Geophysical Research Abstracts, Vol. 9, 07970, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07970

Investigation of 2-D and 3-D characteristic-based open boundary conditions for regional ocean models

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The solution of regional ocean models is generally strongly dependent on the way the model is forced at its open boundaries. This forcing consists of two parts : on one hand, the available boundary data; on the other hand, the open boundary conditions (OBCs), i.e. the mathematical conditions through which the boundary data are provided to the model. It has been shown in a recent study (Blayo and Debreu, 2005) that a key point for the design of relevant OBCs is to consider the fundamental hyperbolic nature of ocean models. The approach consists in using OBCs of the form *Bw* = *Bwext*, for each incoming characteristic variable w, where B is a partial differential operator (the simplest choices being the identity or the normal derivative) and $wext$ is the value of w given by the external data.

The implementation of such characteristic OBCs is quite simple for the barotropic part of the flow, but is much more difficult for the baroclinic part, since the hydrostatic assumption leads to some loss of hyperbolicity of the momentum equations. It is thus necessary to implement 3-D OBCs using a local vertical modes decomposition.

In this poster, we describe the method and present an ongoing study of the implementation of such 2-D and 3-D OBCs in two ocean models : MARS and OPA. Several configurations are presented, both idealized (channel) and realistic (Bay of Biscay and Gulf of Lion). It is shown that the use of characteristic OBCs for the barotropic flow leads to improved results as compared to the other usual OBCs.

The tests in the 3-D case are currently underway. Nevertheless, the preliminary results show a reduction in the RMS error, which can be two times lower in some configura-

tions than that obtained using a standard method. The relevance of the characteristics method must now be explored further with more realistic test cases.