Refactoring the elastic-viscous-plastic (EVP) sea ice dynamics solver

Science

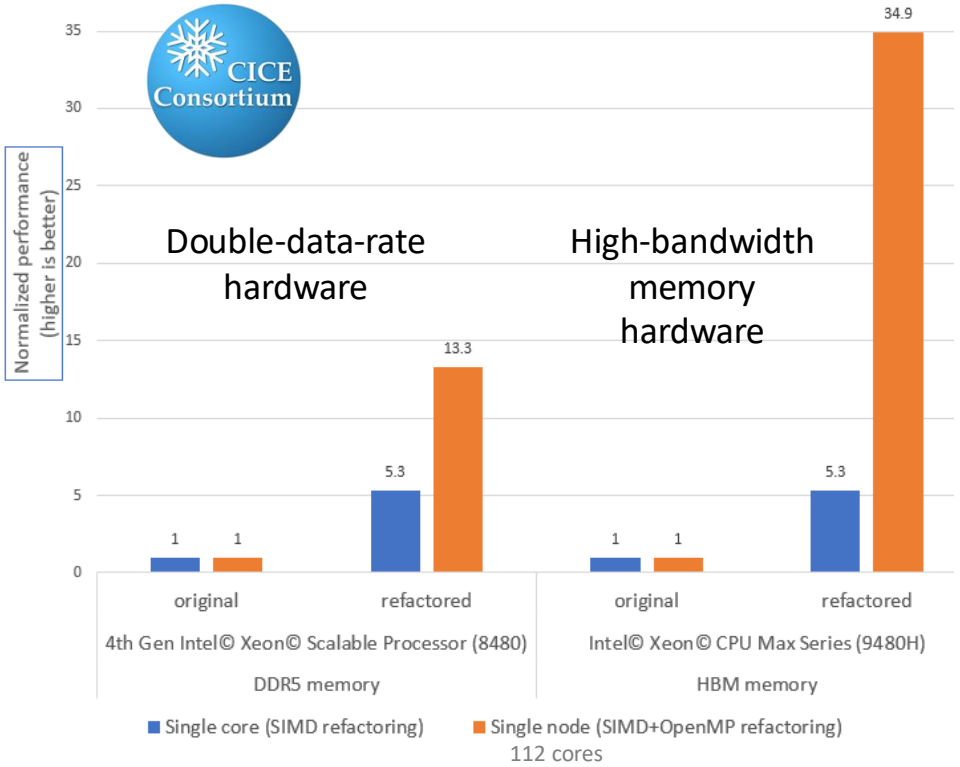
- Bandwidth to memory is now the limiting hardware resource for computational efficiency, rather than floating point operations, requiring code redesign.
- Identified EVP efficiency bottlenecks:
  - Synchronization during parallel computations
  - Lack of single-instruction, multiple-data (SIMD) code generation

Approach

- Rewrite the code to improve memory access patterns
- Test across a range of hardware, including high memory bandwidth

Impact

- Allows the entire EVP calculation to be performed on a single compute node
- Can significantly improve the efficiency of the sea ice component in Earth system simulations



Single-core performance improves more than 5x compared to the standard implementation, and up to 35x on high-bandwidth memory hardware.

Rasmussen, T., Poulsen, J., Ribergaard, M, Sasanka, R., Rethmeier, S., Hunke, E., Craig, A. Refactoring the elastic–viscous–plastic solver from the sea ice model CICE v6.5.1 for improved performance. Geosci. Mod. Dev., 2024.