



Spatio-temporal patterns in simple models of marine systems

U. Feudel (1), M. Baurmann (1), and T. Gross (2)

(1) Institute for Chemistry and Biology of the Marine Environment, Carl von Ossietzky University Oldenburg, Oldenburg, Germany (feudel@icbm.de), (2) Max-Planck Institute for Physics of Complex Systems, Dresden, Germany (thilo.gross@physics.org)

Spatio-temporal patterns in marine systems are a result of the interaction of population dynamics with physical transport processes. These physical transport processes can be either diffusion processes in marine sediments or in the water column. We study the dynamics of one population of bacteria and its nutrient in a simplified model of a marine sediments, taking into account that the considered bacteria possess an active as well as an inactive state, where activation is processed by signal molecules. Furthermore the nutrients are transported actively by bioirrigation and passively by diffusion. It is shown that under certain conditions Turing patterns can occur which yield heterogeneous spatial patterns of the species. The influence of bioirrigation on Turing patterns leads to the emergence of "hot spots", i.e. localized regions of enhanced bacterial activity. All obtained patterns fit quite well to observed patterns in laboratory experiments. Spatio-temporal patterns appear in a predator-prey model, used to describe plankton dynamics. These patterns appear due to the simultaneous emergence of Turing patterns and oscillations in the species abundance in the neighborhood of a Turing-Hopf bifurcation. We observe a large variety of different patterns where i) stationary heterogeneous patterns (e.g. hot and cold spots) compete with spatio-temporal patterns ii) slowly moving patterns are embedded in an oscillatory background iii) moving fronts and spiral waves appear.