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**Picophytoplankton dynamics in a real ecosystem in the
presence of environmental noise**

D. Valenti¹, G. Denaro¹, B. Spagnolo¹, G. Basilone², S. Mazzola², S. W. Zgozi³, S. Aronica², A. Bonanno²

¹Dipartimento di Fisica e Chimica, Università di Palermo
Group of Interdisciplinary Physics and CNISM, Unità di Palermo
Viale delle Scienze, Ed. 18, I-90128 Palermo, Italy.

²Istituto per l'Ambiente Marino Costiero, CNR, U.O.S. di Capo Granitola, Via del Faro,
3, I-91020 Campobello di Mazara (TP), Italy.

³Marine Biology Research Centre, P.O. Box 30830, Tajura, Libya.

Abstract

The dynamics of picophytoplankton communities in marine environment is studied by a stochastic reaction-diffusion-taxis model. The model, valid for weakly mixed waters, is used to obtain the stationary spatial distributions, along a water column, of two groups of picophytoplankton, i.e. picoeukaryotes and Prochlorococcus, which accounts about for 60% of total *chlorophyll a* on average in Mediterranean Sea.

The model is based on three stochastic differential equations, which describe the dynamics of diffusion of the picophytoplankton biomass and nutrient concentrations, in the presence of environmental noise and intraspecific competition for light and nutrient. Specifically, the random fluctuations of the environmental variables are considered by inserting terms of multiplicative white Gaussian noise into the differential equations. The spatio-temporal dynamics of the picophytoplankton biomass and nutrient concentrations along the water column is obtained by numerically solving the equations of the model. In particular, the equations are integrated over a time interval long enough to obtain the steady spatial distributions of the biomass concentrations, expressed in $cell/m^3$, of picoeukaryotes and Prochlorococcus.

The total biomass concentration is converted into *chlorophyll a* concentration and compared with experimental data collected in two different sites of the Sicily Channel (southern Mediterranean Sea). The comparison indicates that real *chlorophyll a* distributions are better reproduced, respect to the deterministic case, by theoretical profiles obtained in the presence of noise. In particular, position, shape and magnitude of the theoretical deep chlorophyll maximum exhibit, for suitable values of the noise intensities, an improved agreement with the experimental values, as confirmed by goodness-of-fit statistical tests.