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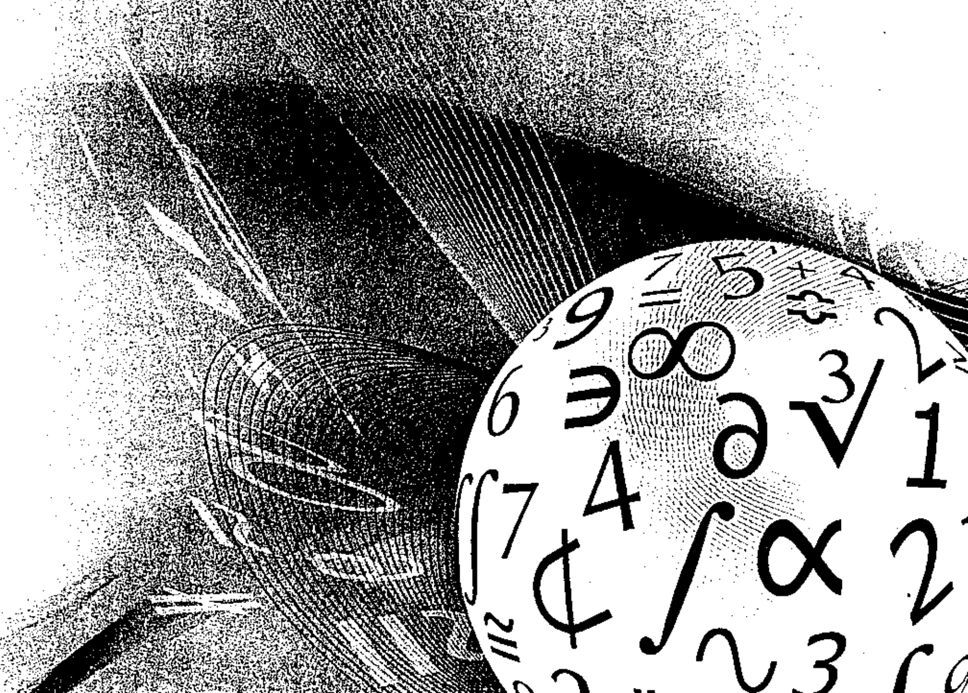

XXIII Congreso de Ecuaciones Diferenciales y Aplicaciones
XIII Congreso de Matemática Aplicada

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Comité Organizador CEDYA2013
Institut de Matemàtiques i Aplicacions de Castelló (IMAC)
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Un modelo 1D NPZ de acoplamiento entre la hidrodinámica y los flujos biogeoquímicos en estrechos bicapa. Aplicación a la dinámica mareal en el Estrecho de Gibraltar

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Resumen

Nutrient-phytoplankton-zooplankton (NPZ) models are a common tool in oceanographic-biological research. NPZ models incorporate one of the simplest sets of dynamics that usefully describe oceanic plankton dynamics. The three state variables considered (nutrients, phytoplankton and zooplankton) are usually modeled in terms of their hydrogen content,since nitrogen is often limiting to primary production in the ocean. The first issue in putting an NPZ model together is the choice of the transfer functions (the functional forms of joining the variables to each other) and their choice is critical to the dynamics of the model. A general set of NPZ model equations can be written as [2]:

$$\begin{cases} \dfrac{dP}{dt} = f(I)\, g(N)\, P - h(P)\, Z - i(P)\, P, \\[2ex] \dfrac{dZ}{dt} = \gamma\, h(P)\, Z - j(Z)\, Z, \\[2ex] \dfrac{dN}{dt} = -f(I)\, g(N)\, P + (1-\gamma) h(P)\, Z + i(P)\, P + j(Z)\, Z. \end{cases} \tag{4}$$

In an NPZ model there are five transfer functions to be considered: phytoplankton response to light $f(I)$, phytoplankton nutrient uptake $g(N)$, zooplankton grazing $h(P)$, and phytoplankton $i(P)$ and zooplankton $j(Z)$ loss terms due to death, excretion, and predation by organisms not included in the model. Zooplankton assimilation γ is usually modeled as a simple linear function of food ingested.

The NPZ model is implemented inside a physical model describing the two-layer dynamics in the Strait of Gibraltar. Initially a 1D finite volume shallow water model has been considered [1], with a special treatment of the linearly degenerate fields, associated

to the transport. Every state variable of the NPZ model will have a separate equation describing its evolution of the form:

$$\frac{dC}{dt} = \partial_t C + u\,\frac{\partial C}{\partial x} + \left(\frac{\partial C}{\partial t}\right)_m + \Sigma \text{ transfer functions (fluxes)} \tag{5}$$

where C is the concentration of the state variables (N, P, or Z), u first layer water velocity determined by the hydrodynamical model, and the term $\left(\frac{\partial C}{\partial t}\right)_m$ parameterize mixing when the physical model determines that mixing takes place. This happens when the model looses its hyperbolic nature and imaginary eigenvalues appear. This is equivalent to a stability Froude number greater than one.

The functional form for the transfer functions, mixing term parametrizations and values for the parameters have been taken following [3].

The aim of this preliminary work is to simulate the effects of mixing processes on biogeochemical fluxes and the pelagic community in the Strait of Gibraltar area: The hydrodynamical model is used to predict interfacial mixing and advection which drive the dynamics of the pelagic community that is modeled using a simple NPZ model.

Sesión especial en el CEDYA 2013: Matemáticas del Planeta Tierra.

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