environmental-population correlation time, closely followed by the population autocorrelation time. The increased predictability of the population fluctuations arises as an increase in its autocorrelation and cross-correlation times. These increases are enhanced by the slow damping of the population fluctuations, which has an integrative effect on the impact of correlated environmental fluctuations. Therefore, population fluctuation predictability is enhanced when the damping time of the population fluctuation is larger than the environmental fluctuations. This general mechanism can be quite frequent in nature, and it largely increases the perspectives of making reliable predictions of population fluctuations.

References

[1] R. Crespo-Miguel, F. J. Cao-García, Predictability of Population Fluctuations. Mathematics, 10(17), 3176 (2022).