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Finite Volume simulations of dynamos in ellipsoidal planets

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It is widely accepted, that the planetary magnetic fields are powered by a magnetohydrodynamic dynamo-process. So far theoretical studies and numerical simulations have mostly assumed that the flow generating the dynamo-process is driven by buoyancy forces. But also precession can drive a dynamo, as first suggested by Bullard in 1949. A precession-driven laminar flow is mainly toroidal and cannot maintain a dynamo. However, experimental and numerical studies show that these basic flows are unstable and several kind of wave-like instabilities are generated. Therefore precession can also be regarded as a viable driving-mechanism of a core flow generating the planetary magnetic fields.
We have used a spherical, finite-volume code, already used for the simulation of convection-driven dynamos and mantle convection, to solve the equations of a precession-driven dynamo in a spherical shell. Furthermore the non-sphericity of the planetary bodies trigger some crucial instabilities. However, up to now there is only one available full MHD study of precessing spheroids. These preliminary results for a full spheroid showed that topographic coupling offers more favourable conditions than viscous coupling for the generation of a sizeable dipole component of the magnetic field. We shall discuss how the ellipticity of the planets can be included in numerical simulations by the use of a non-orthogonal grid. We will present some first results of MHD calculations with parameters similar to known dynamo solutions but with no-slip instead of stress-free boundary conditions to clarify the influence of boundary layers on the dynamo process.