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Preface

Before you is the special issue of the *Journal of Sea Research* dealing with the results from the second phase of the European Regional Seas Ecosystem Model (ERSEM) project.

ERSEM was an EU project in the Marine Science and Technology programme (MAST) with the objective of developing a generic model system of the cycling of carbon and the macro-nutrients nitrate, ammonium, phosphate and silicate in the temperate shelf seas of Europe.

A generic model of the C, N, P and Si cycles demands the explicit description of all the main processes affecting these cycles — in the sediment as well as in the water column — and the integration of the different process descriptions into a coherent framework. This biochemical model complex then has to be combined with a model describing the physical processes in the model domain. As the biogeochemical processes involved in the carbon and nutrient cycles have widely different space and time scales, combining fast and slow processes in one model has been quite a challenge.

Solving these challenges has required contributions from the whole spectrum of marine sciences, varying from hydrodynamics to ecology. Thanks to the fact that the ERSEM consortium comprised the necessary range of disciplines and, moreover, could draw on additional expertise from within their institutes, the resulting model system reflects the state of our knowledge of marine ecosystem functioning. As will be clear from the contributions in this issue, our understanding of some aspects is quite good, but there are other aspects where we are still whistling in the dark and have had to generalise from anecdotal evidence.

The genericity of the ERSEM model is illustrated to some degree by the different applications in this issue. The applications of the model to smaller regions in and around the North Sea, described in this issue for the Humber plume and for a mooring site in the Frisian Front, as well as the continental coastal application (COCOA) demonstrate the possibilities for forcing ERSEM with different physical models. The consequences on system dynamics of a detailed vertical resolution of the physical structure of the water column are shown, using a mooring dataset. The large effect of temporally slightly different evolutions of water-column stability on the seasonal evolution of the pelagic ecosystem indicates that the vertical resolution as used in the standard ERSEM-II model is not suitable for capturing the consequences of high-frequency variability in water column structure on system behaviour. To achieve that, it will be necessary to continue the development of directly-coupled modelling systems by combining a general circulation model with the ecological model.

Even more tests of the genericity of ERSEM, by applying the model system to different regional seas, are on-going in two MAST regional seas projects, BASYS, which deals with the Baltic Sea, and MATER, which concerns the Mediterranean.

One of the main objectives of the ERSEM project

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has been to develop a model system with a prognostic capability in order for it to be useful as a decision-support tool. ERSEM's prognostic capability has been tested by making a 40-year-long hindcast with realistic physical forcing and realistic river inputs. The results, which give ground for cautious optimism, are described in this issue.

However, as the present ERSEM model in its North Sea application is not forced on-line by an operational hydrodynamical model, it cannot, as yet, be used for forecasting purposes. This requires the direct coupling of a hydrodynamical model to the biogeochemical model(s), a numerically and computationally challenging undertaking which has been started in the MERMAIDS project.

My hope is that this issue will contribute to enlarging the number of groups that are actively developing and applying ecosystem models to address environmental issues, by showing that the complexity of the models needed to do so is high, but necessary, and manageable.

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