COST-ESF Workshop on Coastal Model Validation

From Wednesday November 18th at noon
to Friday November 20th at noon (2009)

Brest, Ifremer centre

A workshop to initiate activities related to:

Developing methodologies/frameworks for marine model Quality Assurance, including data requirements

Necessity

The development of coastal numerical models is ongoing for twenty years already, and it is timely to focus on their validation. Indeed, their usage has become more intensive since the arising of the operational oceanography, with forecast, nowcast and hindcast being used as well as the testing of whatif scenarios.
For instance, from the latest IPCC report (AR4, 2007) it becomes clear that the current climate undergoes changes, which have impacts in all compartments of the Earth System: the atmosphere, the land and the ocean. Observations already indicate changes in all compartments and also in the marine environment. To understand these changes sustainable monitoring together with modelling efforts of the Earth system are needed. Current activities related to the modelling of the climate system show very good progress and climate models are being extended towards Earth System models by introducing more and more components.

With respect to the models for the blue ocean, coastal models carry several specificities:

- a higher dynamic, which calls for finer resolutions in time and space,
- more processes to be coupled, e.g. circulation hydrodynamics with sea state, wind, precipitation, sediment transport, biology up to a given level in the trophic chain, (often a hierarchy of processes is considered, forcing each other rather than actually coupled together),
- less data at hand at the proper density and with adequate proxies.

The emergence of more and more sophisticated mathematical models is paralleled by an increasing public and regulatory awareness that many of these models have never undergone a procedure of formal evaluation of their quality (fitness-for purpose). Nevertheless the coastal models are used to assist in decision making with political and economic consequences: environment assessment carried out with hindcast, alert systems for storm surge or toxic blooms, etc. This connection is hence closer than for global oceanographic models.

From a European perspective it would be wise to take action now to encourage the harmonization of the different quality assurance approaches before they have settled nationally. This topic should give rise to projects using both COST and ESF instruments in a complementary and synergistic manner. They can select among the following deliverables/tasks those being the most appropriate to the respective instruments.

Objective

The objective of the initiative is (1) to develop a coherent and structured model evaluation procedure and (2) to build consensus within the European scientific and operational community about its application.

Focus

The concerted action will focus on marine models (especially in coastal areas) applied in earth and environmental sciences.

General outline of the initiative

It is suggested that a Quality Assurance core group is established. This group is tasked to prepare a state of the art report on previous quality assurance initiatives and to develop a general concept for assuring the quality of models (ref: Modelling in Coastal and Shelf Seas – European Challenges, ESF Marine Board Position Paper 7, june 2005). Previous QA initiatives can be quoted, among others: the Tidal Flow Forum (1987), GESAMP Workgroup 43, with its report (early 1990-ies), the IAHR Guidelines on Model Validation (1994), FWR/FR0374, and the EU/HARMONI_QUA project.

Although the details of the concept are not yet determined, they will be the outcome of the work within the group; something similar to the guidelines which were worked out under the EU's Major Technological Hazards Programme might be expected. These guidelines were meant as a help for model developers and suggested the preparation of structured evaluation protocols comprising the following steps:

- The *model description* which provides a brief identification of the model to the interested party, either a user or a referee. It contains details of the model as, e.g., its name, version number and release date, the model type, its area of application, the name and the affiliations of the model developer, hardware and software requirements, the efforts taken to assure the quality of the model and a list of references to relevant publications.
- *The data base description* which identifies the data sets employed during the development of parameterisations contained in the model, and which were used during the process of model validation. It contains text on the appropriateness of the data and the features and parameters covered by the data sets.
- *The scientific assessment* that comprises a detailed description of the physics, chemistry and biology contained in the model; an assessment of the appropriateness of the scientific content; the limits of applicability of the model and any special features (data assimilation, downscaling capabilities, detailed compartments in the food web, etc.).
- *The user oriented assessment* which provides information on the availability of the model, computational costs, the associated documentation, the installation procedures, a description of the user interface, explanations concerning the output, etc.
- *The model verification* which is to ensure that the computer code is producing output in accordance with the model specifications. This includes checks for internal consistency of, e.g., mass or momentum flux balances as well as possible comparisons with idealized cases for which an analytic solution exists.
- *The model validation* that deals with the comparison of model results with experimental data. It starts with a statistical analysis of the performance of the model, i.e., measures are defined for the comparison of model output and the observed values. It should comprise an estimation of both, the model uncertainty and the uncertainty in the data.

Approach

A more detailed evaluation strategy, which goes beyond this 6-step procedure and which would be universally applicable to any model, is unlikely to be practicable. The models are simply too diversified with respect to scale (micro-, meso- or regional scale), content (column models, 3-d hydrodynamic models, physical parametrisations, ecological paradigms) or field of application (regional circulation, pollutant dispersion models or ecological models). Additionally it should be noted that strategies for evaluating the quality of a model can in general only be based on scientific principles such as the principle of falsification. Which particular tests and which particular model/dataset comparison should be made for a given model type can ultimately be based only on a consensus built up within and by the scientific and operational community.

It is therefore suggested to establish a cluster of working groups within a joint European project (e.g. COST or ESF), each for a specific type of model (e.g. micro-scale models, including air-sea fluxes, meso-scale shelf sea models, etc.). The individual working groups should be tasked to adjust the general evaluation procedure to the particular model type.

