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Perspective

Mathematical modelling is a necessary step in biology and in environmental sciences

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The French Academy of Sciences jointly with the French Academy of Agriculture has organized a common meeting on mathematical modelling in biology and in environmental sciences. A thematic issue of *Comptes rendus Biologies* is devoted to articles from the participants to this conference. Some contributions are mathematically oriented, such as the note by Lobry and Harmand [6] about the coexistence of *n* competing species. Others are more applied, such as the note by Martineau and Saugier about modelling of plant succession [7]. The article by Leredde et al. [5] is a key contribution about data assimilation methods for mathematical modelling. It shows that in the near future, mathematical models used in ecology and in community and population dynamics will be validated using experimental field data. This is an important step toward the use of mathematical models as tools to make decisions about ecosystems and renewable resources' management.

Indeed, a crucial problem in oceanography and in particular in marine biogeochemistry and in planktonic ecology is the validation of mathematical models using experimental data. Most mathematical models that are used in order to describe the dynamics of ecological communities and ecosystems are based on mechanistic assumptions about interactions between species such as Lotka–Volterra or Holling prey–predator interactions in phytoplankton–zooplankton interaction models [8]. In most cases, one uses qualitative models that are rarely validated by using experimental field data. Recently, new methods, namely data assimilation, have been developed [2], in particular in the field of biogeochemistry modelling [3], turbulence [4] pelagic ecosystems modelling such as N–P–Z models (nutrient–phytoplankton–zooplankton models) [1] or also in fish population dynamics modelling, for example tuna fish. Field-data assimilation allows one to look for an optimal parameter set that minimizes some cost function and estimates the difference between simulated variables of the mathematical model and observed data. Leredde et al. present a generic method to obtain such a cost function. They also use this method in two cases about N–P–Z marine ecosystems models. Their paper shows how the method can be used successfully, but also its limitations. Sometimes, the algorithm can converge toward local minima.

There is no doubt that in the next future data assimilation methods will play a more and more important role in the field of mathematical modelling of biological and social systems.

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