Bernsen, Erik; Dijkstra, Henk A.; Thies, Jonas; Wubs, Fred W.

The application of Jacobian-free Newton-Krylov methods to reduce the spin-up time of ocean general circulation models. (English) Zbl 1196.86004

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Summary: In present-day forward time stepping ocean-climate models, capturing both the wind-driven and thermohaline components, a substantial amount of CPU time is needed in a so-called spin-up simulation to determine an equilibrium solution. In this paper, we present methodology based on Jacobian-Free Newton-Krylov methods to reduce the computational time for such a spin-up problem. We apply the method to an idealized configuration of a state-of-the-art ocean model, the Modular Ocean Model version 4 (MOM4). It is shown that a typical speed-up of a factor 10-25 with respect to the original MOM4 code can be achieved and that this speed-up increases with increasing horizontal resolution.

MSC:

86-08 Computational methods for problems pertaining to geophysics
86A05 Hydrology, hydrography, oceanography
86A10 Meteorology and atmospheric physics
76M25 Other numerical methods (fluid mechanics) (MSC2010)

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ocean modelling; Jacobian-free Newton-Krylov methods; preconditioning

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