1135-76-487 **Guoyi Ke*** (guoyi.ke@ttu.edu), Texas Tech University, Mathematics and Statistics Dept., Lubbock, TX 79409-1042, and **Eugenio Aulisa** (eugenio.aulisa@ttu.edu), Texas Tech University, Mathematics and Statistics Dept., Lubbock, TX 79409-1042. *New preconditioner techniques for the buoyancy driven flow problems.*

In this work, we study the performances of generalized minimal residual method (GMRES) preconditioned with geometric multigrid (GMG), applied to steady and unsteady buoyancy driven flow problems, discretized with the finite element method. For the unsteady case, the second order Crank-Nicolson method is used for the temporal discretization. At each geometric multigrid level, we use Richardson iterative solvers preconditioned with different combinations of physics-based and domain decomposition preconditioners. Three different preconditioners are considered: incomplete LU decomposition (ILU), overlapping Vanka-type domain decomposition for additive Schwarz method (ASM), and field split (FS) physics-based decomposition. We also analyze the effect on the smoother of how the variables are ordered, and in particular whether the leading variable is the velocity or the temperature, resulting in six classes of preconditioners: ILU_VT, ILU_TV, ASM_VT, ASM_TV, FS_VT and FS_TV. Numerical results show that the pair of FS_VT and FS_TV preconditioners works better than the other two pairs, and that the FS_TV preconditioner always performs the best in terms of the computational time for all the steady and unsteady cases. (Received September 05, 2017)