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# Emergence of antipersistence and persistence from a deterministic toy model

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A toy model is developed to demonstrate the emergence of antipersistence and persistence using simple deterministic dynamics. Because of its simplicity it may be useful in understanding these behaviours and in avoiding misinterpretation of more complex natural systems. A hypothetical plain is assumed with water stored in the soil, which sustains some vegetation. Each year a constant amount of water enters the soil and the potential evapotranspiration is also constant, but the actual evapotranspiration varies following the variation of the vegetation cover, which in turn varies with soil water. The vegetation cover and the soil water storage are the two state variables of the system. The system dynamics is expressed by very simple equations. It is demonstrated that the system trajectory, as seen from synthesized time series, is characterized by antipersistence or fluctuations around the mean value with fast recovery of the mean. The fluctuations seem to be periodic but longer series reveal that there is no constant period. This behaviour reminds time series of phenomena that have been called "oscillations" such as the El Nino Southern Oscillation. On the other hand, the series of consecutive peaks of the system storage exhibits large and long excursions of local average from the overall mean, a behaviour known as long-term persistence or scaling behaviour. The produced trajectories give the impression of nonstationary time series but there is nothing nonstationary in the model, which involves only three parameters constant in time, i.e. the constant infiltration and potential evaporation rates, and a standardizing parameter for soil moisture.