Growth and death of populations in a fluctuating environment

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Introduction

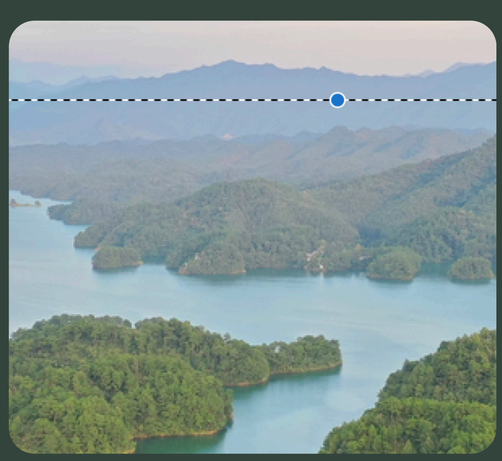
The properties of the dynamics in time of a population are crucial in order to understand the possibility of its extinction. This evolution can be modelled in various ways, usually starting from simple stochastic mathematical equations. In addition, populations are subject to temporal changes in external parameters (e.g temperature T) that modify their time dynamics. The goal of this internship is to study one or several of these ecologically-relevant models, building on the knowledge of classical methods and existing bibliography -Refs 1,2,3-. The study will benefit from several existing projects, among them the seasonal dynamics of seagrass, or the process of colonization of species from one mainland to islands.

Methodology

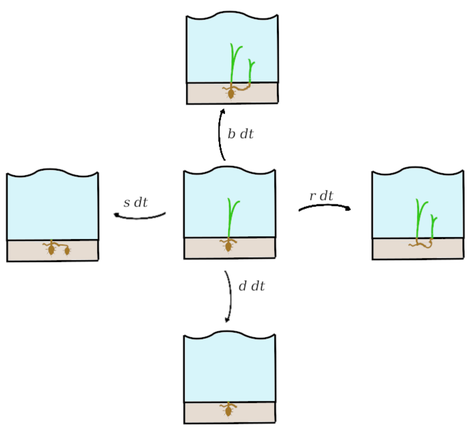
- Bibliography: ecological questions + mathematical modelling

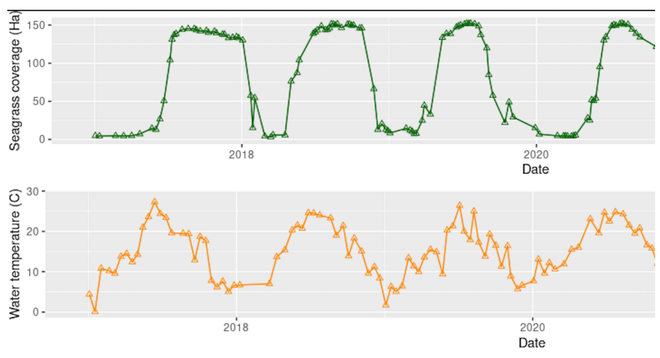
- Analytical techniques: Master Equation approach
- Numerical techniques: Gillespie algorithm

- Exploration of different scenarios of temperature variation
- Computation of extinction times and persistence times
- Interpretation of the results

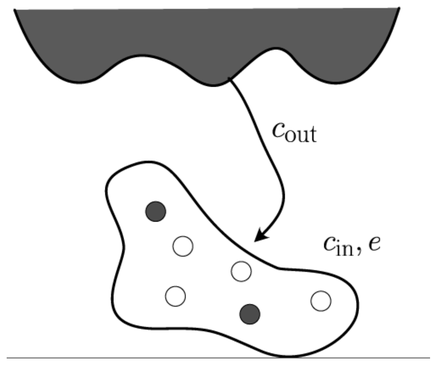


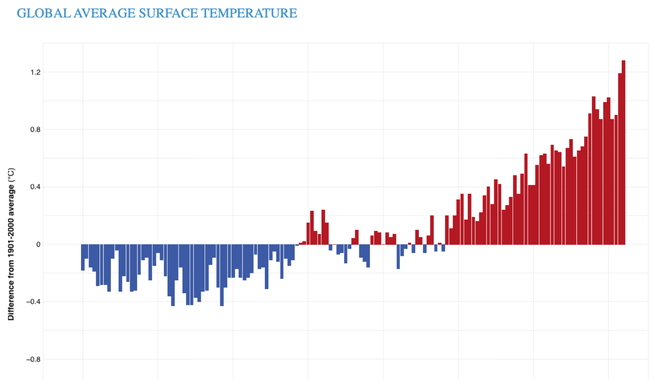
Example 1: Seasonal dynamics of seagrass -Ref 4- the aim is to study a model with a bell-shaped birth rate b(T) , T being the temperature.





Example 2: Mainland-Island colonization -Ref 5- the aim is to study a model subject to climate change, with a bell-shaped local colonization rate cin(T).





In Brief

The internship will take place in the Theoretical Physics Department of L2C in building 13 (Triolet campus) with gathers a community of researchers in Statistical Physics and Complex Systems.

- Taste for interdisciplinary fundamental questions is required.
- Strong skills in theoretical modelling will be learned as necessary tools for the research project.
- The student will have the opportunity to contribute to at least one of the 2 proposed ecological questions on extinction or persistence of populations, and to confront the physicist's perspective to the ecologist's view thanks to regular discussions with ecologists in Montpellier, in particular in the ISEM lab.

Expected Results

- We expect a dependence of the population dynamics on the way the growth parameters b or cin depend on temperature T.

- We will compute the effect of temperature variations on the extinction/persistence properties of the population for at least one of the ecological situations described above.

References

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