ID: W2102140204

TITLE: Modeling Global Sea Ice with a Thickness and Enthalpy Distribution Model in Generalized Curvilinear Coordinates

AUTHOR: ['Jinlun Zhang', 'D. A. Rothrock']

ABSTRACT:

A parallel ocean and ice model (POIM) in generalized orthogonal curvilinear coordinates has been developed for global climate studies.The POIM couples the Parallel Ocean Program (POP) with a 12-category thickness and enthalpy distribution (TED) sea ice model.Although the POIM aims at modeling the global ocean and sea ice system, the focus of this study is on the presentation, implementation, and evaluation of the TED sea ice model in a generalized coordinate system.The TED sea ice model is a dynamic thermodynamic model that also explicitly simulates sea ice ridging.Using a viscous plastic rheology, the TED model is formulated such that all the metric terms in generalized curvilinear coordinates are retained.Following the POP's structure for parallel computation, the TED model is designed to be run on a variety of computer architectures: parallel, serial, or vector.When run on a computer cluster with 10 parallel processors, the parallel performance of the POIM is close to that of a corresponding POP ocean-only model.Model results show that the POIM captures the major features of sea ice motion, concentration, extent, and thickness in both polar oceans.The results are in reasonably good agreement with buoy observations of ice motion, satellite observations of ice extent, and submarine observations of ice thickness.The model biases are within 8% in Arctic ice motion, within 9% in Arctic ice thickness, and within 14% in ice extent in both hemispheres.The model captures 56% of the variance of ice thickness along the 1993 submarine track in the Arctic.The simulated ridged ice has various thicknesses, up to 20 m in the Arctic and 16 m in the Southern Ocean.Most of the simulated ice is 1-3 m thick in the Arctic and 1-2 m thick in the Southern Ocean.The results indicate that, in the Atlantic-Indian sector of the Southern Ocean, the oceanic heating, mainly due to convective mixing, can readily exceed the atmospheric cooling at the surface in midwinter, thus forming a polynya.The results also indicate that the West Spitzbergen Current is likely to bring considerable oceanic heat (generated by lateral advection and vertical convection) to the Odden ice area in the Greenland Sea, an important factor for an often tongue-shaped ice concentration in that area.

SOURCE: Monthly weather review

PDF URL: https://journals.ametsoc.org/downloadpdf/journals/mwre/131/5/1520-0493_2003_131_0845_mgsiwa_2.0.co_2.pdf

PUBLICATION YEAR: 2003

TYPE: article

CONCEPTS: ['Sea ice', 'Curvilinear coordinates', 'Geology', 'Sea ice thickness', 'Arctic ice pack', 'Sea ice concentration', 'Arctic', 'Drift ice', 'Climatology', 'Meteorology', 'Geodesy', 'Geometry', 'Mathematics', 'Physics', 'Oceanography']