In addition some complementary work needs to be done by the groups. Most important for any validation work is the availability of appropriate data. Therefore, one of the major tasks of the working groups will be to check the existing data base (i.e. the various existing data sets). The data should be classified with respect to its usefulness for the present purpose and made generally available via the Web. Since it is very likely that most of the existing field and laboratory data sets are poorly documented, were taken with insufficient instrumentation, lack completeness or are for other reasons of questionable quality, the working group should make suggestions for focused experimental programmes to close the gaps in the existing data base. The group should organize model comparison exercises which, if the generation of new data can be stimulated, should comprise ‘blind tests’ as well.

Finally, the working groups should promote the application of their quality assurance procedures within the corresponding communities of model developers and users.

Benefits

The COST/ESF-initiative would have numerous benefits. First of all, the sheer existence of a widely accepted European standard for quality assurance work would significantly ‘improve the culture’ within which numerical models are developed and applied. Model developers would obtain step-by step guidance on how to prove that their model is ‘fit for its purpose’. Data sets obtained within expensive experiments would be made accessible and more widely exploited. Research over-resourcing or under-resourcing would become evident. An informal transfer of information and views of interested parties occurs; the interested parties being both researchers and operational users. Expertise available throughout Europe would be brought together and combined to a unified standard.

Organizing committee

Bernard Avril (European Science Foundation)
Pierre Brasseur (LEGI, University of Grenoble)
Aurélien Carbonnière (Marine Board-ESF)
Yann-Hervé De Roeck (Ifremer), contact: yhdr@ifremer.fr
Herman Gerritsen (Deltares)
Sylvain Joffre (Finnish Meteorological Institute)
Laurent Kerléguer (SHOM)
Jacques Legrand (Ifremer)
Carine Petit (COST), contact: cpetit@cost.esf.org
Hugues Ravenel (Météo-France)

Preliminary Agenda

Introduction and objectives of the workshop, supporting possibilities by COST and ESF:

Speaker	***Subject***
Sylvain Joffre	The COST funding system and the ESSEM Domain
Bernard Avril	Future ESF opportunities and current LESC activities
Aurélien Carbonnière	Marine Board-ESF perspectives regarding the Integrated Maritime Policy : emphasis on environmental monitoring

Oceanographic & Atmospheric programmes/projects:

- Examples of selected ongoing inter comparison activities within (WMO/JCOMM, WCRP, MERSEA, ECOOP, MyOcean, WWRP, etc.)
- Examples of validation within national activities (Mercator, Prévimer, Polcoms, ESEO,…)
- Gaps and needs in terms of inter comparison exercises, validation data, critical modules to be compared, methodologies and procedures for QA, etc.
- Examples of Ensemble Prediction Systems (EPS) techniques

In practice, the following participants have already agreed to make a presentation, but we still expect at this time several more initiatives:

Speaker	***Subject***
Fabrice Ardhuin	Wind-induced surface drift: analysis of HF-radar observations in the framework of ocean circulation validation
Laurent Bertino	Validation of the HYCOM model over the Norwegian coastal seas
Pierre De Mey	The role of the data assimilation framework towards quantitative ocean science (with examples in the coastal ocean)
Hans de Vries	Validation of storm surge forecasts for the Dutch coast
Herman Gerritsen	The 1994 IAHR guidelines for model validation and documentation - practical experience and outlook
Fabrice Hernandez	Assessment procedures in MyOcean, feedback from Mersea and Godae
Gilles Larnicol	Review of potential use of altimetry products for coastal/regional models validation
Bruno Levier	Validation over the IBI façade between Mercator and other systems
Alain Ménesguen	Outcome from the work of the OSPAR working group on Eutrophication Modelling (ICG-EMO)

Speaker	***Subject***
Yves Morel	EPIGRAM and MOUTON, two national projects that can help assess the quality of numerical models in the Channel, the Bay of Biscay and along the Iberian coast
Pertti Nurmi	Activities of the WMO - Joint Working Group on Forecast Verification Research
Dano Roelvink	Issues and useful metrics in validating morphodynamic models
Petra Roiha	Verification of Ensemble Forecasts of the Baltic Sea
Jun She	DMI coastal model validation and some general issues in building up long-term database for coastal model validation
Greg Smith	Quality assurance procedures used in the development of the CMC model for the Gulf of St. Lawrence
Marina Tonani	Ongoing validation protocols over the Mediterranean in the MyOcean project

Summary and discussion:

- What do we know and what do we need for developing methodologies/frameworks for oceanographic-atmospheric model QA, incl. data requirements
- Linkages and gaps in existing application and research programmes
- Coordinate efforts to avoid duplication
- Realise potential synergies from related projects

Future initiatives:

- Identification of a suite of models/model systems that could be involved
- Identification of key projects (model projects) developing and/or testing the topic related activities
- Identification of data issues that must be addressed in order to produce model results less uncertain and better used by the community and for users
- Identification of the main issues (methodology/science, data & application) that need to be solved
- Outline of the core issues to be addressed, with related possible methodologies, to solve the above

At the end of the meeting, the participants will prepare a roadmap and work plan for the preparation of a COST Action and/or an ESF Programme forming a cluster aiming at addressing these issues.

Practical timetable:

Wednesday 18th, afternoon	Introduction, goals of the workshop, by the organizing committee Validation experiments and methods, by volunteering attendees

Thursday 19th, morning	Continued, validation experiments and methods, by volunteering attendees
Thursday 19th, afternoon	Discussions, in subgroups, defining priorities for future initiatives
Friday 20th, morning	Decision of a global raodmap by synthetizing the reports of the subgroups

Coffee-breaks, lunches and dinners are offered by the organizing bodies, for these moments spent together favour further fruitful discussions.