Parametrically forced rapidly rotating container flows

Juan M. Lopez
School of Mathematical and Statistical Science,
Arizona State University, Tempe AZ, USA

Rapidly rotating contained flows subjected to low amplitude parametric forcing, such as libration or precession modulating the rotation amplitude or direction, are ubiquitous in geophysical and astrophysical flows, as well as in many technological applications. Rapidly rotating flows, characterized by small Ekman numbers (ratio of viscous time scale to rotation time scale), suport inertial waves due to the restorative Coriolis force. Low amplitude parametric forcing can extract a portion of the available rotational energy in a rapidly rotating contained body of fluid and convert it into intense fluid motions via the resonant excitation of inertial waves. The Ekman numbers of geophysical and astrophysical flows are many orders of magnitude smaller than what can be achieved in laboratory experiments, and the forcing amplitudes in experiments need to be relatively large in order to measure a signal reliably. The response flows are then dominated by viscous and nonlinear effects that may not be prevalent in the very low Ekman and low forcing amplitude regimes. Direct numerical simulations of the Navier-Stokes equations with no-slip boundary conditions are now able to simulate librating and precessing flows at Ekman numbers as small as, or smaller than, those in laboratory experiments, at small forcing amplitudes over the entire inertial range of forcing frequencies. This is opening up new insights into these fascinating flows. The talk will present an overview of recent results.