Post-doctoral position: mechanistic model of phytoplankton and zooplankton

Developing a mechanistic model of phytoplankton and zooplankton growth based on a global ocean biogeochemical model (PISCES)

General goals

Currently, the biogeochemical model PISCES follows the classical but too simplistic Monod formalism. In other words, phytoplankton (and zooplankton) growth directly depends on the availability of necessary nutrients with basic colimitation rules. A major consequence of this "ad-hoc" approach is the constant stoichiometry of the living organisms which is highly unrealistic and the lack of mechanistic roots of the different processes. The objective of this task is to abandon this approach to adopt a more mechanistic formalism. Several mechanistic descriptions of phytoplankton physiology have been published so far (e.g., Geider et al., 1998; Flynn et al., 2001; Pahlow et al., 2009). Rather than using these specific descriptions, we will develop a rather new model based on the dynamic energy budget theory proposed by Kooijman (2000). This choice is dictated by the following reasons:

i. This theory is general and can be applied to all living organisms. As such, both phytoplankton and zooplankton can be modelled using the same theoretical background. However, for phytoplankton, an extension or an adaptation of the available theoretical formalism will be necessary.

ii. This position is funded by a French national project called MACROES. One of the objectives of MACROES is to couple the biogeochemical model PISCES with the pelagic ecosystems model APECOSM (Maury et al., 2007a,b). As APECOSM is based on the DEB formalism, the achievement of the work proposed here will allow to model the whole marine ecosystem (PISCES coupled with APECOSM) using the same theoretical formalism resulting in a maximum consistency between the two different models.

Activities

1) The first task of the post-doc will be the development of a DEB-based model of phytoplankton . In a first step, a generic DEB model of phytoplankton will be constructed including the main physiological aspects. Six limiting factors will be considered (Light, Carbon, Nitrogen, Phosphorus, Iron and Silicon) and explicitly represented in cells reserves and structures. This model will be tested against laboratory experiments, in a manner similar to what has been done with previously published mechanistic models. In a second step, this model will be embedded within PISCES, without changing the ecosystem structure of the model (two phytoplankton species). The model will then be run at 1-D stations where data are available (for instance, NABE, BATS, HOT, ...) and then, at the global scale.

2) The second planned activity is to extend the model to zooplankton.
The engineer will be based in Brest (France) under the supervision of Olivier AUMONT. Strong collaborations will be established with J.-C. Poggiale in Marseille and Bas Kooijman from the Netherlands.

Eligibility

Strong knowledge of biological oceanography and ecosystem modelling is required.

Knowledge of physical oceanography will be considered as a plus. Furthermore, the model is developed in fortran 90. As a consequence, strong knowledge in this programming language is requested.

Salary
23 000 € per year before taxes.

Principal Investigator
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Duration:
18 months