Parametric study of strong-form meshless method for mantle flow

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ABSTRACT

The thermal conditions and convection-generated structures in a planetary mantle have considerable impact on the shape of the planetary crust and its movements [1]. The importance of these phenomena spurs great interest in development of new, advanced numerical models, targeted at modelling of thermofluid flow in the mantle [2,4].

In this paper we adapt the solution strategy that has been successfully used to model electromagnetics and transport phenomena in metal solidification [3] to the problem of planetary flows. The solution procedure is based on discretization of the governing equations in strong-form with diffuse approximate method, which constructs Gaussian weighted least-squares approximation on localized stencils with monomials.

In the contribution, the related strongly coupled heat, mass and momentum problem is validated by comparing it with the reference benchmark case [4] for several values of Rayleigh number and initial conditions with varying levels of symmetry in temperature field, formulated in stationary reference frame. We have extended these test cases by considering their solution in a rotating reference frame where the contribution from centrifugal and Coriolis forces has considerable impact on the stationary temperature profile and plume distribution.

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