CLIMATE CHANGE AND THE IMPACT OF A HETEROGENEOUS ENVIRONMENT

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We consider a natural population facing a climate change.

To survive climate change, a species can change its range, migrating toward colder regions (see [1]). This is however not the only possible strategy: a species can also change its phenotypes to be able to tolerate higher temperature. This evolution is the result of mutations and selections (we neglect here more complicated phenomena, such as phenotypic plasticity or sexual reproduction [3]).

This evolutionary dynamics are known to play a role at the ecological scale: it is well documented that the phenotypes of a species are not uniform throughout the species range, and that each individual tends to be adapted to its local environment [6].

We consider a PDE model, that can be derived as a large population limit of an individual-based model [2]. In a first study [5], we show that in linear environments, and in the presence of climate change, the propagation speed can be computed explicitly. This analysis relies on a careful use of Harnack inequalities. We also try to go beyond this first result: large scale heterogeneities, such as mountains, play an important role in the dynamics of species. On a few examples, we are able to push the analysis further to provide new ideas in a few biologically relevant situations. This and the study of multi-dimensional position spaces is a current work also involving biologist Ophélie Ronce.

Finally, I will discuss some ideas to develop an interface dynamics limit that could be useful to link this type of result to presence/absence maps that are used by field biologists working on those questions.

References

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