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Experimental investigation of precession driven flows in a triaxial ellipsoid

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Precession driven flows are relevant for geo- and astrophysical fluid dynamics as well as industrial applications. In the context of planetary core dynamics, they are attributed to the generation of magnetic fields and/or anomalous dissipation. While precession driven flows have been frequently studied in a cylindrical, spherical or spheroidal container shape, the geometry of a triaxial ellipsoid, representing the geophysical case of core mantle boundary deformation in a tidally locked planet, has received less attention.

Here, we present results from an experimental study in a triaxial ellipsoid. The main focus of our study is on the base flow of uniform vorticity and we report a good agreement between experimental data and existing semi-analytical models. The amplitude of the time averaged uniform vorticity displays a hysteresis loop as a function of the precession forcing and we demonstrate that this observation depends on the ellipticity of the container. Our study also comprises experiments where the boundary layer is expected to be in a turbulent state. Therefore, we discuss the applicability of an effective damping coefficient in the semi-analytical models to account for the dissipation in a turbulent boundary layer.