Abstract Submitted
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Zonal winds and flows generated by harmonic forcing in planetary atmospheres, subsurface oceans and cores ALBAN SAURET, DAVID CEBRON, MICHAEL LE BARS, STEPHANE LE DIZES, PATRICE LE GAL, IRPHE, CNRS and Aix-Marseille University — A huge amount of energy is stored in the spin and orbital motions of any planet, and under certain circumstances, harmonic forcings such as libration, precession and tides are capable of conveying a portion of this energy to drive intense three-dimensional flows in its liquid layers. These mechanisms are studied here by combining theoretical, experimental and numerical approaches. At first, we focus on the effect of longitudinal librations, corresponding to oscillations of the rotation rate of a planet. This boundary forcing systematically leads to a correction to the mean solid body rotation through non-linear interactions in the Ekman layers. This geostrophic zonal wind is well described by an analytical approach. Additionally, at sufficiently large libration amplitude or small Ekman number, the oscillating flow is periodically unstable with respect to centrifugal instability. The resulting Taylor-Görtler vortices generated in the Ekman layers then generate inertial waves in the bulk with well-defined characteristics and temporal signatures. Inertial waves can also be resonantly excited by any harmonic forcing, when the forcing frequency ranges between plus and minus twice the rotation rate. In any case, the nonlinear self-interaction of excited inertial waves may drive an intense and localised axisymmetric jet, which becomes unstable at low Ekman number following a shear instability, generating space-filling turbulence. This generic mechanism is illustrated here by an experimental study of tidal forcing in a spherical shell.

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