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Parallel implementation of a Lagrangian-based model on an adaptive mesh in C++: application to sea-ice. (English) Zbl 1380.86006

J. Comput. Phys. 350, 84-96 (2017).

Summary: We present a parallel implementation framework for a new dynamic/thermodynamic sea-ice model, called `neXtSIM`, based on the elasto-brittle rheology and using an adaptive mesh. The spatial discretisation of the model is done using the finite-element method. The temporal discretisation is semi-implicit and the advection is achieved using either a pure Lagrangian scheme or an arbitrary Lagrangian Eulerian scheme (ALE). The parallel implementation presented here focuses on the distributed-memory approach using the message-passing library MPI. The efficiency and the scalability of the parallel algorithms are illustrated by the numerical experiments performed using up to 500 processor cores of a cluster computing system. The performance obtained by the proposed parallel implementation of the `neXtSIM` code is shown being sufficient to perform simulations for state-of-the-art sea ice forecasting and geophysical process studies over geographical domain of several millions squared kilometers like the Arctic region.

MSC:

86A05 Hydrology, hydrography, oceanography
35Q86 PDEs in connection with geophysics
74F10 Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
65Y05 Parallel numerical computation

Keywords:

parallel computing; finite element methods; Lagrangian advection; sea ice

Software:

bamg; Boost; Gmsh; ISSM; METIS; neXtSIM; PETSc; TOPAZ4

Full Text: DOI

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