Geophysical Research Abstracts
Vol. 20, EGU2018-7122-2, 2018
EGU General Assembly 2018

A Fast Versatile Ocean Simulator (Veros) in Pure Python

Dion Häfner (1), René Løwe Jacobsen (1), Carsten Eden (2), Mads R.B. Kristensen (1), Markus Jochum (1), Roman Nuterman (1), and Brian Vinter (1)

(1) Niels Bohr Institute, University of Copenhagen, Denmark (nuterman@nbi.ku.dk), (2) Institut für Meereskunde, Universität Hamburg, Hamburg, Germany

General Circulation Models (GCM) of different complexity have been dynamically developed and used during the last 50 years. Most state-of-the-art GCMs are written in FORTRAN, because of historical reasons and reluctance towards employment of modern programming languages and practices by scientists. These lead to accumulation of legacy source code and code fragmentation in the models, which cause wasting of human resources during new developments of the models. While such tendency is slowly changing during the last decade, there is still a utilization lack of new programming paradigms, languages and hardware.
In order to address these issues, a first attempt to translate the entire Ocean GCM (OGCM) from FORTRAN to Python has been made. It is described how its code structure is optimized to exploit available Python utilities, remove simulation bottlenecks, and comply with modern best practices. Furthermore, support for Bohrium is added, a recently developed framework that automatically fuses array operations and supports parallel execution on CPUs and GPUs, and that can be used as a drop-in replacement for NumPy.
For applications containing more than a million grid elements, the typical size of a one degree resolution ocean model, the Veros is approximately half as fast as the MPI-parallelized FORTRAN base code on 24 CPUs, and as fast as the FORTRAN reference when running on a high-end GPU. By replacing the original conjugate gradient stream function solver with a solver from the Python Algebraic Multigrid Solvers (pyAMG) package, this particular subroutine outperforms the corresponding FORTRAN version by a factor of 2 to 11. The study is concluded with a simple application in which a signal propagation across Atlantic and Pacific Oceans due to a Southern Ocean wind perturbation is investigated.