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A PREDICTOR-CORRECTOR NUMERICAL SCHEMES FOR OCEAN PRIMITIVE EQUATIONS WITH LARGE TIME STEPS

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ABSTRACT

Explicit numerical schemes have been widely used in the context of ocean models since several years ago. The problems to be studied are always closely related to the Navier-Stokes equations; so that, the explicit treatment of some of its terms, avoid the use of algorithms that can slow down the code in such a way that 3D problems could not be addressed numerically. In doing so, small time steps of order of a few minutes must be used in order to get a stable calculation. Nowadays, computers allow us the computation on very fine meshes for oceans that could permit to study the behaviour of small scale processes. However, if explicit schemes are being used, time step must be even smaller in order to get a stable numerical solution.

Many of the ocean models arise from the Navier-Stokes equation with an additional term due to the rotation of the Earth, this is the so called Coriolis term that introduces some difficulties, since an implicit treatment of it yields a non-symmetric problem, that must be solved with either GMRES or BiCGSTAB algorithms. From the computational point of view, the result can be a scheme as slow as the explicit one.

In this work we propose an explicit predictor-corrector scheme for the treatment of the Coriolis term with a large stability region. This allows large time steps of the order of hours on very fine meshes. The behaviour of our predictor-corrector scheme will be ilustrated with numerical experiments carried out with a 3D semiLagrangian finite element Primitive Equations model.