Geophysical Research Abstracts, Vol. 9, 00258, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00258

Small-scale spatial structure in plankton distributions: Introducing a maturation time into the biology.

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The observed filamental nature of plankton populations suggests that stirring plays an important role in determining their spatial structure. In a flow where the fluid parcels follow chaotic trajectories and in a regime where diffusion can be neglected, the concentration in a fluid parcel is given by the parcel time history.

The spatial structure of the biological fields has been shown to be a result of competition between the rate of convergence of the biological processes involved and the rate of divergence of the distance of neighbouring fluid parcels. It has also been argued (except under rather special conditions), that the small scale behaviour should be the same for all interacting species *(Neufeld et al. (1999))*. However, a set of numerical results presented by *Abraham et al. (1998)*, in which a maturation time is introduced into the predator evolution equation, show that different species have different small-scale spacial structures (specifically, different structures for zooplankton and phytoplankton).

In this talk we examine a class of models involving a nutrient, a predator and a prey, coupled to a Batchelor-regime chaotic flow. Theoretical and numerical investigations suggest that the addition of a maturation time should not decouple the scales of the fields, provided sufficiently small spatial scales are considered. However, under certain conditions and at scales larger than a characteristic length scale, there is a decoupling of the spatial structure of zooplankton with respect to phytoplankton and nutrient. The factors that determine this lengthscale and its physical significance will be quantified and discussed.