Revisiting: Refactoring the elastic-viscous-plastic solver from the sea ice model CICE v6.5.1 for improved performance

Gustav Larsen, Gustav Strand

This study focuses on the performance of the elastic-viscous-plastic (EVP) dynamical solver within the sea ice model, CICE v6.5.1. The study has been conducted in two steps. First, the standard EVP solver was extracted from CICE for experiments with refactored versions, which are used for performance testing. Second, one refactored version was integrated and tested in the full CICE model to demonstrate that the new algorithms do not significantly impact the physical results.??The study reveals two dominant bottlenecks, namely (1) the number of Message Parsing Interface (MPI) and Open Multi-Processing (OpenMP) synchronization points required for halo exchanges during each time step combined with the irregular domain of active sea ice points and (2) the lack of single-instruction, multiple-data (SIMD) code generation.

This is the demonstration PDF of the article.

This study focuses on the performance of the elastic-viscous-plastic (EVP) dynamical solver within the sea ice model, CICE v6.5.1. The study has been conducted in two steps. First, the standard EVP solver was extracted from CICE for experiments with refactored versions, which are used for performance testing. Second, one refactored version was integrated and tested in the full CICE model to demonstrate that the new algorithms do not significantly impact the physical results.??The study reveals two dominant bottlenecks, namely (1) the number of Message Parsing Interface (MPI) and Open Multi-Processing (OpenMP) synchronization points required for halo exchanges during each time step combined with the irregular domain of active sea ice points and (2) the lack of single-instruction, multiple-data (SIMD) code generation.

This is the demonstration PDF of the article.

This study focuses on the performance of the elastic-viscous-plastic (EVP) dynamical solver within the sea ice model, CICE v6.5.1. The study has been conducted in two steps. First, the standard EVP solver was extracted from CICE for experiments with refactored versions, which are used for performance testing. Second, one refactored version was integrated and tested in the full CICE model to demonstrate that the new algorithms do not significantly impact the physical results.??The study reveals two dominant bottlenecks, namely (1) the number of Message Parsing Interface (MPI) and Open Multi-Processing (OpenMP) synchronization points required for halo exchanges during each time step combined with the irregular domain of active sea ice points and (2) the lack of single-instruction, multiple-data (SIMD) code generation.

This is the demonstration PDF of the article.