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A Parallel Approach for 3D-Variational Data Assimilation on GPUs in Ocean Circulation Models

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Abstract : This work is the first dowel in a rather wide research activity in collaboration with Euro Mediterranean Center for Climate Changes, aimed at introducing scalable approaches in Ocean Circulation Models. We discuss designing and implementation of a parallel algorithm for solving the Variational Data Assimilation (DA) problem on Graphics Processing Units (GPUs). The algorithm is based on the fully scalable 3DVar DA model, previously proposed by the authors, which uses a Domain Decomposition approach (we refer to this model as the DD-DA model). We proceed with an incremental porting process consisting of 3 distinct stages: requirements and source code analysis, incremental development of CUDA kernels, testing and optimization. Experiments confirm the theoretic performance analysis based on the so-called scale up factor demonstrating that the DD-DA model can be suitably mapped on GPU architectures.

Keywords : data assimilation, GPU architectures, ocean models, parallel algorithm
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