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Experimental study of the non-linear saturation of the elliptical instability: inertial wave turbulence versus geostrophic turbulence[1]
THOMAS LE REUN, BENJAMIN FAVIER, MICHAEL LE BARS, IRPHE, Aix-Marseille Universit, ERC FLUDYCO TEAM — We present an experiment of the turbulent saturation of the flow driven by parametric resonance of inertial waves in a rotating fluid. An ellipsoid filled with water is brought to solid-body rotation and then undergoes harmonic modulation of its rotation rate. This triggers the exponential growth of a pair of inertial waves via the elliptical instability. As the instability reaches non-linear saturation, it creates a turbulence where energy is injected into the resonant waves only. Depending on the amplitude of the rotation rate modulation, two different saturation states are observed. At large forcing amplitudes, the saturation flow mainly consists of a steady, geostrophic anticyclone. Its amplitude vanishes as the forcing amplitude is decreased while remaining above the threshold of the elliptical instability. Below this secondary transition, the saturation flow is a superposition of inertial waves which are in weakly non-linear resonant interaction, a state that could asymptotically lead to inertial wave turbulence. The present study is an experimental confirmation of the model of Le Reun, PRL (2017) who introduced the possibility of these two turbulent regimes. The transition between these two regimes and their relevance to geophysical applications are finally discussed.

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Thomas Le Reun
IRPHE, Aix-Marseille Universit

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