Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Formulation and implementation of free-slip boundary condition on a deformed domain in the context of continuous Galerkin high-order element-based discretization.[1] THEODOROS DIAMANTOPOULOS, PETER DIAMESSIS, Cornell University, MAREK STASTNA, University of Waterloo —

The free-slip condition is a convenient choice of boundary condition (BC) used in the simulation of stratified flows to circumvent the resolution of fine-scale no-slip-driven bottom boundary layers when numerically solving the incompressible Navier-Stokes equations (INS). The nodal spectral element method is a commonly used strategy in the discretization of the INS where the free-slip condition arises as a natural BC from the integration-by-parts of the viscous term in the INS. In the context of a deformed domain, the tangential component of the force associated with the free-slip condition, couples the Cartesian velocity components leading to a larger system of equations for the calculation of the velocity field. One approach to mitigate this complexity is to impose a pseudo-traction BC, where each velocity component can be solved for independently. Effectively, the velocity components can be treated as scalar quantities allowing the use of the same computational machinery as for the calculation of the density and the pressure. In a series of test problems, which include the propagation of an internal solitary wave, the effective numerical drag produced by the pseudo-traction BC will be quantified thereby enabling the assessment of the accuracy of the pseudo-traction approach.

[1]NSF-OCE 1634257

Theodoros Diamantopoulos
Cornell University

Date submitted: 18 Jul 2019 Electronic form version 1.4