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Diagnostic/Metagnostic Modelling of the Western Mediterranean's General Circulation with a 3D primitive equations k-ϵ Model

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ABSTRACT

An essential characteristic of a mathematical model is its *accuracy*, i.e. its ability to reproduce reality in the framework of the model's objectives. In this regard, one must make a distinction between *diagnostic models* which emphasize accuracy in state space and *metagnostic models* which emphasize accuracy in physical space.

A diagnostic model is generally devised to investigate, in details, particular mechanisms, scrutinize the behaviour of the specific state variables and elucidate fundamental questions. Very refined in its representation of, sometimes, rather subtle processes, it may be content with very crude approximations of the physical world (constant depths, rectilinear coasts, infinite ocean, steady two-dimensional fronts, rigid sea surface ...).

A metagnostic model, on the contrary, is in general called upon to tackle a practical situation and may not ignore the real field conditions (depths, coastlines, actual atmospheric forcing ...). Its aims however is to assess the consequences of particular events and provide the marine nowcasts and forecasts which will assist interdisciplinary field studies, planning and management. The model must be sound, expeditious and efficient but is not required to provide detailed information on the delicate machinery subtending its parameterization schemes.

From a purely scientific point of view, of course, the distinction is meaningless. Processes must be studied thoroughly using models of increasing sophistication and realism, converging to a truly *prognostic model*.

However the convergence is generally slow (It appears to have been particularly stagnant, in fact, in the case of the Western Mediterranean's General Circulation).

Modellers participating in huge interdisciplinary research programs may not be satisifed, in answering the biogeochemists' questions, with current, temperature, salinity ... fields calculated in a hypothetical square box rigid lid ocean. The answers must be realistic and require the operation, on a routine basis, of a system-oriented (as opposed to process-oriented) metagnostic model.

In illustration, the GHER metagnostic model developed and run for the study of the Western Mediterranean's General Circulation in the scope of the EEC EROS 2000 Project is briefly described with emphasis on the parameterization of sub-grid scale processes.

It is shown that the model reproduces well the main trends of the general circulation and evidences essential synoptic processes such as deep water formation, coastal upwellings, gyres ... .

The model, tuned in to diagnostic modelling, is then applied to process studies, jointly and severally with the LODYC diagnostic model in the scope of the EEC Euromodel Project.

It is shown how parallel diagnostic and metagnostic simulations can improve, continuously, both types of models ; diagnostic studies providing useful information to improve the mathematical representation of dominant processes, metagnostic nowcasts and forecasts supplying realistic boundary conditions by which one can progressively free oneself of the rigid wall box-ocean limitations.

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