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SOME NUMERICAL RESULTS ON THE FINITE-ELEMENT APPROXIMATION OF THE NAVIER-STOKES EQUATIONS USING DYNAMIC SUBSCALES

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Abstract. In this work we analyze a particular stabilized finite-element method for the incompressible Navier-Stokes equations which is based on the decomposition of the fluid velocity into a resolvable finite element component plus a sub-grid scale component. The main characteristic is that the sub-grid scale component is modeled to be dynamic and L^2-orthogonal to the finite element space. We are particularly interested in understanding the purest mathematical aspects for this method such as long- and short-time stability and convergence under mild regularity of the problem data. Stability analysis provides a control of the sub-grid scale component in term of the energy norms which is translated into an extra control of the gradient of the pressure and the convective term for both short- and long-time behavior. These estimates are independent of all viscosity sizes. This benefit contributes to think that this method is a good candidate to model turbulence. Estimates of the Dirichlet norm for the velocity are also proved for two-dimensional domains giving arise to the existence of appropriate absorbing sets and a compact global attractor. Moreover, compactness results show that one can recover a weak solution of the Navier-Stokes equations under minimal requirements on the initial condition, forcing terms, and the domain. Finally, we investigate if such a solution is suitable in such a way it holds an entropy energy inequality.