naturally occurring stage in the dinoflagellate life history and environmental parmeters can only favoured optimum growth conditions.

THE BIOLOGY AND ECOLOGY OF *PYRODINIUM BAHAMENSE*: INPUTS INTO MODELING A TROPICAL TOXIC DINOFLAGELLATE

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Pyrodinium bahamense var. *compressum* has been causing toxic blooms in the tropical world for more than three decades now. In the Philippines its bloom was first recorded in 1983 and to date, about one thousand eight hundred and twenty four (1,824) Paralytic Shellfish Poisoning (PSP) cases and one hundred and nine (109) deaths have been reported in about twenty six (26) areas/embayments. Modeling of the bloom dynamics of this tropical toxic dinoflagellate has been attempted for the first time in 2000 using data sets from the Philippines. With more observations and results from studies in the laboratory and the field, additional synthesis and modeling of the bloom dynamics of the organism are in order.

ECOPHYSIOLOGY OF PHYTOPLANKTON UNDER SMALL SCALE TURBULENCE: FROM THE LABORATORY TO THE MODULATION OF NATURAL BLOOMS

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Laboratory studies have shown that small-scale turbulence may interfere with different physiological processes on phytoplankton cells. Relevant observations include: 1) changes in the metabolite fluxes in and out of the cell, 2) changes in the morphology and cellular volume, 3) alterations of the cellular content of DNA, toxins or DMSP, 4) modifications of the cell division and live cycles (cyst formation) and of motility patterns, 5) interferences with predator-prey and parasite-host interactions, and 6) cell death. Altogether, these results point to the particular sensitivity of dinoflagellates to small-scale turbulence, although the fundamental mechanisms of these responses are not known. One challenge now is to ascertain to what extent experimental laboratory designs and setups approximate natural conditions and how the physiological capacities of the organisms interact with other biological factors, environmental forcings and water circulation at a variety of spatio-temporal scales, to determine the dynamics of dinoflagellate populations in nature. With this objective in mind, we are conducting a multidisciplinary study in the Alfacs Bay (Ebro Delta, NW Mediterranean). Velocity data have been almost continuously recorded during 2 years by a 2MHz acoustic Doppler current profiler deployed on a fixed station (6 m depth). Additional physical (using a CTD and a SCAMP microstructure probe) and biological (chlorophyll concentration, phytoplankton species composition) parameters have been obtained from several sampling points. Meteorological data are provided by a nearby station. We will show our preliminary results on the main scenarios under which several HABs have occurred during this period.

ALTERNATIVE MODEL APPROACHES TO HAB PREDICTION

A.N. Blauw

Models can be used to as a tool for ecosystem analysis and for prediction of harmful algal blooms. Several model approaches are available that all have their specific advantages and disadvantages. Both the level of understanding of the bloom phenomenon, data availability, the type of processes that are most controlling and the purpose of the model play a role when selecting the most suitable modelling approach. The most commonly used model approach is a process-based deterministic numerical model. Alternatively, data-based model approaches are available, such as statistical models and neural network models. These are useful is cases when the bloom phenomena are not sufficiently understood or too complicated to apply the deterministic approach. However, they require a lot of data and cannot predict what will happen under changing circumstances. As intermediate approaches between process-based and data-based model approaches combinations can be made that benefit optimally from available process knowledge and fill in the knowledge gaps with data-based submodels. An example of such an intermediate model approach is fuzzy logic modelling. Some examples of model approaches applied on HAB phenomena are evaluated to illustrate their applicability for specific situations.

EXPLORING CHANGES IN WATERSHED NUTRIENT SOURCES, FORMS AND EXPORTS: A GLOBAL NEWS IMPLEMENTATION OF THE MILLENNIUM ECOSYSTEM ASSESSMENT SCENARIOS

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The rapidly increasing global anthropogenic nutrient production on land and negative impacts on coastal systems due to export from rivers are extensively documented. According to the comprehensive Millennium Ecosystem Assessment (MA) the excessive nutrient loading of ecosystems and nutrient mobilization is expected to continue during the coming decades in response to economic and population growth. For developing a firm scientific basis for actions to reverse these trends and sustain riverine and coastal ecosystem health, quantitative models are needed for simulating changes in river loads of nutrients based on changes in watershed anthropogenic forcings at regional to global scales. Particularly, models are needed to predict changes in element ratios and nutrient forms (dissolved vs. particulate, organic vs. inorganic) which have been shown to modulate the impacts of nutrient loading on marine ecosystems. The Global Nutrient Export from Watersheds (NEWS) system of models was designed to meet these requirements. We will present preliminary results from an application to past (1970) and current (2000) conditions, and compare them four MA scenarios for the coming five decades. These scenarios integrate economic and social processes, changing climate, hydrology and water engineering, and land cover and