8th. World Congress on Computational Mechanics (WCCM8)
5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 –July 5, 2008
Venice, Italy

A method to reduce the spin-up time of ocean models

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Key Words: *planetary geostrophic ocean model, spin-up, Jacobian-Free Newton-Krylov method.*

ABSTRACT

The spin-up timescale in large-scale ocean models, i.e., the time it takes to reach an equilibrium state, is determined by the slow processes in the deep ocean and is usually in the order of a few thousand years. As these equilibrium states are taken as initial states for many calculations, much computer time is spent in the spin-up phase of ocean model computations. We propose a new approach which can lead to a very large reduction in spin-up time for quite a broad class of existing ocean models. Our approach is based on so-called Jacobian-Free Newton-Krylov methods which combine Newton's method for solving nonlinear systems with Krylov subspace methods for solving large systems of linear equations. As there is no need to construct the Jacobian matrices explicitly the method can in principle be applied to existing explicit time-stepping codes. To illustrate the method we apply it to a 3D planetary geostrophic ocean model with prognostic equations only for temperature and salinity. We compare the new method to the 'ordinary' spin-up run for several model resolutions and find a considerable reduction of spin-up time.

REFERENCES

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