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Niche construction as an emerging phenomenon between fast ecological and slow evolutionary timescales in individual-based models

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This is joint work with Coralie Fritsch, Cristóbal Quiñinao, Leonardo Videla and Nicolás Zalduendo-Vidal. We consider an individual-based model of niche construction based on birth-death processes of d interacting (sub)species immersed in an environment which is influenced by the population state and evolves according to a slower dynamic. Under the above hypothesis, extinction and/or re-emergence of negligible (sub)species on long time scales can be observed. We prove that the joint dynamics of the species sizes on a logarithmic scale and the environment undergo a piecewise deterministic Markov process in a large time regime, which can be approximated by an explicit dynamical system in the limit of large populations. This convergence result holds true under the assumption that no "bad event"occur during the population dynamics, corresponding to situations where several species become dominant or go extinct simultaneously. We also prove that no such bad event occur for Baire-almost all initial conditions of the populations and the environmental resources. We apply this method to study the long term coexistence of two specialist species consuming two resources, with a "joint" niche construction where each species constructs the niche of the other while depleting its resources. We also study an example of immune escape in cancer.

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