Parallel geometric multigrid solver at the reduced latitude-longitude grid

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Reduced latitude-longitude grid is considered (Staniforth, Thuburn, 2012) as one of possible options for global atmospheric models. Although, the meridians convergence problem is less severe for this grid, construction of the scalable and robust elliptic problem solver is still an issue. In this work we present geometric multigrid algorithm (Trottenberg, 2000) for the solution of 2D elliptic type equations (e.g. Poisson equation, Helmholtz equation) at the reduced latitude-longitude grid. This method can also be considered as the basis for the implementation of 3D elliptic type equations solver. The new algorithm is based on the modification of the regular lat-lon grid conditional semi-coarsening method (Larsson et al, 2005; Buckeridge, Scheichl, 2010) and the use of uniform coarse-grid points distribution along longitude (instead of more common cell-centered or vertex-centered treatment). The use of this approach allows to achieve fairly fast convergence with the use of local pointwise smoothers, which is an important aspect for the parallel implementation of the method. Numerical convergence tests of the proposed algorithm show that it is robust with respect to the problem size and grid reduction rate. Preliminary scalability results will also be presented.

References

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