



Deviations from project proposal

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EPFL, Décembre 2024

Introduction

As a reminder, our initial project involved modeling the impact of temperature, pH and pollution on a coral ecosystem composed of corals, macroalgae and turfs. Please read our project proposal for details of the equations and model. However, we quickly realized that the model was not viable. Indeed, the values of constants and certain parameters, such as pollution, were very difficult to model precisely and accurately.

Study area and time orientation

We therefore chose to set ourselves a study area, the Gili Matra Marine Recreational Park, in order to obtain accurate year-round temperature values and real initial populations. This led us to choose a 20-year period, from 2020 to 2040. Initially, we had envisaged a scale of 100 years, but we realized that we were losing precision and moving away from reality.

Change of differential equation system

The essential deviation was to change the system of differential equations. We drew inspiration from a model presenting the interactions between corals, anemones, wrasses and starfish, populations found in the Gili Matra Marine Recreational Park, with constants whose values we knew. We then added the impact of temperature in a more realistic and precise way (see reports).

To take pH in account, we don't put in the differential equations and search a term for it, but we made a linear regression to have a relation between pH and health coral. It's better to do like this, because we don't have any values of the term that multiplies pH in differential equation, and we can make a simulation as the exercise on the polluter ship. We find that its more realistic to do like that.

Technical choices and tools

Despite the difficulties encountered, the initial idea of solving the differential equations in C and generating the graphs in Python was the right one. It minimized compilation time, facilitated debugging and optimized time complexity. However, to simplify the implementation of linear regression for pH, we decided to use Python exclusively, thanks in particular to the efficiency of the Numpy module.

Conclusion

So, while we've changed the shape of the model significantly, we've stayed true to our basic idea, which was to model the impact of human activities on a coral ecosystem.